State Steering in Polycentric Governance Systems: Climate Policy Integration in Ontario and California's Transportation Sectors

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Abstract

The post-Kyoto era of climate governance has witnessed a dramatic increase in the number and diversity of actors and organizations, resulting in a complex institutional regime that displays the essential features of polycentric governance (Keohane and Victor 2011; Abbott 2012; 2018). The complexity of polycentric climate governance systems makes them hard to describe and compare. That being said, they are also everywhere (Harford 2013). As our current reality, polycentric climate governance systems require research attention even though their 'messy' nature presents unique research challenges. This research furthers work by Elinor Ostrom and others on operationalizing polycentric climate governance, given the complexity and 'institutional void' associated with polycentric governance systems. In particular, this research argues that the state is a unique actor within polycentric climate governance systems, and serves a critical and exclusive function in crafting and enforcing overarching rules within which all other actors operate.

A key focus in this research is climate policy integration and its drivers that are comparatively analyzed for the climate-transport governance regimes of the two case studies underpinning this research: Ontario, Canada and California, U.S.A. Additionally, the research introduces a novel approach for evaluating the degree of polycentricity in each case's climate governance system. Finally, the research evaluates the degree to which overarching rules enhance these systems in relation to varying contexts. Ultimately, a polycentric approach to climate change governance is found to be a best fit strategy for pursuing low-carbon transitions. This is especially the case in contexts characterized by separation of powers type governance system, where there are especially high degrees of regulatory capacity, and a consistent and robust social consensus supporting climate change action. In particular, the ability of these systems to maintain a low-carbon governance orientation in the face of technological and political disruption, and also promote innovation, coalition and capacity building, makes them well-suited to managing the challenges inherent to steering low-carbon transitions. Governments should recognize the complexity of current climate change governance systems, understand their unique roles within these systems, and work purposefully to develop and implement overarching rules to leverage the benefits of these systems and mitigate their inefficiencies.

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Chapter 1: Introduction

Climate Change and Polycentric Governance Systems

Global climate change is an extremely complex issue, fraught with deep uncertainty and ethical conundrums. As a policy problem, it has been described as “diabolical”, “super wicked” and "a collective action problem par excellance" (Steffen 2011; Levin, Cashore, Bernstein & Auld, 2012; Lazarus 2009; Craik, Studer & VanNijnatten, 2013; Harris, 2007, 196). Dryzek, Norgaard and Schlosberg (2011, p. 3) argue climate change is "perhaps the most profound challenge ever to have confronted human social, political, and economic systems… as the stakes are massive, the risks and politics bitter and complicated, the psychology puzzling, the impacts devastating, the interactions with other environmental and non-environmental issues running in many directions". The issue of climate change is the quintessential collective action dilemma and has been characterized as "the largest commons governance problem that humanity has ever faced" (Dietz and Zhao, 2011, p. 15671; Dryzek et a. 2011; Steffen 2011).

The past three decades have seen the creation of sophisticated international institutions like the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC). Twenty-four UNFCCC Conferences of the Parties (COPs) have occurred, and yet progress to date has "been painfully slow" (Inman 2009, p.130). As it stands, it would be an understatement to say the UNFCCC goal of limiting global warming to well below two degrees Celsius to avoid catastrophic climate change is a long shot. To put the intense nature of the challenge in perspective, according to a 2017 article in the journal *Nature* titled, "Three Years To Safeguard Our Climate", "should emissions continue to rise beyond 2020, or even remain level, the temperature goals set in Paris become almost unattainable" (Figueres, Schellnhuber, Whiteman, Rockstrom, Hobley and Rahmstorf 2017, p. 593).

Considering the failure of the international climate change regime to address this difficult collective action dilemma effectively, this research supports Elinor Ostrom's proposal for a polycentric approach to combatting global climate change. A polycentric approach to climate change governance, developed and refined from the pioneering work of Nobel Laureate Elinor Ostrom (2009; 2010; 2012), provides a model for an effective governance response to this immense collective action challenge. This

type of approach allows for costs and benefits to be assessed in particular policy ecosystems and compared to results from other areas (Ostrom 2010; 2012). Enhanced innovation and experimentation improve policy learning and progresses our understanding of what works where and why. Small and medium-sized governance units are better able to undertake climate governance efforts, especially because this approach (as opposed to a top-down solution) better meets the "matching principle" of international law (Ostrom 2009; 2012). Critically, the dynamics produced by this governance approach, specifically higher degrees of reflexivity, innovation and resilience, make it best suited to deal with the disruptions and fluctuations inherent to low-carbon transitions.

The term "polycentric" was introduced by Victor Ostrom in 1961, and connotes "many centers of decision-making that are formally independent of each other…" (p. 831–32). Generally, a polycentric system of governance includes the following characteristics: multiple levels of governance (local, provincial, national, regional and global), multiple types of political units (general-purpose, specialized and cross-jurisdictional), multi-sectoral organizations (i.e., private, public, voluntary, community and hybrid types), and finally multiple functions (e.g., production, financing, coordination, monitoring, sanctioning) (McGinnis 2011, p. 171-2; Daley, Abel and Stephan 2014). The numerous governing bodies that interact are assumed to have the autonomy to create and enforce rules in a given locale and policy arena (Schoon, Robards, Meek and Galaz, 2015; Ostrom 2010). Polycentricity in governance systems suggests something more than just multi-level federalism. As McGinnis and Ostrom (2011, p. 15) explain:

> Polycentricity conveys more than just federalism as it typically is understood. A federal system may consist only of a sequence of neatly nested jurisdictions at the local, state or provincial, and national levels. However, a polycentric system also includes cross-cutting jurisdictions specializing in particular policy matters, such as an agency managing a river basin that cuts across state lines (cited in Carlisle and Gruby 2017, p. 17).

The complexity of these systems makes them hard to describe and compare. That being said, they are also everywhere (Harford 2013). The post-Kyoto era of climate governance has witnessed a "'Cambrian explosion' of organizations, norms, 'contributions', commitments and other institutions" (Keohane and Victor 2011; Abbott 2012) resulting in "an intricate, diverse institutional complex that exhibits the defining features of polycentric governance" (Abbott 2018). Indeed, the Paris Agreement

explicitly acknowledges this reality. As our current reality, polycentric climate governance systems require research attention even though their 'messy' nature presents unique research challenges.

Concerning the challenge of mitigating global climate change, Ostrom (2009; 2010) asserts that a polycentric approach is more likely to induce cooperation and enhance innovation than strictly top-down approaches. Ostrom (2009; 2010) points out that this approach is by no means a panacea, but that it works with the current reality of diverse climate governance experiments occurring in greater abundance at subnational and local scales (Rabe 2009; Daley et al. 2014). Pursuing a polycentric approach to climate change also matches the current reality of climate policy, which, according to Cole (2011, pp. 406), is, at minimum, weakly polycentric. Rabe (2009, p. 36) also agrees that a "mixture of strategies at multiple levels may be the best approach" to deal with the unique complexities of the problem. Polycentric systems attempt to match governance levels to the scale of the problem and rectify the often-mismatched 'fit' between 'institutional attributes' and the properties of the system (Young 2002; cited in Schoon et al. 2015). In this way, a polycentric approach is best suited to deal with the problem of climate change, as the global atmosphere provides ecosystem services that have very strong multi-level aspects.

Furthermore, a polycentric approach to governing climate change is the best strategy, as it recognizes the complexity of the challenge at hand and encourages learning from a variety of governance experiments at different scales. Due to the relatively short time frame left to mitigate and manage the climate crisis effectively, it seems appropriate that as many different experiments be tried at as many scales as possible in a way that leverages the innovation potential of subnational and non-state actors. The literature on collective action discussed in this paper points to the fact that this more bottom-up and diversified approach to governing the global atmosphere, in theory, should prove more effective than top-down solutions. Attempting to work with current realities by enhancing polycentric approaches to climate change governance is simply the most pragmatic way forward.

Logic of Inquiry and Theoretical Context

This research reflects an adherence to 'environmental pragmatism', "a philosophy of environmental action that begins with real-world problems...and focuses on learning our way out of uncertainty in particular situations" (Norton 2007, pg. 29). Following the pragmatic tradition, the central focus of this

research is on attaining a better understanding of the problem and what methods will best facilitate this understanding, as opposed to ontological or epistemological debates about truth and knowledge. While a philosophy of pragmatism underpins this research, a post-positivist epistemology is also employed in this work to generate usable policy analysis. Going beyond technocratic positivism, this orientation holds that there is not one objective understanding of policy problems and argues for subjective reflection analysis as a better way to understand policies and the policymaking process (Howlett, Ramesh and Perl 2009). This approach interprets policymaking as a more contested and value-laden process than other epistemologies that focus mainly on a technical analysis of empirical evidence. The post-positivist orientation is a good fit for studying the messy reality of climate policy as it allows for technical analysis to be complemented by studies of other factors, including interests and values (Howlett et al. 2009). This orientation's sensitivity towards complex realities is argued to be its greatest strength (Howlett et al. 2009).

The problem of mitigating global climate change in this work is approached using collective action theory and understands climate change as the most challenging collective action problem humanity has ever faced. From a policy perspective, climate change policy "requires an unprecedented level of coordination and a greater collective commitment to political change than has ever occurred" (Bryner and Duffy 2012). The vast scope of activities that contribute to the problem means integrating policy efforts, or policy integration, must be an essential part of the solution. Elinor Ostrom's polycentric approach to mitigating climate change, and the literature on polycentric/networked governance systems, provide the main theoretical backing for this dissertation in terms of informing the direction of research. Theory around policy integration in general, and more specifically, climate policy integration, also provides the basis for the research.

While it is clear that the mode of governance has shifted from more hierarchy/bureaucracy-based models to more polycentric/networked governance models, it is important not to underestimate the power and unique role of the state within modern networked governance systems. This research explicitly acknowledges this fact and attempts to understand how best the state (in this case, subnational governments) can improve governance effectiveness and efficiency, essentially reducing the transaction costs associated with the coordination of such complex governance systems. The focus on subnational levels of government reflects the fact that these scales are increasingly *the site* for meaningful climate mitigation efforts, and especially climate governance experimentation. A key focus in this research is on

climate policy integration and its drivers, a normative aim and real practice, which has been acknowledged as a critical research project in and of itself.

This study differs in that it places the analysis of CPI within broader questions about operationalizing polycentric governance systems with a particular focus on climate change mitigation. In essence, climate policy integration is conceptualized as the focal mechanism for evaluating how overarching rules by higher levels of government enhance the benefits of a polycentric approach to climate change mitigation (e.g., innovation and resilience) while mitigating the associated inefficiencies. Following this conceptualization, the research pays careful attention to functions highlighted in established EPI/CPI frames, such as nodes within policy networks that act as knowledge and coordination platforms, which aid in climate mitigation governance efforts at various levels within the system.

Relation and Advancements in the Field: State Steering in Polycentric Governance Systems

The research aims to further the work by Ostrom and others on operationalizing polycentric climate governance, given the complexity and 'institutional void' associated with modern polycentric governance systems, especially large federal systems like Canada and the United States. In particular, this research argues that the state is a unique actor within polycentric governance systems and serves a critical and unique function in crafting and enforcing overarching rules within which all other actors operate within a given jurisdiction. The role of the state has been given very little attention within this conceptual frame, and mid-level emerging governance theory, leaving a key gap in understanding how polycentric governance systems operate in practice. Importantly, this research acknowledges that the actions of subnational and local governments, in addition to non-state actors, are not simply "filling the gap between NDCs and the emissions levels necessary to reach the Paris Agreement's aspirational goal" but "as experiments in the new context the Paris Agreement acknowledges—a decentralized, fragmented global response to climate change" (Bernstein and Hoffman 2018; Jordan et al. 2015; Zelli and van Asselt 2013; Bulkeley et al. 2014).

Ostrom (1990; 2009; 2010) did not spend much time exploring the role of higher-order government, given she was writing against a state-centric tradition of governance. Although the role of state-steering in providing overarching rules has not been a core focus of the development of this emerging

governance theory since Ostrom, "references to a set of overarching rules are found in almost all definitions of polycentric governance" (Jordan et al. 2018, p. 19). This key element with regards to operationalizing polycentric governance has started to be studied in recent years (see Setzer and Nachmany 2018; Abbott 2017; Mansbridge 2014; Jordan, Huitema, Schoenefeld, van Asselt, Forster 2018; Heikkilia and Weible 2018). In the recent book *Governing Complexity: Analyzing and Applying Polycentricity* (2018), the following concise definition of polycentric governance systems is given, highlighting the importance of overarching rules: "In polycentric governance systems, multiple centres of decision-making are formally independent of each other but interact within a system of overarching rules" (p. 115).

There has also been a lack of understanding with regards to how varying contexts impact structures and functions of polycentric systems (see Baldwin 2018; Thiel and Moser 2018), especially how systems function where there are varying configurations of local and higher-level decision-making (Carlisle and Gruby 2018). It is critical to understand what kind of overarching rules enhance the effectiveness of polycentric governance systems, and what contexts enable states to fulfill this role effectively. It is this conceptual gap that forms a focal point of this dissertation.

This work by no means represents a formal conclusion on the complex interactions and workings of polycentric climate governance models. However, it does provide advancements around the role of state steering in enhancing polycentric climate governance 'in action'. From a prescriptive standpoint, this research aims to provide initial insights into what desirable overarching rules, norms and organizations enhance polycentric climate governance, a “tricky task given that they may blend elements of monocentricty and polycentricity" (Jordan et al. 2018, p. 20).

A case study approach, based on two subnational jurisdictions with varying degrees of polycentricity with regards to their climate governance regime, allows for a comparative analysis of contexts and climate governance performance, enabling a core question stemming from the literature on polycentric approaches to climate change governance to be answered: what works where and why? The research also attempts to address a key methodological limitation in understanding the functions and features of polycentric governance systems. From a methodological perspective, a key critique of research on polycentric governance systems revolves around a lack of a consistent or agreed-upon method for

measuring degrees of polycentricity in a given governance system (Aligica and Tarko 2012). The research is intentionally designed with this limitation in mind; The methodological approach for measuring and describing the degree of polycentricity in a given system utilized in this work stems from early attempts to develop frames for providing nuanced understandings of polycentric governance systems, as opposed to a binary approach (polycentric vs. monocentric). Specifically, the method employed draws from Schoon, Robards, Meek, and Galaz's (2015) two continua for measuring and describing varying degrees of polycentricity in polycentric governance systems: collaborative degree and breadth of inclusion.

The delineation of varying degrees of polycentricity and its operationalization, within a set of overarching rules, provides a starting point for understanding the relationship between higher-order governance levels and polycentric governance arrangements involving diverse actors with regards to enhancing the performance of these systems. This work utilizes an analytical framework drawn from well-established studies within the field of environmental/climate policy integration to evaluate how the overarching rules provided by higher-order governance levels (in this case state/provincial governments) enhance or effectively operationalize a polycentric approach to climate change governance.

Evaluating overarching rules: Environment/Climate Policy integration (EPI/CPI)

Environmental and climate policy integration is a longer-standing body of literature that has its origins in public policy studies of the European Union, a highly polycentric jurisdiction. EPI/CPI frameworks for analysis focus on organizational, procedural and communicative instruments that work to vertically and horizontally integrate environment and climate policy objectives into non-environment/climate policies and programs. The focus on analyzing how coordination and coherence can be achieved using legal and policy tools in complex, multi-level governance systems provides a useful framework for analysis when applied to the evaluation overarching rules from higher-order governance levels in polycentric governance systems. In this way, these two bodies of work are extremely complementary and the use of EPI/CPI frames for analysis represents a methodological advancement in terms of understanding how overarching rules can enhance polycentric governance systems.

With regards to the topic of climate policy integration, this work follows a large literature of similar research done on many EU countries furthering attempts to understand how to best operationalize a

polycentric approach to mitigating climate change (for example Ahmand 2009, Casado-Asenio and Steurer 2012; Rietig 2012; Meijers and Stead 2004). It represents an advancement in that it draws together the latest research on climate policy integration on the one hand, and polycentric/networked governance on the other, to better understand how climate objectives can be advanced in the complex (and somewhat chaotic) reality of modern governance systems, in a way that maintains a long-lasting low-carbon orientation. The evaluative framework has been adapted from previous models with the hopes of improving the analysis in a way that highlights critical factors pertaining to the form and function of overarching rules, something that theorists cannot yet agree upon (Aligica and Tarko 2012).

Overview of this Dissertation

The key research questions (and sub-questions) of this dissertation research reflect the core hypotheses with regards to polycentricity, climate policy integration, and environmental performance in the transportation sector. Three high-level research questions form the primary direction of inquiry for the dissertation. First, the dissertation aims to answer: to what extent have climate mitigation objectives been integrated into the road passenger transport sector in each subnational jurisdiction? To answer this question, climate-transport policy outputs for each jurisdiction will be inventoried and compared. The second high-level research question aims to understand: what factors have hindered or aided in the passing of climate-transport policy and regulations? A setlist of variables stemming from policy studies, and more specifically, policy integration studies, are used as the framework for this context analysis.

The final high-level research question revolves around the role of overarching rules in operationalizing each system's polycentric climate governance system (i.e., mitigating inefficiencies and enhancing benefits). A key focus of the sub-questions, stemming from the last question, are around experimentation, innovation, coalition building, and policy learning in relation to understanding how the degree of polycentricity and associated degree of functional redundancy impact the performance of each system's climate governance regime in terms of emission reductions and resilience. The hypotheses formulated at the outset of this research (described below) are based on the latest literature on polycentric governance systems and environmental and climate policy integration (EPI/CPI).

Hypothesis 1: Higher degrees of polycentricity and especially functional redundancy will correlate with more effective climate governance, specifically higher degrees of climate policy integration and successful policy innovation with regards to successful policy experiments aimed at reducing emissions from the road transportation sector. Put more simply, more diverse institutional arrangements will result in more effective climate governance. Following this logic, better performance in terms of emission reductions will be seen where a higher proportion of local governments are engaged in climate change mitigation programs and policy experiments.

Hypothesis 2: Overarching rules provided by higher-order governments that integrate climate change objectives into transportation-related policies and facilitate vertical and horizontal coordination will improve polycentric governance systems. Governments facilitating higher levels of climate policy integration via communicative, organizational and procedural mechanisms (overarching rules) will better enhance polycentric climate governance systems. Better performance in operationalizing these systems will be evidence by reduced associated inefficiencies and enhanced associated benefits.

Hypothesis 3: The number and effectiveness of knowledge-for-policy institutions facilitating policy learning, will be a key factor in how well polycentric systems are operationalized and made more resilient. The effectiveness of these knowledge-for-policy institutions will be related to the level of high-level political commitment, in that government support will be essential for the support and maintenance of these networks.

Hypothesis 4: The role of social consensus and associated regional identity narratives will figure prominently in given levels of high-level political commitment for climate policy integration and, subsequently, environmental performance in terms of efforts aimed at reducing emissions, in this case, from the road passenger transportation sector.

Why transportation?

While much more work has been done on EPI/CPI in the energy sector, transitioning the transportation sector to a low-carbon system remains a major technical and governance challenge. Transportation remains the largest sector in both subnational jurisdiction with regards to emissions: In

Ontario transportation accounts for 35% of emissions (Ministry of the Environment and Climate Change [MOECC] 2016) and in California it accounts for 41% of emissions (California Air Resources Board [CARB] 2019f). From a governance perspective, Bryner and Duffy (2012, p. 128) argue that "Nowhere is the case for policy integration clearer and more compelling than for reducing greenhouse gas emissions from transportation". The scope of this research project will be contained to road passenger transportation, both urban and regional. Setting this boundary will ensure the scale of the project is feasible, given that a detailed analysis of overarching rules in each case forms a central piece of this research. Also, using this category allows for a consistent comparison between California and Ontario.

In terms of the transferability of findings from this research, focusing on transportation also highlights the performance of polycentric governance performance with regards to orienting this transition and ultimately reducing emissions, as compared with other major emitting sectors like the energy sector. Transportation presents a similar challenge between jurisdictions and is not based on natural resource endowments in the way that reducing emissions from the energy sector is. If a jurisdiction has vast hydro resources, for example, the scale of the challenge in terms of reducing emissions is very different from a jurisdiction relying mainly upon fossil fuels, like coal. Given that a low-carbon transition for transportation depends entirely on the intent and actions of governments and non-state actors, regardless of natural resource endowments or other exogenous factors, insights from this work are arguably more transferable to other North American jurisdictions.

Why Ontario and California?

Ontario and California have key similarities that make them appropriate cases to compare. Although the level of polycentricity is arguably higher in the US system, both subnational jurisdictions are situated in complex multi-level federations and have been relative leaders with regards to climate governance initiatives. Significant to the transportation sector, both California and Ontario are comparatively large geographically speaking. Although Ontario is almost double the size of California, both jurisdictions must deal with this challenge. Also, in both the US and Canada, meaningful climate action at the federal level has stalled over the past few decades, and in response to this vacuum, states and provinces, in addition to local governments, have become leaders in formulating and implementing climate policy. As "hotbeds of climate change activity" (Bedsworth and Hanak 2013, p. 664), subnational

jurisdictions provide excellent case examples where years of substantial experience with climate policy can be analyzed.

At the outset of this research, Ontario and California's climate governance regimes were also joined formally, alongside Quebec, via linked cap-and-trade systems under the Western Climate Initiative[1]. Unlike Quebec, whose energy system is essentially based entirely on low-carbon hydropower, Ontario and California have relatively diverse energy systems. This makes these two subnational jurisdictions a better choice for comparison, especially because Quebec's hydropower generation and distribution company, Hydro Quebec, has dedicated substantial resources to push for electrified transportation.

Progressive climate leadership demonstrated through decades of work in California has resulted in this state's position as arguably *the* climate policy leader in North America (Bedsworth and Hanak 2013), and therefore an important case to analyze. Similarly, Ontario has been a relative climate change policy leader within the Canadian federation. At the outset of this research (2017), both subnational governments were very active in crafting overarching rules to facilitate climate change mitigation efforts, with a keen focus on reducing transportation emissions. As two subnational jurisdictions where successive governments have been meaningfully engaged in climate change governance (albeit a shorter experience in Ontario), these two cases provide promising sites for evaluating the role of the state in operationalizing their respective polycentric climate governance systems via overarching rules. Put simply, if rules provided by higher-order governments can help operationalize polycentric climate governance systems, we should see evidence of this in these cases.

Brief introduction to the case: Ontario, Canada

Ontario is Canada's second-largest province in terms of geography; stretching more than 1 million square km (415,000 square miles), it is just over twice the size of California (Government of Ontario 2017e; World Atlas 2018). This vast province contains varied landscapes, including the mineral-rich Canadian Shield, fertile farmlands in the south and grassy lowlands in the north; it spans from northern

[1] Ontario withdrew from the WCI in 2018 following the election of the Progressive Conservative Party led by Doug Ford

latitudes roughly equivalent to London, England to southern latitudes roughly parallel to Rome, Italy (Government of Ontario 2017e). Ontario is rich in natural resources; it contains over half of Canada's highest quality farmland, roughly one-fifth of the world's freshwater, 18% of Canada's forests and has significant mineral deposits (Government of Ontario 2017e). Although the province has substantial natural endowments, the economy is primarily a service-based economy with a significant manufacturing component, especially in automotive parts manufacturing and assembly (Ontario Ministry of Finance 2017).

Given its large population and economy, Ontario is an important player in the Federation of Canada. In 2017, the province contained roughly 40% of Canada's population and, in 2018, produced approximately 40% of the country's GDP (Ontario Ministry of Finance 2018). Of Ontario's 14.375 million inhabitants more than 85% live in urban centers, primarily on the shores of the great lakes, including

Figure 1. The Greater Golden Horseshoe (Allan and Campsie 2013).

Canada's largest urban area, the Greater Golden Horseshoe (GGH), where more than 9 million people live (Ontario Ministry of Finance 2018; Government of Ontario 2017c). The GGH is one of North America's fastest-growing regions and is a significant region nation-wide; it is home to 25% of Canada's population and acts as the economic engine of Canada, producing roughly 25% of the country's GDP (Wallace 2017; Government of Ontario 2017c). Figure 1 shows the location of the GGH within the Province of Ontario.

The physical attributes of the province, notably its vast geographic scale and its climate characteristic of hot summers and very cold winters, pose additional challenges from a climate change mitigation perspective. Temperatures can range from well above 30 degrees Celsius in summer and drop below -40 degrees Celsius in winter (Government of Ontario 2017e), which means a substantial amount of energy is required for cooling and heating, respectively. Critical for transportation emissions, the

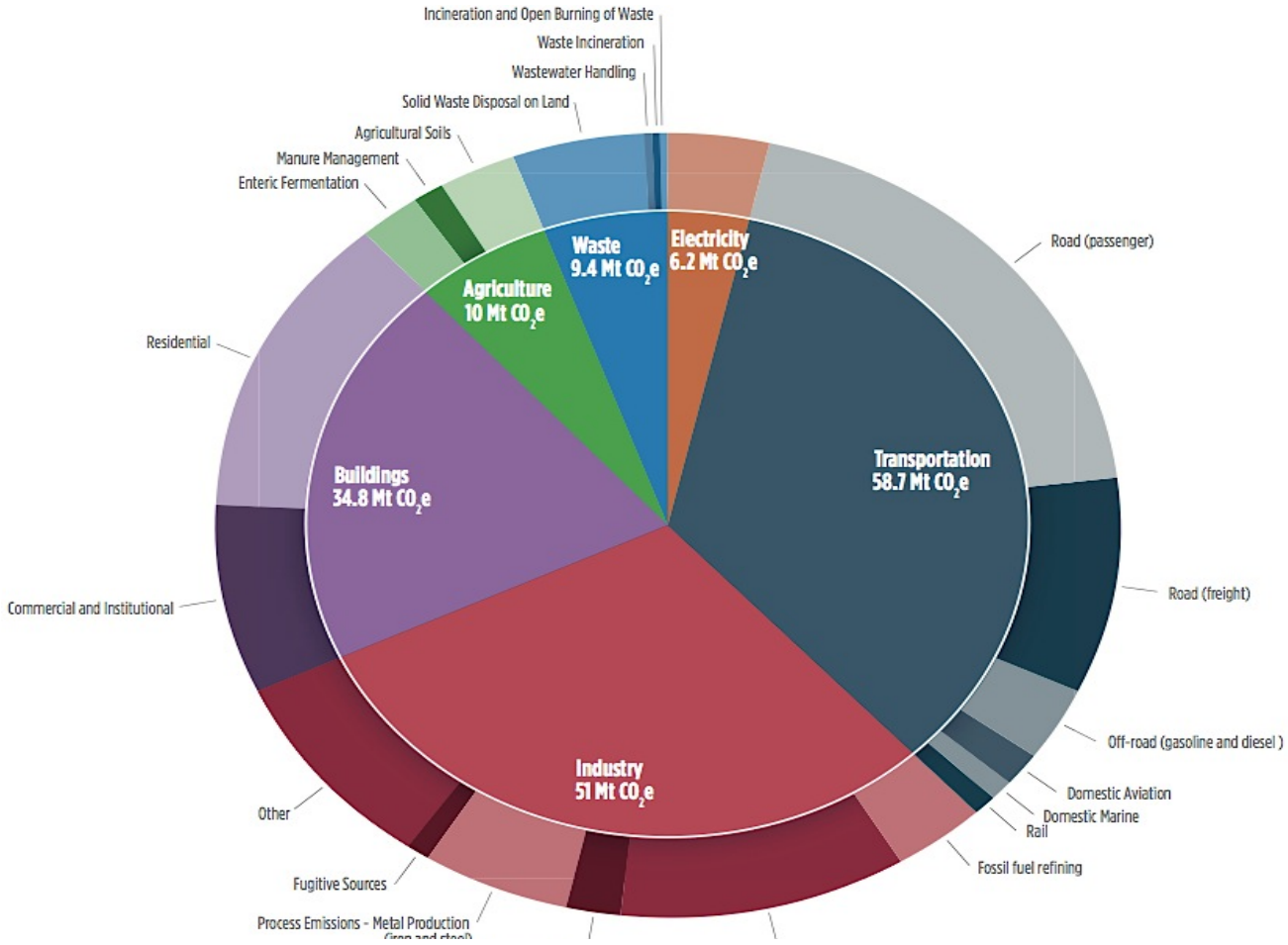


Figure 2. Ontario GHG Emissions in 2014 by sector (Environment and Climate Change Canada 2016; cited in ECO 2016).

province's large landmass and low average population density (roughly 14 people per square km) results in high demand for passenger and freight vehicle travel. Due to its large manufacturing sector, historically Ontario has produced the most emissions compared to the other Canadian provinces; currently, it ranks as the second-highest emitting province, as Alberta's oil and gas sector has expanded in the past decade and Ontario has taken significant steps to decarbonize its electricity supply (Environment and Climate Change Canada 2018). Currently, transportation-related emissions account for nearly one-third of all the province's emissions, the largest of any share, making the reduction of these emissions "the biggest opportunity - and also the biggest challenge - to achieving Ontario's 2020 GHG reduction target." (Mahony 2016, 9-57) (see Figure 2).

Ontario's road passenger transportation system consists of road and public transit infrastructure, which is valued at CAD 82 Billion and CAD 11 billion, respectively (Office of the Auditor General of Ontario 2017). Ontario has a total of 250,000 km (155,342.8 miles) of roads and highways, including 2,100 km (1,304.9 miles) of controlled multi-lane highways, 14,800 km (9,196.3 miles) of other highways in addition to municipal and other roads (Government of Ontario 2014). The province also administers over 100,000 km (62,137.1 miles) of roads on Crown land, including approximately 30,000 km of resource access roads (Government of Ontario 2014). Ontario, in particular Southwestern Ontario, has some of the heaviest road traffic in North America; the estimated cost of road congestion in the GTHA (Greater Toronto Hamilton Area) was CAD 6 billion in 2006 (Government of Ontario 2014).

With regards to mass or public transit, Ontario transit systems serve more than 130 communities, although most of the trips take place in the 15 largest urban communities (Government of Ontario 2014). Metrolinx, an agency of the Ministry of Transportation, operates a regional transit network in the Greater Toronto and Hamilton Area (which accounts for 25% of Canada's population), consisting of trains and buses operating over 11,000 sq. km (Wallace 2017; Office of the Auditor General of Ontario 2017). Metrolinx vehicles move roughly 69 million passengers annually (Office of the Auditor General of Ontario 2017) and municipal transit services in Ontario's 15 largest urban areas carry over 800 million passengers each year, with ridership expected to increase to 908 million trips annually by 2019 (Ontario Ministry of Transportation 2016c). Ontario municipalities operate 61 conventional public transit systems that vary widely in scope and complexity (Association of Municipalities Ontario [AMO] 2017). Local governments spend a substantial amount of money building and operating these systems.

The Toronto Transit Commission (TTC) is the largest municipal transit system in Ontario and the third largest in North America (Toronto Transit Commission [TTC] 2017). The subways, buses and streetcars that comprise the system served an annual ridership of just under 540 million passengers in 2017 (TTC 2017). Municipal transit systems in the GTHA, such as Zum (Brampton, ON), Transitway (Mississauga, ON) and VivaNext (York Region, ON), have seen higher growth rates than the TTC and are currently undergoing rapid expansion of their service networks (TTC 2017). In 2011, eight of ten Ontarians drove to work, although carpooling rates were considerable (Ontario Ministry of Finance 2011). While Ontario has the largest number of light vehicle registrations in Canada at 7.9 million, it has one of the lowest ratios of these vehicle registrations in relation to the driving age population (Statistics Canada 2015).

Although total emissions have fallen in the province, roughly six percent between 1990 and 2014, transportation-related emissions grew by 27 percent (Environment and Climate Change Canada 2016; cited in Government of Ontario 2017b). Passenger transportation emissions (cars, trucks, bus, rail, domestic aviation) accounted for roughly 66 percent of transportation-related emissions in 2014, growing 15 percent since 1990, due primarily to increased vehicle miles traveled (VMT) and an increase in the fleet composition of larger vehicles like SUVs, minivans and pick-up trucks (Government of Ontario 2017b). Freight emissions are also significant, making up roughly 30% of transport-related emissions in 2014 (Government of Ontario 2017b). For roughly a decade, Ontario Provincial governments have been planning and implementing measures to reduce GHG emissions. The province met its 6% reduction goal for 2014 (from 1990 levels) and is now pursuing reduction targets for 2020, 2030 and 2050: 15% below 1990 levels for 2020, 37% below 1990 levels by 2030 and 80% below 1990 levels for 2050 (Government of Ontario 2016).

Brief introduction to the case: California, U.S.A.

California is the United States' third-largest state, geographically speaking, stretching two-thirds up the West Coast of the United States (U.S. Energy Information Administration [U.S. EIA] 2018). It has been the most populous state since the early 1960s and currently has a population of 39.5 million people, making up 12.1% of the population of the United States (Lewis and Morgan 2018; U.S. EIA 2018). California's population is concentrated primarily along its roughly 1,100-mile coastline, with 75% living in the Los Angeles, San Francisco and San Diego metropolitan areas (Lewis and Morgan 2018). The geography of the state is varied to the point of contrasting extremes; rich agricultural land is found in the

central valley, various mountainous ranges, including the Sierra Nevada range, contain peaks reaching 4,200 meters in elevation, border eastern and western state lines, and vast desert areas, situated both above and below sea-level, are found mainly in the eastern part of the state (Lewis and Morgan 2018). California's climate varies alongside its geography. High mountain ranges see heavy snows, while the coast sees mainly mild and temperate conditions; humidity and temperature fluctuate dramatically in the valleys; arid deserts also experience wide variations in temperatures (Library of Congress n.d.). California is a state endowed with stunning natural beauty, which is protected through a substantial number of state and federal parks, including the country's first national park, Yosemite National Park, established in 1872 (Hetter 2017).

With a GDP of USD 2.747 trillion, California has the largest economy in the U.S. and the 5th largest economy in the world, surpassing the United Kingdom in 2018 (Corcoran 2018). By the mid-1960s, California surpassed New York as the leading exporter of manufactured goods in the U.S., which is now dominated by computer and electronics as a result of the development of Silicon Valley starting in the late 1970s (Lewis and Morgan 2018). Within the U.S., California dominates the agricultural industry and globally remains the center of the film and television industry (Lewis and Morgan 2016). Tourism and hospitality is a top industry cluster in the state, which saw 17 million international visitors in 2015 (State of California 2018). The state's ability to attract and retain world-class talent, alongside the state's extensive university system containing leading research institutes, has helped bolster its economic dominance. Although, as a whole, the state has a very strong economic profile, and is home to some of the wealthiest people in the U.S. (Taylor et al. 2016), the distribution of wealth is quite uneven across the state. In fact, California holds the position as the 'poverty capital of America', where one in five Californians are considered poor (Jackson 2018).

California's road passenger transportation infrastructure is extensive, especially the number and length of roads and freeways. Transportation dominates the state's energy consumption profile, ranking number one in the U.S. for vehicle miles traveled (U.S. EIA 2018). California has almost 400,00 lane-miles of pavement between highways and local streets and roads, second only to the state of Texas in lane-miles (Simbol, Golaszewski and Van Heeke 2018; U.S. Department of Transportation 2016; American Society of Civil Engineers 2017). Although the state highway system is much smaller in terms of lane-miles vs. local streets and roads, highways are heavily used; of the 35 miles per day a Californian on

average drives, 19 miles are on state highways and 16 miles are on local streets and roads (Simbol et al. 2018). As a result of a total increase in the number of drivers in the past decade, and hardly any new state highway capacity added over this time, congestion has increased in recent years (Simbol et al. 2018). As of 2016, 35.3 million vehicles were registered with the DMV, meaning there are roughly .89 registered vehicles in California for every person, more than any other state (Simbol et al. 2018; U.S. EIA 2018). The vast majority of these vehicles run on gas or diesel and the emissions from driving these vehicles are the single largest source of GHG emissions in the state (approx. 1/3 of total emissions or 440 Million Metric Tons of CO2e) (Simbol et al. 2018). While hybrid and electric vehicles make up only 3 percent of registered vehicles, ownership of these vehicles has rapidly increased in the past few years (Simbol et al. 2018).

In terms of mass or public transportation, California has over 100 public transit and bus districts that provide service at various scales, including state-wide, intercity, regional and local public transportation systems (California Energy Commission [CEC] 2018). Roughly 45 of these public transit agencies are considered 'larger transit agencies', which see more than 2 million boardings per year (American Public Transportation Association 2018). The ten largest transit systems accounted for 81% of all transit trips in 2016, based on ridership (Simbol et al. 2018). As Table 1 shows, the L.A. Metro is by far the largest transit system in terms of ridership at 31%.

Table 1. Largest Transit Systems Located in Major Urban Areas in California (Simbol et al. 2018, p.22).

Agency	Share of Total Ridership
Los Angeles Metro	31%
San Francisco Municipal Railway	17
Bay Area Rapid Transit	10
San Diego Metropolitan Transit System	7
Alameda-Contra Costa Transit	4
Orange County Transportation Authority	3
Santa Clara Valley Transportation Authority	3
Long Beach Transit	2
Sacramento Regional Transit District	2
Los Angeles Department of Transportation	2

An estimated 5.3% of Californians commute to work using public transportation, which in large urban areas is dominated by motorbuses that are increasingly fuelled by natural gas (CEC 2018a). Of the

1.3 billion transit trips taken in 2016, two-thirds took place by bus (Simbol et al. 2018). Transit ridership, in general, has decreased in recent years, including bus travel, except for intercity rail ridership that has increased by roughly one million passenger trips between 2006 and 2016 (Simbol et al. 2018). Long-distance, intercity transportation is dominated by rail, specifically, three intercity rail routes operated under AMTRAK, which are funded by the state (CEC 2018a; Simbol et al. 2018).

As Figure 3 from the 2018 California Air Resources Board (CARB) Emission Trends Report illustrates, the state of California has made substantial progress in terms of GHG emission mitigation. Absolute GHG emissions have followed a declining trend since 2007, falling 13% as of 2016 from their peak in 2004 (CARB 2018). Since 2000 the carbon intensity of the state economy and GHG emissions per capita have declined significantly; the carbon intensity of the economy declined by 38% between 2000 – 2016 and GHG emissions per capita declined 23% from a peak in 2001 of 14.0 tonnes per person to 10.8 tonnes per person in 2016 (CARB 2018). Against the backdrop of a steadily increasing population and state GDP growth of 41% since 2000, these numbers represent significant progress in terms of climate change mitigation.

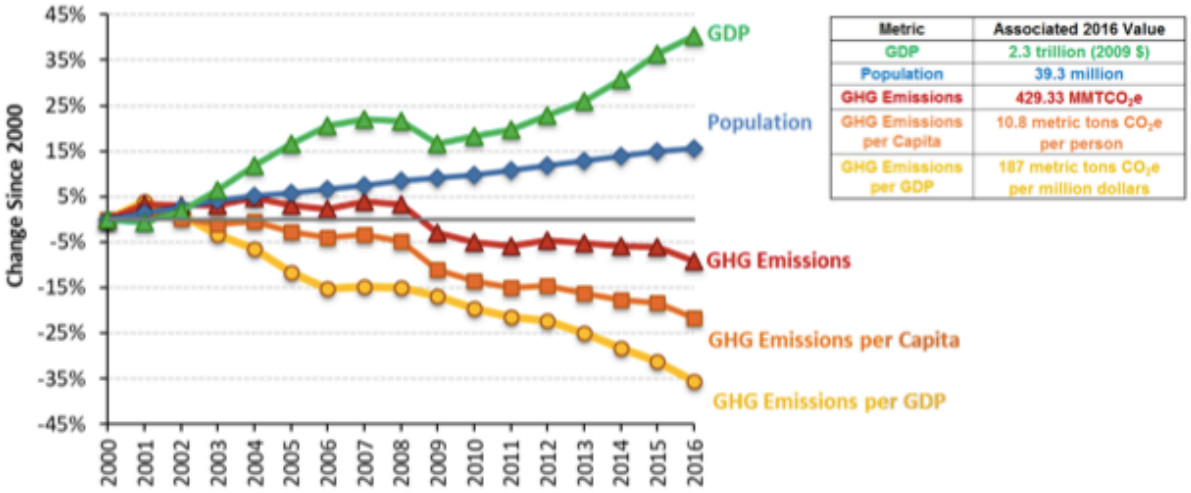


Figure 3. California's GHG emissions, population, GDP, GHG per capita and carbon intensity of the economy since the year 2000 (CARB 2018).

As Figures 4 and 5 illustrate, mixed progress has also been made with regards to lowering emissions from the transportation sector, yet this still remains the most significant contributor to state GHG emissions overall, comprising 39% of total emissions in 2018 (Taylor 2018). Transportation emissions were relatively stable between 2000-2007, then decreased for roughly 5-6 years, and in the most

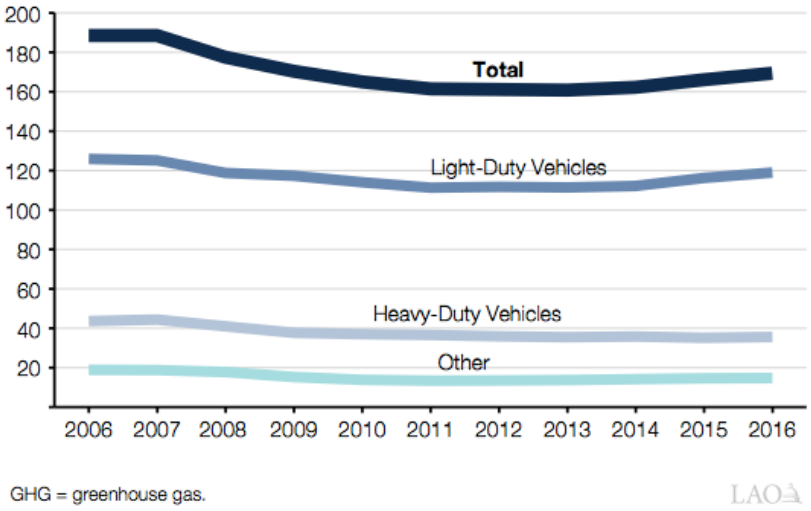


Figure 4. California Transportation Emissions in Million Metric Tons (Taylor 2018).

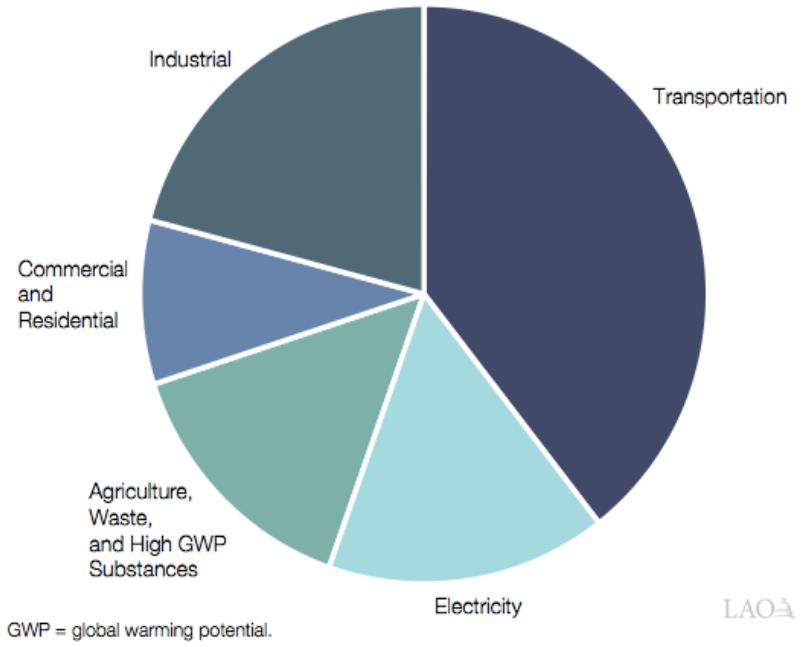


Figure 5. California GHG Emissions since in 2018 by sector (Taylor 2018).

recent years have increased slightly. According to CARB (2018) emissions from on-road vehicles are the main driver of this increase; increased fuel use has stemmed from a combination of population growth, lower fuel process, improved economic conditions and higher overall employment. Regulatory measures and improved vehicle fuel efficiency have been the key factors driving down emissions over time (CARB 2018). Overall, California has a relatively low-carbon output considering it is the 5th largest economy in the world, producing roughly 1% of global emissions and 6.9% of U.S. emissions (California Energy Commission [CEC] 2017; U.S. EIA 2018). In addition to concerted efforts to reduce state emissions, the state's relatively low emission profile, especially per capita energy consumption, has direct links to the physical climate of the state. Most of the more densely populated areas of California have a relatively mild and dry climate, meaning heating and cooling energy consumption is limited: more than two-fifths of households report not using air conditioning and roughly one-seventh do not use space heating (U.S. EIA 2018).

Outline of the dissertation:

The remainder of this dissertation proceeds as follows. Chapter 2 outlines the methods utilized in this research, including the framework for delineating policies and laws aimed at reducing emissions in each case, which is based on a state-of-the-art review completed for this research (see Appendix A). Key explanatory landscape variables for the comparative context analysis are presented alongside two novel methodological approaches underpinning the case study analysis. The method for measuring degrees of polycentricity in each cases' governance system is explained, as well as the application of an established analytical framework used in policy integration studies for assessing the impact of overarching rules and state steering in operationalizing a polycentric approach to climate change mitigation.

Chapter 3 provides a detailed review of collective action theory and its application to global climate change, underpinning the logic of regime failure. Chapter 4 discusses the evolution in modes of governing, ending with an introduction to polycentric governance systems, generally, and as an approach to mitigating global climate change, including the role of state steering. This chapter also reviews the concept of environmental/climate policy integration as a critical mechanism for 'managing institutional voids' and as an evaluative framework for assessing overarching rules from higher-order governance levels.

A comprehensive review of the key overarching rules for reducing emissions from the transportation sector in each case is found in Chapters 5 and 6. See Appendix B for a full list of all rules and regulations relating to reducing emissions from the passenger transportation sector in each case. Chapter 7 provides a comparative context analysis for each case based on the landscape variables set out in Chapter 4. Key context variables that have hindered or helped the passing of climate change legislation and programs in each case are discussed. Chapter 8 delineates the degrees of polycentricity in each case and discusses this in relation to the case contexts discussed in Chapter 7. Chapter 8 is dedicated to analyzing overarching rules in each case in relation to enhancing a polycentric approach to climate change governance. Finally, Chapter 9 provides concluding thoughts stemming from the research findings, including what the results mean for polycentric climate change governance systems in theory and practice.

Chapter 2: Research Design and Methodology

Two core bodies of literature underpin this research: collective action theory and polycentrism/networked governance. The framework for analysis is drawn primarily from environment and climate policy integration studies, with an emphasis on EPI as policy learning. The notion of policy learning and shaping institutions for learning connect with core themes in the polycentricity literature around resilience and operationalizing polycentric governance systems. The literature around understanding EPI as a learning process connects with the theory on operationalizing polycentric governance systems in many ways. Arguably the key link is the emphasis on coordination and learning in both bodies of literature. Intrinsic to coordination and learning is the dissemination and spreading of knowledge both vertically and horizontally through polycentric governance systems. Themes of innovation, coordination and learning also overlap and complement key mechanisms found in the literature on collective action, including communication, transparency, trust, and reciprocity.

The aim of using this framework is to focus the analysis on variables crucial to ensuring governance effectiveness and climate policy resilience in the chosen sector, road passenger transportation. The methodology employed in this research stems from the shared focus between these bodies of literature. The core explanatory factors utilized in this analysis have been carefully drawn from these bodies of literature in a way that emphasizes overlap and includes complementary variables. The variables evaluated to understand given levels of CPI and the effectiveness of polycentric climate governance will reflect the most recent literature on CPI and operationalizing networked/ polycentric governance systems. Importantly, the relationships between variables are also evaluated; For example, assessing the impact of high levels of political commitment and a well-grounded social consensus around protecting the environment.

Strategies of Inquiry and Framework for Analysis

Qualitative strategies of inquiry, both primary and secondary, are utilized in this research. Qualitative research was carried out sequentially; research using secondary sources was carried out first, then semi-structured interviews were conducted to fill any knowledge gaps. Carrying out this research sequentially allowed set questions and unplanned discussions to benefit from an already established knowledge base. Interviews were designed to function as a means of answering research questions that

could not be adequately addressed using secondary sources. Altogether, this research involved an analysis of a wide variety of government documents, government legislation and policy programs, peer-reviewed and grey literature, polling data and emissions data. In addition, 15 semi-structured interviews with key actors from government, academia, industry/business and the non-profit sector were conducted. Primary qualitative data was also attained through attending relevant conferences and workshops, especially group workshops for the Joint Clean Climate Transport Research Partnership[2] (JCCTRP).

The first section of this chapter will discuss the method for the comparative legislative and regulatory analysis and key landscape variables. This forms the basis for the comparative context analysis. They represent the empirical anchor for this research. The landscape variables framing the comparative case context analysis, where contextual drivers and barriers to the passing of climate-transport policies are analyzed, stem from traditional landscape variables commonly used in the field of policy studies, and more specifically, in climate policy integration studies (e.g., Dupont and Oberthur 2012).

Next, this chapter reviews the framework for inventorying overarching climate-transport rules in each case. Information on overarching rules collected through this research is organized chronologically by the level of governance (federal, state/provincial), crossed by two categories under the road passenger transportation system: 1) cleaner vehicles and 2) transportation demand management. This chapter includes a state-of-the-art review of potential mechanisms to reduce emissions from the road passenger transportation sector, which provides the framework for organizing this comparative legislative and regulatory analysis.

Next, the methodology employed for measuring degrees of polycentricity for each case's climate change governance regime is explained, in addition to the method for evaluating operationalization via overarching rules. Specifically, overarching rules were evaluated using a long-standing EPI/CPI frame that breaks out organizational, procedural and communicative, horizontal and vertical integration mechanisms. The method for primary qualitative analysis, meant to supplement the extensive secondary

[2] The JCCTRP is a partnership organization funded through the Social Science and Humanities Research Council that brings together leading climate-transport experts in Ontario, Quebec, California and Vermont. Comprehensive notes were recorded for each workshop.

research, concludes this chapter. Figure 6 summarizes the overall framework for analysis, which is divided into two major sections, reflecting the two major lines of inquiry underpinning this dissertation.

1) *Context Analysis: Landscape Variables*

    a. Problem Characteristics and the Transaction Costs of Change
    b. Institutional Context
    c. Structure of the Regional Economy
    d. Framing and High-Level Political Commitment
    e. Public Opinion, regional narratives and social consensus

2) *Assessing Degrees of Polycentricity and Operationalization*

    a. Measuring Polycentricity:
        i. Breadth of Inclusion and Functional Redundancy
        ii. Degree of Collaboration for policy learning
    b. Evaluating Operationalization by Overarching Rules
        i. Procedural, communicative, organizational vertical and horizontal integration and coordination mechanisms

Figure 6. Framework for Analysis.

Analysis: Key Explanatory Variables Influencing CPI Efforts in Each Case

In order to gain a comprehensive understanding of which variables are most significant in terms of impacting the extent of CPI in each jurisdiction's road passenger transportation sector, a combination of primary and secondary research was utilized. Secondary research on the following variables provided the base of the analysis, with semi-structured interviews providing a more focused discussion on the relative importance of each variable for the state/province. The following section individually reviews each variable and discusses its relevance and stated impact on policy integration. The key landscape variables are as follows:

a. Problem Characteristics and the Transaction Costs of Change
b. Institutional Context
c. Structure of the Regional Economy
d. Framing and High-Level Political Commitment

e. Public Opinion, regional narratives and social consensus

Problem characteristics and the transaction costs of change

The transaction costs of change, i.e., the cost of switching from a fossil-fuel-powered passenger transportation system to a low carbon one, was researched and factored into this discussion as an important 'problem characteristic', which in large part defines the scale and nature of the challenge from a policy perspective. For example, reducing emissions from the transportation sector is more costly in the short-term than many other sectors (Pew Center 2008), which has obvious implications in terms of garnering support for progressive low-carbon transportation policies. Analysis of the transaction costs of change and problem characteristics was carried out using socio-technical transitions theory, and the highly related concept of carbon-lock-in.

The concept of socio-technological systems was developed significantly in the late 1980s and captures "the view that individual technologies, the way they develop, are best understood as apart of wider technological and innovations systems" (Foxon 2007, 141). In this way, technological change and transitions are embedded in a wider system, the socio-technical regime, "which constitutes the mainstream" (Smith, Peter and Grin 2010, 440). When a technical regime becomes more powerful, is more widely adopted and embedded in society, it transforms into a socio-technical regime (Geels 2004). The 'transitions' concept originated in the 19th century and was applied to the research of socio-technical systems in the 1990s and has been increasingly applied to transitions aimed at sustainability (Geels 2011). The concept of technological transitions is used to understand better the diffusion of various technologies (Evans 2012).

One method that has been employed to gain insights into technological diffusion has been the study of historical socio-technical transitions, for example, the socio-technical transition of electricity systems. In large technical systems such as the electricity system, transformation is argued to be gradual, but as Bon Meier (1994) postulates in his work on possible future transformations of electricity systems, sustainable technologies might first be introduced into the system to deal with specific problems. Eventually, this leads to further incremental changes due to specific functional and performance advantages that may eventually lead up to a major reconfiguration (cited in Elzen et al. 2004).

Nevertheless, it is important to note that insights and lessons about barriers to technological diffusion from historical energy transitions might not have much relevance within the context of a low carbon energy transition. This doubt stems from the fact that unlike energy transitions in the past that were driven by the availability of technologies with cost and performance advantages, current efforts to transition to a lower-carbon economy are essentially policy-driven (Wilson and Grubler 2011). Regardless, there are useful insights provided by these related theoretical concepts on factors potentially constraining further diffusion of low carbon transportation technologies.

Throughout most of the world, the dominant technological regime for passenger transportation is based on hydrocarbons, specifically oil. This situation of path-dependency or 'lock-in' of incumbent hydrocarbon technology resulted from historical availability of cheap fossil fuels and "a process of technological and institutional co-evolution driven by path-dependent increasing returns to scale". (Foxon 2007; Unruh 2000, 817). In the case of low or zero-carbon passenger transportation vehicles, there may be a potential conflict between the existing institutions, networks and infrastructures based around hydrocarbons, which acts to constrain policies, as building non-dominant technology inherently includes 'switching costs'. From the perspective of transportation demand management, land-use and infrastructure patterns have co-evolved with the dominant hydrocarbon transportation regime, presenting a challenge to attempting to induce modal shifts. For example, active transportation or public transit are not as viable alternatives in areas characterized by low-density urban sprawl.

Institutional context

Although the analysis of institutional conditions has not been a key focus in the past studies of EPI (Nunan, Campbell, and Foster 2012), they are an important variable. Inherent to EPI is the requirement for "civil servants to juggle conflicting demands and loyalties, and organizational structures can make that process harder – or easier" (Nunan, Campbell, and Foster 2012). One challenge that arises in evaluating institutional arrangements and their impact on EPI/CPI is that there has been limited practical experience with them (a few decades), reducing definitive assessments available (Jordan and Lenschow 2010). In their state-of-the-art review, Jordan and Lenschow (2010) utilize a political systems perspective to help analyze institutional conditions that support EPI in practice. EPI is viewed as a process "anchored in a

political system" that relies on institutions to deliver more coordinated governance (Jordan and Lenschow 2010, 150).

Regarding horizontal coordination, Jordan and Lenschow (2010) find that political systems with high levels of ministerial independence (e.g., Germany) are more likely to reinforce sectoral thinking versus those with less ministerial independence (e.g., Sweden, UK), which are more suited to integrating environmental objectives across agencies. In terms of vertical coordination, they find that more federal systems (e.g., Germany, USA) have encountered "significant institutional obstacles", whereas less federal systems that are more centralized and parliamentarian (e.g., U.K.) are more "conducive to a decisive style of reform politics – including organizational innovation – and strong communication" (Jordan and Lenschow 2010, 151). Meadowcroft and Toner (2009a, p. 10) argue this has also been the case in Canada, where decentralization of powers to subnational governments, especially with regards to the environment, clearly makes "decisive government action more difficult".

Rayner and Howlett (2009) similarly highlight the increased challenge of attaining required levels of multi-level coordination in their study of 'integrated land management' in Canada. Additionally, integrated decision-making is made more difficult in Canada due to problems with policy coherence and alignment; for example, there are 62 overlapping government agencies involved in protecting the Fraser River in British Columbia (Dale 2009). Moreover, path dependencies resulting from the institutional and policy context also influence the level of integration in the policy process and policy outputs (Dupont and Oberthür 2012). Past policy and institutional decisions influence the range of available opportunities and options in a given policy arena. Actors involved in governance also learn from previous successes and failures, which can hinder or perpetuate "a dynamic that facilitates change" (Dupont and Oberthür 2012, p. 232).

The constitutional division of powers in each case, explicitly impacting local government autonomy, is an essential variable with regards to how polycentric climate governance works in practice. This institutional variable has been delineated for each case to highlight how this has impacted the ability for sub-state/province actors to engage meaningfully in mitigating emissions (specifically transport emissions) and initiative policy innovations. This factor is linked to regulatory and policy capacity, another critical variable analyzed under the 'institutional context' variable.

The policy/regulatory capacity of the bureaucracy that make up governance institutions has also been emphasized under the broader category of institutional context, as it has the potential to be a powerful explanatory variable with regards to why progressive climate change legislation has been able to (or not been able to) be passed in the case jurisdictions. Generally, Persson (2007) argues, "regulatory capacity is a key factor for EPI" (cited in Mullally and Dunphy 2015, p. 35). As Stedman and Wellstead (2010, p. 896) explain, policy capacity has been defined in slightly different ways:

> Honadle (1981: 578) defines it as 'the ability to: anticipate and influence change; make informed, intelligent decisions about policy; develop programs to implement policy; attract and absorb resources; manage resources; and evaluate current activities to guide future action'. Others are more concerned with the ability to respond to change (Weiss 1979), the intellectual and organizational resources of the State (Cummings and Nørgaard 2004), the management of knowledge and organizational learning (Parsons 2004) or policy formulation (Goetz and Wollmann 2001).

Regardless of the exact variation of the definition, it is widely agreed upon that "ensuring strong policy capacity based within a public service is a critical factor in avoiding policy failure" (Stedman and Wellstead 2010, p. 894) and contributing to evidence-based policy-making (Howlett 2009; Wellstead and Stedman 2011). This is the case, especially with a policy problem as complex as mitigating climate change. For example, in the case of California, the argument has been made that the high regulatory capacity of the California Air Resources Board, and earned trust from past regulatory success regulating air pollution, helped the passing of progressive climate legislation because lawmakers were more willing to give the institution wide-ranging power and scope for regulating (Carlson 2017). Also, the institution's high degree of regulatory capacity meant they were able to implement these plans effectively (Carlson 2017). This line of argument fits in with the broader argument of "the California Effect", which in part theorizes that the State's high policy/regulatory capacity has led to it being a leader among states and often the federal government as well (Vogel 1997; Rabe 2008; Carlson 2017). Past performances of government institutions in each subnational jurisdiction with regards to regulating air and energy issues are assessed to understand how relative levels of policy capacity influence the ability to approve and implement progressive policies aimed at lowering transportation emissions.

In addition to regulatory/policy capacity, the ability of external climate stakeholders (ENGOs, members of epistemic communities) to influence the policy process is a crucial focus under this explanatory variable. Economic advocacy groups tend to have a much stronger influence on governments than environmental groups. This is often based on the fact that environmental groups have fewer resources, and "possess less direct political leverage", which results in the ambitions of environmental proposals being significantly downgraded during government negotiations (Hertin and Berkhout 2003; Casado-Asenio and Steurer 2012). While this proposition accurately reflects the dynamics in Ontario, it is not reflective of the California context, where environmental groups have relatively much higher levels of influence. Different institutional structures and 'rules of the game' in terms of influencing the policy process impact the ability for interest or pressure groups to either hinder or promote the integration of climate mitigation objectives into policies being formulated.

The relative power of economic interest groups is also a potential barrier with regards to given levels of sector conflict within governments, as there is a built-in advantage for economic groups to hinder EPI efforts when they conflict with their agenda (Vogel et al. 2010; Polk and Schmultzer 2005; cited in Casado-Asenio and Steurer 2012). Legislative and electoral rules influencing the ability of external stakeholders to influence policy outputs are analyzed for each case to understand these dynamics. The role of courts in this context are also briefly examined.

Finally, the influence of 'governance driving governance' is evaluated as an institutional context variable. In analyzing various national and international drivers of climate change legislation, Clare, Fankauser and Gennaioli (2017) find that the number of existing climate change legislation, in particular, broad framework, or so-called "flagship" legislation, improve the chance that more climate change rules and regulations will be passed in the future. That being said, at a certain point when the stock of existing climate legislation is high, the need to legislate on the issue of climate change decreases, and the effect continues to weaken the need for more climate legislation as more laws are passed (Clare et al. 2017). The effect of existing climate change laws on the propensity to pass more legislation is not just about the number of laws but very much depends on the content of the laws as well (Clare et al. 2017).

Structure of the regional economy

Many major corporations have deeply entrenched interests in ensuring that business continues as usual, and a low-carbon energy transition, centered around a shift away from fossil fuels, is not realized. Sustainable development, generally, but especially progressive climate change policy, has been very much hindered by industry lobbying and misinformation campaigns. Influence Map is a neutral British non-profit organization, "whose goal is to accurately assess, rank and communicate the extent to which corporations are influencing climate policy and legislation worldwide" (Influence Map 2016). In an April 2016 report titled, "How much big oil spends on obstructive climate lobbying", the organization found the fossil fuel industry spends almost USD 115 million annually on obstructive climate lobbying (Influence Map 2016a). This includes the "direct spending on climate obstruction by ExxonMobil (USD 27 million), Shell (USD 22 million), the American Petroleum Institute (API) (USD 65 million) and USD 9 million by two smaller trade associations - the Western States Petroleum Association (WSPA) in the U.S. and the Australian Petroleum Production & Exploration Association (APPEA) in Australia" (Influence Map 2016a, p. 2). The organization uses a broad definition of influence based on a 2013 UN report, which in addition to direct lobbying includes political contributions, marketing, public relations, advertising, trade and regulatory organizations[3] (Influence Map 2016a; Roston 2016).

The Union of Concerned Scientists (2012, p. 1) conducted a similar analysis of how U.S. corporations were influencing the dialogue around climate science; they found:

> While some American companies have taken consistent and laudable actions in support of climate science—and of consequent policy—others have worked aggressively to undermine the science and block science-based policy proposals. Still, other companies have taken contradictory actions in different venues.

In some cases, the political commitment by governments to the fossil fuel industry has enhanced corporate efforts to attempt to block or slow progress on climate change. In Canada, direct and indirect subsidies and lobbying campaigns by the government for the fossil fuel industry continue to be significant even after the Harper era (Carter 2016). In 2010, subsidies were estimated to be roughly CAD 2.8 billion and

[3] For a comprehensive explanation of the methodology used by InfluenceMap see: http://influencemap.org/page/Our-Methodology

during the Harper years (not surprisingly) the fossil fuel industry's access to federal decision-makers was higher than any other interest group in the country (Carter 2016, p. 296; Demerse and Lemphers 2016, p. 25).

To understand the implications for CPI in the transportation sector, the most powerful (economic power) industries in each case jurisdiction have been researched and evaluated, not only in terms of their relative hold over a given region but also with regards to how active they are in attempting to influence policy. Generally, the relative level of threat to established sectors presented by a low-carbon transition, in general, and in transport, are assessed based on the relative carbon-intensity of each industry and potential risks and benefits implied by such a transition. For example, if information and communication technologies are the most influential industry in a given region, it is likely there will be less pushback or active blocking of climate change mitigation legislation, as opposed to if the largest industry is automotive manufacturing.

Framing and high-level political commitment

Cross-sectoral policy integration, such aligning energy project decisions with climate change objectives, is 'highly political' (Mullally and Dunphy 2015), and the irreducible *political* character of governance for sustainable development cannot be ignored (Meadowcroft 2009), given "disrupting carbon lock-in fundamentally a political activity" (Bernstein and Hoffman 2018, p. 191). A recent UN expert group report also highlights this fact, noting, "Policy integration challenges are fundamentally political…Everyone agrees with the need for coordination, but no one wants to be 'coordinated'" (UN Department of Economic and Social Affairs 2015). Political commitment for EPI/CPI, though highly unpredictable and conditional, is, in general, widely regarded as an important factor for enhancing the degree of integration (Mullally and Dunphy 2015; Jordan and Lenschow 2008; Dupont and Oberthür 2012; Nilsson 2007). In practice, 'issue champions' in various sectors and levels of government assist in enabling effective implementation of EPI (Nilsson 2007). Without high-level political commitment, it is less likely that EPI efforts will succeed, let alone be undertaken.

That being said, even when there is high-level political commitment to pursue sustainable development strategies, there is no guarantee that the environment will be prioritized over the economy

when it comes down to making final decisions. A 'win-win' (economy-environment) rhetoric is often employed by politicians when discussing economic development, yet the economy typically wins out when competitiveness is at stake. Casado-Asenio and Steurer (2014) found through their comparative study of National Sustainable Development Strategies, National Mitigation Strategies and National Adaptation Strategies that one of the three major categories of constraints observed in integration strategies is the fact that the economy almost always ranks higher than the environment in decision-making regardless of the oft-invoked win-win rhetoric. That being said, individual leaders who are politically committed to climate action are "expected to exercise significant influence on the development of local climate programs" (Rabe 2004; Betsill 2001; Collier and Lofstedt 1997; Bulkeley 2000; cited in Bedsworth and Hanak 2013, p. 666).

In Canada, the influence of politics, and tension between environmental and economic objectives, can easily be seen in the Trudeau Government's very recent carbon pricing regime proposal based on a rather unambitious price of CAD 10 per tonne of GHGs, which was implemented in 2019 (Winfield 2016a). Perhaps the most recent clear-cut case of political commitment acting as a barrier to EPI/CPI would be the ten years under the Harper Conservative government in Canada. The years 2006 – 2015 were essentially a lost decade for environmental policy and a low for EPI in Canada at the federal level. Stephen Harper had an unprecedented commitment to the oil and gas industry and focused his economic leadership on getting resources to market. The commitment to big business and economic growth and the influence of industry power is perhaps most clearly witnessed in the efforts by the Harper Government to cut so-called "green tape", to expedite major resource projects. Perhaps the most damaging reform made by this government to the policy analytical capacity of the country was the repeal and replacement of the Canadian Environmental Assessment Act (CEAA) via the "responsible resource development" provisions of the notorious omnibus bill, Bill C-38 (Winfield 2015).

Finding the right narrative, i.e., one that encourages governing for sustainable development is essential for gaining legitimacy (Wejs 2014; cited in Runhaar et al. 2014). When an environmental problem like climate change is framed traditionally, as an environmental problem, often conflicts of interests between sectors and political/policy actors are amplified and (as mentioned) these sector conflicts are key barriers to EPI (Runhaar et al. 2014). On the other hand, framing environmental problems as too detached from actual environmental quality may also hinder integration efforts (Runhaar et al. 2014). For

example, Weber and Driessen (2010) found in their study of Dutch spatial planning and environmental noise that less attention was paid to environmental noise when concepts like 'sustainability', 'livability', and 'quality of life' were introduced into Dutch environmental policy. Hoornbeek (2008) argues that the outcomes associated with EPI efforts in the USA have been less than sufficient, with varied and incremental success because The United States, unlike Europe, has not developed a shared vision of 'a sustainable America' to inspire the broader public and help shape national EPI efforts. Dale (2009) argues that Canadians have also not been able to develop a coherent understanding of sustainable development.

More generally, increasing adherence by governments in the industrialized world to neoliberal ideas and 'new public management' as a mode of governance, in addition to the recent rise of right-wing populist politics, has hindered the progress of EPI. Program reviews and increased financial stringency in the corporate sector have resulted in budgetary cuts for environmental initiatives and "corporate retrenchment [has] left little time for luxuries such as the environment" (Runnalls 2009, p. 27). Overarching narratives and the dominant ideas that characterize the policy context are important to the framing and re-framing process. Ecological modernization narratives that emphasize win-win opportunities and development/growth that benefits both economies and the physical environment seem much more conducive to galvanizing support for efforts to meet environmental objectives than narratives that pin the environment against the economy. That being said, if a stated concern for protecting the environment stays at the level of rhetoric, a win-win narrative may act to legitimize ‘business as usual’ and minimize attention paid to environmental harm by disguising business as usual using a ‘green growth’ discourse.

Framing environmental problems, like climate change, and the need to integrate environmental objectives into non-environmental sectors should be done in a way that non-environmental actors feel that the integrated strategy is beneficial and legitimate to them, or at a minimum, not conflict with their objectives (Runhaar et al. 2014, p. 242). Wejs (2014) adds that identifying the correct narrative is a critical factor for legitimizing EPI, for example, he suggests framing climate change as a "means of socio-economic development" vs. an environmental issue (cited in Runhaar et al. 2014, p 240). An example that would be especially applicable for regions that are net importers of energy might be to frame the construction of renewable energy and storage infrastructure as a way to ensure domestic energy security as opposed to a way to mitigate GHG emissions. Another approach suggested by Biesbroek (2013, p. 3)

for the case of climate change adaptation is to deconstruct and re-frame climate change adaptation as "a more definable problem" such as 'water safety' (cited in Runhaar 2014, p. 239). Re-framing issues in a way that acknowledges sector trade-offs is also a useful strategy. Nilsson (2007, p. 168) argues that if complexities and conflicts of interest can be acknowledged in a way that builds trust, the right conditions might arise where tensions can fuel "deployed creativity for learning purposes" as opposed to fueling conflict.

Individual choices, and more broadly societal opinions, are sensitive to the framing process, and whether or not there is a general societal consensus on a given issue like acting on climate change, is essential in terms of how progressive politicians are willing to be with regards to drafting and passing policies containing climate mitigation objectives. To assess the relative level of framing and high-level political commitment in each case, discourse analysis has been employed to analyze the framing used and level of political commitment, as seen in public statements. Political commitment is evaluated for climate change action generally, and also for climate mitigation action in the road passenger transportation sector. Discourse and framing invoked in formal government plans, as well as high-level political statements (for example, in Ontario, the Speech from the Throne) have been assessed in addition to direct statements to the public. To go beyond stated or rhetorical political commitment, budgetary commitment to key climate mitigation programs and policies has been researched and evaluated to gain a better idea of the depth of commitment (i.e., backing up words with actions funded by the government).

Public opinion, regional narratives and social consensus

In order to assess the relative impact of public opinion, regional narratives and social consensus on CPI in the transportation sector, a few different methods have been used. With regard to regional identity narratives, secondary sources have been analyzed to gain an understanding of the historical regional identity narratives concerning the environment and environmental issues. To gain an understanding of the opinions of the people in each case jurisdiction, concerning climate change and the transportation sector, information has been gathered from recent polling data and web search trends, using the Google Trends application. While polling data analysis represents a more traditional approach to measure issue saliency, Ripberger (2011; cited in Schwartz 2012) suggests Internet searches are a better

measure of public attention. Together, these are discussed and evaluated to provide insight into the potential impacts on CPI in California and Ontario.

Relationships between variables

Importantly, relationships between landscape variables are analyzed and discussed in this research. For example, the relationship between external shocks and public opinion on a certain issue is analyzed. This relationship between exogenous events and public salience has been developed in academic literature, for example, Kingdon's (1984; 2011) writing on external shocks and policy windows. In the case of public support for climate change mitigation, it makes logical sense that if external shocks are experienced by the general population that can be linked to the impacts of climate change (e.g., wildfires), then public awareness and salience will likely increase for that issue (climate change) alongside support for mitigation policies. For example, In California, 65% of adults think that recent wildfires are directly linked to climate change (Baldassare et al. 2016).

Evaluating the Extent of CPI in Each Jurisdiction's Road Passenger Transportation Sector

Table 3, presented at the beginning of the following section, provides a base list of key horizontal and vertical mechanisms/instruments for CPI in the road passenger transportation sector. CPI levels for the two subnational jurisdictions will be judged by the presence of these tools/mechanisms for CPI in the policy process and output. As opposed to judging the level of CPI for each subnational against some ideal level of CPI, they will be judged comparatively to understand where 'more or less' levels of CPI have been achieved. While this might not be a comprehensive enough measurement for a paper focused solely on integration efforts, it is appropriate for the purposes of this dissertation, which is more focused on understanding why and how these levels were achieved, given varying degrees of complexity/polycentricity in the governing process. This does not mean the in-depth literature on explanatory factors presented in these frameworks will be ignored. Rather they will be incorporated with factors drawn from the literature around polycentric and networked governance.

While Table 4 lists tools and measures generally utilized to incorporate environmental objectives into non-environmental sectors, the state-of-the-art review on integrating (explicitly) climate mitigation

objectives into the road passenger transportation sector below provides a more specific 'checklist' of fundamental mechanisms against which the governance efforts of each jurisdiction can be analyzed. These tools/instruments fall into one of two major categories: (1) Alternative/cleaner vehicles and (2) Transportation Demand Management. Outside of this analysis on policy tools, 'flagship' sustainability and climate change legislation and plans have also researched and accounted for, as these can be important drivers of CPI in and of themselves.

Measuring Degrees of Polycentricity and Evaluating Operationalization via Overarching Rules

Delineating degrees of polycentricity in each climate change governance regime

Degrees of polycentricity must be specified in order to produce a meaningful analysis in comparative research, such as this. Absent of this distinction, anything outside of highly monocentric governance systems could be considered polycentric. As Lubell (2017) points out in his critical piece on polycentric governance, "If everything is polycentric, and polycentric is always the "right approach" to governance, then how can we compare the effectiveness of polycentric governance to some other approach?" In distinguishing a more nuanced categorization of varying degrees of polycentricity, the effectiveness of these systems (specifically with regards to climate change governance), can be analyzed through detailed empirical research. This distinction is especially important in the vein of polycentric climate governance research, where the role of the state (monocentric role) in steering/operationalizing polycentric climate governance forms the key analytical variable in understanding performance outcomes.

Few attempts have been made to distinguish degrees of polycentricity, but broadly speaking, polycentric governance systems can be assessed along two continua: collaborative degree and breadth of inclusion (see Figure 7) (Schoon et al. 2015). The structure of government ranges from a strictly top-down, monocentric to highly decentralized, polycentric governance systems that vary based on the 'breadth of inclusion' (sometimes called 'diffusiveness') and degree of collaboration, which influences the degree of weakness or strength of the polycentric governance system (Schoon et al. 2015, pp. 230). The breadth of inclusion refers to the number and variety of governance bodies, while the degree of collaboration refers to the continuum of coordination between bodies (Schoon et al. 2015). For example, the collaborative degree in a weak polycentric system might include coordinating activities such as

information sharing, while internal conflict resolution would be associated with a strongly polycentric system with a high collaborative degree (Schoon et al. 2015). Degrees of polycentricity are detailed at the level of organizations, following Ostrom's (1990) logic that organizations are the result of the organizing (or collective action) process. The organizations delineated in this research reflect the collective action activities, or the organizing process, of individuals aiming to reduce climate-transport emissions.

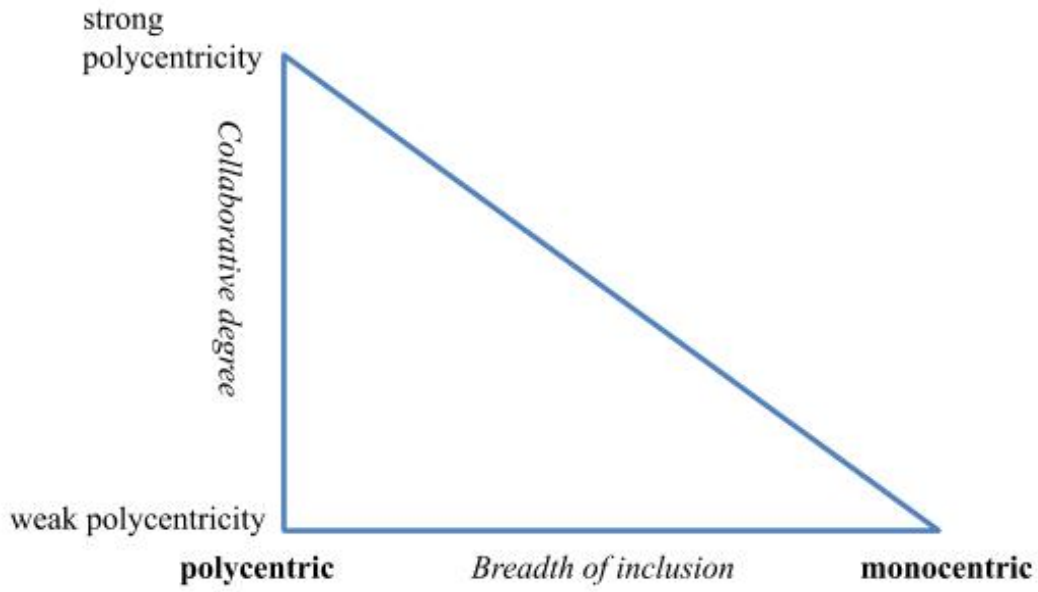


Figure 7. The two continua of polycentricity (Adapted from Schoon et al. 2015, pp. 240).

The degree of polycentricity for California's and Ontario's climate-transport governance systems has been characterized along these two continua. The degree of polycentricity in these subnational jurisdictions is evaluated comparatively, with a larger number of government and non-government bodies involved correlating to higher levels with regards to the breadth of inclusion, and higher levels of coordination (i.e., collaborative degree) between various actors and institutions signaling 'stronger' polycentricity. The methodology employed in this research represents an early attempt to empirically measure the degree of polycentricity in climate governance regimes in a more nuanced way. It is by no means a perfect approach, but it does provide sufficient insight for answering the key research questions posed in this dissertation; it should be considered a heuristic approach that can be adapted and built upon.

Breadth of inclusion and functional redundancy

The breadth of inclusion and functional redundancy refers to the number of government and non-government organizations undertaking similar functions to aid in emission reductions, generally and from road passenger transportation. There is more data in the case of California concerning how active local governments are in this area; comprehensive inventories of local government's progress in planning and implementing climate change plans exist for California but not for Ontario. Therefore, for the purposes of even comparison, sub-state/province organizations that are active in this area have been inventoried for each case, in addition to state/province-wide organizations. In particular, regional governance organizations undertaking climate/transport planning and emission reduction activities serve as a proxy for local government activity.

Due to the fact that these diverse organizations undertake different functions, they have been classified by major and minor functions across four functional categories key to operationalizing polycentric climate governance, which have been drawn from literature on networked governance and environment/climate policy integration: 1) formal advocacy/policy development, 2) technical /financial assistance (capacity building), 3) knowledge/coordination platform 4) monitoring, certification, reporting. These functions highlight critical themes relating to the posited advantages of polycentric governance systems. Each organization has received a numerical score based on the major and minor functions they carry out; a full point (1) has been given for a major function, and a half point (.5) has been given for a minor function.

The assessment is based, at minimum, on the organization's website and publications; in some cases, interviews have been conducted with organization members to gather the needed information. Both the stated purpose of the organization, as well as its activities, were evaluated to capture not only what the institution has set out to accomplish, but also the activities and efforts that were undertaken to carry out its mission. For example, in addition to the mission statement, ‘about us’ and governance documents available on the organization’s websites, the publications (newsletters, research, formal advocacy documents, annual reports) as well as events were assessed. In most cases, the organization’s website and publications were a sufficient evidentiary basis upon which to draw for the purposes of this classification. In some cases, interviews were conducted with organization members or staff to fill gaps.

For example, The League of California Cities' stated primary aim is to advocate for the needs of local California governments. A significant part of carrying out this task is through knowledge-exchange and acting as a knowledge repository for legislative resources related to what they call 'hot issues' (League of California Cities 2020). Ultimately based on both the stated purpose and the actual activities carried out, this organization was given a full point (1- primary function) for both formal advocacy *and* knowledge/coordination platform. In order to receive even a minor function score (.5), a given organization needed to undertake a formal *and reoccurring* activity. For example, policy learning and coordination via informal means (typical to almost every organization in this space) would not be sufficient to receive a minor function score (.5) under the category knowledge/coordination platform. However, if an organization held even an annual workshop or event that could be classified as carrying out the function of knowledge-sharing and coordination (convening members, sharing best-practices, etc.), then this would justify a minor function score. By contrast, a one-off event, such as a side event at another conference or workshop, would not quality as both formal *and* reoccurring, and therefore not qualify under this approach as a minor function.

When there was not enough evidence available to substantiate that a given function was being carried out, reliance on the formally stated purpose became the key assessment mechanism. For example, Regional Climate Collaboratives in California were formally established to carry out capacity building functions. Day to day activities of aiding stakeholders (e.g., assisting in funding applications) are not necessarily reported on or made public in a formal way. Given that these organizations were established with the explicit goal of undertaking capacity building functions, they received a primary function score (1) for this category. Given the diversity in size and capacity of individual organizations, assessing what functions constituted a primary or minor function was completed on a relative basis. If a given function was not clearly the primary work of an organization (assessed using the method above), then secondary functions that were formal and reoccurring were considered minor functions (.5).

The guideposts for classifications utilized in this work by no means represents a perfect method. However, this approach is appropriate for the level of information required to feed into the overall analysis. Ultimately this 'scoring' method was important as it allowed for a more comprehensive assessment of the degrees of polycentricity and functional redundancy in the system, as the inventory provides more than

just a comparison of the number of organizations but a more detailed comparative analysis of functions. An excerpt from this assessment is illustrated in Table 2.

Table 2. Method for assessing breadth of inclusion and functional redundancy utilized in this research.

CALIFORNIA sub-state climate-transport organizations (24)	formal advocacy/policy development	technical /financial assistance(capacity building	knowledge/coordination platform	monitoring, certification, reporting	
California State Association of Counties	1	0	0.5		0
League of California Cities	1	0	1		0
Institute for Local Government	0	1	1		0
CivicSpark	0	1	0		0
Green Cities California	0	1	1		0
LOCAL GOVERNMENT COMMISSION	0	1	1		0
The Statewide Energy Efficiency Collaborative	0	1	1		0

Degree of collaboration and learning:

The degree of collaboration and learning was assessed by the number of organizations in each case jurisdiction, which explicitly aimed to play the role of knowledge/learning platform and whose primary objective was to coordinate actors vertically and horizontally (and potentially diagonally) across the system for collaboration. In large part, this information comes from the functional classification inventories. Special attention was paid to the role of higher-order governance levels in enhancing collaboration and learning, either by initiating these platforms, supporting these platforms, or by scaling up and adopting policy learning and coordination institutions that originated at lower levels of government. A key focus of the analysis was the connectivity between organizations, both state and non-state.

Evaluating overarching rules in operationalizing a polycentric approach to climate change governance

The basic assessment frame of horizontal vs. vertical integration and instrument classification (formally reviewed in Chapter 4) continue to be useful ways to make sense of diverse institutional arrangements and EPI efforts. Through various studies (Lafferty and Hovden; Lafferty 2002; 2004; 2012)

numerous iterations of "benchmarks for governing mechanisms for EPI" have been developed to provide a minimum standard, or floor, necessary to achieve a minimum level of meaningful integration of environmental concerns/objective into sectoral governance (Mullally and Dunphy 2015, p. 27). These proposed benchmarks for both vertical and horizontal EPI are useful for analyzing the rudimentary institutional arrangements (overarching rules) conducive to enhancing polycentric governance efforts, especially policy innovation and learning. Table 3 lists operational and steering mechanisms for both horizontal and vertical EPI, as proposed by Lafferty (2004; 2012 cited in Mullally and Dunphy 2015, p. 27-28). Table 4 illustrates the basic evaluative frame for assessing overarching rules in terms of enhancing a polycentric approach to climate change governance.

Table 3. Operational and steering mechanisms for both horizontal and vertical EPI (Lafferty 2004; 2012 cited in Mullally and Dunphy 2015, p. 27-28)

Horizontal EPI	**Vertical EPI**
● A 'constitutive' mandate providing principles and procedures for reconciling conflicts and trade-offs related to de-coupling and environmental policy integration ● An overarching strategy for sustainable development goals and operational principles, and a political mandate for implementation with direct backing from the chief executive authority ● A national action plan with both over-arching and sectoral targets, indicators and time tables ● A responsible executive body with designated responsibility (and powers) for the overall coordination, implementation and supervision of integration process ● A communications plan stipulating sectoral responsibility for achieving overarching goals, and outlining how cross-sectoral communications are to be structured and made transparent	● Scoping reports of sectoral activity identifying major environmental impacts associated with key actors and processes ● Sectoral forums for dialogue and consultation with relevant stakeholders and affected citizens ● Sectoral strategies for change, with basic principles, goals, targets and timetables ● Sectoral action plans with specified initiatives for achieving goals with target-group related policy instruments ● Green budgets for highlighting, prioritizing and carrying through action plans ● Monitoring programs for evaluating implementation and revising strategies and action plans

Table 4. The basic evaluative frame for assessing overarching rules in terms of enhancing a polycentric approach to climate change governance.

	Horizontal	Vertical
Communicative		• Constitutional provision • National Environmental Plans (NEPs) • National Strategies for Sustainable Development (NSSD), • Requirements to develop sectoral environmental strategies • Reporting obligations on environmental performance • External reviews of environmental performance
Organizational	• Amalgamation of departments • Green cabinets • Environmental units/correspondents in other sectors/departments • Interdepartmental working groups	
Procedural	• Strategic Environmental Assessment (SEA) • Department of the Environment	• Green Budgeting • Policy Appraisal

Supporting Method: Primary Qualitative Analysis

In order to supplement secondary research and fill information gaps, interviews with key stakeholders, representing government, academia, civil society and industry/business were conducted. Fifteen interviews, roughly an hour in length, were conducted between January 2018 and August 2018, including a few follow-up interviews conducted in 2019. Where recordings were allowed, interviews were transcribed; otherwise, comprehensive notes were taken. In addition to formal interviews, first-hand information relevant to this work was gathered by attending conferences and workshops. In particular, attending and presenting at three Joint Clean Climate Transport Research Partnership (JCCTRP)

workshops in November 2018, February 2019 and November 2019 resulted in fruitful informal conversations and gaining relevant information through formal presentations by members.

The next two chapters introduce the theoretical foundations for this dissertation research, specifically, collective action theory and polycentric governance, within the context of climate change mitigation. The framework for analysis for evaluating each cases' overarching higher-order rules, environment/climate policy integration, is also introduced and applied through a state-of-the-art review to decarbonizing road passenger transportation.

Chapter 3: The Problem of Global Climate Change: Collective Action Theory and Understanding the Failure to Mitigate Global Climate Change

With few mainstream climate change sceptics left and currently viable options for mitigation, how is it that the international climate change governance regime has failed to address the problem meaningfully? Collective Action Theory (CAT) offers one way to understand this conundrum. CAT is not just useful for confirming the challenges or probable failure of an international climate regime. Insights arising from more advanced collective action theory imply a more effective route for mitigating climate change would put much more emphasis on 'bottom-up' efforts (Ostrom 2010; 2012; 2014; Bodansky, Hoedl, Metcalf & Stavins 2014; Craik et al., 2013). This chapter will review the basic tenants of collective action theory as well as insights from more advanced collective action theories that support the notion that a polycentric approach to mitigate climate change is our best option. This more pragmatic approach is reviewed and discussed as a potentially useful alternative to solely focusing efforts on securing a self-enforcing *global* treaty.

Collective Action Dilemmas: Key Concepts and the Atmosphere as the Global Commons

To begin, "collective action arises when the efforts of two or more individuals are needed to achieve an outcome" (Sandler 2004, p. 17). At the core of all collective action dilemmas are the existence of different types of goods and the problems associated with their provision. Economists categorize goods into four categories based on their characteristics of rivalness and excludability: private, common-pool, club and public goods. This section will focus on public goods, as their provision is most relevant for understanding collective action to protect the atmosphere, a global public good.

Private goods are both excludable and rival in nature, meaning that it is possible to exclude someone from using the good and also that one person's use of the good subtracts from another person's ability to use the same unit of that good. Food is a good example of a private good. Common-pool resources such as timber or fish are also rival in nature but are non-excludable or at least prohibitively costly to exclude others from consuming. Club goods are goods where it is possible to exclude others from their consumption, but where the consumption of that good does not subtract from another person's ability to consume the same unit that good. Attending a film at a movie cinema is a good example of a club of

good. Finally, public goods are neither excludable nor their consumption rival in nature. For example, no individual can be excluded from the benefits of the global atmosphere and neither does their consumption of this good limit any other person's ability to consume the same unit (Sandler 2004, p. 17).

Public goods must have the two following criteria: 1) benefits with strong qualities of publicness (non-rival consumption and non-excludability) and 2) benefits that are quasi-universal with regards to countries (geography), people (socio-economic) and generations (temporality) (Kaul, Grunberg and Stern, 1999). In relation to public goods, Kaul et al. (1999) note that external coercion does not necessarily yield optimal results and that public goods often can face a double challenge of both market failure and government failure. It is also useful to distinguish between final public goods and intermediate public goods (Kaul et al. 1999, p. 13). For example, negotiating and committing to a global environmental treaty on climate change can be viewed as a 'second-order collective dilemma', as Ostrom (1990, p. 42) refers to it, where the challenge is in supplying the intermediate global public good (i.e., the international agreement) that contributes to the provision of the final global public good (in this example protecting the global atmosphere).

Collective action theory: When will individuals cooperate?

The tragedy of the commons

In 1968, economist Garrett Hardin introduced his now-famous model of collective action, "the tragedy of the commons." This model illustrates that incomplete property rights lead to an overuse of natural resources or 'the commons'. The model centers on an individual farmer and his strategic behaviour with regards to the use of a common pasture where his herd can graze. The pasture is a common-pool resource (CPR), meaning individuals cannot be effectively excluded from using it, and that consumption of the good is rival in nature. Hardin's model assumes each farmer is a utility-maximizing individual "locked into a system that compels him to increase his herd", that is, to act in a self-interested manner even though the result will be sub-optimal (Hardin 1968, p. 1244). In Hardin's model, each utility-maximizing farmer enjoys the full benefit of adding one more additional animal to graze on the pasture but only bears a share of the cost of this action. In other words, the farmer does not internalize the entire negative externality (deterioration of the pasture/commons) associated with adding an additional animal.

The result is sub-optimal; a common resource will be degraded to the point where marginal benefit meets private marginal cost instead of the social marginal cost (see Figure 3).

As Figure 8 shows, the distribution of costs is unequal, resulting in more than the socially optimal quantity of animals added to graze on the pasture (i.e., Qs < Qp). In this limited model (e.g., communication limitations), the policy implications concluded by Hardin are that private or state rights must be assigned to these many environmental goods, which are often characterized by non-excludability and non-rival consumption. This model has been influential (along with other centrist approaches) in shaping real-world environmental policy but is limited by its inherent assumptions (Dietz, Ostrom and Stern 2003, p. 1907). Key critiques include: ignoring common-property regimes as a legitimate alternative to state and private rights regimes (equating them to open access) and a reliance on assuming perfectly rational human behaviour (Dietz et al. 2003; Ostrom 1990). Additionally, Ostrom (1990, p. 10) notes that reaching an optimally efficient equilibrium in the case of centralized control *is not* a given and relies on crucial factors like accurate and complete information and effectively monitoring and sanctioning appropriators. Although collective action theory has developed much since this seminal work, Hardin's illustration of the 'free-rider problem' has been an essential foundation upon which this development has been able to occur. Concerning the problem of climate change, overcoming the free-rider incentive is a central part of an effective self-enforcing international treaty (i.e., providing the intermediate public good).

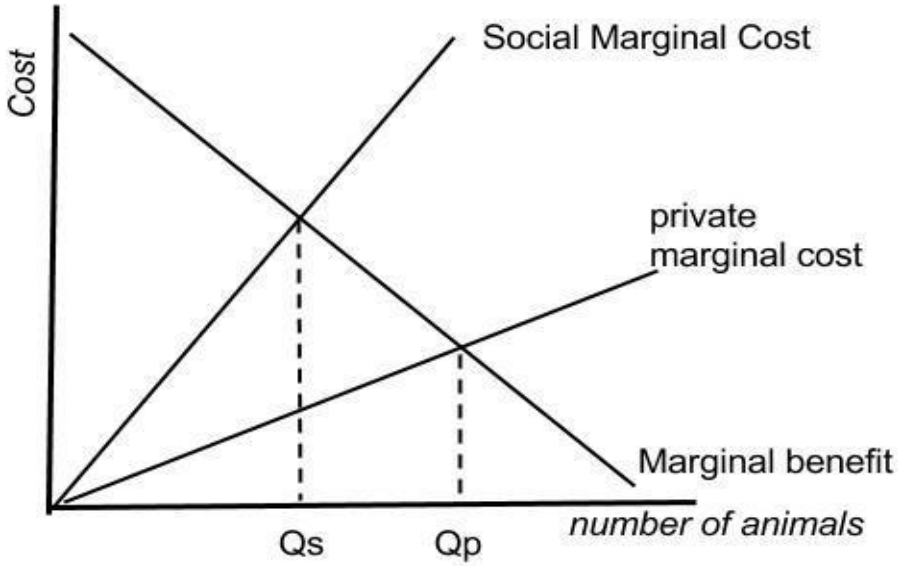


Figure 8. The Tragedy of the Commons (Author's Own).

The logic of collective action

Mancur Olson's theory, 'the logic of collective action,' overturned the conventional thinking on individuals cooperating, which was, that individuals would generally choose to cooperate in most situations (Harris 2007). The basic premise of Olson's theory is that "unless the number of individuals in a group is quite small, or unless there is coercion or some other special device to make individuals act in their common interest, rational, self-interested individuals will not act to achieve their common or group interests" (cited in Harris 2007, p. 200). Olson explains that a collective good is both non-rival and non-excludable and categorizes three types of groups based on how they would respond to providing a collective good: privileged, intermediate and latent (Harris, 2007, p. 201-2). In 'privileged' groups, each member is willing to pay for the collective good. Olson's 'intermediate' group category consisted of "small groups where no one member has an interest in bearing the costs of providing the good, but in which there is some possibility for cooperation because the members are unable to recognize those who are free-riding" (Harris, 2007. p. 202). Finally, 'latent' groups will not provide a collective good, unless one member is willing to bear the cost of providing the collective good, short of selective incentives or coercion (Harris 2007, p. 202).

The notion of selective incentives is key to inducing collective action and can 'energize' even latent groups to provide a collective good (what Olson calls a 'mobilized latent group') (Harris 2007, p. 202). Although economic incentives are the most common, a variety of other selective incentives exist, such as psychological and social incentives. Olson points out that to be effective, selective incentives must work individually on each member as opposed to the group as a whole (Harris 2007, p. 203). Critically, Olson (1965) asserts that the incentive to free-ride is higher in larger groups where each additional member is needed less to achieve the collective action; therefore, the motivation for collective action decreases as group size increases due to higher transaction costs for preventing free-riding (Barrett 1994). It follows that Olson proposes that action-taking groups will be smaller than non-action taking groups (Harris 2007, p. 203). In his seminal paper on self-enforcing agreements, game theorist Scott Barrett (1994) shows using econometric modeling that indeed, groups with fewer members can make stronger/deeper commitments in terms of action as opposed to larger groups. The following section will discuss key insights from traditional and advanced game theory regarding collective action.

A game-theoretic approach to collective action dilemmas

Game theory is a formal mathematical discipline used to analyze behaviour in which actions are interdependent whether it is a situation of cooperation or competition (Peters 2008). By interdependent, it is meant that the outcomes of a decision by one 'player' (e.g., individual, firm, country) depend on the decision by other 'players', and these decisions are not known in advance. In this way, the initial decision of each player is affected by the anticipated choices of other players (Markandya, Perelet, Mason and Taylor, 2001, p.101). Although game theory has a wide range of applications, it is most often used in the field of economics (Peters 2008). One major milestone in the development of this formal discipline was the proof of the minimax theorem for zero-sum games by Von Neumann (Peters 2008; Binnmore 2007). There are various types of 'games', which can be broadly classified into non-cooperative and cooperative games. While this section is by no means an exhaustive review of the multitude of game designs, it introduces critical models seminal in the development of the field.

The Prisoner's Dilemma is perhaps the most well-known nonzero-sum game that does a good job of representing the situation captured by Hardin's (1968) model (Peters 2008; Sandler 2004). While all Prisoners' Dilemma games lead to collective action failures, not all collective action failures are Prisoner's Dilemmas (Sandler 2004). The Prisoner's Dilemma will be focused on as most climate negotiations are modeled as such unless some action is needed to avoid dire consequences, in which a 'chicken game' may apply (Pittel and Rübbelke 2012; cited in Edenhofer et al. 2013; Sandler 2004). The Prisoner's Dilemma game refers to a situation in which there are two individuals, in this case, two people suspected of committing a crime together, who must decide whether to tell on their partner in crime (i.e., defect) or stay silent (i.e., cooperate). This situation is modeled by the payoff matrix below, illustrated in Figure 9.

$$\begin{array}{cc} & \begin{array}{cc} \text{C} & \text{D} \end{array} \\ \begin{array}{c} \text{C} \\ \text{D} \end{array} & \begin{pmatrix} -1,-1 & -10,0 \\ 0,-10 & -9,-9 \end{pmatrix} \end{array}$$

Figure 9. Payoff matrix for a prisoner's dilemma game.

In this case, the choice/strategy to defect is the 'strictly dominant' decision for both players (Peters 2008). As the payoff matrix illustrates, if one person defects while the other one stays silent (i.e., cooperates), then the person who defects gets no time in jail while the other person receives the largest punishment represented by ten years in prison (and vice versa). If both defects, both receive a relatively large penalty of nine years each in jail. If they both cooperate and stay silent, each receives only one year in jail. Clearly, the situation in which both defects is inferior, and certainly not what is known as 'Pareto optimal'. A Pareto optimal situation is one in which the decisions by all players results in the best/optimal collective outcome. In other words, "a state of affairs *x* is said to be Pareto-inefficient (or suboptimal) if and only if there is some state of affairs *y* such that no one strictly prefers *x* to *y* and at least one person strictly prefers *y* to *x*" (Ingram 2016). The Prisoner's Dilemma game is useful at illustrating outcomes when the strategy to defect is strictly dominant, for example, in a 'commons' dilemma; however, the model is limited in its predictive capacity in more complex real-life scenarios due to the implicit assumptions made in the 'game'. Notably, in real life, 'players' can communicate in repeated negotiations, meaning there is the possibility of behaviour being punished or rewarded.

International environmental agreements (IEAS) and climate change negotiations modeled as a game

International environmental agreement negotiations, when modeled as a game, are solved backward starting with the emissions stage and then a membership stage (Finus, Sáiz and Hendrix 2009). A 'self-enforcing agreement' is a crucial concept in understanding how a global climate treaty, in the absence of a worldwide government, can be effective in practice. Without any supranational authority to intervene, a self-enforcing treaty needs to provide an internal incentive to cooperate. Two properties are required to ensure a renegotiation proof solution: profitability (each country profits by joining the coalition) and stability (no incentive to modify or leave the treaty) (Barrett 1994). This means that a coalition established by signing an international environmental agreement is considered self-enforcing when no country wants to join the coalition, and no country has an incentive to leave (Barrett 1994). Barrett (1994) argues it is the "essential feature" of an international environmental agreement; the agreement must be self-enforcing because no one can force a country to sign an agreement and countries are always free to leave an agreement.

In his seminal paper on the matter, "Self-enforcing international environmental agreements" (1994), two models are used to investigate the effectiveness of self-enforcing international environmental agreements where there is not full cooperation. The first is set up so that the number of signatories (i.e., countries) and their actions, as well as the terms of the agreement, are determined jointly. The other is set up as an infinitely repeated game. Instead of detailing the econometrics of each model, the significant insights and implications from the simulation will be discussed for the case of a potential global climate treaty.

Barrett's (1994) game theory models are limited by the implicit assumptions invoked; however, key insights are presented from the econometric analysis that have proved useful in understanding the challenge of securing a self-enforcing agreement. One such key insight is the relationship between the depth of commitment and extent of participation possible in reaching a self-enforcing agreement, and the implications this has for the effectiveness of a possible global treaty on climate change. The results of Barrett's (1994) econometric simulations illustrate that it is very unlikely that climate negotiations will result in a self-enforcing international climate agreement that has both a large extent of participation and significant depth of commitment. This is because when coalitions add more members, incentives shift, as each additional player is needed less to achieve the group goal. This means there is less pressure to avoid free-riding as coalitions increase in terms of the extent of participation. This insight is consistent with Olson's proposition that stable coalitions are more likely in smaller groups.

Figure 10 illustrates this point in the diagram below. An 'ideal' climate treaty would have both significant depth of commitment (which is binding) and extent of participation (i.e., full cooperation). Currently, many countries are undertaking unilateral action to mitigate climate change, meaning their actions would be taken regardless if they were participating in a global climate treaty. The Kyoto Protocol, signed in 1997, had many countries sign on to the treaty, and although the Protocol in effect failed to spur meaningful mitigation activities, there were top-down set targets and timetables that were meant to be (in theory) enforceable, backed by punishments. The successor to the failed Kyoto Protocol, the Paris Agreement (adopted in December 2015), was essentially a bottom-up process where the agreement was based on intended nationally determined contributions for emission mitigation. The agreement is completely non-binding with shallow depth of commitment, yet secured extensive participation in terms of the number of signatories.

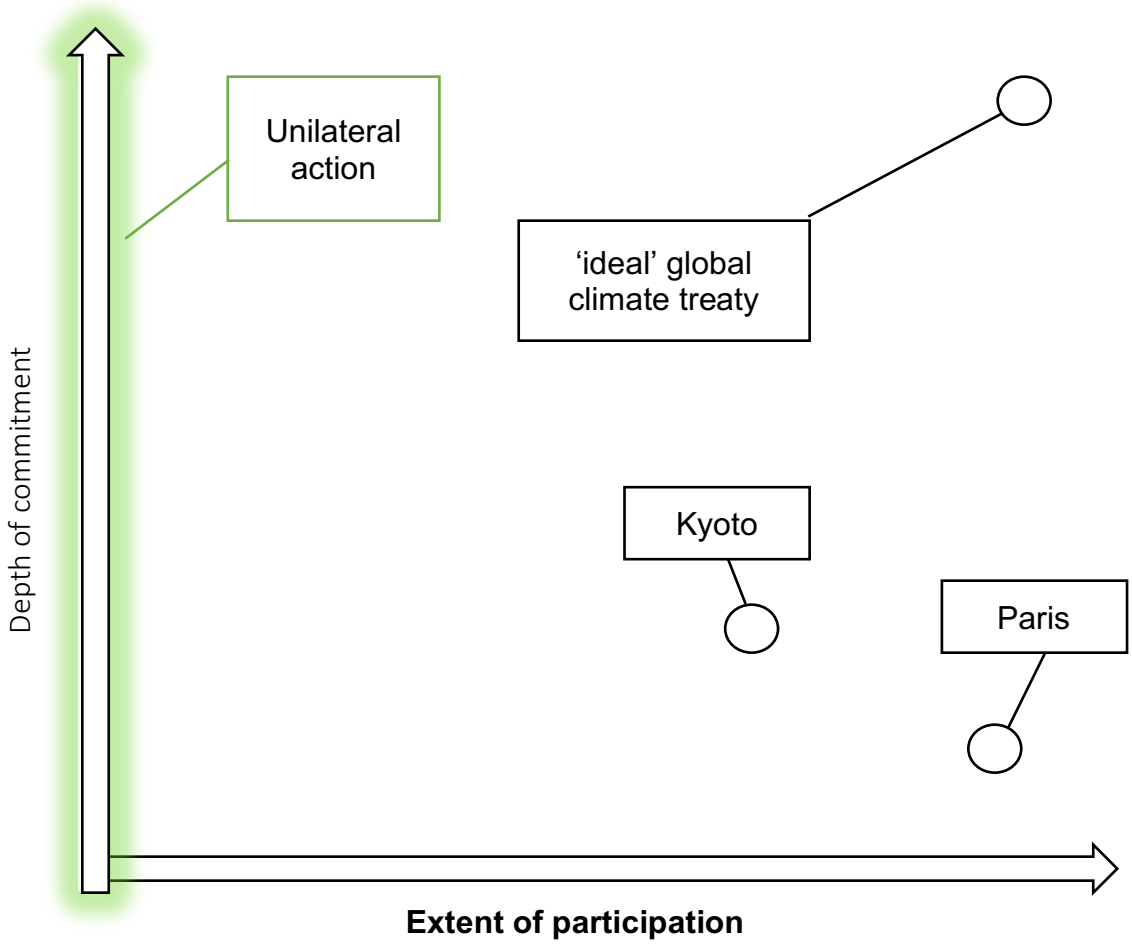


Figure 10. Key insight from Barrett's 1994 work: Depth of commitment vs. Extent of participation for self-enforcing IEAs (Author's Own).

With regards to the effectiveness of a global climate treaty, Barrett's (1994) first model also shows that global abatement will only by high (i.e., the treaty 'effective') where there are very few participants involved. Conversely, little global abatement will take place if there is full cooperation, shown in Table 5 (i.e., most countries are signatories to the treaty). This is because the difference between the global net benefits between non-cooperative and cooperative behaviour is very small; therefore, international environmental agreements signed by many countries might have little effect. As Table 4 illustrates, each country is better off with cooperation (Qc is great than Qo) but no individual country has the unilateral incentive to choose Qc. Results of the simulations show that self-enforcing IEAs that contain a large number of signatories would only happen when the difference between the global net benefits between

non-cooperative behaviour and full-cooperative behaviour is very small. This implies that IEAs signed by many countries might have little effect and therefore, failure to reach an agreement would not have any significant consequence.

Table 5. Global abatement under IEA, full and non-cooperative outcomes (Barrett 1994).

*Global abatement under the noncooperative, IEA, and full cooperative outcomes**

		c		
		0.01	*1*	*100*
	0.01	500.0	9.9	0.1
		503.9	10.1	0.1
		990.1	500.0	9.9
b	1	990.1	500.0	90.9
		990.2	503.9	95.2
		999.9	990.1	909.1
	100	999.9	990.1	500.0
		1,000.0	990.2	503.9
		1,000.0	999.9	990.1

* Assumes $N = 100$ and $a = 1{,}000$. The top number in each cell is Q_o, the middle $Q(\alpha^*)$, and the bottom Q_c.

Barrett's (1994) second model, set up as an infinitely repeated game, yields a result consistent with the first. The results of simulations indicate that the maximum number of countries that can sustain the full cooperative outcome may be large, but only when the difference between global net benefits under the non-cooperative and full cooperative outcomes is small. This second game was unable to sustain full cooperation even though it was an infinitely repeated game, (meaning there was the benefit of punishments) with small, yet credible punishments. Barrett (1994) concludes that repetition may not be enough for IEAs to sustain a full cooperative outcome, even for arbitrarily small discount rates, because punishments in this kind of game are "vulnerable to renegotiation and such punishments could not be supported by a self-enforcing IEA" (Barrett 1994, pp. 889).

Although the models above are limited by their implicit assumptions, the general conclusions drawn have proven useful in understanding collective outcomes in the case of international environmental agreements. More advanced coalition theory models have attempted to include more variables to better

represent the complex reality of real-life climate negotiations. New, useful insights have come out of this kind of advanced game theory; in addition, many of the core insights from traditional collective action theory and game theory have been reaffirmed. This section briefly discusses some of the most relevant insights.

Although advanced coalition theory has provided insights into understanding the 'climate cooperation conundrum,' it has not led us to a solution (Pearson 2011). More fundamental reasons (from an economic lens) for non-cooperation lie in the nature of the challenge, including: "…providing a global public good in a context of asymmetric national costs and benefits, wide disparities in income, highly unequal past and prospective emission contributions, and free-riding untamed by either a supranational EPA or an adequate stock of carrots and sticks…" (Pearson 2011, p. 202).

Since, at minimum, a loosely coordinated global effort is needed to effectively mitigate climate change (i.e., large extent of participation), the empirical result has been what Arlid Underdal calls, "the law of the least ambitious program" (cited in Harris 2007, p. 204). This reflects Olson's logic, that "where international management can be established only through an agreement among all significant parties involved, and where such a regulation is considered only on its own merits, collective action will be limited to those measures acceptable to the least enthusiastic party…" (Sandler 1991; cited in Harris 207, p. 204).

Given the struggle and limited progress made to date mitigating global climate change at the international level, it is not surprising that alternative approaches to a global solution are gaining wider notoriety. One such approach to global collective action around the problem of climate change is Nobel Prize winner Elinor Ostrom's polycentric approach. Ostrom (2008) argues that institutions provided by both public officials and private citizens are needed at multiple scales to effectively meet the challenge of climate change. A crucial part of a polycentric approach to combatting climate change is for policy experiments to be undertaken in different jurisdictions and at different scales (local, regional, national) to understand what works in different contexts so that successful experiments can be transmitted vertically and horizontally in terms of governance levels (Ostrom 2009; 2010; 2012; 2014). This research supports Ostrom's assessment that waiting for a global solution is highly problematic, and that a polycentric approach better matches the current reality of climate governance (Ostrom 2009; 20010; 2012; 2014). The

following chapter further discusses a polycentric approach to climate change governance against the backdrop of broader shifts in modes of governance over time.

Chapter 4: The Rise of Networked Governance: Operationalizing a Polycentric Approach to Combating Global Climate Change Through State Steering

This chapter provides the governance context for this dissertation research, beginning with a review of the evolution in modes of governing, ending with the rise of networked governance. The concept of polycentric governance systems is introduced and their advantages and disadvantages, generally, and specifically for the case of combating global climate change, are discussed. This chapter also introduces the role of higher-order rules established by national and subnational governments aimed at enhancing polycentric climate governance systems alongside the concept of climate policy integration, which is conceptualized as the framework for analyzing higher-order rules. Finally, an overview of a state-of-the-art review of climate policy integration mechanisms that have been successful in reducing emissions from the road passenger transportation sector is provided.

The Evolution in Modes of Governance: Polycentric Governance Systems and the Rise of Networked Governance

There has been a shift towards networked forms of governance globally and an evolution in public administration narratives and coordination models over time from bureaucracy/hierarchy to new public management/market-oriented models, to new governance/networked-centred models (Jordan and Schout 2006; Steurer 2007). This shift has by no means been linear, nor anything close to uniform across regions or timescales, but these models do capture the general transition from government to governance represented by 'more diffuse' methods of societal steering (Flinders 2002; 2004; cited in Jordan and Schout 2006). The understanding of 'governance' used in this paper is the following by Trieb et al. (2007, p. 3):

> In general, the term governance is associated with a change in the nature of the state. In this sense, governance denotes a process of governing which departs from the traditional model where collectively binding decisions are taken by elected representatives within parliaments and implemented by bureaucrats within public administrations. Governance takes into account a change in the actor constellation, both during the formulation and the implementation of policies and in the method of political steering. Governance thus refers to societal steering and is often described as a process of co-ordination within networks (cited in Jordan and Schout 2006).

This section briefly reviews this evolution and discusses in more detail the notion of networked governance and polycentric governance systems, both benefits and limitations, as well as their application to the challenge of climate change governance. One of the key challenges associated with such systems is what Rhodes (2006) calls "managing the institutional void". A very important project for dealing with the challenges associated with a more "hollow state" (Howlett 2000), and the challenge of sustainable development more broadly, is pursuing and building "integration" into the system to improve coherence (Meadowcroft 2013). Before environmental and climate policy integration is discussed in more detail, the evolution of public management narratives from hierarchy to new public management to new governance models are reviewed.

Hierarchy/bureaucracy-based models

As early as the 1920s hierarchy-based models were used to describe to the administrative branches of government (Steurer 2007) as "one of a top-down command structure, where the flow of direction is 'downwards' from higher to lower tiers in a pyramid type matrix" (Thompson 2003, p. 24; cited in Jordan and Schout 2006). Over time this system replaced the older system of patronage built on personal loyalty, reflecting the dominant view that actors will not coordinate on their own and need to be coerced (Jordan and Schout 2006; Steurer 2007). During this transition, government activities become professionalized and the notions of specialization, accountability and professionalism were the central focus (Steurer 2007). As a part of this shift to specialization within the government, distinct departments were established, forming the earliest image of a bureaucracy, defined by Hughes (2003) as "the unambiguous structure of departments, each headed by a minister who is responsible for all actions of the departmental sub-units. Bureaus are designated to fulfill very specific and clearly defined tasks in a rule-bound way" (cited in Steurer 2007, p. 207).

The goal of this arrangement was reaching the "highest level of technical efficiency", reflecting the influence of Taylorism (Hughes 2003, p. 24; cited in Steurer 2007, p. 207). Integration was not a core focus, but rather "Precision, speed, unambiguity, knowledge of the files, continuity, discretion, unity, strict subordination, reduction of friction and personal costs…" (Weber, quoted by Hughes 2003, p. 4; cited in Steurer 2007, p. 207). The major issue with this model of governance was that the public sector was turned

into administrative silos, built around specific policy areas, resulting in a lack of recognition for related problems/policies (Steurer 2007). The popularity of this system began to fade in the 1970s/80s as it was increasingly critiqued for being inefficient, especially when dealing with an increasingly complex society. As Scharpf (1994, p. 37) explains:

> The advantages of hierarchical coordination are lost in a world that is characterized by increasingly dense, extended and rapidly changing patterns of reciprocal interdependence, and by increasingly frequent, but ephemeral, interactions across all types of pre-established boundaries, intra- and inter-organizational, intra- and intersectoral, intra- and international (cited in Jordan and Schout 2006).

Beginning in the 1980s/90s managerial critiques began to coalesce under the 'new public management school' and the transition to market-based governance arrangements gained momentum (Howlett, Rayner and Tollefson 2009; Steurer 2007; Jordan and Schout 2006).

New public management/market-based models

New public management (NPM) started gaining ground in the 1980s as a more efficient management-focused governance arrangement. NPM is generally associated with deregulation, privatization and the sub-contracting out of government activities (Howlett et al. 2009; Steurer 2007; Jordan and Schout 2006; McArthur 2007). This reform movement brought 'managerialism' to 'bureaucratism', shifting the focus to management, performance appraisal and efficiency as opposed to policy, public order and accountability (Steurer 2007). This movement has been associated with the 'agencification' or the further disaggregation of governments (e.g., turning departments structures into service agencies). Additionally, NPM is associated with privatization and outsourcing of government activities and the prominent use of markets (vs. hierarchies), reflecting the NPM school's adherence to 'efficiency first' and their belief that competition squeezes the slack out of organizations (Jackson 2001; Hood 1991; Jann 2002; cited in Steurer 2007). Various governments explicitly adopted this school of thought, including in the Canadian province of Ontario, which subscribed to this 'new idea for re-defining government' in the latter part of the 1990s (McArthur 2007). In a 1999 government publication providing the rationale for this new approach to government, the Provincial Government described the expected transformation of government resulting from the adoption of NPM:

- Planning the Business of government by means of business plans that include performance measures
- Identifying the core and doing business differently
- Refining accountability and a new context, and which managing externally delivered services and performance expectations are addressed
- Developing and disseminating a vision based on a smaller government focused on the core business, service quality, flexibility, cohesiveness, and accountability (cited in McArthur 2007, p. 254).

In reality, this reform movement (generally speaking) further enhanced the problems associated with government compartmentalization and segregation and did nothing to address the lack of attention to cross-sector/inter-organizational coordination necessary for EPI and for successfully pursuing sustainable development strategies (Hood 1991; Dunleavy and Hood 1994; Hood 1995; Gray and Jenkins 1995; Mathiasen 1999; Lane 2001; Jackson 2001; Jann 2002, 2003; Hughes 2003; cited in Steurer 2007; Winfield 2015).

New governance/network-centered model

In response to the 'market-hype' associated with NPM and the continuation of problems associated with the segregated nature of the public sector, there has been a widespread shift towards new or networked governance arrangements, where the guiding principle is effectiveness, not efficiency (Jordan and Schout 2006; Steurer 2007). New governance arrangements reflect the polycentric reality of governance, shifting governing architectures towards patterns of networks, which can be defined as "patterns of long-term relationships between mutually interdependent actors, formed around policy issues or clusters of resources (Jervis and Richards 1997, p. 13; cited in Steurer 2007, p. 209). The concept of 'new governance' applied to the resource/environmental field, is defined by Gunningham (2007) as:

> Involving a cluster of characteristics: participatory dialogue and deliberation, devolved decision-making, flexibility rather than uniformity, inclusiveness, transparency, institutionalized consensus-building practices, and a shift from

> hierarchy to heterarchy. Not all these characteristics need to be present for a particular experiment to be regarded as involving new environmental governance, but the more characteristics that are present, the greater the claim as falling within this category (cited in Howlett et al. 2009, p. 187).

Howlett et al. (2009, p. 185) argue that "networked governance emerged from a distinct historical trajectory that began with the 'crisis of command and control' in its mid-twentieth century form of public provision of goods and services and the detailed, prescriptive regulation of markets, and ends with network steering". In reality, many more trajectories exist. Governance arrangements, including diverse elements from multiple modes of governance arrangements (e.g., market, command and control, corporatist) and new modes of governance strategies, like the use of 'softer' regulatory instruments. These build on the existing capacity found in 'older' modes of governing through networked forms of multi-level governance (Howlett et al. 2009; Jordan and Schout 2006). In practice, networked governance is a hybrid form of governance where networks work in the 'shadow of hierarchy' (Lowndes and Skelcher 1998; Cabinet Office 2000; Davies 2002; Marinetto 2003; Martinuzzu and Steurer 2003; Steurer and Martinuzzi 2005; Meuleman 2006; cited in Steurer 2007).

An inter-organizational approach, as opposed to an organizational approach, is invoked to "take public administration out of the narrow tunnel of formally designed structures and mandated organizations" (Toonen 1998 p. 250; cited in Steurer 2007, p. 209). Networks are said to be the best fit for complexity, or as Rhodes (1997, p. xv) puts it, "messy problems demand messy [that is network-like] solutions" (cited in Steurer 2007, p. 209). Additionally, Steurer (2007, p. 209) argues that networked governance arrangements are the best fit for the pursuit and realization of sustainable development strategies, due to the following reasons:

- Since networks involve a broad variety of societal actors, they help not only to identify widely accepted solutions but also in sharing information and better understanding complex problems (Jackson, 2001, p. 17).
- The fact that networks provide strong inter-organizational capacities implies that they serve cross-sectoral issues better than narratives with a strong intra-organizational focus, such as NPM (Williams, 2002a, p. 105).

- While competition is good for efficiency, collaboration is assumed to facilitate effectiveness because networks provide or generate valuable resources such as local knowledge and experience, ownership and commitment (Jackson, 2001, p. 18; World Bank, 2002).

Networked governance arrangements and related polycentric governance systems are by no means a perfect model, nor guarantees success in overcoming the challenges associated with governing towards sustainable development. However, they are improvements compared to hierarchical bureaucracies or NPM. The following section will discuss in more detail the related concept of polycentric governance systems, including their advantages and limitations in general and as applied to arguably the most pressing environmental problem, global climate change.

Polycentric Governance Systems: An Overview

The term ‘‘polycentric’’ was introduced by Vincent Ostrom in 1961, and connotes “many centers of decision-making that are formally independent of each other…” (p. 831–32). Generally, a polycentric system of governance includes the following characteristics: multiple levels of governance (local, provincial, national, regional and global), multiple types of political units (general-purpose, specialized and cross-jurisdictional), multi-sectoral organizations (i.e., private, public, voluntary, community and hybrid varieties), and finally multiple functions (e.g., production, financing, coordination, monitoring, sanctioning) (McGinnis 2011, p. 171-2; Daley, Abel and Stephan 2014). Jordan et al. (2018) identify three defining features of polycentric governance systems: (1) it operates at multiple centres of decision-making authority with overlapping jurisdictions, which (2) interact through a process of mutual adjustment and with (3) their interactions generating a regularised pattern of overarching social order.

In these systems “political authority is dispersed to separately constituted bodies with overlapping jurisdictions” (Skelcher 2005, p. 89) meaning that “the scope of the issues that are addressed is not discrete” (McGinnis 2018, p.7; cited in Jordan et al. 2018, p. 11). The numerous governing bodies that interact through cooperation and competition are assumed to have autonomy to create and enforce rules in a given locale and policy arena (Schoon, Robards, Meek and Galaz, 2015; Ostrom 2010; Jordan et al. 2018). As Galaz et al. (2012, p. 22) note, polycentricity is not a binary variable, yet few attempts have been made to distinguish levels of polycentricity. Polycentricity at its most general level “describes the

degree of connectedness or structuring of a polycentric domain and/or system", which can range from loosely to tightly coordinated (Jordan et al. 2018, p. 12). Schoon et al. (2015) begin to distinguish degrees of polycentricity in governance systems, which they put forth can be assessed along two broad continua: collaborative degree and breadth of inclusion (see Figure 7).

The structure of government ranges from a strictly top-down, monocentric to highly decentralized, polycentric governance systems that vary based on the 'breadth of inclusion' (sometimes called 'diffusiveness') and degree of collaboration, which influences the degree of weakness or strength of the polycentric governance system (Schoon et al. 2015, pp. 230). The breadth of inclusion refers to the number and variety of governance bodies, while the degree of collaboration refers to the continuum of coordination between bodies (Schoon et al. 2015). For example, the collaborative degree in a weak polycentric system might include coordinating activities such as information sharing, while internal conflict resolution would be associated with a strongly polycentric system with a high collaborative degree (Schoon et al. 2015).

Advantages and disadvantages of polycentric governance systems for the provision of ecosystem services

Both theoretical and empirical insights have affirmed that polycentric governance systems lead to some key benefits that enhance the resilience of social-ecological systems (Biggs, Schlüter and Schoon 2015). These benefits, as well as the limitations of polycentric governance systems are discussed in more detail below, both generally and in the context of combating global climate change. Schoon et al. (2015) outline six mechanisms by which polycentricity enhances the resilience of ecosystem services, based on the work of leading researchers in the field. These mechanisms are discussed individually below for polycentric systems in general. These benefits are then be applied to the challenge of climate change in order to illustrate how the approach of polycentric climate governance is best suited to help 'solve' this immense collective action problem.

Advantages of polycentric governance systems

Polycentric forms of governance are increasingly common and are said to have many advantages when dealing with complex policy issues requiring effective policy integration. Generally, it is argued,

"polycentric governance systems provide opportunities for enhanced learning and experimentation" (Schoon et al. 2015; Ostrom 2009; 2010; Cole 2011; 2015; Thiel 2017; Goldthau 2014; Abbott 2018). Polycentric governance systems have the advantage that participants can use local knowledge and learn from other governance units who are also going through the process of parallel experimentation and learning (Ostrom 2010, pp. 552). This kind of system tends to enhance learning and innovation even though there is no institutional arrangement to fully eradicate opportunism related to providing collective goods (Toonen 2010; cited in Ostrom 2010). The strength of this kind of a system in dealing with complex, dynamic biophysical systems is that each sub-unit is quite autonomous, therefore having the ability to create 'natural experiments' for various policies in diverse ways, which is crucial for effective policy learning (Brondizio et al. 2009; cited in Schoon et al. 2015, pp. 231; Ostrom 2001). Experimentation among smaller scale sub-units allows for local knowledge to be accessed and feedback to be quickly given regarding their policy changes, while learning can take place from parallel units also undertaking experimentation (Ostrom 2001; Ostrom 2010).

Additionally, "polycentric governance systems broaden participation across scales" (Schoon et al. 2015; Ostrom 2010; Cole 2011; Araral and Hartley 2013; Thiel 2017; Homsy and Warner 2015). Aside from broadened participation being a good governance goal in and of itself, if the breadth of inclusion of a polycentric governance system is increased, the system can capitalize on advantages such as the use of increased scale-specific knowledge, with learning and sharing across levels and cultures (Olsson et al. 2004; cited in Schoon et al. 2015). Broadened participation at the local level also serves to potentially increase the legitimacy of decision-making authorities at various levels as more scale-specific information goes into the decision-making process (Engle and Lemos 2010). Broadening participation (especially at lower scales) and decentralizing power to lower levels can also support more effective monitoring and enforcement, as there is the advantage of locally crafted rules and implementation strategies (Schoon et al. 2015). Monitoring and enforcement are vital to ensuring that institutional arrangements are long-lasting and sustainable, a proven necessity if the provision of ecosystem services is to be resilient (Ostrom 1990).

Very much connected to the advantage of broadening participation across scales is that "Polycentric governance systems improve connectivity in governance" and also "create modularity" (Cole 2011; Schoon et al. 2015). It is argued that modularity and connectivity present in varying degrees in polycentric governance systems can preserve social-ecological system elements in the face of disturbance

(Garmestani and Benson, 2013; Gupta et al., 2010; cited in Thiel 2017; Schoon et al. 2015; Ostrom 2001). In addition to enhanced modularity and connectivity, functional redundancy is a closely related concept that advantages polycentric governance systems. Schoon et al. (2015, pp. 233) argue, "polycentric governance systems build in redundancy that can minimize and correct errors in governance". When governance failure occurs at one level, the system characteristics of functional redundancy, connectivity and modularity, allow the system to overcome somewhat a failure at one level by having other levels step in who already perform the same governance role (albeit at a different scale). For example, Nagle and Ruhl (2002; cited in Schoon et al. 2015) point to a case where the U.S. Federal Government stepped in to help protect endangered species as they had the capacity to do so and lower-scale governance efforts were proving ineffective. The modularity of the system especially allows for governance failures to be isolated, while connectivity helps successful experiments and knowledge spread. The notion of functional redundancy is very much connected to the advantage of improved response diversity, explained next.

Another benefit of polycentric governance systems is that they "improve the potential for response diversity" (Biggs et al. 2015; Ostrom 2010; Ostrom 2001; Thiel 2017). Ostrom (2001) notes that there is a great benefit to having multiple, varied governance units at many scales over one geographic area, as opposed to one governance unit for a large geographic area with regards to system responsiveness. In the case of an external threat, the failure to adequately identify and respond when there is only one governance unit means an enormous disaster for the whole system (Ostrom 2001; Carlisle and Gruby 2017). In contrast, in polycentric governance systems, the failure of one governance unit to adequately identify and respond to an external threat in no way means a disaster for the whole system; instead, failure of a sub-unit might mean a small scale disaster that can be "compensated by the successful reaction of other units in the system" (Ostrom 2001). This argument counters the critique that polycentric governance systems are too redundant (and therefore, inefficient).

Limitations associated with polycentric governance systems

According to Schoon et al. (2015), three main challenges arise under polycentric governance systems where the resilience of ecosystem services may be compromised. The first is the need to balance redundancy and experimentation with the inefficiencies associated with higher transaction costs and very likely overlapping authority (Parks and Ostrom 1999; cited in Schoon et al. 2015; Mewhirter, Lubell and

Berardo 2018). In more decentralized, polycentric systems with multiple and sometimes overlapping governance units, transaction costs may increase because of the need to coordinate with many nodes of authority both vertically and horizontally and also rise due to potentially inefficient or lacking coordination mechanisms. Especially when ecosystem services are produced at a wide range of scales, for example, the global climate, a sizeable number of governance arrangements are needed to fulfill the 'matching principle', which can increase transaction costs and prove overwhelming, especially in developing countries (Schoon et al. 2015). This critique is linked to the frequent criticism that polycentric governance systems are "too complex, redundant, and lacking a central direction when viewed from a static, simple-systems perspective" (Ostrom 2001). Also, questions of legitimacy arise with the inclusion of non-state actors and non-democratically elected participants, which are common to polycentric governance approaches, making it very important to balance increasing breadth of inclusion with the potential costs (Schoon et al. 2015).

Secondly, a challenge arises in negotiating trade-offs between the potentially conflicting goals and interests of appropriators of ecosystem services (Søreng 2006; Rodriguez et al. 2006; Robards et al. 2011; cited in Schoon et al. 2015). Struggles can occur between competing groups at a given level or between uncoordinated or ineffectively coordinated levels of a polycentric system and can produce contradictory or conflicting outcomes (Schoon et al. 2015). Power is central to this challenge; if at some scales "powerful elites externalize trade-offs from their area of interest", the outcome may be the degradation of ecosystem services (Schoon et al. 2015, pp. 237). In the case of climate change, a classic example of this occurrence would be the trade-off between mitigating climate change and domestic energy security when trying to develop a nation's oil and gas policy (Chalvatzis and Hooper 2009; cited in Schoon et al. 2015).

Linked to the challenge of trade-offs between user groups is the third challenge proposed by Schoon et al. (2015). This challenge deals with the politics of resolving these conflicts collectively, including allocating trade-offs. They argue that increasing the degree of collaboration in the polycentric system can help deal with this challenge, especially when the focus is on collective conflict resolution and problem solving. In addition to these three challenges, from an academic and applied perspective, there has also been a lack of understanding on how to operationalize polycentric approaches to governance or even design studies that would allow for more understanding (Schoon et al. 2015). Although the notion that polycentric governance systems are a 'good idea', to date, analysis has been missing on how to assess

degrees of polycentricity and link this to the impact on governance outcomes. That being said, there has been progress using social network analysis, ethnographies and case studies to evaluate polycentric systems using the concepts of the breadth of inclusion and collaborative degree (Schoon et al. 2015).

Rhodes (2006, p. 438; quoting Hajer 2003, p. 175), argues that "if we live in a world of 'polycentric networks of governance', then the task facing politicians, managers, and citizens is to manage 'the institutional void', that is, to make and implement policy when there are no generally accepted rules and norms for conducting policymaking". Rhodes (2006) classifies four categories of problems associated with managing the network state, one of which is 'enhancing coordination'. Complex governance systems require purposeful integration measures and efforts to ensure coherence and effectiveness in terms of policy outcomes, especially in cross-sectoral policy issues like climate change. This is the project with which the following section explicitly engages.

A polycentric approach to climate change

Overall, with regards to the challenge of mitigating global climate change, Ostrom (2009; 2010) asserts that a polycentric approach is more likely to induce cooperation and enhance innovation than strictly top-down approaches. Ostrom (2009; 2010) points out that this approach is by no means a panacea, but that it works with the current reality of diverse climate governance experiments occurring in greater abundance at subnational and local scales (Rabe 2009; Daley et al. 2014; Thiel 2017). Pursuing a polycentric approach to climate change also matches the current reality of climate policy, which, according to Cole (2011, pp. 406), is at minimum weakly polycentric. Rabe (2009, p. 36) also agrees that a "mixture of strategies at multiple levels may be the best approach" to deal with the unique complexities of the problem.

Polycentric systems attempt to match governance levels to the scale of the problem and rectify the often-mismatched 'fit' between 'institutional attributes' and the properties of the system (Young 2002; cited in Schoon et al. 2015). In this way, a polycentric approach is best suited to deal with the problem of climate change as the global atmosphere has ecosystem services that have very strong multi-level aspects. Furthermore, a polycentric approach to governing climate change is the best strategy, as it recognizes the complexity of the challenge at hand and encourages learning from a variety of governance experiences and policy experiments at different scales. Due to the very short time-frame left to mitigate and manage

dangerous climate change effectively, it seems appropriate that as many different experiments are tried at as many scales as possible. In fact, climate governance experimentation has now become an important research project in and of itself (Turnheim, Kivimaa and Berkhout 2018).

National and subnational governance: The state's role in steering/operationalizing polycentric climate governance

An important line of inquiry under the research program initiated by Ostrom is the extent to which states facilitate and steer polycentric climate governance systems by providing overarching rules, that in theory, will enable the enhanced performance of initiatives by diverse actors. At the outset, the critical function of overarching rules for enhancing polycentric climate governance systems might seem counterintuitive in that it emphasizes some level of monocentricty in polycentric governance systems. Recognizing the nuanced reality of these systems as they operate in practice highlights the importance of avoiding characterizing these systems in binary terms. Within the context of climate change governance, overarching rules, such as laws, policies and regulations, "provide incentives for climate mitigation, provide mechanisms for mainstreaming and serve as a focal point for actors" (Setzer and Nachmany 2018, p. 51).

Not only do laws and policies create specific policy instruments, but they also create institutional arrangements, "defining responsibilities for actors at various stages of the policy cycle" (Setzer and Nachmany 2018, p. 51). Most of the governance functions set out by overarching rules are only able to be carried out by the state, at least in the sense that they are mandatory and enforceable. Many other functions would also not likely take place without state intervention. For example, it is unlikely that a majority of individuals and corporations would impose a price to internalize the environmental and social cost of carbon upon themselves. Overarching rules constitute 'the shadow of hierarchy' or the background against which diverse actors act.

The state has unique powers that other actors in polycentric governance systems do not possess, relating directly to the provision and enforcement of overarching rules; for example, the mandatory collection and distribution of funds via tax and budgetary regimes (Setzer and Nachmany 2018). In recent developments of polycentric climate governance literature, overarching rules by higher-order governance levels are said to serve regulating and mobilizing functions to contribute and enhance these systems

(Setzer and Nachmany 2018). The provision of mechanisms for mainstreaming, also known as policy integration, serves as a useful lens through which the impact of overarching rules on operationalizing these systems can be evaluated. This research draws on the lessons of climate policy integration, developed in the context of the European Union and stemming from its predecessor environmental policy integration, as a framework for evaluating how states effectively steer polycentric climate governance.

Climate/Environmental Policy Integration: Introduction to the Evaluation Frame

Environmental policy integration (EPI) has been "one of the most powerful concepts to emerge in environmental policy discourse in the late 20th century" and has been "widely regarded as a prerequisite for sustainable development", its 'mother concept' (Owens 2007, xvii; Rietig 2012). The integration of environmental objectives and concerns into decision-making procedures of non-environmental policies and strategies has received widespread support as a concept since its emergence in the 1990s as a first order principle to guide transitions to sustainability (Lenschow 2005; Jacob, Volkery and Lenschow 2008; Adelle and Russel 2013; cited in Runhaar 2014, Driessen and Uittenbroek 2014; Jordan and Lenschow 2010; Hertin and Berkhout 2003; Jacob and Volkery 2004; Ahmad 2009). The policy principle aims to integrate environmental objectives and concerns into decision-making procedures of non-environmental sectors so that all sectors incorporate strategies and objectives aimed at sustainable development (Jordan and Lenschow 2008; Jordan and Lenschow 2010).

In general, policy integration can be active (deliberate coordination by actors to achieve integration), defensive (actors restrict integration effects but still coordinate on some level) or indirect (unplanned integration) (Casado-Asenio and Steurer 2012, p. 5). Coordination capacities or mechanisms "facilitate coordination within networks of interdependent actors" in various ways, including but not limited to: information exchanges among actors, identifying issues where solutions require coordination and arbitrating conflicts among participants when informal methods fail (Jordan and Schout 2006). EPI is also a concept that has different interpretations. The strong (pro-environment) understanding of the concept sees sustainable development as the first priority and overarching objective of decision-making in other sectoral policies (Lafferty 2004), whereas weak interpretations 'take into account' environmental considerations but focus more on coordination and 'win-win' synergies (Jordan and Lenschow 2010; Jordan and Schout 2006).

There are also differing justifications for pursuing integration, namely normative and organizational reasons (Nilsson and Persson 2003; Persson 2007; Mullally and Dunphy 2015), both of which are important parts of the rationale. From an organizational perspective, the concern mainly centers on ensuring effectiveness in the face of fragmented government architectures. Nilsson and Eckerberg (2007) note that it is widely accepted that the fragmented nature of governments impedes the pursuit of sustainable development, in that the specialized nature of sectoral policies often fails to incorporate environmental impacts (Lafferty and Hovden 2003; Lenschow 2005; Jacob et al. 2008; cited in Runhaar et al. 2014).

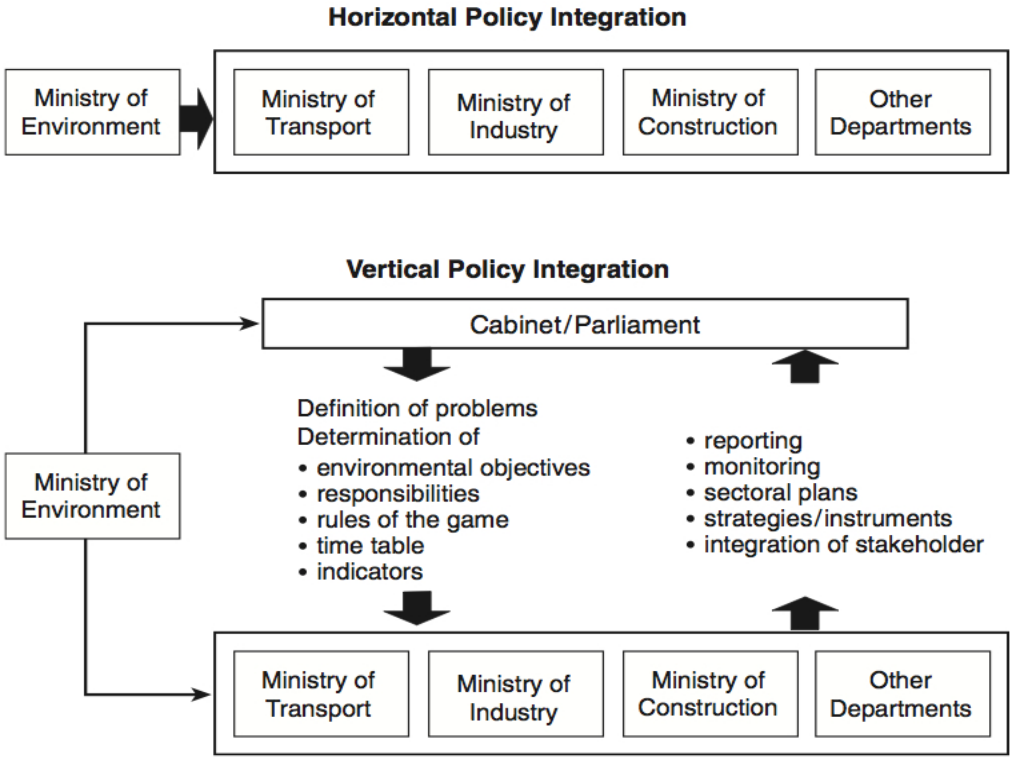
Ensuring effectiveness via the realization of mutual benefits, reduction of redundancy and promoting innovation are also included in the organizational reasoning for EPI and policy integration in general (Stead and Meijers 2009; Brouwer et a. 2013; cited in Runhaar et al. 2014). The normative rationale for EPI stems from a genuine concern for environmental integrity. Lafferty (2002, p. 2; cited in Persson 2007, p. 33) argues for an almost explicitly normative rationale for EPI, with the key difference from an organizational rational being "the general environmental or ecological element of sustainable development is the most fundamental – the one without which the concept loses its distinctive meaning". A key focus from this perspective is identifying win-win situations, and equally important, identifying sector conflicts with environmental objectives having the status as principled priorities (Lafferty 2002; cited in Persson 2007).

The organizational arrangements developed by governments to facilitate EPI in practice are largely characterized by 'vertical' and 'horizontal' integration approaches (Nunan, Campbell, and Foster 2012)[4]. As Figure 11 illustrates, horizontal integration refers to the incorporation of environmental objectives across sectors, while vertical integration refers to the inclusion of environmental objects between the multiple levels of governance. Table 6 outlines the major EPI instruments and institutions by their

[4] It is important to note that both EPI and CPI in practice can occur along a third dimension in the form of diagonal integration (Casado-Aresnio and Steurer 2012; Mullally and Dunphy 2015). The approach is underdeveloped from both a theoretical and evaluative perspective but Casado-Asenio and Steurer (2012) suggest it "be thought of as an additional mechanfism that takes account of both cross-scale interdependencies and cross sector linkages" (cited in Mullally and Dunphy 2015, p. 32).

operation for policy integration (as classified by Jacob, Volkery and Lenschow 2008) and cross-referenced as either vertical or horizontal integration.

Figure 11. 'vertical' and/or 'horizontal' integration approaches (*:* Janicke 2000; cited in Klaus and Volkery 2004).



	Horizontal	**Vertical**
Communicative		• Constitutional provision • National Environmental Plans (NEPs) • National Strategies for Sustainable Development (NSSD),

		• Requirements to develop sectoral environmental strategies • Reporting obligations on environmental performance • External reviews of environmental performance
Organizational	• Amalgamation of departments • Green cabinets • Environmental units/correspondents in other sectors/departments • Interdepartmental working groups	
Procedural	• Strategic Environmental Assessment (SEA) • Department of the Environment	• Green Budgeting • Policy Appraisal

Table 6. Core EPI instruments and institutions by their operation for policy integration (as classified by Jacob, Volkery and Lenschow 2008).

Climate policy integration (CPI)

The increased interest in CPI in recent years reflects not only the development of CPI as building on the EPI experience but also the recognition that mitigating and adapting to global climate change needs to be addressed very urgently and in almost every sector of the economy and our society (Kettner, Kletzan-Slamanig and Köppl 2011; Dupont and Oberthür 2012). The notion of CPI is generally conceptualized in two different ways (Rietig 2013). One way is to see CPI as essentially the same as EPI, the exception being a narrower focus on climate objectives as opposed to the larger category of environmental objectives. An example of this perspective is the definition put forth by Klein et al. (2007; cited in Ahmad 2009, p. 9):

> The integration of policies and measures to address climate change in ongoing sectoral and development planning and decision-making, aimed at ensuring the sustainability of investments and at reducing the sensitivity of development activities to future climactic conditions.

The second conceptualization builds on the first but goes further in taking into account the differences between climate change and the environment as policy problems (2013). Like EPI, there is also a focus on minimizing contradictions between climate policies and other policies and realizing mutual benefits (Collier 1997; cited in Retig 2013; Kok de Coninck 2007; cited in Kettner et al. 2011).

Unlike EPI, it is problematic to assign CPI a principled priority, based on differences in normative and legal aspects (Rietig 2013). Aside from the fact that CPI has developed in part out of EPI, there is no strong legal standing in both international and regional treaties and law (Rietig 2013). Also unique to CPI, as opposed to the broader notion of EPI, is the fact that there are two major distinct areas of operation, mitigation and adaptation, which are defined by Ahmad (2009. P. 3) below:

- Mitigation: an anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks.
- Adaptation: adaptation in natural or human systems in response to actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities.

These two areas of operation have been dealt with quite separately in literature and practice, with climate policy generally being associated with mitigation efforts in the energy sector. However, Ahmad (2009) argues that it is now being linked more broadly with sustainable development. CPI also differs from EPI in that it is not an automatic sub-category of EPI and although normatively, it should contribute to sustainable development, in practice, this is not automatically the case (Rietig 2013). For example, a government decision in the energy sector to promote nuclear power meets climate change objectives in that emissions will be reduced as compared to fossil-fuel-based energy production; yet, this choice does not automatically align with sustainable development objectives. For example, this decision poses challenges ensuring intergenerational equity resulting from the extremely long-lasting and toxic nature of spent nuclear fuel. Like EPI, CPI strategies can be categorized as horizontal or vertical approaches.

The strategies for horizontal and vertical integration and types of instruments will not be discussed in great detail for CPI as much of the detailed discussion above on EPI instruments translates almost directly for CPI. Briefly, conventional means of horizontal integration of climate objectives include macro

climate change strategies at national or subnational levels, integration of climate policies in annual national or subnational budgets and regulations (Beck et al. 2009). For example, in Canada, the Federal Government under Prime Minister Trudeau has committed CAD 2.65 billion in climate finance over five years, which includes the establishment of a Low Carbon Economy Trust to assist provinces' efforts to reduce emissions (ECCC 2015). Typical vertical climate policy integration measures involve the integration of climate objectives into sector-specific strategies and decisions, and into various agencies under specific ministry supervision (Beck et al. 2009).

Organizational measures often used include changing department or ministry titles to highlight an increased specific focus on climate objectives. With the election of Wynne Liberal Government in the Province of Ontario came title changes for the Ministry of the Environment to Ministry of the Environment and Climate Change. Also, similar organizational strategies have occurred with linking climate change objectives to sectors outside the environment; for example, the Ministry of Energy and Climate Change in the UK. Organizational measures are important for establishing some kind of governance structure to house cross-sector and/or multi-level government groups working towards common mitigation goals. These kinds of institutions are especially important in enhancing coordination in more complex federal systems like the United States and Canada.

Procedural elements, like including a specific requirement to assess greenhouse gas emissions associated with a given project in environmental assessments, is a good example of how climate considerations are highlighted and integrated into the decision-making process. Greenhouse gas reporting measures, internally, for the public, and to meet UNFCCC requirements, are conventional communicative instruments. These types of reporting instruments can also be quite robust at the subnational level. For example, in California, periodic scientific assessments on the current and potential climate change impacts, and suggested responses, are required by Executive Order S-03-05; four assessments have been produced since 2006 to inform policy-makers in decision-making (California Climate Change 2018).

Some independent environmental evaluative organizations have had their mandates updated to put more emphasis on climate change mitigation and adaptation. For example, the Environmental Commissioner of Ontario’s mandate was updated in 2009 to require it to produce annual reports on the Province’s progress to mitigate greenhouse gases (ECO 2014). Another common and important

communicative instrument that enhances climate policy mainstreaming is National Climate Change Plans/Strategies. In addition to providing mechanisms for climate policy integration, they also provide a focal point for various actors and increase incentives for climate change mitigation (Dubash, Hagemann, Höhne and Upadhyaya 2013).

Evidence of underperformance with EPI/CPI

Jordan and Lenschow (2008, 5) argue, "As policy goals, sustainable development and EPI appear more remote and more politically contested today than they did twenty years ago". In a later paper, Jordan and Lenschow (2010, 147) note, the practical fulfillment of environmental policy integration (EPI) is "complex and contingent" and results have not met initial aspirations of connecting "the seemingly incompatible goals of economic competitiveness, social development and environmental protection". In the modern context of multi-level, polycentric governance systems and associated increasing organizational complexity, Nilsson, Eckerberg, and Finnveden (2007, p. 154) point out that EPI has become "a very messy enterprise". Although a widespread consensus on best practices for how to implement EPI in specific settings is limited, policy experience to date has provided a solid foundation upon which to build. The following section provides a starting point for attempting to close this implementation gap within the context of reducing emissions from road passenger transportation. This state-of-the-art review outlines mechanisms that have proven effective at enabling the integration of emission reduction objectives in this sector and provides a useful framework for evaluating overarching rules to this end.

CPI in the Road Passenger Transportation Sector

There has been a growing interest and body of research on sustainable transportation systems (Kivimaa and Virkamäki 2014). As the second-largest producer of carbon emissions globally (Kivimaa and Virkamäki 2014), intensified focus on the transportation sector makes logical sense given the growing significance of this sector with regards to GHG emissions and the pressing challenge of global climate change. Many studies have focused on single policies or technologies (e.g., biofuels, electric vehicles) with fewer studies looking at the whole transportation system, especially those encompassing a systems transition lens (Kivimaa and Virkamäki 2014). Transportation systems are multifaceted and interlinked,

requiring much more than the dominant focus on the technological efficiency of vehicles (Kivimaa and Virkamäki 2014), especially given the ambition of climate targets and the complexity involved in effectively of promoting a socio-technical transition to a low-carbon transportation system. There are also diverse actor interests involved in the transportation system, all of which must be targeted through policy measures to ensure a comprehensive and effective approach. For example, the US Transportation Research Board (2011, p. 99) classifies three major groups of actors:

> Transportation consists of three broad groups of actors: (a) the suppliers of vehicles, fuel, and infrastructure; (b) the owners and operators of the vehicles and providers of the transportation services; and (c) the users of transportation services. The composition, interests, and roles of each differ, and they can vary greatly by mode. Thus, strategies and policies to influence transportation energy use and emissions must take these decision-makers and their differing incentives, interests, and capabilities into account.

Reflecting this need, there has been a growing interest and focus on demand-side management and a broadening of scope in transport planning, witnessed by an increase in different short and long-term measures, such as improved cycling and walking infrastructure, car-sharing, teleworking, pricing, an increased supply of public transit and (critical for long-term change) strategic land-use planning geared at promoting sustainable transportation modes (Kivimaa and Virkamäki 2014). At a more macro level, transportation as a policy issue, like the environment, necessarily entails integration across sectors. The challenge of difficult institutional conditions related to the highly sectoral nature of governments poses in some way a double complication to the integration of climate change objectives into the transportation sector as both of these areas are highly subject to what Banister (2002) calls the institutional/political structure barrier to the implementation of sustainable transport policies (Hatzopoulou and Miller 2008).

Many of the mechanisms to reduce emissions from the transportation sector are not novel. For example, mechanisms for promoting a sustainable transportation system such as government support for electric vehicles, high-speed rail and alternative fuels are mentioned in articles that are over twenty years old (e.g., Rienstra, Vleugel and Nijkamp 1996). While Rienstra et al. (1996) mention ‘telematics’, arguably, the biggest change in policy options has been the immense technological progression witnessed in the past two decades, providing a new set of opportunities to reduce emissions from the transportation sector via information and communications technology (ITC) and its applications. In developed regions,

like the cases in this study, ITC applications in the transportation sector have progressed substantially over the past 30 years, resulting in substantial improvements in conventional transportation systems in terms of effectiveness and safety (The World Bank 2015).

There are many ways to classify measures to achieve CPI in the transportation sector, including by policy goal, by level of government, or by regulatory vs. market mechanisms. This research on-road passenger transportation utilizes two broad categories to organize CPI efforts, 1) Cleaner vehicles, and 2) Transportation demand management, representing the two key goals of policies and mechanisms aimed at developing a low carbon transportation system: 1) make passenger vehicles emit fewer GHGs, and 2) reduce the number of vehicles on the road. Monni and Raes (2008) identify four categories where instruments can impact transportation emissions, two of which fall under the category 'cleaner vehicles' (vehicle efficiency and fuel efficiency) and two of which fall under 'transportation demand management' (amount of transport and mode of transport). The table below provides a list of key existing policy mechanisms for emission reductions in the road passenger transportation sector drawn from a state-of-the-art review conducted for this research. These instruments are classified by the two broad categories utilized in this research, cleaner vehicles and transportation demand management (see Table 7). Appendix A describes these individual mechanisms.

The following chapter provides an introduction to the first jurisdiction in this comparative case study: Ontario, Canada. In addition to general background information, the institutional context as it relates to relevant federal-provincial authority is outlined alongside the extent of climate policy integration in Ontario's road passenger transportation sector. The extent of CPI is discussed utilizing the framework for analysis introduced above.

Cleaner Vehicles	**Transportation Demand Management**
Climate Change Commitments and Carbon Pricing Information measures	
– Fuel standards – Vehicle standards – Mandated emissions testing (I & M) – Alternative Vehicle Standards and Mandates – Alternative vehicle charging infrastructure development – Tax on transportation fuels – Tax on inefficient vehicles – Feebates – Subsidies for alternative vehicles – Non-financial clean vehicle incentives – Funding for research and development and industry partnerships – Government procurement	– Transit-Integrated land-use planning, "smart growth" policies – Enhanced public transportation services – Policies aimed at making current public transit systems more effective (funding for R and D; implementing intelligent traffic control systems) – Policies encouraging the use of bicycles (bike lane infrastructure development, bike-sharing) – Policies aimed at increasing occupancy rate of vehicles (car-sharing; car-pooling; HOV lanes) – Tolls and congestion charges – Insurance schemes – Telework and other employee travel reduction programs

Table 7. Key existing policy mechanisms for emission reductions in the road passenger transportation sector.

Chapter 5: Extent of CPI in Ontario's Road Passenger Transportation sector

System of government: Ontario, Canada

Canada was originally established as a self-governing British Colony in 1867, as per *The British North America Act,* 1867, and is now a federal parliamentary democracy under a constitutional monarchy. In 1982 Canada 'patriated' its Constitution, transferring the highest authority from British Parliament to Canada's legislatures, as well as adding the Canadian Charter of Rights and Freedoms to the Canadian Constitution. The government consists of the executive, legislative and judicial branches. The executive branch is made up of the Queen, who is the head of state, represented by the Governor and Lieutenant Generals, and the Prime Minister and ministers, who make up the cabinet, which is responsible to parliament for government business. The legislative branch consists of the Parliament, i.e., the Senate, the House of Commons and the Queen (represented by the Governor General). The judicial branch is made up of federally appointed judges who interpret and apply the law.

In Canada, the federal and provincial governments work on a cabinet-parliamentary basis vs. a separation of powers system, like the U.S. This has implications for climate change policy due to the concentration of power under the Prime Minister and Provincial Premiers, as opposed to the diffuse power in the U.S. congressional system (Vipond 1998). The result of this set up is that the executive tends to have very high levels of executive decision-making and policy-making within their jurisdictional authority. This can become an issue if a Prime Minister or Premier is elected who is not interested in environmental protection, which was the case under Canada's former Prime Minister, Stephen Harper, and Ontario's current Premier, Doug Ford. Therefore, this particular institutional set up also gives more weight to the landscape variable, high-level political commitment, in the Canadian context.

Canada is a very decentralized federation, which has and continues to complicate climate change governance, including pursuing a low carbon transportation system. Section 91 and 92 of *the Constitution Act* (1867) set out the division of powers between the Federal and Provincial levels of government. Local governments are not given explicit powers but are considered "creatures of the province" whereby certain Provincial powers are devolved to local governments. In addition to its enumerated powers under section 91 of *the Constitution Act*, the Federal Parliament has the power "to make laws for the peace, order and good government of Canada," except for "subjects assigned exclusively to the legislatures of the

provinces." Essentially this means the federal government has default authority over any subject not explicitly assigned to the provinces (Beaudoin 2015). This "centrist" set up is opposite to the U.S., where states are the default source of authority for residual powers.

As the matters of the environment were not explicitly assigned when the Canadian Constitution was developed, the jurisdictional authority has evolved over time through court rulings. Generally speaking, the environment is considered a shared jurisdiction. As clarified by the Supreme Court ruling in *R. v. Hydro-Quebec* (1997) ruling, the environment is considered "a diffuse subject that cuts across many different areas of constitutional responsibility, some federal, some provincial." The authority to legislate on environmental matters was further clarified by the *Friends of the Oldman River Society v. Canada (Minister of Transport*) (1992 S.C.R. 3 at p. 76 and 81) ruling, which states that either level of government may legislate on environmental matters as long as the exercise of power is "linked to the appropriate head of power" or to "several heads of power at the same time". Federal authority to regulate environmental matters was originally interpreted as limited. However, generous rulings supporting federal intervention on implementing environmental legislation, such as the Supreme Court rulings in *R v. Crown Zellerbach* (1988, 1 S.C.R. 401) *and R v. Hydro Quebec* (1997 3. S.C.R. 213), have "upheld the legislative competence of Parliament to engage in environmental regulation within the territory of the provinces (Mahoney 2016, 3-4).

Even though the Canadian constitution is more centrist in its allocation of powers compared to the U.S., in practice, provinces have more authority over many areas directly related to the environment, and more specifically, climate change mitigation. This is due in part to a trend of decentralizing of powers over time in the Canadian context since 1867, opposite of the centralizing trend over time seen in the U.S., where a stronger central government has evolved over time (Field 1992). Key provincial powers related to matters of the environment include land-use planning, natural resources, property and civil rights, and energy production (Hogg 2007; Mahoney 2016). In addition to relative dominance over environment-related authority, provinces have key heads of power in terms of reducing emissions, specifically from road passenger transportation.

As a start, provinces have authority over public health and "matters of a local or private matter", which is the derivative authority authorizing provinces to regulate sources of pollution, including GHG

emissions from transportation (*the Constitution Act* 1867). Of particular importance in terms of direct control over transportation, is the authority over 'local works and undertakings', meaning control over road, highway, transit construction and operation, authority over road regulations, and the authority to set standards and codes for goods sold in the province (*the Constitution Act* 1867; Benidickson 2016; Mahoney 2016). In terms of powers more indirectly related to reducing emissions from transportation is the province's authority over the electricity system, which is key to upstream emissions, and total authority over land-use planning, except on federal lands (roughly 5%) (*the Constitution Act* 1867; OECD 2017). Ultimately, Provinces can override local decisions. Province's also have the authority to implement carbon-pricing systems within their jurisdiction (Mahoney 2016).

Federal heads of power also provide for potentially significant points of intervention with regards to mitigating climate change in general, and in terms of reducing emissions from transportation. The Federal government has power over criminal law, as per sec. 91(27) of *The Constitution Act* (1867), under which it regulates toxic substances, including GHGs, under the *Canadian Environmental Protection Act* (CEPA) 1999 and other environmental acts. Under part 7 (division 4 and 5) of CEPA (1999), the federal government is enabled to enact regulations to control the quality of fuels and emissions performance of vehicles (Government of Canada 2017). The previously mentioned *R v. Hydro-Quebec* ruling had a substantial impact on enhancing the significance of this federal power in Canadian environmental law, having the effect of settling the constitutionality of *CEPA* (1999) as criminal law (Hogg 2009; Mahoney 2016).

In addition, the recent case of *Syncrude Canada Ltd. v. Canada (Attorney General)* (2014) was important in clarifying the federal government's authority to enact fuel regulations using their power over criminal law. The Federal Government also has power over trade and commerce, under which it regulates vehicle/product fuel economy and emissions standards, enacts labeling policies, and the forthcoming low-carbon fuel standard (Mahoney 2016). Judicial interpretation over time has constrained the use of this federal power in Canadian environmental law, typically supporting provincial jurisdiction (Mahoney 2016). Control over treaty powers allows the federal government alone to sign international treaties related to climate change, like the most recent UNFCCC Paris Treaty, committing the country to emission reduction targets and other related climate mitigation obligations. It is important to note there are limits to treaty power in terms of legislative limitations restricting implementation powers (Carasco 2006). Federal

treaty power does not provide the federal government with any additional powers to implement a treaty (Hogg 2009).

A key federal power with regards to mitigating climate change is the power over taxation by any mean or mode and over spending (Hogg 2009). This head of power provides the federal government to enact a national carbon pricing system and to spend public monies for projects and programs aimed at reducing GHG emissions. Instead of relying on taxation power, the Canadian federal government is relying on its power of peace, order and good government (POGG) to justify its authority to implement its carbon pricing regime.

Federal POGG power essentially means that any matter not assigned to the provinces or directly pertaining to the provinces should be under complete federal authority (Mclellan and Gall 2006). Four branches outside provincial or federal jurisdiction have been established through judicial interpretation over time where the federal government has authority: emergency, residual, national concern and federal paramountcy (Mclellan and Gall 2006). Constitutional experts have determined that the Federal Government could enact climate change legislation as the issue can be said to affect the principle of "peace order and good government" (Hogg 2009). Currently, the Federal Government is using this justification in ongoing court cases brought by the Province of Saskatchewan, Alberta and Ontario, who are arguing against the imposition of a federal carbon-pricing regime.

Local governments are under the express power of the province, as per subsection 92(8) of *the Constitution Act* (1867), now subsumed within *the Constitution Act* (1982). Unlike U.S. states, Canadian Provinces do not have their own constitution outlining duties and powers of local governments and generally exist in a 'state of tension' with higher levels of government, especially around finances and autonomy (Stoett 2009). Provincial governments delegate authority to local governments; in Ontario, extensive powers and environmental-related authorities have been delegated to municipalities. For example, although the primary responsibility for land-use planning is the provincial level (stemming from authority over property and civil rights (*the Constitution Act* 1867)) in practice municipalities control planning within their jurisdiction, following provincial plans, policies, guidelines, appeal and review procedures (Benidickson 2016). Official Plans developed by municipalities contain important transportation elements, which conform to provincial policy directions.

Long-term transportation and transit plans are also developed by municipal staff and transit agencies; these are subject to approval by municipal councils, a process that brings high levels of politicization to transportation and transit decision-making. Local governments in Ontario also have control over implementing active transportation measures, ITS and traffic control measures, municipal licensing (e.g., taxi fleets) and are authorized to set standards for things like the use of EVs. Local governments have potentially an expanded scope to regulate stemming from the *114957 Canada Ltée (Spraytech, Société d'arrosage) v. Hudson (Town)* (2001) ruling, where the court upheld the Town of Hudson's ban on cosmetic pesticides even though this conflicted with provincial rules in Quebec.

Broad Climate Change Policies and Commitments

Early legislation related to GHG emissions and air pollution

Within the Canadian context, Ontario has had a relatively long history of air pollution regulation, with direct involvement through a formalized air pollution regime beginning in the late 1960s under the *Air Pollution Control Act* (1967) (Drowley 1965; Jephcott 1960; Powell and Wharton 1982; McKetta 1976). The principle environmental statute in the Province is the *Environmental Protection Act* (1971), originally enacted in 1971, which governs a broad range of environmental topics, including air pollution (Wood, Levy, Mitchelle and Lax 2013; Mahony 2016 9-8, 9-9). The primary provincial legislation regulating air contaminants and GHG emissions (excluding CO2) was enacted under the *Environmental Protection Act* in 2005: *Air Pollution - Local Air Quality* (2005), O. Reg. 419/05, limits the concentration of emissions from specific facilities and also requires them to model the dispersion of their emissions (Mahony 2016 9-9, 9-10). This regulation was introduced to establish a regime to deal with smog-causing pollutants, identified as criteria air contaminants and hazardous air pollutants, not to deal with GHGs. This kind of regulation represents the pre-climate change justification for government intervention with regards to protecting the environment.

It was only in the mid-2000s, following the end of the Ontario Progressive Conservative (PC) government's reign (1995-2002), that more comprehensive legislation and programs were established in the province dealing directly with mitigating climate change. Before this time, implementation of climate change policies meant to meet international mitigation obligations consisted primarily of ineffective

voluntary measures (especially the Voluntary Climate Registry) alongside research and development efforts (Winfield 2012). This matches the trend at the federal level, where climate change was addressed in a 'shallow' or rhetorical way until the change in government in 2015.

A few years after the 2003 election of the Liberal Party in Ontario, comprehensive efforts to address emission reductions began in earnest, evidenced by a substantial increase in efforts to develop and implement emission reduction measures in all sectors, with prominent legislation directed at decarbonizing power generation and promoting renewable energy installations. It is important to provide some context to this increased focus on environmental protection and sustainable development under the Liberal Party's rule from 2003-2018. The election of the PC Government in 1995, led by Mike Harris on the basis of their Common Sense Revolution platform, ushered in an era of strong neoliberal ideals, which included a disregard for the environment as a policy issue. A series of government budgetary cuts, particularly to the environmental ministry, as well as a host of environmental and natural resource amendments, meant the province was not only not progressing with regards to environmental protection, but rolling back past progress. ENGOs, which were excluded from policy discussions under the Harris Government forged relationships with the opposition parties during this time and strongly influenced the Liberal Party 2003 election platform, and as they were elected, the post-2003 environmental policy agenda (Winfield 2003).

In 2006 the provincial Liberal government passed Bill 200, the *Ontario Climate Change Act* (2007), with the goal of reducing provincial emissions to reach the larger national emission reduction obligations under the Kyoto Protocol; the Executive Council was required to ensure emission reductions of 6% below 1990 levels by 2012 and 25% below 1990 levels by 2020. The Act tasks the Minister of the Environment to prepare a plan with strategies for meeting emission reductions, set emission reduction targets annually between 2008-2020, and report annually on progress and future emission reduction strategies for the following year, which are to be reviewed by the Environmental Commissioner (*Ontario Climate Change Act, 2007*, "explanatory note", para. 1). The *Ontario Climate Change Act* (2007) also empowers the Lieutenant Governor to make broad regulations relating to reducing GHG emissions.

Following this Act, the government released its 2007 climate change plan, "Go Green: Ontario's Action Plan on Climate Change", which set ambitious targets for emission reductions in all sectors: a 6% reduction from 1990 levels by 2014, a 15% reduction from 1990 levels by 2020, an 80% reduction from 1990 levels by 2050 (Government of Ontario 2007). With regard to transport-related emissions, the "Go

Green" Plan called for a 13% reduction from 1990 levels by 2020 for passenger transportation (Metrolinx 2008). While this plan was a positive step in organizing actions specifically meant to reduce GHG emissions, it did not contain a comprehensive long-term vision based on an analysis of climate change impacts in the province, and was instead very much a consolidation of existing initiatives (Winfield 2012).

A key measure in meeting the initial emission reduction target set out in "Go Green" was to eliminate coal-fired generation from Ontario's electricity supply. In addition to meeting GHG reduction targets, the decision to eliminate coal as a source of power generation, which made up 25% of the supply mix in 2007 (Kilpatrick 2017), was heavily motivated by poor air quality, evidenced by a peak in smog advisories, and associated significant health risks and costs at the turn of the millennium (Government of Ontario 2018c). In 2007, the Liberal Government passed the *Cessation of Coal Use Regulation* (2007), O. Reg. 496/07, which set an end date for the ability to use coal for power generation in the province by Dec. 31, 2014 (Government of Ontario 2015). The eventual elimination of coal from the province's supply mix reduced emissions by 17% and remains the largest single emission reduction initiative taken in North America (Kilpatrick 2017).

The replacement of coal in the provincial supply mix was facilitated in part by the passing of the *Green Energy and Economy Act* (GEEA) (2009). The 2009 GEEA introduced a feed-in-tariff system to bring more renewable energy projects online, which required only one environmental approval (the Renewable Energy Approval), in addition to requiring public sector agencies to develop and update every five years Energy and Conservation Demand Management plans (Government of Ontario 2017b; Harper et al. 2016; Osler, Hoskin & Harcourt LLP 2018).

The GEEA had some significant design issues, particularly with the siting and approval process (McRobert and Tennent-Riddell 2016). This led to significant conflict with municipalities who were left out of the approval process, and within rural communities between those who supported wind energy development and those who did not. The legislation was also blamed (not entirely) for rising electricity costs (McRobert and Tennent-Riddell 2016). Despite significant critiques, the GEEA facilitated a large increase in renewable energy capacity in the province, from .7% in 2005 to 10.8% in 2016 (National Energy Board 2017). While the province now leads Canada in installed wind and solar capacity (National Energy Board 2017), it is important to note that the shift came at a significant cost.

Following 2014, the Liberal Government further intensified its focus on addressing climate change issues by developing a comprehensive climate change strategy in 2015, laying the groundwork for the modern legislative approach, which was articulated in legislation and programs between 2016-2017.

The current legislative approach: 2015 – present

Following a steadily-increasing intensity in efforts beginning in the early 2000s, the current legislative approach represents a peak in directly addressing GHG emission mitigation by the Ontario provincial government. The 2015 Climate Change Strategy, the 2016 *Climate Change Mitigation and Low Carbon Economy Act* (2016) and the 2016 five-year Climate Change Action Plan represent the critical pieces of the current climate change governance regime.

Ontario's Climate Change Strategy was released in November 2015, setting the government's vision to 2050 for how it would grow a prosperous, low-carbon and resilient society and economy (Government of Ontario 2017a). The Strategy justified the case for climate action and proposed actions that were wide in scope, with carbon pricing making up the cornerstone of the plan (Government of Ontario 2016). Five areas were highlighted as key pillars of the Strategy: A prosperous low-carbon economy with world-leading innovation, science and technology; government collaboration and leadership; reducing GHG emissions across key sectors; a resource-efficient, high productivity society; adaptation and risk awareness (Government of Ontario 2016) (see Figure 12). High-level measures were outlined under each key area of transformation. Importantly, the Strategy contained a commitment to release a more detailed five-year climate change plan outlining specific commitments and initiatives to meet interim and long-term emission reduction targets (Wood 2017).

Figure 12. Key Pillars of Ontario's Climate Change Strategy (Government of Ontario 2016).

On May 19, 2016, Bill 172, the *Climate Change Mitigation and Low Carbon Economy Act* (2016), received Royal Assent. This landmark piece of legislation provides an overarching, long-term framework for tackling the issue of climate change in the province of Ontario, including establishing targets for greenhouse gas (GHG) reductions in a legal statute for 2020, 2030 and 2050: 15% below 1990 levels for 2020, 37% below 1990 levels by 2030 and 80% below 1990 levels for 2050 (see Figure 13) (Government of Ontario 2016; Ontario Ministry of Environment and Climate Change [OMECC] 2017; Osler 2018).

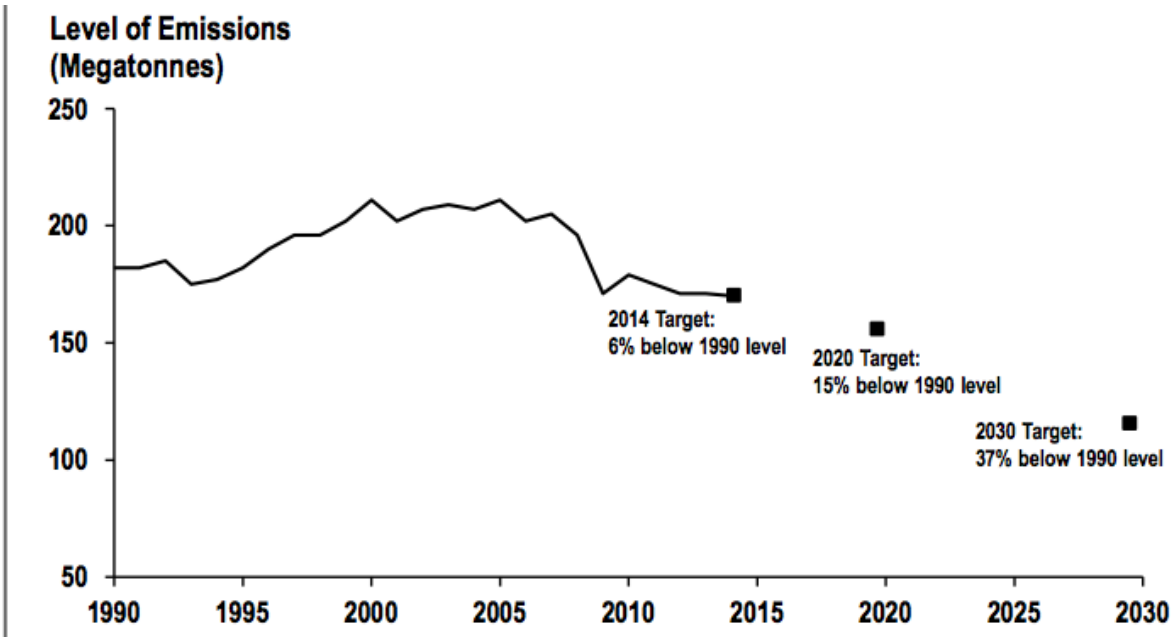


Figure 13. Ontario's Greenhouse Gas Emissions and Target (Environment and Climate Change Canada; cited in Ontario Ministry of Finance 2017).

Central to the government's approach to GHG emission mitigation was the introduction of a cap-and-trade system in the province. The *Climate Change Mitigation and Low Carbon Economy Act* (2016) laid the legal foundation for the cap-and-trade program to begin in 2017, the proceeds of which are directed to a new fund, the Greenhouse Gas Reduction Account, supporting activities and projects that will reduce GHG emissions in the province (Government of Ontario 2018). The Act also required a comprehensive climate change action plan, which was produced for the years 2016-2020, and provided a framework for reviewing and revising GHG reduction target stringency and the ability to introduce interim targets (OMECC 2017; Government of Ontario 2016a). A critical feature allowed for by the *Climate Change Mitigation and Low Carbon Economy Act* (2016) is the ability for the cap-and-trade system to be linked with other jurisdictions (Osler, Hoskin and Harcourt 2018; Government of Ontario 2018).

The *Climate Change Mitigation and Low Carbon Economy Act* (2016) must be understood in conjunction with related regulations and documents, the two key items introduced in 2016 under this legislation being: *The Cap and Trade Program* (2016), O Reg 144/16 and *Quantification, Reporting and Verification of Greenhouse Gas Emissions* (2016), O Reg 143/16 (Osler 2018). In 2017, two other regulations were passed under the Act that also set out important rules for offsets and penalties under the

program: *Ontario Offset Credits* (2017), O. Reg. 539/17 and *Administrative Penalties* (2017), O. Reg. 540/17.

The Cap and Trade Program (2016), O. Reg. 144/16, (the program), outlines key elements of the cap-and-trade system, including caps, auctions and sales rules, allowance reserves, allocations and market rules (OMECC 2017). This regulation provides detailed rules and requirements for participants under the program as well as enforcement and compliance mechanisms (Government of Ontario 2018). The regulation also sets out rules for how the proceeds from auctions will be governed and spent, which averaged roughly CAD 2 billion per year (Osler, Hoskin and Harcourt 2018).

The other key regulation, which must be read alongside the *Climate Change Mitigation and Low Carbon Economy Act* (2016) is *Quantification, Reporting and Verification of Greenhouse Gas Emissions* (2016), O. Reg. 143/16. This regulation provides details for how GHG emissions will be quantified, verified and reported, and which activities explicitly trigger the requirement to do so (Osler, Hoskin and Harcourt 2018).

Two important additional regulations passed under the Act in late 2017 are regulations dealing with offsets and administrative penalties. *Ontario Offset Credits* (2017), O. Reg. 539/17, outlines the rules for how offset credits can be used to meet compliance obligations. Up to 8% of a facility's compliance obligation can be met through offset credits created through the program for initiatives with verified emission reductions (ECO 2016; Osler, Hoskin and Harcourt 2018). The Administrative Penalties Regulation (2017), Reg. 540/17, provides additional key information on penalties for non-compliance with the *Low Carbon Economy Act* (2016) or its regulations; at its core is a three-step process for calculating penalties, which fall between a written warning and prosecution measure with financial penalties, which max out at CAD 1 million (Osler, Hoskin and Harcourt 2018; Kramer and Grochalova 2018).

Overall the cap-and-trade system established through the *Climate Change Mitigation and Low Carbon Economy Act* (2016) and related regulations imposes a modest carbon price on the province's largest emitting facilities. The system design is moderate in providing many of the initial allowances for free to industry, allowing ample time to adjust to the new system and imposing a feasible reduction in combustion allowances at a rate just under 5% per year.

Climate change action plan

As required by the *Climate Change Mitigation and Low Carbon Economy Act* (2016), the provincial government released its Climate Change Action Plan in June 2016, forming the 'backbone' of its climate change mitigation strategy (Office of the Premier 2016). In addition to a broad scope of initiatives meant to ensure that the short term (2020) emission reduction target is met, the Plan also set a mid-term 2030 target and focuses on longer-term transformational areas, especially pursuing a shift to a lower-carbon transportation system (Government of Ontario 2016a). It is not surprising that as the largest source of emissions, transitioning to a low-carbon transportation system is a central focus of the plan. In addition to longer-term TDM strategies, such as land-use planning efforts, promoting active transportation and transit expansion, the Plan contains ambitious initiatives to promote the diffusion of cleaner vehicles, with the objective that these vehicles make up 5% of sales by 2020:

- Working with the federal government to eliminate HST on zero emission vehicles
- Free overnight EV charging
- Providing rebates to replace older less fuel-efficient vehicles with new or used EVs
- EV-ready new homes and workplaces
- Electric and Hydrogen Advancement Program
- Work with Plug'n Drive to establish and operate a facility to showcase EVs
- EV charging stations at government properties
- Establish EV requirements for existing condominiums and apartment buildings (Ontario Ministry of Transportation 2017a).

Outside of the transportation sector, initiatives to reduce emissions include incentives to install and retrofit clean energy systems, new rules and regulations to increase the energy efficiency of new buildings, creating a 'green bank' to aid businesses and homeowners to pay for energy-efficient technologies, helping business adopt lower carbon technologies, and intensify efforts to support low-carbon innovation, research and development (Osler, Hoskin and Harcourt 2018; Government of Ontario 2016a). From a governance perspective, the Plan begins to address the issue of limited capacity (e.g.,

expertise, money) at the local level in terms of being able to develop and implement climate change mitigation and adaptation strategies.

Funding is promised under the Plan to assist in what the government is calling 'Municipal Action Planning', where support is provided to municipalities to develop or update climate change inventories, targets and strategies, and promote the completion of Municipal Energy Plans (MEP) by making completed MEPs a requirement for the Municipal GHG Challenge Fund (Ontario Ministry of Environment and Climate Change 2017; Government of Ontario 2016a). To ensure effective monitoring and policy evaluation, progress against the Plan is to be reported annually and a comprehensive review is set for every five years (Office of the Premier 2016).

With regards to lowering emissions from transportation from these measures, it is estimated that the pump price of one litre of gasoline (based on current predictions about the price of carbon) would increase 4.3 cents CAD as a result of the program (Wood 2017). Proceeds allocated from the program will also help in reducing emissions from the transportation sector through activities such as: building a provincial electric vehicle (EV) charging network, subsidizing the purchase of new EVs, and funding the expansion of transportation demand management measures such as expanded cycling infrastructure and public transit (Government of Ontario 2017a; Government of Ontario 2016a; Ontario Ministry of Transportation 2017). Progress has already been made through initiatives funded through proceeds from cap-and-trade. For example, as of December 2017, 85 EV charging stations were installed, with 200 EV charging stations to be installed by March 2019, in addition to charging stations being updated and built at provincial GO Transit[5] stations (Government of Ontario 2017a).

While the CCAP represents a substantive push for climate change mitigation efforts in the province, it is not without critiques, which mostly have to do with the economic efficiency of the plan. According to Green (2017, p. iii), this plan is missing the mark on "obeying fundamental economic principles of true revenue neutrality, regulatory displacement, and allowing markets to find lower cost ways to reduce carbon". The government also seems not to be following another economic principle of avoiding picking 'technological winners'; the government has clearly chosen to support particular technologies under this plan (e.g., particular biofuels and vehicle technologies) as opposed to following

[5] GO Transit is the regional public transit service for the Greater Toronto and Hamilton Area (GO Transit n.d.).

the broadly accepted advice of implementing technology-neutral carbon policies. This approach will result in emission reductions costing more than they need to.

Extent of CPI in Ontario's Road Passenger Transportation Sector

Cleaner vehicles

It has only been over the past ten years that both federal and provincial efforts to lower emissions from the transportation sector have been framed in terms of climate change mitigation. Longer-standing approaches, such as vehicle emission standards and fuel taxes, were primarily aimed at reducing smog and sprawl and, in the case of fuel taxes, as a means of raising revenues for the government. Significant decarbonization of the electricity system in Ontario post the 2014 complete phase-out of coal has created a situation where the government must target emission reductions from the transportation sector. The relatively clean electricity system, which also consistently produces surpluses overnight, makes the increased use of EVs in the province a very attractive method for reducing transportation-related emissions. Recognizing this, the government of Ontario has introduced a host of initiatives to promote the growth of the EV market in Ontario, both supply-push and demand-pull, which are necessary to complement the economy-wide carbon price, which is said to have a relatively weak signal for transportation (Macedonia 2017). Not only has the number of government initiatives proliferated in recent years, the actual amount of dedicated funding for these programs is significant, which is particularly important for ensuring market instruments are sending a strong signal. For example, Ontario subsidies/incentives for purchasing cleaner vehicles are the highest in North America, by far (Richardson and Lightstone 2018). The following section will discuss specific programs, first to reduce emissions from internal combustion engine (ICE) vehicles, and second, to promote the use of cleaner vehicles in the province.

Reducing emissions from ICE vehicles

One of the most widely used and long-standing ways of reducing emissions from automobiles in Canada (and Ontario) has been for the government to set vehicle emission standards and tax vehicle fuels. Both tools were introduced in Canada, in part as a response to the energy crisis of the 1970s. Regulations for both vehicle standards and vehicle fuel taxes have been amended over the decades in response to changing political motivations and technical objects. Most recently, requirements have been increasingly

tailored to incorporate climate change mitigation objects. This follows the pattern more broadly for environmental policy, where environmental regulation previously enacted to protect lands and reduce pollution (usually talked about as smog) has followed a consistent arc, but since roughly 2013 have been re-framed in terms of climate change mitigation and/or adaptation.

In Canada, vehicle emissions standards are set at the Federal level; the first limits were set under the *Motor Vehicle and Safety Act*, (1969-70) (Anastakis 2013). The general approach for Canadian emission standards or fuel-efficiency standards has been to harmonize with U.S. regulations. In a move towards harmonizing with U.S. Corporate Average Fuel Economy (CAFE) standards, the Government of Canada established voluntary Company Average Fuel Consumption (CAFC) targets in agreement with the motor vehicle industry in 1976 (Government of Canada 2007).

In 1982, the federal government passed the *Motor Vehicle Fuel Consumption Standards Act* (RSC 1985), which moved the effort to reduce vehicle emissions from a voluntary model to empowering the government with the legal authority to regulate fuel consumption for specific vehicle classes (Government of Canada 2007). Although the above act was passed in 1982, the government did not proclaim the Act, and only in 2007 did the government finally implement it, shifting to mandatory fuel economy standards (Government of Canada 2007). This follows a consistent higher-level trend when comparing Canadian and U.S. environmental regulation, where the Canadian government has intervened later and relied more on softer voluntary and fewer interventionist approaches when dealing with industry.

Legislative authority to regulate vehicle emissions and fuel quality was transferred from the *Motor Vehicle Safety Act* to the country's primary legislative act protecting the environment and human health, the *Canadian Environmental Protection Act (CEPA)* (1999), effective one year after its passing in 2000 ("Canada: Regulatory Background" 2018). The CEPA (1999) expanded the range of ways vehicle emissions can be regulated, including the ability for the government to control multiple characteristics impacting fuel quality, the ability to use a performance-based approach to fuel standards, as well as the ability to regulate emissions for off-road engine applications (Mckitrick 2006). Subsequent regulations under CEPA (1999) have been passed over the years dealing with a variety of vehicle emissions issues, such as limiting specific compounds or tightening engine emission standards, for example, the *On-Road Vehicle Engine and Emission Regulations* (2003), SOR/2003-2, which tightened national emission standards for on road vehicles beginning in 2004 (New Climate Institute 2015).

In 2010, Transport Canada's Fuel Consumption Program (FCP)/CAFC was replaced by the *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations* (2010), SOR/2010-201. This change was significant in that it marked the federal government's first ever GHG regulation and "was a major milestone for Environment and Climate Change Canada's transportation regulatory work", while continuing the trend of harmonizing with U.S. standards (Environment and Climate Change Canada 2017). It was, in fact, the changes to U.S. vehicle emission and performance standards by the Obama Administration that drove the then Conservative Federal government to change the (FCP)/CAFC program to align with U.S. EPA regulations. The regulations include flexibility mechanisms for compliance; for example vehicle manufactures can earn compliance credits through action such as selling extra zero emission vehicles (Bérubé and Turcotte 2018).

In 2013 Environment Canada adopted GHG emission regulations for heavy-duty vehicles, which introduced performance-based emissions standards for model years 2014 and later aligned with US EPA Phase 1 regulations (Government of Canada 2018). The following year, the government continued its light-duty emission regulation program by passing *Regulations Amending the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations* (2014), SOR/2014-207, which extended the fuel economy program to align with US regulations for 2017 and beyond. On-road heavy-duty vehicles have also been regulated at the federal level in order to reduce GHG emissions. The most recent amendments to the *Heavy-duty Vehicle and Engines Greenhouse Gas Emissions Regulations* (2013), SOR/2013-24, were made in 2018. The government amended GHG emission standards for heavy-duty vehicles, increasing the stringency (beginning with model year 2021) for on-road heavy duty vehicles and engines (*Heavy-duty Vehicle Reg* (2013); Stevens 2018).

Another long-standing tool to promote the use of more efficient vehicles has been to tax motor vehicle fuels in the province. Fuel taxes are levied in by the Federal and Provincial governments to provide money to pay for infrastructure, and more recently, to incorporate the cost of driving on the environment. Taxes on vehicle fuels were first introduced in Ontario under the 1925 *Gasoline Tax Act* (1925), which placed a tax directly on consumers for the consumption of gasoline (Ryan 1999). Subsequent changes to Ontario's fuel tax regime were made under the Motor Vehicle *Fuel Tax Act* (RSO 1990) and the *Gasoline Tax Act* (RSO 1990) (see Appendix B for details). In 2004 the Liberal McGuinty Government started Ontario's Dedicated Gas Tax Funds for Public Transportation, which provides long-term funding to Ontario municipalities for capital and operating expenditures on public transit (Ontario Community

Transportation Network [OCTN] 2017). As of 2017, CAD 3.8 billion in gas tax funding has been committed to Ontario municipalities (OCTN 2017).

The most recent changes to provincial fuel taxes came in 2017 when the *Fuel Tax Act* was amended to promote a lower-carbon transportation system. Specifically, the amendments aimed to encourage the production of biodiesel, by exempting a newly created category of registered dyers from fuel transportation requirements, enabling more companies to offer coloured biodiesel products (Ontario Ministry of Finance 2017b). The *Gasoline Tax Act* is also levied the wholesale level and required all purchasers to pay a current tax rate of 14.7 cents per litre on unleaded gasoline and 17.7 cents per litre on leaded gasoline. To put these rates in perspective, in 1981, the tax rate for unleaded and leaded gasoline was 5.8 and 5.4 cents per litre respectively (Government of Ontario 2014a).

The Federal government also taxes gasoline in two different ways: a flat rate excise tax and a sales tax. Since 1975 the federal government has charged a flat rate of 10 cents per litre on gasoline, and since 1987, 4 cents per litre on diesel fuel in accordance with the *Excise Tax Act* (Boyd 2015; Natural Resources Canada 2017). The federal government also imposes a sales tax on these fuels based on a percentage of the retail price; the 5% sales tax is combined with the Ontario sales tax (the Ontario portion of the HST) resulting in a 13% sales tax rate in the province (Natural Resources Canada 2017). There are two key issues with the federal gas tax: the tax rate is very low, and also it has not been updated to keep pace with inflation (Boyd 2015). This has resulted in an already weak price signal to become even weaker over time, thereby reducing the effectiveness of this mechanism. In addition to taxing vehicle fuels, fuels can also be regulated using standards or mandates aimed at reducing the emission profile of the fuel itself.

Non-financial regulation of fuels, such as the use of fuel standards to reduce transportation-related emissions, is a much more recent strategy utilized in the province. Fuel standards were first taken up in Ontario in 2007, with the passing of the *Ethanol in Gasoline Regulation - Renewable Fuel Standard* (2007), O Reg 535/05. This was the first provincial attempt to increase the use of biofuels for powering vehicles.

This regulation required a minimum of 5% renewable content in gasoline, in particular incentivizing cellulosic ethanol, with the goal of increasing ethanol use in the province to 750 million litres (*Ethanol in Gasoline Reg* 2007; Environment and Climate Change Canada 2017a). In addition to gasoline, regulations for renewable fuel requirements for diesel were also introduced. In 2014, the *Greener*

Diesel - Renewable Fuel Content Requirements for Petroleum Diesel Fuel (2014), O. Reg. 97/14, introduced progressively stringent requirements for the bio-based component of the fuel phased in over three years (2014-2017):

- In 2014/15, 2% of the total volume of diesel fuel must be bio-based. The bio-based diesel component of this blend must have 30% lower greenhouse gas emissions than standard petroleum diesel
- In 2016, 3% of the total volume of diesel fuel must be bio-based. The bio-based diesel component of this blend must have 50% lower greenhouse gas emissions than standard petroleum diesel.
- In 2017, 4% of the total volume of diesel fuel must be bio-based. The bio-based diesel component of this blend must have 70% lower greenhouse gas emissions than standard petroleum diesel (Government of Ontario 2018e).

Both the *Greener Diesel* (2014) and the *Ethanol in Gasoline* (2007) regulations were amended in 2018 to recognize emerging low-carbon fuels, increase blending requirements and improve the environmental performance of fuels (Government of Ontario 2018f). *The Greener Diesel - Renewable Fuel Content Requirements for Petroleum Diesel* (2018), O Reg 226/18 and the *Ethanol In Gasoline* (2018), O Reg 227/18 come into force in 2020. Each regulation incentives emerging renewable fuel technologies, for example, biocrude, by introducing these technologies as compliance options. The Ethanol in Gasoline amendments increase the blending requirements to 10% ethanol in gasoline starting in 2020 and require ethanol used for compliance to emit much less GHG emissions (35%) on a lifecycle bases (determined using a specified model) in comparison to petroleum gasoline (Government of Ontario 2018f). The amendments are aimed at advancing Ontario's Climate Change Action Plan and also to better align with the anticipated federal Clean Fuel Standard.

While standards have been the traditional method for ensuring vehicles meet or exceed specific emission profiles, the Government of Ontario has used financial incentives and disincentives to promote the purchase of vehicles with lower emitting internal combustion engines. In the early 1990s, Ontario became a pioneer with regards to innovative financial incentives and disincentives to promote the purchase and use of lower-carbon vehicles when the provincial government designed and implemented North America's first automobile feebate system, the *Tax and Credit for Fuel Conservation* in 1991 (Rivers and

Schaufele 2014). The program was eliminated in 2010 when the province underwent large-scale tax reform (Rivers and Schaufele 2014). Table 8 illustrates the evolution of fees and rebates for Ontario's feebate program.

Table 8. The evolution of fees and rebates for Ontario's feebate program (Rivers and Schaufele 2014).

Highway fuel efficiency rating (L/100km)	1989 Cars	1990 Cars	1991-2010 Cars	1991-2010 SUVs
less than 6.0	-	-	-100	-
6.0-7.9	-	-	75	-
8.0-8.9	-	200	75	75
9.0-9.4	-	700	250	200
9.5-12.0	600	1200	1200	400
12.1-15.0	1200	2400	2400	800
15.1-18.0	2200	4400	4400	1600
over 18.0	3500	7000	7000	3200

All fees and subsidies are in nominal Canadian dollars. Sources: Government of Ontario (1989), Government of Ontario (1991) and Government of Ontario (2010).

While the introduction of this feebate system was a progressive action, its application was modest. This system was much more 'stick' than 'carrot,' and price signals resulting from this 'tax' were much too low to make a difference in purchase behaviour. Roughly 90% of vehicles sold were taxed at a flat rate of CAD 75 (Bregha and Moffet 1995) and the inexpensive CAD 100 rebate for fuel-efficient meant neither the 'carrot' or the 'stick' embedded in this program had little impact on purchase behaviour (Antweiler and Gulati 2013). While this government initiative attempted to influence emissions from new vehicles, during this time, the government also started to turn its attention to managing emissions from existing vehicles, particularly older, higher-emitting ones.

In order to ensure that older vehicles (especially older vehicles) in the province are meeting a certain standard with regards to emitting smog-causing pollutants, mandated inspection and maintenance (I and M) has been required since 1999 (Ontario Ministry of Environment and Climate Change 2017b). *Motor Vehicle* (1998), O Reg 361/98, requires all vehicles that are seven years or older to be tested before vehicle license plates and registrations can be renewed (Ontario Ministry of Environment and Climate Change 2017b).

In 2017, the government eliminated the fee for the 'Drive Clean' program, established by O. Reg. 361/98, which has been an effective complementary measure for reducing emissions from vehicles, especially light-duty vehicles (Ontario Ministry of Environment and Climate Change 2017b; Office of the Auditor General of Ontario 2012, p. 113). In addition to implementing measures to ensure traditional ICE vehicles are more environmentally friendly, the Ontario government has also encouraged the growth of the cleaner vehicle market (EVs, PHEVs, Hybrids, etc.). Programs providing financial and nonfinancial incentives, as well as charging infrastructure development, make up the bulk of the new low-carbon transportation policies and regulations under the modern climate change governance regime.

Policies to promote clean vehicles (EVs, ZEVs, Hybrids, etc.)

The Ontario Provincial Government once again took a leadership role within Canada, designing and implementing the country's first EV subsidy program in 2010, the Electric Vehicle Incentive Program (Axsen, Goldberg and Melton 2016). Initially, a CAD 8,500 subsidy was provided for the purchase or lease of new EVs based on their battery capacity, but in 2016 the range and price of subsidies were increased (ranging from CAD 3,000 - 14,000) and applied in a more nuanced manner based on battery capacity, seating and vehicle price (Ontario Ministry of Transportation 2017b; Axsen, Goldberg and Melton 2016).

The same year the government extended the program to 2020 and introduced a supply-side policy, a ZEV sales target, to complement the significant demand-push subsidy policy (Clean Energy Canada et al. 2016). The target, as opposed to a mandate, was aspirational, aiming to see 5% of all vehicle sales in the province be electric vehicles by 2020, a considerable leap from the .7% market share recorded in 2015 (Axsen, Goldberg and Melton 2016; Clean Energy Canada 2016). In 2018, the program was again updated to include a focus on hydrogen powered vehicles. The modernized Electric and Hydrogen Vehicle Incentive Program included the following key changes, making Ontario the most financially attractive jurisdiction in North America to buy an EV (DeRochie 2016):

- Increased the current incentive range for EVs from CAD 5,000 - 8,500 to CAD 6,000 - 10,000
- Provided an opportunity to receive an additional CAD 3,000 incentive for vehicles with larger battery capacities

- Provided an additional CAD 1,000 incentive for vehicles with five or more seats
- In addition, the modernized EVIP included two caps: First the incentive amount was capped at CAD 3,000 if the MSRP of the vehicle was over CAD 75,000. Second, the incentive value was capped such that its value would not exceed 30% of the MSRP (Ontario Ministry of Transportation 2018b).

It is important to note that these substantial subsidies for EVs are a very costly way to reduce emissions from the transportation sector. A recent estimate of the cost per tonne for emission reductions under Ontario's program was calculated at CAD 523/tonne (Green 2017), which is an extraordinarily high price to pay for reducing emissions.

Non-financial incentives to purchase or lease an EV were introduced alongside the start of the EVIP. The key incentive was the ability for drivers of EVs to use HOV and HOT lanes even if there is only one person in the car. This benefit was provided by the introduction in 2009 of the Ontario Green License Plate Program, whereby plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) eligible for the EVIP, as well as used BEVs and PHEVs that are no older than model year 2010, receive 'green license plates' allowing single occupancy use of these lanes starting in 2010 (Ontario Ministry of Transportation 2017d). Both supply and demand side policies to encourage the uptake of cleaner vehicles make up the bulk of new efforts around low-carbon transportation, in comparison to older policies (emission standards, etc.), and signify a clear government focus and aim to address transportation-related emissions for the purposes of mitigating climate change.

Alongside subsidies and non-financial incentives for cleaner vehicles, the government also began building up a province-wide EV charging network and incentivizing homeowners and businesses to install charging stations. The provincial government launched the Electric Vehicle Charging Incentive Program (EVCIP) in 2013 to support and encourage homeowners and businesses to purchase and install EV charging stations for personal use by providing up to 50% of the purchase cost (up to CAD 500) and 50% of the installation cost (up to CAD 500) (Electric Mobility Canada 2016). Since its inception, roughly CAD 2.2 million has been provided to subsidize roughly 2,600 home charging stations (Ontario Ministry of Transportation 2018c). Beginning in 2015, the government has dedicated funds, first through a CAD 20 million endowment under the Green Investment Fund, and then through cap-and-trade revenues under

the Greenhouse Gas Reduction Account, to build up a province-wide EV charging network (DeRochie 2016).

The government's goal is to build roughly 500 charging stations at over 250 locations in the province by establishing the Electric Vehicle Chargers Ontario (EVCO) program, which is working with 24 public and private partners to this end (Ontario Ministry of Transportation 2017c). In 2018, the government announced the creation of The Workplace Electric Vehicle Charging Incentive Program, providing 80% of capital costs (up to CAD 7,500 per level 2 charger) to employers and commercial building owners to promote further the uptake of EVs in the province (Ontario Ministry of Transportation 2018c). Taken together, these financial incentives for EVs and charging stations will continue to be funded by CAD 285 million in cap-and-trade proceeds between 2017-2021 (Morrow and Keenan 2016).

Complementary building code regulations to lower barriers for installing EV charging stations were passed in 2017 and 2018. In 2017, amendments to Ontario's Building Code were made under *Building Code* (2017), O Reg 332/12 (filed under Building Code Act, 1992, S.O. 1992, c. 23) in order to ensure homes and workplaces are built to be "EV ready" (*Building Code*, 2007; ECO 2017). Specifically, all homes with parking must be built with a minimum 200 amp panel and a conduit to facilitate the potential future installation of a charging unit and all other buildings with parking (except multi-unit apartment buildings) need to be built with EV charging equipment covering at least 20% of parking spots, with the other 80% to be built "EV ready" (*Building* Code 2007, s 3.1.21.1). In 2018, *General* (2018), O Reg 114/18 was passed, which made amendments to the *Condominium Act* (SO 1998) to reduce the obstacles to installing an EV charger in condo buildings (O. Reg. 114/18; Thoms 2018). Taken together, these measures illustrate a strong commitment to meet the 5% EV 2020 sales target, both in ambition and dedicated funding.

Funding and support for research and development, industry partnerships, and local industry development

Prior to the establishment of the modern climate change governance approach in 2015, two funds were established, which included low-carbon transportation innovation objectives. In 2005, the Ontario Ethanol Growth Fund was established to support the production of ethanol fuel in Ontario by providing capital assistance to independent blenders and monies for pursuing research and innovation opportunities (Ontario Ministry of Agriculture, Food and Rural Affairs 2005). In 2008, the Next Generation Jobs Fund

was introduced as an element of the province's earlier climate change plan "Go Green" (Metrolinx 2008). The CAD 1.15 billion fund's goal is "to support research, development and commercialization in innovative industries and attract new investments in strategic areas of Ontario's economy", including the development of clean cars and fuels (Government of Ontario 2017c).

A large amount of money for funding for low-carbon research, development and technology commercialization was provided under various funds and programs post-2015; for the most part, these programs remained very focused on industry. These include the 2016 Green Investment Fund (GIF) for Low-carbon Technology for Industry, the Low Carbon Innovation Fund and Ontario's TargetGHG Collaborative Technology Development Program (DeRochie 2016; ECO 2017; Sustainable Technology Development Canada 2017) (see Appendix B for details).

Additionally, in 2017 the provincial government passed O Reg 46/17, creating an organization, The Ontario Climate Change Solutions Deployment Corporation (OCCSDC), to help facilitate local cleantech industry development, reducing some of the transaction costs and barriers associated with this kind of activity. Critically, the OCCSDC does not support early-stage research and development but focuses on bringing commercially viable low-carbon technologies to market (Timmins 2017), which is a critical focus and important area to fund in order to meet near-term climate change policy objectives.

Funding has also been explicitly allocated for reducing transportation-related emissions in the province. Under the research and development element of the Climate Change Action Plan, CAD 375 million has been earmarked to cleantech R and D broadly, CAD 140 million of which has been provided to set up a Global Centre for Low Carbon Mobility at an Ontario university or college to develop electric and other low-carbon vehicle technology (Morrow and Keenan 2016). In 2017, the government also brought together industry, environmentalists and academics, under the newly formed Electric and Hydrogen Vehicle Advancement Partnership, in order to work with the government to advance low-carbon vehicle technologies; the Partnership received CAD .09 million in cap-and-trade proceeds in 2017 (ECO 2017).

In order to organize a more comprehensive and coordinated approach to support low-carbon technologies, industries and development, the Ontario Government released its Cleantech Strategy in 2018, with the overall goal to leverage the province's position as having the fastest-growing cleantech sector in Canada and to become a leading cleantech hub in North America (Ontario Ministry of Research

and Innovation and Science 2018; Ontario Ministry of Economic Development, Job Creation and Trade 2017). Four pillars have been outlined under the Cleantech Strategy to help the expansion of this sector in the province: Venture and scale readiness support, such as improving access to global market intelligence; access to capital, including providing guidance on available provincial and federal cleantech funding and simplifying access; regulatory modernization, such as reducing barriers for cleantech market entry; adoption and procurement, by increasing demonstration and pilot opportunities (Ontario Ministry of Economic Development, Job Creation and Trade 2018).

Government procurement and pilot projects

A demand-pull policy, government procurement and pilot projects for cleaner vehicles include the government investing in demonstration projects like purchasing and using electric vehicles for public fleets (Gouldson et al. 2008; cited in Taylor et al. 2012; Axsen et al. 2016). While the GreenFIT Procurement Strategy, introduced in 2010, is by no means limited to the transportation sector, it is an early example of contributing to the broader 'greening' of government by helping the Ontario Public Service, schools, hospitals and municipalities find green solutions to meet their purchasing needs (Ontario Ministry of Government and Consumer Services 2017). With the release of the 2016 Climate Change Action Plan, funding for pilot and demonstration projects specific to low-carbon transport was established in the province. In 2017, the provincial government established a pilot program in order to study the electrification of school buses (and chargers), whereby eligible school bus operators apply for funding to add 100% BEV school buses to their fleet (ECO 2017; Ontario Ministry of Transportation 2017e). To date, the scope of the program remains limited and there are questions about the feasibility of a province-wide roll-out of the program (ECO 2017).

The same year the government passed *Pilot Project - Low Speed Vehicles* (2017), O Reg 215/17 launching a 10-year pilot program to study the use of low-speed vehicles on Ontario roads (Ontario Ministry of Transportation 2017f). The low-speed vehicles pilot program is aimed at better understanding how people can be moved safely and efficiency with limited environmental impacts, including a reduced reliance on conventional fuels, and to determine if existing road rules in Ontario are appropriate for the use of these kinds of vehicles (Ontario Ministry of Transportation 2017f). At the federal level, the 2016 budget also supported climate action, specifically lower carbon transportation, by allocating CAD 46.1 million over two years to fund EV infrastructure demonstration projects under the broader Energy Innovation Program (Natural Resources Canada 2017a). The goal of these demonstration projects is to

understand better how costs can be reduced and barriers to deploying next-generation EV charging infrastructure can be mitigated (Natural Resources Canada 2017a). In order to support all of the above-mentioned programs, the provincial government has taken seriously the need to mitigate information failures in the market.

Information measures

Information campaigns are information-based policy measures aimed at combating information failures in the market. A novel approach to educating consumers about electric vehicles was established in 2017 by the Ontario Government. In May of 2017, the government supported the opening of the Plug'n Drive Electric Vehicle Discovery Centre to combat information failures hindering the uptake of cleaner vehicles (The Canadian Press 2017). According to the Centre's website, the facility is "focused entirely on providing an experiential learning environment for electric vehicles", where visitors can learn about all facets of ZEVs in a non-sales environment (Plug'n Drive 2017).

Transportation demand management

Besides making passenger vehicles 'cleaner', the other major aim in developing a low-carbon road passenger transportation system is to try and reduce the use and number of personal vehicles on the road. Policies that aim to meet these goals can be categorized as Transportation Demand Management (TDM) efforts.

Transit-integrated land-use planning, smart-growth measures

Land-use planning has been and continues to be a key lever for the Government to curb transportation-related GHG emissions. Since the original *Planning Act* (RSO 1950) was passed in 1946, foundational rules for land-use planning in the province have been set out, at the most basic level, how land-uses can be controlled and who is able to control them. Critically, the Act allowed for municipalities to develop formal, binding official plans for their area, as well as the ability to create joint planning boards made up of more than one municipality (White 2007). Within the Canadian context, large-scale plans to protect the ecological integrity of particular areas were pioneered in Ontario in the mid-1980s. The country's first, large-scale environmental land-use plan, the Niagara Escarpment Plan, was established in 1985 in Ontario by the *Niagara Escarpment Planning and Development Act*, (RSO 1990). Since then, plans and legislation that have specifically integrated the need to address climate change issues, follow a

similar trend to broad climate change and air pollution policies, outlined above, in that it was only in the 2000s that substantive attention was given to addressing the concern.

In 1985, the Liberal Party was elected led by Premier Peterson; partially as a response to concerns over sprawl, a refocused attention on regional planning under this government marked a shift away from "an age of non-planning", which began in the mid-1970s (White 2007). Although the Provincial Liberals lost the 1990 election to the New Democratic Party, led by Bob Rae, the renewed focus on improving regional planning continued under the new government (White 2007). The NDP developed a new Planning Act in 1994, which introduced accompanying Provincial Policy Statements and implementation guidelines, which for the first time emphasized the links between land-use planning and transportation, as well as referencing transit-supportive measures and TDM efforts (White 2007; Winfield 2012).

The 1995 election of the Progressive Conservative Government, led by Mike Harris, was a significant turning point for environmental protection in the province, including for land-use planning (Winfield 2012). The strongly neo-liberal agenda, outlined in the parties Common Sense Revolution platform, was not surprisingly detrimental to progress made on this file. Between 1995 and 1998, every single provincial statute relating to the environment and natural resource management was significantly amended, except for the Environmental Bill of Rights (Winfield 2012). With regards to land-use planning, transit funding was dramatically cut and instead, road-building became a major focus (Winfield 2012). As the problem of smog increasingly moved higher on the political agenda in the late 1990s, the Harris Government started to realize it needed to re-engage at some level in transit planning and funding; they also began discussing the concept of 'smart growth' in a formalized manner, launching a formal initiative in 2001, which in part led to the establishment of the Oak Ridges Moraine Conservation Plan and a five-year review of the Provincial Policy Statement (White 2007; Winfield 2012). The momentum around 'smart growth' was picked up by the next big change in government, the election of the Liberal Party, led by Dalton McGuinty in 2003.

The McGuinty Liberal Government (2003-2013) took an issue-by-issue approach, balancing competing interests on policy items, as opposed to pursuing a more comprehensive and long-term vision for Ontario's economy, environment and people; however, the notion of integrating environmental and economic decision-making was embraced by the government in stark contrast to the former Progressive Conservative government under Harris and Eaves (Winfield 2012). Smart-growth planning reforms (2005-6) under the McGuinty government were able to repair much of the damage done by the dismantling

of transit-supportive development under the Harris Government; however, the issue-by-issue "balancing" approach characterizing this government's policy development did not move the province further ahead in this area than the status quo of the mid-1990s, reflecting the overall pattern of environmental protection governance as "one of incremental (sometimes more than incremental) gains and losses that tended to cancel each other out" (Winfield 2012, p. 183).

The province saw a ramping up of key pieces of legislation since 2005 to curb sprawl, such as the creation of the "Greenbelt". Provincial Policy Statements and various Growth Plans have addressed the need for municipalities to follow 'smart growth' patterns of development, such as increasing density, expanding and creating coherent transit systems, and integrating climate change policies into Official Plans. Regional planning efforts, specifically in the Greater Toronto Hamilton Region (Canada's largest urban area), have become much more sophisticated and nuanced in integrating environmental objectives, with a particular focus on expanding transit and creating a world-class regional transportation network. In order to support these objectives, the Liberal government established various mechanisms for funding mass transit projects, sought money from the federal government, and ended a long period of transit underinvestment with comprehensive transit plans that were bolstered by the largest transit and infrastructure investment in Canada's history. While many of these initiatives have aided in reducing transportation-related emissions, combatting smog, traffic congestion and sprawl were the main considerations in their development, not climate change mitigation.

It was only in 2014, under the Wynn Liberal Government (2013-2018), that climate change was integrated into land-use planning as a consideration in decision-making in earnest. In particular, the 2014 Provincial Policy Statement mentions climate change alongside longer-standing themes of transit-supportive, compact development, although there was no formal mandate included requiring municipalities to plan to reduce emissions (Ontario Ministry of Municipal Affairs and Housing 2014). This would come a few years later in the 2017 update to the Growth Plan for the Greater Golden Horseshoe, alongside the establishment of the modern climate change governance regime in Ontario. The following section will outline major land-use planning legislation and programs in the province that have integrated environmental objectives (see Appendix B for further detail).

By the mid-1980s, there were widespread calls for planning reform in the province, which led an overhaul of the 1946 *Planning Act*, resulting in the 1983 *Planning Act*, which started to recognize the importance of regional planning (White 2007; Cooper 1996). Some planning professionals, especially

those on the left of the political spectrum, were not satisfied with the 1983 Act and sought to study the matter and "do the job properly" (White 2007, p. 37). The next significant amendments to the Planning Act were made in 1989 under the *Planning Amendment Act* (1989). The *Planning Act* continued to be revised to include a complete set of policy statements from the province expressing provincial interests in conjunction with comprehensive implementation guidelines, which allowed the Province to intervene in municipal planning affairs for various reasons (White 2007). The evolution of amendments reflects the increasing competence of municipal governments and the shift from a system where the province closely supervised planning and development activities by municipalities (by the Minister and Ontario Municipal Board), to one where policies were set, which were required to be implemented by local governments and private developers (via provincial plans and policy statements) (Wood Bull LLP 2017).

The first Provincial Policy Statement was released in 1996, linking the development of municipal Official Plans to the provincial *Planning Act* so that provincial priorities are incorporated into planning decisions (Toronto Center for Active Transportation 2014; White 2007). Currently, the *Planning Act*, (R.S.O. 1990) contains sections where local governments can potentially address climate change, including: Sec. 28 (Community Improvement Plans), Section 34 - Zoning By-Laws (especially ability to ensure mixed-use and compact development), Sec. 41/114 and 113 City of Toronto Act (Site Plan Control) (especially ability require sustainable design features to support sustainable transportation options), Section 37 (Height and Density Bonusing), and Sec. 51 (Plan of Subdivision) (especially ability to assess street connectivity to support transit, cycling and walking) (Murphy et al. 2017; Mahoney 2016, 9-23).

It is important to note that while the PPS authorizes local governments to promote emission reductions and TDM measures through these sections, it is not mandated and in practice mechanisms like density bonuses (sec. 37) are not utilized outside of major metropolitan centers; applications also vary greatly by local governments who are using these mechanisms, often in non-standardized, arbitrary manner (P. Bustard, personal communication, May 12, 2019).

The Conservative governments of Harris and Eves dismantled much of the progress on transit-integrated planning, which began under the previous governments. The implementation of their Common Sense Revolution platform resulted in withdrawing from transit funding and dismantling the 1994-5 reforms in 1996 (Winfield 2012). By the late 1990s/early 2000s, it became clear that this approach was not palatable with Ontarians, particularly those in the areas outside of Toronto where rapid housing development and sprawl was making government inaction a political liability (Winfield 2012). In

response, the PC government started formally discussing 'smart growth' planning policies (White 2007); climate change was still not a consideration at this time. A key example regarding the conservation of lands, was the *Oak Ridges Moraine Conservation Act* (2001) and subsequent *Oak Ridges Moraine Conservation Plan* (2002), O Reg 140/02. The Act established a "six-month moratorium on development on the Moraine in order to allow the government to consult on how to protect the Moraine", which is an ecologically significant stretch of land (190,000 hectares) in the Province (Ontario Ministry of Municipal Affairs and Housing 2002, p. 2).

While little intervention was made during the Conservative reign, studies and growing discourse around the concept created a ripe opportunity for a more interventionist government to develop comprehensive regional plans in the province (White 2007). This is exactly what happened in the years following the Liberal McGuinty government. In relation to 'smart growth' policies and sustainable development, the newly elected Liberal government passed a number of acts and amendments during their tenure, including:

- Bill 26, The *Strong Communities (Planning Amendment) Act,* (2004, S.O. 2004, c. 18)
- Bill 135, the *Greenbelt Act*, (2005, S.O. 2005, c. 1)
- O. Reg. 59/05, *Designation Of Greenbelt Area* and The Greenbelt Plan
- Bill 136, the *Places to Grow Act*, (2005, S.O. 2005, c. 13)
- O. Reg. 416/05, *Growth Plan Areas*
- O. Reg. 311/06: *Transitional Matters - Growth Plans, Growth Plan for the Greater Golden Horseshoe,* 2006
- O. Reg. 311/06 *Transitional matters - Growth Plan for Northern Ontario,* 2011
- The Provincial Policy Statement, 2014
- Bill 73, The *Smart Growth for Our Communities Act,* (2015, S.O. 2015, c. 26)
- Bill 139, The *Building Better Communities and Conserving Watersheds Act*, (2017, S.O. 2017, c. 23)
- Bill 68, *Modernizing Ontario's Municipal Legislation Act*, 2017.

The following discussion highlights a few notable changes resulting from these acts and plans that are significant in terms of reducing transportation emissions via TDM efforts.

Bill 26, *the Strong Communities Act* (2004) amended the *Planning Act* by changing the criteria to be met by local or provincial governments, boards, commissions or agencies when making a decision, comment, submission or advice impacting a land-use planning matter. *The Strong Communities Act* (2004) (Section 2) changed the language with regards to how decisions, comments, submissions or advice follow Provincial Policy Statements (PPS), requiring that they must be 'consistent with' as opposed to 'regard' PPSs. Overall, the amendments under Bill 26, especially Section 2, were found to be "essential to the provincial government's ability to provide the policy direction to planning authorities needed to curb urban sprawl and promote more sustainable development patterns" (Winfield 2004, p. 2). Although the Act was critiqued in a number of areas[6], its passing was important in signaling a substantive and symbolic shift towards 'smart growth' land-use planning norms in the province, after which a number of significant pieces of legislation followed in the same vein.

One year after *the Strong Communities Act*, the 'groundbreaking' *Places to Grow Act* (2005) was passed, providing important powers to the Province to identify which areas were to be designated 'growth areas', creating a comprehensive approach to land-use planning, specifically cutting-edge growth planning integrated with environmental protection (Ontario Ministry of Infrastructure 2005). Section 4 of the Act directs the preparation of a proposed growth plan by the Minister, in consultation with various community stakeholders, for areas given such a designation under clause 3 (a) (*Places to Grow Act* 2004, s 3(a)). Following this Act, two significant growth plans were produced for areas designated under *Growth Plan Areas* (2005), O. Reg. 416/05: The Growth Plan for the Greater Golden Horseshoe (Ministry of Public Infrastructure Renewal 2006) and the Growth Plan for Northern Ontario (Ontario Ministry of Infrastructure and Ontario Ministry of Northern Development, Mines and Forestry 2011). Details for each plan was set out under *Transitional Matters - Growth Plans* (2006), O. Reg. 311/06, under the *Places to Grow Act* (2005). At this time, climate change was still not a key consideration of these pieces of legislation; concerns over urban sprawl, traffic congestion and smog remained the major driver for the establishment of these acts and plans.

[6] See Winfield 2004 for a comprehensive discussion of critiques around Bill 26

While the 25-year Growth Plan for Northern Ontario is an important long-term program for ensuring Northern lands and communities are developed in a sustainable manner (Ontario Ministry of Infrastructure 2011), with regards to environmental impact, the Growth Plan for the Greater Golden Horseshoe (GGH) provides critical guidance and direction regarding environmentally-sound land-use planning, in a region containing 25% of Canada's population (Wallace 2017).

The Growth Plan for the GGH provides a framework for better managing growth in the region over the long-term by guiding decision-making on a range of issues, including "transportation, infrastructure planning, land-use planning, urban form, housing, natural heritage and resource protection – in the interest of promoting economic prosperity" (Ontario Ministry of Public Infrastructure Renewal 2006, p. 8). It is a key tool for integrating transit expansion and climate change mitigation and adaptation objectives into land-use planning decisions. The Plan identifies urban growth centres and controls growth through mechanisms like density and intensification targets. Further attention was focused on climate change and transit-integrated land-use planning in the 2017 update to the Plan through new policy directions made under the Coordinated Provincial Plans Review.

The 2017 Plan explicitly calls for municipalities to take action on climate change, both in terms of mitigation and adaptation (sec. 4.2.10 Climate Change). Policies are to be developed in the Official Plans of Upper and Single-tier municipalities that align with TDM efforts under the Provinces' 2015 Climate Change Strategy and 2016 Climate Change Action Plan, including:

- supporting the achievement of *complete communities* as well as the minimum intensification and density targets in this Plan;
- reducing dependence on the automobile and supporting existing and planned transit and *active transportation*;

In addition, the 2017 Plan more aggressively directs growth to priority transit corridors:

> This Plan recognizes transit as a first priority for major transportation investments. It sets out a regional vision for transit, and seeks to align transit with growth by directing growth to major transit station areas and other strategic growth areas, including urban growth centres, and promoting transit investments in these areas. To optimize provincial investments in higher order transit, this

> Plan also identifies priority transit corridors and the Province expects municipalities to complete detailed planning for major transit station areas on these corridors to support planned service levels (Ontario Ministry of Municipal Affairs 2017, p. 11).

When placed in the historical context of planning in Ontario, the *Places to Grow Act* and the Growth Plan for the Greater Golden Horseshoe, mark a significant shift in the prioritization and promotion of a 'new-style' *regional* planning that acknowledges the importance of land-use planning as a means of promoting sustainable development. These initiatives can be seen as a first attempt to bring together top-down provincial direction and bottom-up input from municipalities, where local planning authorities implement a shared vision stemming from a regional conversation around planning as opposed to a region-wide body (White 2007). Stronger language *requiring* municipalities to develop such plans would be much more effective in ensuring reductions actually happen on the ground, as opposed to simply encouraging localities to do so, as stated in Policy 4.2.10.2. Of the GGH Growth Plan.

In addition to these key pieces of legislation and plans, many amendments to the *Planning Act*, as well as guidance documents, such as the Ministry of Transportation's Transit Supportive Guidelines (2012), have aided in producing positive environmental outcomes stemming from land-use and transportation planning and development. Subsequent Provincial Policy Statements (2005 and 2014) have also prioritized the need for 'smart growth' development and transit-integrated planning. These statements can be seen as another key crossover mechanism for the integration of transit and climate change objectives in land-use planning; unlike the Growth Plan for the GGH, the PPS integrates these objectives province-wide. For example, the most recent Statement (2014), for the first time discussed the concept of 'active transportation.

While the 2014 PPS certainly provides a step in the right direction with regards to prioritizing transit-integrated planning and climate change adaptation and mitigation, the Statement is not without critiques. The term 'sustainable' and 'resilience' are found throughout the 2014 PPS with regards to development. For example, Policies 1.1.4.1(f), 1.1.6.1 and 1.1.6.4 explicitly promote sustainable management and resource use of rural lands and Policies 1.2.3 and 1.3.1(c) each promote the notion of 'resilient communities' (Ontario Ministry of Municipal Affairs and Housing 2014; Flynn-Guglietti and Forristal 2014). Importantly, as Flynn-Guglietti and Forristal (2014) point out, neither of the terms 'sustainable' or 'resilient' are defined in the document. With regards to climate change, planning

authorities are directed in Policy 1.8.1 to mitigate and adapt to climate change through land-use development; however, exactly what compliance with this policy would look like remains uncertain (Flynn-Guglietti and Forristal 2014).

In 2015, the *Planning Act* and the *Development Charges Act* were amended by Bill 73, the *Smart Growth for our Communities Act* (2015). With regards to the first issue, the Act generally gives community residents more of a say in how their communities develop and grow while providing municipalities with more independence and power to resolve planning disputes and to control planning instruments (Smart Growth for Our Communities Act 2015; Parker 2017). A key change under the *Smart Growth for our Communities Act* (2015, s 5(5)) is the addition of transit services to the list of services not requiring a 10% reduction for development charges, which will result in a greater portion of transit costs recovered by municipalities. Among other grievances with this Act, critics maintain that municipalities should have full cost recovery, with no services allowed to be prescribed ineligible by government regulations (Sustainable Prosperity 2015).

In 2017, the Province's three major plans with regards to conserving lands, the Niagara Escarpment Plan, The Oak Ridges Moraine Conservation Plan, and the Greenbelt Plan were all updated. These plans build on the latest Provincial Policy Statement and work in concert with the Province's climate change strategy, acting as a barrier to sprawl while protecting ecologically important land and water, as well as providing carbon sinks where emissions can be effectively sequestered (Ontario Ministry of Municipal Affairs and Housing 2017a). In particular, the Greenbelt is significant due to the vast amount of land it protects, nearly 2 million acres, and the location surrounding the province's largest urban areas, the Golden Horseshoe (Ontario Ministry of Municipal Affairs and Housing 2005). The Provincial government announced the expansion of the Greenbelt in 2013 (the first expansion since the 2005 Plan) and after much consultation, the updated 2017 Greenbelt Plan explicitly linked the protection of these lands to climate change action and expanded the Greenbelt to link key hydrological features (21 urban river valleys and 7 coastal wetlands) from the Greenbelt to Lake Ontario (The Friends of the Greenbelt Foundation n.d.) (see Figure 14).

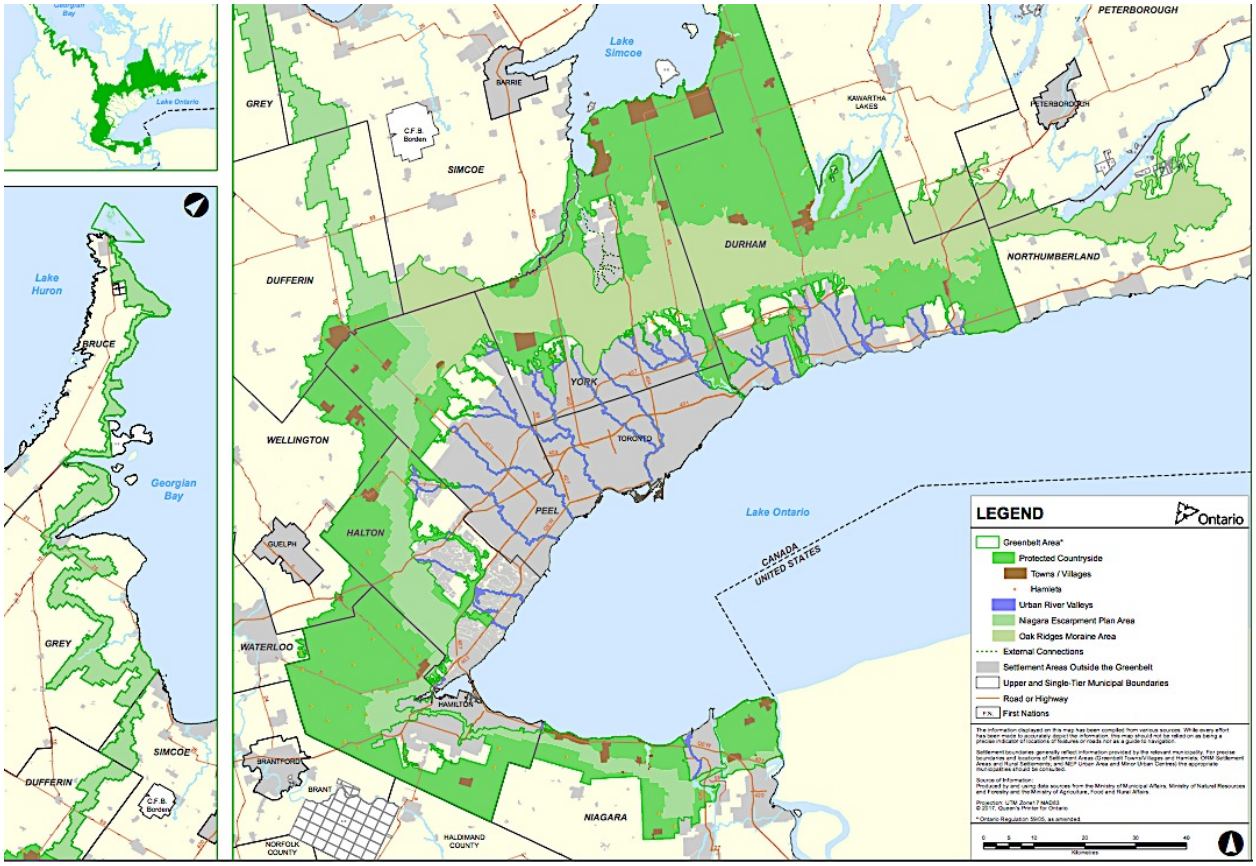


Figure 14. The 2017 Greenbelt Plan Map. The various shades of green depict the protected land, which encompasses the Country's most populous urban area, the GTHA (Government of Ontario 2017g).

In 2017, Bill 139, the *Building Better Communities and Conserving Watersheds Act*, (2017), provided a boost to the institutionalization of climate change adaptation and mitigation planning at lower levels of government. The Act highlights the role of land-use planning as a mechanism for protecting the environment and empowers Conservation Authorities with increased flexibility to deal with climate change and other environmental threats (Ontario Ministry of Municipal Affairs and Housing 2017). The *Building Better Communities Act* (2017) adds a new clause to sec. 16 of the *Planning Act* (which governs the content of Official Plans), requiring that municipal Official Plans, for the first time, contain climate change policies where objectives are set and strategies and actions delineated that will reduce emissions and increase community resilience through adaptation strategies (Murphy et al. 2017; Environmental Commissioner of Ontario 2017). In the same section, an additional amendment allows the inclusion of policies relating to development around transit stations and stops (*Building Better Communities and*

Conserving Watersheds Act 2017, Explanatory note). One key outcome of the changes this Act makes is that municipalities should, in theory, be able to develop transit projects with fewer barriers (ECO 2017).

In addition to the updates to environmental protection plans (e.g., the Greenbelt Plan) and the passing of the *Building Better Communities Act*, 2017 also saw the passing of Bill 68, the *Modernizing Ontario's Municipal Legislation Act,* (2017). This Act amended the *Planning Act* by incorporating "the mitigation of greenhouse gas emissions and adaptation to a changing climate" as a matter of provincial interest. The Act also clarified that municipalities are able to pass climate change by-laws and participate in long-term energy planning as a means of mitigating the negative impacts of climate change in their communities (Murphy et al. 2017; Ontario Ministry of Municipal Affairs and Housing 2017b).

Changes to land-use planning in the province, especially new policy frameworks, over the past 15 to 20 years reflect the emergence of ideas around 'smart growth' and transit-supportive community building and the incorporation of best-practices in the field. The policy changes also reflect the province's significant population growth, especially the growth of the urban mega-region of the GTHA, and the need to take aggressive action on minimizing urban sprawl. In addition to land-use planning taking on a 'smart growth' or sustainable development orientation under the past Liberal governments, efforts to promote transit-integrated planning in the province also became quite comprehensive during this time. Institutional and legislative innovations have evolved to promote an increase in comprehensive urban and regional transit ridership, as well as to promote an increase in active transportation as a means of transportation. The development of comprehensive regional transportation plans, supported by historical levels of dedicated funding, are hallmarks of the province's efforts to pursue transit-integrated land-use planning seriously.

Transit specific planning or investments

After a generation of significant under-investment in transit, the provincial government passed the *Metrolinx Act*, (2006) creating an agency (Metrolinx) tasked to deal with coordinating and integrating transit planning, design, construction, with a particular focus on the largest urban region in the country, Greater Toronto Hamilton Area (GTHA) (Metrolinx 2018). Modern, comprehensive, transit-specific planning has since been formalized in the province, first in 2007, with the announcement of the "MoveOntario 2020" plan, which represents the largest transit investment in Canadian history at an estimated CAD 17.5 billion (Government of Ontario 2007). The plan includes 52 rapid transit projects in

the GTHA, representing 902 kilometers of new rapid transit, with an estimated 175,000 associated construction jobs (Government of Ontario 2007). With regards to the environmental impact from this plan, the Province estimates 10 megatonnes of CO2 reductions by 2020 and associated smog reductions (Office of the Premier 2007). Although this was a positive step in the sense that serious funding was committed to transit, it is important to note that the decision-making process for what projects would be funded was and remains largely political, as opposed to being based on an analysis of resulting GHG reductions or planning rationales (Pagliaro and Spurr 2017).

In 2008, transit expansion planning continued with the announcement of "The Big Move", the first long-range regional transportation expansion plan for the GTHA (Metrolinx 2013). The Plan provides an ambitious 25-year strategy to design and build an extensive regional transportation system in this rapidly expanding urban area (Metrolinx 2013). MoveOntario 2020 was incorporated in this first comprehensive regional transportation plan, which has now been updated and led to the second draft regional transportation plan for the GHTA, the 2041 Regional Transportation Plan works together with the previously mentioned Growth Plans (Metrolinx 2017; Metrolinx 2018). The 2041 Regional Transportation Plan, which builds on past progress and continues the aggressive expansion of rapid transit in the GTHA, which will see its population increase to roughly 10 million people by 2041:

- More than CAD 30 billion is being invested in rapid transit infrastructure over the next eight years
- An extension of the Yonge-University Subway to Vaughan Metropolitan Centre opened in late 2017
- Led by Metrolinx, the Eglinton Crosstown light rail transit (LRT) line is under construction in Toronto, and more Viva/YRT bus rapid transit (BRT) is being built in York Region
- UP Express has answered the decades-long call for a fast, permanent rail link between downtown Toronto and Lester B. Pearson International Airport
- Planning and engineering design are underway for 14 projects including expansions of LRT, BRT and subway services

- The Regional Express Rail program, our most ambitious program yet, will transform the region with frequent, two-way all-day rail service, more than doubling the number of GO Transit riders by 2031
- Union Station—the hub of the regional transit network—is expanding to meet the needs of 300,000 people who use it every weekday, and even more who will use it in the future
- Across the GTHA and Ottawa, fare payment has been modernized with the PRESTO fare card (Metrolinx 2018).

The expansion of rapid transit in the GTHA is currently the largest in North America, so it is not surprising that the government has increased methods and sources for funding transit planning, design and construction along the same time period. The first major fund to assist cities with projects to improve air, soil and water quality, including transit building, was set up in the year 2000 by the Federal government. The Green Municipal Fund was established to provide low-interest loans for municipal projects directly or indirectly addressing climate change challenges. Initially, CAD 550 million was endowed to the Federation of Canadian Municipalities, with an additional CAD 125 million in 2016 and CAD 72 million announced in 2017 (Federation of Canadian Municipalities 2017; Federation of Canadian Municipalities 2017a). In 2008, the Liberal Provincial government passed Bill 38, the *Public Transportation and Highway Improvement Amendment Act* (2008), which opened up additional funding to municipalities "for the purpose of constructing, maintaining or operating a rapid transit or public transportation system" in the form of rebates under the Gasoline Tax Act (R.S.O. 1990, c. G.5) (*Public Transportation and Highway Improvement Amendment Act* 2008, "explanatory note").

In the same year, the Ontario Ministry of Transportation established a voluntary, competitive grant program for municipal governments wishing to implement TDM projects (Ontario Ministry of Transportation 2011). Also in 2008, the government passed *Transit Projects and Metrolinx Undertakings* (2008), O Reg 231/08 aimed at expediting all public transit projects by exempting them from environmental assessment requirements under the *Environmental Assessment Act* (R.S.O. 1990), so long as they go through an alternative expedited review process (Mahony 2016, 9-55).

Post-2010, much more significant funding efforts by the government to expand and upgrade regional transportation networks have been established. In 2014 the province established a Green Bond

Program to fund projects with environmental benefits, including transit projects like the Toronto Eglinton Crosstown Light Rail Project, which received the first round of funds raised. In another effort to fund mass transit and infrastructure projects, the Provincial government passed the *Trillium Trust Act* (2014), establishing a separate account funded by the sale of particular provincial assets, dedicated explicitly to funding modern infrastructure and transportation networks (Ontario Ministry of Finance 2015).

As of 2017, the government was on track to meet its goal of reaching CAD 5.7 billion to the Trillium Trust, having already dedicated CAD 5.3 billion (Ontario Minister of Finance 2017a, p. 160). The money from the Trust will go towards the larger Moving Ontario Forward plan, which will invest CAD 130 billion over 10 years in transit, transportation and other priority infrastructure, representing the largest investment of its kind in the history of the Province (Ontario Minister of Finance 2017a, p. 160; Ontario Ministry of Finance 2015). It is important to emphasize again that the nature of transit investment decision-making remains largely political in the province; the process lacks sophisticated formalized and standardized modelling requirements in order to ensure investments optimized by directing funding to projects with maximum GHG reductions. As Professor Haider from Ryerson University in Toronto explains, politicians view building transit in part as a way to get elected, therefore political as opposed to evidence-based rationales dictate decisions:

> The public transit infrastructure investment is a taxpayer subsidy to politicians' political ambitions because there's no rationale for it most of the time. What gets built and what should have been built are completely two different things. (Pagliaro and Spurr 2017)

In 2017, significant additional funding for public transit projects and service improvements were announced by the government in the annual budget. The 2017 Provincial Budget provided a significant boost to public transit expansion in the province. The Budget dedicated CAD 56 billion over the next ten years for rapid transit projects in Southwestern Ontario, as well as a transformation for the GO rail system under the GO Regional Express Initiative aimed at quadrupling the number of weekly trips to 6,000 by 2024-25 (Ontario Minister of Finance 2017a, p. 150). In addition, the 2017 Budget increased the share of the provincial gas tax that municipalities will receive from CAD 334 million in 2016–17, to roughly CAD 642 million by 2021–22 (Ontario Minister of Finance 2017a, p. 154).

With regards to making existing transit systems more efficient, the 2017 Budget also announced a CAD 50 million investment over 11 years "to establish a Trade and Transportation Information System to fill significant information, data and analytical gaps in strategic elements of the transportation system"

(Transport Canada 2016, p. 29). The effort to increase delivery of expanded funding for transit, efforts to ensure timely completion of projects, and efforts to improve transit system efficiency with data and information systems illustrate that the prioritization of creating a regional rapid transit network in key provincial locations goes much further than rhetoric or plans on paper.

Other TDM measures

Complementary TDM measures that are substantive and designed to work directly in concert with land-use planning and transit expansion efforts have only been introduced in recent years, spurred on by a reinvigorated focus on addressing climate change issues beginning with Ontario's Climate Change Strategy in 2015. In particular, efforts to promote active transportation (especially cycling) in order to support a modal shift in commuting behaviours, as well as more nuanced approaches to differential road treatments, like HOV and HOT lanes, have formed a central part of recent TDM programs. Funding TDM projects like the expansion of cycling infrastructure has also increased along this same time period.

Active transportation

The beginnings of a shift in policy to encourage the use of bicycles started with small changes, such as allowing public transit vehicles to be equipped to carry bicycles in 2008 (*Public Vehicles Amendment Act* 2008). A much more comprehensive approach to encouraging commuter cycling in the Province began in 2014 with the "CycleON" Ontario Cycling Strategy, followed by the 2015 Ontario Municipal Cycling Infrastructure plan (Ontario Ministry of Transportation 2016; 2016a). The Ontario Cycling Strategy consists of multi-year action plans to make the province more cycling-friendly over a 20-year horizon; the first plan #CycleON Action Plan 1.0 was an intergovernmental approach being implemented by twelve different ministries and the second plan, Action Plan 2.0, will continue this work over its implementation between 2018-2023 (Ontario Ministry of Transportation 2016; Ontario Ministry of Transportation 2018).

As a part of the first "CycleON" Action plan, the Ministry of Transportation established a CAD 10 million Ontario Municipal Cycling Infrastructure Program to encourage growth in cycling over the next 20 years (Ontario Ministry of Transportation 2016). The Ministry also released guidelines and manuals to aid in the design and development of cycling facilities, including" the Ontario Traffic Manual Book 18: Cycling Facilities and the Bikeways Design Manual (Ontario Ministry of Transportation 2018).

Legislative and regulatory amendments were also passed in 2015 to encourage more people to cycle by promoting cycling safety, including a requirement for drivers to maintain a minimum distance of one metre when passing cyclists, allowing contra-flow bike lanes on on-way highways, and increasing the range for fines for "dooring" from CAD 60-500 to CAD 300-1000 with an associated increase in lost demerit point from two to three (Ontario Ministry of Transportation 2018).

The new plan includes a host of initiatives to continue progress made in Action Plan 1.0. Some of these include ensuring active transportation is built into official municipal plans and implemented in the 2041 Regional Transportation Plan for the GTHA, promoting and expanding active commuting to school, expanding provincial cycling infrastructure, continuing to promote cycling safety and awareness of cycling rules, and increasing cycling tourism opportunities (Ontario Ministry of Transportation 2018). As a part of Ontario's Climate Change Action Plan, CAD150-225 million has been dedicated from cap-and-trade proceeds to accelerate the implementation of the Ontario Cycling Action Plan, including the construction of curb-separated bike lanes and bike parking at GO stations (Morrow and Keenan 2016; Ontario Ministry of Transportation 2018). Further to these efforts, in 2017, the Ontario Municipal Commuter Cycling Program was established, which directs CAD 94 million over four years to municipalities to invest in commuter cycling infrastructure (Ontario Ministry of Transportation 2018; ECO 2017).

Car-sharing/pooling

There are relatively limited government efforts to increase car-sharing/car-pooling in Ontario. The main intervention has been to provide parking spaces at main transit hubs. For example, the Ministry of Transportation provides 6000 parking spaces specifically for park & ride or carpooling vehicles located in 80 lots (Ferguson, Harrison, Pang, Higgins, & Kanaroglou 2016). Governments may also facilitate car-sharing, for example, through setting up organizations that facilitate information provision and sharing and reduce the transaction costs associated with organizing car-pooling. A good example of this in Ontario is the Greater Toronto-Hamilton region 'Smart Commute' program (Metrolinx 2017).

Although millions have flowed into the Smart Commute program, this government effort has had a negligible impact on reducing VMT (Yauch 2013). Anecdotal evidence would suggest that various technological applications have produced a much more widespread user base for car-sharing and carpooling in comparison to government-directed programs like Smart Commute. Car-sharing and pooling

applications like Uber and Uberpool, as well as more informal Facebook groups for carpooling over longer distances (e.g., Waterloo to Toronto), have proliferated since the advent of the modern smartphone and social media websites and applications.

HOV and HOT lanes

Toll roads and lanes are a scarcely used tool in Canada, which has only three significant highway stretches that are tolled, two of which (Highway 407 and 412) are in Ontario (Ferguson et al. 2016; Ontario Ministry of Transportation 2017). Similarly, Ontario highway travel "is largely general purpose in its implementation and orientation; there are only four highways with High Occupancy Vehicle (HOV) lanes in the province and one pilot project for High Occupancy Toll (HOT) lanes (Ferguson et al. 2016; Ontario Ministry of Transportation 2018a). The *Highway Traffic Act* (R.S.O. 1990) is the primary piece of legislation regulating HOV lanes and road pricing in the province.

Currently, the Ministry of Transportation has converted HOV lanes on the Queen Elizabeth Way to HOT lanes as a first-ever pilot project to test new ways to improve traffic flow and increase carpooling (Ontario Ministry of Transportation 2018a). Within the Canadian context, Duff and Irvine (2005) suggest road pricing is underutilized. This would especially seem to be the case in Southwestern Ontario, where congestion and traffic delays have been stated to cause billions of dollars per year (Duff and Irvine 2005).

As mentioned above, a first-ever pilot project for testing the impact of HOT lanes was rolled out in 2016, covering 16.5 km of the QEW highway (Ontario Ministry of Transportation 2016b), a positive sign for this underutilized method of managing traffic flows and raising revenues. Further use of HOT lanes are planned in the next few years; a 15.5 km stretch of Highway 427 will be outfitted with electronic tolling in both directions starting in 2021 (Ontario Ministry of Transportation 2016b). The cost of using the HOT lane is a key consideration and potential issue for the design of this project in Ontario. The cost of a permit to use the HOT pilot lane is CAD 60/month (Ontario MTO 2018a), or less than CAD 3 per day for someone commuting five days per week. If the goal is to create a modal shift in commuting behaviour, this price signal is far too weak. The price must at least equal the cost of regional public transit, the GO Presto fare, if any considerable results in commuting behaviour and environmental benefits are to be realized.

HOV lanes are, in comparison, a more commonly used and accepted mode of manipulating traffic flows in the province, which is seeing an expansion of a planned HOV lane network. In 2005, the

Transportation Statute Law Amendment Act (2005) introduced a new section (154.1) allowing the Minister of Transportation to designate any lane an HOV lane and to regulate what kind of vehicle type or class, and the number of occupants were able to use the lane. This is important not only to provide for the expanded use of HOV lanes but as previously mentioned, allowed for 'cleaner vehicles' to use the lane even with single occupancy. An important concern arises with the promotion of HOV lanes in the province. A key critique from experts like Dr. Barry Wellar (Professor Emeritus, University of Ottawa) is that the Ministry of Transportation is "attempt[ing] to pass off HOV lanes as a sustainable transport practice, even though they have been panned in the literature, at public meetings, and in governmental correspondence as a gimmick to expand the highway network and add to the amount of private motor vehicle traffic on Ontario's highways, thereby creating the demand for more highways..." (Wellar 2010, p. 19).

The Dismantling of Ontario's Climate Change Regime 2018-present

Nearing the end of the writing of this dissertation, the Ontario Progressive Conservative Government, led by Doug Ford, won the 2018 provincial election based on a right-wing populist campaign. Not unlike the victory of President Trump in 2016, the change in government has resulted in a dramatic shift in government orientation with regards to climate change governance. Although recent polling and analysis have illustrated Ford's win had less to do with a referendum on the cap-and-trade system, implemented January 1st, 2017 (what Ford called a "job-killing carbon tax"), and more to do with traditional populist ideas around immigration and a dislike for the previous premier (Lachapelle and Kiss 2019), Premier Ford wasted no time in actively dismantling Ontario's nascent climate governance regime.

First, the PC government changed the name of the Ministry of Environment and Climate Change to the Ministry of Environment, Conservation and Parks, eliminating the 'climate change' from the title (McGrath 2018a). In addition, early in July 2018, Premier Ford fired the province's first Chief Scientist, who was appointed to the newly created position in November of 2017 (Maloney 2018). While the exact meaning of these changes is not completely clear, the general orientation of the new government with regards to environmental issues has been illustrated very clearly via early actions. For example, almost immediately after his election, Premier Ford announced the cancelation of 758 renewable energy installations, representing the latest round of planned renewable energy project procurements in the

province (Winfield 2018). A particular hostility towards climate change action has been evidenced, in particular, by early action to follow through on dismantling the provincial cap-and-trade system.

Not long after being elected, the government withdrew Ontario from the Western Climate Initiative and canceled Ontario's cap-and-trade program (Office of the Premier Designate 2018; Buchta, Corpuz and Coburn 2018). In addition to the lost revenue from cap-and-trade, roughly CAD 2 billion per year, Lisa DeMarco of the Toronto law firm DeMarco Allan, estimates the cost of canceling the program, including buying back allowances already sold to companies covering emissions expected and beyond 2020, would cost the province between CAD 2-4 billion (Sharp 2018). The cost also includes the price of potential litigation, estimated to be upwards of CAD 100 million CAD, which will likely result from this action (Sharp 2018). As of early July 2018, Ford has revoked the regulations outlining the carbon pricing system in the province and has begun the process of deciding how to revoke funding for projects paid for by carbon pricing proceeds (Loriggio 2018).

The new government's disdain for carbon pricing also goes beyond provincial borders. The *Greenhouse Gas Pollution Pricing Act* (2018), which legally established the federal carbon backstop price, received Royal Assent in 2018. Premier Ford launched a legal challenge against the federal government's imposition of a carbon-backstop pricing regime for provinces who do not already have an equivalent pricing scheme. The Ontario Provincial Court of Appeal found the Federal Government's backstop carbon pricing regime was constitutionally sound[7] in 2019 (Keller 2019), but that has not stopped Premier Ford's push to oppose this measure. In August 2019, a notice of appeal was submitted to the Supreme Court of Canada to challenge the federal carbon price (Keller 2019).

In addition to lost revenue from cap-and-trade and significant costs associated with pulling out of the system, the province may also not receive its CAD 420 million share of the federal Low Carbon Economy Fund as a result of cancelling carbon pricing in the province, effectively pulling out of the national climate change plan without any alternative plan to address climate change issues (Wechsler 2018). Finally, the province's flagship climate legislation, the *Climate Change Mitigation and Low Carbon Economy Act* (2016), which established GHG reduction targets enshrined in law, was repealed November 14th, 2018, by the *Cap and Trade Cancellation Act,* (2018).

[7] Reference *re Greenhouse Gas Pollution Pricing Act*, 2019 ONCA 544

With regards to policies impacting transportation-related emissions, the new PC government has canceled many of the 'cleaner vehicle' programs and policies, which made up the bulk of new environmentally-oriented policies in the transportation sector. The Electric and Hydrogen Vehicle Incentive Program and the Electric Vehicle Charging Incentive Program were both cancelled, effective July 11, 2018 (Ontario Ministry of Transportation 2018d; Blinch 2018). The PC government has also committed to reducing the provincial gasoline tax by 10 cents/litre (Winfield 2018).

In terms of public transit projects, Premier Ford has a strong preference for subways and underground transit, committing CAD 5 billion for subways in Toronto and support for other regional rapid transit projects (Canadian Press 2018). It is highly problematic that there is no clear strategy for how these would be funded (Canadian Pres 2018), especially with funds not being continued through cap-and-trade, in addition to the fact that subways tend only to be financially feasible to construct and maintain in areas with significant population density, potentially leaving out much of the province. Also problematic is the continuation of political decision-making around transit priorities as opposed to more evidence-based decision-making. On the whole, the funding announced by Premier Ford for transit is less than the previous Liberal Government (Canadian Press 2018). Finally, the promotion of active transportation has been impacted by the cancelling of the Ontario Municipal Commuter Cycling Program (Stuckless 2018).

Brief Summary

It has only been over the past ten years that both federal and provincial efforts to lower emissions from the transportation sector have been framed in terms of climate change mitigation. Longer-standing approaches, such as transportation demand management, provision of enhanced transit services, vehicle emission standards and fuel taxes, were primarily aimed at reducing smog, traffic congestion and urban sprawl. In the case of fuel taxes, they were also a means of raising revenues for the Government. The peak of Ontario's climate mitigation efforts, generally and for the transportation sector, came under the Wynne Administration. During this time, subsidies for electric vehicles and charging infrastructure were the government's biggest focus in terms of making vehicles cleaner. With regards to transportation demand management, integrating climate change considerations into land-use planning processes represent the most substantive governance efforts.

Although the connection between land-use planning, transit-supportive development and transportation demand management started to be made in the 1990s, specific references to the need to

reduce GHG emissions and address climate change impacts were only incorporated into provincial planning policies on from 2014 onwards. Regional planning efforts, specifically in the Greater Toronto Hamilton Region (Canada's largest urban area), have become much more sophisticated and nuanced in integrating environmental objectives, with a particular focus on expanding transit. In order to support these objectives, the Government, particularly under recent Liberal Party administration (2003-2018), established various mechanisms for funding mass transit projects, sought money from the federal government, and ended a long period of transit underinvestment. However, specific major transit investments continued to be strongly influenced by political considerations, as opposed to rational planning or transportation emission reduction considerations. Complimentary TDM measures that are substantive and designed to work directly in concert with land-use planning and transit expansion efforts have only been introduced in recent years. These were spurred on by a reinvigorated focus on addressing climate change issues beginning with Ontario's Climate Change Strategy in 2015.

Beginning in 2018, a majority of Ontario's nascent climate change governance regime was undone under the Progressive Conservative Government, led by Doug Ford. Although Premier Ford has dismantled much of Ontario's modern climate change governance regime, the substantive integration of climate change objectives in the land-use planning process made in 2017-2018 remain, alongside some energy efficiency measures. A lack of evidence-based decision-making continues to worsen as rules around the decision-making process continue to be streamlined.

Chapter 6: Extent of CPI in California's Road Passenger Transportation Sector

System of government: California, U.S.A.

The United States of America was also originally a British Colony, but unlike Canada, they took their independence through war and were recognized as a new nation following the end of the American Revolutionary War through the Treaty of Paris in 1783 (Jaenen 2016). Like Canada, the U.S. is a federation, but it is a constitutional federal republic with three branches of government: the executive, the legislative, and the judicial. The executive branch is made up of: The President, who is the chief of state and the head of government, and the cabinet, who is appointed by the President and approved by the Senate (Levy and McDonald 2019). The President is elected indirectly by the Electoral College of 'electors' chosen from each state and may rule for a maximum of two, four-year terms. The U.S. President is vested with substantial powers and "is arguably the most powerful elected official in the world" (Levy and McDonald 2019). The President must ensure all laws are executed faithfully; in practice, this happens via department agencies and cabinet-level committees (Levy and McDonald 2019). The President is also the commander of the military and has the power to approve or veto legislation, although this is subject to override by a two-thirds majority of Congress (Levy and McDonald 2019).

The Legislative branch is made up of a bicameral Congress consisting of the Senate and House of Representatives. Two senators are elected from each of the 50 states, while the members of the House of Representatives are elected from each state based on individual state populations. Senators serve six-year terms with one-third of the Senate elected every two years; Members of the House of Representatives are directly elected in single-seat constituencies for two-year terms (USA.gov 2019). The Judicial branch consists of the judges who interpret and apply the law. Unlike the Prime Minister of Canada, the President must gain approval from the Senate for the appointment of Supreme Court justices (Levy and McDonald 2019). Compared to Canada, the American judiciary is said to be more 'activist' (Field 1992).

The founding fathers intentionally crafted the American Constitution to limit the powers of the central government out of concern for "the tyranny of a powerful central executive" (Peters 2016, p. 21). Authority over matters not explicitly assigned to the federal government, under Article one section 8 of the Constitution, fall to the states, as per the Ninth and Tenth Amendments (U.S. Const. amend. IX and X; U.S. Const. art. 1 § 8). Therefore, states have inherent lawmaking power and do not need to point to

sources of authority in the constitution (Farber and Carlarne 2018). When conflicts arise between federal and state/local law, the federal law is supreme, as per article 6 of the U.S. Constitution (U.S. Const. art. 6). Over time the central government in the U.S. has become more powerful in terms of increasing mandates and regulations on states and also increasing grant-in-aid to state and local government over time (upon which they have come to rely on significantly) that come with controls (Peters 2016). State law is 'protected' in the United States, as clarified in *Memphis v. Murdock* (1875) and *Erie R.R. v. Tompkins* (1938); This is unlike the case in Canada where common law is national and provincial statutes are subject to interpretation by the Supreme Court of Canada (Field 1992).

Unlike Canadian Provinces, American States have their own constitutions. Article eleven of the California Constitution provides inherent home rule power to both general and charter cities (section 7), providing them with the authority to "make or enforce within its limits all local, police, sanitary, and other ordinances or regulations not in conflict with the general laws" (McKenzie 2014). Effectively this allows local governments to exercise what powers appear necessary, as opposed to powers explicitly granted to them by the legislature or by prior approval of the legislature (League of California Cities 2007). In the late 1800s, the California Constitution introduced the concept of municipal affairs and provided for the authority of Charter cities to supersede state general law depending on the subject of the municipal affairs (League of California Cities 2007). Today charter cities provisions prevail over general state law in areas of municipal affairs, as per section 5, subdivision (b) of article XI, or those determined to be municipal affairs by a court (League of California Cities 2007). This results in local governments in California having much more autonomy than is the case of local governments in Ontario. This situation has implications for reducing emissions from transportation in California, which will be discussed later.

In terms of reducing emissions, generally, and from transportation, both federal, state and local governments in California have the authority to regulate these matters. Because the default lawmaking authority resides with the states, this discussion will focus on federal authority based on enumerated powers and federal limits to state lawmaking authority in this area, based on express and implied limits. Although not as pertinent to reducing emissions from transportation, the federal government can legislate climate change related matters under the *National Environmental Protection Act* (42 U.S.C. §§ 4321 et seq. 1970), especially Sec 102(2)(c), and the *Endangered Species Act* (16 U.S.C. §§1531-1544 1973) (Farber and Carlarne 2018). The federal government also has the authority to implement a national carbon-

pricing scheme, but political gridlock in Washington has resulted in multiple failed attempts to pass national climate policies like this. Sixteen national climate bills, most of them cap-and-trade programs, failed to attain congressional approval between 2003 and 2010 (MacNeil 2017).

The federal government's regulatory activity in terms of reducing transportation emissions mostly comes under laws passed by President Nixon in the 1970s, especially the empowering of the federal Environmental Protection Agency (EPA) under the *Clean Air Act* (1970) to regulate air pollution from stationary and mobile sources (Farber and Carlarne 2018). Similar to Canada, the U.S. EPA has the authority to set rules for new vehicles, such as emission standards, known in the U.S. as CAFE (Corporate Average Fuel Economy) standards (Burtraw, Fraas and Richardson 2011). Initially, the EPA determined it did not have the right to regulate GHGs under the Clean Air Act in 2003 (Grady, Killeen and Levinson 2016). This changed with a critical court ruling in the case *Massachusetts v. EPA* (2007), which clarified that the EPA not only had the right to regulate GHGs but the duty to do so under the *Clean Air Act* (Cox 2015). The court-mandated the EPA issue an endangerment finding under section 202(a) of the *Clean Air Act* to provide a statutorily grounded justification for not doing so; the EPA issued a positive endangerment finding for GHGs in 2009 (Burger et al. 2017). The EPA also signed a Cause/Contribute Finding stating that motor vehicles contribute to GHG pollution, threatening public health (Cox 2015).

The federal government has also used its statutory authority to pass laws taxing 'gas-guzzling' vehicles and set standards for alternative fuels, and incentivize their development (MacNeil 2017). Spending money on research and development and pilot projects are also ways the federal government supports emission reductions from road passenger transportation, specifically attempts to make vehicles 'cleaner'. Unlike Canada, the federal government plays a significant role in transportation planning, specifically in terms of funding and mandated planning procedures, which in recent decades have been linked with air pollution governance. The federal government administers a mandatory transportation planning process in metropolitan (49 U.S.C. 5303 and 23 U.S.C. 134) and rural areas (49 U.S.C. 5304 and 23 U.S.C. 135). Two foundational acts passed in the 1920s, known as 'the standard acts', form the basis of the national land-use planning system.

The federal government uses controls tied to grant-in-aid funding to shape state and local environmental protection planning, including measures to reduce transportation-related emissions, such

as mandated State Implementation Plans for meeting air quality and congestion mitigation targets. Unlike Canada, the U.S. (like many other industrialized nations) has national standards for air quality known as U.S. National Ambient Air Quality Standards (NAAQS), established under the Clean Air Act (42 U.S.C. 7401 et seq.). Environmental considerations, including reducing emissions from vehicles, are integrated into mandated transportation plans developed by federally mandated Metropolitan Planning Organizations, in addition to state and regional governments. Federal transportation funding bills tie money to state governments and agencies (e.g., MPOs) to meeting certain environmental performance targets and require additional planning and actions to be taken when standards are not met. In this way, the U.S. federal government has high levels of direct control in state transportation planning as compared to the Canadian federal government.

States have broad powers to regulate environmental matters, given they have the authority to make any laws as long as they do not conflict with federal laws (U.S. Const. amend. IX and X). That being said, limitations on state regulatory action on climate change do exist, in particular stemming from the Dormant Commerce Clause and pitfalls around statutory pre-emption (Farber and Carlarne 2018). According to Farber (2008), the most apparent constitutional barriers for states include discriminating against interstate commerce, banning or burdening behavior explicitly authorized by federal law, taking steps with foreign countries that directly contradict presidential or congressional initiatives, or attaching penalties to transactions that occur wholly outside state borders.

The Dormant Commerce Clause, more commonly known as the Commerce Clause, is a judicial doctrine originating from Article I, Section 8, Clause 3 of the Constitution. This enumerated power of Congress provides authority “to regulate Commerce with foreign Nations, and among several states, and with the Indian tribes”, allowing federal courts to strike down any state regulation that discriminates against interstate commerce (Drapalski 2011). Two seminal cases dealing with California’s low carbon fuel standard (LCFS) exemplify the potential limitations on state regulations attempting to lower emissions from transportation stemming from the Commerce Clause, specifically issues around extraterritorial regulation and discriminatory state regulation (Farber and Carlarne 2018).

In 2010 California’s LCFS was struck down when the court sided with plaintiffs claiming the LCFS interfered with interstate commerce, contained discriminatory elements and violated the Supremacy

Clause by pre-empting federal law, including the *Energy Independence and Security Act* (2007) (*Rocky Mountain Farmers Union v. Goldstene* 2010). The ruling in *Rocky Mountain Farmers Union v. Goldstene* (2010) was overturned in the *Rocky Mountain Farmers Union v. Corey* (2013) case, where the court determined that the LCFS did not violate the Commerce Clause, nor did the ethanol or crude oil provisions qualify as discriminatory (Detar 2014; Farber and Carlarne 2018).

Another critical clause potentially limiting coordinated climate action between states is the Compact Clause, which prohibits states from entering into agreements with other states or foreign powers without the consent of Congress (U.S. Const., art. 1 § 10). This limitation on states has been relaxed over time through key court cases, notably: *Virginia v. Tennessee* (1893)*, U.S. Steel Corp. v. Multistate Tax Commission* (1978), and *Northeast Bancorp Inc v. Board of Governors of the Federal Reserve System* (1985) (Farber and Carlarne 2018). This is most relevant to linked carbon trading systems and whether or not these constitute a violation of the Compact Clause with regards to states entering into agreements with other states and foreign jurisdictions. According to Farber and Carlarne (2018), the existing emissions trading regimes, such as the Western Climate Initiative (WCI) and Regional Greenhouse Gas Initiative (RGGI), are authorized as they are not legally binding agreements and there is no interstate entity with regulatory power. Instead, MOUs are individually adopted by states or foreign jurisdictions based on a model rule.

Aggressive state climate action in the form of cross-border cap-and-trade programs like RGGI and WCI might also face a related challenge on the basis that they conflict with U.S. national climate change policy. In this case, cross-border state cap-and-trade systems could be limited by conflict pre-emption, stemming from the Supremacy Clause (U.S. Const., art. 6, clause 2). As clarified in *Crosby v. Nat'l Foreign Trade Council*, (2000), when a national policy has been set on a subject of foreign affairs, states cannot take actions that conflict with national policy and potentially reduce the federal governments 'bargaining chips' (Welton 2012). Two court cases, *Green Mtn. Chrysler Plymouth Dodge Jeep v. Crombie,* (2007) and *Central Valley Chrysler-Jeep, Inc. v. Goldstene,* (2007), have upheld the constitutionality of cross-border cap-and-trade systems (Welton 2012). Outside of constitutional limitations, such as those described here, states have the ability to reduce emissions from transportation through a broad portfolio of measures like those described in Chapter 3.

Given the relative autonomy of local governments in California, California cities have the authority to take measures to reduce emissions from transportation more than Ontario municipalities. In particular, charter cities have broad authority stemming from the fact that they can make laws concerning municipal affairs that trump state general law on the same topic. Like Ontario municipalities, local governments in California are very active in transportation and land-use planning, in addition to making rules around building codes and other local ordinances. The main difference is that the authority to engage in these kinds of regulatory activities is permanent and inherent due to California's home rule, and not delegated by a higher authority. The legal and operational flexibility of local governments in California is not limited by the state like Ontario municipalities. California local governments also have more financial and operational control over their transportation system, including most airports within their jurisdiction. The ability for local governments in California to raise revenues through the direct democracy mechanism of ballot propositions also provides a significant pathway through which cities can fund major projects to reduce emissions from transportation, like mass transportation infrastructure.

Extent of CPI in California's Road Passenger Transportation Sector

Given the significant amount of climate change legislation passed in California, the following sections will discuss in chronological order *key* pieces of legislation and programs for climate change mitigation broadly and in more detail for the passenger transportation sector. A comprehensive list of all climate and climate-related transportation policies enacted in California can be found in Appendix B.

Broad climate change policies and commitments

Early legislation related to GHG emissions and air pollution

By 1940 California already had a population of 7 million people with an estimated 2.8 million vehicles registered in the state (California Air Resources Board [CARB] 2017). The summer of 1943 saw the state's first visible smog episodes; visibility was limited to three blocks and many people were suffering health consequences from what was being called the "gas attack", including respiratory and eye issues, nausea and vomiting (CARB 2017). In the years following this initial smog crisis, the County of Los Angeles established an Air Pollution Control District in 1947, the first institution of its kind in the country (CARB 2017). The same year, then-Governor Earl Warren signed the *Air Pollution Control Act of 1947* into law, which authorized every county in the state to create an Air Pollution Control District

(CARB 2017). While California began constructing institutions to control air pollution during this time, the Federal government-initiated efforts to only study the health effects of air pollution. The first federal legislation on air pollution, the *Air Pollution Control Act of 1955*, provided funds to the Public Health Service to analyze the health effects of air pollution as opposed to regulating air pollution, which was delegated to the state and local level (Stern 1982).

The late 1960s and early 1970s was a landmark period for environmental regulation. Comprehensive air pollution control legislation was introduced, first at the Federal level under the 1963 *Clean Air Act (1963)* and *Federal Air Quality Act (1967),* and then in California under the 1967 *Mulford-Carrell Air Resources Act (1967).* The *Mulford-Carrell Air Resources Act (1967)*, created the Air Resources Board (ARB), which would house all air resource activities in the State, including ensuring standards and plans for the federal air quality control regions, as set out under the *Federal Air Quality Act (1967)*, were met (CARB 2017). California's unique situation as a state with areas of very high pollution was recognized under the *Federal Air Quality Act (1967)* through the provision of a waiver to set and enforce its own emission standards for new vehicles (CARB 2017). This would mark the beginning of another consistent trend in air pollution and transportation policy between these two levels of government, where additional regulatory authority is granted to the State of California.

In the late 1960s and early 1970s, broad national and state frameworks for the protection of the environment were introduced. In 1969 *The National Environmental Policy Act* (NEPA) *(1969)* placed the environment on the federal government's policy agenda across sectors. In 1970, the federal Environmental Protection Agency (EPA) was created by the *National Environmental Protection Act (1970)* and Congress passed the 1970 amendments to the *Clean Air Act*, which introduced state and federal limits on emissions by requiring the EPA to establish national ambient air quality standards and states to produce enforceable plans to meet these standards; the Act serves as the principle source for statutory authority for controlling air pollution (U.S. EPA 2017a; CARB 2017).

By 1970 California was home to 20 million people and had 12 million registered vehicles (CARB 2017). That year California passed the 1970 *California Environmental Quality Act (1970)*, establishing the state's broadest environmental law, which required environmental impacts to be factored into government decision-making, for example, issuance of permits and project approvals (Governor's Office

of Planning and Research 2018). In 1974, *The Warren-Alquit Act (1974)* created the Energy Resources Conservation and Development Commission (now called the California Energy Commission), which was granted regulatory authority to set energy efficiency standards for appliances and new buildings, promote alternative energy development, carry out research and forecasting and decide plant siting (amongst other things) (Karapin 2016). While the above-mentioned statutes and regulations aided in the reduction of air pollution, it was not until 1978 at the federal level and 1988 at the state level that climate change and greenhouse gas emissions are specifically targeted by government legislation.

In 1978 the U.S. government passed the *National Climate Act (1978)*, which for the first-time established government institutions focused on climate change research and governance. Acts passed around this time, including the 1978 *Public Utilities Regulatory Policies Act (1978)* and the *Energy Security Act of 1980*, aided in emission reductions by promoting domestic renewable energy generation; however, these statutes can be seen as a result of the energy crisis of the 1970s, and not a direct attempt to mitigate human-made climate change.

1988 marked the emergence of a formalized climate change governance regime in California (Farber 2015) with the passing of Assembly Bill 4420 (1988), which made the California Energy Commission the lead agency with regards to studying and coordinating the management of climate change governance activities. This 1988 law led to the preparation of two high profile climate reports: "The Impacts of Global Warming on California" (CEC 1989) and "Climate Change Potential Impacts and Policy Recommendations" (CEC 1991) (cited in Franco et al. 2008). While these reports were important in generating public discussions around climate change in California, it would take over another decade for the state government to implement its initial policies "taking real action to address climate change" (Franco et al. 2008, p. 9).

In 1990, the federal government passed amendments to the *Clean Air Act (1970)*, which included elements aimed at the reduction of transportation-related emissions (Weiner 2013; U.S. EPA 2017b; U.S. Department of Energy 2017). Amongst the authorization of programs aimed at improving air quality, the 1990 amendments to *the Clean Air Act (1970)* expanded and revised requirements for attaining National Ambient Air Quality Standards (NAAQS); in relation to transportation emissions, "non-attainment areas" were mandated to undertake "transportation actions", the number of which depended on the severity of

non-attainment (Weiner 2013). The following years would see the U.S. federal government begin to engage in international efforts to address global warming.

Following the 1992 Earth Summit in Rio de Janeiro, Brazil, where the U.S. government signed the UN Framework Convention on Climate Change, then-President Clinton introduced The Climate Change Action Plan, which included no less than 50 measures to return U.S. emissions to 1990 levels by the year 2000 while growing the economy (Clinton 1993). Between 1994 to 2000, USD 1.9 billion was to be redirected to The Plan. In 1997, following international negotiations under the United Nations Framework Convention on Climate Change (UNFCC), the first global climate treaty was established and signed by the U.S. government.

In California, a few years after the signing of the Kyoto Protocol, Senate Bill 1771 (2000) was passed, which established governance institutions to enable actual emission reductions in the state. SB 1771 (2000) mandated the establishment of the California Climate Action Registry, a non-profit organization aimed at ensuring emissions were effectively managed through the creation of emissions monitoring systems and inventories to be housed in a database under the organization. The bill also directs the California Energy Commission to update the state's own GHG inventories every five years (SB 1771 2000). From a governance perspective, this bill helped provide an organizational integration mechanism necessary to start to measure and manage emissions from state and non-state entities comprehensively.

In 2002, the state passed Senate Bill 1078 (2002), which established the state's Renewable Portfolio Standard Program requiring electric utilities and other entities under the jurisdiction of the California Public Utilities Commission to increase their supply mix to 20% renewable energy by December 2017.

The modern legislative approach (2006 – present)

California has far exceeded any other U.S. state with regards to the "sheer range of climate policies enacted and the boldness of its overall emission reduction plan" (Rabe 2008; cited in Derthick 2010, p. 67). The modern legislative approach, defined by the 2006 flagship legislation AB 32, *The Global Warming Solutions Act (2006)*, calls for a range of strategies to be utilized in order to reduce emissions

significantly while planning for continued economic and population growth. This Act provided the state with a bold and comprehensive technical and governance framework to mitigate and adapt to climate change. At the time of its signing, Governor Schwarzenegger described it as "the most radical climate policy in the world" (Derthick 2010, p. 67). AB 32 generated much worldwide attention, in part due to its bold content, in part due to the dramatic contrast of California's approach to addressing climate change in comparison to the Bush Administration, and in part because the Governor, Arnold Schwarzenegger, was an international celebrity (Farber and Carlarne 2018).

The origins of AB 32 date back to a year earlier with the announcement of Executive Order 3-05 (2005) by then Governor Schwarzenegger. Executive Order 3-05 (2005) established greenhouse gas emission reduction targets to 2050 and codified them under Health and Safety Code section 38550: reduce emissions to 2000 levels by 2010, 1990 levels by 2020 and reduce emissions by 80% below 1990 levels by 2050. This executive order also created the Climate Action Team, which brought together sixteen state departments with some role in climate policy and directed the Secretary of the California EPA to coordinate efforts to meet this target in concert with the heads of other state agencies (Rabe 2013; Exec. Order No. 3-05, 2005). Market-based emission reduction measures were also authorized under this executive order from January 1, 2012 to December 31, 2020 under Health and Safety Code section 38562 (Exec. Order No. 3-05, 2005).

AB 32, *The Global Warming Solutions Act (2006)* gave legal authority to the California Air Resources Board (CARB) to set policies to meet the required emission reduction target of reaching 1990 levels by 2020 and eventually an 80% emission reduction (from 1990 levels) by 2050. Since it has passed, AB 32 has been aggressively implemented; while the actual text of the bill is notably brief, AB 32 gives wide discretion to the government on what strategies it chooses to achieve emission reductions (Farber and Carlarne 2018). Key programs implemented include the State's cap-and-trade program, the low carbon fuel standard, advanced clean cars program, sustainable regional transportation and land-use planning measures, renewable electricity standard and energy efficiency and conservation measures. The passenger transportation-related components will be discussed in more detail under the following 'Cleaner Vehicle' and 'Transportation Demand Management' sections.

In 2007, climate change impacts and mitigation objectives were integrated into the state environmental assessment process (a key procedural environmental policy integration mechanism) via the passing of SB 97, which directed the Governor's Office of Planning and Research to develop California Environmental Quality Act (CEQA) guidelines for the mitigation of GHG emissions (Sen. Bill 97, 2007). The Strategic Growth Council was created the following year by SB 732 (2008); this cabinet-level committee was developed to play an important governance coordination role, and also importantly, to help lower levels of government reduce emissions, especially through sustainable community planning. Many other key pieces of legislation, particularly relating to transportation emissions, were passed in the following years; these will be discussed in subsequent sections. This time period also saw a ramping up of climate change legislation efforts at the national level.

At the Federal level, 2009 represented a peak in momentum around formulating and passing comprehensive climate legislation under the newly elected progressive Democratic Party led by Barak Obama, who campaigned in part on climate mitigation targets adopted by California (Studer 2013). By June 2008, 235 bills, resolutions or amendments had been proposed to the 110th Congress and the 111th Congress also saw a number of proposals for clean energy and climate action (Studer 2013). While national climate-specific legislation, for example, introducing a nation-wide carbon pricing mechanism, had failed to pass both houses (in large part due to the political economy of energy resources in the U.S.), President Obama was able to bolster climate mitigation efforts through the 2009 *American Recovery and Reinvestment Act (2009;* Studer 2009).

The most important early action following AB 32 was the establishment of the state cap-and-trade system. The initial cap was set at 2 percent below the forecasted emissions for 2012 and was set to decline every year to 2020 at roughly 20 percent below 2015 levels or a reduction of 16 percent by 2020 (Farber and Carlarne 2018; C2ES 2014). Initially, large industrial facilities (those emitting over 25,000 metric tons of CO2E per year) and electricity generators were covered; however, in 2015, transportation and other fuel providers were also covered and the system encompassed roughly 360 businesses and 85 percent of the state's emissions (C2ES 2014).

The system was designed so that allowances for industrial facilities, electric utilities (not generators) and natural gas distributors were initially allocated for free with declining allowances over

time; other allowances must be purchased at auction or via trade (C2ES 2014). The program allows linking with other state or regional programs; California's system is part of the Western Climate Initiative and officially linked with WCI partner Quebec in 2014 (C2ES 2014) and Ontario in 2018. Revenues raised via the cap-and-trade system are deposited in the Greenhouse Gas Reduction Fund (GGRF) established in 2012 by Sen. Bill 1018 (2012). Sen. Bill 1018 (2012) also prescribes accountability requirements for those entities receiving proceeds from the GGRF.

Executive leadership at the Federal level moved from aspirational targets to substantive legislation in 2015 with the announcement by then-President Obama that carbon pollution from fossil fuel-powered U.S. power plants would be regulated for the first time. The Clean Power Plan (Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units 2015), developed under the *Clean Air Act*, aims to reduce emissions from the national electricity sector by 32% below 2005 levels by 2030; enforceable emission reduction limits are designed to come into force in 2022 and ramp up until 2030 with incentives for power companies to move earlier on reductions (National Resource Defense Council [NRDC] 2017).

2015 was also an important year for executive leadership at the state level in California. In April of 2015, Governor Brown announced Executive Order B-30-15 (2015), establishing the most ambitious GHG reduction target in North America: a 40% reduction below 1990 levels by 2030. This executive order contained procedural integration elements to ensure actual emission reductions by requiring state agencies to implement GHG reduction programs and to include current and future climate change impacts in the State's 5-year Infrastructure Plan (Orenberg 2016; Office of the Governor 2015). Governor Brown further elaborated on key climate change strategy pillars in his 2015 inaugural address, which included the goal of reducing petroleum use by 50% (CARB 2016).

In an attempt to capitalize on federal momentum regarding climate change action, the Government of California passed ARJ 43 (2016), which encouraged the U.S. Congress to adopt a national revenue-neutral carbon tax on carbon-based fossil fuels (CARB 2016). Continuing California's international leadership on promoting climate change action, the state legislature passed an additional joint resolution the following year: ARJ 20 (2017). ARJ 20 (2017) re-affirmed California's commitment to play a leading role in encouraging action on climate change domestically and internationally. Reflecting the growing

importance of subnational action on climate change, it also called for the UN to create a category for subnational jurisdictions committed to the Paris Climate Agreement, where parent countries are not participating (ARJ 20 2017).

Senate Bill 32 (2016) was passed in 2016 to ensure the emissions reduction goal set out by EO B-30-15 (a 30% reduction below 1990 levels by 2030) would be met; all state agencies were required by this legislation to implement emission reduction programs, and importantly from a CPI standpoint, to integrate climate change objectives into all planning and investment under the 5 year State Infrastructure Plan (SB 32 2016; C2ES 2014). The same year, AB 197 (2016), which was linked to SB 32, was passed to provide increased oversight via governance reforms to CARB, which had (and continues to have) wide regulatory scope and power. The bill also attempted to increase transparency by mandating the agency to make available on its website "emissions of greenhouse gases, criteria pollutants, and toxic air contaminants throughout the state, broken down to a local and sub-county level for stationary sources and to at least a county level for mobile sources, as specified", with updates (at minimum) annually (AB 197 2017, s. 4).

In 2017, legislative battles over the state's cap-and-trade system were occurring, inducing legal uncertainty around the program. Specifically, there was legal uncertainty regarding CARB's authority to operate the cap-and-trade system beyond 2020 and whether spending proceeds beyond 2020 would require a two-thirds vote of the legislature after a state appeals court ruling held the cap-and-trade system constituted a tax, therefore requiring a two-thirds vote as per the state constitution (Farber and Carlarne 2018; LAO 2017). In July 2017, AB 398 (2017) was passed by the state legislature by a two-thirds vote, legally extending the cap-and-trade program through 2030. Following this mandate, Governor Brown, in the last months of his final term, once again increased the ambition of California's climate change governance approach. In September of 2018, Brown announced in Executive Order B-55-18 (2018) that the state would be committed to full, economy-wide carbon neutrality by 2045.

No less than seven additional climate-related bills were passed in September 2018, continuing the trajectory of passing highly ambitious climate legislation nearing the year's end. SB 1131 (2018) and SB 237 (2018) targeted changes to the electricity sector that would support the newly introduced carbon-neutral electricity generation goals. Also, incentives for distributed, self-generated energy (e.g., wind,

biogas) were extended by SB 700 until Dec. 31, 2024, with the administration of the program extended until Jan. 1 2026 (SB 700 2018).

In order to facilitate the necessary regulatory structure to incorporate microgrids into the electricity system, SB 1339 was passed requiring the California Public Utilities Commission to work with the State Energy Resource Conservation and Development Commission and the Independent System Operator to take actions so that local, publicly owned utilities would develop a standardized process for the interconnection of a customer supported microgrid (SB 1339 2018). Reflecting the substantial restructuring of the electricity required by SB 100, SB 1136 was passed in order to adjust the resource adequacy requirements to better facilitate the integration of new clean energy sources and retain existing non-generating and hybrid capacity (SB 1136 2018).

Outside of legislation aimed at the electricity system, two additional bills were passed in September of 2018: SB 1013 (2018), "The California Cooling Act" and SB 1072 (2018). SB 1072 (2018) begins to tackle the critical issue of under capacity at lower levels of government, especially in disadvantaged communities, by establishing a program to bolster support to regional climate collaboratives, providing funding and technical assistance for climate mitigation and adaptation projects. From a governance perspective, SB 1072 is important for operationalizing the polycentric nature of the state's climate change governance regime.

The following sections will outline key transportation policies that integrate climate mitigation goals in the State of California, many of which pre-date similar policies at the federal level. Given the large number of policies enacted in the state, the most significant policies will be outlined; however, a comprehensive delineation of all cleaner vehicle and transportation demand management can be found in Appendix B.

Cleaner vehicles

Reducing emissions from ICE vehicles

Like many jurisdictions, setting emissions standards and taxing vehicle fuels form the earliest attempts at reducing emissions from vehicles, although given the early stage at which these policies were

introduced, they were posed as a response to rising pollution levels as opposed to climate change mitigation. Nonetheless, older measures, especially vehicle emission standards, have consistently proven effective in achieving emission reductions from the transportation sector. State legislation in California for ambient air standards and controls on motor vehicles predates similar legislation at the federal level, in large part due to the comparatively severe pollution issues previously discussed. In 1959 legislation allowed the California government to develop motor vehicle controls, which resulted in the nation's first automotive emission control technology requirements by the California Motor Vehicle Pollution Control Board (CARB 2018b). By 1965 the federal government had amended the *Clean Air Act* (1963) by passing the *Motor Vehicle Air Pollution Control Act* (1965), providing for the direct control of air pollution by the Department of Health, Education and Welfare, which was directed to establish automotive emission standards (CARB 2017). The result was the introduction of the first tailpipe emission standards under the 1970 *Clean Air Act* (1970) (to take effect in 1975) that controlled levels of carbon monoxide, volatile organic compounds and oxides of nitrogen (US EPA Office of Mobile Sources 1999). By 1966 the California Motor Vehicle Pollution Control Board had already adopted standards for hydrocarbons and carbon monoxide, which following federal legislation in 1971, included control for oxides of nitrogen in their tailpipe emission standards (CARB 2018c).

The modern regulatory program for controlling emissions from motor vehicles at the federal level, the Corporate Average Fuel Economy (CAFE) standards, was introduced in 1975 for passenger vehicles and in 1979 for light trucks; manufacturers and importers of vehicles were required by this program to meet certain standards for various emissions, measured as grams per mile (gpm) and averaged across vehicle sales in each year (Yacobucci 2012). These standards were tightened via amendments in successive years for both cars and trucks.

In 1988, California passed the *California Clean Air Act* (1988), which included an ambitious legislative mandate to "achieve the maximum degree of emission reduction possible from vehicular and other mobile sources" (Cal. Health and Safety Code 43018(a)). As a response, CARB adopted the state's first Low Emission Vehicle (LEV) Standards in 1990 to run from 1994-2003 (CARB 1996). The LEV standards introduced a more nuanced system of control for vehicle emissions; requirements for the introduction of progressively cleaner vehicles by manufacturers for four new classes of vehicles alongside introducing increasingly stringent annual fleet average emissions requirements were established to help phase in low-emission vehicles and meet the state's clean air goals (CARB 1996).

The initial LEV regulation also contained a ZEV mandate (Reed 1997). A credit system was established for NMOG and ZEV requirements where credits could be banked, sold or traded amongst manufacturers starting in 1992, providing built-in flexibility for compliance (Reed 1997). At this time the main impetus for imposing this standard was not necessarily climate change, but a concern for air quality; Over 75% of California residents lived in non-attainment areas at the time of the regulation for at least one criteria air pollutant, of which motor vehicles were a dominant source (Reed 1997). The initial LEV standards are an early example of thoughtful policy design, which ultimately led to the success of the program.

The LEV II regulations were passed in 1999 (to run from 2004-2010), amended a number of aspects of the original LEV regulations, including but not limited to: increasing the stringency of emission standards for cars and extending these standards to SUVs and trucks, including a 75% reduction in oxides of nitrogen; creation of a new super-ultra-low emission vehicle category; creation of partial ZEV credits for manufactures; an increase in emission control durability standards from 100,000 miles to 120,000 miles for passenger vehicles and light trucks; and removal of a less stringent standard for pickup trucks and SUVs (CARB 1999).

For the first time, in 2002, legislation was introduced, which specified reductions in GHG emissions from vehicles. AB 1493 (2002), the so-called “Pavley Law”, broke legislative ground as the first law in the country where a state set its own standards for GHGs from private cars; CARB was required to adopt regulations by 2005 to meet a 40% reduction in new vehicle GHG emissions by 2016 (Transportation Research Board 2011; Sperling and Eggert 2014; Baldassare et al. 2013). In 2012, stricter emission standards were again imposed at the federal and state level. Following the example of California, the Obama administration introduced new CAFE standards, this time framed around reducing GHG emissions for model years 2017-2025, with the goal of achieving 54.5mpg for passenger cars, light trucks and medium-duty passenger vehicles by model year 2025 (U.S. EPA 2018).

The year 2012 also saw the introduction of California’s LEV III standards. Departing from the previous two iterations, the LEV III standards represented a new approach to controlling vehicle emissions by combining GHG emissions and smog-causing pollutants into a single package of standards for model years 2017 and beyond (CARB 2018a). The LEV III standards include a “deemed to comply” provision whereby manufacturers have the option to comply with state regulations by meeting the U.S. EPA

standards through model year 2025; this has been complicated by the Trump Administration's view that the standards are too strict and the resulting withdrawal of prior determination by the EPA that these standards are appropriate (CARB 2018d).

Like the case of Ontario, Canada, transportation fuel taxes are set at both the federal level and at the state level in the case of California. Once again pre-dating the imposition of federal transportation fuel taxes, the Government of California introduced their gasoline tax in 1923 (Shughart and Fors 2018). The two-cent per gallon tax established as per the *California Vehicle Act* (1923) was initially established to help pay off long-term bond debts used for maintaining and constructing roads in the state (Garrett 2016). Most recently the gas tax was raised 12 cents per gallon in 2017 and was set to increase another 7.5 cents per gallon in July 2019 as per SB 1 (2017), which will bring the combined state and federal tax on gas to a total of 65.7 cents per gallon (SB 1 2017; Shughart and Fors 2018). This puts California's state gas tax about 10 cents higher than most states, which according to the American Petroleum Institute, in 2015 had average state excise tax rates on gasoline and diesel at 20.7 cents and 19.1 cents per gallon respectively (Lowry 2015). The purpose of the gas tax revenues remains almost the same as when the mechanism was implemented in 1923: to fund a backlog of road repair and maintenance in the state. The only difference with the latest legislation is that monies are also directed to low-carbon transportation projects like mass transit funding and active transportation infrastructure.

Federal taxes on transportation fuels are collected by the Internal Revenue Service and deposited into the Highway Trust fund; currently, the tax is set at a rate of 18.4 cents/gallon for gasoline and 24.4 cents per gallon for diesel fuel (California Department of Transportation, Economic Analysis Branch, Division of Transportation Planning 2017). The original purpose of the tax, which was introduced in 1932, remains the same today: to raise revenues to finance government activities, not to combat carbon-based pollution (Lowry 2015). Importantly, these tax rates do not automatically adjust for inflation and have not been raised since 1993, meaning by November 2017 the real value of the tax had fallen by 60% (Lowry 2015; McClelland 2018). The federal government also introduced a tax on inefficient vehicles in 1978. The so-called "Gas Guzzler Tax" (1978) imposed a tax on the sale of new vehicles that didn't meet the federally imposed minimum fuel economy standard (MacNeil 2017). Critically this tax has been undermined by two loopholes: firstly, the tax doesn't apply to minivans, SUVs and pickups and the tax levels depend on the car's fuel efficiency rating, and as these have improved dramatically over time very few cars are subject to the tax whose parameters have not been updated since 1991 (Boyd 2015).

In order to promote the use of alternative fuels, the federal government has provided tax relief and/or credits to various alternative fuel producers, especially biofuel producers, since the 1990s but especially between 2005-2011 under the *Energy Policy Act* (2005), *U.S. Energy Independence and Security Act* (2007) and *American Jobs Creation Act* (2004). Non-financial regulations have been introduced since 2000 at the state level and are an important component of reducing emissions from ICE vehicles. In 2005, the California Legislature passed AB 1007 (2005), which required the California Energy Commission to develop a plan for the state to increase the use of alternative fuels in partnership with CARB (AB 1007 2005).

Continuing the momentum from the passing of AB 1007 (2005) and especially AB 32 (2006), then Governor Schwarzenegger announced Executive Order S-01-07, which established a first-of-its-kind low carbon fuel standard (LCFS) (Exec. Order S-01-07 2007). The executive order required a low carbon fuel standard to be applied to transportation fuels sold in the state with the goal of reducing the carbon intensity of fuels in the transportation sector by 10% by 2020 (Exec. Order S-01-07 2007; Orenberg 2016). Two years later, CARB adopted the low carbon fuel standard, which was designed to be based on a lifecycle assessment of GHGs, fuel-neutral and applicable to all current and potential transportation fuels (Yeh and Sperling 2013; Transportation Research Board 2011; California Climate Change 2017b).

As per the LCFS, declining annual carbon intensity standards are set for gasoline, diesel and any fuels that replace them (CARB 2019). The implementation of the LCFS took place in 2010 in the form of a system of tradable permits whereby fuel sellers receive credits for the emissions difference if their average carbon intensity (CI) is below the set targets to trade or bank for future use (Parson, Forgie, Lueders and Hecht 2018). Two CI standards are set, one for gasoline and gasoline substitutes (e.g., ethanol, electricity) and one for diesel and diesel substitutes (e.g., biodiesel); these standards are set relative to a 2010 baseline and are designed to increase in stringency annually to 2030 (Parson et al. 2018). The system was amended in 2011, and re-adopted in 2015 (CARB 2019).

The key effect of this program is to increase the cost of high-carbon fuels and reduce the cost of low carbon fuels. Between 2011 and 2016 California's LCFS has replaced upwards of 5.3 billion gallons of gasoline and 1.2 billion gallons of diesel fuel, and as of 2017 the carbon intensity based on a composite measure of gasoline and diesel fuel has been reduced by approximately 3.5% (Clean Energy Canada et al. 2016; CARB 2019). While this program has been an effective complementary policy to carbon pricing,

as different sources of emissions are targeted and different incentives and disincentives are created, it has been a relatively costly method for targeting emission reductions (Parsons et al. 2018).

As mentioned previously, implementing programs to get older cars off the road can be a very cost-effective strategy to reduce emissions. In addition to mandated inspection and maintenance programs, programs that set aside funds to modernize fleets and clean up older engines have been running in California since the late 1990s. The flagship program designed to replace older, more polluting vehicles and equipment, the Carl Moyer Memorial Air Quality Standards Attainment Program, was created in 1998 and implemented in 1999 as per AB 1571 (CARB 2017a). Since 2017, almost USD 1 billion has been granted through this "successful and popular air pollution reduction program" (CARB 2017a). The types of projects funded by this program (currently USD 69 million annually) range from replacing, repowering and retrofitting older higher polluting engines or other equipment, scrapping old vehicles, and providing energy infrastructure to power covered sources (CARB 2017a).

In 2007 a more focused type of vehicle retirement program was created as a part of Assembly Bill 118 (2007). The Enhanced Fleet Modernization Program (EFMP) is a voluntary vehicle retirement and replacement incentive program, targeted at lower-income motorists, to remove the oldest, highest-polluting cars from California roads in order to assist in meeting climate change and air quality targets (Pierce and DeShazo 2017). Depending on household income and type of vehicle replacement, monetary incentives of up to USD 4,500 are provided to motorists scrapping older vehicles to buy more fuel-efficient vehicles; alternatively, transit-passed and other transportation mobility options are offered in lieu of a vehicle replacement purchase (Pierce and DeShazo 2017).

California also has retirement and replacement programs specifically for school buses. In order to reduce negative health effects associated with particulate matter from buses, the State of California has been funding the Lower Emission School Bus Program since 2001, a significant part of which is a retire and replace program (CARB 2008). The original program, which ran from 2000-2006, was replaced in 2007 by voter approval of Proposition 1B (2006), establishing a USD 200 million School Bus Retrofit and Replacement Account, as per SB 1266 (2006). In 2017, SB 110 (2017) established a similar program, The School Bus Replacement Program, now administered by the California Energy Commission (SB 110 2017). The program is authorized, with USD 75 million from the California Clean Energy Jobs Act

(Proposition 39, 2012), to replace the oldest school buses, with priority going to school buses operating in disadvantaged communities (SB110 2017).

Another, even longer-standing measure to mitigate pollution from older vehicles is the state's Smog Check California program, which started in 1982 under the authorization of SB 33 (California Department of Motor Vehicles 2017; SB 33 1982). The original program, implemented in 1984, mandated bi-annual smog inspection testing for vehicles' emission control components; a second iteration of the program, Smog Check II, was authorized in 1994 to target vehicles polluting 2 to 25 times more than the average vehicle (CARB 2017). Smog checks are required for more ICE vehicles in order to renew vehicle registrations and must be tested at licensed Smog Check stations (California Department of Motor Vehicles 2017). The most recent revision to this program, as per AB 1274 (2017), exempts vehicles eight or fewer model years old from bi-annual testing beginning in 2019.

In 2010, CARB introduced tire inflation requirements for vehicles weighing 10,000 pounds or less by automotive service providers whenever they perform any automotive repair or maintenance activity (CARB 2010). According to CARB (2010), only 19% of consumers properly check and inflate their tires, which lose, on average, one pound of pressure per month. Given that ensuring proper tire pressure is maintained will eliminate 700,000 metric tons of GHGs and reduce the State's fuel consumption by 75 million gallons (CARB 2010), this relatively small and simple regulation provides an example of an extremely monetarily efficient way of reducing transportation emissions.

Policies to promote 'clean' vehicles

California has had a long history of promoting the uptake of cleaner vehicles and continues to be a leader in this area. The state's first Zero Emission Vehicle (ZEV) Mandate was introduced almost 30 years ago, well before most governments began focusing on promoting these technologies. In 1990, the Government at that time introduced an ambitious Zero Emission Vehicle program, administered by CARB, that imposed ZEV sales requirements in the state: 2% of vehicles sold in California had to be ZEVs by 1998, 5% in 2011 and 10% in 2003 (2011b). Even though flexibility was built into the ZEV mandate via the credit system and the ZEV mandate provided long-lead times, this aspect of the LEV regulations was considered far-reaching. It resulted in much industry opposition, not only to its implementation in California but in other states looking to adopt similar regulations (Reed 1997).

Following numerous court battles, CARB decided to push back the ZEV mandate to MY 2003 (Reed 1997). The "ramp-up years" under the ZEV mandate were eliminated and extremely clean vehicles were granted partial ZEV credits (CARB 2011b).

In 2001, further modifications were made in light of challenges associated with the commercialization of these technologies; further flexibility was introduced for how large manufacturers could meet their ZEV requirement, specifically the ability to meet theirrequirementst using various non-pure ZEV technologies (CARB 2011b). To complement this pressure on increased ZEV supply, the Government established a program in 2009 to bolster ZEV demand via subsidies. As Table 9 illustrates, the number of rebates for different vehicle categories has changed over time and also varies for low-income consumers. In total, The Clean Vehicle Rebate Program has provided over USD 600 million in rebates for more than 250,000 clean vehicles since 2010 (CARB 2019).

Table 9. Rebate values and types of eligible vehicles for the CVRP since 2010 (Center for Sustainable Energy 2018).

	Effective Dates					
Vehicle Types	**3/1/2010**	**6/18/2011**	**7/4/2013**	**6/1/2014**	**3/29/2016**	**11/1/2016**
Plug-in Hybrid Electric (PHEV)	$3,000	$1,500	$1,500	$1,500	$1,500–$3,000*	$1,500–$3,500**
Battery Electric (BEV)	$3,000–$5,000***	$1,500–$2,500***	$2,500	$2,500	$2,500–$4,000*	$2,500–$4,500**
Fuel Cell Electric (FCEV)	$3,000–$5,000***	$1,500–$2,500***	$2,500	$5,000	$5,000–$6,500*	$5,000–$7,000**
Zero-Emission Motorcycle (ZEM)	$1,500	$900	$900	$900	$900	$900
Neighborhood Electric Vehicle (NEV)	$1,500	$900	$900	$900	$900	$900
Commercial Zero-Emission Vehicle (CZEV)	$20,000	$0	$0	$0	$0	$0
** Lower-income consumers eligible for an additional $1,500.* *** Lower-income consumers eligible for an additional $2,000.* **** Amounts varied by ZEV type. For definitions, see CCR 1962.1.*						

The ZEV requirement under the LEV regulations provided a strong market signal and resulted in "unprecedented research and development" into EVs and battery technologies not only in California but the rest of the United States, in addition to Japan and Europe (Reed 1997). The most significant initial result of this policy lever was the increased commercialization of hybrid cars (Greene 2014). In

comparison, the USD 50 million program to domestically produce a pollution-free automobile launched by President Nixon in 1970 effectively faded after five years without meaningful outcomes (Reed 1997).

As ZEV technology began to mature, then Governor and climate change advocate Jerry Brown, announced in 2012 a new and even more ambitious ZEV mandate alongside a set target for the reduction of transportation emissions (CARB 2018a). This program included a focus on building charging infrastructure in the state, supported by dedicated funding, in order to support the target of 1.5 million ZEVs in California by 2025 (Orenberg 2016; CARB 2018a). A ZEV Action Plan was developed the following year to make sure all barriers to uptake were being researched and addressed; the Plan required all state agencies to work together to support ZEV commercialization (Sperling and Eggert 2014). Bolstering this plan, the Charge Ahead California Initiative was legally established in 2014 by SB 1275, requiring CARB to appropriate funds from the Air Quality Improvement Program in order to ensure at least 1,000,000 zero or near zero emission vehicles were on the road by January 1, 2023 (SB 1275 2014). The bill also required planning and reporting on vehicle incentive programs and a focus on increasing access to and benefits from ZEVs for low-moderate income consumers (SB 1275 2014).

Unlike Ontario's aspirational ZEV target (vs. mandate), the design and combination of the ZEV mandates and CVRP in California, to some extent, mitigate critiques about ZEV subsidies primarily benefiting higher income consumers. The CVRP has, like many California climate-related policies, a substantial focus on providing additional funding to low-income consumers and, as of 2016, income caps in the eligibility criteria and increased rebates for low- and moderate-income consumers (Center for Sustainable Energy 2018). In addition, the ZEV mandate (in addition to clean car standards) shifts costs to purchasers of higher emitting vehicles as vehicle manufacturers discount lower-emitting vehicles in order to meet targets and subsidize this by increasing the cost of higher emitting vehicles (Taylor 2018).

The U.S. federal government has subsidized the purchase of cleaner vehicles primarily via tax credits. The Alternative Fuel Motor Vehicle Credit was established under the *Energy Policy Act* (2005), providing a tax credit of up to USD 4,000 for the purchase of a new hybrid, electric or diesel fuel vehicle (based on fuel economy) between 2005 – 2016 (Berzanskis 2015; U.S. Department of Energy 2017; MacNeil 2017). Since 2008 the Qualified Plug-In Electric Vehicle Tax Credit has provided between USD 2,500 to 7,500 for eligible clean vehicles; the subsidies are phased out for individual manufacturers after

the second quarter, in which a minimum of 200,000 eligible PEVs have been sold for use in the United States (U.S. Department of Energy 2017).

Non-financial incentives for the use of cleaner vehicles like HOT and HOV lanes have been integrated into the state's vast road network. The introduction of toll roads began in the early 1990s when private sector parties entered into agreements with Caltrans (authorized by AB 680 1989) to build roads at no expense to the state (California Department of Transportation 2009). While the early 1990s marks the modern era of toll road building, many state roads were historically constructed by private entities in hopes of company dividends (Klein and Yin 1994).

Since 2014, the free use of toll roads for clean air vehicles has been authorized as per AB 1721 (2014). Starting in 2010, clean air vehicles are identified by green or white stickers as part of a program established to provide clean air vehicles the non-financial benefit of using HOV lanes. SB 535 (2010) provided 40,000 HOV access stickers/decals starting in 2012 for eligible clean air vehicles. The number of decals was increased in 2014 to 70,000 as per AB 2013 and in 2016 the cap was removed entirely on the number of 'green decals' the DMV was authorized to provide (SB 838 2016).

Finally, a critical measure to ensuring the highest uptake of cleaner vehicles is the development of a sufficient charging network for non-ICE vehicles. California, again in advance of many jurisdictions, had a relatively long-standing program, the Clean Fuels Outlet regulation (under the Advanced Clean Cars Program), to ensure alternative fuels (originally methanol, ethanol and CNG) were available in a sufficient number of California fueling stations (CARB 2014). The regulation, introduced in 1990, was updated in 2000 and again in 2012 to reflect the growing push for ZEVs and the need for sufficient battery-electric charging capacity; the program ended in 2013 with the passing of AB 8 "Alternative fuel and vehicle technologies: funding programs" (2013), which ensured funding for alternative fueling infrastructure, making the CFO program unnecessary (CARB 2014; AB 8 2013).

Another program, Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP), was established in 2007 by AB 118 (2007) following the passing of AB 32 (2006). This program, administered by the California Energy Commission, contains a substantial focus on building alternative fuel infrastructure and has funded the construction of 7,000 ZEV charging and hydrogen refueling stations to date (Taylor 2018). The state has also used two settlement funds, the Volkswagen settlement and the

NRG settlement, to further charging infrastructure for ZEVs. A 2012 NRG settlement requires the energy company to install at least 200 public fast-charging stations and infrastructure with up to 10,000 private charging stations at workplaces and residences (Taylor 2018). The 2016 Volkswagen settlement requires the company to invest USD 800 million in ZEV projects – mostly fueling infrastructure – over ten years; the first two rounds of funding amount to roughly USD 270 million, which should fund the construction of approximately 3,000 charging stations (Taylor 2018). As of December 2018, California led the United States in the installation of charging and refueling infrastructure, with almost 18,000 public chargers installed (CEC 2018).

Following Governor Brown's 2012 Executive Order (B-16-12) announcing a new ZEV mandate and transportation emission reduction goal, a concerted effort began to establish electric charging and hydrogen fueling outlets across the state. As previously mentioned, in 2013, AB 8, "Alternative fuel and vehicle technologies: funding programs" was passed, ensuring funding for alternative fuel infrastructure, specifically hydrogen fueling stations. The bill requires the CEC to allocate USD 20 million annually (or no more than 20% of the ARFVTP budget) to develop hydrogen fueling stations until there are 100 stations available in the state (AB 8 2013).

The following years saw legislative changes that would lower barriers (especially approvals) for installing electric vehicle charging infrastructure at non-residential, multifamily and single-family residential developments (AB 1092 2013; AB 2565 2014; AB 1236 2015). To ensure more parking spaces were available for dedicated electric vehicle charging on public streets, AB 1452 (2017) was passed giving local authorities the ability to designate any public street parking space for electric charging purposes and the right to remove any vehicle in that designated parking spot not connected for charging purposes.

Like federal support for cleaner vehicles, tax credits form the bulk of mechanisms to support alternative fuel infrastructure development. Initially, the federal Alternative Fuel Station Credit was introduced in 2005 as a part of the *Energy Policy Act* (2005), then expanded by the *American Recovery and Reinvestment Act* (2009) and extended by the *Tax Relief, Unemployment Insurance Reauthorization Act* (2010). Under these statutes, The Alternative Fuel Station Credit allows a taxpayer to take a 30% credit for the installation of an alternative fuel infrastructure project, up to USD 30,000 with residential installations qualifying for a USD 1,000 credit through 2011 (Yacobucci 2012). In 2018 the credit (Section 48 and 25D Investment Tax Credit) was reinstated under the *Bipartisan Budget Act* (2018), this time

designed with a tiered phased-out of the credit: 30% credit until 2019, 26% until 2021, and 22% until Jan. 1 2024 (Yacobucci 2012).

Government funding, R and D, procurement and pilot projects

Funding for research and development is an area where the U.S. federal government has been more active with regards to promoting cleaner vehicles. Since 1980 the U.S. federal government has provided funding and developed organizations for low carbon research and development, beginning with the promotion of synthetic fuels. *The U.S. Synthetic Fuels Corporation Act* (1980) and the *Biomass Energy and Alcohol Fuels Act* (1980) are two early examples of this kind of support. In 1991, the federal government established an organization, the Alternative Fuels Data Center, to support the development of alternative fuel vehicles under the Department of Energy's Renewable Energy Lab (U.S. Department of Energy 2017).

Incentives and loans for cleaner vehicles and advanced vehicle technologies research, demonstration projects and subsidized vehicle technologies continued through the early 2000s with programs such as the National Hydrogen Learning Demonstration (starting in 2003), the Advanced Technology Vehicle and Alternative Fuel Manufacturing Incentives (starting in 2004), the Joint Flexible Fuel/Hybrid Vehicle Commercialization Initiative and the Title XVII Innovative Clean Energy Projects Loan Program, both established by the *Energy Policy Act* of 2005 (MacNeil 2007; U.S. Department of Energy 2017). Funding for the development of vehicle battery technologies was targeted under the Alternative Fuel and Advanced Vehicle Technology Research and Demonstration Bonds (starting in 2008) and under Title IV, Energy and Water Development, under the American Recovery and Reinvestment Act of 2009 (U.S. Department of Energy 2017; Rabe 2010).

Targeted support for incentivizing biomass crop production and the expansion of advanced biofuels were provided under the Biomass Crop Assistance Program and Bioenergy Program for Advanced Biofuels, which were operational between 2008-2012 (Yacobucci 2012). More recent funding efforts at the federal level have targeted alternative vehicle infrastructure research and development as well as research and demonstration projects for low carbon mass transit; specifically, The Moving Ahead for the 21st Century Act (2012) established additional funding opportunities for alternative fuel

infrastructure and research and the Low and Zero Emission Public Transportation Research, Demonstration and Deployment Funding provides funding to public, private and non-profit institutions to undertake pilot programs and research for low carbon public transit (U.S. Department of Energy 2017).

In 1998 a substantial research funding program at the state level, the Public Interest Energy Research (PIER) program, was established in part as a response to 1996 legislation (AB 1890), which restructured the California electricity industry (California Council on Science and Technology 2018). The California Energy Commission administers the program, supporting clean energy research, development and demonstration projects, including low carbon transportation projects (California Council on Science and Technology 2018; Adaptation Clearinghouse 2011).

In recent years, the state has focused on funding research specifically aimed at cleaner vehicle R & D. As previously mentioned, AB 118 created the Alternative and Renewable Fuel and Vehicle Technology Program, which has provided funding to a wide range of recipients since 2007 for the development and deployment of innovative technologies to "transform California's fuel and vehicle types to help attain the state's climate change policies" (AB 118 2007, sec. 5). The funding allocation under the program is designed to be technology-neutral and projects are prioritized by their ability to reduce fossil fuel dependence, meet the state's climate policies and how they align with the state's low carbon fuel standard (AB 118 2007).

The Government of California has also been relatively active in supporting local industry development in the cleantech sector, which includes supporting funding for start-ups, establishing industry partnerships and technology transfer that are relevant to low-carbon transportation. California's iHub program is one innovative example of this kind of work. In 2013, AB 250 established the program, which aims to improve the state's competitiveness in the cleantech sector by providing (in partnership with universities, research institutions, venture capital networks and local governments) regionally-based organizations that effectively operate as incubators and networking sites (Governor's Office of Business and Economic Development 2019).

Another program focused on supporting state cleantech businesses and research is the CalSEED program, established in 2017 and administered by the California Energy Commission (CalSEED 2019).

CalSEED provides up to USD 600,000 per project accepted by the program with the complementary goals of accelerating the state's (already nationally dominant) cleantech economy and also meeting the state's clean air goals (CalSEED 2019).

The most significant funding project, specifically for transportation in the state, was established in 2017 under the landmark transportation investment legislation, SB 1, *The Road Repair and Accountability Act* (2017). Roughly USD 70,000,000 will be allocated to transportation research at programs at the University of California and California State University (SB 1 2017). While this legislation was passed to address the severe shortage of monies to maintain the state transportation system in at least a state of 'good repair' (SB 1 2017), the investment of roughly USD 7,000,000 per year into transportation research is significant. The same year AB 419 (2017) authorized the appropriation of USD 500,000 from the GHG reduction fund (cap-and-trade proceeds) to fund a study at one or more of the University of California campuses to study and analyze life cycle emission profiles.

The U.S. federal government has also been relatively active in low carbon transportation demonstration projects and procurement measures, in addition to the state government in California. The first major policy at the federal level requiring fleets to contain alternative-fueled vehicles was the Federal Energy Management Program, established under the *Energy Policy Act* of 1992 (U.S. Department of Energy 2017). The Energy Policy Act of 1992 also authorized USD 50 million annually for electric vehicle demonstration programs and USD 35 million per year for three years for alternative fuel urban transit bus demonstration programs (Wiener 2013). Additional requirements for federal fleets were included in the *Energy Independence and Security Act* (2007, sec. 141, sec. 142, sec. 246); specifically, procurement requirements for low-GHG emitting vehicles (sec. 141), mandated fleet management plans (sec. 142) and requirements around installing renewable fuel infrastructure (sec. 246). *The Energy Policy Act* (1992) also imposed fleet procurement requirements on state governments, whereby fleets made up of 50 or more vehicles are required to acquire a certain amount of alternative fuel vehicles as per the State and Alternative Fuel Provider Fleet Program rules (10 C.F.R. § 490 1992).

The Energy Policy Act of 2005 also contains measures for procurement alternative fueled vehicles by government fleets and monies for demonstration programs. Additionally, the Energy Policy Act (2005, sec. 734) established a fuel cell school bus demonstration program, which authorized USD 25 million for

local government agencies' natural gas school buses. Smaller programs targeting procurement of cleaner vehicles for specific government agencies or regulated entities like airports were introduced in the following years; however, the last significant change to federal fleet management came in 2015 under Executive Order 13693: Planning for Federal Sustainability in the Next Decade. As a part of meeting the new GHG reduction goal for federal government operations announced in this E-O 13693 (2015), federal fleets with a minimum of 20 vehicles are required to reduce fleet-wide GHG emissions by 4% in 2014, 30% by 2025 and increase the share of zero emission or hybrid plug-in vehicles to 20% of new passenger vehicles procured by 2020 and 50% by 2025 (Grantham Institute on Climate Change and the Environment 2018a).

CARB first adopted fleet rules for transit agencies and more stringent urban bus requirements in 2000 (13, CCR, sec. 1956.1, 2020, 2023, 2023.1 & 2023.4). The zero emission bus procurement requirement for larger transit agencies (operating over 200 urban buses) set to start in 2008 under this regulation, was postponed in 2010; however, a stronger procurement requirement has been incorporated in the Innovative Clean Transit Regulation, which is being proposed to replace the Fleet Rule for Transit Agencies (CARB 2019b). Specifically, large transit agencies must ensure 25% of new bus purchases are zero emission starting in 2023, 50% starting in 2026 and 100% starting in 2029; smaller transit agencies must ensure 25% of new bus purchases are zero emission starting in 2026 and 100% starting in 2029 (CARB 2018e).

The California Climate Investments program, which distributes cap-and-trade proceeds from the Greenhouse Gas Reduction Fund, funds (among other things) demonstration and pilot projects, in addition to subsidizing clean vehicle procurement. There are simply too many projects and funding schemes to speak to them all individually, but the scale of funding to umbrella programs under which projects are supported, signals the substantial focus on accelerating clean vehicle technologies. For example, since 2013, the California Energy Commission’s Transportation Technology and Fuels program has received USD 12.5 million, the Department of Transportation’s Low Carbon Transit Operations program has received roughly USD 300 million, and most significantly, the CARB’s Low Carbon Transportation program has received over USD 1.7 billion (CARB 2018f). The California Public Utilities Commission also oversees large research, development and demonstration programs, for example, the Electric Program Investment Charge, established in 2012 to fund applied R & D and technology demonstration and

deployment, including millions granted to projects advancing low-carbon transportation (CEC 2019). The California Public Utilities Commission has also provided funding, as required by AB 1083 (2017), for EV infrastructure pilot projects at educational facilities and state parks/beaches.

Governor Brown's executive order, B-16-12 (2016), requires, amongst other things, an increase in purchases of ZEVs for the state's vehicle fleet, establishing a goal for 25% ZEV share of state vehicle fleets by 2020. Following this executive order, State procurement rules for low-emission vehicles were tightened in 2017 by SB 498 (2017) "Vehicle fleets: Zero emission Vehicles" and AB 739 (2017) "State vehicle fleet: Purchases". Amongst other actions, SB 498 (2017) requires the Director of General Services to ensure at least 50% of light-duty vehicles procured for state vehicle fleets are ZEVs by 2024-2025. AB 739 (2017) requires that larger vehicles (weighing 19,000 pounds or more) purchased for state vehicle fleets must be 15% ZEVs by December 2025 and 30% ZEVs by December 2030. In order to provide more flexibility for meeting targets, the Director of General Services is making ongoing efforts to expand procurement options for state agencies, including purchase financing options and potentially leasing (Governor's Interagency Working Group on Zero Emission Vehicles 2018).

Information measures

The State of California has had a relatively long history in providing information for assisting consumers in purchasing lower polluting vehicles. The state's Smog Index Label was established in 1978 and has evolved over time, most recently to include a 'global warming score' (CARB 2011a). While all new vehicles have been required to have labeling with vehicle smog information since 1995, the re-branded Environmental Performance Label, with a global warming score, has been required on all new vehicles since January 2009, as per AB 1229 (2005; CARB 2011a). The federal government also requires vehicle labeling, for example, dual-fuel vehicles must be labeled as per section 759 of the Energy Policy Act (2005), and the re-designed Fuel Economy and Environment Labels, required since MY 2013, mandates all vehicles have a comparable fuel economy and environmental rating, including advanced technology vehicles like EVs (40 C.F.R. § 600 2011).

The other major information measure related to cleaner vehicles is the state's Drive Clean Buying Guide website, administered by CARB. As Figure 15 illustrates, the user-friendly website provides

various search options, including searching by car category, fuel type, greenhouse gas rating, smog rating, a specific make and model, or a specific test group (Drive Clean 2019). The Drive Clean website also provides links to websites and apps that have information on charging station locations (Drive Clean 2019).

In addition to the Drive Clean website, the California Public Utilities Commission has been required since July 2011 to develop a website that provides information to consumers about plug-in hybrid or fully electric vehicles, specifically: how to find out if a consumers residence will require any utility service upgrade for vehicle charging, utility rate options and load management techniques, as well as basic charging circuit requirements (CA Pub Res Code § 25227). As of 2019, CARB has also been tasked with information provision measures; the agency is now required to provide information outreach in low-income communities in order to increase awareness about the Clean Vehicle Rebate Project, which provides additional subsidies to low-income consumers for the purchase of clean vehicles (AB 2885

Figure 15. California's Drive Clean Website (Drive Clean 2019).

2018).

Transportation demand management

Transit-integrated land-use planning and smart growth measures

Comprehensive and formal land-use planning rules were established in the 1920s at both the federal level and in the State of California. There are two foundational federal acts that can be seen as the roots of professional planning, and which still continue to shape how cities are developed today: *A Standard State Zoning Enabling Act* (SZEA) *of 1926* and *A Standard City Planning Enabling Act* (SCPEA) *of 1928.* In an era of increasing urban population growth and inadequate resources (e.g., sanitation and housing) to deal with the significant number of people entering cities, these so-called 'Standard Acts' effectively provided model legislation, that when adopted by regions and cities, enabled them with tools to plan and manage growth (Rosenberg 2013). Specifically, SZEA (1926) authorized that a legislative body could divide a local government's territory into districts and provided procedures to develop and amend zoning regulations, under the initial mandated establishment of a zoning commission (APA 2019). The companion legislation to the SZEA (1926), the SCPEA (1928), covered six subjects:

(1) the organization and power of the municipal planning commission, which was directed to prepare and adopt a "master plan";
(2) the content of the master plan for the physical development of the territory;
(3) a provision for adoption of a master street plan by the governing body with control of private building in mapped, but unopened streets;
(4) a provision for approval of all public improvements by the planning commission;
(5) control of private subdivision of land; and
(6) a provision for the establishment of a regional planning commission and a regional plan (Meck 2000, p. 297-8).

Importantly, the SCPEA (1928) did not make the local planning process mandatory, although it was advised (Meck 2000). In California, 1914 legislation (Proposition 13) ensured local independence from state interference with regards to control over land-use. Specifically, charter cities were authorized to create and enforce all laws that deal with municipal affairs and in 1929 (following the federal Standard Acts) cities and counties were granted authority to pass ordinances regulating subdivisions as per the *Map Filing Act* (1929) (Barbour and Silvia 1999; Santos, Watt and Pincetl 2014; Los Angeles Bureau of

Engineering 2009). These early legislative acts permitted local governments to dominate land-use control and make decisions in accordance with local community needs.

In 1937, the adoption of comprehensive general plans was mandated in the state; these served as guidance documents to decide the overall vision for how lands were to be used (Santos et al. 2014). Planning was further institutionalized at the state level by the creation of the State Planning Office in 1959 and in response to consistent population growth and land management challenges, a group called California Tomorrow published a 1962 report calling for better growth management in the state (Santos et al. 2014). The report, titled "California, Going, Going ... our state's struggle to remain beautiful and productive", promoted regional planning to deal with problems such as contaminated air and water, wildfires, and "the auto: the most voracious land consumer" (Wood and Heller 1962).

Although mass transportation planning was acknowledged as an integral part of comprehensive urban planning under the *Housing Act of 1961* (Smerk 1972), arguably, the most significant federal legislation impacting urban transportation planning in the U.S. since the passing of the Standard Acts is the *Highway Act of 1962.* On the surface, it may seem this legislation has very little to do with the subject, but key stipulations in the Act (specifically section 134) mandate a comprehensive urban transportation planning process by tying federal highway aid funding to the existence and utilization of such a process (Smerk 1972; Barbour 2016; Weiner 2013). The transportation planning process was required to be "continuing, cooperative and comprehensive", involving state and local communities, and as a result, provided the opportunity for alternatives to highway development to be considered (Smerk 1972; Barbour 2016). The passing of this legislation introduced metropolitan planning organizations in urban areas with populations over 50,000 people; these novel institutions were intended to ensure a transparent and comprehensive planning process, through which federal funding would flow (U.S. Federal Highway Administration 2017).

Since the introduction of these organizations, a much larger emphasis has been placed on developing multimodal transportation systems to reduce traffic congestion, including the integration of mass transit and active transportation infrastructure (U.S. Federal Highway Administration 2017). To follow through with building transportation alternatives, capital funding was needed. The legislation that followed in 1964, the *Federal Mass Transportation Act* (1964), became the cornerstone of the federal

transit program, providing funding for the first time for mass transit systems, in addition to calling for regional planning to coordinate both mass transit and auto transportation (Smerk 1972; Barbour 2002).

At the state level, attention was also being paid to the increasing need to coordinate various planning subjects (e.g., land-use, transportation, air and water pollution), especially in the face of increasing populations growth, deemed by the Government as California's "nightmare of numbers" (Governor's Commission on Metropolitan Area Problems 1960). In 1963 *the Knox-Nisbet Act* (1963) was passed, requiring each county to establish a Local Agency Formation Commission (LAFCO), replacing Local Boundary Commissions (Barbour 2002). The new agencies were tasked with carrying out various functions, including discouraging urban sprawl (Martin and Wagner 1978). Following the federal Highway-Aid Highway Act of 1962, which called for comprehensive planning processes, the state legislature passed the *Regional Planning Act* (1963) providing for the division of California into regional planning areas, which were to be run by local officials, unless a voluntary associated already existed (Barbour 2002).

Aside from restructuring planning administration, the conservation of land became a focus of legislation in California during the 1960s. The 1965 *California Land Conservation Act*, known more commonly as the *Williamson Act*, provided the ability for the government to establish agreements with private landowners, whereby land would be set aside for agricultural or open space purposes in return for much lower property tax assessments (State of California Department of Conservation 2017). The same year the legislature passed the *Quimby Act* (1965) whereby local governments can require developers to set aside land for parks or open space, provide conservation easements, or purchase parklands (Santos et al. 2014). Environmental protection measures were also further promoted at the federal level through the integration of such requirements under the *Federal-Aid Highway Act* of 1968. Specifically, the *Federal-Aid Highway Act* (1968) required public hearings to be held, which in part looked at the environmental effects of highway projects.

In response to increasing development and population pressure, the government of California passed its first attempts at legislative solutions to sprawl-related problems in the 1970s (Freilich et al. 2010). In 1970, California developed its *California Environmental Quality* Act (1970), which was modeled on the federal government's first environmental protection statute, which was passed a year prior,

the *National Environmental Protection Act* (1969). Similar to the *Quimby Act* (1965), the CEQA required developers to set aside parkland or open space or pay parkland acquisition fees, but more importantly, CEQA (1970) required environmental assessments of development projects and the adoption of all feasible measures to mitigate adverse impacts (CEQA 1970).

In practice, the CEQA (1970) has become "the main source of judicial review of city and country plans, regulations and development approvals" (Freilich 2010, p. 86). Also, in 1970, 'Open Space' elements began to be required in General Plans in California and the following year, comprehensive local planning via General Plans became mandatory, transforming these documents "into true constitutions for growth and development rather than simply advisory documents" (Fulton 1999; cited in Barbour 2002, p. 28; Santos et al. 2014).

Adding to the number of special districts and agencies involved in planning, regional transportation planning agencies (RTPAs) were designated by the 1971 *California Transportation Development Act* (1971), and were required (starting in 1972) to submit comprehensive, long-range transportation plans to the state government (Barbour 2002). These county-level agencies received funds generated by a ¼ cent increase in the state general sales tax and allocated these funds, which were primarily earmarked for mass transit (Barbour 2002). Both MPOs and RTPAs are tasked with developing long-range (20 year) transportation plans; in practice, this is carried out mainly by MPOs in urban areas and RTPAs in rural areas (California Association of Councils of Governments [CALCOG] 2009).

By the early 1970s, the population of California had grown by more than 25% over the 1960s, and industrial, residential and commercial development had intensified along the state's iconic coastline (Frank, Oh, Hecht, Sivas, Armsby and Herbert 2017). In response, the *California Coastal Protection Act* (1976) was passed in 1976 putting into place much of the California Coastal Plan, which was developed by the California Coastal Zone Conservation Commission (Frank et al. 2017). Permits were required by this legislation by anyone (government, private citizens or businesses) before development projects were approved in the 'coastal zone', in order to ensure coastal ecological integrity and access to the coast are maintained or improved (Frank et al. 2017).

Although this section details the progress in terms of promoting transportation-oriented or 'smart-growth' development, it would be amiss to not briefly touch on the passing of Proposition 13 during this

time, which remains a key root of urban sprawl in California. Passed in 1978, Proposition 13 was a property tax reduction measure, which has been called "the most consequential act of direct democracy in California history", due to its long-lasting and widespread ramifications on land-use development patterns, California's tax structure and housing affordability (Friedersdorf 2018; Santos et al. 2014). Proposition 13, amended California's constitution in two significant ways: (1) it significantly reduced California property taxes, setting them at 1% of the sale price of the property and capped any annual increase to 2% or under and (2) it required any future tax increase of any kind to receive a two-thirds or more vote in the legislature to pass (Friedersdorf 2018). As a result of Proposition 13, local government revenues dropped by roughly half shortly after its passing, which induced county and city governments to make land-use decisions favouring commercial development of open lands (Goldman 2001).

In 1977 important reforms were made at the federal level to the *Clean Air Act* that led to increased integration of clean air goals in transportation planning. At this time, many states had failed to meet federal air quality standards, which the federal government recognized was due in large part to an increase in VMTs, stemming in part from a larger workforce and expanding suburban development patterns (Weiner 2013; Barbour 2002). Addressing this issue, the Amendments to the *Federal Clean Air Act* in 1977 required consistency between transportation plans under MPOs and regional air quality goals and plans (Barbour 2002). How these two plans and sets of objectives would be reconciled was not clearly laid out, and as a result, this requirement was often ignored (Garrett and Wachs 1996). In 1981 the U.S. DOT passed regulations to try and ensure this requirement was no longer ignored. For the first time, federal funding for major transportation projects was tied to an area's transportation plans conforming with the approved State Implementation Plan (Weiner 2013). Federal transportation funding for those areas that had not met air quality goals ("non-attainment areas") was directed/prioritized for "transportation control measures" aimed at reducing air pollution from transportation sources (Barbour 2002; Weiner 2013).

In 1990, Proposition 111 was approved by voters, which in addition to providing more funds for public transit projects, also strengthened the role of counties in transportation planning under the Congestion Management Program (Barbour 2002). In addition, CMAs were responsible for setting congestion limits and for evaluating the transportation effects of land-use planning decisions in terms of reducing congestion (Nash 1992; Wilshusen 1992; cited in Barbour 2002). These county-wide CMAs are required by law to assess whether cities' transportation programs, plans and projects conform to the

Congestion Management Program; non-conformance potentially results in 'significant consequences' to city transportation funding (San Francisco Country Transportation Agency 2007).

In 1991, the government of California became more involved in land-use planning legislation in order to ensure growth-related issues were being addressed. Then-Governor Pete Wilson issued an executive order (Exec. Order W-2-91 1991), which required the Office of Planning and Research to develop a Strategic Growth Plan (SGP), which was delivered in 1993 (Freilich et al. 2010). The SGP established multiple planning policies to address the state's growth-related problems, including conservation and voluntary growth guidelines (Freilich et al. 2010). While the state government certainly started to become more involved in land-use planning through top-down efforts like the SGP, it is important to note that the voluntary nature of guidelines and emphasis on encouragement rather than requirements.

The following year, congestion management programs were further institutionalized (among other transportation programs) under the federal *Intermodal Surface Transportation Efficiency Act* (ISTEA) (1991). ISTEA (1991) required states and metropolitan areas to develop new institutional arrangements in order to implement six management systems; three of these management systems were directly related to the integration of transit-oriented development objectives in decision-making: traffic congestion, public transportation facilities and equipment, and intermodal transportation facilities and systems (Weiner 2013). The federal government implemented further and stricter regulations under the Clean Air Act in 1993 to ensure transportation plans and programs were clearly aligned with air pollution reduction aims found in State Implementation Plans (Barbour 2002). Specifically, tighter transportation conformity provisions were issued and criteria and procedures for conformity determinations for transportation plans, programs and projects were set out (Clean Air Act Amendments of 1990, sec. 176). As a result of these more stringent requirements, there was increased coordination between air quality and transportation agencies, an increased focus on travel demand management strategies, and a focus on improving travel and air quality forecasting (Weiner 2013; Barbour 2002).

The Transportation Equity Act for the twenty-first Century (TEA-21) (1998) continued all the major ISTEA (1991) programs and expanded funding for the environmental programs established by ISTEA (1991) (Weiner 2013). The increasing recognition of 'smart growth' initiatives/development is

reflected in this federal legislation, particularly the prioritization of multi-modal transportation systems and environmental protection (and their links to quality of life) (U.S. Federal Highway Administration 2017).

By 1998, California's growth-related problems had intensified; and 40% of urban freeways were congested, a 27% increase from ten years earlier (Barbour 2002). In 2002, "the most important growth policy changes in California" in a decade were made under a new law, AB 857 (2002) (Fulton 2003; cited in Pallagst 2017). Broadly speaking, AB 857 (2002) set out state planning priorities for the management of development and growth (Freilich et al. 2010). More specifically, this legislation requires that the Governor submit a proposed five-year infrastructure plan at the time of budget submission, in addition to an Environmental Goals and Policy Report that establishes state-wide comprehensive land-use policy and plans to meet stated environmental goals in the face of population growth pressures facing the state (AB 2002 sec. 13102 and 65041). AB 857 (2002 sec. 65041.1) sets out 'smart growth' planning priorities and mandates that the State's Environmental Goals and Policy Report be consistent with them.

While these state planning priorities are important for guiding government infrastructure plans, programs and other investments, it is important to note that no comprehensive state land-use plan exists for decisions regarding private development or for local comprehensive plans (Freilich et al. 2010). Further state involvement in land-use planning would continue with the passing of the 2006 Strategic Growth Plan, and the *Transportation Planning, Traffic Demand Modeling and Sustainable Communities Strategy Act* (SB 375) in 2008.

In 2006 voters approved the implementation of phase one of the newly developed Strategic Growth Plan, which set out a 20-year vision for the rebuilding of California through substantial infrastructure investments (Freilich et al. 2010). In order to coordinate the numerous state agencies and local governments involved in implementing the plan, the Strategic Growth Council (SGC) was created in the Office of the Governor, tasked with:

- Coordinating activities to best improve (and water) quality, improve natural resource protection, increase the availability of affordable housing, improve transportation, meet the goals of AB 32, and encourage sustainable land-use

- Encourage the development of sustainable communities consistent with the intent of Proposition 84 to support planning and sustainable communities
- Collect, manage, and provide data and information to local governments that will assist local governments in developing and planning sustainable communities (Freilich et al. 2010, p. 89).

Three aspects of this newly created organization and its functions are notable in the context of policy integration and state steering to enhance polycentric governance. First, multiple interlinked areas are integrated under this approach, including land-use, transportation, housing and the environment. Second, a key function of the SGC is to assist local governments by collecting, managing and providing information in order to improve decision-making, in part compensating for the lack of capacity (financial, human, technical/modeling) common to this level of government. Lastly, the positioning of this organization at an executive level implies the seriousness with which the state government takes this organization's role, as opposed to creating an organization embedded at a lower level within a specific government department where coordinating activities would be much less effective.

In 2007, the legislature passed SB 97 (2007), which effectively enhanced CEQA as a procedural policy mechanism for integrating climate mitigation objectives into environmental assessments (required by CEQA) and, therefore, decision-making. SB 97 (2007) required that amendments to CEQA be made to include an analysis of GHG emissions as a part of the CEQA process (CEQA Guidelines, § 15064.4, subd. (a)). Continuing this momentum in smart growth planning and investment, SB 375 was passed in 2008, introducing requirements to integrate interlinked issues further (e.g., transportation, housing, environment, land-use planning) in Regional Transportation Plans in order to meet regional vehicle GHG reduction targets, developed by CARB as per this legislation. The passing of SB 375 was hailed as an innovative and leading-edge approach to sustainable growth management legislation. Like the Strategic Growth Council and Plan, SB 375 attempts to overcome implementation issues within multi-level governance systems by designing a system through legislation to ensure land-use and transportation decisions align with environmental, social and economic objectives.

The so-called Sustainable Communities Law (SB 375) attempts to do so by requiring all Metropolitan Planning Agencies to coordinate Regional Transportation Plans with housing assessments and needs, and also provide for transit-oriented development, transit corridors and centers, mixed-use and walkable communities, and the preservation of rural, agricultural and environmental lands (Freilich et al. 2010). The integration of these issues is structured as Sustainable Community Strategies (SCS) within the Regional Transportation Plans, developed with the ultimate goal of reducing vehicle GHG emissions in line with regional reduction targets developed by CARB (Freilich et al. 2010). Vehicle GHG reduction targets set by CARB for individual regions vary in their stringency, from 6-8% by 2020, and 13-16% by 2035 (Sperling and Eggert 2014; Transportation Research Board 2011). The SCSs are vetted by CARB which is tasked with confirming that the plan, when implemented, will meet the regional GHG reductions goals set by the agency; if the measures set out in the SCS would not meet the reduction targets then a separate "alternative planning strategy" outside of the regional transportation plan is required in order for targets to be met (CARB 2019c). Table 10 shows the status of Sustainable Communities targets set by CARB in California, as of 2018.

Table 10. The status of Sustainable Communities Strategies targets as of 2018 (CARB 2018i).

MPO	Targets Thru September 30, 2018 [a]		Targets Beginning October 1, 2018 [a]	
	2020	2035	2020	2035
MTC/ABAG	-7%	-15%	-10%	-19%
SACOG	-7%	-16%	-7%	-19%[b]
SANDAG	-7%	-13%	-15%	-19%
SCAG	-8%	-13%	-8%	-19%
Fresno COG	-5%	-10%	-6%	-13%[c]
Kern COG			-9%	-15%[c]
Kings CAG			-5%	-13%[c]
Madera CTC			-10%	-16%[c]
Merced CAG			-10%	-14%[c]
San Joaquin COG			-12%	-16%[c]
Stanislaus COG			-12%	-16%[c]
Tulare CAG			-13%	-16%[c]
AMBAG	0%	-5%	-3%	-6%
Butte CAG	1%	1%	-6%	-7%
San Luis Obispo COG	-8%	-8%	-3%	-11%
Santa Barbara CAG	0%	0%	-13%	-17%
Shasta RTA	0%	0%	-4%	-4%
Tahoe MPO	-7%	-5%	-8%	-5%

[a] Targets are expressed as a percent change in per capita passenger vehicle greenhouse gas emissions relative to 2005.

SB 375 sets out an approach for local and regional governments and agencies to meet vehicle reduction targets that consist of three components:

1. Modifying transportation patterns and investments at the regional level through the regional transportation plan;
2. Linking land-use, transportation, and housing decisions at the regional and local level through the regional housing needs assessment process and the housing element of the local general plan; and
3. Providing incentives to streamline the environmental review of plans and projects that assist in meeting regional greenhouse gas reduction targets (Institute for Local Government 2011).

State provision of infrastructure funding is also mandated to be consistent with the regional plans (SB 375 2008). In addition, the *Sustainable Communities Act* affords incentives to developers in the form of relief from environmental review requirements under CEQA in cases where proposed developments, specifically mixed-use and residential projects, are consistent with regional SCS (or alternative planning strategies) (CARB 2019c). Although this "landmark anti-sprawl legislation" (Freilich et al. 2010) is arguably the closest the state has come to comprehensive regional planning promoting smart growth and transit-oriented development, it importantly does not change land-use law or local control over land-use decisions (Santos et al. 2014). This reality has not helped combat implementation issues around transit-oriented development, which stems in large part from widespread NIMBY attitudes (Boarnet and Crane, 1997, 1998; cited in Barbour 2002).

The most recent federal effort to promote smart growth development was the establishment of an interagency "Partnership for Sustainable Communities" in 2009 (Weiner 2013). In recognizing that, historically, federal policies have often contributed to sprawl, congestion and pollution, then-President Obama tasked three agencies, the U.S. EPA, DOT and Housing and Urban Development (HUD), with coordinating federal transportation, environmental protection and housing investments to promote smart growth and transit-oriented development (Weiner 2013). The interagency partnership ensures knowledge is shared and the work of each respective agency is coordinated in order to ensure that investments support housing, transportation and environmental protection goals. In this respect, the Partnership represents a classic horizontal policy integration mechanism at the federal level.

The next major policy innovation at the state level for promoting sustainable community planning targeted California's disadvantaged communities that are most burdened by pollution. AB 2722 was passed in 2016, creating the Transformative Climate Communities Program, under which competitive grants are awarded to develop and implement Transformative Climate Communities Plans and fund infrastructure projects that will reduce GHG emissions and provide other substantial co-benefits (Strategic Growth Council 2019a). The grants are funded through California's cap-and-trade revenues, and therefore recipients of funding are responsible for monitoring and reporting emissions reductions in addition to reporting on co-benefit indicators (Strategic Growth Council 2019a).

In 2016 the government released the California Transportation Plan 2040, a core document which aims to set out the state's role in pursuing a sustainable transportation system, in large part by tying together the state's multiple inter-related plans, including the Interregional Transportation Strategic Plan (ITSP), the California Freight Mobility Plan (CFMP), the California State Rail Plan (CSRP), the California High-Speed Rail Business Plan, the Statewide Transit Strategic Plan, the California Aviation System Plan (CASP), and the Bicycle and Pedestrian Plan (California Department of Transportation 2016a). The California Transportation Plan 2040 will serve to guide the development of future modal plans, programs and investments in order "to provide a statewide transportation system capable of meeting mobility, safety, sustainability, and economic objectives in the fight against climate change" (California Department of Transportation 2016a, p. 11). From a governance perspective, this Plan represents an important first step in integrating disparate but related efforts to reduce emissions from transportation, amongst the plan's other goals (see Figure 16).

Under-resourced communities received additional support in 2018 under SB 1072 (2018), which established the Regional Climate Collaborative Program. As per SB 1072, Regional Climate Collaboratives have been created to undertake 'capacity building activities', defined by this legislation as including (but not limited to) "identifying and planning for needed climate change mitigation and

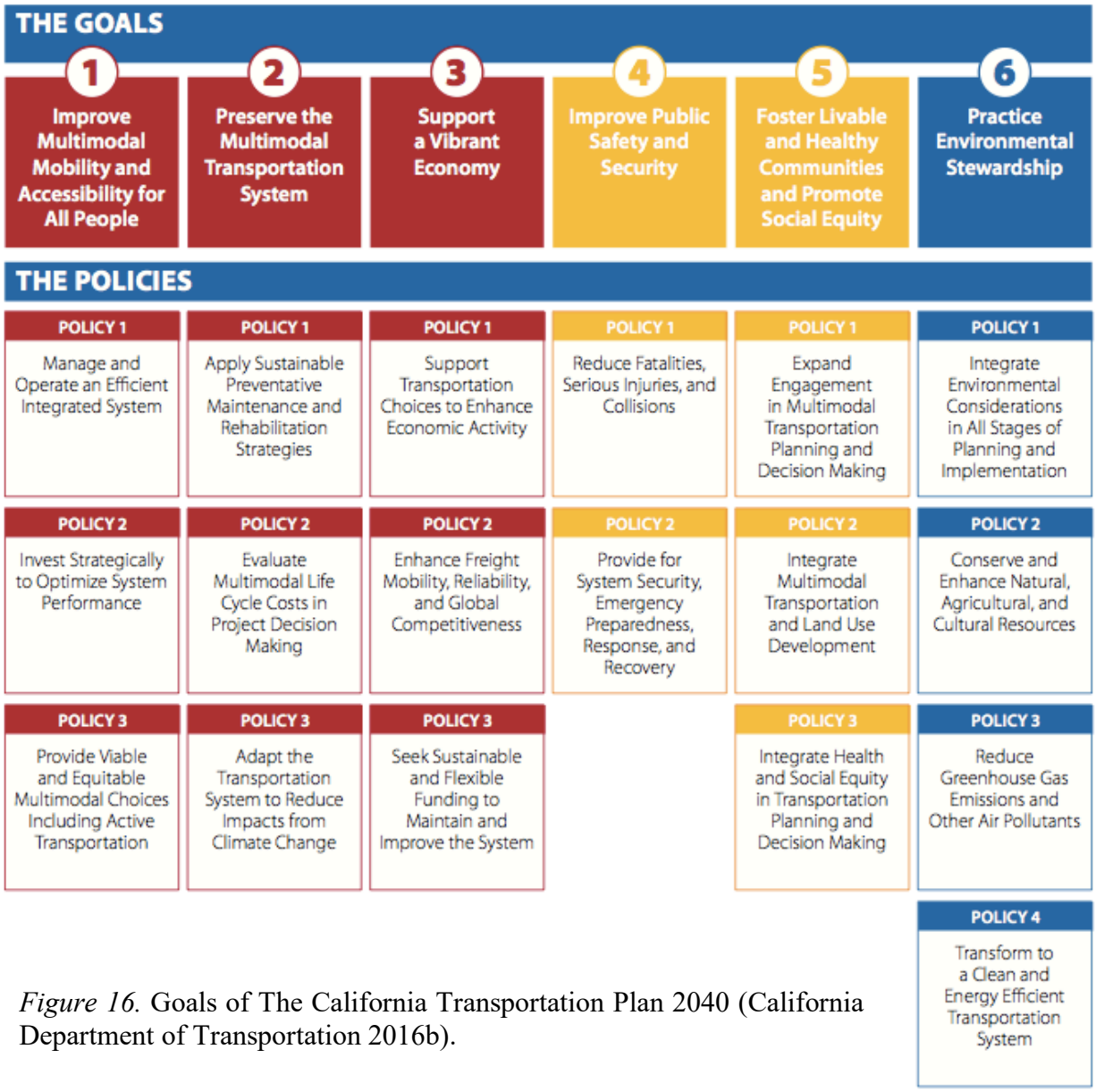


Figure 16. Goals of The California Transportation Plan 2040 (California Department of Transportation 2016b).

adaptation projects in a given region and identifying the tools and resources needed to successfully access, apply for, and receive grant funding" (SB 1072 2018, sec. 2(3.6)). Both of these laws acknowledge in their design and aim that disadvantaged and under-resourced communities often lack the monetary, human and technical capacity to apply for grant funding, which under SB 1072 is authorized for project planning and implementation (Georgetown Climate Center 2018).

Transit-specific planning or investments

Landmark funding programs for mass transit were introduced in the 1970s at both the state and federal level. At this time, there was an increasing awareness of the negative environmental impacts of automobiles combined with frustrations about long-line ups at gas pumps resulting from the OPEC oil embargo, which had the combined effect of stimulating efforts to support alternative transportation modes (Garrett 2016). In 1970 the federal government passed *The Urban Mass Transportation Assistance Act* (1970), which provided for the first time a long-term commitment of federal funds for mass transportation, which until this time had been limited (Weiner 2013). Ten billion dollars USD was committed over a 12-year period, including USD 3.1 billion for urban mass transit (Weiner 2013).

The California *Transportation Development Act* (1971), passed the following year, provided, for the first-time, consistent funding for public transportation expenditures by leveraging portions of the state's general sales tax and statewide tax on diesel (Tahoe Regional Planning Agency 2017). Landmark government funding to develop mass transit systems was, in part, a response to public discontent over air pollution and smog in parts of the state (see Figure 17).

Figure 17. "Gas Masks", Los Angeles November 16, 1967 (Los Angeles Public Library 2019).

Two funds were created via the *Transportation Development Act* (1971): The Local Transportation Fund (LTF) and the State Transit Assistance Fund (STA). The LTF derives its funding from a ¼ cent of the general sales tax and expenditures from this fund are returned via spending in the county where the tax was collected; the STA derives funding from the statewide diesel tax and allocates funds based 50% on population and 50% based on operator revenues from the prior fiscal year (Tahoe Regional Planning Agency 2017). The TDA (1971) continues to be a significant source of consistent funding for public transportation in California, providing billions of dollars to fund a range of projects (California Department of Transportation 2013). In 1973 the California legislature proposed a constitutional amendment (Stats. 1973, res. c. 145 (S.C.A. 15)) to allow the use of motor fuel excise taxes to be used for certain mass transit purposes; In the June 1974 primary voters approved this measure (Proposition 5) (Garrett 2016).

Three additional substantive pieces of federal legislation were passed in the 1970s, which provided increased funding for mass transit, including both capital and operating expenses: *The Federal-Aid Highway* Act (1973), The *National Mass Transportation Assistance Act* (1974) and *The Surface Transportation Assistance Act* (1978). In 1974 the federal government launched its first program designed at developing, demonstrating and evaluating ways to manage transportation better and promote innovative transit services. The Service and Methods Demonstration Program sought to demonstrate and evaluate how existing technologies could improve transportation management in the short term and at low capital costs, with the ultimate objective of making mass transportation more efficient (Weiner 2013). These Acts, in addition to the *Urban Mass Transportation Act of 1970*, represent a huge federal investment in public transit, at just under USD 35 billion dedicated in the 1970s.

Rail transit was provided with a massive funding boost in 1987 under Title III, The Federal Mass Transportation Act (1987), under the *Surface Transportation and Uniform Relocation Assistance Act* (1987). Between 1987-1991, the federal government authorized USD 17.8 billion, 80% of which was dedicated to new rail starts and extensions and for rail modernization grants (Weiner 2013). At this time, rail, in particular, was also targeted for funding at the state level. In 1990, voters approved Proposition 111, authorizing the 1989 legislation the Blueprint for the Twenty-Firstt Century (Stats. 1989, c. 105), which effectively doubled the state's gasoline tax and providing authorization for bond funding of rail transit projects (Barbour 2002). The blueprint tax increases raised USD 18.5 billion over ten years, for

highway and mass transit projects (Garrett 2016). Following this authorization, the *Passenger Rail and Clean Air Bond Act* (1990) was passed, providing for a USD 1 billion bond to be deposited in the Passenger Rail Bond Fund (established by this bill) for the purposes of expenditures for intercity rail, commuter rail and rail transit programs. The link between supporting rail transportation and reducing sprawl and transportation-related emissions is made clear, not only in the name of the act, but in the bill text, which justifies this significant spending with projections that every rail car will remove 75-125 vehicles from California roads, providing for better air quality and traffic relief in the state's most congested corridors (*Passenger Rail and Clean Air Bond Act* 1990).

Rail projects received additional support from Proposition 116, which was also passed in 1990, enacting the *Clean Air and Transportation Improvement Act* (1990). This legislation authorized almost USD 2 billion for specific transportation projects, almost all of which were passenger rail capital projects (California Transportation Commission 2014). In 1991 the federal government passed *The Intermodal Surface Transportation Efficiency Act (ISTEA) (1991)*, which established the Congestion Mitigation and Air Quality Improvement Program. This legislation specifically targeted reductions in transportation-related emissions by funding projects in air quality non-attainment areas; by 2015, the program had provided over USD 30 billion, funding more than 30,000 transportation-related environmental projects at the state level (U.S. Department of Energy 2017).

ISTEA (1991) also established the federal program to research and test formal Intelligent Transportation Systems (ITS) and support their implementation in order to improve efficiency, productivity, safety and convenience for surface transportation users (U.S. DOT 2000; cited in Weiner 2013). A few years later, at the state level, the Intelligent Transportation System Society of California was established as a public/private partnership to foster the development and implementation of innovative ITS technologies to improve public service and provide opportunities for private investment (Intelligent Transportation Systems Society of California 2017).

A few years later, the federal government introduced an innovative financing mechanism for transportation projects designed to provide States with increased flexibility for how infrastructure investments could be funded and to maximize the purchasing power of federal surface transportation funds (Weiner 2013). The State Infrastructure Bank Pilot Program was authorized by section 350 of the *National*

Highway System Designation Act (1995) and was extended for four states, including California, by *The Transportation Equity Act for the Twenty-First Century* (TEA-21) (1998). TEA-21 (1998) built upon and expanded ISTEA (1991) policies and programs; importantly, it added guaranteed funding for continuing and expanding surface transportation environmental programs under ISTEA (1991) between 1998-2003. Another sizeable federal funding package for mass transportation came in 2005 under the *Safe, Accountable, Flexible, Efficient Transportation Equity Act* (SAFEETEA-LU) (2005). This legislation authorized a total of USD 52.6 billion for mass transportation programs between 2004-2009, continuing all existing TEA-21 (1998) programs and adding two new programs in 2006: the New Freedom Program and the Alternative Transportation in National Park and Public Lands Program (Weiner 2013). SAFEETEA-LU (2005) also authorized USD 110 million for ITS research and development between 2005-2009 and USD 112 million in 2005 to implement ITS technologies (Weiner 2013).

In November 2006, the government of California and California voters authorized a new wave of funding for mass transportation with the objective of improving air quality and relieving congestion. Proposition 1B authorized the issuance of USD 19.925 billion for state transportation programs; USD 1 billion was deposited in the State-Local Partnership Program Account (California Transportation Commission 2017). Proposition 1B (2006) also created the Public Transportation Modernization, Improvement, and Service Enhancement Account Program, which was allocated USD 3.6 billion of the roughly USD 20 billion authorized in state general obligation bonds (Caltrans 2017).

The states increasing focus on building a high-speed rail network received a funding boost by voters in 2008 with the passing of Proposition 1A (2008). Proposition 1A (2008) authorized just under USD 10 billion in state general obligation bonds specifically for the purpose of funding high-speed and traditional passenger rail. Improving passenger rail, including the development of high-speed rail, was also the focus of the federal government's 2008 *Passenger Rail Investment and Improvement Act* (PRIIA). The U.S. Department of Transportation was authorized to award nearly USD 10 billion in grants to the National Railroad Passenger Corporation (Amtrak) between 2009-2013 for capital and operating expenditures that would improve passenger rail service, operations and facilities with the goal of strengthening the national rail network (Amtrak 2011; Weiner 2013).

The first long-term highway funding authorization since SAFEETEA-LU in 2005, *The Moving Ahead for Progress in the 21st Century Act* (2012), was signed into law by then U.S. President Obama in 2012, continuing the custom of financing major transit programs (Weiner 2013). MAP-21 built on the transit, bike and pedestrian programs initiated in 1991, and added a "core capacity" funding criteria that allowed increased spending flexibility, in addition to enabling the funding of more bus rapid transit projects (Weiner 2013). This legislation authorized approximately USD 105 billion for FY 2013 and 2014, representing a stable amount of funding from the previous authorization bill, but with significant reforms to the policy and programmatic framework for investments in the U.S. transportation system, in part to meet environmental protection and congestion relief objectives (U.S. DOT 2012). California received roughly USD 3.5 billion in both 2013 and 2014 from federal-aid program funds authorized under MAP-21 (U.S. DOT 2012). MAP-21 (2012) also continued to support ITS research and development started under SAFEETEA-LU (2005) and bolstered this research by providing USD 400 million annually for competitive research grants at U.S. universities to undertake further innovative ITS research and transportation research more broadly (Weiner 2013).

The state's support of rail programs, which was bolstered in the early 1990s and 2008 by directed funding measures, began being framed a few years ago as part of the state's larger effort to electrify transportation, relieve congestion, and reduce vehicle miles travelled in order to reduce GHG emissions. In 2014, SB 862 established the Transit and Intercity Rail Capital Program (TIRCP), which authorized grants from California's Greenhouse Gas Reduction Fund for "transformative capital improvements" in the state's rail system; the first stated objective listed in this legislation is a reduction in greenhouse gases (Caltrans 2018). In 2015-2016 The TIRCP received USD 200 million and has since appropriated 10% of the state's annual cap-and-trade proceeds; Approximately USD 3 billion in additional funds have been directed to the TIRCP from SB 1 (2017) between 2017-2027 (Caltrans 2018a).

The state government continues to pay particular attention to the development of 100% renewable energy-powered high-speed rail, to which 25% of annual proceeds from the state's Greenhouse Gas Reduction Fund are directed Beginning in FY 2015-2016 (SB 862 2014). According to the Governor's Interagency Working Group on Zero Emission Vehicles (2018), the development of a comprehensive high-speed rail network "represents the backbone of the state's transition to electrified transportation".

The most recent reauthorization of federal transit program funding since MAP-21 (2013) is the *Fixing America's Surface Transportation Act* (FAST) (2015), which is providing stable funding analogous with MAP-21 funding until 2020. In addition to funding existing transit programs, FAST (2015) reintroduced the Discretionary Bus Program, whereby grants will be used to replace older fleet buses and increase deployment of zero or near-zero emission buses (Federal Transit Administration 2017). At the state level, the most recent transportation funding initiative, and most significant legislation in a generation in terms of the amount of funding, is SB 1, *The Road Repair and Accountability Act* (2017). This landmark legislation provides USD 54 billion over ten years to fix a backlog of transportation-related repairs and pursue a more sustainable, low-carbon transportation system (State of California 2019). Roughly half of the USD 54 billion is directed to state transportation infrastructure investments (e.g., highway improvements), while the remaining funds are directed to programs significant to supporting mass transit, active transportation and congestion relief (State of California 2019).

SB 1 (2017) also provides significant funding to programs that have a large focus on transit initiatives such as the State-Local Partnership Program (USD 200 million annually) and the State Transportation Improvement Program, which was restored by this legislation (State of California 2019). While the magnitude of funding under this legislation may seem enormous, it is just a start to addressing the backlog of transportation funding shortfalls. During the ten years of SB 1 funding program, the state faces a USD 59 billion shortfall to keep the existing state highway system in a state of goof repair, cities and counties face a USD 78 billion shortfall to adequately maintain local streets and roads, and California's public transit system faces a USD 72 billion shortfall over the same time period (Garrett 2016; SB 1 2017).

Other TDM measures

Active transportation

Early efforts to encourage active transportation in California, specifically bicycle commuting, began in 1993 with the establishment of the Bicycle Transportation Account (BTA), which provides USD 7.2 million in dedicated annual funding for city and county bicycle projects (Caltrans Division of Local Assistance 2017). In order to receive funding for eligible projects, local agencies must prepare a Bicycle Transportation Plan conforming to Streets and Highways Code 891.2, which must then be approved by

the local Regional Transportation Planning Agency (Caltrans Division of Local Assistance 2017). Dedicated funding efforts for active transportation also increased in the early 1990s at the federal level.

Changes to federal transportation funding in the 1990s mark the shift to dedicated funding streams for active transportation infrastructure and programs, starting with ISTEA (1991). Prior to this the *Federal Aid Highway Act* (1973) allowed for discretion for how local governments would spend federal transportation funds, but this flexibility did not result in a large portion of funded active transportation projects; between 1974 and 1991 only 385 active transportation projects were obligated nationally, representing roughly USD 85.6 million in 2013 dollars (Fields and Cradock 2014). The passing of ISTEA (1991) represented a shift to a "post-interstate" era where transportation policy started to have much more of a multi-modal focus, specifically in the form of a dedicated funding stream for "transportation enhancement projects" (Weingroff, 2001; cited in Fields and Cradock 2014).

ISTEA (1991) resulted in a "dramatic increase" in federal funding for bicycle and pedestrian infrastructure and facilities, which was continued and built upon in two subsequent federal transportation bills, TEA-21 (1998) and SAFETEA-LU (2005) (Handy, McCann, Bailey, McRee, Meharg, Ewing and Wright 2009; Fields and Cradock 2014). TEA-21 (1998) increased funding for bicycle and pedestrian projects significantly, more than doubling spending over the six-year life of the bill from the previous transportation bill ISTEA (1991) (Handy et al. 2009). SAFETEA-LU (2005) further expanded opportunities for federal funding for bicycle and walking projects. Over the course of this funding bill (2006-2010), 11,669 projects were funded by roughly USD 4 billion authorized under this legislation (Handy et al. 2009; Fields and Cradock 2014).

In the early 2000s, Caltrans set ambitious targets to increase active transportation trips and developed a plan to meet these objectives, specifically through increasing funding and comprehensive planning efforts to integrate active transportation infrastructure into the state transportation system (Safe Transportation Research and Education Center [SafeTREC] 2017). The 2003 plan, California Blueprint for Bicycling and Walking, set goals to increase walking and bicycling trips by 50% by 2010 and reduce pedestrian and cyclist fatalities by 50% by the same year (Safe Transportation Research and Education Center [SafeTREC] 2017).

Also, in 2001, the first comprehensive and significant Deputy Directive for Caltrans on walking and cycling, DD-64, was set out, stating "the need to accommodate non-motorized travelers as an important consideration in improving the transportation network" (California Department of Transportation 2016). In 2008, this directive was updated to reflect the planning changes made by the *Complete Streets Act* (AB 1358, 2008). Specifically, this act required that the needs of all roadway users (including cyclists and pedestrians) be accounted for in any updates to local general plans; the updated Caltrans directive, (DD-64), explicitly calls for the promotion of 'complete streets' to ensure all travelers can safely and efficiently move (CalBike 2019). According to CalBike (2019), Caltrans has not succeeded in implementing its internal directive, often failing to improve streets during repairs for cyclists, pedestrians and transit users. Integrating measures to increase active transportation in transportation planning was further bolstered in 2008 with the passing of SB 375, which requires that Metropolitan Planning Agencies expressly identify ways to increase walking and biking in their Sustainable Communities Strategies (CARB 2017b). In order to ease the process for retrofitting streets and highways to add bicycle lanes in urban areas, these restriping projects became exempt from assessments under the California Environmental Quality Act in 2012 as long as they are consistent with a bicycle transportation plan (AB 2245 2012).

Unfortunately, the enthusiasm for building complete streets at state and local levels was not matched at the federal level at the same time, resulting in a scaling back of funding for active transportation programs under the next major federal transportation bill, MAP-21 (2012) (Fields and Cradock 2014). On a positive note, MAP-21 introduced increased flexibility for how federal monies could be used. For example, the government clarified under MAP-21 that funding under the Highway Safety Improvement Program should be directed at improving the safety of all road users, not just motorists (California Walks 2018).

The government of California continued to ramp up its active transportation efforts, passing some significant pieces of legislation and increasing funding efforts beginning in 2013. In 2013 the California Government consolidated various active transportation governance initiatives (both federal and state) in order to become a national leader in active transportation. The Active Transportation Plan was established in the Department of Transportation as per SB 99 (2013) and AB 101 (2013), consolidating the Transportation Alternatives Program, Bicycle Transportation Account and Safe Routes to School

(Caltrans Division of Local Assistance 2019). Goals are set out under this plan in order to promote an overall increase in active transportation (Caltrans Division of Local Assistance 2019).

Approximately USD 200 million is appropriated annually from state and federal transportation funds by Caltrans to fund projects under the Active Transportation Program (Caltrans Division of Local Assistance 2019). In 2017, SB 1 (*The Road Repair and Accountability Act* of 2017) added another USD 100 million annually to the Active Transportation Program (ATP); all programmed ATP projects are required to submit progress reports to Caltrans (California Department of Transportation 2017a). As of 2019, 776 active transportation projects were programmed (Petek 2019). As Figure 18 illustrates, ATP funding represents USD 1.6 billion of the approximately USD 3 billion in total project costs (other sources like local funds constitute the remainder of project funding).

Funding Cycle	Number of Projects	Funding
Cycle 1		
State	126	$183.6
SUR	22	36.6
MPO	115	133.7
Subtotals	(263)	($353.9)
Cycle 2		
State	87	$179.9
SUR	27	35.5
MPO	93	143.4
Subtotals	(207)	($358.8)
Cycle 3		
State	101	$212.8
SUR	19	47.9
MPO	125	348
Subtotals	(245)	($608.7)
Cycle 4		
State	51	$237.6
SUR	10	43.8
MPO[a]	—	—
Subtotals	(61)	($281.4)
Totals	**776**	**1,602.8**

Figure 18. Active Transportation Projects and Funding in millions of dollars (USD) (Petek 2019).

A new law was passed the same year in order to help ensure cyclists experienced safer road conditions. The *Three Feet for Safety Act* (2013) requires all motorists to give at minimum three feet of clearance when passing cyclists on the road (California Bicycle Coalition 2016). The following year

Congress passed legislation to enable the building of protected/separated bikeways in order to help meet the state objective "to encourage the planning, design, and construction of protected bikeways, so as to foster bicycling as a means of transportation, in a manner that improves safety for all users" (AB 1193 2014, sec. 1(f)). *The Protected Bikeways Act* (AB 1193 2014) effectively ended the prohibition on protected bikeways by removing the requirement for cities and counties to follow Caltrans' dated guidelines and adding a new class of bikeways, "class 4" separated bikeways, amending sections 890-891 of the California Streets and Highways Code (California Bicycling Coalition 2014). In order to provide additional funding for state bicycle infrastructure projects, local governments and regional park districts were authorized in 2014, as per SB 1183 (2014), to impose a motor vehicle registration surcharge solely for this purpose (CARB 2014a).

Active transportation measures feature as a core piece of the previously mentioned "California Transportation Plan 2040", which was released in 2016. In particular, expanding bike and pedestrian facilities under the Active Transportation Program, in a way that supports citywide or corridor-wide active transportation, is a key implementation component for meeting the Plan's goals. Comprehensive planning of state-wide active transportation activities was further developed in 2017 by the production of "Toward an Active California", the state's mechanism for providing "state-wide policy direction to support travel by bicyclists and pedestrians" (California Department of Transportation 2017b).

In 2016 and 2017, increased funding for active transportation was bolstered through budget allocations. In 2016, USD 100 million of cap-and-trade funding was authorized to implement a new Low Carbon Road Program, defined as "competitive grants for improvements to local streets and roads that encourage active transportation, such as walking and bicycling, transit, and other carbon-reducing road investments" (Curry 2016). Two key issues were highlighted with the announcement of this program: first, the existing Active Transportation Program serves the same function and is underfunded, meaning this money would be better spent simply being allocated to the existing program; second, projects eligible for funding under the Low Carbon Road Program include the vaguely defined "other carbon-reducing road investments", meaning this money could go to projects other than active transportation (Curry 2016). For example, traffic light improvements using ITS or new highway toll lanes have been defined as emission-reducing measures in some regional plans (Curry 2016). Expanded funding was provided the next year for the Active Transportation Program; the 2017-18 State Budget allocated an additional USD 100 million to

the program for bicycle and pedestrian infrastructure projects that would increase access to transit services (Government of California 2017).

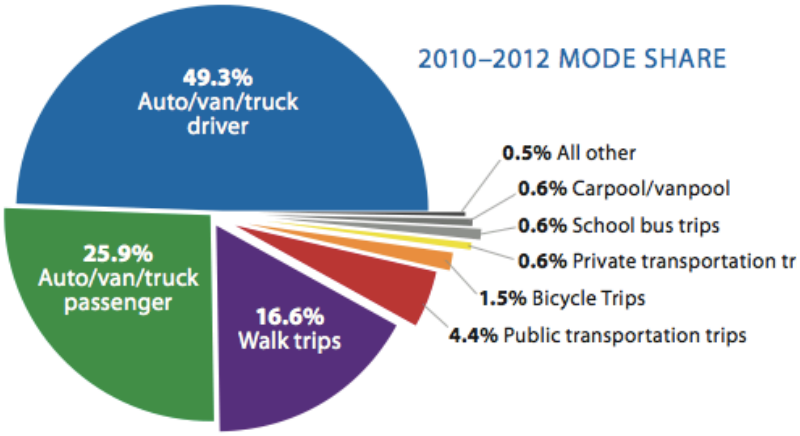


Figure 19. California Transportation Mode Share 2010-2012 (California Department of Transportation 2016a).

The efforts by successive California governments to promote active transportation have proven to be successful, at least with regards to promoting the use of cycling and walking as a transportation mode. In 2013 California ranked 19th under the League of American Bicyclists nationwide survey but has moved up considerably to 3rd in the nation in their latest survey in 2017 (California Department of Transportation 2017a). That being said, as Figure 19 illustrates, in 2012 cycling still makes up a very small percentage of transportation mode share (1.5%). Given the state's moderate climate, the Department of Transportation continues to set ambitious goals for increasing active transportation mode shares, aiming for 4.5% mode share for cycling and 33.2% mode share for walking by 2020 (California Department of Transportation 2017b). In 2019, the Legislative Analyst's Office resealed the first-ever evaluation of California's Active Transportation Program. The report found, mainly due to inconsistent counting and reporting methodologies, that meaningful conclusions were unable to be made regarding the effectiveness of the program in actually increasing modal shares for walking and biking (Petek 2019, p. 5).

Ride-Sharing/Carpooling/HOV lanes

Carpooling in the United States dates back almost as early to the advent of the motor vehicle itself (Cozza 2012). Starting in the early 1900s in San Francisco, car owners started offering seats in their cars to people for the same price as a streetcar fare, but government policy, especially liability rules, diminished

this trend greatly (Cozza 2012). These informal car-sharing vehicles were known as 'jitneys,' and by 1915, there were over 1,400 operating in the city of San Francisco (Amey 2010). Given California's early history of air pollution and congestion issues, it is not surprising that the state was once again a pioneering jurisdiction, this time with regards to differential road treatment. Local authorities were authorized by the Department of Transportation to permit preferential or exclusive use of highway lanes for high-occupancy vehicles in 1959 (Cal Veh Code § 21655.5). In 1970 the nation's first HOV lane was built as a by-pass lane on the San Francisco – Oakland Bay Bridge (Levin 2018).

Substantial federal government support for ridesharing started after the Oil Embargo when then-President Nixon signed the *Emergency Highway Energy Conservation Act* (1974), which provided that Federal-Aid Highway funds could be used for ridesharing initiatives like demonstration projects (Weiner 2013). A few years later, the federal government expanded two state energy conservation programs requiring states to implement specific conservation actions, which included carpooling and vanpooling (Weiner 2013). The context of constrained oil resources and government support made the 1970s the peak in carpooling in the U.S.; by 1980, 23.5% of Americans were carpooling (Cozza 2012) compared to 9% in 2016 (Tomer 2017). Participation in carpooling fell in the following years as oil prices fell alongside government support (Cozza 2012).

ISTEA (1991) encouraged the building of HOV lanes as a part of the legislation's aim to renew America's surface transportation; expanded funding was provided under ISTEA (1991) by allowing Congestion, Mitigation and Air Quality funds to be used for HOV lane development (U.S. Department of Energy 2017a). In 1998 mass transit vehicles in California were permitted to use HOV lanes without meeting the occupancy requirement, as per SB 236 (1998). Paratransit vehicles were granted the same exemption in 2003, as per AB 2582 (2003). The most recent federal amendments to HOV provisions (23 U.S.C. § 166) came in 2015 under section 1411 of the *FAST Act* (Pub. L. 114-94). This legislation allows states to authorize specific vehicle exemptions for the use of HOV lanes when excess capacity exists or is anticipated (U.S. Federal Highway Administration 2016). Specifically, environmentally-friendly vehicles are encouraged for authorization of both HOV lanes and tolled HOT lanes when excess capacity exists (U.S. Federal Highway Administration 2016).

Emission reduction standards are not included in the federal criteria (under 23 U.S.C. § 166.) for determining HOV lane effectiveness, instead the federal government considers an HOV lane to be effectively utilized if it carries at least 800 vehicles per hour during rush hours and ensures traffic flows at least 45 mph most of the time (Levin 2018). California HOV lanes have failed to meet the federal benchmark regarding congestion, i.e., traffic flow of 45 mph most of the time, but surpass the 800 vehicles per hour during rush hour criteria, in some cases by a lot (Levin 2018). In terms of reducing emissions, recent research has shown that California's HOV lanes have resulted in 10-15% fewer hydrocarbon/nitrous oxide emissions than untreated lanes in both Northern and Southern California (Levin 2018).

Given that California's Silicon Valley is home to a significant number of technology companies, it is perhaps not surprising that the state government was the first in the nation to ensure its regulations matched the rapid rise of car-sharing services, such as Uber and Lyft. In 2013, the California Public Utilities Commission passed proposed rules to create a new class of 'transportation network companies', making California the first state in the nation to legalize and regulate these peer-to-peer services (Geron 2013). Local governments and organizations like transit agencies and universities also facilitate carpool and rideshare programs in California. For example, the LA Metro provides an online platform for ride-matching based on user commute input (LA Metro 2018). In 2015, California legislation authorized local governments to designate parking spaces for the use of vehicles involved in car-sharing or rideshare programs (AB 1015 2015). California's Department of Transportation has roughly 327 park and ride parking lots containing roughly 34,000 parking spaces (Ferguson et al. 2016).

Road pricing

The establishment of modern tolls on California roads dates back to the mid-1920s when Bay area bridges began to be constructed. The Antioch Bridge opened in 1926, followed by the Carquinez and Dumbarton bridges in 1927, San Mateo Bridge in 1929, and the Bay Bridge in 1936 (California Department of Transportation 2004). In 1929, the California Toll Bridge Authority was created (Stats. 1929, chap. 763, p. 1489) to govern bridge tolls on existing bridges and future bridges: The Richmond San Rafael Bridge (opened 1956), the Benicia-Martinez Bridge (opened 1962) new San Mateo Bridge (opened 1967), the Vincent Thomas Bridge (opened 1963) and the Coronada Bridge (opened 1969) (California Department of Transportation 2004). Currently, the state owns and operates seven toll bridges,

which are said to be the largest and most complicated bridges in California (California Department of Transportation 2019).

The establishment of HOT lanes experiments in California in the 1970s was intended to be a solution to underutilized capacity in HOV lanes. The idea was that by allowing drivers to buy into HOV lanes at a low enough price, the excess capacity of the HOV lane would be used, but not to the point of overcrowding (Elliott 1986). Other early toll road projects were very much stemming from congestion issues as opposed to trying to impact travel demand. Although experiments would take place, it would not be until the late 1980s and early 1990s that both the state government and U.S. federal government would take substantive action to promote the establishment of tolled roads and lanes. In 1987, the California legislature authorized the establishment of a joint-powers authority to build toll roads in Orange County and in 1989, the legislature passed Assembly Bill 680 (1989), permitting Caltrans to develop and implement demonstration projects for privately funded transportation projects (Fielding 1993).

HOT lane projects, in particular, were supported by ISTEA (1991), which eliminated restrictions on tolling on interstate facilities and facilitated HOT demonstration programs under its Value Pricing Pilot Program (VPPP) (U.S. Federal Highway Administration 2016). In 1995 the 91 Express Lanes, a 10-mile, four-lane toll project, opened to the public (California Department of Transportation 2009). The USD 130 million project, connecting Orange and Riverside counties, was privately financed by a joint-powers authority (permitted under AB 680) (Fielding 1993). The following year the first publicly operated toll road in Southern California, State Route 73, opened to the public (Arduin and Winegarden 2013). In addition to these two early projects, Southern California's current toll road network consists of the I-10 and I-110 express lanes, the 241, 261, 133 toll roads, the I-15 express lanes and the SR-125 (IE511.org n.d.). Federal support for differential road treatment continued to evolve under SAFETEA-LU (2005). This 2005 federal transportation legislation mainstreamed the authority to build HOT lanes, granting the authority for all states to do so, which was reconfirmed under the following federal transportation bills MAP-21 (2012) and the FAST Act (2015) (U.S. Federal Highway Administration 2016).

Insurance Schemes

One innovative method for attempting to reduce VMTs in California is the state's Pay as You Drive (PAYD) Insurance Program. This 'green' car insurance option bases the amount of insurance payments to the number of miles a given car drives (California Department of Insurance 2008). The establishment of this program follows the passing of AB 2800, which is, in part, aimed at mitigating obstacles to pursuing PAYD insurance (Bordoff and Noel 2008). Currently, six companies are authorized to provide PAYD insurance options in California (California Department of Insurance n.d.). Environmental Defense has estimated this program to reduce 55 million tons of CO_2 from its introduction to 2020 if 30% of Californians participate, making it no surprise that the California Air Resources Board endorses it as an effective measure to help meet climate change mitigation targets (VTPI 2017b).

Employer-based travel reduction programs

Federal transportation bills have supported telework or employer-based trip reduction programs since ISTEA (1991) authorized federal funds for programs having air quality benefits under the Clean Air Act (Weiner 1994; cited in Weiner 2013). At the state level, employer-based trip reduction programs have been promoted formally through legislation. An early example of this Regulation XV, established in 1988 by the L.A. Southern California Air Quality Management District; this rule requires that employers with more than 100 employees must maintain a specified "average vehicle ridership" (AVR) for commutes to work between 6 and 10 AM (Weiner 2013). Regulation XV impacted roughly 7,000 firms and institutions, employing roughly 3.8 million workers when it was implemented in 1988 (Giuliano and Wachs 1991; cited in Weiner 2013). In 1992, the California legislature passed AB 2109 (1992), the Parking "cash-out" law. The law mandated that employers with 50 or more employees in a nonattainment area who offer subsidized parking to employees provide the option of a cash allowance in lieu of the parking space (CARB 2009). While employee participation varies across individual workplaces, studies have shown that approximately 12% of employees will take the "cash-out" and find alternative means of commuting (transit, bicycle, etc.) (CARB 2009).

In 2001 the Federal government established its Commuter Choice Program (CCP), which complements California's parking 'cash out' law by providing incentives to employers that they can offer

their employees for commuting to work in other ways than driving alone (U.S. EPA 2002). The CCP was designed as an innovating government-business partnership modeled on the successful 'Energy Star' Program (U.S. EPA 2002). Similar to California's parking 'cash out' law, the CCP provides monetary incentives for employer-paid parking spaces alongside incentives for transportation, teleworking programs, walking, biking and carpooling (U.S. EPA 2002). In 2012 the Bay Area Air Quality Management District was authorized, as per SB 1339 (2012), to adopt and implement a regional commuter benefits pilot program through December 2016. In 2016, SB 1128 (2016) lifted the end date for this program, which requires employers with more than 50 employees to offer one of four commuter benefits outlined in SB 1339 (2012). The four options are:

1) Pre-tax option: The employer allows employees to exclude their transit or vanpool expenses from taxable income, up to the maximum amount allowed by federal law.
2) Employer-Provided Subsidy: The employer provides a subsidy to cover the employee's monthly transit or vanpool cost.
3) Employer-Provided Transportation: The employer provides free or low-cost commuter transportation service for its employees. This could include bus or vanpool service from the employee's home community to the worksite, or a shuttle service from a nearby transit station(s) to the worksite.
4) Alternative Commuter Benefit: An employer may propose an alternative commuter benefit, subject to approval by the Air District and MTC, that would provide at least the same result in reducing SOV trips as any of the three basic options described above (Bay Area Air Quality Management District, & Metropolitan Transportation Commission 2016).

Although the government of California has had a relatively long history of implementing substantive transportation demand management programs and policies, little progress has been made in terms of reducing vehicle miles travelled. As Figure 20 illustrates, outside of the dip in VMTs that can be attributed to the economic slowdown following 2008, VMTs have consistently increased in the state, frustrating government efforts to reduce transportation-related emissions.

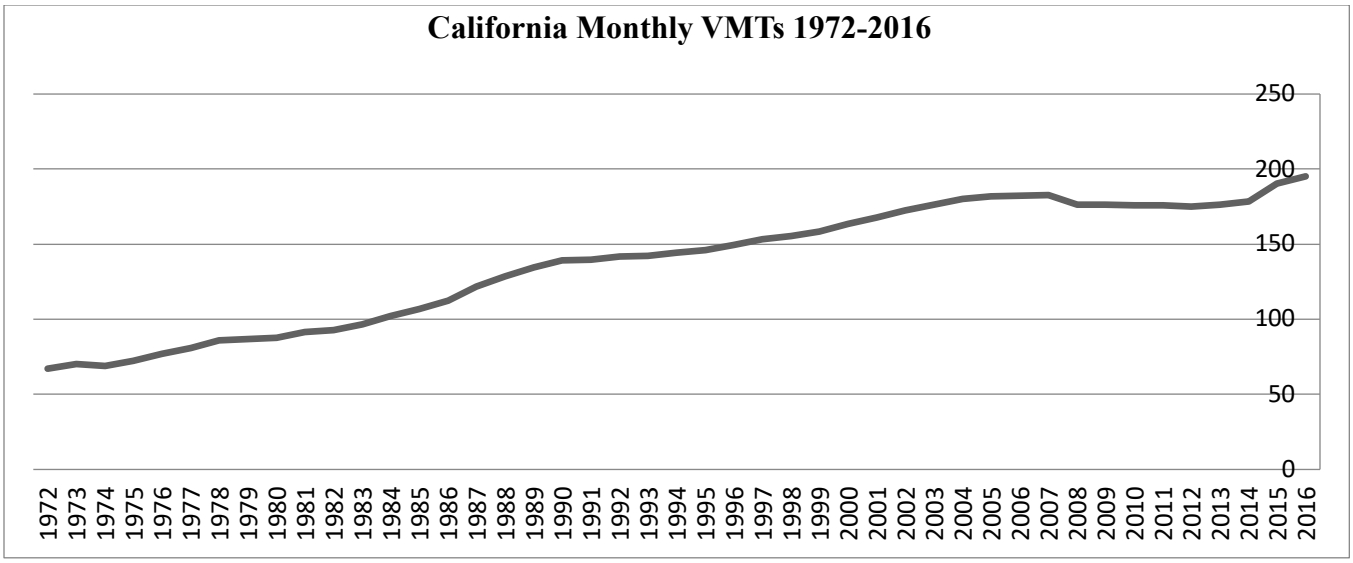


Figure 20. Historical Monthly VMTs in California (1972-2016). (Data from California Department of Transportation 2018).

Brief Summary

California is considered a global leader with regards to addressing climate change and has enacted a significant amount of legislation to meet its stringent emission reduction targets and adaptation goals. State efforts to control air pollution predate similar federal legislation; this has become a consistent trend that continues today with climate change policy. A formal climate change governance regime in California began emerging in the late 1980s, decades before most other jurisdictions. However, a formal regulatory regime for air pollution dates back as far as the late 1940s.

California's modern climate change governance regime is made up of a broad suite of policies, which target both cleaner vehicle and transportation demand management objectives. In addition to market instruments, mandates are widely used, often in the form of 'flexible regulations. Indeed, California has pioneered some of the most sophisticated policy tools to reduce passenger transportation emissions, including its low carbon fuel standard and low emission vehicle regulations. California's extraordinary levels of regulatory capacity allow this massive package of regulations and laws to be effectively implemented. Substantive funding, including the billions raised annually via the state's cap-and-trade system, have been directed to efforts to reduce emissions from passenger transportation. These activities range from research and development to building a high-speed rail network throughout the state.

Reflecting the state's high poverty rates and significant environmental justice issues, many of California's climate change policies and programs have elements aimed at helping disadvantaged communities. Often this comes in the form of prioritized spending in these areas, or in terms of targeted capacity-building efforts. In comparison to Ontario, successive governments of California have imposed many rules upon themselves, often aimed at ensuring coordination and communication. This is, in part, reflective of the separation of powers system (vs. cabinet-parliamentary) but also reflects the complexity of their climate change governance system and the need to ensure coherence in the governance process. Finally, the U.S. federal government also plays a relatively important role (in comparison to Ontario) in the transportation planning process, and subsequently, in reducing passenger transportation emissions. Specifically, legislation requiring the integration of air quality standards into state transportation planning processes, with monies tied to compliance, form a critical lever from a governance perspective.

Chapter 7: Context Analysis: Landscape Variable Influence on Ontario and California's CPI Efforts in Road Passenger Transportation

This chapter comparatively analyzes the impact of key landscape variables on CPI output in each subnational jurisdiction. Ultimately this evaluation aims to inform the debate about how varying contexts influence the operationalization of a polycentric approach to climate governance, leading to a better understanding of 'what works where and why'.

Evaluating the Influence of Landscape Variables on CPI Output

Problem characteristics: The transaction costs of change

Decarbonizing transportation presents unique challenges compared to low-carbon transitions in other areas, like energy systems and buildings. These challenges are specific to meeting the two objectives of decarbonizing this sector: making vehicles cleaner and reducing the number of vehicles. From the perspective of making vehicles cleaner, compared to other sectors, transportation is especially dirty. Almost all passenger transportation emissions are CO_2 derived from fossil fuels used in internal combustion engines (Transportation Research Board 2017). From the perspective of transportation demand management, there are significant challenges associated with inducing modal shifts. Unfamiliarity with new passenger transportation technologies and risk aversion act as significant barriers to consumer acceptance (Transportation Research Board 2017). Also, the traditional automobile industry has been associated with job creation and the private car has been seen "as a key factor bringing a sense of well-being to citizens as part of the social contract of Fordist capitalism" (Transportation Research Board 2017).

Critically, the costs associated with interventions to decarbonize transportation are very high compared with other low-carbon interventions in other sectors. The strong and direct connection between the private automobile, land-use patterns and infrastructure greatly contributes to this high cost. For example, in contrast to the flourishing renewable energy sector, which is seeing consistent cost-efficient gains, there are very few low-cost replacements to fossil-fuel-based transportation (Kaufmann and Krause 2016). Additionally, a carbon price has a smaller impact on gasoline as it does, for example, on coal for electricity production (Aldy et al. 2012), and this is before taking into account the dampening effect of consumer price elasticity of demand.

The largest barrier to change is arguably the socio-technical co-evolution that has occurred over the last 100 years or so, resulting in strong lock-in dynamics. Especially in the United States and Canada, our people, infrastructure and urban form have all co-evolved with the rapid uptake of the private automobile from the 1920s onward as the dominant transportation mode. Figure 21 illustrates the various facets of this socio-technical system. The effect has been a strong socio-technical lock-in, where the dominant existing technology (ICE vehicles) experience increasing returns to their adoption, resulting in new entrants (e.g., EVs) being significantly disadvantaged (Klitkou et al. 2015). Many authors have recognized this kind of carbon lock-in in the transportation sector (Banister et al. 2011).

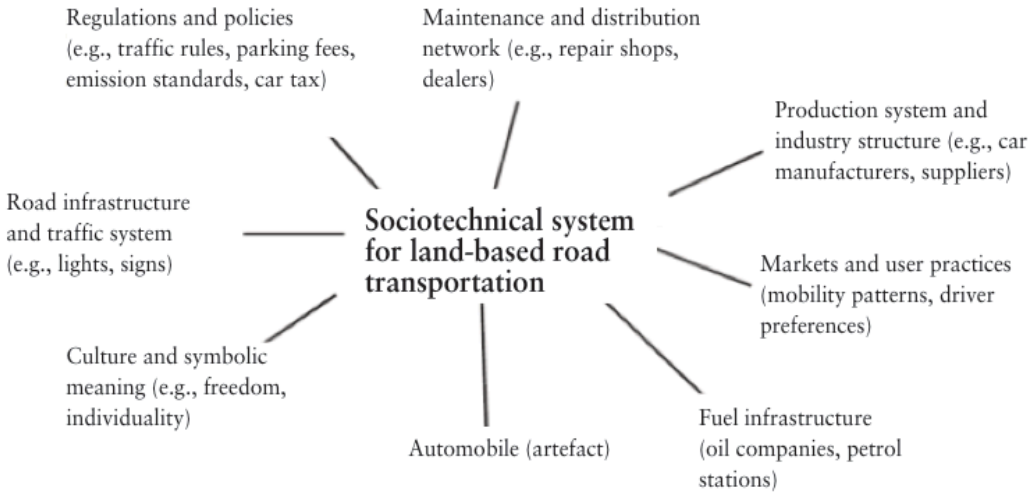


Figure 21. Sociotechnical system for modern car-based transportation (Geels 2005).

While this socio-technical lock-in remains a challenge in present times, lock-in dynamics do not last forever. As the socio-technical transition for land-based road transportation continues to progress in a more low-carbon direction, theoretically, this barrier should reduce over time for niche technologies, in particular, due to cost reductions. Lock-in of a hydrocarbon-based road passenger transportation regime poses a larger barrier to reducing the number of vehicles on the road as compared to switching from ICE vehicles to EVs. The availability of EV charging infrastructure is arguably one of the largest barriers dampening EV uptake (Engel, Hensley, Knupfer, and Sahdev 2018), as opposed to pursuing mechanisms for transportation demand management and modal shifting (e.g., mass transit), for which 'locked-in' low-density land-use patterns pose a significant hindrance.

Figure 22 illustrates the assessed lock-in of various types of CO2 emitting infrastructure, plotted according to their historical lifetime (x-axis) and the carbon price required to equalize the marginal cost (mainly fuel) and total levelized cost (operating and capital costs) of the existing infrastructure of a low-carbon replacement (y-axis). The size of the circles represents the cumulative future emissions that are in excess of what that type of infrastructure can emit under a 2-degree scenario, and the colours represent the strength of the techno-institutional resistance (level of the barrier) to unlocking it.

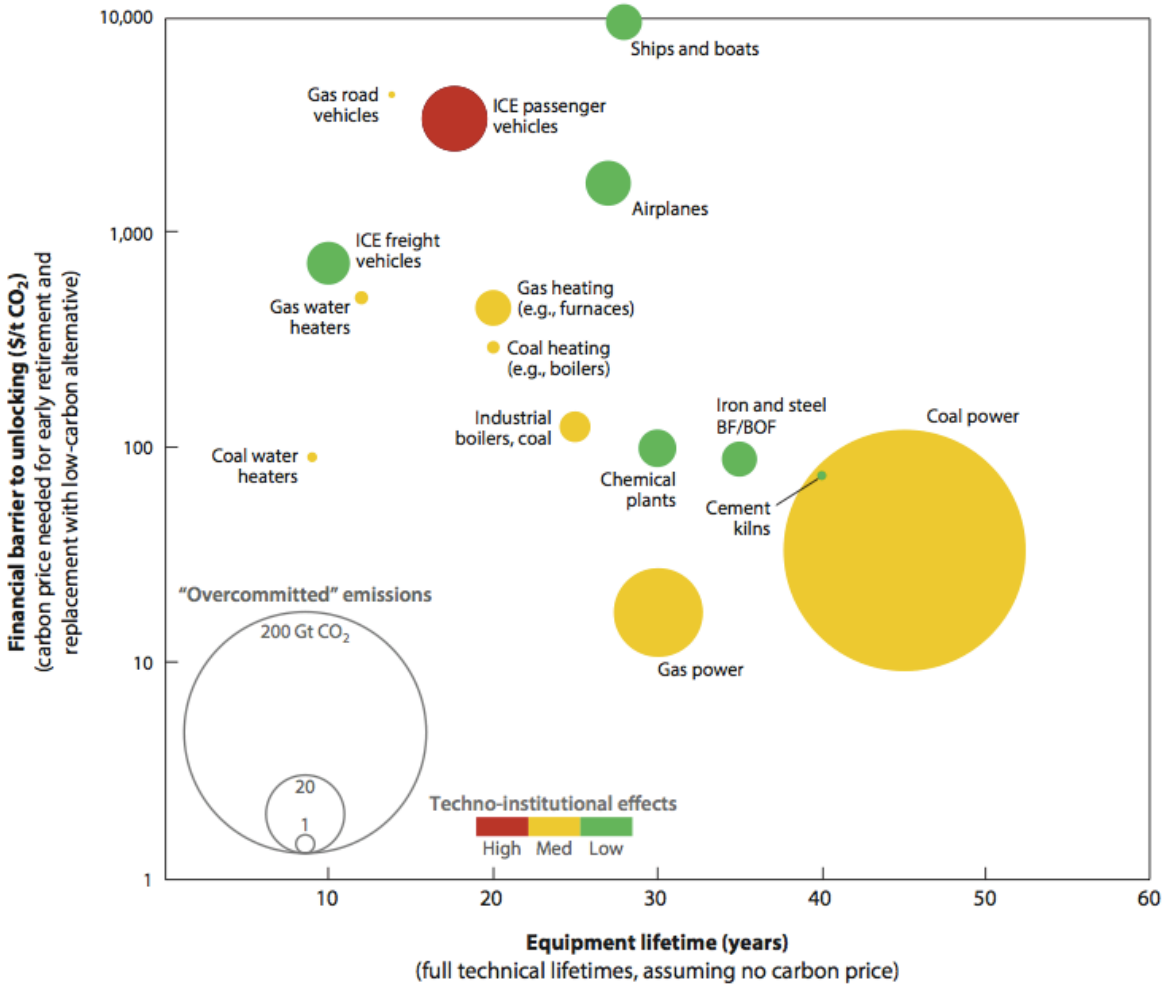


Figure 22. Assessed lock in of various types of CO2 emitting infrastructure, plotted according to their historical lifetime (x-axis) and the carbon price required to equalize the marginal cost (mainly fuel) and total levelized cost (operating and capital costs) of the existing infrastructure of a low-carbon replacement (y-axis) (Erickson et al. 2015).

The assessment illustrates the immense challenge associated with 'unlocking' the ICE passenger vehicle. The financial barrier to a low-carbon alternative is well above USD 1000/CO_2 and the techno-

institutional resistance is higher than any other CO_2 emitting infrastructure assessed. This represents not only lock-in impacts associated with infrastructure or land-use patterns but also the equally significant behavioral lock-in associated with the private automobile. Social and psychological factors, like the association between car travel and personal economic progress, social esteem, and individuality, should not be dismissed as irrational, but as "a distinct obstacle for reducing carbon emissions" (Seto et al. 2016, p. 439; Transportation Research Board 2017).

Finally, transportation governance has itself become a barrier to decarbonization. Fundamental transportation discourses and governance practices are heavily influenced by the era in which they came about, i.e., facilitating the growth of carbon-intensive transport to meet growing demands (Bannister et al. 2011). The governance of transportation planning remains a mostly technocratic, top-down exercise that includes a small set of stakeholders, resulting in "the structural bias towards determinism, instrumental rationality, and technology push…reproduced continually in transportation governance (Banister et al. 2011). The informal and formal rules and procedures in transportation governance have themselves become a mechanism for further lock-in, blocking radical change and heavily favouring the status quo (Banister et al. 2011). As a result of all these features characterizing the challenge of decarbonization in the passenger transportation sector, the transaction costs of change pose a great hindrance to the passing of climate-transport policies in both subnational jurisdictions being evaluated. That being said, there are some nuanced differences between the cases that are important for understanding the specifics of the challenge and corresponding policy responses in each case.

Transportation is a key issue area for both California and Ontario with regards to emissions; the sector makes up roughly 40% of total emissions in each case. The key difference is the level of infrastructure lock-in. In California, a vast state road and highway system were built over time to meet California's historically high population growth. Along with the Hollywood sign, giant redwoods, and sprawling beaches, California's expansive freeways have become iconic (see Figure 23).

Figure 23. The four-level interchange of the Harbor Freeway and 101 in Los Angeles, featured in the opening scene of Oscar nominated film, La La Land (Rose 2019).

By 1930, 20% of Californians owned a car, a level not reached in Western Europe until the 1970s (Sperling and Eggert 2014). Although California may not have the highest road miles per capita, California's development over time has been heavily influenced by the private automobile. As Sperling and Nicholas (2012, p. 1) explain,

> No place in the world is more closely associated with the romance of the automobile and the tragedy of its side effects than California…. California pioneered car-dependent cities and living and took it to an extreme, creating a highly expensive and resource-intensive transportation system. It has overindulged.

The result of this evolution has meant that reducing transportation emissions has become a vital focus of the California government's climate change governance approach. The relatively high-level of infrastructural and behavioural lock-in in the case of California has meant that a key focus to meet transportation emission reduction goals has been on promoting cleaner vehicles, given the immense challenge of reducing VMTs based on established land-use patterns and habits. Whether through EV subsidies, the low-carbon fuel standard, or other technology-forcing efforts, a significant focus has been

on reducing emissions from vehicles, understanding that getting people out of their cars is a massive challenge. It is not just the large stock of existing roads and freeways that result in this challenge. Low employment densities and high residential densities "do not offer much promise for reducing VMTs" (Bedsworth, Hanak and Kolko 2011). Density patterns have long life spans, and opposition to increasing density has long been a significant barrier to reducing driving in California communities (Bedsworth et al. 2011).

Ontario, on the other hand, has seen concentrated growth in the south-central part of the province (i.e., the GTHA), although sprawl has certainly spread outwards from dense urban cores. The northern part of the province is rural, with a few small cities spread in between rural and dense urban areas in the south (see Figure 24). Ontario does not have the same sprawling road infrastructure as California, which, in some respects, provides an opportunity to avoid the same extent of infrastructural lock-in that plagues that state. This is not to say that Ontario does not also suffer from sprawl and land-use patterns developed around the private automobile, it just presents a lower barrier to decarbonizing passenger transportation

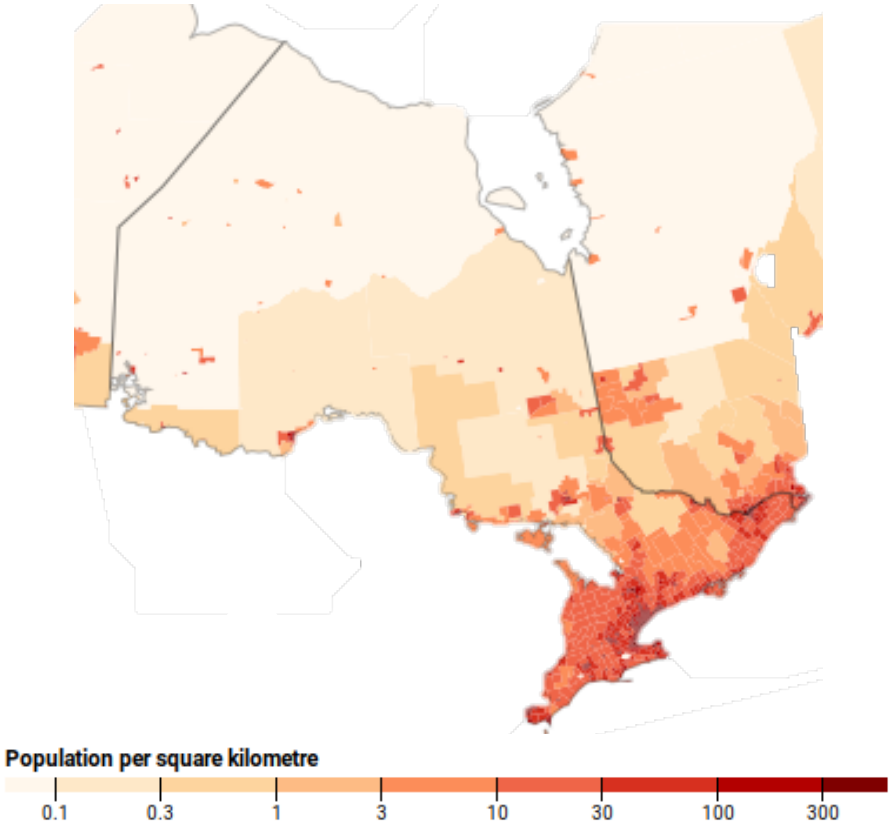


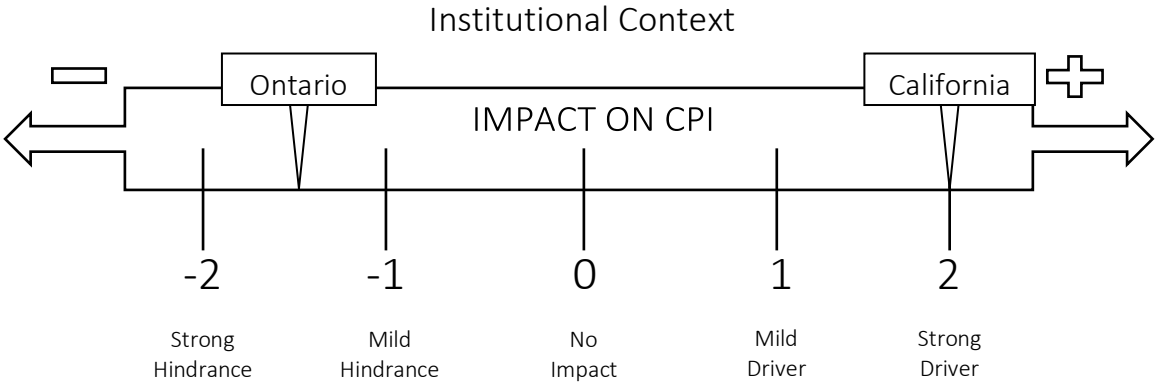
Figure 24. Population density of Ontario (Statistics Canada 2016).

than in the extreme case of California. The fact that there is much land in Ontario to be developed/redeveloped presents both an opportunity and a risk depending on how it is managed. Given this reality, transportation demand management techniques have been utilized more than policies to promote cleaner vehicles. Land-use planning mechanisms and public transit expansion in southwestern Ontario have been utilized over the past 15 years or so, to prevent further sprawl and reduce dependency on the private automobile.

Overall the transaction costs of change remain high, as they generally do for transportation. However, but the challenge of overcoming infrastructure lock-in is less in Ontario than in the case of California. More than anything, the nuanced differences between cases provide a starting point for understanding the different strategies in each jurisdiction with regards to reducing emissions from transportation. The following sub-sections will discuss and analyze the impact of key landscape variables on the passing of climate-transport policies in each jurisdiction.

Institutional context

In the case of Ontario, Canada, the institutional context, specifically the jurisdictional division of authority, electoral rules, and regulatory independence, form a medium hindrance to the passing of climate-transport policies. In California, U.S.A., individual aspects under the theme of institutional context have mixed impacts, but overall act to promote the passing of climate-transport policies, mainly due to high levels of regulatory capacity and independence found in the state and relatively higher levels of local government autonomy. The following section will discuss key institutional elements and analyze their impact on the passing of climate-transportation policies in each jurisdiction. Specifically, the



following relevant sub-variables will be evaluated: division of powers/jurisdictional authority, electoral and legislative rules, regulatory capacity and independence, and the ability for interest groups to impact policy decisions.

In the case of Canada, and Ontario, the system of government and treatment of powers relating to the environment under *the Constitution Act* is a source of frustration for proponents of strong action on climate change (Stoett 2009). Particularly with the case of regulating greenhouse gases, the boundaries of provincial and federal jurisdiction "are far from clear" (Mahoney 2016, 3-4.1). Like the environment in general, a lack of institutional clarity has become a factor in why Canada lags on climate change performance (Boyd 2015). This uncertainty around powers has resulted in lowering the willingness of either level of government to enact and enforce climate change policies, or where governments 'pass the buck' onto to lower levels of government (e.g., regions, municipalities) who do not have the capacity to address the issue adequately (Boyd 2015).

For example, the provinces of Saskatchewan, Ontario and Alberta have launched legal challenges in response to the federal government's 2019 implementation of a backstop carbon pricing mechanism, which is imposed on provinces who do not have equivalent schemes. Both Ontario and Saskatchewan's Court of Appeal found the federal backstop carbon pricing regime to be constitutional, whereas the Alberta Court of Appeal ruled in late February 2020 that the carbon levy was unconstitutional on the basis that it erodes provincial jurisdiction (*Reference re Greenhouse Gas Pollution Pricing Act*, 2019 ONCA 544; *Reference re Greenhouse Gas Pollution Pricing Act*, 2019 SKCA 40; *Reference re Greenhouse Gas Pollution Pricing Act*, 2020 ABCA 74). Of the 15 judges that ruled on this matter between these three court cases, eight decided the federal carbon price was constitutional and seven ruled against the federal government. The constitutionality of the federal carbon price will be decided in late March 2020 by the Supreme Court of Canada. The vulnerability of the federal carbon pricing regime, stemming from a lack of institutional clarity with regards to climate change, illustrates how the boundaries of federal and provincial jurisdiction have hindered the implementation of climate change legislation in Canada.

The institutional set up has also meant there is tension between the federal government and provinces, who (in practice) have more powers and autonomy in contrast to U.S. states, around federal intervention in cross-cutting matters like the environment and climate change. As opposed to American

states, Canadian provinces have almost complete autonomy with respect to reducing emissions from passenger transportation. The Canadian federal government does provide funding, but until the establishment and implementation of the Pan Canadian Framework, federal funding was inconsistent. In comparison, the U.S. federal government provides substantial and consistent infrastructure funds that are tied to federal clean air and water legislation/standards, which must be met by states. In this way, the U.S. federal government plays a much more assertive role with regards to reducing emissions from the passenger transportation sector.

Varying levels of support for climate action across provinces, combined with tension around federal intervention and constitutionality, has made introducing a federal carbon price politically challenging and resulted in one-off political deal-making with certain provinces in return for support their support. The Trudeau Administration's purchase of the Trans-Mountain pipeline exemplifies this dynamic; In return for ensuring project completion, so Alberta's oil reaches tidewater for export, Alberta's Notley Administration gave their support for the federal climate change plan, the Pan-Canadian Framework for Clean Growth and Climate Change. As illustrated in Chapter 6, the lack of meaningful climate-related rulemaking at the federal level, until the Trudeau Administration, is also reflective (in part) of institutional tensions.

Due to the type of separation of powers system in the U.S., Congress has significant influence over climate policy (Karapin 2016). This set up also results in multiple veto points at the federal level, making initiating change quite difficult and thwarting change easy (Peters 2016). For decades 'gridlock' and 'divided government' have been standard descriptions of the U.S. federal government (Peters 2016). While the U.S. division of powers has stalled the passing of climate legislation at the federal level, the fact that residual powers are granted to states provides broad opportunities for statutorily grounded interventions around climate change at the subnational level. Even where California state law aimed at reducing emissions has conflicted with U.S. Federal law, the division of powers has not yet proven to be a hindrance to passing climate legislation. For example, California has been granted waivers to enact its own vehicle emission standards since the 1970s by the U.S. EPA and won multiple court battles challenging climate-transport policies like emissions standards and California's low carbon fuel standard. That being said, under the current Trump administration, which is extremely hostile towards action on

climate change, this trend of granting exceptions to California has been reversed and the waiver for California to set its own emission standards withdrawn (Koseff 2020).

Local government autonomy and capacity

In the case of Ontario (as in other provinces), there is somewhat of a mismatch between the level of responsibilities delegated to municipalities and the financial assistance and local autonomy needed to carry out duties effectively. According to McAllister (2016), this is the case with addressing climate change, where a lack of resources and adequate authority at the local level are making it difficult for local governments to respond to this challenge effectively. The City of Toronto has additional powers, as per the *City of Toronto Act* (2006), but still suffers from the same tension around autonomy and financial capacity. This is in part because the additional powers provided to the City of Toronto do not include the ability to access significant tax bases like retail sales, income, gasoline, or payroll (Côté and Fenn 2014). While the *City of Toronto Act* has been a modest step in the right direction for Toronto, other larger Ontario municipalities are treated the same as the hundreds of small rural municipalities (Côté and Fenn 2014).

The lack of resources and authority to act at the local level has been a significant barrier to substantive action on climate change mitigation across Canada (McAllister 2016). Although certain Ontario municipalities have shown great leadership with regards to prioritizing action on climate change, and low-carbon transportation measures, capacity remains "very limited" (McVey 2018) and a "meaningful degree of self-governance" has hindered progress (McAllister 2016). Even when additional climate change funding was introduced in Ontario by the cap-and-trade system, Ontario municipalities were not directly able to access funds. As the President of the Association of Municipalities of Ontario (AMO)explained when the province's Climate Change Action Plan (2016) was established,

> We need to be able to access cap-and-trade revenue that underpins this Plan…Relying on the nine cents of every household dollar won't get us there. Municipal governments' ability to achieve the Plan's goals will only be as good as their financial capacity. Leadership is there, but we need other supports. (AMO 2016)

In contrast, local governments in California are empowered via the California Constitution's 'home rule'. This means that local governments in California, especially charter cities, have substantive autonomy and authority to undertake climate-transport policies within their jurisdiction. State and Federal funding

also flow to regional organizations, for example, MPOs, providing a more sufficient level of financial resources and improving local government's capacity to undertake measures to reduce emissions from transportation. That being said, local governments are still beholden to key requirements within this context from higher-order governments; for example, local governments cannot set their own air quality standards. Direct democracy, in the form of ballot propositions, also allows voters to tax themselves, providing funding to local governments for specific measures like building public transportation infrastructure. Local governments in California are also able to access local sales taxes and income taxes. In contrast, Ontario local governments are limited to raising funds by provincial legislation. This has become a major concern for municipalities who are seeking a more reliable funding base through revenue sharing and/or authority to set their own taxes by accessing fuel excise and personal income taxes (Brigdale et al. 2003; Slack 2011).

For example, in terms of transportation demand management, the rules of the game in California, specifically the local government's ability to raise revenues, create a much more favorable environment for expanding TDM efforts such as the maintenance and expansion of mass transportation. A comparison of dedicated funding for Toronto and LA's mass transit systems, the TTC and LA Metro, clearly illustrates how legislation in California more than adequately supports large urban transit systems, something the TTC sorely lacks. The Sankey diagrams (see Figure 25) for the flow of revenues and expenditures for the LA Metro and TTC illustrate how legislation in California provides significant dedicated funding for the LA Metro through sales tax propositions and the *Transportation Development Act (1971)*. In contrast, the TTC must fund most of its operation through passenger fare revenues in the absence of dedicated funding sources. This is just one example of how levels of local government autonomy and authority act as a barrier for local governments to undertake climate action in Ontario and aid climate change efforts by local governments in California.

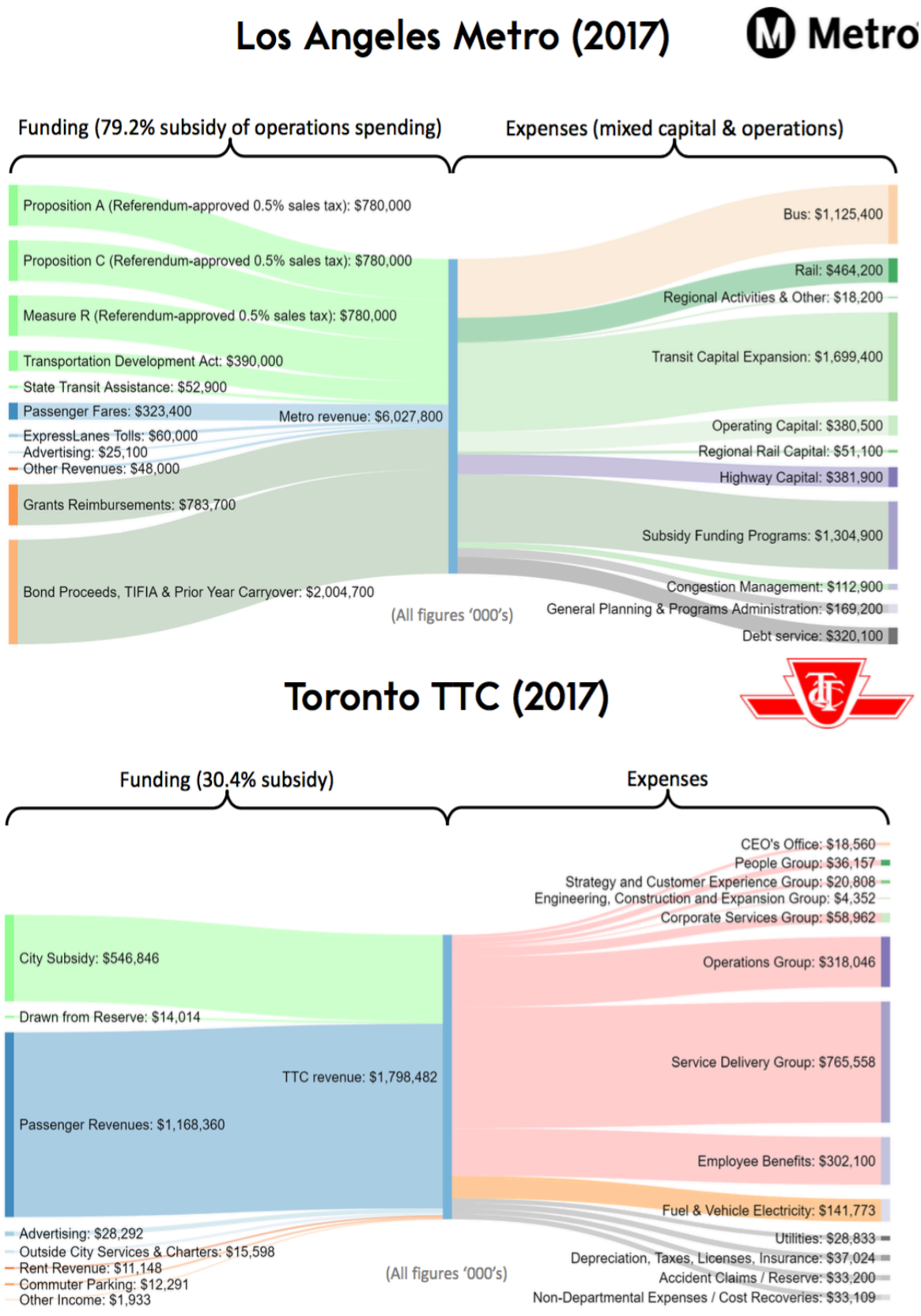


Figure 25. Funding and Expenses for the LA Metro for 2017 (CodeRedTO 2018).

Electoral and legislative rules

Two particular components of California's institutional context are of note when evaluating the impact of institutions on the passing of climate-transport policies. Out of 26 states that have enacted the citizen's initiative process, no other state has used the process as much as California except Oregon (Baldassare, Bonner, Petek and Shrestha 2013). The use of citizen's initiatives in California has seen a dramatic increase over the past two decades, many of which have brought about significant policy change (Baldassare et al. 2013). As mentioned above, the availability of direct democracy measures in the state of California has had a positive impact on local government capacity to regulate and financing actions that reduce emissions from transportation. The availability and culture of commonly having ballot propositions in the case of California, has provided a mechanism through which California voters can directly reject or support climate change policies. Clearly, this mechanism could hinder or aid the passing of climate legislation based on the public's dominant position on a particular item. In the case of California, which has relatively high levels of social consensus in terms of acting on climate change, this mechanism has served to bolster state climate change programs more than once.

For example, California's 2010 ballot included Proposition 23, which was a "yes" vote on freezing the state's cap-and-trade system until the state's economy had recovered to the point of seeing sustained decreases in statewide unemployment (Rabe 2018). California voters rejected Proposition 23 by a significant margin (Rabe 2018), clearly illustrating to lawmakers Californians support for the program and bolstering state confidence in continuing its climate change efforts. The existence of citizen initiatives provides a direct line of communication between voters and lawmakers on specific topics, to which specific funding levels are often tied. In the context of operationalizing polycentric climate governance, this type of mechanism can be seen as enhancing transparency and accountability, as specific agenda items are democratically decided on and the state government is required to carry out the will of voters. In theory, increased accountability, transparency and democratic participation in decision-making should enhance further collective action. Legislative rules also have important implications for the ability of interest groups to influence policies and decision-making.

California represents direct democracy to the extreme, to the point where the state legislature has been characterized as a ‘citizen legislature’; Recalls allow for elected officials to be fired mid-term, referendums allow for the legislature to be turned over, and in particular the common use of ballot

initiatives, which allows voters to “write their own rules” (The Economist 2011). One implication, as previously discussed, is a sense of greater transparency, accountability and public participation, which in theory should enable collective action on climate change in a state with a relatively high social consensus on the issue. The flip side of extreme direct democracy in the state, with regards to passing climate-transport policies, is the fact that this kind of system allows for powerful interest groups to influence policy outcomes, specifically with regards to commonly used ballot initiatives.

Ballot initiatives have brought about substantive change in California and are increasingly being used in election cycles (Baldassare et al. 2013). With the increased use of ballot initiatives, there has also been a large influx of money spent on campaigns; between 2000-2013, roughly USD 2 billion was spent on the initiative process (Baldassare et al. 2013). Not surprisingly, large, powerful interest groups have been able to fund comprehensive campaigns to block initiatives that do not benefit or even harm them. For example, USD 100 million was spent on Proposition 87 (2006) alone; the initiative that would tax oil extraction to fund alternative energy projects was, not surprisingly, rejected (Baldassare et al. 2013). Another example was the USD 151 million spent on the campaign for Proposition 32 (2012), which was an initiative to prohibit political contributions by payroll deduction; again, this initiative was rejected (Baldassare et al. 2013). The size of California's legislature and the term limits of representatives also lends itself to increased political spending and potential increased ability for interest groups to influence policies.

Although California is the most populous state in America, it has a relatively small legislature, ranking only the 35th largest in the country (The Economist 2011). The implication is that candidates are not close to their voters because the area they are representing is so large, and therefore significant money is needed to fund campaigns because they need to advertise heavily in lieu of being able to "shake enough hands" (The Economist 2011). The result of this dynamic is that once elected, representatives are beholden to large political donors, which has been posited as an explanation for the "hyper-partisan animosity in the capital" (The Economist 2011). Proposition 140, passed in 1990, introduced the strictest term limits for legislators in the U.S., for states that have limits, which has also had the impact of making California's representatives and senators increasingly beholden to political donors and contributes to a hyper-partisan dynamic (The Economist 2011).

Legislative and electoral rules do not seem to have the same potential implications for the passing of climate-transport policies in Ontario. For one, Ontario has stricter rules about campaign contributions; these rules were made even stricter with the 2017 amendments to the *Election Finances Act* (1990), which included significant changes like limiting corporate, union and other organization campaign contributions and prohibits Members of Provincial Parliament (MPPs) from attending fundraising events (Goldberg, Firestone, Bala, Larusso 2018). There are also no term limits on Members of the Provincial Parliament in Ontario. This lends itself to an environment where bipartisan cooperation may be more favourable, although there are long-standing opponents of term limits on representatives generally, for fear of 'career politicians' amassing too much power. That being said, a system with no mandatory term limits does allow expert policymaking capacities to build up and remain.

One notable exception, which potentially hinders pro-environmental policy influence and bipartisan cooperation, is the first past the post electoral system utilized in Ontario. First-past-the-post electoral systems, like the one employed in Ontario and Canada, have had somewhat negative implications for smaller parties, like the Ontario Green Party, as these systems favour large, incumbent parties. For example, in the 2007 election, the Green Party won just over 8% of the popular vote in the Ontario election but failed to win a seat; improved strategic campaigning in the most recent Ontario election resulted in the leader of the Green Party winning one seat with 4.5% of the popular vote (Green Party of Ontario 2019). Empirical evidence illustrates that jurisdictions electing officials using proportional representation, as opposed to FPTP, score higher on environmental metrics like air quality and renewable energy use (Green Party of Canada n.d.). The FPTP electoral system has also led to an increasing number of ‘false majorities’, where a party can win a majority with less than half of the popular vote because it wins the most seats. Not only does this system disenfranchise smaller parties, like the Green Party, it also discourages parties acknowledging another party might have a good idea, or common ground, for fear of bleeding votes (Green Party of Canada n.d.).

The role of courts and the ability for advocates to exert influence using the legal system is another way California and Ontario differ due to overarching rules. This is perhaps most clearly illustrated in the case of environmental assessment legislation and processes in each jurisdiction. For example, in California, the *California Environmental Quality Act* (1970) is a "self-enforcing" statute, meaning no state agency actually implements or enforces *CEQA*. In practice, the enforcement and implementation of the

statute rely on litigation by private parties acting in the public interest (BAE Urban Economics 2016). The authority for advocates to sue and use the courts in this way to hold parties to account gives them relatively high levels of power in comparison to the environmental assessment legislation in Ontario, which does not provide the same authority to advocates. In addition, reviewing the legality of completed environmental assessments is outside the jurisdiction of federal courts in Canada, as clarified by the Federal Court of Appeal in *Gitxaala Nation v. Canada* (2016). The precedent set, in this case, may block the ability for advocates to launch future legal challenges against environmental assessments that they perceive to be flawed (EcoJustice 2016).

At the national level, "Courts have almost shut the door on environmental class actions in common law Canada, emphasizing the predominance of individualized issues of causation and damage over common issues…They are slow to find that legislation creates a duty of care and quick to rule that government conduct involves policy decisions that are immune from civil liability" (Wood 2019, p. 119). Where Canadian law benefits those attempting to hold polluters to account is through private prosecution avenues. In contrast to the U.S., in Canada, anyone is able to lay charges against a purported offender, and indeed, private charges have been utilized to make changes addressing bird deaths from oil sands tailing ponds and reflexive glass offices windows, in addition to addressing to lax environmental practices at the municipals level (Wood 2019).

Regulatory/policy capacity and independence

Higher levels of regulatory capacity can be an important driver in terms of legislator's willingness to pass comprehensive climate legislation. If regulatory agencies have proved themselves to be capable of effectively developing and implementing programs, political decision-makers may feel more comfortable passing climate policies, knowing a proficient group of experts are up to the task. Institutional trust is also important in shaping the public's policy attitudes "in complex and contested issues such as climate change, as the public has to rely more heavily on political elites to accurately evaluate the need for different policies" (Dietz et al. 2007; Kellstedt et al. 2008; cited in Matti 2015, p. 406). The importance of institutional trust as it relates to policy support is most pronounced with regards to redistributive measures and those entailing some level of personal sacrifice (Matti 2015), making it a highly relevant variable for understanding climate policy outcomes, which often center around a direct or indirect carbon price.

Additionally, as Carlson (2017, p. 65) argues, the interaction between high-levels of regulatory capacity and environmental leadership can result in a positive feedback dynamic, ultimately benefitting the passing of climate policies:

> States lead in a particular environmental area and develop regulatory expertise necessary to implement their environmental policies. But that regulatory expertise can, in turn, lead to further environmental leadership, which can, in turn, solidify and enhance regulatory expertise. Regulatory expertise and environmental leadership, in other words, are mutually reinforcing in ways we have previously overlooked.

Arguably, both of these influences have been and continue to be at play in the California context, and can be singled out as a relatively important variable in explaining California's aggressive legislative action aimed at reducing emissions, especially in the transportation sector. To some extent, an inverse dynamic has plagued Ontario's efforts to pass comprehensive climate legislation; While Ontario has significant expertise in its environmental ministries, past policy failures in the environmental field have resulted in the diminished trust from Ontarians in government capabilities. A lack of regulatory independence, separate from capacity, has resulted in highly politicized decision-making, procedure missteps, and ultimately varying levels of underperformance of some policy programs.

California's long history of advancing environmental and energy policies, stemming from an even longer history of severe air pollution, has often been touted as key to understanding how the state has become a climate change leader from a policy and regulatory perspective (Farrell and Hanemann 2009; Rabe 2018; Allison et al. 2016). What has not been as explicitly discussed in academic literature is the causal connection between this long regulatory history and the state's immense regulatory capacity with regards to managing air pollution issues. That being said, multiple interviewees in California pointed to this dynamic as a strong explanatory variable for why California became, and continues to be, a leader in climate change governance.

Early pioneering environmental regulations and governance measures date back to the late 1940s when the state authorized the establishment of air pollution organizations, followed by broader air pollution policies in the 1950s, and substantive energy efficiency policies in the 1970s (Sperling and

Eggert 2014; Farrell and Hanemann 2009). For example, in 1947, the California government passed a law allowing for the creation of county-level air pollution control districts, which enabled the creation of the nation's first kind of institution to deal with these matters (Hanemann 2007). Again, spurred by severe air pollution events, the nation's first motor vehicle pollution controls were mandated in 1960 by the California government (Karapin 2016). Legislation passed in 1967 created the California Air Resources Board and in 1968, additional legislation further empowered CARB's role and regulatory independence (Karapin 2016). Early and sustained air pollution issues are also key in understanding public opinion and social consensus around taking pro-environmental actions in the state, which will be discussed in more detail later in this chapter.

The regulatory authority, administrative capacity and technical, legal and policy expertise of CARB have been widely recognized as unique and a key driver enabling the passing of comprehensive climate legislation in the state (Aronoff 2018; Allison et al. 2016; Carlson 2017). By the late 1990s, the environmental policy community in California started seriously focusing on mitigating climate change, confident that in the wake of federal inaction, they could continue their pioneering work to achieve emission reductions (Farrell and Hanemann 2009). The long history of successfully regulating air pollution issues, especially those stemming from motor vehicles, resulted in "regulatory institutions of extraordinary sophistication and capacity and real political agility" (Carlson 2017, p. 64-65). In particular, CARB was well-positioned to tackle, from a regulatory perspective, such a complex and cross-cutting problem; over time, this organization had gained the trust of politicians and developed a 'robust' administrative structure with expert staff (Allison et al. 2016). Although a long history of experience regulating air and energy issues has undoubtedly aided in producing a highly sophisticated regulatory agency, strong political support for CARB by successive administrations has also been key to the agency has the money and expertise it has (G. Giuliano, personal communication, Feb. 21, 2018).

Today CARB is considered “the most powerful air pollution regulatory agency in the world” (Leslie 2017), enacting “what is arguably the world's most ambitious policy to tackle greenhouse gas emissions" (Carlson 2017, p. 63). CARB is even seen to have risen to a level of power where it dominates over other state agencies (A. Eaken, personal communication, June 21, 2018). The experts in this organization have largely developed the details of California's climate policies, including their implementation, monitoring, evaluation and updates. This has lowered levels of politicization in decision-

making and ensured policies are (mostly) developed based on a robust evidence base, something this formidable agency is well capable of amassing. It is arguably due to the trust that California legislators have in CARB that politicians in California are willing to pass comprehensive climate policies, knowing the Agency is very capable of developing details and managing and overseeing the implementation of various programs. Finally, the unique regulatory capacity of CARB allowed for the strategy of 'de-politicization' to be utilized with the aim of maintaining stable political commitment, a critical factor upon which climate governance rests, given the inherently long-term process required to reach the desired outcome (Duwe et al. 2017).

As mentioned, a lack of regulatory independence in Ontario has resulted in highly politicized decision-making, especially in areas related to climate change (e.g., energy/electricity and transportation). Additionally, while Ontario has sufficient levels of expertise, it is nowhere near the 'unique' capacity and resulting political backing of CARB. Again, this is not to say that Ontario does not have high levels of policy capacity in its environment-related ministries, but in comparison to CARB and other climate-transport related agencies and departments in California, it pales in comparison. This would arguably be the case for many other subnational jurisdictions. One would be hard-pressed to find another subnational agency working on decarbonizing transportation with 12 modelers working solely on a low-carbon fuel standard, as is the case at CARB. So, to be specific, it is the lack of regulatory independence in Ontario, as opposed to policy capacity, that has in some cases, hampered the crafting of effective climate-related policies. This has resulted in policy critiques and a diminished view of government by voters regarding the government's ability to intervene effectively.

In a 2017 report assessing energy governance in the province, Vegh (2017) concludes that agencies have failed to provide the 'check and balance' function that regulatory agencies regulatory carry out. Instead, Ontario energy agencies simply implement government policy and communications as opposed to providing an evidence-based check on political decision-making. Arguably this can be said for the transportation sector as well. Although the previous Liberal government established Metrolinx as a politically-neutral regional transit agency, its actions "undercut any pretense that Metrolinx was the 'arm's length' planning agency it was supposed to be when they created it" (McGrath 2018).

Structures to ensure decisions are made based on evidence provided by regulatory impact assessments and cost-benefit analyses are sorely lacking, let alone the use of more sophisticated modeling for decision-making. In part, environmental assessments were meant to provide the appropriate mechanism to structure the evidence-based decision-making process properly. In practice, comprehensive environmental assessments hampered political expediency and the process was "streamlined to meaninglessness", a relatively easy exercise under cabinet-parliamentary systems (Winfield 2019). In some cases, methods to generate evidence, such as cost-benefit analysis, are also lacking. Given the complexity of the policy problem at hand, this is highly problematic and has led to "less than ideal decision-making" (Vegh 2017). For example, there is no requirement for cost-benefit analysis or formal procedures for quantifying GHG reductions for municipalities applying for project money under the provincial Municipal GHG Challenge Fund. The most recent 'fixing' of hydro rates in the province (under the Fair Hydro Plan) was also a purely political adjustment. In part, Vegh (2017) argues this stems partially from the institutional context in Ontario, where there is no separation between the executive and legislature, and in part due to a culture and history of a lack of regulatory independence in Ontario. The trend of diminished evidence-based decision-making in Ontario directly contrasts with the situation in California, where climate change considerations are increasingly being embedded in decision-making procedures.

Decisions made based on political calculations have, not surprisingly, resulted in controversy and public dissatisfaction at times. A key example would be the establishment of the Feed-in-Tariff system in the province, under the *Green Energy and Economy Act.* The GEEA had some significant design issues, particularly with the siting and approval process, that resulted from a rushed legislative process lacking genuine consultation and opportunities for dialogue with municipalities and rural communities (McRobert and Tennent-Riddell 2016). This led to significant conflict upon implementation; municipalities were angered, as they were left out of the approval process. Decisions like these have resulted in a lowering of the public's opinion of government in terms of trust and credibility, in part stemming from a lack of transparency and overt politicization of the governance process. With a view to collective action, this is a damaging trend.

Governance driving governance: Policy outputs and flagship legislation

The United States and, until 2015, Canada, are good examples of a lack of flagship climate change legislation at the federal level (Averchenkova and Nachmany 2017) and embody another trend identified by Averchenkova and Nachmany (2017) in their study of the institutional aspects of climate legislation: the increased passing of climate legislation at the subnational level where there is a vacuum of climate change legislation at the national level. This dynamic is said to occur when national action on climate change is perceived to be falling behind and subnational governments substantively fill this void, leading as agents of change (Averchenkova and Nachmany 2017; Schreurs 2008). The case of California, and to a lesser extent Ontario, exemplifies this type of trend.

California, in particular, fits the model identified by the first trend/theory that the passing of flagship and other climate legislation leads to the passing of more climate legislation. With over a decade since the passing of California's *Global Warming Solution Act* (2006), this positive feedback dynamic can easily be seen in the increasing number of climate-related bills and executive orders passed. Also, California's long history of regulating air pollution and implementing other environmental protection measures has provided a culture more conducive to the passing of interventionist environmental policies, and arguably aided the passing of comprehensive climate legislation. This dynamic might be characterized as 'governance driving governance', where the historical progression of providing overarching rules becomes a variable in and of itself for the likelihood of passing future state legislation. California's pioneering environmental regulatory schemes have also driven similar legislation to be passed at the U.S. federal level through a process characterized by UCLA legal scholar, Ann Carlson, as 'iterative federalism', where California produces policy innovations that are subsequently adopted at the federal level (Bryner and Hankins 2018).

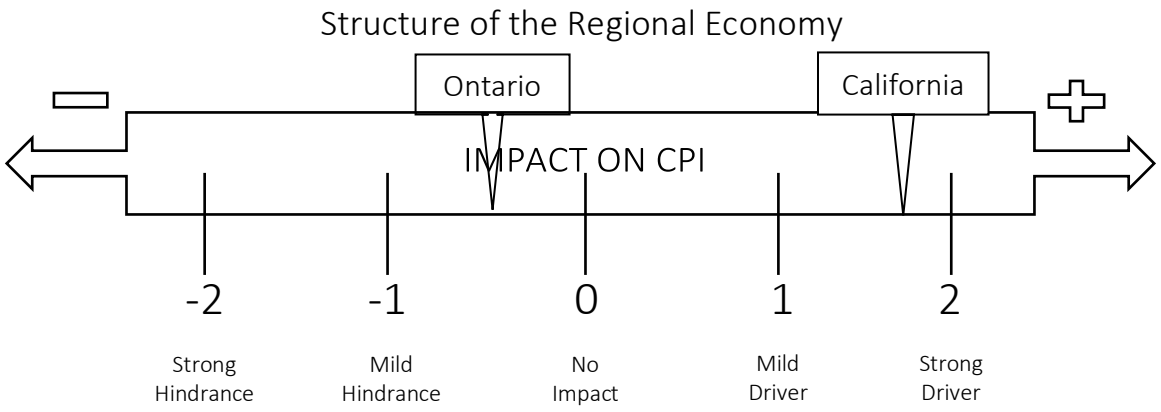
In the case of Ontario, the Province's flagship climate legislation was passed in 2016 and repealed in 2018, cutting short the opportunity for this effect to be evaluated in this subnational jurisdiction. Where this trend is arguably somewhat present is in land-use planning and integrated transportation planning laws and policies, which over time, have increasingly incorporated environmental protection objectives, and since the early 2010s, climate change mitigation and adaptation objectives. Since 2005, the province saw a ramping up of key pieces of legislation to curb sprawl and indirectly reduce transportation

emissions, such as the creation of the Greenbelt. With particular regards to directly reducing transport-related emissions, Provincial Policy Statements and various Growth Plans have addressed the need for municipalities to follow 'smart growth' patterns of development, such as increasing density, expanding and creating coherent transit systems, and integrating climate change policies into Official Plans.

Regional planning efforts, specifically in the Greater Toronto Hamilton Region (Canada's largest urban area), have become much more sophisticated and nuanced in integrating environmental objectives, with a particular focus on expanding transit and creating a world-class regional transportation network. In order to support these objectives, the government, particularly under recent Liberal Party rule (2003-2018), established various mechanisms for funding mass transit projects, sought money from the federal government, and ended a long period of transit underinvestment with comprehensive transit plans that were bolstered by the largest transit and infrastructure investment in Canada's history. In this regard, the trend of governance driving governance can be seen at some level in transit-integrated land-use planning, which is important for reducing road passenger transportation emissions. As mentioned, the Province's short experience with a formal climate change regime does not allow for this variable to be analyzed for climate governance more broadly.

Federal governance driving state governance may also be a potentially important source of influence with regards to 'governance driving governance'. Although climate-specific legislation has been notably absent at the federal levels in both countries, the federal U.S. government has air and water quality standards, in addition to a federal mandated land-use and transportation planning system that integrates environmental objectives, whereas the Canadian federal government does not. Compared to other wealthy industrialized nations, Canada's environmental laws are 'strikingly substandard' (Boyd 2015, p. 239). Canada has no national environmental health surveillance system (unlike the US and Europe), and no comprehensive environmental health strategy (unlike the U.S., Australia and Europe); moreover, what laws do exist are simply weaker than other comparable nations (Boyd 2015). In this way, federal rules are not spurring regulatory action at subnational levels the way mandated conformity to federal environmental standards and targets do so in the U.S.

Structure of the Regional Economy



The prevalence of a large auto manufacturing industry has somewhat hindered Ontario in passing aggressive climate-transport legislation, whereas lower carbon and climate-sensitive industries dominating California's economy have aided in the passing of aggressive climate-transport policies.

California

California's economy is the 5th largest in the world and largely dominated by lower-emitting industries like information technology services, retail, healthcare services, clean-tech, hospitality and tourism and entertainment. Historically California had a very large manufacturing sector, stemming from a boom in World War II, and an intensive oil industry, but significant shifts in the structure of the economy over the past 60 years have meant that "the old bastions of economic power are losing influence" relative to newer, powerful industries like information and communication technologies (G. Giuliano, personal communication, Feb. 21, 2018). That being said, California remains a large oil-producing state, which has resulted in concessions and weakening of climate legislation in some cases. Although sustained lobbying efforts by the oil and gas industry in California has resulted in the weakening of some legislation, it has not had the effect of completely blocking the passing of climate-transport policies. This is partly due to sustained pressure from industries that have a vested interest in protecting California's environment, like

the state's large agricultural sector and tourism industry (Vogel 2015), or those that will be advantaged by pursuing a first-mover advantage associated with leading low carbon transitions.

California does not just have traditional low-carbon industries making up a significant part of the state economy, which in theory should present a lower barrier to the passing of climate legislation, it also has an extremely substantive clean-tech industry and innovation/knowledge economy, which has provided support for these policies. To put the size of its ITS economy in perspective, if the San Francisco Bay Area, which is home to California's Silicon Valley, were its own country, it would have the 19th largest economy in the world (Evans 2019). California is the leading hub for venture capital investment with regards to innovation and is ranked first in the U.S. Clean Tech Leadership Index (Clean Edge 2017; PwC and CB Insights 2018; cited in Hess and Sudibjo 2018). The University of California is the world's largest academic research system, consistently leading in granted U.S. patents and contributing over USD 46 billion annually to the state economy (Cho 2016). This immense research capacity has allowed California to benefit from 'first mover advantages' with regards to the cleantech sector, a dynamic which has aided in the passing of climate change legislation. California's position as an innovation hub is partly a result of the strong environmental and energy transition demand policies established by successive governments (Hess and Sudibjo 2018). Not only does this dynamic mean there is less opposition to climate-related policies, but it has also driven pushes for sustaining and enhancing low-carbon policies and regulations.

One clear example of the backing of state climate change policies by the business community was the strong opposition by commercial interests to Proposition 23, a 2010 ballot measure that proposed to roll back state climate change legislation (Vogel 2015). When Proposition 23, also known as the "California Jobs Initiative", was put on the agenda, an intense media campaign, led by the clean energy industry, was launched to garner support to reject the initiative (Rabe 2010). Strong labour union coalitions also rallied support to reject Proposition 23 (Karapin 2016). The result was a strong rejection of the proposition, with a decisive margin of 62% to 38% (Karapin 2016). The state's flagship climate legislation, AB32, also saw significant support for individual companies and industry associations (outside of heavy industry) (Karapin 2016). Critical for support for reducing transportation emissions, "the Detroit car companies have relatively small investments in California", allowing for "more political space to maneuver than many other states" (Sperling and Eggert 2014, p. 89).

Support for environmental protection by industry is not new in the state. Since the mid-1800s, steamship companies, farmers and tourist companies have played an important role in promoting environmental interests and shaping environmental protection regulations (Vogel 2015). Historically, farmers fought gold miners who were poisoning and flooding parts of the Sacramento River valley; tourist companies fought offshore oilrigs from threatening the coast of Los Angeles with extensive oil drilling (Vogel 2015). In each case, industrial interests to protect the environment triumphed and led to improvements in environmental quality (Vogel 2015). Support for climate mitigation efforts by California industries continues to often stem from an economic motivation. For example, California makes 81% of all wines in the United States, a crop that is especially susceptible to climatic shifts (Mozell and Thach 2014). Los Angeles and Long Beach California are home to the two largest ports in the United States, which handle USD 478 billion in cargo annually (Barnard et al. 2019); sea-level rise associated with climate change threatens the 40% of inbound US containerized freight handled here (Evans 2019).

Importantly, industry has not had, and continues to lack, a unified opposition to environmental legislation, weakening the ability of this coalition to hinder the passage of environmental protection laws and regulations, including climate change policies and programs. That being said, the oil and gas industry is still a major player in California's economy and has had recent 'wins' with regards to reducing the stringency of regulations that would apply to them. Although California's oil and gas industry are much less significant than it once was (California was the top petroleum-producing state from 1900-1936), California's petroleum refining still represents 10% of total U.S. capacity (U.S. Energy Information Administration [US EIA] 2018) and the industry has been able to lobby for regulatory relief successfully.

The most notable recent example of this was the passing of AB 398 in 2017, which legally extended the state's cap-and-trade system to 2030 (Lewis and Morgan 2017; AB 398 2017. In the first half of 2017, three of the top four lobbying spenders were oil interests, who collectively spent USD 13.5 million to influence the development of the climate legislation for extending cap-and-trade, AB 398 (Morris 2017). In the end, the oil lobby got much of what they wanted in the legislation, for example, 'kneecapping' local air quality districts authority to regulate emissions from refineries (Aronoff 2018; Morris 2017). Other notable 'wins' for big oil in the state include the re-writing of language governing GHGs from transportation fuels in 2015 legislation that set higher renewable energy standards for state electric utilities (Mernit 2017). Governor Brown also declined to curtail drilling and fracking, continuing

to grant new permits for exploration and eased restrictions to clear the path for more drilling (McKibben 2017; Mishnak 2017).

The disproportionate grip the 'big oil' has on California regulations and legislation stems from substantial strategic lobbying campaigns and the development of a close relationship with then-Governor Brown, in addition to moderate democrats (Mishak 2017). Between 2011 and 2017, the oil lobby spent more than USD 122 million on campaign contributions to boost influence in shaping energy regulations (Mishak 2017). As previously explained, California's large voter districts, which require expensive media campaigns to gain voter support, and short-term limits in Congress, amplify the influence of interest groups when donating to political candidates. Four years of emails between then-Governor Brown and appointees and oil industry representatives acquired by the Centre for Public Integrity "suggest a comfortable – at times, chummy – relationship", something that seems quite at odds for Brown, known as a liberal icon and climate evangelist (Morris 2017). Perhaps this is not surprising given the industry represents more than USD 148 billion in direct economic activity, supports roughly 370,000 jobs, and has supported Brown on legislative measures in the past when business support was needed (Morris 2017). Figure 26 provides a look at one of the many modern oil fields in California.

Figure 26. A general view shows oil pumping jacks and drilling pads at the Kern River Oil Field in Bakersfield, Calif. Photo: Mark Ralston/AFP/Getty Images (Aronoff 2018).

An important characteristic to understand about California's oil and gas industry in terms of analyzing their impact on climate legislation is the fact that California refineries are highly sophisticated and configured to produce cleaner fuels, in large part due to strict state regulations (U.S. EIA 2018). The oil and gas industry in California is also keenly aware that Government is not going to back-track on mitigation progress and therefore the most strategic approach is to try and support administrations so that their input on regulations and policies is accepted (G. Giuliano, personal communication, Feb. 21, 2018). The impact the industry has on climate legislation is nuanced because of these factors and is not simply a 'back or block' stance, but an attempt to influence regulations to avoid destruction. As Gen Giuliano, USC Professor and Director of the METRANS Transportation Center explains, the oil industry "is basically running defense at this point" (personal communication, Feb. 21, 2018). Therefore, the hindrance posed by this industry in terms of passing climate legislation is very different than say the threat a California coal industry might present to state climate action if California had any coal production or reserves (they do not) (U.S. EIA 2018). That being said, the political and economic clout of the oil industry remains the biggest industry barrier to progressive climate legislation.

Ontario

Historically, Ontario was primarily a goods-producing economy with a large manufacturing sector. Over time Ontario's economy has diversified to the point where it is now mainly a service economy (see Figure 27) (Ontario Ministry of Finance 2019) with automotive manufacturing dominating Ontario's manufacturing and exports. All five major automakers operate in Ontario, which produces more vehicles than any other U.S. state or Canadian province (Invest Ontario 2017). The value of Ontario's auto exports is 30% higher than its forestry, agriculture, food manufacturing, mining and primary metals combined, accounting for roughly CAD 63 billion worth of international exports in 2014 (Unifor Research Department 2015). Although the Although Ontario economy is now dominated by services vs. goods production, the prominence of the auto-manufacturing industry in Ontario, especially export dominance, has had a hindering impact on the passing of climate-transport policies.

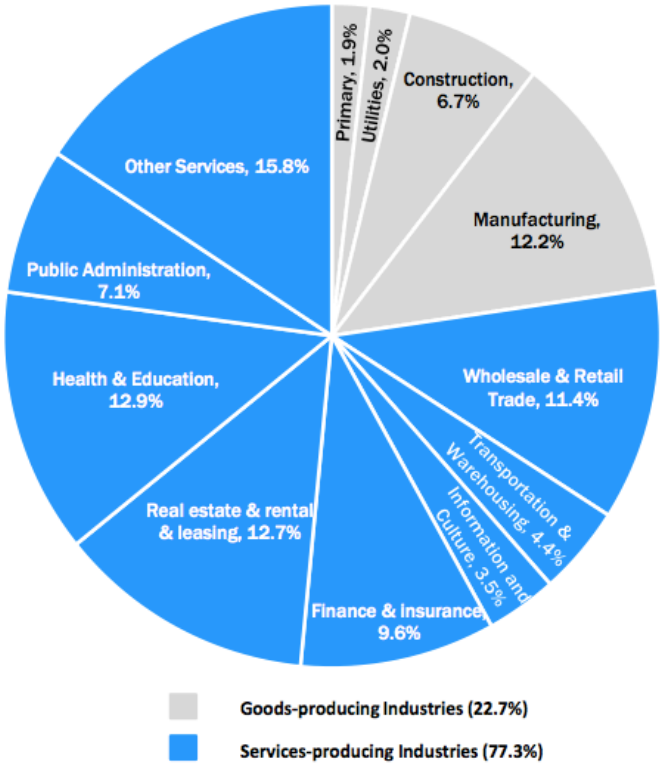


Figure 27. Structure of Ontario's Economy - Per Cent Share of Nominal GDP, 2018 (Ontario Ministry of Finance 2019).

This impact can be seen clearly through the unique treatment that the Ontario government gives to the auto industry when dealing with climate-transport policies. For example, when the pro-climate action Wynne administration joined the Western Climate Initiative, the government negotiated special concessions so that it would not have to abide by California's more stringent tailpipe emission standards (Institute for Competitiveness and Prosperity 2016). Another recent example of the barrier the Ontario auto industry presents to aggressive climate action has to do with the introduction of the ZEV target in Ontario. Originally the Liberal Wynne Administration (2013 - 2018) intended to introduce a ZEV mandate, much like the policy in neighboring Quebec; however, due to concerted lobbying efforts by the auto manufacturing association, the ZEV mandate was downgraded to a ZEV target (F. Volpe, Personal Communication, Feb. 5, 2018).

The strategy employed by the Automotive Parts Manufacturers Association (APMA) was effective in large part because they "lobbied in plain sight", publicly criticizing the ZEV quota and engaging in a public fight with then Minister of the Environment, Glen Murray, which over the course of three weeks got "nasty" (F. Volpe, Personal Communication, February 5, 2018). According to Volpe (Personal Communication, Feb. 5, 2018), who is president of the APMA, eventually, the Ministry came around and

the Premier's Office asked him what he "would like to see" along with a written apology from the Minister; the ZEV quota was downgraded to a target shortly after, and Volpe gave the written apology to The Globe and Mail, which he explained was an important move "because the next time the Minister is going to go ahead with something, that at least deemed by us to be harmful to the industry, he now has in his model that he will be debating me in the biggest newspaper in the country".

Although the Canadian and Ontario auto industry makes concerted attempts, and because of the importance of the industry, can shape climate-transport policies in their favour, they are not attempting to block climate legislation whole-heartedly. As Volpe explained (personal communication, Feb. 5, 2018), there is a good business case to do so:

> Where we position ourselves is skilled labour and a highly engineered product…if you map the auto clusters in North America, Ontario is the number one jurisdiction for units of products per year, and if you take the IT map and overlay it, it's the only place – we have the second biggest IT cluster – a lot of climate change is not just fossil fuels and materials. From our point of view – which is our automotive suppliers – which means a lot of people banging steel but a lot of people writing code for connected vehicles.

In this way, the auto industry's position on climate-transport policy is similar to the oil and gas industry in California; they are effective at shaping regulations in their favour but are not interested in fully blocking the passing of climate legislation, in part due to the advanced nature of their products. The auto industry in Ontario was also not outright adversaries of the past two Liberal Administrations (2003-2018) because they were benefitting from progressive Ontario Government policies and programs aimed at building a cluster of leading-edge passenger transportation technologies, such alternative propulsion, autonomous and connected vehicles (F. Volpe, Personal Communication, February 5, 2018). When the big automakers and assembly companies are looking at jurisdictions to make big investments in this area, "Ontario [was] in the discussion every time" (F. Volpe, personal communication, February 5, 2018).

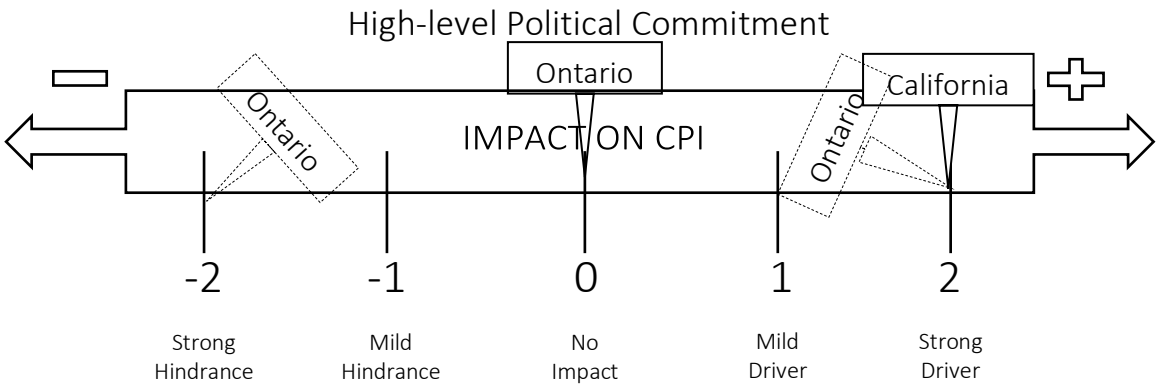
The Conservative Ford Administration's climate change plan also illustrates the special treatment of the auto industry in terms of environmental regulatory relief. The Plan, released in late 2018, states that a regulatory system for industrial emitters will be introduced that is "tough but fair" and "flexible to the needs and circumstances of our province and its job creators" (OMECP 2018, p. 25). There are very few details about this regulatory system described in the Plan, but what is made very clear is that the auto

industry will receive special treatment, including loopholes and exemptions: “Our made-in-Ontario standards will consider factors such as trade-exposure, competitiveness and process-emissions, and allow the province to grant across-the-board exemptions for industries of particular concern, like the auto sector, as needed” (OMECP 2018, p. 25).

Ontario has made efforts to grow its cleantech industry in the past decade and now has the fastest growing and largest cleantech sector in Canada (Ontario MOECC 2017). While this is an important economic strategy in and of itself, given the growing size of the cleantech industry in North America and globally, this industry does not influence politics the same way the auto industry does in Ontario, nor the same way the cleantech industry influences California politics. There are also challenges for the growth of Ontario's cleantech economy stemming from Ontario's 'innovation ecosystem', especially: "weak business R and D spending, underinvestment in information and communication technologies, weak multifactor productivity growth relative to other advanced economies such as the United States and weak intellectual property protection" (Ontario Ministry of Finance 2017, p. 71).

In Ontario, there is little industry pushback against climate action from electricity providers. Like California, Ontario now also lacks a coal industry, having shut down all of its coal plants between 2005-2014 (Government of Ontario 2019). Roughly 35% of Ontario's electricity is now supplied by nuclear power, which is the largest share in the province's supply mix (IESO 2019). The nuclear industry has a strong advocacy coalition, but is in support of climate action and positioning itself as a low emission provider of base-load power. In fact, the dynamics of Ontario's electricity system, which has constant (relatively low-carbon) surplus energy in the late evening and overnight hours, has spurred some support from those who see increased electric vehicle charging demand overnight as an economically beneficial shift, compared to selling surplus electricity to neighboring states (often at a loss) (Partners in Project Green 2016; Ontario Society of Professional Engineers 2017). Given the lack of pushback from what would be considered typical industries lobbying against climate action (e.g., coal), Ontario's energy-intensive manufacturing sector, especially auto manufacturing, can be singled out as the dominant industry limiting the aggressiveness of climate policies. That being said, the pushback from this industry is essentially limited to the transportation sector, and not as substantial as the oil and gas industry in the Canadian context.

Framing and high-level political commitment



High-level political commitment

High levels of sustained political commitment for climate change action over the past 20 years or so have been integral to the passing of climate change legislation and the building of a comprehensive climate change governance regime in California. In particular, the past two governors of California, Arnold Schwarzenegger and Jerry Brown, can be considered quintessential climate change 'issue champions. In contrast, Ontario has suffered from intermittent high-level political commitment following somewhat dramatic pendulum swings in political orientation over the past 20 years or so. Certain administrations, especially the 15 years (2003-2018) of Liberal Rule, have seen high levels of political commitment to reducing emissions and this has had an important positive impact on the passing of climate legislation. The impact of administrations where climate support is notably absent, especially the most recent election of an Ontario Progressive Conservative Government, has netted out this effect as these governments have blocked not only environmental protection legislation but also dismantled existing governance mechanisms aimed at combatting climate change.

California

Relatively high levels of consistent political commitment to acting on climate change have benefitted by a long history of environmental leadership in the state of California. Specific events in California's recent history, such as the electricity crisis of the early 2000s, help explain the motivation for

political commitment to reducing emissions, but the long history of direct state intervention in regulating emissions, provide an understanding for widespread support for the passing of climate legislation. As Hanemann (2007) explains, "Chance events explain why the legislation happened to occur at this particular time, but the context for the legislation and the reason why it was widely supported come from California's previous experience of using state legislation to regulate automobile air pollution and promote energy efficiency". This sustained high-level political commitment for progressive climate policy was and continues to be a key driver of the passing of climate legislation and the establishment of a comprehensive climate governance regime.

Consistent high-level political commitment for reducing emissions has been a hallmark of the past four California Governors: Gray Davis, Arnold Schwarzenegger, Jerry Brown, and now Gavin Newsom, and certain members of Congress. The electricity crisis of the early 2000s provided a window of opportunity for then-Governor Davis to implement his energy omnibus program in 2002, which included the largest renewable portfolio standard in the country (Bradley 2015). The same year, dedicated climate leadership from then Assemblywoman (now Senator) Fran Pavley resulted in the passing of AB 1493 (2002), also known as the "Pavley Law", which required a 40% reduction in average new vehicle GHG emissions by 2016. This law arguably marks the beginnings of the modern climate change governance regime in California.

Pavley also authored the state's flagship climate legislation, AB 32 *The Global Warming Solutions Act*, which was passed in large part due to sustained efforts by then-Governor Schwarzenegger, who worked effortlessly to build a broad coalition of support, and critically, "vigorously attempted to gain business support, or at least acceptance of AB 32 by emphasizing the benefits of emissions trading and offering reassurances about the costs" (Karapin 2016, p. 159). The fact that high-level political support for California's flagship climate legislation came from a Republic Governor was instrumental in securing the support of the business community, and ultimately the passage of AB 32 (Karapin 2016). Not only did Governor Schwarzenegger secure the passage of AB 32, but he also endorsed the Pavley rules and signed an executive order requiring the California Protection Agency to report to the legislature every two years on climate mitigation progress and the state of global warming in California (Karapin 2016).

Governor Brown, a Democrat who succeeded Governor Schwarzenegger, was first Governor in the 1970s. He showed a strong commitment to environmental protection in his first terms as Governor and continued to promote aggressive environmental policies, especially climate policy, over his two terms between 2011 – 2019. Jerry Brown's leadership and commitment to climate change mitigation and adaptation elevated the state from a U.S. climate leader to an international leader on climate governance. For example, Governor Brown signed bi-lateral agreements with foreign jurisdictions like China to cooperate to lower greenhouse gases (Wilson 2017). He also established the U.S. Climate Alliance with New York and Washington's Governors and the Under2Coalition, which is a coalition of over 220 governments, spanning 6 continents and 43 countries to meet even more ambitious greenhouse gas reduction targets than those set in Paris (Gutierrez 2017; Wilson 2017) (see Figure 28). Brown also formed America's Pledge Initiative with New York's Governor to compile and quantify climate action of U.S. states, cities and businesses to track and encourage national progress on emission reductions (Governor's Press Office 2017). In addition to Brown taking a very prominent leadership role helping establish coalitions for climate action nationally and internationally, he also was instrumental in helping the passing of some of the state's most aggressive climate policies.

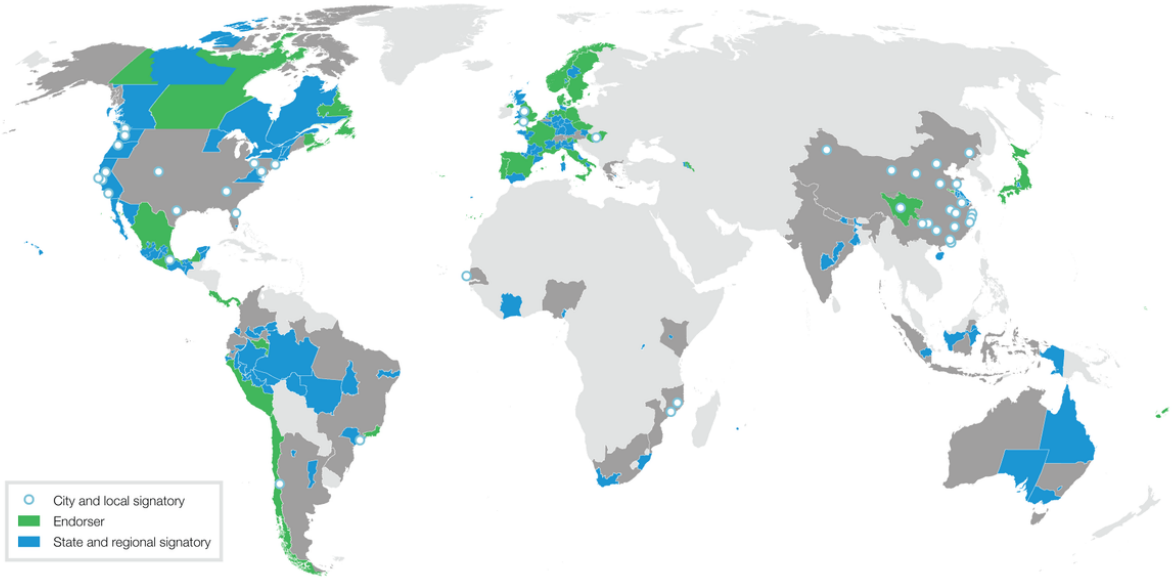


Figure 28. Signatories and Endorsers of the Under2 Coalition (The Climate Group 2019).

It is important to note the connection between strong political commitment to act on climate change in the face of federal inaction, and the sheer ability of leaders in the state to do so. As the 5th largest

economy in the world, which includes the world's largest academic research system and largest vehicle market in the United States, California in and of itself shares many characteristics of a modern nation-state, as opposed to a state within a federation (G. Giuliano, personal communication, Feb. 21, 2018). As Genevieve Giuliano, explains, California "definitely has the size and economic power to act as a nation-state… and sometimes it does" (personal communication, Feb. 21, 2018). Understanding this dynamic provides for a more nuanced picture of why leaders, like Governor Brown, were able to take such strong leadership positions on climate change mitigation and governance.

One year into his first term Brown gave Executive Order B-16-12 (2012), which ordered state agencies to facilitate the rapid commercialization of ZEVs, setting a target for 1.4 million ZEVs in California by 2025 and infrastructure to accommodate 1 million ZEVs by 2020. He also ordered a very ambitious transportation emission reduction target of an 80% reduction by 2050 from 1990 levels (Exec. Order B-16-12 2012). Brown also ordered new, stringent emission reduction targets for the state in 2015; Executive Order B-30-15 (2015) mandated state agencies update and prepare plans to reach a 40% reduction in state emissions, below 1990 levels by 2030, by far the most ambitious emission reduction target in North America. Executive Orders like these led to the passing of many pieces of aggressive climate legislation and policies enacted to meet these goals. Governor Brown also committed significant funding to support the implementation of these ambitious policies. Of particular significance was SB 1 (2017), a landmark transportation funding bill with significant climate mitigation components, which will see 5.4 billion dollars USD invested annually over a decade (2017-2027). As per SB 1 (2017), a significant portion of the funding is sourced from a 12 cents gas tax increase, a traditionally politically unpopular move that Brown committed to make this once in a generation transportation funding bill a possibility.

"There is also a lot of local support" outside of leadership from state-level administrations (G. Giuliano, personal communication, Feb. 21, 2018). Local champions at lower levels of government have also been key in seeing progress though on the climate change front in California, in particular with regards to transit projects. For example, various Mayors like former Santa Monica Mayor Denny Zane, have been instrumental in pushing for legislative and organizational change to improve local transit systems (D. Clarke, personal communication, Feb 26, 2018). Then-Mayor Zane created Move LA in 2007, an organization that brought together industry, labour and environmental leaders with the aim of raising funds to improve LA County's transit system; this coalition was critical in getting sales tax Measure R passed,

which enabled an ambitious expansion of LA County's transit system (MoveLA n.d.). Once Move LA was set up, former Los Angeles Mayor, Antonio Villaraigosa (2005-2013), also stepped up to champion the organization's commitment to increased sustainability through transit development, becoming an active spokesperson for the project (D. Clarke, personal communication, Feb 26, 2018). Many individual local/regional government agencies and organizations also show a strong commitment to reducing emissions. For example, LA Metro, the nation's second-largest transit authority, has committed to having 100% electric vehicles by 2030 (G. Giuliano, personal communication, Feb. 21, 2018).

A legacy of a strong commitment to environmental protection policies, at both the local and state level, including a norm of state intervention in regulating of numerous entities, has created a culture in California where high-level political commitment for environmental protection has become the rule, not the exception. This consistent support over time has been a key factor in understanding why a comprehensive climate change regime, which includes a large number of interventionist regulatory policies, has been able to be established in this jurisdiction.

Ontario

In contrast, Ontario has experienced somewhat dramatic swings in political support for climate policy, which can be linked to the orientation of the government of the day, and the level of issue salience for climate change. In general, political support for climate change policy has reflected a classic post-materialist/materialist divide, with the Liberal Party, Green Party and New Democratic Party reflecting post-materialist ideals and the Progressive Conservative Party embracing classic materialist principles. This divide shifted in the 2018 election when voters in Southern Ontario who were being hurt by economic restructuring sided with the New Democratic Party in urban areas and the Progressive Conservatives in rural areas. As previously mentioned, the newly elected Progressive Conservative government eliminated the provincial cap-and-trade system and dismantled many other climate-related efforts, particularly in the transportation sector. One piece of understanding how seemingly easy it was to dismantle much of the established climate change governance regime is to look at how it was developed. Unlike California, which saw support from across the political spectrum during the development of flagship climate frameworks, Ontario's framework legislation and programs were very much a project of post-materialist political parties, headed by the Liberal Party of Ontario.

Following a steadily-increasing intensity in efforts beginning in the early 2000s, the most recent legislative/climate change governance approach prior to the 2018 provincial election represented a peak in directly addressing GHG emission mitigation by the Ontario provincial government. The 2015 Climate Change Strategy, the *Climate Change Mitigation and Low Carbon Economy Act* (2016) and the 2016 five-year Climate Change Action Plan, represented critical pieces of the most recent climate change governance regime. Before the establishment of a formal, comprehensive climate change governance regime by the Wynne Liberal administration, the previous Liberal government also undertook emission reduction actions, but these were not framed as climate action, nor was an explicit high-level political commitment to mitigating climate change a key motivator. This 'balanced' approach to climate change mitigation is reflective of the managerial/facilitative orientation of the government, post the 2008 economic downturn when issue salience was low (Winfield 2018).

It has only been over the past ten years that provincial efforts to lower emissions from the transportation sector have been framed in terms of climate change mitigation in Ontario. Moreover, it was only in the past few years that an explicit high-level political commitment to climate action formed central campaign platforms for the Liberals under Premier Wynne, who oversaw a more activist/progressive government (Winfield 2018). Longer-standing approaches for reducing transportation emissions, such as transportation demand management, provision of enhanced transit services, vehicle emission standards and fuel taxes, were primarily aimed at reducing smog, traffic congestion and urban sprawl. In the case of fuel taxes, there was also a means of raising revenues for the Government. The phase-out of coal-fired electricity in 2014, which a decade earlier had provided 25 percent of the province's electricity supplies, was very much motivated by health concerns stemming from air pollution. Although Ontario experienced a peak in high-level political commitment for climate change mitigation between 2015-2018, the potential for continued support was not benefited by a long-standing history of environmental protection regulation, and also a voter base that was still very concerned with traditional 'bread and butter' issues.

On June 7, 2018, Ontarians elected a Progressive Conservative Party (PC) government, led by now Premier Doug Ford, ushering in a new era characterized by a neo-liberal orientation. The PCs won a majority of seats (76), followed by the Ontario New Democratic Party (NDP) (40 seats), ending a 15-year rule by the Ontario Liberal Party who won only 7 seats, and as a result, lost official party status (Elections

Ontario 2018). The Ontario Progressive Conservative Government won the provincial election with a campaign platform that was explicitly un-supportive of aggressive climate action and reminiscent of the neo-liberal Harris government's (1995-2002) Common Sense Revolution. This government has moved very quickly on dismantling climate change action in the province. Its hostility towards this particular area is being evidenced by the convening of a rare summer session of the legislature to begin repealing the cap-and-trade system in the province (alongside canceling a wind project), despite the extraordinarily high costs of doing so (roughly CAD 2-4 billion) (Sharp 2018). The cost also includes the price of potential litigation, estimated to be upwards of CAD 100 million, which will likely result from this action (Sharp 2018).

As of early July 2018, Ford has revoked the regulations outlining the carbon pricing system in the province and has begun the process of deciding how to revoke funding for projects paid for by carbon pricing proceeds (Loriggio 2018). With regards to policies impacting transportation-related emissions, the new PC government has canceled many of the 'cleaner vehicle' programs and policies, which made up the bulk of new environmentally-oriented policies in the transportation sector. The Electric and Hydrogen Vehicle Incentive Program and the Electric Vehicle Charging Incentive Program were both cancelled, effective July 11, 2018 (Ontario Ministry of Transportation 2018d; Blinch 2018). The PC government has also committed to reducing the provincial gasoline tax by CAD 10 cents/litre (Winfield 2018). Finally, the promotion of active transportation has been impacted by the cancelling of the Ontario Municipal Commuter Cycling Program (Stuckless 2018).

The new government's disdain for carbon pricing also goes beyond provincial borders. The *Greenhouse Gas Pollution Pricing Act* (2018), which legally established the federal carbon backstop price, received Royal Assent in 2018. Premier Ford has launched a legal challenge against the federal government's imposition of a carbon-backstop pricing regime for provinces who do not already have an equivalent pricing scheme, a legal battle he is unlikely to win according to constitutional and environmental law experts (Sharp 2018; Buchta, Corpuz and Coburn 2018; Rolfe 2018). Given that this government is extremely focused on not spending money, the fact that they are moved so quickly to repeal cap-and-trade and pull out of the Western Climate Initiative without a fully costed assessment illustrates an extreme lack of political commitment to take responsibility for addressing climate change issues.

The fact that Ontario's climate change governance regime was able to be dismantled so quickly highlights the vulnerability of nascent climate governance regimes, especially carbon pricing programs, and the importance of path dependency as it relates to the increasing density of polycentric governance systems over time. Ontario's cap-and-trade system was in place for just over a year and free allowances were given away as a part of the initial compliance phase. This resulted in almost no industry push-back to the repeal of the system because industries covered under the program were not 'bought-in' or fully invested in the program the same way they would have if the program had been running for years. The rapid dismantling of the climate change regime, more broadly, reflects the vulnerability of nascent systems in comparison to more complex and layered regimes that have evolved over longer time periods. For example, if a 'Ford-like' Governor won a California election at a similar time, attempts to dismantle California's complex and multi-faceted climate change regime would be much more difficult, in part due to the industries invested in the current model.

At this early stage, it is still unclear how the government bureaucracy will respond and how diminished evidence-based decision-making and regulatory independence become, to understand the magnitude of the impact the new government's actions ultimately have. The Ford Government released its 'Made in Ontario Environment Plan' in late 2018 (note no use of the term 'climate change'). The Plan turns the polluter pays principle on its head by paying emitters to reduce emissions and establishes GHG emission reduction targets that are roughly 1/3 as ambitious as the previous government (Ontario Ministry of Environment Conservation and Parks [OMECP] 2018). As previously mentioned, the Plan also introduces a new regulatory framework for industrial emitters that include broad loopholes and exemptions, allowing the province "to grant across-the-board exemptions for industries of particular concern, like the auto sector, as needed" (OMECP 2018). One bright spot is that energy efficiency and conservation measures, essentially leftover from the previous government, are contained in the plan.

Taken together, the political and policy paradigm has dramatically shifted in the province, directed by the Premier himself, in a way that is going to be very damaging to the established climate change governance regime. High-level political commitment, and its relation to issue salience and shifting government orientations, is without a doubt illustrating its dominant power in Ontario as a key explanatory variable for varying levels of government progress on addressing climate change.

Framing

Framing, very generally, is a sense-making process (Schäfer and O'Neill 2017); Frames "play an essential role in distilling complex topics into more manageable components so that people can identify its relevance and form opinions" (Spence and Pidgeon, 2010; cited in Stecula and Merkley 2019, p. 10). Given the complexity of climate change as an issue (complex science, uncertainty, trade-offs, solutions), the use of frames to understand and process this dilemma is inevitable (Stecula and Merkley 2019). How an issue is framed has potentially significant implications for gaining policy support and stakeholder engagement. As Tabara and Miller (2012, p. 59) explain, "New information is mentally ordered and knowledge is mediated by existing frames – or challenged by new ones. Hence, frames mark the points of reference in which cognitive and moral interpretations are carried out, but not the actual messages or claims contained in these frames".

In order to better understand how public support and political will can be promoted with regards to taking action on climate change, communication strategies utilized, especially framing approaches, have increasingly become a focus of expert analysis (for example Nisbet 2009; Schlichting 2013; Shehata and Hopmann 2012; Schäfer and O'Neill 2017). Frames are not neutral (Nisbett 2009) and vary depending on the stakeholder group (e.g., ENGO, Industry, Academia). Given this research is concerned with the role of government in helping or hindering the passing of climate/climate-transport policies, the impact of the frames and discourse utilized by top politicians will be evaluated for each case. For example, when advocating for carbon pricing policies, analysts have concluded that too often, governments emphasize the mechanics of a particular policy instead of what the policy can accomplish (Aronoff 2018). Emphasizing the economic benefits of climate policy is more effective than emphasizing the costs of inaction (Spence and Pidgeon 2019).

Overall, framing strategies used by successive governments have been relatively effective in the case of California. In particular, framing climate change in a way that de-politicizes the issue, as an explicit environmental threat that has been causing severe droughts and wildfires, and as an economic and political leadership opportunity has proven to be a relatively effective science communication strategy. In Ontario, overly technical communication strategies emphasizing the mechanics of climate change policy by the past Liberal government, over what these policies can achieve, have been relatively less effective in

garnering support for continued action. In contrast, the newly elected Progressive Conservative government, led by then-candidate and now Premier Ford, have been successful in their use of right-wing populist framing of climate change to garner enough support to dismantle the nascent climate governance regime in the province.

The communication efforts by the Liberal Wynne Administration in Ontario around introducing carbon pricing and other climate mitigation measures arguably fell into this less than ideal framing and communication approach, where mechanisms are emphasized over macro impacts and visions. Website communications and government reports contained many details on the workings of the province's Five-Year Climate Change Action Plan, and the various instruments being implemented under the plan. In general, the past liberal administration employed a typical ecological modernization frame, which emphasized win-win (economy-environment) outcomes from transitioning to a low-carbon economy. In addition to increasing economic competitiveness, a health frame was also utilized, something which proved very effective in building sufficient support for closing the province's coal-fired power plants. For example, in an August 2015 speech to the Association of Municipalities of Ontario, Premier win introduced the topic of climate change by saying, "Climate change represents the single greatest threat to our health and prosperity -- today and for generations to come" (Office of the Premier 2015). For all the Liberal government's efforts, the sheer number of micro-targeted climate programs and policies, and the government's failure to focus on the larger vision as opposed to explaining the details of the mechanics, failed to resonate with voters who were concerned about making ends meet and being able to pay day-to-day bills like hydro.

On the other hand, then PC Leader (now Premier) Doug Ford's simple and consistent message of cap-and-trade as a government tax grab, wrapped up in a right-wing populist campaign approach claiming 'a government for the people', was effective just enough to win him the 2018 election. Even before taking office, Ford's election victory speech utilized strong framing that positioned his win as a victory for the people, automatically positioning the incumbent Liberal regime as opponents of the people: "Together we made history. *We have taken back Ontario*. We have delivered a government that is for the people [emphasis added]". Similarly, legislation to repeal the province's cap-and-trade system was framed as providing 'relief', automatically framing the carbon pricing system as the problem (Office of the Premier 2018a).

Even if the nuanced climate policy regime being introduced was on the right track from a policy perspective, it failed from a political perspective. Liberals were seen to be engaging in high-brow, post-materialist, expert-led policy discussions, while Ford squarely placed himself in the position of someone your average voter would like to have a beer with. Ford's right-wing populist style can be seen clearly in his critique of the cap-and-trade and other climate policies brought in under the Liberal Wynne Administration. The framing approach proved to be effective, similar to anti-climate 'wins' in the U.S. under President Trump.

As a start, in every single tweet leading up to the election dealing with climate policy, Ford referred to the province's cap-and-trade system as a 'tax' or a 'tax grab', along with framing residents of Ontario as 'taxpayers' instead of voters. In Premier Ford's August 2018 speech to the Association of the Municipalities of Ontario, the term 'climate change' was not once used. Instead, Premier Ford referred to "so-called green energy projects", which "the previous government decided to ram…into the backyards of communities that didn't want them" (Office of the Premier 2018). In the vein of populist traditions, Ford justified repealing the province's *Green Energy Act* by classifying it as an attack on 'the people', representing "the largest transfer of money from the poor and middle class to the rich in Ontario's history" (Office of the Premier 2018).

The discourse employed by Ford, in talking about the previous government's climate change policies, positions the issue as a liberal elitist project and a justification to expand government and spending. In this way acting on climate change was disconnected from the notion that it was a need of 'the people', further exacerbating the inherent characteristic of climate change as a collective action dilemma, whereby the issue feels far removed from the actions and people causing it, due to the physical scientific characteristics of the problem. Overall the framing strategy, which fits within the broader approach utilized by right-wing populist governments, was effective in gaining enough support for the Ford campaign to win the election and to justify the dismantling of the province's nascent climate change mitigation regime.

In California, climate change as an issue has and continues to be framed much more explicitly as an environmental threat by successive governments than it is in Ontario. This is arguably, not surprising, given the number and severity of extreme weather events that have caused significant damage to the

people, environment and economy of California in recent years, and which have been explicitly linked by government and media to climate change. It has also consistently been framed as an economic opportunity and an economic threat; on the one hand, the issue can benefit the state's relatively large cleantech and R & D industries that can take a 'first mover' advantage, on the other, key state industries will be adversely affected. Finally, California has framed itself (rightly so) as a leader in environmental protection, bringing in the notion of some kind of duty to continue this legacy. This frame is clearly illustrated the pre-amble to the passing of California's flagship climate legislation, AB 32 *The Global Warming Solutions Act*, states:

> The Legislature finds and declares all of the following:
>
> (a) Global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California. The potential adverse impacts of global warming include the exacerbation of air quality problems, a reduction in the quality and supply of water to the state from the Sierra snowpack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment, and an increase in the incidences of infectious diseases, asthma, and other human health-related problems.
>
> (b) Global warming will have detrimental effects on some of California's largest industries, including agriculture, wine, tourism, skiing, recreational and commercial fishing, and forestry. It will also increase the strain on electricity supplies necessary to meet the demand for summer air-conditioning in the hottest parts of the state.
>
> (c) California has long been a national and international leader on energy conservation and environmental stewardship efforts, including the areas of air quality protections, energy efficiency requirements, renewable energy standards, natural resource conservation, and greenhouse gas emission standards for passenger vehicles. The program established by this division will continue this tradition of environmental leadership by placing California at the forefront of national and international efforts to reduce emissions of greenhouse gases.

Then-Governor Schwarzenegger's overall framing approach was intended to create a broad advocacy coalition. When AB 32 was introduced, it was heavily framed as something that did not require sacrifice on the part of Californians, but instead was an economic opportunity for the state; three different economic studies were presented during the 2006 debate on AB 32, which ranged from zero economic impact to gaining several billions of dollars (Karapin 2016). This introduction of this flagship climate legislation was also unique in that it was a bipartisan effort led by a Republican Governor. In a way, this

depoliticized the framing of this issue, enabling a broader coalition to form supporting the passing of this legislation.

Governor Brown, who succeeded Governor Schwarzenegger, continued to emphasize the economic benefits of taking increasingly aggressive action on climate change mitigation, as well as the state's unique position as a global leader in this area. In Brown's 2012 executive order (E.O. B-16-2012) that set aggressive targets for EV deployment and transportation emission reductions, an economic rationale was emphasized more than any other justification:

> WHEREAS California is the nation's largest market for cars and light-duty trucks; and
>
> WHEREAS the transportation sector is the biggest contributor to California's greenhouse gas emissions and accounts for approximately 40 percent of these emissions; and
>
> WHEREAS California should encourage the development and success of zero-emission vehicles to protect the environment, stimulate economic growth and improve the quality of life in the State; and
>
> WHEREAS California is a leader of technological innovation, including the innovation necessary to produce commercially successful zero-emission vehicles; and
>
> WHEREAS California attracts over half of the nation's venture capital for clean technology and ranks high among the states in the number of workers and facilities supporting the clean-car industry; and
>
> WHEREAS California is leading the nation in enacting laws and establishing policies and programs that are reducing greenhouse gases, protecting air and water quality, promoting energy diversity and supporting low-carbon alternative fuel technologies; and
>
> WHEREAS zero-emission vehicles provide multiple benefits in addition to reducing greenhouse gas emissions, such as reducing conventional pollutants, operating quietly and cleanly, allowing home refueling and lowering operating and fuel costs; and
>
> WHEREAS California should support and encourage car manufacturers' plans to build and sell tens of thousands of zero-emission vehicles in California in the coming years (Office of the Governor 2012).

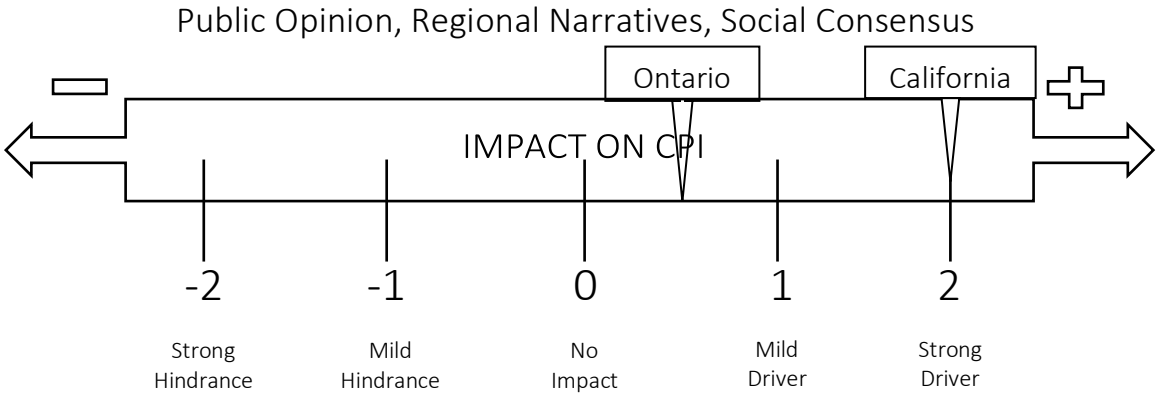
The government of California under the Brown administration also leveraged the fact that it is the state with the biggest economy, the most people, and an international climate leader to frame not taking action on climate change as a nonsense position. This especially became the case after Donald Trump, an anti-climate science, right-wing populist, won the U.S. Presidency and shortly after pulled out of the UN Paris Agreement. Brown was immediately a prominent, highly vocal critique of this move and quickly filled the space as the de-facto representative of U.S. climate change actions.

Brown's words and actions in the face of the Trump Administration's anti-climate stance and actions started framing this tension, not only around sound climate change governance, but also linking it to strong leadership, the fulfillment of duty, and the dismissal of misinformation, 'junk science' and retrenchment to the economies of past. For example, in response to threats from the Trump Administration to cut climate change research funding, Brown stated, "We've got the scientists, we've got the lawyers, and we're ready to fight…If Trump turns off the satellites, California will launch its own damn satellite!" (Leslie 2017).

This kind of framing also seems to be following recent insights from science communication that argue when communicating about climate change, one of the most important considerations in terms of improving efficacy is to match the frame to the audience (Hendricks 2017). Given that part of Californian's regional identity includes an "innovative and pioneering spirit" (League of California Cities 2017), utilizing a leadership frame makes sense in terms of trying to resonate with citizens and residents. This appeal can be seen clearly in then-Governor Brown's remarks, days after President Trump pulled out of the Paris Agreement: "California is the leading economic state in America and we are also the pioneering state on clean technology, cap-and-trade, electric vehicles and batteries…" (Wilson 2017). Similarly, Californians have experienced severe climate change impacts like droughts and wildfires in recent years; framing climate change as an explicit environmental threat matches the experience of 'the audience'. The link between political commitment, framing and public opinion on climate change for each case will be discussed further below.

Public Opinion, regional narratives and social consensus

Studies of public perceptions of global warming date back roughly to the 1990s; early studies typically looked at contrasts between laypeople and experts and were mostly limited in geographic scope (e.g., Bostrom et al. 1994; Lofstedt 1991, 1992, 1993; Kempton 1991; cited in Tabara and Miller 2012, p. 54). A majority of studies focus on the national level, many of which have confirmed that public policies do reflect the general opinion of the electorate (Borick 2010). There is, however, a lack of refined measures linking public opinion with a particular policy area, as opposed to the link between public opinion and government action more generally (Borick 2010). That being said, public opinion polls regarding climate change, at the subnational level, do provide important insights for the degree of public consensus on the issue, which informs government action. Previous policy efforts in the arena of environmental protection, and existing environmental conditions, are also important factors in understanding varying levels of public support for government action on climate change (Borick 2010). In particular, CPI in California has consistently benefitted from a relatively strong social consensus around the need to mitigate climate change, whereas it has only been a mild driver of CPI in Ontario.

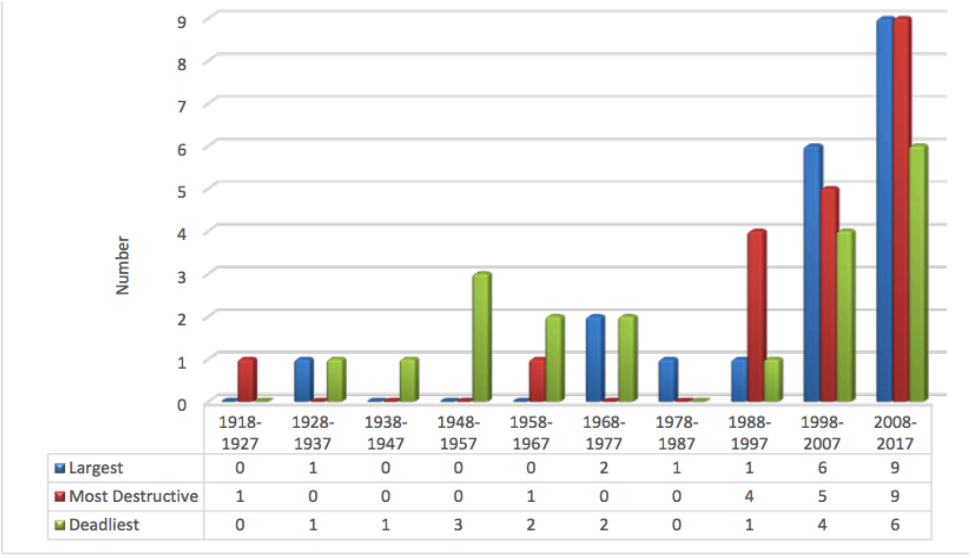


California

Californians exhibit serious concern over the impacts of climate change and support unilateral action to reduce emissions (Derthick 2010). California's unique ecological diversity and natural beauty, as well as severe air pollution issues and vulnerability to climate change, have helped build a strong social consensus concerning acting on environmental matters - especially air and energy issues. Extreme weather events such as severe droughts and wildfires, as well as increasing temperatures, have increased public

concern about mitigating and adapting to climate change, even if these events have not been directly linked to a warming climate (Derthick 2010). Relatively powerful environmental advocacy communities, which include a higher than average number of affluent and professionally accomplished members,

As Figure 29 illustrates, the past two decades have seen increasingly higher rates of the largest, most destructive and deadliest wildfires in the state. The summer of 2018 saw the largest wildfires in the state's history, including the single largest wildfire and the largest ever wildfire complex prompting a national state of emergency to be declared (Cal Fire 2018; Frost 2018). Although press images of the fire (Figure 30) illustrate the power of these blazes, photos taken from space truly illustrate the scale of these destructive events (see Figure 31).



	1918-1927	1928-1937	1938-1947	1948-1957	1958-1967	1968-1977	1978-1987	1988-1997	1998-2007	2008-2017
Largest	0	1	0	0	0	2	1	1	6	9
Most Destructive	1	0	0	0	1	0	0	4	5	9
Deadliest	0	1	1	3	2	2	0	1	4	6

Figure 29. The largest, most destructive, and deadliest California wildfires in the last century (California Energy Commission 2017).

Figure 30. Flames from the Holy Fire scorch a hillside in Lake Elsinore, California, on August 9. ROBYN BECK / AFP / GETTY (Meyer 2018).

Figure 31. The Carr and Ferguson wildfires, as glimpsed earlier this month by the astronaut Alexander Gerst. “These fires are frightening to watch, even from space,” he said on Twitter (NASA) (Meyer 2018).

It is one thing for a state to experience extreme weather events and other impacts of climate change, like flooding, etc., but this cannot in and of itself explain higher levels of issue salience or pro-climate action opinions. As Dr. Giuliano insightfully points out, states like Florida and Texas are essentially disappearing without any response from the government in terms of passing comprehensive climate regulations (personal communication, Feb. 21, 2018). Dr. Giuliano explains that in California, the mainstream media has long been reporting what climate scientists have predicted in terms of impacts and reporting on extreme weather events like the state's recent wildfires. This is communicated in a way that reaffirms a narrative directly linking this harm to climate change (G. Giuliano, personal communication, Feb. 21, 2018).

Even before extreme weather events linked to global warming became prevalent, Californians exhibited a strong preference for environmental protection. This is especially true for a significant number of influential, affluent Californians, who "have periodically mobilized to support policies that supply them with the public goods that enable them to access and enjoy various features of the state's natural environment, particularly those that are physically contagious to them" (Vogel 2015, p. 3). This dynamic can be seen to stem from California's "unusually attractive natural environment", which forms a large part of the state's 'golden' identity and appeal (Vogel 2015). This continues to be bolstered by the large number of highly-skilled knowledge workers who come to work in California's Silicon Valley and have very strong preferences for natural amenities, like clean air and water (G. Giuliano, personal communication, Feb. 21, 2018). The unique beauty and natural features have not simply inspired wealthy citizens to protect its aesthetic appeal; it has also been the basis for significant economic benefits.

The state's unique ecological beauty and diversity, some parts of which are considered national treasures, have been motivators for environmental protection. For example, California's Redwood Forests contain the largest, tallest, oldest trees in the United States, which are also the oldest living species on Earth (Vogel 2015). In fact, it is the protection of the Redwoods found in California's Yosemite Valley that forms the origin of California's long history of environmental protection. Only 14 years after California became a state (1864), then-President Abraham Lincoln signed legislation during the American Civil War that gave 60 square miles of redwood trees to the state on the condition that they are protected for "public use, resort and recreation and be held inalienable for all time" (Vogel 2015).

Economic interests tied to the state's natural beauty have also been important in widening and strengthening California's environmental advocacy coalition. Many businesses, which are based on the natural environment in California, have benefited from environmental protection policies and have historically mobilized to support them (Vogel 2015). This is also the case in contemporary times; both strong environmental activism and supportive, influential business communities continue to push for increasingly stringent environmental protection regulations and play "a critical political role" in their enactment (Vogel 2015, p. 3). The inclusion of certain business communities and affluent citizens in California's environmental movement (broadly speaking) has provided this group with a relatively strong 'voice', and made it an influential advocacy coalition in the state.

In addition to recent extreme weather events shaping public opinion on mitigating climate change, California benefits from a long history of strong environmental activism (Vogel 2015), which has aided in building a strong social consensus to act on climate change in contemporary times. In part, these deep roots of environmental protection advocacy are tied to a long history of pollution issues (especially air pollution), in a state containing spectacular natural beauty and ecological diversity (Schmidt 2007, p. 146). For example, events such as the oil spills off the coast of Santa Barbara in the 1960s were "a big deal" in terms of spurring environmental activism in California, which ended up leading initial Earth Day campaigns and the passing of a more stringent version of the federal *National Environmental Protection Act* (NEPA), the *California Environmental Quality Act* (CEQA) (G. Giuliano, personal communication, Feb. 21, 2018).

Not only have California's air and water pollution issues been uniquely severe, but they also have early origins, have been long-lasting, and due to California's geography, have mostly been contained within the state itself. Unlike other states, environmental harms in California are self-contained; air and water pollution generated in California stays within the state (Vogel 2015). For example, the state's rivers begin and end within its political boundaries and similarly, air pollution cannot be exported to neighboring states (Vogel 2015). From a collective action standpoint, this changes the parameters of the issue as the costs of environmental degradation are internalized, resulting in a motivation to supply public environmental goods (i.e., protect the environment).

A clear illustration of the importance of this characteristic of California's environmental advocacy coalition was the effort by liberal elites, such as billionaire hedge fund manager and environmentalist, Tom Steyer, in funding "very effective commercials" to gain support to defeat the industry-supported ballot initiative, Proposition 23, which would effectively overturn California's cap-and-trade system (D. Clarke, personal communication, Feb. 26, 2018). USD 10.6 million was raised by backers of Proposition 23, which included oil companies and the California business trade associations; they "were steamrolled by a USD 31.2 million campaign" funded by wealthy philanthropists like Tom Steyer, and Silicon Valley green-tech moguls like John Doerr and Vinod Khosla (Rooselvelt 2010). In addition to effective organizing, Seyer attributed the defeat of Proposition 23 to the frame with which Californians view the challenge of climate change (discussed previously in this chapter): "In the end… voters saw the global warming law as paving the way to a new economy based on clean energy" (Roosevelt 2010).

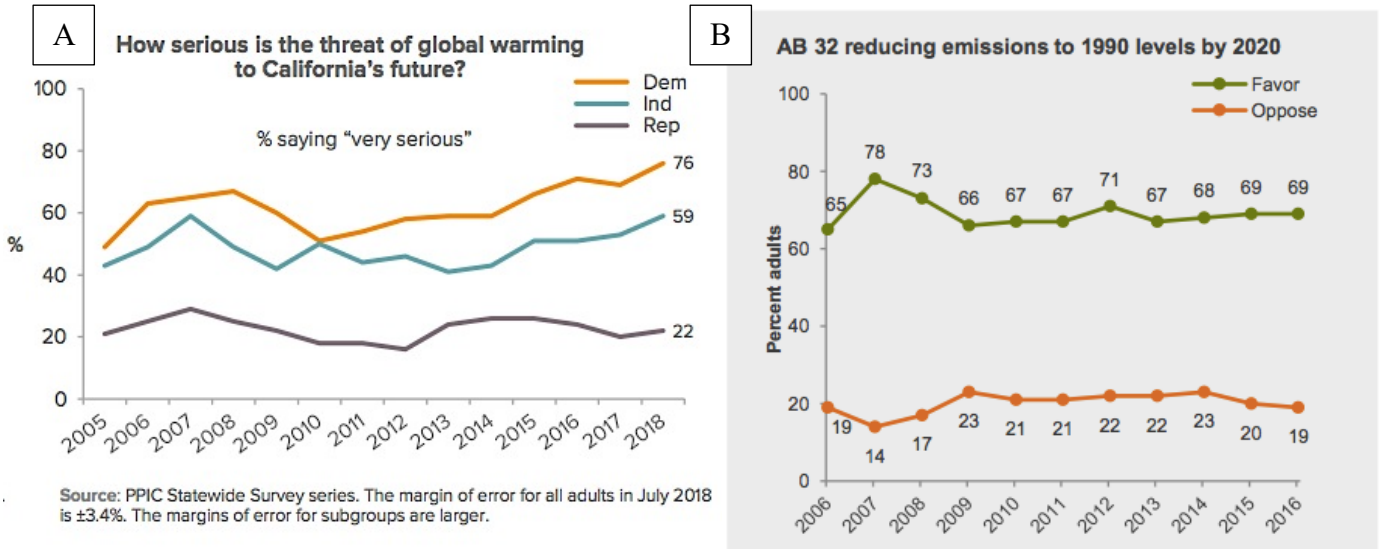
The other aspect of California's environmental advocacy coalition (broadly speaking) that enhances their ability to influence policy is the level of professional expertise in the volunteer community. For example, a long-time San Diego Sierra Club volunteer created an essential fee and dividend system whereby parking would be charged by the minute and then be rebated to the greater world, a task easily accomplished and communicated by this volunteer who also happened to be a retired aerospace systems engineer (D. Clarke, personal communication, Feb. 26, 2018). Finally, the relatively long experience of California's deep historical roots in environmental activism and environmental protection have enhanced the advocacy power of the state's environmental coalition as 100s of years have allowed for a sophisticated and professional network to evolve. In particular, the modern tradition of environmental activism of the 1960s and 70s, stemming from pollution events, has been carried forward in a way that has established a tradition of activism in the state (D. Clarke, personal communication, Feb. 26, 2018).

Large, sophisticated ENGOs, like the Sierra Club, have a significant presence in the state, with a dozen Chapters in California, as opposed to other states which have just one. Overall the environmental advocacy coalition in California has, for many reasons discussed here, found itself in a relatively powerful position and an important constituent of politicians, especially Democrats, in contemporary times (D. Clarke, personal communication, Feb. 26, 2018). Established ENGOs in California are much more likely to have a carved out 'seat at the table' than is the case in Ontario. According to a long time Sierra Club organizer, Darrell Clarke, California's environmental advocacy groups have also had a "pretty important"

role in terms of influencing the passing of climate legislation within the context of the state's modern climate governance regime (roughly 2002 →)(D. Clarke, personal communication, Feb. 26, 2018). Similarly, Amanda Eaken of the National Resource Defence Council (San Francisco) explained that any time relevant policies and laws are being developed, they look to the NRDC for input (A. Eaken, personal communication, June 21, 2018). The relative power of this coalition in supporting successful elections of particular candidates means those elected, in part by the environmental advocacy community, tend to listen to what these groups have to say. Over time this has "become entrenched," and ongoing relationships have evolved where these groups are granted a seat at the table in terms of commenting on legislation (D. Clarke, personal communication, Feb. 26, 2018).

Comprehensive, consistent polling by the Public Policy Institute of California confirms the relatively high-level of issue salience for climate change amongst Californians. Between 2005 and 2018, a significant portion of Democrats and Independents have characterized the threat of global warming to California's future as "very serious" (see Figure 32) (Baldassare et al. 2018). This aligns with the results from a 2016 PPIC survey by Baldasarre et al. (2016), where a majority of Californians supported AB 32 (the Global Warming Solutions Act) over roughly the same time period (see Figure 35). This may be linked to the fact that twice as many Californians believe that California's emission reductions policies will create jobs as opposed to 'kill jobs' (Baldassare et al. 2016). With regards to reducing emissions from transportation, an overwhelming majority (77%) of Californians support building more electric vehicle charging stations, and 47% of Californians say they have *seriously* considered getting an electric vehicle (Baldassare et al. 2016). This survey also found that a majority of adults (64%) still favour AB 32's goals and 63% of adults are in favour of expanding these goals, even though they assume these policies will increase gasoline prices statewide (Baldassare et al. 2016).

Figure 32. Polling results from the Public Policy Institute of California. A) Percentage of Californians answering "very serious" in 2016 to the question "How serious is the threat of global warming to California's future?" B) Percentage of adults who favor or oppose AB32 emission reduction targets over the years 2006-2016 (PPIC 2016; 2018).



Consistent with the discussion above regarding the impact of extreme weather events linked to public opinion on climate change, 81% of Californians say that global warming is a 'very serious' or 'somewhat serious' threat to the state's future, and most adults (66%) say the effects of warming have already begun (Baldassare et al. 2017). Two in three Californians also believe that global warming has contributed to wildfires (Baldassare et al. 2016). Polling is also consistent with another previous discussion regarding Californians' perception of themselves as global leaders on climate change; 81% of Californians said in 2017 that it is 'very important' or 'somewhat important' that the state act as a global leader in the effort to fight climate change (Baldassare et al. 2017).

While polls and media coverage are two examples of more long-standing approaches to measure issue saliency, the rise of the modern Internet provides new avenues to assess issue salience, such as internet searches. Ripberger (2011; cited in Schwartz 2012) suggests Internet searches are actually a better measure, with regards to validity, to measure public attention as opposed to media coverage. Google Trends provides one method for analyzing the popularity of top queries submitted through Google search. Figure 33 illustrates, 'climate change' as a Google search trend for the United States. The popularity of this search has steadily increased over time, with peaks in 2009 and 2015 that coincide with the UNFCCC

conference of the parties, and also Donald Trump's election as U.S. President. Spring 2019 is witnessing the highest peak for this trend, which has been building (from a trendline viewpoint) since 2009).

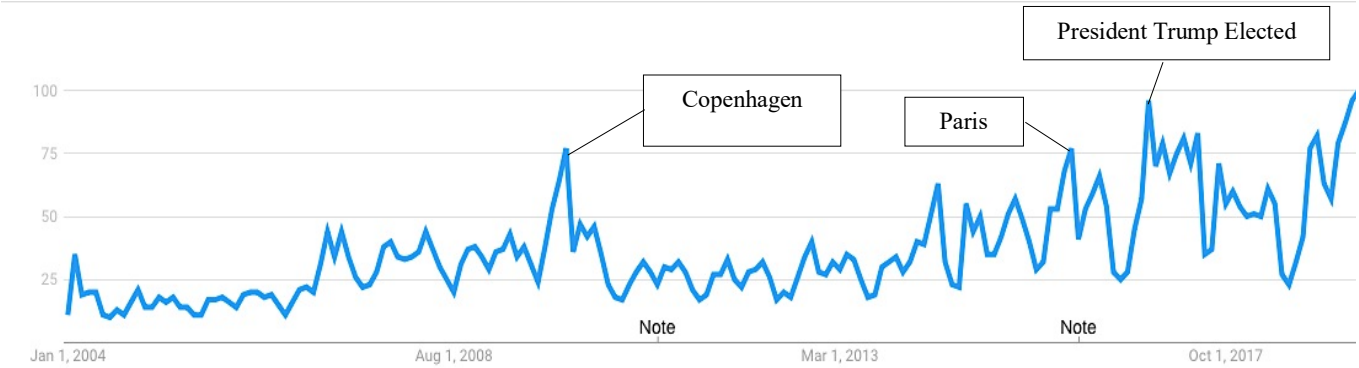


Figure 33. Frequency of Google searches for "climate change" in the U.S. from Jan. 2004 to May 2019 (Google Trends 2019a).

Ontario

Overall, public opinion on the issue of climate change has been a mild driver of the passing of climate policies and regulations in the Ontario context. Historically, extreme weather events linked to climate change have not been pervasive and a relatively weak environmental advocacy coalition has dampened the importance of this variable. Since the early 2010s (but especially post 2015), issue salience has increased and voters have started to prioritize this issue, although traditional voter issues still dominate. VanNijnatten (2016) argues that a state of ambivalence characterizes public support for environmental protection in Canada; while the public generally supports environmental protection policies, they are also not willing to choose these over economic growth policies. This trade-off between economic and environmental priorities is illustrated by the fact that the peak of three major periods of high salience for environmental issues in Ontario (the late-1960s to mid-1970s, mid-1980s to the early-1990s, and 2004-2008) were all ended by a significant economic downturn (Winfield 2018).

Environmental advocacy coalitions and movements serve to amplify public opinion on issues like climate change, which ideally lead to policy impacts. The modern environmental movement in Canada began in earnest in the late 1960s, with the founding of outspoken environmental groups like Pollution Probe in 1969 and Greenpeace in 1971 (Demerse and Lemphers 2016). As is the case in many other jurisdictions, these early groups were founded in response to pollution issues. Canadian environmental

groups continued to evolve over the following decades, with groups tending to lean towards direct action/radical environmentalism or those engaging 'from the inside' with business and government (e.g., World Wildlife Fund) (Demerse and Lemphers 2016). Over time, public attention and environmental leadership fluctuated in Canada, based on the state of the economy and occurrences of environmental disasters (Demerse and Lemphers 2016), with federal environmental leadership peaking in the early 1990s. 21st-century Canadian environmental activism continues to evolve, most notably with regards to higher levels of professionalization of ENGOs and the ability to more easily form strong networks through the use of the Internet and social media (Demerse and Lemphers 2016). A shift in focus from local pollution issues to broader issues like climate change also characterizes recent changes of the modern environmental movement in Canada.

Although the modern environmental advocacy community has seen increasing levels of professionalization, it still tends to be relatively weak in terms of money and resources (Boyd 2015). In some respects, the ability of these groups to influence policy outcomes has to do with the orientation of the government of the day. For example, input from environmental stakeholders was included in the Province's *Growth Plan* under the past Liberal Administration (McVey 2018), which was already prioritizing environment and climate issues on their agenda. The influence of these advocacy organizations on local policy is also very much concentrated in larger urban areas, with much less influence on council decisions, for example, in the sub-burbs of Ontario (McVey 2018). Generally speaking, the influence of ENGOs on policy decisions is "marginal" in Ontario (Winfield 2019).

The ability of environmental advocacy organizations is also limited by their charitable status, which limits the ability of these organizations to engage in 'political activity' (Boyd 2015). Recent attempts to highlight federal government inaction on climate change by these organizations were met with then-Prime Minister Harper ordering the Canada Revenue Agency to investigate and audit these organizations, such as the David Suzuki Foundation (Broadbent Institute 2014). This action further weakened the power of these organizations in the short term and perpetuated 'advocacy chill' in the long-term, sending the message that those who criticize the Conservative government may be subject to special scrutiny (Broadbent Institute 2014, p. 3).

Traditionally, issue salience around the environment in Canada has been dampened by an enduring myth of a 'great green Canada', perpetuated by the fact that the country is geographically vast and contains a small population, of which most live far from heavy industrial pollution (Boyd 2015). This is not to say that air pollution has not been a political issue in Canada. In fact, air pollution has been on the political agenda for over a century in Canada, leading to early government interventions, such as regulations on smelters in Sudbury, Ontario in the early 20th century, provincial clean air statutes in the 1960s, and combatting acid rain in the 1970s (Tremby, Munton and Weibust 2016). That being said, climate change as a specific issue, has only broken through as a mainstream issue in very recent years. As Bruce Anderson of Abacus Data explained, following a 2017 poll asking Canadians what issues they are mostly paying attention to:

> One other thing stands out in these results – the fact that climate change is now a topic of broad mainstream interest across the country. We may have entered something of a new normal in terms of the level of interest in this issue, and the policy choices that governments make around it. (Abacus Data 2017)

In recent years there have been extreme weather events that have been linked in the media to climate change, increasing the profile of this issue. Specifically, wildfires in northern Ontario and flooding in many parts of the province have brought increasing attention to climate change in local and national media and made this rather abstract issue feel more grounded and immediate. As Figure 34 shows, flooding in the spring of 2019 prompted many communities to declare a state of emergency, and in some cases, soldiers were brought in to aid with mitigation and relief (The Canadian Press 2019). The issue is also gaining more traction nationally. Over 40 Canadian municipalities, including 15 Ontario municipalities have declared a climate emergency, and in June 2019, the Federal Government declared a national climate emergency (Jackson 2019; Gough 2019).

Figure 34. Canadian army brought in to aid with Ottawa flooding in Spring 2019. (REUTERS / Canadian Armed Forces/2nd Canadian Division/Master-Corporal Emir Islamagic).

Boyd (2015, p. 217) also argues that Canadians are "ecologically illiterate" – one-quarter of Canadians have no idea where their water comes from and only 60% of Canadians were aware Canada pulled out the Kyoto Protocol. There also seems to be an insufficient level of ecological literacy in Ontario; in 2018, only 30% of Ontarians knew there was a price on carbon in the province (Anderson 2018). Those who were aware of the cap-and-trade system also misunderstood the carbon pricing system in place in Ontario. A 2018 poll found that 72% of Ontarians believed the cap-and-trade system was either a pure tax grab or a symbolic gesture (Kalvapalle 2018), which is a stark contrast to the reality of the system that raised significant revenues (roughly CAD 2 billion/year) for public spending from the largest industrial emitters in the province. Although there is clearly an issue with climate change literacy in the province, the issue in and of itself has gained increasing attention from Ontarians (and Canadians) in recent years, moving it from relative unimportance to a top ten voter issue.

Figure 35, generated from an Ipsos poll leading up to the 2017 Provincial election, shows that climate change made the top ten list of voter priority issues (albeit barely). The poll found that although Ontarians feel the government is doing an OK job on the climate change file (just over 50% on the performance scale), it still is a much lower priority than many other issues, especially healthcare, jobs and

the economy, energy costs, lowering taxes, rebalancing the budget. The results of an April 2018 poll confirms the modest issue salience of climate change amongst Ontario voters, and also shows a relatively even split amongst Ontario voters with regards to political candidate's positions on carbon pricing: 37% prefer to vote for a candidate who promises to price carbon compared to 26% who prefer a candidate opposed to a price on carbon, the remaining 37% said it would have no impact on their vote (Anderson 2018). Concern for climate change has certainly reached a tipping point in the province, but the immediacy of 'bread and butter issues', such as the costs of electricity bills, seems to take priority (as witnessed in the 2018 election). For example, a 2019 poll following the release of the Ontario Progressive Conservative climate change plan, found that while 89% of Ontarians said they are very or somewhat concerned about climate change, 80% also felt a carbon price would increase everyday costs (Jones 2019).

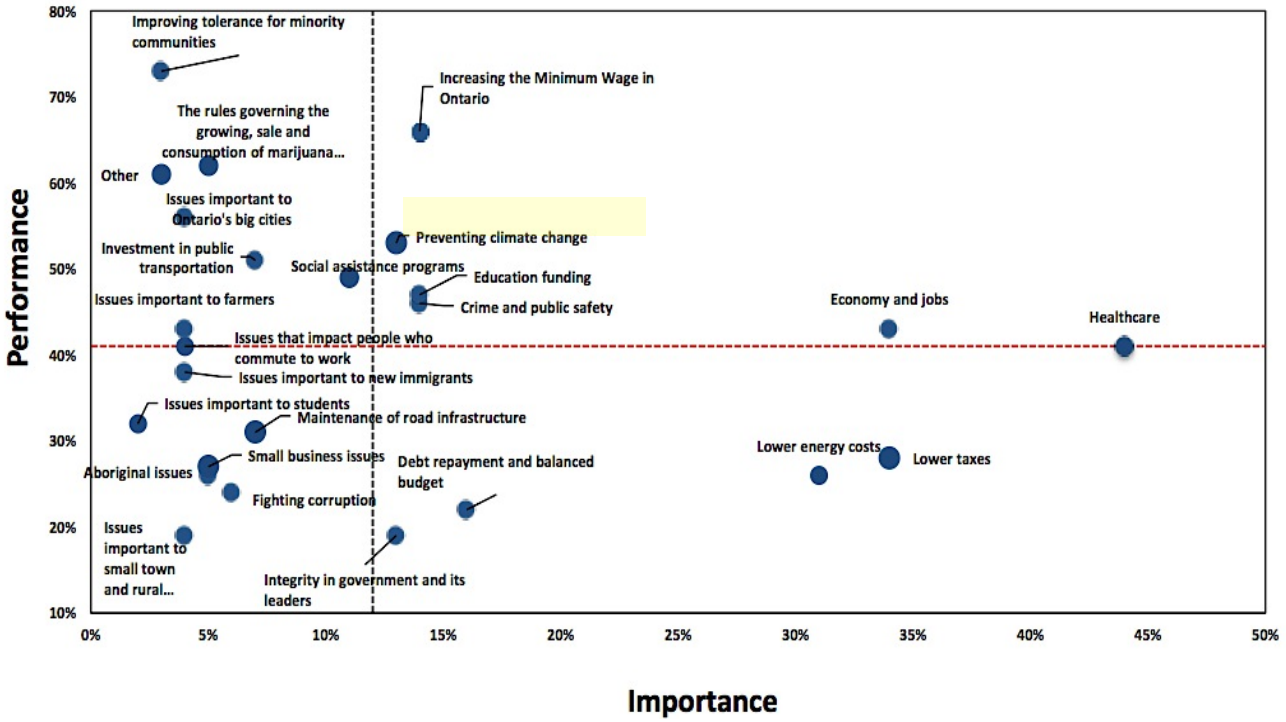


Figure 35. Plot of the relative importance of each issue to Ontarians, and the performance of the Wynne Liberals on each issue (Ipsos 2017).

With regard to climate change governance at the federal level, Ontario voters seem to have prioritized the issue more than at the provincial level. A 2018 poll, asking where climate change fits into voting priorities for the October 2018 federal election, illustrates higher levels of issue salience amongst Ontario voters at the federal level: 10% of Ontarians said it would be the top issue, 20% said the second most important issue, and 39% said it would be in their top 5 issues they will be voting on (see Figure 36).

Overall, polling from Ontario indicates higher levels of support for government action on climate change, but that traditional voter issues (economy, jobs, healthcare) still dominate in terms of issue salience.

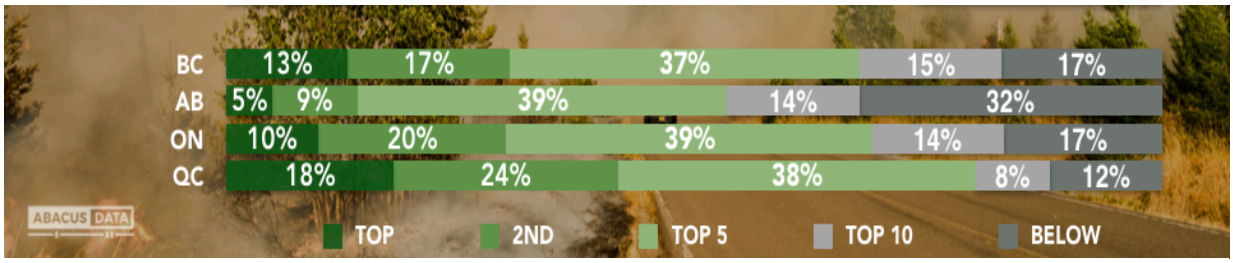


Figure 36. Response to the question "how important will climate change be in your vote [for the upcoming federal election]?" (Abacus Data 2019).

Another way this trend can be seen is by tracking Google Canada searches for the term "climate change" over time. Figure 37 illustrates the frequency of this search from January 2004 to May 2019 in Canada. Two notable peaks align with the UNFCCC Conference of the Parties in Copenhagen (2009) and Paris (2015). There is also much higher levels of sustained climate change Google searches post-Paris, which supports Anderson's conclusion that climate change has now become a 'topic of broad mainstream interest' in Canada. As of May 2019, "climate change" reached its highest rate of 'trending' since tracking began in January 2004 (see Figure 37).

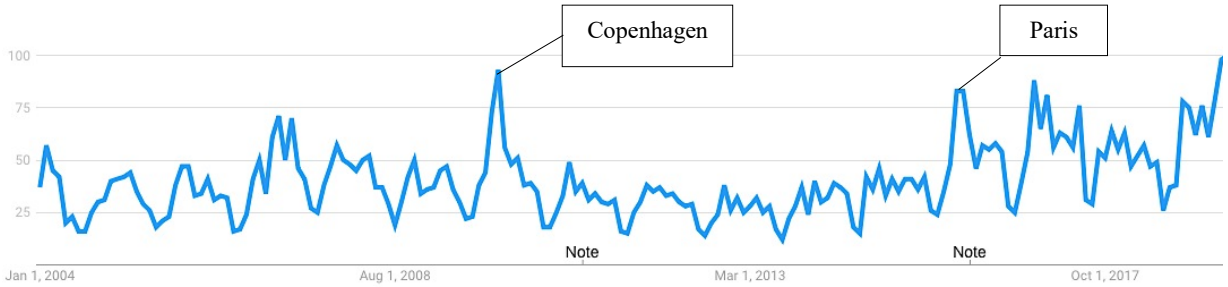


Figure 37. Frequency of Google searches for the term "climate change" in Canada between January 2004 – May 2019 (Google Trends 2019).

Summary: Key Variables Promoting or Hindering CPI:

Although not predicted at the outset of this work, institutional contexts, specifically regulatory capacity and independence, feature prominently as strong explanatory variables in the promotion and hindrance of the passing of climate-transport policies. The varying levels of social consensus and public opinion also feature as key explanatory variables, especially as these greatly influence levels of political

commitment. The structure of each jurisdiction's regional economy, specifically the relative presence of industries standing to benefit from first-mover advantages, also plays a relatively important role in understanding varying outcomes.

In particular, high levels of regulatory capacity and independence in California feature as key elements in promoting the passing of legislative and policy efforts to reduce emissions from the transportation sector. The reverse is true in the case of Ontario, where issues around regulatory independence have resulted in relatively strong barriers to passing and implementing formal programs to reduce emissions from the transportation sector. This is linked to highly politicized decision-making in the province, in part stemming from the increased concentration of power in the executive, under a system that already provides substantial autonomy to this branch of government. The governance culture in the province remains one of political bargaining and patronage, where evidence bases of decision-making are declining. Those in power have no incentive to institutionalize processes to ensure evidence-based decision-making within government institutions and indeed have eroded what little progress was made on this front through the 1970s-1990s (e.g., environmental assessments).

In these cases, regulatory independence is linked to the level of politicization of climate-transport governance efforts, which consequently interacts with varying levels of sustained, high-level political commitment for climate-transport efforts. The (mostly) bi-partisan nature of California's climate change regime has insulated it from aggressive policy dismantling when government orientation changes. In contrast, Ontario's climate change regime has very much been a Liberal Party project and has greatly suffered from policy dismantling in the face of political swings. As mentioned, this is partly related to regulatory capacity and independence; The development and implementation of California's climate change regime were essentially passed off to non-partisan regulators, de-politicizing policy outputs. The relatively significant weight of regulatory capacity and independence carries in understanding the varying outcomes in these cases, reaffirms the argument made in the outset of this work, that institutions and overarching rules require more focus as a key mechanism for operationalizing polycentric climate governance systems.

In addition to institutional contexts, the level of issue salience and social consensus around meaningfully addressing climate change has proven (as predicted) to be an important factor in promoting

CPI. Higher levels of issue salience are not only linked to the prevalence of extreme climate impacts in a given jurisdiction but are also related to longer histories of environmentalism. In the case of California, a long history of environmental activism and environmental protection measures, stemming from an even longer history of pollution issues, has created an environment in which government intervention to protect the environment is commonplace. As previously mentioned, this kind of dynamic can be seen as 'governance driving governance'. This is linked, in part, to the fact that California's economy features key industries that either rely on the state's natural beauty and ecological diversity, or which benefit from 'first-mover' advantages in low carbon innovation. This is reflected in the dominant framing of climate action in the state, which frames low-carbon policies as both a strategic approach to combatting environmental/health/security issues and an important economic growth strategy.

In contrast, Ontario has a much smaller clean-tech industry and a politically and economically important auto parts manufacturing sector, which has somewhat hindered CPI efforts, particularly through its relation to high-level political commitment. Although there is evidence Ontarians care about the environment, and specifically climate change, most are not willing to support measures that would increase the cost of everyday living. In addition, ENGOs in Ontario have limited influence on policy decisions and relatively weak organizing power in comparison to California ENGOs. Finally, although there might not be an explicit recognition of the issue amongst the public itself, political decision-making, especially around large energy and infrastructure decisions resulting in sub-optimal outcomes, have over time, eroded public trust in government. It is important to note that a lack of evidence-based decision-making has been a problem for both conservative and progressive governments in Ontario and that the problem continues to worsen.

In all, this context analysis demonstrates that there are unique landscape factors that have enabled successive governments in California to pass and implement aggressive climate-transport mitigation legislation and policies. In comparison, key landscape variables in the Ontario context have had more of a mixed effect, resulting in less comprehensive climate-transport mitigation efforts, which have suffered from fits and starts over different periods of issue salience and government orientation. A concise summary of the relative impacts of these landscape variables is presented in Table 11.

Table 11. Impact Summary for Individual Landscape Variables.

	Ontario	**California**
Institutional Context	Medium hindrance	Strong driver (mostly from high regulatory capacity and independence)
Structure of the Regional Economy	Very mild hindrance	Medium-Strong driver
Framing and High-Level Political Commitment	Mixed effect (strong hindrance and strong driver)	Strong driver
Public Opinion and Social Consensus	Mild driver	Strong Driver

The following chapter analyses the varying degrees of polycentricity in these cases' climate governance systems, and the overarching procedural, organization and communicative rules operationalizing them. This work will then conclude with a discussion of how these contexts interact with the operationalization of varying degrees of polycentricity in Ontario and California's climate governance systems and provide key implications for theory and practice.

Chapter 8: Comparing degrees of Polycentricity and Operationalization and Evaluating Overarching Rules

This chapter first describes the varying levels of polycentricity in each cases' climate governance system using the methodology outlined in Chapter 2. Given there have been minimal attempts to date to measure nuanced degrees of polycentricity in governance systems, this delineation represents a methodological advancement. There are multiple ways this measurement could have been approached; the approach utilized here represents a heuristic method, but one which fits well with the nature of the research questions, especially the fundamental dynamics of polycentric governance systems. The following analysis of overarching rules operationalizing each cases' polycentric climate governance system, provides insights into ways the state can best enhance polycentric climate governance. The discussion is framed utilizing the EPI/CPI evaluative frame of horizontal and vertical organizational, procedural and communicative instruments (also presented in Chapter 2). Implications stemming from this analysis conclude this chapter, including the importance of procedural policy instruments, clear directional mandates and high-level integration organizations. The summary discussion also highlights interactions between contexts and overarching rules, for example, the interactions between system complexity and the nature of overarching rules.

Delineating Degrees of Polycentricity in California and Ontario's Climate Governance Systems

The organizations accounted for in this delineation of the degree of polycentricity in each jurisdiction's climate governance system represent the organizing efforts of groups aiming, at least in part, to reduce emissions from the transportation sector. As recent work has highlighted (e.g., Biddle and Baehler 2019), it is essential to look at both the structure and functions of polycentric governance systems to help understand governance outcomes. The structure of these polycentric governance systems is analyzed in terms of governance scale and government vs. non-government (state and sub-state) classification. The functions of this system are also analyzed and measured using four functional categories. In many cases, these organizations undertake activities related to other aspects of climate change mitigation, but all of them have at least part of their work focused on decarbonizing passenger transportation. The first analysis looks at organizations that are non-state and government/quasi-government organizations that operate at the sub-state/province level. These organizations fall outside of the category of state/province government organizations, but have a state/province-wide focus, and are

not organizations serving a specific local/regional area. As expected, California has a higher number of these organizations, even when the state's population is taken into account. California has just under three times the population of Ontario, but over three times the number of climate-transport organizations (see Figure 38).

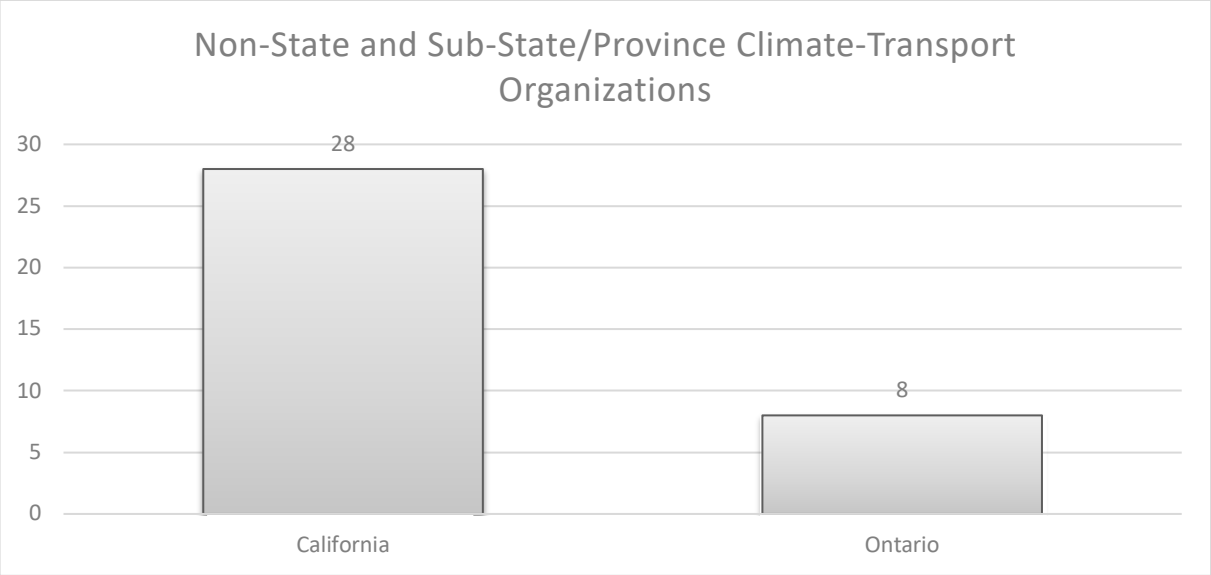


Figure 38. Non-State and Sub-State/Province Climate-Transport Organizations.

Four functional categories were established to evaluate levels of functional redundancy and collaborative degree in each system based on this inventory: 1) formal advocacy/policy development 2) technical and financial assistance (capacity building) 3) knowledge/coordination platform 4) monitoring, reporting, certification. In order to qualify for at minimum a minor function under this approach, activities aimed at carrying out the function had to be both formal and reoccurring (see Chapter 2 for more detail). Figure 39 illustrates the results of this analysis by functional category. In the case of California, there are higher levels of functional redundancy, where more organizations carry out multiple functions. In each case, the function of knowledge/coordination platforms was the most prominent role carried out by these organizations. Similarly, organizations carrying out monitoring/reporting/certification functions were the least prominent in each case. In California, the number of organizations that conducted capacity building activities far outweighed the presence of these organizations in Ontario. In the case of California, this function was often linked to coordination and policy learning as a second primary function. Overall, the

result of this analysis is that California has higher levels of functional redundancy and collaborative degree than in the case of Ontario.

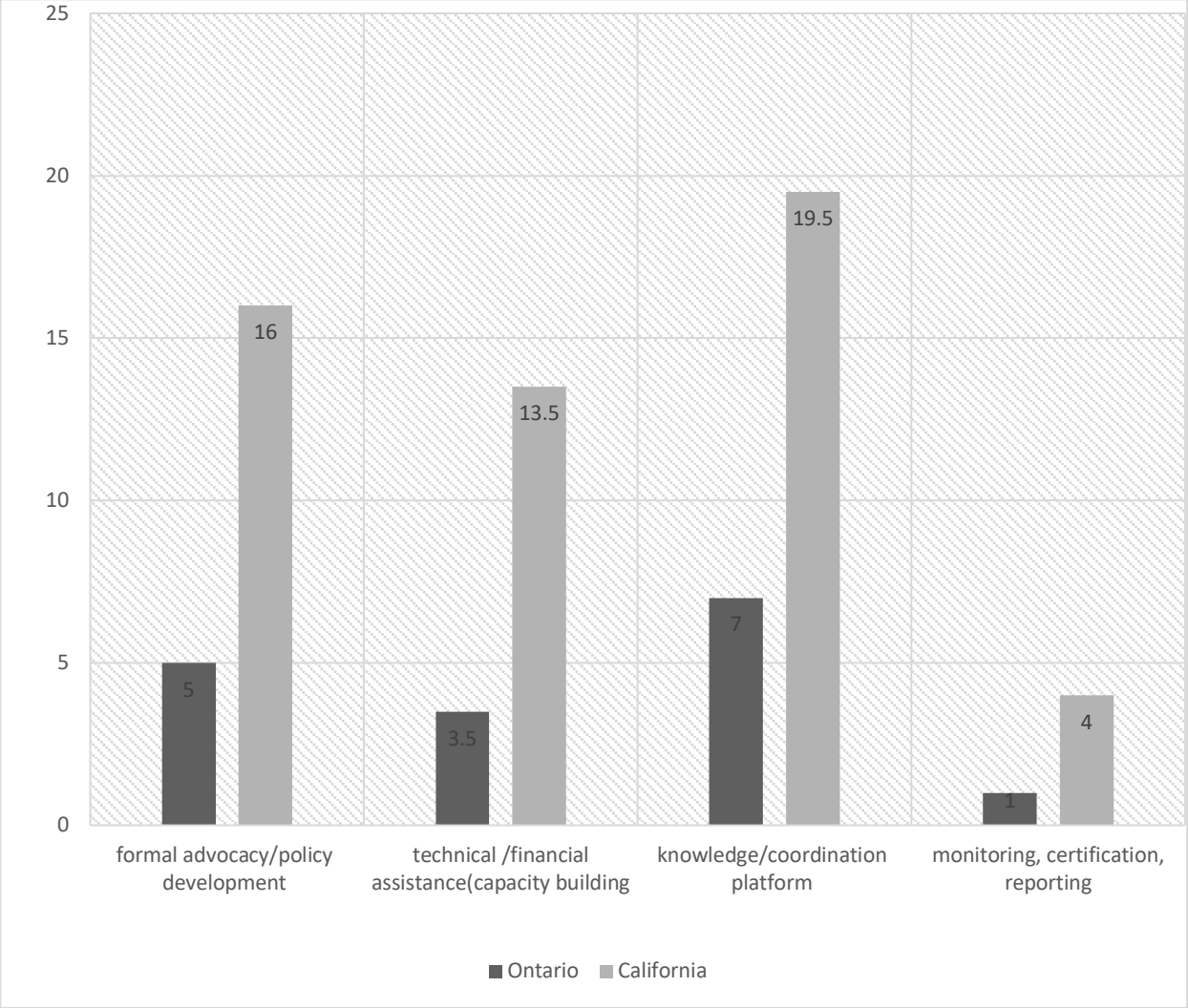


Figure 39. Breadth of Inclusion and Functional Redundancy: Primary (1.0) and Secondary (.5) Functions of Non-Government Sub-state/province level organizations.

The second phase of this delineation and analysis brings in government organizations at the state/provincial level of government conducting efforts to mitigate emissions from transportation. All government organizations, including the sub-state/province organizations accounted for in the work above, are categorized in this analysis as regional or state/province-wide. Once again, higher levels of polycentricity are found in the case of California's climate governance system. California has three times as many state-wide government organizations involved in these efforts, and essential to vertical

integration, four times as many regional government organizations. When accounting for all non-state, regional government and state/province-wide government organizations, California has almost four times these units when population is taken into account, as compared to Ontario. This breakdown is illustrated in Figure 40.

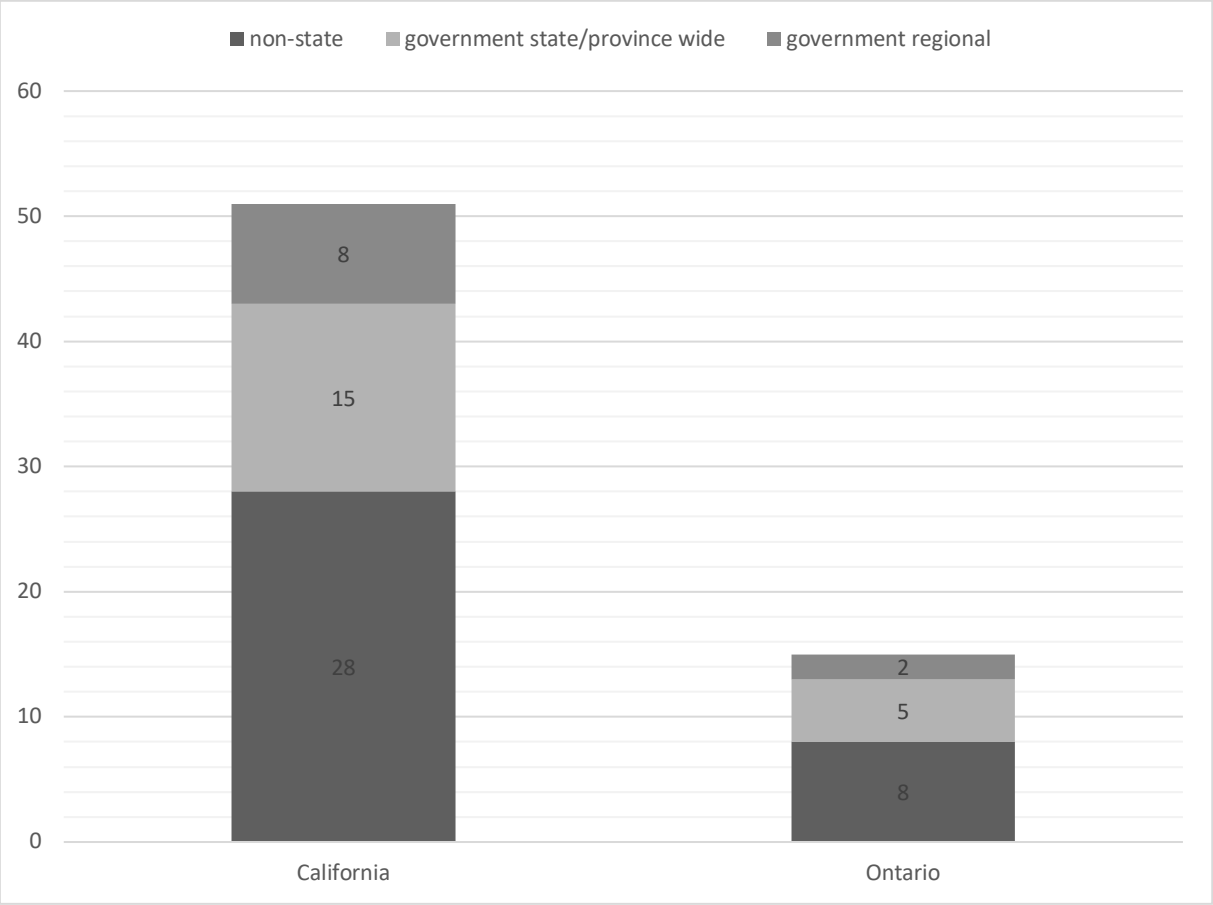


Figure 40. Number of non-government and government organizations (state/province-wide and regional) involved in reducing climate-transportation emissions in Ontario and California.

A note on local governments

The fact that organizations with a local focus, such as the Toronto Environmental Alliance or the San Diego Climate Action Network, are not accounted for in this inventory somewhat obscures the extent of participation in these climate governance systems, but particularly in the case of California, which has a large number of local organizations dealing with low carbon transportation. Due to the extensive effort needed to analyze at this level of granularity, specifically in the case of California, the level of sub-state/province was the chosen focus of this work. That being said, existing studies and inventories on local

climate governance are useful as one way to illustrate the extensive degree of polycentricity in California's climate governance system, in comparison to Ontario's. For example, government inventories and studies by the Governor's Office of Planning and Research (2014; 2018) in California illustrate the majority of cities and counties in the state actively address climate change mitigation, including through transportation and land-use planning plans. The majority of these jurisdictions have implemented or are in the process of implementing these measures, as opposed to being at the planning stage. In contrast, a recent report card by the Urban Climate Alliance (2018) evaluating five major population centers in southern Ontario (the cities of Toronto, Ottawa, Hamilton, Oakville, Windsor), illustrates that while all major cities have climate change action plans, implementation is very limited. Only one city (Toronto) has GHG reduction strategies, and none of the major cities have committed full funding to implement the plan, nor are any of these city's climate change plans integrated into all other municipal master plans.

Meaningful local climate change mitigation efforts, in many cases related to transportation, are much more prolific in the case of California, as is the actual degree of polycentricity in their climate governance system. An overall assessment of the degrees of polycentricity in California and Ontario's climate governance system, as measured along the two lines of continua, collaborative degree and breadth of inclusion, is illustrated in Figure 41. Overall, California's climate governance system can be characterized by a very high level of breadth of inclusion, and a medium-to-high level of collaborative

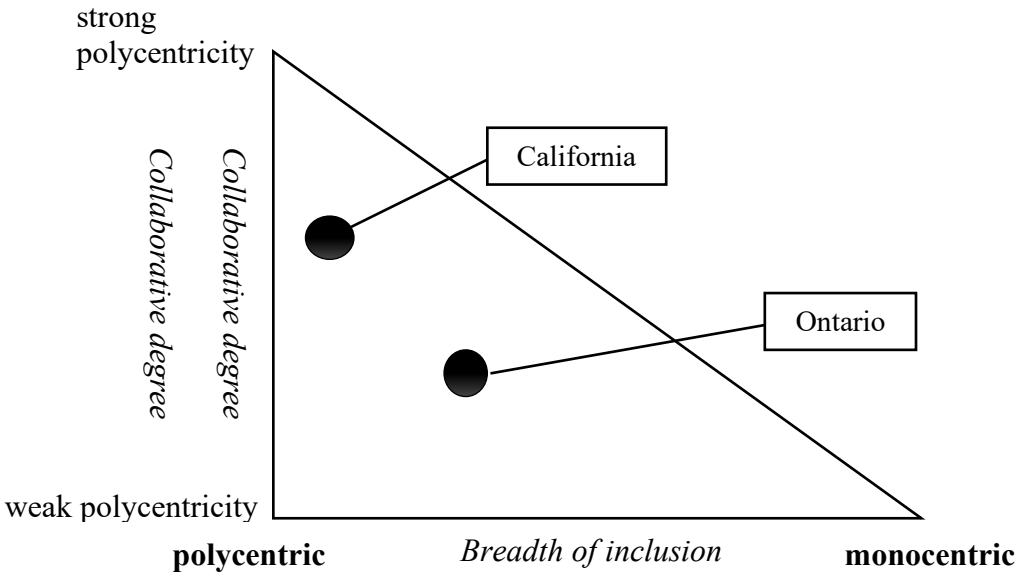


Figure 41. California and Ontario's climate governance regime mapped using the two continua of polycentricity (Adapted from Schoon et al. 2015, pp. 240).

degree. Ontario's climate governance system can be considered to be weakly polycentric, with medium levels of inclusion and somewhat weak levels of collaboration.

The following section analyzes the role of overarching rules in operationalizing these polycentric climate governance systems following the evaluative framework for EPI mechanism classification: procedural, organizational and communicative mechanisms that vertically and horizontally integrate climate-transport mitigation objectives in these governance systems. Given the higher levels of polycentricity and rules and mechanisms aimed at increasing coherence in California's climate governance system, analysis of this jurisdiction features more prominently in the following analysis.

Overarching Rules: Highlighting State Steering in Operationalizing a Polycentric Approach

Climate policy integration is a crucial mechanism for governing towards sustainable development, shaping mandates, policies, programs and budgets of government agencies to ensure they support ecologically and economically sustainable activities (Mullally and Dunphy 2015). Within the context of polycentric climate governance systems, these integration mechanisms serve a critical role in enhancing the touted benefits of this approach, including high levels of policy innovation and learning, increased reflexivity, enhanced engagement, and resilience of the policy stream. The following discussion will highlight key organizational, communicative and procedural mechanisms that have served to enhance the benefits and mitigate the inefficiencies of polycentric climate governance in the case of California and Ontario. This analysis highlights examples of key mechanisms operationalizing polycentric climate governance systems for each jurisdiction, as opposed to an exhaustive review of all overarching rules previously discussed in Chapters 5 and 6.

Organizational mechanisms

Organizational mechanisms provide essential functions with regards to operationalizing polycentric climate governance systems. Importantly, they enable horizontal coordination and collaboration, facilitate the linking of governance units through information networks (Ostrom 2009), and provide key sites for learning, capacity building and coalition building. Overall, California has many more of these types of intuitions at the local, regional and state levels in comparison to Ontario. Critically, Ontario is very 'thin'

on organizations like this at the provincial level, hampering high-level coordination and integration efforts. These organizations in California also illustrate a greater institutional diversity with regards to the composition and function.

One of the earliest examples of a horizontal organizational mechanism to ensure climate policy integration and coordination was introduced in the year 2000 under SB 1771 (2000). This legislation, which was introduced a few years after the signing of the Kyoto Protocol, represents an early attempt to manage the state's GHG emissions comprehensively. In addition to reporting requirements (discussed further under communication mechanisms), the bill required the development of an interagency task force "consisting of state agencies with jurisdiction over matters affecting climate change to ensure policy coordination for those activities" and the establishment of a climate change advisory committee, which would make recommendations to the Energy Resources Conservation and Development Commission "on the most equitable and efficient ways to implement international and national climate change requirements" (SB 1771 2000).

California's Strategic Growth Council is a more recent example of an effective horizontal organization tool that aids in operationalizing this jurisdiction's polycentric climate governance system. In fact, multiple interviewees in California were quick to point out this organization as a prime example when discussing institutional innovations for operationalizing California's complex governance system. Horizontal integration groups, explicitly created to ensure inter-agency government coordination, have been effective in the case of California, in part, due to positioning these bodies in high-level government organizations or mandating that members are high-ranking government officials within their respective departments and agencies. In addition to the Strategic Growth Council, other examples of these kinds of groups established at the state level include The Climate Action Team (Exec. Order S-3-05 2015), the Governor's Interagency Working Group on Zero Emission Vehicles, the Integrated Climate Adaptation and Resiliency Program (Sen. Bill 246 2015) and the Caltrans Office of Smart Mobility and Climate Change. CARB can also be considered a horizontal integration organization, coordinating transportation, energy and air quality governance.

California's Strategic Growth Council was established by legislation in 2008 as a cabinet-level committee housed in the Office of the Governor. The 10 member council is required to consist of high-

ranking public servants, including the Director of State Office of Planning and Research, Secretary of California Natural Resources Agency, Secretary for California Environmental Protection Agency, Secretary of California Business, Consumer Services and Housing Agency, Secretary of California State Transportation Agency, Secretary of California Health and Human Services Agency, Secretary of the California Department of Food and Agriculture (California Strategic Growth Council 2019). In order to capitalize on expertise outside of government, three public member council positions are appointed, one each by the Governor, Speaker of the Assembly and the Senate Committee on Rules (California Strategic Growth Council 2019). For example, public members of the current council include the Executive Director of the non-profit Climate Action Campaign and a chief industry executive who also serves as the vice-chair of the NRDC Board of Trustees.

The Council ensures coordination and integration of climate mitigation and adaptation objectives, especially in the context of sustainable communities and growth management, through (at minimum) monthly meetings with staff from the respective agencies. The Council directs multiple programs, such as the Transformative Climate Communities Program, which with the use of dedicated cap-and-trade funding, supports community-led infrastructure projects that deliver environmental, social and economic benefits to the state's most disadvantaged communities. Another critical program in the context of transportation emission-reductions that is part of the Council's obligatory duties is to direct the Regional Climate Collaborative Program, established in 2018 as per SB 1072 (Chapter 377, Statutes of 2018). The Regional Climate Collaborative Program is a novel organizational mechanism serving to enhance California's polycentric climate governance system, primarily through capacity building. Although other regional-focused state-led programs exist (for example the Office of Smart Mobility works at the sub-state level to improve coordination between transportation planning, land-use planning and decision-making aimed at sustainable transportation) the Regional Climate Collaborative Program is unique in its focus on 'disadvantaged communities' and especially its origin story as a local climate governance experiment, a process that highlights the advantages of polycentric governance in action.

Before the Regional Climate Collaborative Program was established at the state level, individual climate collaboratives were established as bottom-up governance initiatives; these organizations represented networks of cross-sector partnerships, including members from academia, the non-profit sector, regional government agencies and businesses, working to enhance climate mitigation and

adaptation efforts. Specifically, these organizations serve to build capacity, leverage resources and pursue funding, conduct research, share best practices, develop opportunities for multi-jurisdictional collaboration, and engage communities in their jurisdiction. In this way, these organizations cover almost all the essential functions underpinning the degree of collaboration in polycentric climate governance systems. As these groups evolved, they coordinated with each other through the Alliance of Regional Collaboratives for Climate Adaptation (ARCCA), a coalition of the Local Government Commission. ARCCA serves as a mechanism for "sharing best practices and resources, identifying strategies to overcome key barriers and challenges, and conducting joint campaigns and projects" in order to enhance individual and collective efforts of these organizations (Alliance of Regional Collaboratives for Climate Adaptation 2019). ARCCA is also linked directly with the Governor's Office of Planning and Research, which serves as an ex-officio member. This example illustrates the government's willingness to meaningfully engage with non-state climate governance efforts in a formal way.

In September 2018, the state government officially passed legislation establishing the Regional Climate Collaborative Program in recognition of the usefulness of these organizations in facilitating effective climate governance, especially in seeing actions are carried though at lower levels of government. Once established at the state level, the expansion of these organizations, especially in under-resourced communities, became possible through dedicated funding. The process of 'scaling-up' and embedding this successful bottom-up climate governance innovation illustrates how the advantages of polycentric climate governance, in this case, innovation and enhanced experimentation, can be leveraged by higher orders of governance through the use of overarching rules.

In contrast to California's Strategic Growth Council, Ontario's Growth Secretariat, which implements Ontario's growth management strategy (closest analogous group) operates under the Ministry of Municipal Affairs and Housing. The Growth Secretariat works across horizontal lines with multiple ministries and also coordinates vertically downward with regional and local governments to ensure the province's growth management strategy is integrated and implemented effectively. Unlike California's Strategic Growth Council, the composition of Ontario's Growth Secretariat is not mandated to include the same number of high-ranking officials, nor does it have the same legislative mandates in terms of reporting requirements or data/information distribution requirements for lower levels of government. Due to this,

Ontario's Growth Secretariat does not have the same capacity building and integration strength as California's Strategic Growth Council.

In Ontario, Regional Conservation Authorities have organically become sites outside of the provincial government for local and regional climate governance capacity and coalition building. That is, these organizations have not explicitly been mandated to provide assistance or forums for climate change planning, but the existing structure and nature of the organizations have lent themselves to fulfilling this function. According to the CEO of the Toronto and Region Conservation Authority (TRCA), requests from municipalities for assistance on issues related to climate change (including transportation issues) have become increasingly common (J. Mackenzie, personal communication, February 4, 2019). Instead of a formal expansion of the Regional Conservation Authorities' mandate, to ensure adequate staffing and funding for carrying out these kinds of functions, the Progressive Conservative government streamlined their mandates in 2019 (Rider and Kopun 2019). Not only were any climate change type programs not supported, but their mandates were narrowed as per the *More Homes More Choices Act* (S.O. 2019, c. 9), which was designed to make it easier for developers to build homes (Rider and Kopun 2019).

Ultimately, this kind of capacity and coalition building work continues on an ad hoc basis and through affiliated programs like the TRCA's Partners in Project Green, which consists of "businesses, government bodies, institutions and utilities working together to build the largest eco-business zone in the world" (Partners in Project Green 2019). This dynamic, where local and non-state actors continue climate-transportation mitigation efforts in the face of an anti-climate action government, illustrates the benefits of even a mild-medium level of polycentricity in a given jurisdiction's climate governance system. Not only is the policy stream 'kept alive', but functional redundancy has enabled meaningful action to continue in the wake of a provincial vacuum in this space.

High-level organizations to steer a low-carbon transition in the transportation sector exist but are siloed within ministries in the case of Ontario. For example, the Sustainable Transportation Policy Office was established in 2008 to provide for a more holistic, coordinated approach to decarbonization efforts, but the work carried out remained ministry-wide as opposed to government-wide (Ontario Ministry of Transportation 2013). Ontario also has a Ministry of Intergovernmental Affairs, which in part works to

enhance inter-ministerial collaboration, but these organizations have fallen short of integrating climate mitigation objectives across government. As a 2016 report from the Auditor General pointed out:

> Greenhouse-gas reductions are not a priority elsewhere in government: The reduction of greenhouse gases is not an established priority of many ministries, and there is no government-wide process to ensure climate change is adequately considered in decision-making processes. The mandates and key priorities of some ministries are in conflict with the goal of reducing emissions, and these divergent goals have not been addressed to ensure emissions reduction is considered in decision-making (Office of the Auditor General of Ontario 2016).

Unlike the Sustainable Transportation Policy Office, The Climate Change Secretariat was established in the Cabinet Office in 2008 and provided a key example of a cross-cutting horizontal integration organization, which is not siloed in a particular ministry. The organization was established to coordinate the implementation of Ontario's climate mitigation and adaptation activities, primarily through tracking and reporting on individual ministries' activities and reporting on them annually (Government of Ontario 2009). Unfortunately, fears that the Secretariat would not be endowed with enough authority to ensure all ministries were accountable and sufficient 'muscle' to deal with Ontario's strongest lobbying groups (e.g., the Ontario nuclear lobby) (Burda 2008) seem to have been well-founded. The fact that the Ontario Climate Change Secretariat did not live up to its full potential is now a moot point, as the organization no longer exists.

Non-state organizations have proven more resilient in the face of political swings and varying levels of issue salience. They have consistently been able to further climate mitigation efforts, especially at lower levels of government. For example, a key organization providing assistance to lower levels of government on climate change planning and decision-making in Ontario is the Ontario Climate Consortium. Established in 2011, this organization is formally affiliated with the Toronto and Region Conservation Authority, which serves as the secretariat for the organization (Ontario Climate Consortium [OCC] 2019). In addition to in-house staff, the organization draws from a network of members from Ontario academic institutions, NGOs and the private and public sector to provide tailored assistance in the form of paid consulting work. The OCC also hosts workshops and publishes reports, both of which are available for public viewing without cost. As the OCC operates outside the formal government sphere, it has not been subject to the dismantling process that other organizations have fell victim to with the most

recent change in government. In this way, it illustrates the benefits of polycentric climate governance, especially the functional redundancy and resilience of the policy stream in the face of political swings. Similarly, the EV Discovery Centre in Ontario has been able to supplement (albeit at a much lower level) EV subsidies in the wake of the repeal of the Electric Vehicle Incentive Program. The Centre was able to team up with a philanthropist who is providing through the centre, a CAD 1000 subsidy for the purchase of a used EV (Plug 'n Drive 2019).

The significant difference from an organizational integration standpoint between these two cases is not merely that the State of California has many more and diverse variations of these organizations. The key takeaway from the perspective of operationalizing polycentric climate governance systems is the fact that the government of California has been able to enhance the functioning of these organizations via overarching rules. In some cases, legislation has been passed to create these organizations within the government. In other cases, the government has been able to capitalize on successful, bottom-up climate governance innovations and scale these up and embed them as a part of the formal government apparatus. This includes providing sufficient authority and dedicated funding, in addition to thoughtfully positioning and linking novel organizations within the existing governance regime. The fact that there are multiple examples of the California government successfully carrying out this kind of work correlates to both the state's institutional context and high regulatory capacity. Insights into what this means for theory and practice will be discussed further in the following concluding chapter.

Communicative mechanisms

A critical part of operationalizing polycentric climate governance systems is to ensure governance units are linked through information networks with monitoring at all levels (Ostrom 2009; 2010; 2014). High-level communicative instruments, such as state/province-wide emissions reduction targets and plans outlining future goals, are also crucial to setting the overall orientation of governance activities. Mandated reporting requirements and processes that track vertical implementation are needed to ensure chosen strategies are effective, and that the system provides sufficient levels of transparency and accountability. Communicative mechanisms are utilized much more in the case of California, some of which stem from federal mandates. Although utilized less in Ontario, the province has relatively robust communicative

mechanisms geared at policy evaluation; unfortunately, some of these mechanisms have been downgraded or eliminated by the most recent government.

One of the earliest examples of communication mechanisms introduced by the government of California is the reporting obligations established by Senate Bill 1771 in the year 2000. To ensure emissions were being accurately tracked and managed, SB 1771 (2000) established the public benefit non-profit corporation, The Climate Registry, to record and register voluntary emission reductions from California entities from 1990 onwards. Specifically, the registry was tasked with the following functions: adopting standards for verifying emissions reductions, adopting a list of approved auditors that would verify emissions reductions, referring entities to approved firms to verify emissions reductions, establishing emissions reduction goals, designing and implementing efficiency improvement plans, maintaining a record of all emissions baselines and reductions, and recognizing, publicizing, and promoting entities that participate in the registry.

The function of standardizing reporting procedures and forms was an important first step in ensuring a coherent and effective monitoring and reporting system for the state. Aside from the critical integration benefits from a communicative perspective, in practice, The Climate Registry plays a vital engagement and capacity building role in the state. As Chelsea Hasenauer (personal communication, Feb. 20, 2018), manager of Monitoring Reporting and Verification Initiatives at the Climate Registry, points out, measuring emissions is not an easy task and often capacity and resources are lacking at the local level. Given this reality, an organization that can provide tailored services to help in this regard is critical to the capacity building needed to aid in operationalizing polycentric climate governance. The Climate Registry tends to focus its efforts on those municipalities on the lower end of the spectrum in terms of capacity, understanding that often the first hurdle in emissions reporting is the biggest one to get over (C. Hasenauer personal communication, Feb. 20, 2018). In a way, The Climate Registry could be discussed both as an early example of a key organizational and communicative integration mechanism in California.

SB 1771 (2000) also introduced important communication requirements that the government imposed upon itself. Specifically, it required that the Energy Resources Conservation and Development Commission, in consultation with the state board, Department of Forestry and Fire Protection, the Department of Transportation, the State Water Resources Control Board, the California Integrated Waste

Management Board and any state agency with control over matters impacting climate change, to inventory GHG emissions from "all sources located in the state, as identified in a specified report, and to acquire and develop data and information on global climate change and provide state, regional, and local agencies, utilities, business, industry, and other energy and economic sectors with information on the costs, technical feasibility, and demonstrated the effectiveness of methods for reducing or mitigating the production of greenhouse gases from in-state sources" (SB 1771 2000). This report was required to be updated every five years and contained transparency and public participation requirements (as per SB 1771 2000). At least one public workshop was required to be held before finalizing the inventory, and the final inventory and report were not only required to be presented to the Governor and Legislature but also to be posted to the Commission's website (SB 1771 2000).

Fundamental communication mechanisms were introduced a few years later that set the orientation and vision for California's low carbon transition, including high-level goals for individual sectors. A common trend has been for California's Governors to issue executive orders stating high-level goals, and then for legislation and regulations to be crafted to meet these ambitious visions/targets. Indeed, this was the case for California's flagship climate legislation, *The Global Warming Solutions Act*, which in addition to sector-specific targets, included visions for low-carbon energy and transportation systems. For example, in 2012, then-Governor Brown issued Executive Order B-16-12, mandating state agencies to facilitate the rapid commercialization of ZEVs to accommodate 1.5 million ZEVs by 2025, in addition to setting a target of reducing transportation emissions by 80% (compared to 1990 levels) by 2050. Similar orders were issued for other sectors, including energy and buildings. For example, in 2018, Brown issued Executive Order B-62-18 (2018), setting a 100% clean electricity goal and a goal to reach carbon neutrality, both by the year 2045.

California's communicative mechanisms for climate change impact assessments and identifying and implementing opportunities to reduce emissions are also very robust. As required by AB 32 (2006), the Climate Change Scoping Plan was developed as the high-level climate change plan to ensure the state is on track to meet its various emission reduction targets. The Plan accomplishes this by identifying sector-specific, and economy-wide actions, supported by a high level of detail to ensure effective implementation. Legislation mandates that the Scoping Plan be updated *at least* every five years, to achieve the maximum technologically-feasible and cost-effective GHG reductions (Health & Saf. Code,

§ 38561, subd. (h).). There are 14 statutorily-grounded objectives which must be updated using a comprehensive assessment process. The most recent update to the Scoping Plan is a product of extensive horizontal coordination, representing a collaborative effort of 20 different state agencies (CARB 2017c). The Scoping Plan is supported by California's Climate Change Research Plans and California Climate Change Assessments. These high-level communicative mechanisms at the agenda-setting, policy formulation and decision-making phases of the policy cycle are complemented by comprehensive reporting requirements related to vertical implementation and policy evaluation.

A prime example of communicative mechanisms geared specifically at reducing transportation emissions, and supporting vertical integration and implementation, are California's regional Sustainable Community Strategies (SCSs). As previously explained in Chapter 6, SB 375 (2008) requires California's 18 regional Metropolitan Planning Agencies to develop Sustainable Community Strategies in order to meet regional GHG emissions reduction targets, which are proposed by regions and approved by CARB and the California Transportation Commission. Developed by the state's MPOs, in coordination with cities, counties and regional transportation agencies, these strategies require the integration of land-use, transportation and housing planning (oriented at reducing transportation GHGs) into Regional Transportation Plans. With a specific focus on the reduction of passenger vehicle GHGs, regional targets are expressed as a percentage change in per capita passenger vehicle GHGs against a 2005 baseline (CARB 2019d). Importantly, these Strategies are informed by and linked to the state's Scoping Plan, meaning they are effectively integrated as a piece of the entire climate change governance regime and not a stand-alone strategy. For example, more stringent SB 375 targets were adopted in 2018 following the 2017 update to the Climate Change Scoping Plan, which was adjusted to meet a new 2030 GHG emission reduction target (40% reduction from the 1990s), introduced through an executive order and codified as per SB 32 (2016).

SCSs are approved by CARB, ensuring vertical coherence, and while policies for implementation are not mandated, approved plans allow for regional benefits, including CEQA streamlining for residential/mixed-use projects and transportation priority projects; Priority for select regional transportation program funding; Priority for select California Climate Investments program funding (CARB 2019d). In addition, regions implementing SCSs are eligible for SB 1 (2017) transportation funds, which were introduced in 2017 and represent an investment of USD 10 billion over 10 years. In this case,

'carrots' are used to induce implementation of these plans, in part reflecting the high levels of local autonomy in local government decision-making. SCSs must also comply with federal legislation, specifically the *Clean Air Act*.

Mandated reports to the legislature around efforts to reduce transportation emissions are another common communicative mechanism utilized in California. For example, the California Transportation Commission, which is responsible for allocating funds and programming for construction and improvements of highway, transit, active transportation and passenger rail, is mandated to report annually to the legislature on:

> …the Commission's prior-year decisions in allocating transportation capital outlay appropriations and identifying timely and relevant transportation issues facing California… an explanation and summary of major policies and decisions adopted by the Commission during the previously completed state and federal fiscal year, with an explanation of any changes in policy associated with the performance of its duties and responsibilities during the past year. In addition, the Commission is required to report any findings concerning its evaluation of the effectiveness of Caltrans in reducing deferred maintenance and improving road conditions on the state highway system. The annual report also may include a discussion of any significant upcoming transportation issues anticipated to be of concern to the public and the Legislature which, by law, should include specific, action-oriented, and pragmatic recommendations for legislation to improve the transportation system. (California Transportation Commission 2018, p. 8)

The Legislative Analyst's Office (LAO), which serves as the non-partisan fiscal and policy advisor to the California Legislator, also produces mandated annual reports on California's statutory GHG emission goals, as per AB 398 (2017, Chapter 135). In addition to reporting on the economic impacts and benefits of climate mitigation activities, the LAO has started producing a companion report focused solely on assessing California's climate-transportation policies in order to provide more detailed information and analysis on this sector (Taylor 2018).

In the case of Ontario's climate change governance regime, a high-level plan was developed, the Ontario Climate Change Action Plan, outlining the overall vision for transitioning to a lower-carbon provincial economy, including emission reduction targets and sector-specific strategies. Following this, legislation and policies were adopted to meet these goals, centering on the implementation of a cap-and-

trade system. In comparison to California's climate plans, Ontario's Plan contained fewer details in terms of the implementation of identified strategies. Communicative reporting mechanisms were established to ensure progress was evaluated in implementing the 5-year Climate Action Plan. Three reports were legislatively mandated as per the *Climate Change Mitigation and Low-carbon Economy Act (2016)*: The Minister's Progress Report, The Minister's Evaluation Report, and The Annual Report of the Greenhouse Gas Reduction Account. The Minister's Progress Report discussed ongoing initiatives, progress and outcomes, The Minister's Evaluation Report discussed evaluations of the initiatives seeking funding from cap-and-trade proceeds, and the Annual Report outlined amounts credits and charged the account.

In addition to these reports generated by the government itself, the mandate of the Environmental Commissioner of Ontario was expanded to include the development of an annual report on the government's progress in addressing climate change. As a report conducted by the independent auditing body, the Annual GHG Progress Report, required as per Section 58.2 of the Environmental Bill of Rights (1993), provided a non-biased, independent review of progress in reducing emissions and also provided recommendations for future action. Unlike California's Legislative Analyst's Office, the ECO does not produce a separate report on government efforts to reduce transportation emissions. These ECO reports continue to be comprehensive and critical, even though much of the province's climate governance regime has been dismantled at this point by the Progressive Conservative Government. This highlights the advantages of functional redundancy in the Ontario context, i.e., having multiple types of organizations providing similar reporting functions, which has helped to maintain the policy stream in the face of political swings.

Although these reports are still being generated, the Environmental Commissioner's Office was moved under the Auditor General of Ontario in 2019, meaning the government is now essentially in charge of investigating and reporting on itself. Regardless, ECO policy evaluation reports continue to provide comprehensive critical analysis under the Ford Administration. For example, the ECO portion of the 2019 December Auditor General report contained substantive criticisms of the Ford Administration's approach to climate change governance in addition to comprehensive recommendations (Office of the Auditor General of Ontario 2019). The utilization of these kinds of evaluative communication mechanisms reflects the trend of the province's relative strength in policy evaluation.

In comparison to California, Ontario has less robust communicative mechanisms facilitating vertical integration, specific to emission reduction planning. There is no government tracking of regional and local climate mitigation efforts, and no requirements to develop local climate change plans (particularly incorporated transportation) analogous to California's Sustainable Community Strategies. The closest kind of communicative mechanism in the Ontario context, which includes energy reduction from transportation, would be Municipal Energy Plans (MEPs), which focus on reducing energy use and improving energy efficiency in order to reduce municipal GHG emissions (Government of Ontario 2019a). The Ontario Municipal Energy Plan Program provides funding to municipalities to establish MEPs; 50% of eligible costs are covered to a maximum of CAD 90,000 to create a new plan, and CAD 25,000 to continue updating and developing existing plans (Government of Ontario 2019a). MEPs are a voluntary initiative in Ontario, but under the previous (and now scrapped) Climate Change Action Plan, they were often a pre-requisite for various provincial funding opportunities. Similar to California's SCSs, 'carrots' were used to induce local and regional governments to develop and implement these plans.

Related to MEPs, Official Plans (in practice) serve as the primary communicative mechanism for incorporating climate mitigation objectives into local government decision-making. Specifically related to reducing transportation emissions, zoning by-laws, protection of settlement boundary areas, height and density bonusing, parkland dedication, site plan control, community improvement plans and subdivision plans all serve as venues for incorporating climate mitigating objectives (Ministry of Municipal Affairs and Housing 2009). Critically, utilizing these mechanisms under the *Planning Act* is not mandated, they are simply provided as options. High-level land-use planning documents, previously discussed in Chapter 5, serve as the primary communicative mechanisms vertically integrating transportation demand management objectives in the province's land-use planning system. The critical overarching document, in this case, is the Provincial Policy Statement, last updated in 2017.

Two other documents that are also key in minimizing sprawl and ensuring the development of land-use patterns conducive to reducing transportation emissions are the Greenbelt Plan and the Growth Plan for the Greater Golden Horseshoe. In particular, the 2017 version of the Growth Plan contains a substantial number of mandates integrating climate change objectives into land-use planning for the region. Importantly, it is a requirement that these be followed by lower-tier governments in Ontario. Given that cap-and-trade funding could have been provided to lower-tier governments to carry out mandated

climate change planning, it remains a mystery why the integration of climate mitigation objectives was not integrated into any of these planning documents. This remains a clear missed opportunity.

Although the province has shown relative strength in utilizing communicative mechanisms geared toward *high-level* policy evaluation, there are no jurisdiction-specific climate research plans or climate assessments that would be comparable to the comprehensive reports developed (and regularly updated) in California. In part, this may reflect a capacity issue, but more likely, this reflects the ongoing trend of high levels of politicization in choosing given strategies to decarbonize the economy, and in particular, transportation. A potential bright spot for transportation planning is the ongoing plans for Southern Ontario developed under Metrolinx. Starting in 2008, Metrolinx began to develop comprehensive regional transportation plans, which in 2018 culminated in the 2041 Regional Transportation Plan for the Greater Toronto and Hamilton Area (Metrolinx 2018). The plan represents a coordinated effort from 30 GTHA regional and local governments, the provincial government, the federal government, and various transportation agencies (Metrolinx 2018). The plan outlines priority transit projects, including regional express rail and urban mass transit expansion, which are being funded by a CAD 30 billion investment between 2018-2026 (Metrolinx 2018). Although this is a step in the right direction, high levels of politicization continue to plague these efforts.

A key issue in seeing this plan implemented effectively lies with a lack of regulatory oversight and susceptibility to high-level politicization of decision-making. For example, planning and initial groundwork have already started on a downtown relief line for central Toronto, which is a critical measure to add much-needed capacity to the Toronto transit system, as opposed to increasing ridership. Metrolinx is now scrambling to put together a business case for the so-called "Ontario [subway] line" in the eastern portion of the city; a line for which there is no evidence-based substantiation, but which Metrolinx must plan for "because the Premier announced it" (Munro 2019). In many respects, Metrolinx has, in practice, operated like an unregulated utility (M. Winfield, personal communication, Oct. 31, 2019). In part, this stems from a lack of procedural rules requiring evidence-based justifications to higher-order regulatory entities. The importance of these kinds of procedural mechanisms in ensuring decision-making is coherent with overall transportation emission reduction goals is discussed in the section below.

Finally, a prime comparative example that illustrates California's tendency to have stronger communication mechanisms than Ontario is the issuance of ZEV targets and mandates. In the case of California, meeting low and zero emission vehicle targets is mandatory; automakers are required to sell a certain percentage of ZEVs in a given period. In contrast, Ontario introduced a less stringent ZEV sales target, which was meant to encourage the uptake of ZEVs in the province, but which is not binding. As previously mentioned, the decision to go with a target vs. a mandate was very much the result of public lobbying by the Automotive Parts Manufacturing Association. As a result of this choice, most new EVs have been directed to the Quebec market, where there is a ZEV mandate, further exacerbating a key barrier to ZEV uptake in Ontario: limited availability of the number of ZEVs (including makes and models) (Plug'nDrive 2017a).

Procedural mechanisms

One of the most commonly used procedural mechanisms to integrate environmental protection objectives into private and public undertakings is environmental assessments. Legally binding environmental assessment requirements were introduced in California in 1970 under the *California Environmental Quality Act* [CEQA] (1970) and in Ontario in 1975 under the *Environmental Assessment Act* (1975). CEQA is more stringent than the U.S. federal *National Environmental Protection Act* (1969) and is one of many "mini-NEPAs" passed by states following the enactment of this federal legislation (Barbour and Teitz 2005). In Canada, there is the federal *Canadian Environmental Assessment Act* (1999; 2012), which applies to federally owned or regulated projects; in some cases, a coordinated assessment under both laws must be carried out (Canadian Environmental Assessment Agency 2008). Although CEQA has been characterized as controversial at times, the law is generally viewed as one of the most, if not the most, important environmental protection law in the state, playing a critical role in mitigating adverse environmental impacts of private and public undertakings (Barbour and Teitz 2005). Within the context of reducing transportation emissions, small but meaningful updates have maintained the relevance of the law in the face of changing government priorities around climate change mitigation. On the other hand, environmental assessments in Ontario have witnessed a process of 'downgrading' in recent decades under varying governments (Winfield 2016).

In Canada and Ontario, the mid to late 1990s marks the peak of procedural policy instruments and institutions aimed at integrating environmental concerns into decision-making and ensuring meaningful public participation in decision-making (Winfield 2016). These rules and institutions include provisions for public participation under the *Canadian Environmental Protection Act*, The Ontario Environmental Bill of Rights (and associated Environmental Registry), and the creation of the Commissioner for Environment and Sustainable Development (specifically the petition process) (Winfield 2016). Since this time, environmental assessments at both levels of government have undergone 'streamlining' reforms, driven by the increasing popularity of neo-liberal ideas and dynamics associated with trade liberalization and globalization (Winfield 2016). Although examples of 'streamlining' may seem more overt at the federal level (e.g., full replacement of CEAA (1999) with CEAA (2012)), the environmental assessment process has also been downgraded by successive governments in recent decades in Ontario, albeit perhaps more quietly. Significant reforms in 1996 and onward, including reforms happening during the writing of this dissertation under the "Modernizing Ontario's environmental assessment program", have consistently been aimed at 'streamlining', often under an "open for business" justification.

In 1996, the scope of assessments was reduced, alongside the effective elimination of the practice of public hearings for project review before the Ontario Environmental Assessment Board, which saw its last hearing in 1998 (Winfield 2016). Since 1996, there have only been two hearings related to environmental assessments, even though the Act allows any person to request the Minister of Environment refer a matter to the Environmental Review Tribunal (Litner 2016). Continued and intensified streamlining occurred in the 2000s, especially after the 2008 economic downturn. A new 'model' was implemented in 2011 whereby proponents would assert their compliance with procedures through the registry with the ministry before activities took place, without any active review of applications by the government (Winfield 2016). The downgrading of environmental assessments in Ontario is explicitly linked to a reduction in evidence-based decision-making, especially in large infrastructure planning processes. EAs were, in part, designed to provide a robust evidence base for decision-making, which was meant to make it harder to overturn or undue decisions. Weak EAs in Ontario are partially responsible for the very high level of political (as opposed to evidence-based) decision-making, which is especially evident in the decision-making process for large electricity and transportation infrastructure projects.

Other examples of specific issues with the current process include the fact that Ontario generally doesn't require assessments for private undertakings (unique in Canada) and also does not require cumulative environmental impacts to be considered (Lindgren and Dunn 2010; Office of the Auditor General of Ontario 2018), something expressly required by federal legislation (Canadian Environmental Assessment Act, S.C. 1992, c. 37, ss. 16(1)(a)). For example, Ontario is the largest mining jurisdiction in Canada, and yet, the only Canadian jurisdiction where mines are not automatically subject to provincial assessment requirements, including public consultation processes (Litner 2016). Additionally, the former Environment Commissioner, Dianne Saxe, has critiqued the Act for lacking clear criteria and timelines, a chain of accountability, and giving excess discretion for the Environment Minister who may provide a decision on, or review, any project, but without at mandated timeline in which to do so (Syed 2019).

Within the context of climate change mitigation (and particularly important to transportation emissions), not only has the EEA and guidance documents not incorporated climate change considerations into assessments, many key planning documents and policies have been made legislatively exempt from the process, including the Province's Long Term Energy Plan, Integrated Power Systems Plan, the Greenbelt Plan, the Oak Ridges Moraine Plan, the Lake Simcoe Protection Plan, Far North Policy Statements, Growth Plans, and transportation planning policy (Litner 2016). Another critical issue with EA coverage in Ontario is the fact that Municipal Master Plans are not subject to approval under the EAA, only specific projects, which has led to fragmented decision-making (Lindgren and Dunn 2010). Renewable energy projects were also exempt from assessments and allowed to go through an alternative assessment process (read rushed), which partially led to much of the conflicts around siting these projects in rural communities, the members of which did not feel adequality consulted.

These streamlining activities have raised consistent critiques of Ontario's environmental assessment program by the Environmental Commissioner of Ontario in various reports (2008; 2014) and by the Auditor General (e.g., 2018), amongst others outside of government. In short, the legislation has been critiqued for not living up to its vision. In addition to sustained streamlining efforts, there has been a failure to implement recommendations for improvement. Unfortunately, similar streamlining reforms have taken place at the federal level along the same timeline, making Ontario, and Canada, a case study in the longer-term effects of not advancing procedural and distributional justice, in the context of environmental assessments. Going forward, the current reform process of Ontario's environmental

assessment process will no doubt enhance this trend. The PC Government's streamlining project, "modernizing Ontario's environmental assessment program," is focused on eliminating duplication and streamlining approval processes in the name of efficiency. All of this continues to diminish evidence-based decision-making, especially around infrastructure planning.

In California, the environmental assessment process under CEQA has not witnessed the same *orientation* of streamlining reforms over time. Although the process has been critiqued by environmentalists and developers alike, overall, the program has maintained its integrity and been updated to reflect best practices, specifically in terms of criteria in the area of reducing transportation emissions. Unlike Ontario's system for EA, the *CEQA* (1970) was broadened in the early 1970s through court rulings to require all development projects proposals in the state, both public and private, to undergo an environmental assessment by local and state agencies (Barbour and Teitz 2010). That is not to say that all proposals are required to undergo a full environmental assessment, but that each proposal is initially considered for assessment to see if it counts as a "project" and if that "project" qualifies for exemption; unless the development proposal is not counted as a project or is exempt, the project undergoes the CEQA EA process (California Natural Resources Agency n.d.).

In recent decades, the orientation of updating CEQA has often been aimed at streamlining and greenlighting projects that serve the state's environmental goals. Updating of CEQA guidelines is mandated by Public Resources Code section 21083, which requires the Natural Resources Agency and the Office of Planning and Research to produce updates periodically (usually every 1-2 years). Multiple legislative updates have also made substantive reforms. Critically, in 2007, climate change impacts and mitigation objectives were explicitly integrated into the state environmental assessment process via the passing of SB 97, which directed the Governor's Office of Planning and Research to develop California Environmental Quality Act (CEQA) guidelines for the mitigation of GHG emissions (Sen. Bill 97, 2007).

Particularly crucial for reducing transportation emissions, updating was initiated in 2013 when the Legislature passed Senate Bill 743 (2013), requiring a modernization of transportation impacts under CEQA (California Natural Resources Agency 2017). The bill directs the assessment of transportation impacts using vehicle miles traveled (VMTs), as opposed to 'level of service' (LOS), to better align CEQA assessments with state's goals around reducing emissions from transportation (SB 743 2013). In a recent

study of this 'bold step' by Lee and Handy (2018), the researchers found that, indeed, the switch to using a VMT metric, as opposed to LOS, "may lead to streamlining projects that reduce travel demand because of their location or design, whereas LOS metrics have led communities to build expensive, capacity-increasing mitigation measures to ease vehicle delay" (p. 14). Other key examples of legislative updates aimed at aligning the CEQA assessment process with environmental goals include:

- SB 1925, passed in 2002, created an exemption for infill residential development that meets certain criteria related to size, location, uses, and affordable housing.
- SB 375, passed in 2008, included provisions designed to streamline CEQA review for infill residential, mixed-use, and transit priority projects (TPPs).
- SB 226, passed in 2011, created an alternative streamlining method for eligible infill projects by limiting the topics subject to review at the project level where the environmental impacts of infill development had previously been addressed in a planning level decision. SB 226 also establishes an exemption for installing solar facilities on rooftops and existing parking lots.
- AB 900, passed in 2011, provided a streamlined review process for "environmental leadership development projects" that the Governor certifies as providing environmental benefits, meeting wage requirements, and contributing substantial instate investment; CEQA challenges to such development projects are heard directly in the court of appeals and must be decided within 175 days (subject to potential extensions).
- AB 2245, passed in 2012, enacted a temporary exemption for bike lane restriping projects in urban areas.
- SB 743, passed in 2013, created a new exemption from CEQA for transit priority projects that are consistent with a previously adopted Specific Plan and the relevant regional Sustainable Communities Strategy (SCS).
- SB 674, passed in 2014, expanded the statutory exemption for infill residential housing by increasing the allowable percentage of neighborhood-serving commercial uses within a project.
- SB 88, passed in 2015, added interim exemptions (expiring July 1, 2017) for drought related projects, such as recycled water projects, and city or county regulation of groundwater wells. (BAE Urban Economics 2016, p. 10-11)

A central critique of CEQA is the level of uncertainty in particular areas, like determining what constitutes a 'project', feasibility determinations, and (especially relevant to this work) what level of emissions constitutes a ‘significant impact’ under CEQA (Rothman 2011). Since requiring the assessment of GHGs under CEQA, three of the largest air districts have come up with their own thresholds for answering this question, but there has yet to be a uniform standard produced by CARB (Rothman 2011). A problematic state of uncertainty remains, leading to project delays and increased costs, which will undoubtedly continue to drive complaints from project developers (Rothman 2011). The only way these kinds of uncertainty issues are resolved is through the courts.

Aside from delays, the key implication here is that local decision-making bodies can approve projects even if the assessment process shows that environmental impacts may be significant and are perhaps not appropriately mitigated; the only recourse is litigation by private parties. While there are clear, longstanding issues with CEQA, it remains one of California's most important and influential statutes for providing environmental protection. In addition, updating of procedural requirements in recent years illustrates a meaningful level of commitment to align CEQA with the state's climate change mitigation goals, an inverse trend compared to the consistent 'downgrading' in the case of Ontario.

Procedural requirements, in the form of criteria assessments, are required for justifying decisions regarding spending revenues raised via California’s cap-and-trade system. The spending of funds deposited in the Greenhouse Gas Reduction Fund (GGRF), established in 2012 by Sen. Bill 1018 (2012), must be assessed under accountability requirements for those entities receiving proceeds from the GGRF. Specifically, five key pieces of information must be included in the expenditure record: how the money will be used, how this will further AB 32 regulatory objectives, how the proposed expenditure will contribute to achieving and maintaining GHG reductions, how the State agency considered the applicability and feasibility of other non-GHG reduction objectives, how the State agency will document the result achieved. These are illustrated in Table 12, in addition to recommendations set out in the 2018 funding guidelines from CARB.

Individual quantification methodologies and calculation tools are specified by CARB to be used to justify investments for different project types. Each project type has at least one quantification method and calculation tool, which are adjusted for variations of projects under a project type category. There are

19 different project types for the sustainable transportation category alone, many of which (e.g., new transit projects) contain multiple variations for quantification methodologies within guidance documents (CARB 2019e).

Table 12. Summary of Guiding Principles for California Climate Investments 2018 (CARB 2018h).

III.D.1	Facilitate GHG emission reductions and further the purposes of AB 32 and related statutes.	❑ Requirement
III.D.2	Target investments in and benefiting priority populations, with a focus on maximizing disadvantaged community benefits.	❑ Requirement
III.D.3	Maximize economic, environmental, and public health co-benefits to the State.	❑ Requirement
III.D.4	Foster job creation and job training, wherever possible.	❑ Requirement
III.D.5	Encourage projects that contribute to other State climate goals.	❑ Recommendation
III.D.6	Coordinate investments and leverage funds where possible to provide multiple benefits and to maximize benefits.	❑ Recommendation
III.D.7	Avoid potential substantial burdens to disadvantaged communities and low-income communities.	❑ Requirement
III.D.8	Ensure transparency and accountability and provide public access to program information.	❑ Requirement
III.D.9	Conduct outreach to help potential applicants access funding, particularly for priority populations.	❑ Recommendation

Procedural assessment requirements have been updated through legislation over recent years, with varying goals, including an increased focus on disadvantaged communities. From a policy integration and coordination standpoint, an important update to requirements for the Investment Plan came in 2016 as per SB 1464 (Chapter 679, Statutes of 2016). This legislation requires the California Department of Finance to assess interactions between investments and the state's many regulations, policies and programs, in addition to assessing how investments might be incorporated into existing programs (SB 1464 2016). Additionally, SB 1464 (2016) requires metrics to be proposed for assessing progress and benefits from investments.

Two relatively simple procedural mechanisms that have worked well to reduce transportation emissions are California's Smog Check Program and tire inflation requirements. The longstanding Smog

Check Program was updated in 1994 to target the most polluting vehicles (those polluting 2 to 25 times more than the average) and again in 2017, which exempts vehicles 8 years or less from biannual testing (AB 1274, 2017; CARB 2017; SB 33 1982). These tests are required in order to renew vehicle registrations (California Department of Motor Vehicles 2017). Mirroring a similar dynamic seen in the comparative analysis of environmental assessment in both jurisdictions, Ontario's analogous mandated inspection and maintenance program, Drive Clean, has not seen the same kind of substantive updating. The program was critiqued for testing vehicles that rarely ever failed the test. The program, which started in 1999, has now been canceled by the Progressive Conservative Government (The Canadian Press 2018a). California's tire inflation requirements were introduced in 2010, mandating that any vehicle weighing under 10,000 lbs have their tires checked and inflated by automotive service providers whenever a vehicle undergoes *any* maintenance or repair (CARB 2010). This relatively simple program has been extremely effective in reducing fuel consumption and associated emissions (CARB 2010). There is no such analogous program in Ontario.

Although reporting requirements are most often spoken about in the context of communicative integration mechanisms, in some cases, the functions of these mechanisms can be thought of as more procedural in terms of meeting requirements for justifying decisions and actions. In this vein, there are important oversight requirements in the California context that are lacking in the case of Ontario. One such example is California's Joint Legislative Committee on Climate Change Policies, which was established in 2016 as per Assembly Bill 197 (2016). The Committee was established primarily to provide increased legislative oversight of CARB, which has been critiqued for being somewhat heavy-handed (G. Giuliano, personal communication, Feb. 21, 2018). Essentially this legislation makes it mandatory for CARB to report to the legislature and for the Committee on Climate Change Policies to provide a critical analysis and subsequent recommendations on the policies, programs and investments related to climate change (Joint Legislative Committee on Climate Change Policies n.d.).

More specific to transportation emissions, requirements to meet certain air quality targets, set by the federal government in the U.S., are also critical procedural drivers of communication integration mechanisms, specifically state implementation plans (SIPs). Federal funding under successive transportation bills for state transportation projects (which flow through regional MPOs) is tied to meeting air quality targets or having appropriate plans to reach targets when regions have a 'non-conformity' status.

Although funding has rarely ever been pulled, the procedural requirements continue to drive the integration of air quality goals in transportation and land-use planning.

At the sub-state level, requirements for modeling are a prime example of procedural mechanisms that aim to ensure that decisions are based on good evidence. While different transport and land-use models are used by various MPOs for different purposes, CARB requires the use of the EMFAC model to calculate emissions for motor vehicles in California to support their regulatory and air quality planning efforts, and to meet Federal Highway Administration transportation planning requirements. In this way, the procedural requirement to justify decisions not only enhances evidenced-based decision-making but also provides some coherence in translating emissions factors from regional planning activities. After extensive research, there seem to be no such modeling requirements in the Ontario context.

Similarly, California's statewide Congestion Management Agencies (CMAs) are required to assess whether cities' transportation programs, plans and projects conform to the Congestion Management Program; non-conformance potentially results in 'significant consequences' to city transportation funding (San Francisco Country Transportation Agency 2007). In addition, CMAs are responsible for setting congestion limits and for evaluating the transportation effects of land-use planning decisions in terms of reducing congestion (Nash 1992; Wilshusen 1992; cited in Barbour 2002). These procedural requirements were important in strengthening the county's role in transportation planning in a way that explicitly requires the assessment of decision-making on sprawl and congestion.

Summary analysis

As evidenced by the analysis above, and the information presented in Chapter 5 and 6, the extent of policies and acts integrating climate mitigation objectives, and more specifically emission reductions from the transportation sector, both horizontally and vertically are much more numerous at both the federal and subnational levels in the case of the United States and California. At the federal level, the U.S. government primarily utilizes procedural mechanisms to ensure states are meeting air quality goals, including particular elements aimed directly at reducing transportation-related emissions. Since the late 1980s, successive governments in California have utilized all three major categories of CPI instruments, organizational, procedural and communicative, resulting in a large portfolio of policies and acts aimed at

reducing emissions. Communicative mechanisms, especially ambitious target setting and comprehensive mandated reporting requirements, have been used much more in the case of California.

The case of Canada and Ontario illustrates a much more recent entry into climate change mitigation and transportation-emission reduction programs and legislation, where the majority of acts and policies have been introduced at the provincial level and where federal involvement is comparatively limited. The numbers of acts and policies are much fewer than in the case of California and only since roughly 2013 have been framed in terms of climate change mitigation. This is in part due to the design of provincial policies, which are more general and less prescriptive, often relying on incentives as opposed to mandates. This is also reflective of the less prescriptive rulemaking style under parliamentary-cabinet systems, as opposed to the separation of powers systems in the United States where each branch (in particular the legislature) is wary of encroachment of powers from the executive. Tools to ensure effective implementation at lower levels of government (i.e., regional and local) are also notoriously absent. These tools are also needed more in the case of Ontario, where local and regional governments have limited autonomy and authority, and require increased assistance due to lower governance capacities.

In general, there are very clear directional climate change mandates in California, especially with regards to decarbonizing passenger transportation. At the peak of climate change governance efforts in Ontario (under the Wynne Government), communicative mandates for climate change mitigation, and specifically for transportation, were ultimately integrated into planning documents and acts. Climate change objectives were integrated into the planning process under the 2017 update to the Provincial Policy Statement, the Growth Plan for the GTHA, and Planning Act to align with the government's Climate Change Action Plan (Winfield, Wyse and Harbinson 2020). However, incentives and direction to integrate climate change objectives into municipal energy plans were weak. In the face of weakened procedural instruments for climate policy integration (specifically environmental assessments), it is even more critical that climate policy integration efforts in the planning process have survived the Ford Administration's dismantling process. That being said, although they may have survived on paper, all financial supports (originally provided by the cap-and-trade system) have been pulled. Also, the effective downgrading of the Environmental Commissioner of Ontario has potentially weakened the ability for robust policy evaluation, although this does not seem to be the case (so far).

Although positive steps were taken under the Wynne Administration in Ontario, mandates are still more numerous and robust in the California context. In California, multiple mandates at various levels of government clearly set direction and roles for various agencies. Importantly, these agencies had resources or were ensured sufficient resources to carry out critical coordination and integration activities essential to operationalizing California's complex polycentric climate governance system.

Key organizational instruments for operationalizing Ontario's climate governance regime were also either absent or weak, even during the height of climate change mitigation efforts. Both the Climate Change and Growth Secretariat, although seemingly a good step in theory, never performed the coordinating and governance activities needed to help steer a low carbon transition in the province. In part, weak mandates may have been a factor; for example, climate change objectives were not integrated into the Growth Secretariat (Winfield 2019), which, as previously mentioned, was also not situated at a high political level. That being said, even the Climate Secretariat, which had clear climate change-related tasks, was never able to effectively perform (M. Winfield, personal communication, Oct. 31, 2019). The weak nature of these coordinating structures is somewhat surprising given the agenda centrality of climate change mitigation under the Wynne Administration. Outside of government, there have been very few organizations carrying out key roles with regards to climate governance, such as the Ontario Climate Consortium. This is in stark contrast to the numerous non-government or quasi-government organizations undertaking efforts in the same space in California. Especially at the regional level, these organizations have been key to capacity and coalition building, as well as performing advocacy tasks in California, and highlight the benefits drawn from the highly polycentric nature of the state's climate governance system.

An important potential correlation between the comparatively much higher number of sub-state organizations providing capacity building functions in California, and the fact that California's climate governance system is composed of a much higher number of overarching rules steering the system, is that the complexity of the system is the reason there are a higher number of these organizations. It seems in the case of California, the increase in organizations providing this kind of capacity building function, or longer standing organizations which have introduced or shifted their focus to this kind of function (e.g., longer standing environmental advocacy organizations), are a response to a large and increasing number of requirements set by the state and (in some cases) the federal government. A comparative lack of regional organizations carrying out capacity building functions in the case of Ontario may be in part due to the

absence of the same top-down driving impacts that overarching rules provide in the California context. From a policy network perspective, the comparatively much higher number of horizontal integration organizations in California has the effect of increasing the density of California's climate governance network, in that there is a higher portion of all possible connections made between actors than without these hubs. The advantage in terms of operationalizing polycentric climate governance comes in the form of enhanced communication, policy learning, and governance innovation.

Importantly, this highlights the nuanced dynamics in polycentric governance systems, which have mainly been characterized as a strictly bottom-up approach. In reality, this case analysis illustrates the fact that there are important exchanges and influences from both the bottom-up and the top-down. As highlighted in the discussion of organizational mechanisms, the fact that California's climate-related government bodies (especially CARB and the Strategic Growth Council) have been able to effectively scan the landscape for effective climate governance experiments aimed at capacity building and scale them up (e.g., Regional Climate Collaboratives), illustrates and agility and intentionality in understanding the importance of this function for effectively implementing the complex system they have created. This is also reflected by the fact that California has a comparatively large number of government organizations situated at the regional level carrying out functions aimed at reducing transportation emissions. This characteristic is linked to levels of regulatory capacity, and the importance of regional governance in managing transportation emissions, which will be discussed further in the conclusion of this dissertation.

Similarly, it may be the case that the complexity of California's climate governance system, characterized by a broad suite of policies and programs, is driving the use of organizational mechanisms for policy integration and coordination. Cross-sectoral committees, working groups, and mandated minimum consultation rules are even more necessary in a highly complex system where there is a higher potential for inefficiencies, such as unnecessary duplication and policy conflict. This is not to say a given government must take these steps to enhance coordination and coherence of the overall governance regime. The presence of enhanced coordination measures in the case of California's climate governance system is driven partially by the many comprehensive, mandated communication requirements in the form of ex-ante and ex-post reports, including substantive justifications for decision-making. Mandated reporting on climate-transport policies and programs at the provincial level in Ontario is considerably weaker. First, there are far fewer communication requirements in terms of mandated monitoring and

reporting, especially at the sub-province level, and while reports were prepared 'in-house' by the Ministry of Environment, they are far less detailed. Ultimately, decisions are also not subject to the same level of justification.

A critical point, which should not be overlooked, is the frequent use of mandated policies and programs in integrating environmental objectives into non-environmental sectors, and the importance of these mechanisms in steering low carbon transitions, particularly for the transportation sector. This is particularly the case in California where numerous mandates and requirements have lowered emissions from ICE vehicles and driven low-carbon innovation for 'cleaner vehicles'. Specifically, flexible regulations like California's own ambitious vehicle emission standards, low carbon fuel standard and renewable portfolio standard account for more emission reductions than cap-and-trade. In contrast, Ontario has tended to rely more on economic incentives or voluntary actions to reduce transportation and energy emissions, including subsidies for electric vehicles, charging infrastructure and renewable energy installations. It is not the case that California lacks similar incentive programs, but that these are complemented by a multitude of command and control requirements.

The use of flexible regulations, especially those with a technology-forcing nature, has been a key characteristic of California's climate governance regime. Regulators have been able to carry out their implementation with agility, revising and adopting reforms where necessary, in the face of changing landscape factors (especially technological evolution). Indeed, these 'pioneering' instruments have been a critical part of California's status as a North American climate governance leader. Whether for reasons of regulatory capacity, governance culture, or industry influence, Ontario governments have not been able to craft and implement similar flexible regulations for their jurisdiction. Instead, the trend has been reactive and static regulation, with little in the way of driving innovation. It is important to note that the concept of ‘flex regs’ is understood differently in California than in Ontario and Canada. In the Canadian context, the notion of using flexible regulations is understood more as a way to essentially give industries what they want, as opposed to a stringent, yet flexible, means of regulating industry that ideally optimizes efficiency and also drives innovation. California regulators operate in an iterative fashion, continuously evaluating and improving standards and requirements. Unlike Ontario regulators, they are assertive and are willing to reduce flexibility when the approach is not working.

A critical insight stemming from the analysis of these categories is that carbon pricing is not 'the be-all and end-all" for climate change mitigation and steering low carbon transitions. In both cases, the cap-and-trade systems are not (/were not) the main mechanisms driving emission reductions. The carbon price resulting from these systems is much too low to drive behavioural change, especially given the high inelastic demand associated with the transportation sector. Instead, these systems operated more as a 'cap-and-invest' system, whereby the primary function they serve is providing a consistent revenue stream to fund complementary policies and programs (e.g., transit expansion, ZEV incentives, etc.). The advantage of this approach, where a cap-and-trade system is introduced with an associated low carbon price, has to do with political feasibility and social acceptance of the system. Pushback will be much lower with a carbon price of ~ USD 15 (e.g., California) than ~ USD 127 (e.g., Sweden), which is around the level a carbon price would have to be to significantly drive down transportation emissions (The World Bank 2019).

The comprehensive analysis of all regulations working to lower emissions from the passenger transportation sector in this work affords a broader look at the performance of the complete portfolio of policies working together to this end. While carbon-pricing policies have, without a doubt, received the most mainstream attention and are surely a cost-effective method to reduce emissions in an economy-wide manner, they are far from a panacea. In the face of political opposition and voter sensitivity to carbon pricing policies, a more strategic path forward for governments may be to focus on implementing regulations (designed with sufficient flexibility) to lower emissions from the transportation sector. Indeed, long-standing regulations like vehicle emission standards have proven to be effective at doing this for decades. For example, in the case of Canada (and Ontario), developing and implementing the promised (yet delayed) low carbon fuel standard would be an ideal first step. This is not to say that a 'cap-and-invest' system is not a good step for providing a consistent (and often large) revenue stream, as is the case in California and previously in Ontario, but that pursuing carbon pricing in jurisdictions with particularly challenging political circumstances (e.g., Nationally in the U.S.) may not be the most effective strategy for reducing emissions given the relatively short time-frame left to avoid catastrophic climate change.

The following concluding chapter discusses the significant insights stemming from this research, in light of both theory and practice.

Chapter 9: Discussion of Findings and Concluding Thoughts

The key high-level argument of this work is the need to recognize the importance of government as a unique and critical actor in operationalizing polycentric climate governance systems. To date, the role of state steering in the emerging theory of operationalizing polycentric governance systems has been paid insufficient attention. This presents a problem given the state's unique position in these systems, in particular, its potential for enhancing benefits and mitigating inefficiencies associated with these systems. Although much of the literature recognizes 'higher-order rules' and the state's unique role in monitoring and enforcement, there has been little follow-through in terms of focused research on the impact of these mechanisms. There is a need for an increased research focus on the government's role in providing effective overarching rules to enhance polycentric approaches to climate governance. Logically, a key focus must be on the rules themselves. This work utilizes the framework of climate policy integration as a novel approach for evaluating state steering via overarching rules. Climate policy integration fits well as a framework for analysis, and a means of better understanding the types of institutions and rules that are effective in operationalizing polycentric climate governance systems.

The research illustrates that, equally as important, is the sophistication and agility of governance institutions that develop and implement these rules in addition to the level of insulation from political interference. Two critical factors for operationalizing a polycentric approach to climate governance are sufficient levels of regulatory capacity and regulatory independence. Sophisticated government machinery is required to enhance polycentric climate governance systems. Specifically, sufficient capacity and independence are necessary to ensure effective monitoring, rule adjustment, adequate levels of information provision and consultation, and research expertise for high policy analytical capacity. Deep expertise is needed to gather evidence and formulate comprehensive rules that foster coordination and innovation at lower governance levels and from diverse actors. Proficient administrative capacity is required to effectively communicate information to diverse audiences, including those unfamiliar with climate governance work, but who are still paying for these efforts.

High levels of capacity are required to carry out meaningful opportunities for public participation across a given jurisdiction, which aid in the legitimization of knowledge and decisions. This can help

bolster a social consensus around the need to mitigate climate change and decarbonize transportation. This is especially important in an era of "alternative facts", where there is increased concern about the place of experts and science in society (Iyengar and Massey 2019). Robust evaluation mechanisms are needed, institutionalized via procedural policy tools, and carried out by non-political experts, who can report to legislators and laypeople, justifying changes to programs without political interference. Additionally, the provision of open-source technical tools (and accompanying guidance), like models and calculators, enable other actors to carry out research without paying for the development of these tools (which is cost-prohibitive most of the time).

Equally as important is the need to understand the contexts in which polycentric climate governance works best, and what factors promote or hinder the establishment of overarching rules to steer the system. The context analysis of these two cases, with varying levels of polycentricity in their climate governance systems, highlights the relative importance of landscape variables in this regard. For example, institutional contexts based on a separation of powers system with higher levels of local autonomy, in addition to high regulatory capacity and independence at the state/provincial level, seem to provide a better environment for polycentric governance systems to work effectively. The presence of these variables has proven to be significant drivers of CPI in the California context. In contrast, the institutional context, and especially high levels of politicization of rulemaking, have been major hindrances to providing effective overarching rules in the Ontario context. The following concluding discussion looks at the insights stemming from this empirical research and links these into the broader theories framing this work. Interactions between rules and contexts and implications for operationalizing polycentric approaches to climate governance form the majority of the following discussion.

From the perspective of collective action and polycentric governance theory, a few factors are at work in California that enables this jurisdiction to undertake consistent government-led climate mitigation efforts. First, California has benefited from time, and the trust and reciprocity that has been able to build up over time, enabling actors to further collectively act. This very much related to early air and water pollution issues, which have plagued the state since the early 1900s. The relatively large number of institutions that facilitate connection, exchange and learning, whether government-led or not, have had the effect of widening the circle of those willing to collectively participate in climate policy. In this way,

time has also benefitted coalition-building efforts, drawing a wider range of actors into the climate mitigation arena than seen in the case of Ontario (which has a relatively nascent regime).

Theoretically, this characteristic of California's polycentric climate governance system engages 'conditional cooperators' who are "ready to engage in collective action only to the extent they perceive others are willing to do the same" (Ostrom 2005; Torgler 2003; cited in Bšckstrand and Lövbrand 2015). In contrast, Ontario's relatively nascent modern climate change regime (2015→) has suffered from a lack of time and experience. The highly partisan nature of Ontario's climate change efforts, in contrast to the relatively bi-partisan dynamics in California, has tended to hinder the engagement of conditional cooperators.

California has also established a high degree of transparency through its provision of information, in technical and lay formats, to those outside the state government apparatus. Critically, from a collective action standpoint, climate agencies have well established, formal mechanisms for meaningful public participation, supporting quality debates on climate action, increasing transparency and the legitimacy of decisions made. Both elements are made possible by the high regulatory capacity of the state. Also, the state provides robust monitoring and reporting structures to track performance and ensure compliance for mandatory obligations. In some cases, the state has created formal independent institutions for monitoring and reporting, like the Climate Registry. The state must carry out this task effectively for purposes of incentivizing continued collective action, as it is the only actor endowed with enforcement powers. In contrast, meaningful public consultation around climate policies has lessened in recent decades in Ontario.

The relatively high regulatory capacity of state agencies, like CARB and CalEPA, has allowed for the establishment and revision of overarching rules, which have proved effective in operationalizing the somewhat chaotic nature of California's highly polycentric climate mitigation regime. For example, high levels of regulatory capacity and independence have enabled California regulators to be agile and adapt rules when necessary, while ensuring the 'back end' of regulation (i.e., monitoring and enforcement) is effectively carried out. In this way, experimentation with governance arrangements has led to meaningful innovations and not resulted in a streamlining project, as has been the case in Ontario. Given the uncertain and disruptive nature of purposeful decarbonization, a certain level of agility has been a key component for effectively steering California's low carbon transition.

Experimental governance arrangements have also, over time, aided in the establishment of trust between regulated entities and California regulators, thus encouraging collective action from industries that may be perceived as traditionally opposed to low-carbon regulations. This has been especially important in the case of technology-forcing policies for low-carbon transportation. As illustrated by the rollout of CARB's ZEV/LEV regulations, regulators are willing, using an iterative approach, to meaningfully engage with industry and adjust regulations in concert with technological development timelines and pathways. As mentioned earlier, the ability to regulate in such an agile manner is very much tied to the regulatory capacity of this agency, and the autonomy provided to them by the state. High degrees of regulatory capacity is not a given, and in the case of California, reflect trust between the legislature and regulator (CARB) that has developed over many decades based on the regulator effectively performing its duties. Ontario has lower levels of regulatory capacity compared to the almost unmatched capacity of California's regulators. More importantly, a lack of regulatory independence and high levels of politicalized decision-making have hindered the operationalization of the province's mild-medium polycentric climate governance system.

High levels of regulatory capacity and independence have also been important factors in enhancing technological and governance innovations, a key benefit of polycentric climate governance regimes. Not only have agile regulatory institutions been able to capitalize on successful policy innovations (born at the sub-state level), adopting and institutionalizing innovations state-wide, it has also provided forums and established policies that spur innovation. This works well in the case of California, where local and regional governments have relatively high levels of autonomy and authority and where a large, professionalized ENGO network, world-class university research network, and progressive business community can facilitate climate innovation through formal and informal knowledge networks. The structure of Ontario's regional economy has not lent itself to the promotion of progressive climate governance in the same way as California. In particular, the presence of a relatively robust domestic auto parts manufacturing industry has been much more of a hindrance to the province's low carbon transportation transition than, for example, California's oil and gas industry.

CARB, in particular, has been able to undertake effective 'landscape scanning', not only with regards to low carbon technologies but innovative climate governance arrangements. The adoption and

institutionalization of regional climate collaboratives provide a clear example of this kind of sophisticated governance effort. A jurisdictional context where there are higher levels of autonomy, including the ability to raise significant revenues, at the local and regional level seems to fit better with a polycentric approach to climate change governance than jurisdictions where local autonomy is limited. For example, higher levels of autonomy allow for increased climate governance experimentation, which, when combined with 'carrots and sticks' via higher-order overarching rules, amplifies the benefits of this approach. Critically, governance arrangements can be developed for specific local contexts, and when there are sufficient regional horizontal organizations (as is the case in California), the lessons of learning by doing can be shared in a way that acknowledges context-specific factors. This is related to a central insight stemming from this research: regional governance organizations play a critical role in operationalizing complex climate governance systems.

In particular, regional organizations are well-positioned to both effectively represent local interests and also large enough to access the state governance apparatus. As mentioned, they play a critical role not only in policy learning but also advocacy and coordination activities. Regional governance organizations are especially important in the context of decarbonizing transportation, as the geographic scope fits with most transportation and land-use planning. The importance of regional governance in managing California's low carbon (especially transportation) transition is recognized by the state's *Sustainable Communities Act*, which breaks out the state's emission reduction targets into regional blocs, each of which is incentivized by funding to develop a Sustainable Communities Plan to reach individual emission reduction goals. The importance of regional governments is also reflected in the Ontario context, where these organizations, especially in Southern Ontario, continue to lead climate governance efforts regardless of the orientation of the government of the day. A major difference between these two cases is that California has purposefully engaged and supported these kinds of regional governance organizations, whereas in the Ontario context, they have, at best, been left alone, and at worst, downgraded in mandates.

In the case of California, autonomy to fund efforts, for example, via ballot propositions, has also enabled concrete actions to be pursued. Indeed, at both the federal and subnational levels in the United States, there are more institutionalized mechanisms for consistent and substantive funding for transit-oriented development in California vs. Ontario/Canada. A comparison of the two largest public transit systems in each jurisdiction, the L.A. Metro and Toronto Transit Commission (TTC), clearly illustrates

this point. There are a greater number of funding sources for the L.A. Metro, many of which are permanent/dedicated *and referendum-based*, and of which passenger fares make up a much smaller amount. This is a stark contrast from the TTC, which relies mainly on passenger fares and other TTC revenues, operating with an extraordinarily low subsidy rate of 30% vs. roughly 90% for the L.A. Metro (CodeRedTO 2018). In CodeRedTO's (2018) report "Mixed Signals", which compares the TTC to 12 other similar transit systems (based on urban population, transit network complexity and modes), the single biggest differentiator between the TTC and other similar North American transit systems was the lack of a designated revenue stream for transit, even though the TTC had the highest ridership in the study.

The effectiveness of regulatory intuitions is enhanced, in the case of California, by the rules the state has imposed on itself. For example, political decision-makers cannot easily ignore recommendations made by CARB. In contrast, in Ontario, there are no codified rules for how information from regulatory institutions must factor into ultimate decisions. Similarly, requirements for modeling and evidence bases for decision-making are much more prominent in the case of California. In addition, as evidenced by discussions in Chapters 6 and 8, there are many requirements for government agencies to coordinate amongst each other, outside of the much higher number of horizontal integration organizations, such as California's Strategic Growth Council. This is not the case in Ontario, where coordination tends to take place on an ad hoc basis and is comparatively limited.

This variation stems mostly from the difference in institutional systems: a separation of powers system in California, U.S. vs. a parliamentary-cabinet system in Ontario, Canada. As mentioned at the outset of this chapter, a key insight from this research is that a separation of power systems seems to provide a better context for operationalizing polycentric climate governance systems via overarching rules. Parliamentary-cabinet systems have fewer veto points and checks and balances, which, in theory, should make it easier to undertake climate governance activities. The downside to these systems, from the perspective of climate governance, is it is also much easier to dismantle rules and systems, an outcome which was recently demonstrated following the 2018 Ontario provincial election.

This research illustrates that systems, based on a separation of powers, where detailed rules are explicitly laid out and legislated, provide a better context for utilizing overarching rules to ensure sufficient coordination and create coherence in complex climate governance systems. A separation of power

systems, characterized by a higher number of veto points, provides more resilience in the face of policy dismantling; however, they also have to potential to lock in bad policies. Ultimately, these systems, when working in specific contexts characterized by factors favouring climate policy (i.e., California), seemingly have a positive impact. Although the higher number of detailed rules may create additional complexity and associated challenges of high administration and transaction costs, this kind of system ultimately allows for more focused and explicit steering.

Another key difference that has implications for levels of coherence in these systems, stemming from the system of government, is the relatively more prominent governance role the federal government has in the arena of low-carbon transportation in the United States vs. Canada. Federal rules around land-use planning, transportation planning and air quality are institutionalized at the federal level in the United States, imposing top-down requirements that are typically tied to federal transportation funding. In effect, this adds another layer to California's polycentric climate governance system, which, if anything, has only supported state efforts and provided some level of consistency and resilience. For example, EPA requirements for emissions modeling have effectively standardized the way various regional agencies in California quantify emissions, as these are reported to the state and then the federal government.

In contrast, there are no such analogous requirements in the Canadian federal context; land-use and transportation planning almost exclusively falls within provincial jurisdiction and air quality tracking occurs only for required facilities via the National Pollutant Release Inventory. According to Winfield (2018, p. 3), the role of the Canadian federal government "has been limited to some occasional regulatory nudging along with providing financing and subsidies" and should be considered "largely as a weak factor in the Ontario environmental policy story", until recently. In a way, the institutional context can be envisioned as two sets of higher-order rules making an impact on the ability to operationalize polycentric climate governance systems: 1) the rules governing the system of government and 2) the rules the government uses to steer low-carbon transitions in their jurisdiction.

Levels of polycentricity and emission reductions

Although some California climate-transport policy experts were critical about the messiness of the state's climate-transport governance regime, on the whole, this research supports the hypothesis that higher

levels of polycentricity have been beneficial in terms of increased emission reductions. It is difficult to explicitly draw a causal link directly attributing higher levels of emission reductions to higher levels of polycentricity in the governance system. That being said, there are clear correlations in terms of reduced emissions from numerous local and regional efforts, as well as in terms of governance innovations and transportation emission reduction approaches, which have been developed outside of the state apparatus and, in many cases, adopted and institutionalized state-wide. Besides the example of regional climate collaboratives, the development of smart growth strategies provides another key example of an important contribution stemming from this highly polycentric system. The development of the 'smart growth' concept in the State of California, which has been very influential in shaping climate-transport policies, was essentially a project pushed out by the Local Government Commission, a non-profit organization dedicated to environmental, social and economic sustainability (D. Clarke, personal communication, Feb. 26, 2018).

The ability to accurately track emission reductions is a critical issue for evaluating the performance of a highly polycentric regime. As Dr. Giuliano (2019) points out, "the players are almost too many to enumerate" and there doesn't seem to be a clear sense of who is evaluating the net impact (personal communication, Feb. 21, 2018). There is also the potential issue of double-counting when attempting to monitor and track emission reductions from such a highly polycentric climate governance regime. New accounting approaches on the horizon may alleviate some of these concerns, which is especially important given the increasing levels of polycentricity in climate governance systems in many jurisdictions. For example, 'top-down' accurate emissions monitoring using climate satellites, like the "Satellites for Climate Action" program, are now a reality and becoming a more mainstream method for tracking emissions. This initiative to track emissions using real-time satellite data was pioneered by San Francisco's Planet Labs Inc. and is being implemented in partnership with the State of California and Bloomberg Philanthropies to enforce the state's "bold climate policies" (Marshall 2019). Overall, critiques about the complexity and messiness, and potential inefficiencies associated with highly polycentric governance systems, were outnumbered by those experts who ultimately think the benefits associated with polycentric climate governance outweigh the downsides in practice. As one California expert stated, although inefficient at times, “the more, the better” (C. Hasenauer, Feb. 20, 2018).

Polycentricity, reflexivity, and transition resilience

A polycentric approach to climate change governance best fits the current reality of politics and technological evolution, two critical (and often unpredictable) factors that are at the forefront of navigating any low-carbon transition. In many cases, swings in support for governments of varying orientations often lead to policy dismantling (e.g., Ontario). While a focus on policy resilience and design of climate policies to make them 'stickier' are important lines of inquiry, a focus on establishing an overall low-carbon socio-economic orientation, rather than a focus on stability presents itself, is a more pragmatic, and more effective goal (Rosenbloom, Meadowcroft and Cashore 2019). As VanNijnatten and Craik (2013, p. 10) point out, "there will never be a perfect setting for climate change policy…the question for climate policy analysts is how the system responds to disturbances and maintains its functions in the face of changing circumstances". The fundamental argument of this work is that a polycentric approach to climate change governance provides the most resilient strategy to pursue a low-carbon transition. The multiple centres of autonomy and diverse actors provide enough functional redundancy to ultimately stabilize the overarching orientation of a low-carbon transition. This approach provides a hedge against political swings and the reflexivity needed to deal with technological disruptions, as well as driving much-needed innovation in governance and technology.

The case of Ontario clearly illustrates the importance of a polycentric approach to climate change governance as a hedge against political swings. In the wake of the recent change in government, actors outside of the formal provincial government are playing the critical role of ensuring the policy stream stays alive in the face of government reversals and inaction with regards to climate mitigation policies. Environmental non-profit organizations continue to engage members of the public and form effective coalitions to push back against undesirable policies. Most recently, this has been illustrated by the formation of an effective coalition opposing the opening up Greenbelt lands to development. On two different occasions, the Ford Government has backed off this move in response to opposition from civil society, organized under groups like Friends of the Greenbelt.

Private actors have also been able to fill the gap left by repealed policies, such as the removal of EVs in the province. A private philanthropist is now personally subsidizing the purchase of used EVs in

partnership with another non-profit organization discussed earlier, Plug n Drive (2019). Although the privately donated subsidies are much lower (max CAD 1000), this example illustrates the resilience benefits associated with functional redundancy provided by a polycentric approach to mitigating climate change. Also, governments at lower levels, such as cities and regional governments, continue to act unilaterally on climate change mitigation and reducing transportation emissions via transportation and land-use planning efforts. For example, Ontario's Essex Region is piloting a regional climate collaborative, very similar to the collaborative model invented in California (Ontario Climate Consortium 2019).

A Polycentric Approach as a 'Best Fit' Low-Carbon Transition Strategy

Although there are limitations and inefficiencies associated with a polycentric approach to climate governance, its associated benefits and pragmatic 'fit' make it an effective choice as a low-carbon transition strategy in industrialized, democratic jurisdictions. In particular, the reflexivity associated with polycentric governance systems makes it the best approach for dealing with future disturbances of all kinds (i.e., technological, political, economic, etc.). Another important feature of polycentric climate governance system is not only the ability to deal with system disturbance but to drive technological and governance experimentation and innovation. Ideally, governments would purposefully work to craft overarching rules to enhance the benefits of polycentric climate governance systems, especially increased innovation, in order to speed up the technological transitions required to meet low-carbon targets.

Ultimately, governments alone cannot optimally steer the low-carbon transition so desperately needed to stave off the worst impacts of climate change; Non-state actors, like corporations, will also not unilaterally act to 'save us'. By definition, a collective effort is needed to solve the collective action dilemma that is protecting our atmosphere. Further research is needed to understand best how to enhance collective action for mitigating global climate change. Some degree of polycentricity in governance approaches to mitigating climate change is the current reality for many jurisdictions and there is a greater need to understand the interactions between higher-order governance levels and the actions of diverse actors in the field. This dissertation represents an early attempt at evaluating the form and function of overarching rules in enhancing polycentric climate action at various governance levels, utilizing well-established insights from policy integration studies. It also provides a basis upon which future lines of

inquiry can be built upon, a few of which are discussed briefly in Appendix C. As Ostrom (2009) emphasizes, this approach is by no means a panacea; it is, however, a best-fit approach for the characteristics of this immense collective action dilemma, which requires above all innovation, reflexivity, and engagement from all parts of society.

Implications for Polycentric Governance Models

Polycentric governance theory posits that local governments "will take the most meaningful climate actions in the future" (Barber 2013; Sassen 2015; Knieling 2016; cited in van der Heijden 2018). This is clearly illustrated in both the case of California and Ontario (although perhaps less evident in the Ontario case). Predictions stemming from polycentric urban climate governance theory (van der Heijden 2019) were confirmed in this research. Many local governments set higher climate action ambitions compared to higher-order governance levels, were very active in experimentation, and very active in trans-local collaborations (i.e., networks facilitating coordination). A key insight stemming from this research, for advancing polycentric governance theory, deals with the context in which local governments are best situated to carry out these roles.

Specifically, institutional contexts with higher levels of local government autonomy, appear to enhance meaningful action at lower government levels, especially when higher-order rules were established to provide 'carrots' and 'sticks' to local and regional governments. Enhancing the action potential of these local governments even further was the presence of civil society and industry actors supportive of climate action. Often local government initiatives were of a hybrid nature, relying on key civil society actors' participation (e.g., ENGOs). In the case of California, experimentation/innovation and increased coalition and capacity building via trans-local collaborations were the most prominent features of the state's polycentric climate governance regime enhanced by this context.

Within polycentric governance theory, networks and institutions facilitating connection and coordination can be understood as 'trans-local collaborations' (van der Heiden 2018). Although described at the level of theory, the impact of these networks in overcoming regional and national barriers to climate governance has not been tested in the wider literature to date (van der Heiden 2018). This dissertation research explicitly evaluated the role of trans-local collaboration through case studies and find that they

are very important in operationalizing polycentric climate governance. In fact, in the transportation-climate arena, they may be the most critical factor in operationalizing polycentric climate governance from below. These trans-local collaborations provide a key crossover between collective action and polycentric governance theory in that they offer sites for collective action that help engage conditional cooperators and also provide political causal mechanisms, specifically capacity and coalition building, required to progress climate governance from below.

This dissertation also tested the theoretical assertion that higher-order rules set out by the state, which is recognized as a unique actor within polycentric governance systems, can aid in regulating and mobilizing other actors in a way that progresses climate governance (Setzer and Nachmany 2018). The findings of this dissertation confirm this assertion. As hypothesized by Setzer and Nachmany (2018), increased regulation and mobilization provided by domestic governance institutions contributed to enhanced polycentric climate governance. Indeed, a clear trend of 'governance driving governance' is illustrated especially in the case of California, where a comprehensive subnational climate governance regime, consisting of a high number of rules and regulations, has been critical in shaping the behaviour of other actors in a way that allows climate action to move forward. In particular, vertical policy interventions were seen to help upscale non-governmental action in these cases, which contributes to reduced costs and improving technologies (Jänicke, Schreurs and Töpfer 2015).

As predicted in the literature, vertical policy interventions also induced horizontal dynamics and were a source of change, in addition to providing a stable framework and focal point for actors within the system (Setzer and Nachmany 2018). Within the context of reducing passenger transportation emissions, the landmark sustainable communities law, SB 375, confirms the assertation that higher-order rules can act as a source of change, in addition to stability, while inducing horizontal governance dynamics from diverse actors. SB 375, and the shifting focus to regional climate mitigation efforts via planning, created a need for horizontal coordination at this level. Indeed, this shift in direction spurred efforts of organizations like the Los Angeles Regional Climate Collaborative (L. Hunt, personal communication, May 14, 2018).

SB 375 also acted as a source of change in terms of providing an opening for outside actors to revise rulemaking. As Amanda Eaken of the National Resource Defense Council (San Francisco)

explained, SB 375 provided an opportunity to revise rules in the Environmental Quality Act that could now be seen at odds with this legislation (A. Eaken, personal communication, June 21, 2018). The resulting change they and other advocates were able to make because of the introduction of SB 375, was the elimination of 'level of service' from CEQA, which was replaced with a VMT reduction metric (as per SB 743 2013). According to Eaken, this has had a major impact. For example, proposed new freeway projects are now no longer able to 'sail through' assessments based on ‘level of service’. This example illustrates the importance of overarching rules, in not only providing stability, regulating and mobilizing in complex polycentric governance regimes, but also in providing opportunities for adjustment, and in this case, increased coherence. This example illustrates the benefits of mutual adjustment, one of the defining features of polycentric governance systems (Jordan et al. 2018). This also points to the fact that a highly professionalized and prominent ENGO advocacy community may increase the likelihood of the 'sources of change' or 'windows' being utilized for positive adjustment.

Understanding this, governments must recognize the complexity of current climate change governance systems and their unique role within these systems, working purposefully to develop and implement overarching rules to leverage the benefits of this approach and mitigate the inefficiencies. This dissertation research points to the fact that contexts characterized by high regulatory capacity and independence, and a separation of powers type system that lends itself to detailed rulemaking, seems to provide the most complementary backdrop to carrying out this important task. Researchers must also continue to pull apart and piece together what makes these messy systems work, connecting *both* top-down and bottom-up elements that constitute the system. Given that findings are context-specific, place-based research will be necessary, through case studies or other methods, to further understand 'what works where and why' and to accurately assess the transferability of mechanisms effectively operationalizing this approach across jurisdictions. For example, the regulatory capacity of CARB may not be easily replicated elsewhere, but this research illustrates that trans-local collaborations can aid in operationalization regardless of context. The approaches for future research outlined above provide effective potential options to further these lines of inquiry.

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GLOSSARY

BUSINESS AS USUAL: A situation in which individuals, industries or countries continue to operate as they have in the past, with no changes made to deal with some existing or anticipated problem, such as global warming. The business-as-usual path is also called 'baseline[i]

CAPACITY: The combination of all the strengths, attributes, and resources available to an individual, community, society, or organization, which can be used to achieve established goals.[ii]

CLIMATE POLICY INTEGRATION: The development of a set of tools to change the process of policy-making (i) across policy sectors, (ii) across levels of governance within the same policy field, and/or (iii) across sectors and levels of governance at the same time, to ensure that climate mitigation and adaptation objectives are taken into account (weak interpretation) or even given 'principled priority'[iii]

COLLECTIVE ACTION: To begin, "collective action arises when the efforts of two or more individuals are needed to achieve an outcome".[iv]

FUNCTIONAL REDUNDANCY: The presence of species or system elements that can functionally compensate for one another.[v]

GREENHOUSE GASES (GHG): Any 'trace gas that does not absorb incoming solar radiation but does absorb long-wavelength radiation emitted or reflected from the Earth's surface. When discussing global climate change, the term "greenhouse gas" usually refers to the human-induced, or anthropogenic, emissions of carbon dioxide, CFC's, methane and nitrous oxide.[vi]

GOVERNANCE: The way government is understood has changed in response to social, economic, and technological changes over recent decades. There is a corresponding shift from government defined strictly by the nation-state to a more inclusive concept of governance, recognizing the contributions of various levels of government (global, international, regional, local) and the roles of the private sector, of nongovernmental actors, and of civil society.[vii]

INTELLIGENT TRANSPORTATION/TRAFFIC CONTROL SYSTEMS: The application of advanced and emerging technologies (computers, sensors, control, communications, and electronic devices) in transportation to save lives, time, money, energy and the environment.

MARGINAL ABATEMENT COST (MAC): Costs of preventing the emission of an extra ton of GHG from the current level.[viii]

PATH DEPENDENCE: a situation whereby earlier events and experiences pattern the responses to new stimuli[ix]

POLICY CAPACITY: the ability to: anticipate and influence change; make informed, intelligent decisions about policy; develop programs to implement policy; attract and absorb resources; manage resources; and evaluate current activities to guide future action[x]

POLYCENTRIC GOVERNANCE: A governance system in which there are multiple interacting governing bodies with autonomy to make and enforce rules within a specific policy arena and geography.[xi]

REGULATORY CAPACITY: The ways in which resources are allocated to ensure that systems of control maintain their well-functioning in often uncertain environments. Regulatory capacity has been about the exercise of predictable, expertise-rich judgement and political agility. Regulatory capacity involves the informed exercise of regulatory discretion as well as constraints that check on regulatory discretion. Discussions regarding regulatory capacity relate to the capacity of regimes consisting of dispersed actors with shared authority, as well as the capacity of individual organisations.[xii]

REGULATORY INDEPENDENCE: The ability for a regulator to behave and act objectively, impartially, and consistently, without conflict of interest, bias or undue influence - in other words, independently. What distinguishes an independent regulator is not simply institutional design. Independence is also about finding the right balance between the appropriate and undue influence that can be exercised through the regulators' daily interactions with ministries, regulated industries and end-users.[xiii]

RESILIENCE: A capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to social well-being, the economy, and the environment.[xiv]

SOCIAL-ECOLOGICAL SYSTEM (SES): A coupled system of humans and nature that constitutes a complex adaptive system with ecological and social components that interact dynamically through various feedbacks. [xv]

TRANSPORTATION DEMAND MANAGEMENT: a formal designation for programmes in many countries that improve performance of roads by reducing traffic volumes[xvi]

UNCERTAINTY: An expression of the degree to which a value or relationship is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable.[xvii]

APPENDICIES

APPENDIX A: State-of-the-art review of mechanisms to reduce emissions from the transportation sector

Discussion of individual instruments: Carbon pricing

Carbon pricing is a pure market tool that increases the price of GHG emitting activities and also aids in establishing a long-term policy framework for emission reductions in energy markets (Yeh and Sperling 2013; Axsen et al. 2016). A carbon price is a Pigouvian fee on GHG emissions and can be set implicitly through a cap-and-trade approach or explicitly by imposing a carbon tax. The major difference between these two most common carbon pricing approaches is that with a cap-and-trade program, the emission levels (overall cap) are known while the price of carbon is uncertain. This is the opposite of a carbon tax where the price is known but the level of emission reductions is unknown. These two approaches are illustrated by the graphs in Figure 42.

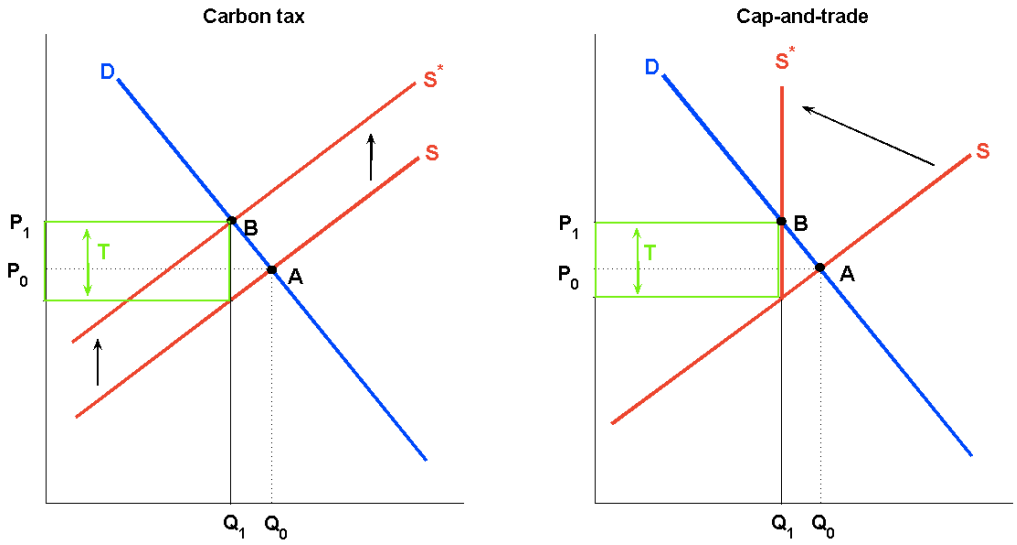

Figure 42. Carbon tax vs. Cap-and-Trade (Gordon 2012).

In the case of the carbon tax, the government sets the tax rate (T) increasing the price of a given good and as a result reducing demand, the extent to which depends on the elasticity of the demand curve. In the case of cap-and-trade, the government sets a limit on emissions so that the supply curve is a vertical line at the desired emission level (Q1). The price of the good increases correspondingly from Po to P1.

In practice, the choice between these two options is often a matter of political feasibility as opposed to technical advantages or economic efficiency (Furman et al. 2007; Stavins 2008; cited in Harrison et al. 2011). Regardless of the approach, the overarching goal remains the same: to include the social cost of emissions in the market price so that the negative externality associated with GHG emissions (environmental degradation) in internalized, requiring producers and consumers to make decisions based on the full social cost of these activities, correcting the "inefficient use of resources and excessive emissions" (as seen from a societal perspective) (C2ES 2013, p. 2; OECD 2008; Harrison et al 2011). As opposed to command and control measures, market-based instruments like carbon pricing are said to be more economically efficient and able to reduce emissions at a lower cost to regulated sectors (C2ES 2013). Table 13 illustrates the key advantages and disadvantages in theory for each approach, carbon taxation and cap-and-trade.

Table 13. Key advantages and disadvantages of implicit (cap-and-trade) and explicit (tax) carbon pricing mechanisms (ECO 2016).

Mechanism	Advantages	Disadvantages
Cap-and-trade system	• Ability to coordinate with other governments to create a larger market that can reduce costs for participants • Certainty, for both the government and participants, about the maximum quantity of emission allowances offered by the government	• Impact on the price of gasoline and fossil fuels alone may not be sufficient to change consumer behaviour • More extensive regulations to put in place • Complex administration • Uncertainty about the cost for participants (market-based fluctuation)
Carbon tax	• Certainty about the cost for participants (cost determined by the government) • Less extensive regulations to put in place • Easier administration and monitoring	• Uncertainty about the quantity of GHG emission reductions • Direct and visible impact that could lead to opposition from the population and businesses

There is growing momentum in terms of countries and subnational governments implementing or planning on implementing some kind of carbon pricing regime. As Figure 43 illustrates, roughly 40 national jurisdictions and over 20 subnational jurisdictions as of 2016 are putting a price on carbon, with each program on average covering about half of emissions sources, resulting in about 25% of global emissions are covered or soon to be covered (World Bank and Ecofys 2016).

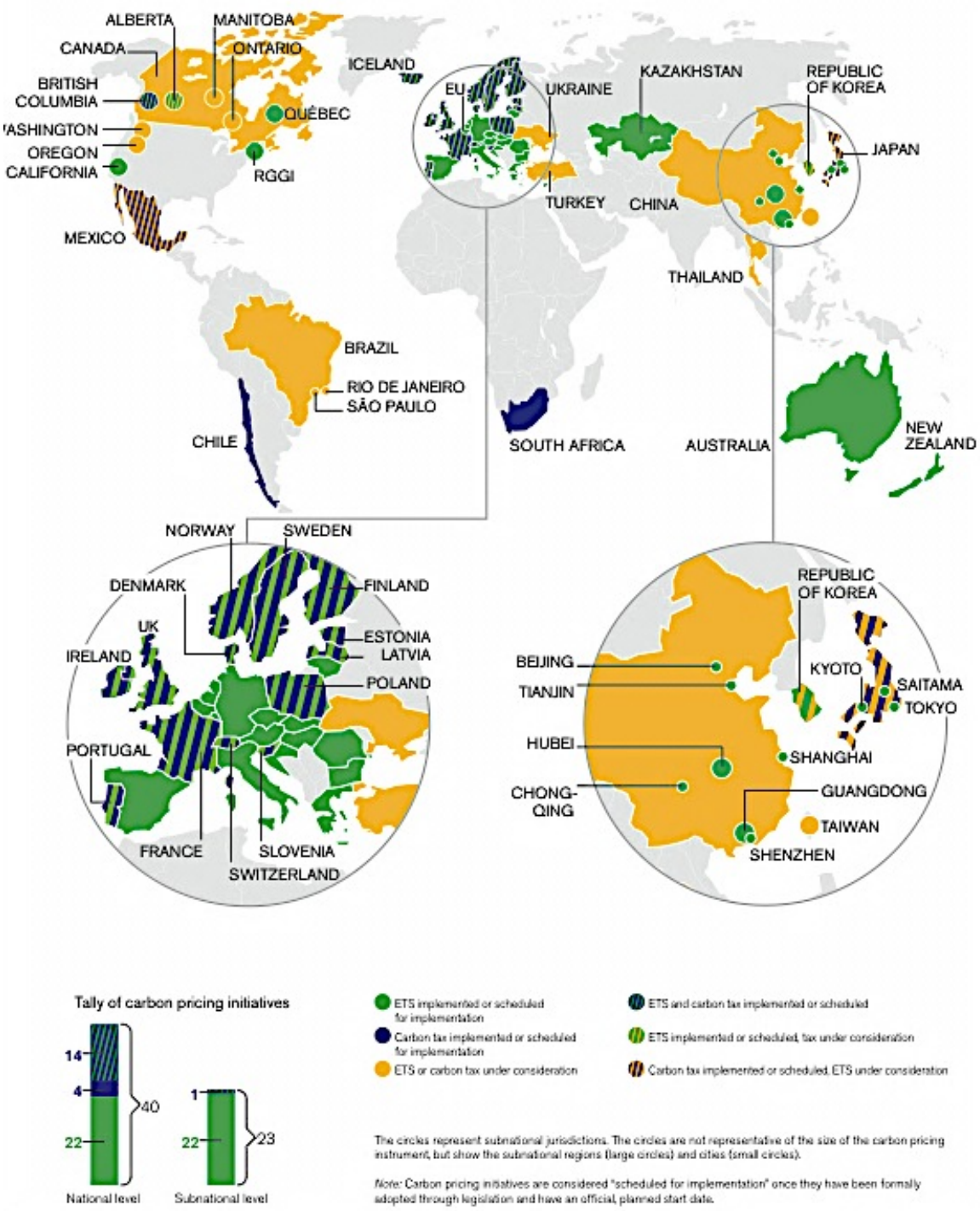

Figure 43. Summary map of existing, emerging and potential regional, national and subnational carbon pricing initiatives (World Banks and Ecofys 2017).

Reducing emissions in the transportation sector using carbon pricing is somewhat more challenging than in other sectors in the short term. One major reason for this is that consumers are price-insensitive (i.e., their demand for fuel is price inelastic) in the near term, meaning that marginal increases in fuel prices due to a carbon price will not make a big impact in their decisions in the short term (Pew Center 2008; Kahn et al. 2007). In many cases the price signal on gas is too week to initially drive technological changes as the "cost of carbon content does not translate into a significant portion of the retail price of gasoline" (Pew Center 2008). In addition, in more car-dependent societies like Canada and the United States, people are simply so dependent on their vehicles that they have little choice in the short term but to pay higher prices (Kahn et al. 2007). Each approach will be discussed below, although the discussion on cap-and-trade will be more comprehensive as it is the pricing system in place in both case jurisdictions.

Cap-and-trade

A cap-and-trade system, also called a tradable allowance system, is one option for setting a price on carbon emissions implicitly through the creation of a market for tradable emissions permits. Unlike a carbon taxation system, the price of the permits is uncertain as is set by demand and supply dynamics of the market and the overall level of emissions is known as it is set by the government in the overall cap (NRTEE 2011). Covered participants are allowed to emit up to point that is covered by permits and must buy additional emissions allowances from other individuals if they need to produce more emissions than allowed. This market approach, like carbon taxation, is said to be an economically efficient way to reduce emissions at a total minimum cost because individual emitters in sectors where abatement costs are higher are able to buy permits from others who have lower costs of abatements, thereby lowering the overall cost of compliance (Pew Center 2008). As with all market-based emission reduction approaches, the ideal situation where reductions are achieved at the least possible cost occurs when individual emitter's marginal abatement costs are equalized (Markandya, Perelet, Mason and Taylor 2001).

There are two main approaches to the macro design of such a system with regards to where the point of compliance is set: an upstream or downstream approach (Pew Center 2008). In the case of the transportation sector, an upstream approach would see the point of compliance where transport fuels

enter the economy, meaning that crude oil producers, refiners or importers would require allowances based on the carbon content of the fuels they are selling, the costs of which are then passed along via the supply chain (Pew Center 2008). A downstream approach to cap-and-trade means that the point of compliance, or the cap, comes into play when the emissions are released into the air (Pew Center 2008). In the case of the transportation sector this approach is very impractical because it would mean every driver, for example, would be required to hold permits for their fuel use, as oppose to imposing compliance on a significantly smaller number of individual oil producers or refiners as is the case with the upstream approach (Pew Center 2008). In addition to an upstream or downstream approach, the following key design features, as outlined by Harrison et al. (2011) are also critical to consider:

- *Coverage of sources:* who is covered and at what point (downstream or upstream)
- *Cap or price trajectory:* setting the cap is the most important factor for the overall price trajectory and should be consistent with the overall reduction goal. Non-covered emissions should be considered.
- *Banking and borrowing*: Banking allows emitters to use allowances from one year to cover emissions in future years and borrowing means covered individuals can use future allowances to cover current emissions then repay they allowances borrowed. These flexibility mechanisms reduce compliance costs and protect against short-term price volatility but in the case of borrowing, may result in delayed or defaulted emission reductions.
- *Offsets/credits:* Credits are often given to covered individuals in many systems to provide cost savings but this kind of design feature also leads to concerns over genuine emission reductions. Often credits have quantitative limits or other restrictions. For example, the Regional Greenhouse Gas Initiative (RGGI) trading system in the United States only allows offsets to be used if allowance prices reach a certain limit and in the European Union Trading System (EUTS) credits are not allowed from land-use and forestry.
- *Other cost-containment measures:* Aside from cost containment measures like borrowing or offsets, safety valves and price collars are other design features that reduce the overall cost of compliance. Safety valves essentially cap the

allowance price by the government selling unlimited allowances after a pre-specified price. A price collar protects against price volatility by using a combination of a price floor and a price ceiling in the system.

- *Allocation of allowances or revenue:* A key point of contention in designing a cap-and-trade system is the allocation of allowances. Governments can auction allowances or provide them for free. It must also be determined how revenues generated will be spent.
- *Allocation method for free allowances:* If allowances are allocated for free, the number of allowances must be determined usually through benchmarking or grandfathering based on historical emissions, as is the case in the EUTS. Allocations may also be provided to non-covered sources who will be impacted by price increases (e.g., local electricity distribution companies).

One major critique of cap-and-trade is the possibility of carbon leakage. If emitters are subject to increased prices in a location under a cap-and-trade system (or a carbon tax for that matter), they may move to another location where they are not under such a cost inducing regime, which reduces the efficacy and gains from such a program (Lomborg 2017). While carbon leakage can present a real threat, Aldy and Stavins (2008, p. 3) remind us that especially in developed jurisdiction the possible effect "is limited because a majority of the emissions in developed countries occur in non-traded sectors, such as in transportation, electricity generation, and residential buildings", thereby dampening the potential for carbon or emission leakage.

Carbon taxation

As stated earlier, a carbon tax is a tool for the internalization of environmental costs that takes the form of an excise tax on GHG emissions, where usually a price is placed on each unit of GHG emissions produced, or more commonly the carbon content of fuels (World Bank and Ecofys 2017). There are a few key design features that ultimately shape the performance (effectiveness and efficiency) of the program, most notably: who pays the tax, setting the rate, considering non-energy CO2/other GHGs/ and sequestration and finally administrative, monitoring and enforcement considerations (C2ES 2013). Who pays the tax, or whom the program covers, can be a contentious political issue and is subject

to “political compromise that can dilute the effectiveness of the policy” (C2ES 2013). If certain interest groups are powerful enough to convince politicians for exemptions or rebates, reducing the scope of the program, the overall environmental objective may be compromised (C2ES 2013).

Carbon taxes can raise substantial revenues for governments and how this money is spent can also be important for political feasibility and the economy-wide cost of the program. If a carbon tax is designed to be revenue-neutral, include a tax swap where taxes on labour and capital are reduced, it can seem much more palatable to the public and reduce economy-wide compliance costs (C2ES 2013). In 2008, British Columbia implemented the world's first revenue-neutral carbon tax, meaning every dollar collected through the tax is returned to the public in some way or another, in the case of B.C. it is through personal and business tax reductions and a Low Income Climate Action Tax Credit, which helps offset the burden on low-income families who spend a greater portion of their income on energy-related costs (UNFCCC 2014). One significant advantage this approach has over cap-and-trade is that it is much simpler for governments to implement in practice as existing administrative structures can be used and there is much less operational work involved as opposed to setting up, maintaining and monitoring a emissions permit trading market (David Suzuki Foundation 2017).

Discussion of individual instruments: Information campaigns

Information campaigns are information-based policy measures aimed at combating information failures in the market. The goal is to educate the public through information provided to help "households and businesses identify economically sensible choices that reduce GHG emissions" (Ecofiscal Commission 2017, p. 4). Information campaigns can take many forms, including websites providing information, labeling for vehicles, consumer outreach and government-funded advertising (Axsen et al. 2016). A novel approach to educating consumers about electric vehicles was pioneered and funded by the Ontario Government. In May of 2017, the government supported the opening of the Plug’n Drive Electric Vehicle Discovery Centre to combat information failures hindering the uptake of cleaner vehicles (The Canadian Press 2017). According to the Centre’s website, the facility is “focused entirely on providing an experiential learning environment for electric vehicles”, where visitors can…

- Discover Ontario's Climate Change Action Plan and the role electric vehicles play in reducing greenhouse gas emissions
- Discover the environmental and economic benefits of driving an electric vehicle
- Discover Ontario's electricity system
- Discover and test drive the latest electric vehicle models from leading manufacturers

…all without the pressure of being in a sales environment (Plug'n Drive 2017).

Discussion of individual instruments: Cleaner vehicles

Standards

Low-carbon fuel standard (LCFS)

Low carbon fuel standards not only aid in reducing GHG emissions from fuels sold in a regulated jurisdiction, but they also have the benefit of reducing dependence on foreign oil imports (National Round Table on the Environment and Economy [NRTEE] 2011; Axsen et al. 2016). A LCFS requires that the carbon intensity, or carbon content, in a total pool of transport fuels must be reduced by fuel suppliers to meet a minimum standard (Axsen et al. 2016; NRTEE 2011). Suppliers may be granted flexibility on how to meet a given standard, for example, a supplier can reduce the carbon intensity of their fuel, increase their supply of low-carbon fuels (for example biofuels) or there may be a mechanism where suppliers can purchase credits to meet some or all of the LCFS requirement (Yeh and Sperling 2013; Axsen et al. 2016). Challenges associated with LCFS have to do mainly with uncertainties, such as uncertainties about the exact carbon intensities of fuels (Kaufman et al. 2010; Mullins et al. 2010; Venkatesh et al. 2010; cited in Yeh and Sperling 2013), and perverse incentives, for example in indirect land-use changes (Hertel et al 2010; Pew Center 2008) and the price of food (Tokgoz et al. 2012; FAO et al. 2011; cited in Yeh and Sperling 2013) and a variety negative socio and environmental consequences associated with the expansion of biofuels (Purdon 2015).

Renewable fuel standards (RFS)

A similar technology-neutral measure to reduce GHG emissions from transportation fuels by reducing the carbon intensity of fuels is to implement a renewable fuel standard (RFS). A RFS is essentially a volumetric requirement for renewable fuels, which also often happen to be low carbon fuels (although it depends on factors related to lifecycle emissions) (Pew Center 2008). Fuel suppliers are required to sell a minimum amount of renewable fuels over a given time, which in addition to emission reductions, also aids in the diffusion of new technologies due to the guaranteed market provided by this type of mandate (Pew Center 2008). This is especially true when lifecycle emissions of fuels are valued:

> By valuing greenhouse gas emissions across the full lifecycle of a fuel – not just at its final combustion – a RFS supports innovation across the whole value chain. It supports the investment in R&D and early demonstrations needed to bring new fuels and vehicles to the market. It also encourages improvements in low-carbon fuel production, distribution and marketing. (Government of Ontario 2017)

It is important to note that a purely volumetric approach to implementing this standard is problematic as lifecycle emissions are ignored; not only is this a problem in and of itself, but also won't be as effective in supporting truly low carbon innovation (Pew Centre 2008; Government of Ontario 2017). British Columbia, California, Oregon and the European Union are all notable examples of governments that have implemented RFSs (Government of Ontario 2017).

Vehicle emission standards

Vehicle emission standards or vehicle efficiency standards put a limit on the GHG emissions from vehicle tailpipes for every vehicle class (Yeh and Sperling 2013; Axsen et al. 2016). This type of regulatory measure has been adopted widely around the world (Yeh and Sperling 2013) and has proven

to be very effective in reducing energy consumption from passenger vehicles (Macadonia 2017). For example, in the United States vehicle emission standards have resulted in a 50% increase in miles-per-gallon performance in new vehicles since 1980 (Macadonia 2017). This type of policy measure has been touted as having great potential to achieve the significant reductions in GHG emissions from the transportation sector required to meet ambitious climate change goals (Karplus and Paltsev 2012; cited in Yeh and Sperling 2013; Sims et al. 2014). In addition to their direct effectiveness in terms of reducing emissions, this policy measure also has equity advantages over policies that can be slightly regressive, such as carbon pricing. Vehicle standards impact new cars and tend to be progressive, impacting higher-income households more, as new vehicle costs are raised (Macadonia 2017).

'Clean vehicle' mandates (EV/ZEV mandates)

Zero emission vehicle (ZEV) mandates are an increasingly popular tool for governments to use to promote increasing market shares for cleaner vehicles (Clean Energy Canada 2016). Vehicles that produce/emit little to no carbon pollution at the tailpipe are considered zero emission vehicles (Clean Energy Canada 2016). Governments use ZEV mandates to set numerical targets for auto manufacturers to sell a minimum number of clean vehicles (e.g., electric, hydrogen fuel-cell) by a certain time frame (Axsen et al. 2016; Zhou et al. 2015). This kind of policy tool aims to speed up market penetration for zero emission vehicles by encouraging vehicle manufacturers "to research, develop, and market a wider variety of models and potentially to lower sales prices as well" (Axsen et al. 2016, p. 12). Norway, France, and most recently Britain has been leading the charge with ambitious clean car mandates. In the United States, roughly one-third of the U.S. auto market is covered by a ZEV standard (Clean Energy Canada 2016).

Mandated emissions testing (inspection and maintenance programs)

In theory, enhancing I and M programs are a very cost-effective way of reducing air pollution and emissions from cars because a relatively small percentage of cars are often responsible for a disproportionate amount of emissions (Bryner and Duffy 2012). For example, in the United States, the EPA estimates 20% of vehicles are responsible for 60% of emissions (Bryner and Duffy 2012). Unfortunately, mandated inspection and maintenance programs have been less effective in terms of

emissions reduction than anticipated and have often been opposed due to concerns over inconvenience in getting vehicles tested, impacts the auto inspection industry, and the costs associated with new equipment (National Research Council 2004; cited in Bryner and Duffy 2012).

Price signals

Tax on transportation fuels

A tax on transportation fuels makes driving conventional gas-powered cars more expensive and makes alternative/clean vehicles more attractive from a cost perspective. There are different ways a tax on transportation can be levied. It can be differentiated by fuel type or it can be based on the carbon intensity of fuels based on a calculation of life-cycle emissions (i.e., dollar per ton of CO2-equivalent per unit of energy (Pew Center 2008). If the tax is based on the carbon content of fuels, this policy tool can also promote technical innovation in low-carbon fuels (Pew Center 2008). As previously mentioned, the efficacy in terms of reducing emissions via a tax on transportation fuels can be limited because consumers are rather price inelastic in the short term, meaning the short-term demand response to increased fuel prices is relatively small (Heptonstall et al. 2009). That being said, in the longer-term demand response increases meaning this type of policy measure can be effective in changing consumer behavior and purchase decisions, for example buying cleaner cars or finding alternative modes of transportation (e.g., public transit, biking, etc.) (Pew Center 2008; Heptonstall et al. 2009).

Subsidies for 'clean vehicles'

A subsidy is a non-compulsory measure to encourage a desired behavior, in this case, the purchase of low-carbon technology, specifically, clean vehicles like hybrid and electric vehicles (Goulder and Parry 2008; cited in Rhodes et al. 2017; Government of Canada 2016). Because subsidies apply to a particular set of vehicles, they are less flexible than broader policies like carbon pricing (Government of Canada 2016). Subsidies of this kind have been criticized for being too costly for the amount of actual emission reductions projected to result from this kind of measure (Bezile and Milke 2017).

Tax on inefficient vehicles

A tax on inefficient vehicles is aimed at influencing consumer behavior by increasing the cost of vehicles with relatively poor fuel-efficiency ratings or those that emit higher levels of CO_2, in turn making more efficient or 'cleaner' vehicles a more attractive purchase option. In 2007, Canada introduced a tax on inefficient vehicles known as the "Green Levy" (Government of Canada 2010). While the tax systems clearly hold great potential in shifting consumer behavior in a low-carbon direction, like all policies, their efficacy depends on design details. The case of the Green Levy in Canada illustrates this point. According to Equiterre (n.d.), the measure has not achieved its intended impact of shifting behavior and ultimately reducing emissions for a number of reasons, including: the tax range was too small to impact consumer purchase decisions, very few people were aware of the tax; the tax applied to too few vehicles (mainly more costly vehicles), the tax included too many exemptions and was based on fuel efficiency vs. CO_2 emissions. One critique of this type of policy measure is that a tax on new vehicles might encourage the consumer to keep their older, more inefficiency/higher polluting cars longer (Bérubé and Sampson 2017). Again, careful design can ensure a perverse incentive like consumers keeping older more polluting cars for longer. For example, the tax can be designed so that discounts are provided to the consumer for buying a vehicle with higher CO_2 ratings (e.g., 25% discount for one level up to a 100% discount for four levels up) (Bérubé and Sampson 2017)

'Feebates'

Building on a tax for inefficient vehicles is the 'feebate' approach to encouraging the purchase of cleaner vehicles. A fee is levied on vehicles based on their fuel economy or carbon emissions when the vehicle falls below the government's fuel economy target or GHG emissions target, a rebate is provided when the vehicle exceeds (in terms of fuel economy or GHG emissions) the target (Pew Centre 2008). The price signal can be directed either at the producer or consumer of the vehicle, i.e., at the point of production or consumption (Pew Centre 2008). Regardless, the price of new vehicles is adjusted, which in the case of the rebate brings the economic benefits of long-term savings from higher fuel economy into the immediate purchase decision (Pew Centre 2008). The Government of Ontario implemented a feebate program from 2000-2011 that analysis revealed: "had a significant effect on the mix of passenger vehicles on the road, despite relatively modest fees per vehicle" (Bérubé and Sampson

2017). One key advantage of this type of policy is that there is a continuous incentive to for auto manufacturers to improve fuel economy as automakers "can always gain a market advantage by introducing vehicles that are more efficient than the current average" (Khan Kahn et al. 2007, p. 374).

Non-financial 'clean car' incentives: HOV lanes and parking incentives

Non-financial clean car incentives, like monetary incentives, are aimed at increasing the adoption of zero emission vehicles in a given jurisdiction. Some examples are HOV/bus lane use, free parking, dedicated parking spots, free license plates, emissions testing exemptions and toll and congestion charge exemption (Zou et al. 2015; Axsen et al. 2016; TCI 2013). These incentives may mean that a person might save money (e.g., in waived parking fees) but there are no direct financial incentives such as a government directly taxing or subsidizing particular actions. Free or dedicated parking, as well as HOV/bus lanes, are increasingly being implemented in highly populated urban areas (Zhou et al. 2015). In the United States, nine states have HOV lane access incentives in nine states for hybrids and fourteen states for electric and natural gas vehicles (DeShazo et al. 2015; cited in Sheldon and DeShazo 2017). Staying with the United States, parking incentives from clean vehicles have been made at the state level, for example Hawaii requires PEV specific parking spots and free parking for PEVs, or at the local level, for example, The City of New Haven, CT offers free parking for HEVs and AFVs on all municipal streets (TCI 2013).

Government funding for R & D

One critical way governments support low-carbon innovation through supply-side policies is by providing funds for research and development, which support collaboration and helps new technologies reach commercialization. In the case of cleaner vehicles, government funding would be targeted at technologies related to ZEVs to encourage innovation that might not otherwise take place. While the rationale for government-funded R & D is well known, the exact method or policy for delivering funding is still up for debate, therefore utilizing a mix of diverse policies is recommended (Bernanke 2011). As Globerman (2012, p. 4) explains, "The complex nature of innovation makes it difficult to determine which policies could truly encourage innovation... At a minimum, an effective national innovation policy should explicitly acknowledge the ways in which government policies affect competitive

conditions in domestic markets, even when the laws and regulations in question are intended to achieve other public policy goals." Regardless of the exact policy mix, funding research either directly in Universities and laboratories or through mechanisms like R & D tax credits is crucial to supporting the much-needed development of low-carbon technologies such as electric vehicle batteries, which are critical to ZEV performance and ultimately uptake.

Government procurement

A demand-pull policy, government procurement of cleaner vehicles includes the government investing in demonstration projects like purchasing and using electric vehicles for public fleets (Gouldson et al. 2008; cited in Taylor et al. 2012; Axsen et al. 2016). When governments purchase and use a significant amount of new low-carbon technologies (e.g., ZEVs), they are aiming to impact demand through the use of demonstration effects. Demonstration projects like a ZEV government fleets help overcome innovation uncertainties by validating product viability and also by raising awareness of the new technology (Taylor et al. 2012). This kind of government investment creates a niche, protected markets for emerging low-carbon technologies that would be too risky or too underdeveloped for commercial markets (Nicholson and Stepp 2013).

'Clean vehicle' infrastructure development

Ensuring there is sufficient electric vehicle supply equipment (EVSE), i.e., ZEV charging infrastructure, is crucial for ensuring an increasing adoption rate of cleaner vehicles. This is another demand-focused policy that ensures those driving clean vehicles, which require charging, can easily re-charge their vehicles away from home (Axsen et al. 2016). Government deployment of public charging infrastructure can be implemented in various ways, including bylaws and building regulations, and take the form of either paid or free charging (Axsen et al. 2016). By governments implementing policy measures aimed at developing a comprehensive charging infrastructure system, they can help mitigate issues around 'range anxiety', a common hindrance to ZEV uptake. In addition to being the most effective way to combat range anxiety, accelerated deployment of a public charging network will encourage inter-city travel (Plug'n Drive 2015).

Discussion of individual instruments: Transportation demand management

Besides making passenger vehicles 'cleaner', the other major aim in developing a low-carbon road passenger transportation system is to try and reduce the use and number of personal vehicles on the road. As Lawless (2018) reminds us, "the only true zero emission vehicle is one that is not driving". Burda, Bailie and Haines (2010) explain that land-use and transit policies can be effective at reducing vehicle kilometers traveled (VKT) by enhancing transit systems and improving urban form in order to influence how far and by what method people travel. Policies that aim to meet these goals can be categorized as Transportation Demand Management (TDM) efforts. One way to define TDM is as "a formal designation for programmes in many countries that improve performance of roads by reducing traffic volumes" (Litman 2003; cited in Kahn et al. 2007, p. 374). The impacts of these kinds of policies are diverse, including: “incentives for users to reduce driving, changing the frequency, mode, distribution, route or timing of their travel…reduc[ing] the need for physical travel through mobility substitutes or more efficiency land use” and reforming policy to correct distortions in transport planning customs (Gwilliam et al. 2004; cited in Kahn et al. 2007, p. 374).

Public investments in alternative modes of transportation (modal shift)

> Of the TDM policies, increasing transit provision is an effective strategy that is capable of addressing many traffic and environmental problems in modern society. Public transit is a generic term involving a large family of conventional and innovative technologies complementing each other to provide system-wide mobility in urban and rural areas. Public transit enables high capacity, energy-efficient and low emission movement of people. In addition, it provides auto owners who do not want to drive with an attractive travel alternative and represents an essential service for those who lack access to private vehicles such as students, senior citizens and others who may be economically or physically disadvantaged. With no doubt, efficient transit systems affect everyone as they save time and money not only for transit riders but also for automobile drivers. (ONE-ITS n.d.).

Enhancing public transit systems through government funding, especially increasing the supply of public transit, can lessen barriers to modal shifting (Cairns and Arros 2014). Governments can provide money both to build (capital funding) and maintain/operate (operating funding) urban and regional transit systems (MacKechnie 2017). For example, capital funding would pay for things like subway lines and buses, while operating funding would go towards things like operator salaries and station maintenance (MaxKechnie 2017). The money for government funding for transit often comes from sales tax or a percentage of a gas tax, development fees or alternative levies and can be provided at the local, state/provincial and/or at the federal level (MaxKechnie 2017; Arizona PIRG Education Fund 2009).

Generally, the farebox recovery ratio (i.e., the percentage of total operating revenues that passengers pay for through fares) is not nearly enough to cover the cost of operating a transit system, although the ratios can vary significantly by region (MaxKechnie 2017). In major Canadian transit systems, the farebox ratios are on average around 50%, much higher than averages in the United States, which are usually between 25-35% (MaxKechnie 2017). Defined funds or programs are often set up to specifically fill the role of subsidizing public transit, for example, Canada's Public Transit Infrastructure Fund aimed at capital funding (Infrastructure Canada 2017). Operating funding is just as critical because most transit systems face recurring shortages in their operating budgets (Arizona PIRG Education Fund 2009).

Making existing transit systems for efficient: Federal funding on tech. R and D and implementing intelligent traffic control systems

Intelligent Transportation/traffic Systems (ITS) technology has had a significant positive impact on improving conventional transport systems over the past 30 years (World Bank 2015). According to the Intelligent Transportation Systems Society of Canada (2012), ITS can be defined as “The application of advanced and emerging technologies (computers, sensors, control, communications, and electronic devices) in transportation to save lives, time, money, energy and the environment.” Further, The Minister of Public Works and Government Services of Canada (2012) describes ITSs as “a combination of innovative technologies, communications systems and management strategies that are applied to the transportation network to optimize operations. In doing so, they maximize benefits from existing

infrastructure—increased efficiency, safety, security and environmental sustainability—and minimize the need for new capital investments. ITS is also used to manage fleets of transportation equipment, while real-time data generated by integrated ITS provides valuable and actionable operational information to system operators, private sector transportation providers and travellers."

In Los Angeles County, California, an ITS application, specifically a synchronization program aimed at improving management of traffic signals to meet demand on major roads, resulted in 31.3 million hours of saved travel time and 38 million gallons of gas for drivers (Information Technology Industry Council [ITI] 2014). ITS applications can take many forms, including vehicle technologies (e.g., adaptive cruise control; wireless connectivity), traveler information technologies (e.g., eco-navigation technologies), infrastructure and system operations (e.g., real-time adaptive signal control) and alternative fuel technologies (e.g., ZEVs) (ITI 2014). According to a 2015 study on the effectiveness of ITS for reducing CO2 emissions from passenger cars, eco-driving or real-time eco navigation is the most effective in-vehicle application and intelligent traffic signal applications hold the most potential of infrastructure applications to reduce emissions (Pandazis and Winder 2015). Intelligent traffic signal applications can also be directed at cyclists to make bike commuting for efficient and ultimately encouraging the use of bikes for commuting. For example, in Copenhagen, Denmark, an ITS application known as the "green wave" optimizes traffic signals to provide continuous green lights for cyclists (Cairns and Arros 2014).

Policies encouraging the use of bicycles: Bike lane infrastructure development and bike-sharing

Encouraging the use of bicycles for transportation purposes by increasing the supply of alternative transportation infrastructures such as bike lanes and bike-parking can also enable a modal shift (Cairns and Arros 2014). Road repurposing is one approach to increase the supply of bike lanes (Cairns and Arros 2014). In Copenhagen, Denmark, this approach has been a part of the Government's efforts to provide more cycling infrastructure like parking and bike lanes, for example, 400 on street parking spaces were converted to bike lanes between 1995 and 2000 (Cairns and Arros 2014). While increasing bike infrastructure is not a very cost-effective way to reduce GHG emissions, there are many co-benefits outside of emission mitigation that make these programs attractive enough to realize

widespread implementation for example "can improve health, fitness, and safety for cyclists, reduce transportation costs for people who cycle instead of drive, reduce the costs associated with traffic congestion, and increase the overall efficiency of the transportation network" (Litman, 2017; cited in EcoFiscal Commission 2017). For example, it is estimated that Ontario's bike infrastructure program would result in reductions costing approximately CAD 500 per tonne of GHGs reduced (Government of Ontario 2016; cited in EcoFiscal Commission 2017). In urban areas with higher densities, bike-sharing programs, which were pioneered in the 1960s are now increasingly widespread, available in more than 1000 cities worldwide, usually in the form of 'station-based' systems meant for one-way trips (Handy 2017; cited in Fulton, Mason and Meroux 2017). Although bike-sharing only accounts for a minute share of cycling trips globally, these programs have the potential to encourage modal shift at a relatively low cost, especially as they continue to expand (Fulton et al. 2017).

Policies aimed at increasing occupancy rate of vehicles

Car-sharing and/or carpooling programs

Car-sharing/car-pooling programs are a cost-effective way to attempt to reduce personal trip distance and vehicle ownership as compared to traditional public transit and have been proven to reduce GHG emissions (Cairns and Arros 2014; Clean Energy Canada et al. 2016). These programs can be operated as a government-owned, private, not-for-profit or hybrid operations (Clean Energy Canada et al. 2016). Various business models exist for car-sharing including: "traditional round-trip, one-way and free-floating, peer-to-peer, and fractional ownership… charges can include an hourly rate, and in some instances, a per-mile charge as well" (Fulton et al. 2017, p. 13). Car-sharing and car-pooling represent a "collective use of private means of transport" and the attractiveness of this kind of program increases with the size and scope of such programs, as well as the "incorporation of other innovations such as smart cards to access cars" (Elzen, Geels and Green 2004). These programs lead to a reduction of fuel consumption and GHG emissions by supplementing transit and active transportation, filling gaps for trips where destinations are not easily or well served by transit or in the case that cargo is needed to be transported (Elzen et al. 2004).

Over the past ten years, the number of for-profit car-sharing services has increased alongside technological developments in app technology allowing for easy on-demand ride services like Uber and more importantly for emission reductions, car-sharing services like UberPool. UberPool was introduced in San Francisco in 2014 and according to an Uber study on emission reductions in that city, found the car-sharing service saves 120 million tonnes of CO_2 per month as compared to Uber cars alone (Hern 2015). Governments may also facilitate car-sharing, for example through setting up organizations that facilitate information provision and sharing and reduce the transaction costs associated with organizing car-pooling. A good example of this is Ontario's Greater Toronto-Hamilton region 'Smart Commute' program (Metrolinx 2017).

HOV lane incentives

Implementing high occupancy vehicle lanes (HOV lanes) is a demand-focused policy that not only aims to support overall TDM goals but also encourages the use of cleaner vehicles (previously discussed above). This kind of policy has the dual purpose of reducing GHG emissions and decreasing traffic congestion by encouraging car-pooling (Sheldon and DeShazo 2017). Usually, a minimum of two to three people are needed for a vehicle to use a HOV lane but governments have also allowed various cleaner vehicles single-occupant access to HOV lanes as a way to increase the utility of such vehicles and encourage their use (Sheldon and DeShazo 2017). Some kind of external marker, like a specific license plate or decal, is used to identify which cleaner vehicles are allowed this benefit.

In Ontario, the Provincial government provides so-called 'green license plates' to battery-electric or plug-in hybrid electric vehicles to distinguish particular vehicles that are allowed single-occupancy use of HOV lanes (Ontario Ministry of Transportation 2017). With regards to TDM, the creation of HOV lanes is another way to try and increase the occupancy rate of vehicles, with the ultimate aim of reducing VKT. HOV lanes can also be modified to include a toll for single-occupant vehicles who wish to use the lane (Pew Centre 2008). This leads to another widely used set of policies to meet TDM goals: road-pricing instruments.

Road pricing: Tolls and congestion charges

Simply, road pricing means that vehicles are charged for access to certain roads to decrease road use and/or shift the time that roads are used (Cairns and Arros 2014). These schemes can take many forms, including congestion charges, cordon schemes, road tolls, distance-based fees and High Occupancy Tolls (HOTs) (Transportation Research Board 2011; Heptonstall et al. 2009). Pricing may be implemented system-wide or just for specified regions at either variable or flat rates; most importantly, the price must be carefully set to induce the targeted behavioral changes and produce as many potential positive benefits as possible, including:

- Reduced GHG emissions
- Reduced air contaminants
- Reduced negative effects of pollution on cardiovascular and respiratory disease
- Reduced traffic on tolled roads while not creating unintended increased traffic and congestion on parallel routes that do not have capacity
- Mode shift
- Fewer traffic collisions
- Revenues that can be used towards various fiscal priorities, especially transit infrastructure
- Some net benefit to drivers in terms of time savings and associated cost savings (Srivastava and Burda 2015).

Table 14 illustrates road pricing goals and outcomes. Two are prominent examples from global cities, London and Stockholm, and the other two are examples from the cases used in this research, Ontario and California.

Table 14. Road pricing goals and outcomes in various jurisdictions (Srivastava and Burda 2015).

Example	Goal(s)	Current price during peak rush hour	Outcomes
London	**Primary goal** Reduce congestion	$20.92 (flat rate)	Reduced congestion by 27%
	Other goals Improve bus service		Bus service quality rated "best ever" in 2014, ridership increased by 77%, wait times for buses decreased by 45%, bus-dedicated lanes specified within zone
	Improve journey time reliability for car drivers		Journey times initially improved as traffic delays declined by 26%; but are now worsening due to increased population and economic recovery
	Improve goods movement		Goods movement not specifically measured
Stockholm	**Primary goal** Raise revenues for transit and road network	$2.42* (AM peak) $2.69* (PM peak)	$137 million (in 2013)
	Other goals Improve environmental quality		Airborne pollutants declined by 10-14%, NO_x declined by 8.5%, CO_2 decreased by 2-3% across the county
	Relieve congestion		Traffic reduced by 19.7%, private trips declined by 30%, VKTs driven in charge zone decreased by 16%, and congestion has reduced on circumferential roads, reducing queuing times by 30-50%
Ontario Highway 407 ETR	**Primary goals** i) Relieve congestion on 401 ii) Maximize profits and dividends for private owners	$0.3294/km* (AM peak) $0.3353/km* (PM peak for light vehicle in Regular Zone)	i) Average of 380,000 work day trips diverted from 401 (2010) (28% of trips) ii) $887.6 million revenues in 2014, 11% increase over 2013; average revenue per trip increased consistently to $6.96 in 2013; but net income declined from 2013 to 2014 by 10% (from $248.7 million to $222.9 million)
	Other goals No other explicit policy goals, other than to provide users with a safe, fast and reliable trip. No emission reduction objectives		Morning commute is 18% faster, afternoon commute is 21% faster, saving about 26 minutes/day; no safety data published; no emissions data available though estimated to save users about 0.4 litres/100 km of fuel
Southern California SR 91 Express Lanes	**Primary goal** Relieve congestion on SR 91	Eastbound: $0.10/km (AM peak) $0.35/km (PM peak) Westbound: $0.25/km (AM peak) $0.35/km (PM peak)	Saves users 30 minutes per day with increasing trips per week; 144 million trips diverted from non-tolled lanes since 2003
	Other goals Provide safe, reliable, predictable commute		No published reports of ongoing monitoring of safety and predictable journey times, though OCTA pays for towing if needed to ensure lanes are clear
	Optimise throughput at free-flow speeds		Lanes remain free flowing through price adjustments, and non-tolled lanes have been widened in past
	Increase average vehicle occupancy		Overall HOV3+ along corridor remains constant, through discounted pricing
	Balance capacity and demand		No clear measurement nor quantification explicitly done
	Generate sufficient revenue to ensure financial viability		$47 million generated in 2013-14, remains financially viable

* These are time-varying charges; an average is calculated for 06:00–09:00, the AM peak period, and 15:00–18:00, PM peak period.

Insurance schemes: Pay as you drive insurance

Pay as you drive (PAYD) insurance is an insurance program that bases premiums directly on the amount a vehicle is driven (VTPI 2017b). In a 2007 study, PAYD insurance, also known as distance-

based, mileage-based, per-mile premiums and insurance variabilization, was concluded to be the most effective strategy to reduce vehicle distance travelled (Winkleman 2007; cited in VTPI 2017b). This kind of incremental pricing strategy is meant to correct distorted market signals given by unlimited distance insurance programs that lead to "economically excessive automobile travel" ("Market Principles", VTPI 2004; cited in Litman 2005). Once insurance becomes a variable out-of-pocket cost as opposed to a sunk cost paid bi-annually, drivers link this price signal with their driving decisions resulting in reduced vehicle distance travelled (Litman 2005; Guensler, Amekudzi, Williams, Mergelsberg and Ogle 2003). Many benefits follow the implementation and uptake of this kind of insurance program in addition to the obvious environmental benefits associated with less driving, including reduced congestion, equity benefits, reduced risks of accidents and improved system efficiency (Litman 2005; Pew Center 2008; Transportation Research Board 2011). A recent example of a government attempting to promote this kind of scheme for environmental ends comes from California. The California Department of Insurance introduced a 'green auto insurance' option based on the PAYD model in 2009 with design flexibility on how mileage could be verified, including through auto repair records, odometer readings or a technical data collection device (VTPI 2017b).

Land-use planning and development: Integrated transit planning/transit-oriented development and Compact development

"The relationship between urban form and transportation choices is well-established" which makes land-use planning potentially a very effective avenue through which to reduce VKT and meet broader TDM goals. (Cairn and Arros 2014, p. 4). As Byner and Duffy (2012, p. 151) explain, "Planning is central to the idea of policy integration" and "Land-use planning provides a vehicle for exactly the kind of integrated policy-making that climate policy requires". Land-use planning that is geared at sustainable development has been called by many names, including 'smart growth', new urbanism, compact development, transit-oriented development, all concepts which represent the idea that urban sprawl should be reversed and planning should be increased in order to reduce energy and resources needed and also negative impacts on ecosystems (Bryner and Duffy 2012; Victoria Transport Policy Institute [VTPI] 2017). Transit-Oriented Development (TOD) is a 'particular category' of the above-listed planning approaches, which goes beyond shifting vehicle trips to transit:

> …it also increases Accessibility and Transportation Options through land-use Clustering and mix, and non-motorized transportation improvements. This reduces the distance required for car trips, allows a greater portion of trips to be made by walking and cycling, and allows some households to reduce their car ownership, which together can result in large reductions in vehicle travel (Land Use Impacts on Transport) (VTPI 2017).

The distance it takes to get to a bus stop or rail stop is a key metric used by planners pursuing TOD. Generally, planners assume that on average users of transit will not walk more than 0.25 miles to bus stops and 0.5 to 0.75 miles to rail stations (O'Neill, et al. 1992; Zhao, et al., 2003; Kuby, et al., 2004; cited in Tal and Handy 2013). In addition to focusing on the distance to transit stops, Renne (2009) explains that the following design features should also be included in TOD:

- The neighborhood is designed for Cycling and Walking, with adequate facilities and attractive street conditions.
- Streets have good Connectivity and Traffic Calming features to control vehicle traffic speeds.
- Mixed-use development that includes shops, schools and other public services, and a variety of housing types and prices, within each neighborhood.
- Parking Management to reduce the amount of land devoted to parking compared with conventional development, and to take advantage of the parking cost savings associated with reduced automobile use (NJDOT, 2007).
- Transit Stops and Stations that are convenient, comfortable and Secure, with features such as comfortable waiting areas, venders selling refreshments and periodicals, washrooms, Wayfinding and Multi-Modal Navigation Tools (cited in VTPI 2017).

An example of legislation aimed at reinforcing this kind of land-use planning and community development is California's Sustainable Communities Law (SB 375) (Sperling and Eggert 2014). This groundbreaking law passed in 2008, called "on the state's urban regions to develop plans for more efficient land-use and development, in order to reduce the greenhouse gases that contribute to global warming" (Altmaier, Barbour, Eggleton, Gage, Hayter, and Zahner 2009).

Teleworking schemes and other employer travel reduction programs

Teleworking schemes, in general, refer to the use of information and communications technology to replace physical travel but in practice, they can take many forms, including:

- *Telecommuting:* Employees who work from home rather than a central office. This is particularly appropriate for tasks that involve information management, such as research, accounting, editing, software development and design. With video conference capability, some tasks that require meetings between employees can be performed from home.
- *Satellite office or local work center:* Neighborhoods work centers can provide office services to a variety of businesses, reducing the need to travel to a central office.
- *Mobility working:* Certain job types, such as fieldwork and traveling sales, require frequent travel, so employees work from their cars, coffee shops and hotels.
- *Video-conferencing:* The use of live video connections as a substitute for physical meetings.
- *Distance Learning:* Teachers and students can use telecommunications as a substitute for physical meetings. Some colleges and universities offer distance-learning classes and projects.
- *Internet-shopping and Errands:* Telecommunications is increasingly used for shopping, banking and other types of errands.

- *Electronic Government:* Telecommunications by government agencies to provide services that would otherwise require visiting a government office.
- *Internet Business-to-Business (B2B):* refers to Internet interactions between businesses, such as bidding, sales and planning (VTPI 2017a).

More specifically, employer-based trip reduction programs aim to reduce GHG emissions associated with travel to work. They can be required or encouraged by governments or voluntarily be implemented by firms, which first started in California in the 1907s (Chan and Shaheen 2012; cited in Boarnet, Hsu and Handy 2014). According to Giuliano et al. (1993), "Employer travel reduction strategies gained prominence from a late 1980s regulation in southern California that required employers with 100 or more employees to adopt incentives and rules to reduce the number of car trips by employees commuting to work" (cited in Kahn et al. 2007, p. 375). Boarnet et al. (2014) reviewed the results of a variety employer-based trip reduction strategy studies in the United States and found that on average vehicle distance travelled was reduced between 4-6%, although other variables come into play (e.g., gasoline prices) which may complicate any analysis of the results. What was clear, however, was that the programs offering a higher number and variety of incentives to employees proved to be more effective (Boarnet et al. 2014).

One example of an employer-based trip reduction scheme that has proven to be very effective is California's parking 'cash-out' law. In this case, the state required employers who subsidize parking for employees and who have more than 50 employees to offer cash in place of them using that spot (CARB 2011). According to a study of eight firms using this program, total vehicle emissions were reduced on average by 12%, with a range of 5-24% across the eight firms (CARB 2011). In addition to reduced pollution and emissions, teleworking schemes can offer many co-benefits, including but not limited to: reduced congestion, reduced parking costs, health benefits resulting from modal shifts (e.g., transit, walking, biking) (Boarnet et al. 2014).

A note on 'rebound effects' and perverse incentives

Policies formulated to produce an intended effect, such as lowering carbon emissions from passenger transportation, do not always produce this impact when implemented. In some cases, policies may actually have the opposite effect. In these situations, a perverse incentive has been created, resulting in a perverse effect: "An unforeseen negative consequence of an action or policy that produces exactly the opposite to the intended effect" (Heery and Noon 2008). A rebound effect is a particular kind of perverse effect that has been the subject of much discussion in the transportation field (Owens and Driffill 2008). Berkhout, Muskens and Velthuijsen (2000, p. 426) define the rebound effect as follows:

> Technological progress makes equipment more energy efficient. Less energy is needed to produce the same amount of product, using the same amount of equipment - ceteris paribus. However, not everything stays the same. Because the equipment has become more energy efficient, the cost per unit of services of the equipment falls…A price decrease normally leads to increased consumption. Part of the ceteris paribus gains is lost, because one tends to consume more productive services, and the extra demand for productive services from the equipment implies more energy consumption.

Within the context of reducing emissions from the passenger transportation sector, the impact of improving fuel efficiency from vehicles provides a clear illustration of a *direct* rebound effect and also highlights the influence of price elasticity of demand for fuel in modifying the overall magnitude of the rebound effect in the transport sector. If vehicle efficiency is improved for a given automobile, meaning less fuel is required to drive an additional distance, than the increase in fuel efficiency can lead a driver to drive more, therefore increasing overall fuel use. This means some of the gains in terms of reduced carbon emissions (from increased vehicle efficiency) is lost or offset by the choice to drive more (Owens and Driffill 2008; Farber and Carlarne 2018). This assumption that a person will make the choice to drive more is based on neo-classical principles of economics, where an actor is assumed to be rational and have certain and complete information, which they use to make optimal decisions that maximize

their utility (Berkhout et al. 2000). The assumption of rationality is a necessary condition for the existence of the rebound effect (Berkhout et al. 2000).

There are also *indirect* rebound effects, where money saved from increased energy efficiency is re-spent elsewhere, or where demand is reduced for energy, lowering prices, and resulting in increased demand for the energy source (Nadel 2012). Using the same example of increased vehicle efficiency, if less fuel is required to drive a given distance, demand for fuel decreases, leading to a price reduction, which may cause other drivers to increase their demand for fuel (Farber and Carlarne 2018). The magnitude of the effect within the context of automobiles is not very large because it is modified by the fact that demand for gasoline is relatively inelastic (Farber and Carlarne 2018). Theoretically, an increase in energy efficiency could actually lead to a increase in total energy consumption, although empirical evidence of the rebound effect suggests the effect is limited (Farber and Carlarne 2018). Although an exact estimate of the magnitude of the rebound effect is difficult to determine, general, economy-wide (indirect) rebound effect for OECD countries is estimated to be around 10 percent (Farber and Calarne 2018).

APPENDIX B: Comparative Climate-Transport Policy Outputs, California and Ontario

The following table chronologically lists all key climate-transport policies in Ontario and California up to the year 2018. The table is organized by the categories set out in the state-of-the-art review of mechanisms to reduce emissions from the transportation sector (outlined in APPENDIX A and in the Table below).

Cleaner Vehicles	**Transportation Demand Management**
Climate Change Commitments and Carbon Pricing Information measures	
– Fuel standards – Vehicle standards – Mandated emissions testing (I & M) – Alternative Vehicle Standards and Mandates – Alternative vehicle charging infrastructure development – Tax on transportation fuels – Tax on inefficient vehicles – Feebates – Subsidies for alternative vehicles – Non-financial clean vehicle incentives – Funding for research and development and industry partnerships – Government procurement	– Transit-Integrated land-use planning, "smart growth" policies – Enhanced public transportation services – Policies aimed at making current public transit systems more effective (funding for R and D; implementing intelligent traffic control systems) – Policies encouraging the use of bicycles (bike lane infrastructure development, bike-sharing) – Policies aimed at increasing occupancy rate of vehicles (car-sharing; car-pooling; HOV lanes) – Tolls and congestion charges – Insurance schemes – Telework and other employee travel reduction programs

Climate change commitments, carbon pricing; reducing air pollution and emissions from energy; broad transport emission reduction programs	**CALIFORNIA** **FEDERAL:** **1955 - U.S. Air Pollution Control Act:** Federal technical assistance to state air pollution control; Funding of Public Health Service for studies of air pollution; Amended 1960 to study health effects of automobile exhaust; Did not impose regulations on air pollution; Delegated regulation to state and local level.[xviii] **1963 - The Clean Air Act:** first federal legislation regarding air pollution control. It established a federal program within the U.S. Public Health Service and authorized research into techniques for monitoring and controlling air pollution.[xix] **1967 - the Air Quality Act:** enacted in order to expand federal government activities. In accordance with this law, enforcement proceedings were initiated in areas subject to interstate air pollution transport. As part of these proceedings, the federal government for the first time conducted extensive ambient monitoring studies and stationary source inspections.[xx] **1969 - The National Environmental Protection Act (NEPA):** was one of the first laws ever written that establishes the broad national framework for protecting our environment. his act presented a significant departure from prior legislation in that it enunciated for the first time a broad national policy to prevent or eliminate damage to the environment. The act stated that it was national policy to "encourage productive and enjoyable harmony between man and his	**ONTARIO** **FEDERAL:** **1971 - Clean Air Act:** The Act itself was brought into force by the Parliament of Canada on June 23,1971. Its primary purpose was, and is, to promote and achieve a uniform approach to air pollution control across the country, to assist provinces in the development and implementation of appropriate air pollution control legislation and programs, and to provide federal regulatory authority appropriate to the shared jurisdictional setting in which this subject must be addressed in Canada. It was repealed by the Canadian Environmental Protection Act of 1988, R.S.C. 1985, c. 16 (supp. 4). [lxxxvii] **1971 - Department of the Environment Act (R.S.C., 1985, c. E-10):** established Environment Canada as a department within the portfolio of the Minister of the Environment responsible for preserving and enhancing the quality of the natural environment, providing meteorological services, and coordinating policies and programs to achieve environmental objectives.[lxxxviii] **1988 - The Canadian Environmental Protection Act (CEPA):** In the late 1980s, the Government of Canada recognized that a systematic approach to assessing and managing chemical substances in the environment would help address any that were not already being addressed under existing programs. CEPA was passed in 1988 to fill this gap. It was an

	environment." NEPA's basic policy is to assure that all branches of government give proper consideration to the environment prior to undertaking any major federal action that significantly affects the environment. NEPA requirements are invoked when airports, buildings, military complexes, highways, parkland purchases, and other federal activities are proposed. Environmental Assessments (EAs) and Environmental Impact Statements (EISs), which are assessments of the likelihood of impacts from alternative courses of action, are required from all Federal agencies and are the most visible NEPA requirements. The law created the Council on Environmental Quality (CEQ) in the Executive Office of the President.[xxi] **1970 - the Environmental Quality Improvement Act of 1970 (Public Law 91-224):** helped to strengthen the ability of the Council on Environmental Quality to perform its functions. This Act accomplished three important ends. First, it provided much needed professional and administrative staff support and greater funding for the Council. Also, the Council was directed to promote the advancement of scientific knowledge of the effects of actions and technology on the environment and encourage the development of the means to prevent or reduce adverse effects that endanger the health and well-being of man. Finally, the Council was to assist the federal agencies in developing environmental quality standards. It required the federal government to make the final determination on the trade-off between facility improvements and environmental quality. Further, it created a complicated and expensive process by requiring the preparation of an EIS and the seeking of	amalgamation of some existing laws and included new powers for the protection of our health and environment. CEPA was also intended to address any risks from chemical substances in the environment not covered by another law. Renewed in 1999 (see below).[lxxxix] **1990 - Canada's Green Plan for a Healthy Environment:** a document that detailed its national strategy on global warming. Canada expressed its commitment to a program to stabilize emissions of CO2 and other [GHGs] at 1990 levels by the year 2000. The Plan primarily focused on improving energy efficiency, promoting public awareness on climate change and encouraging voluntary actions and clearly lacked substance or enforceability.[xc] **1992 - Energy Efficiency Act:** increased the efficiency standards of 33 products including motors. Prohibits imports or interprovincial trade of products not meeting standards.[xci] **1995 - National Action Program on Climate Change (NAPCC):** In 1995, the federal-provincial- territorial National Action Program on Climate Change (NAPCC) was adopted. The goal of this initiative was to set the strategic directions for pursuing the nation's objective of meeting its current commitment of stabilizing greenhouse gas (GHG) emissions at 1990 levels by the year 2000. The NAPCC primarily relied upon voluntary measures.[xcii] **1997 - Kyoto Protocol:** ratified in 2002 and came into force in 2005.[xciii] Canada become the only country to withdraw from the agreement in 2012.

	comments from all concerned agencies. In this manner, the acts actually created a new planning process in parallel with the existing urban transportation planning process.[xxii] **1970 - Clean Air Act:** Congress established much of the basic structure of the Clean Air Act in 1970, and made major revisions in 1977 and 1990. Dense, visible smog in many of the nation's cities and industrial centers helped to prompt passage of the 1970 legislation at the height of the national environmental movement. the Clean Air Act requires EPA to establish national ambient air quality standards for certain common and widespread pollutants based on the latest science. EPA has set air quality standards for six common "criteria pollutants". States are required to adopt enforceable plans to achieve and maintain air quality meeting the air quality standards. State plans also must control emissions that drift across state lines and harm air quality in downwind states. Other key provisions are designed to minimize pollution increases from growing numbers of motor vehicles, and from new or expanded industrial plants. The law calls for new stationary sources (e.g., power plants and factories) to use the best available technology, and allows less stringent standards for existing sources.[xxiii] **1974 - Energy Supply and Environmental Coordination Act of 1974, P.L. 93-319, 88 Stat. 246:** An Act to provide for means of dealing with energy shortages by requiring reports with respect to energy resources, by providing for temporary suspension of certain air pollution requirements, by providing for coal conversion, and for other purposes.	**1999 - Canadian Environmental Protection Act:** Formally known as *An Act respecting pollution prevention and the protection of the environment and human health in order to contribute to sustainable development,* The Canadian Environmental Protection Act, 1999 (CEPA 1999) is the cornerstone of Canada's environmental legislation and an important part of Canada's broader legislative framework aimed at preventing pollution and protecting the environment and human health. The link includes information about CEPA 1999, including summaries of the Act and links to other pieces of legislation that contribute to environmental protection in Canada. includes regulations for vehicle, engine and equipment standards especially (SOR/2003-2; SOR/90-247) found under division five and fuel regulations (division 4). Up until passage of the CEPA in 1999, Ottawa mainly played a coordinating role through the Canadian Council of Ministers of the Environment (CCME). The **2005** amendments added six GHGs to the 'List of Toxic Substances' in Schedule 1 of the Act.[xciv] **2000 - Government of Canada Action Plan on Climate Change[xcv]:** initial plan (one of three) to meet Canada's Kyoto commitment. **2002 - Climate Change Plan for Canada:** Second of three plans issued to meet Canada's Kyoto commitment. The Climate Change Plan for Canada was more elaborate than the first, but still privileged voluntary measures such as the negotiation of voluntary agreements with major emitters [xcvi]

	1977 - Amendments to the Clean Air Act of 1970: Authorized provisions related to the Prevention of Significant Deterioration; Authorized provisions relating to areas which are non-attainment with respect to the National Ambient Air Quality Standards.[xxiv] **1978 – Energy Tax Act of 1978:** Established a series of tax credits to promote renewable energy installation (including a credit of 30% of the costs of solar, wind and geothermal).[xxv] **1978 - National Climate Act:** Establishes a National Climate Program to enable the United States and other nations to understand and respond to natural and man-induced climate processes and their implications. Directs the President to: (1) establish the National Climate Program; (2) promulgate preliminary and final five-year plans each of which shall establish Program goals and priorities; (3) define the roles in the Program of the various departments, agencies, and offices; and (4) provide for Program coordination. Requires the Secretary of Commerce to establish a National Climate Program Office not later than 30 days after the enactment of this Act. Requires the Program to include: (1) procedures for assessing the effect of climate on agriculture, energy supply and demand, land and water resources, transportation, human health, and national security; (2) basic and applied research to improve understanding of climate processes; (3) methods of improving climate forecasts; (4) global data collection and climate monitoring and analysis activities to provide reliable, useful, and available information on a continuing basis; (5) systems for the management and active dissemination of climatological data and information; (6) measures for	**2004 - Greenhouse Gas Emissions Reporting Program (GHGRP), O.N. Reg. 452/09:** which applies to large industrial GHG emitters in Canada. All facilities that emit the equivalent of 50,000 tonnes or more of CO2e per year are required to submit a report to Environment Canada. Facilities with emissions below the reporting threshold of 50,000 tonnes per year can voluntarily report their GHG emissions.[xcvii] **2005 - Project Green - Moving Forward on Climate change: A Plan for Honouring Our Kyoto Commitment:** Third of three plans set out in order to meet Canada's Kyoto commitment. As with the plans that preceded it, the 2005 plan primarily focused on offering information and subsidies to encourage voluntary emission reductions. The 2005 plan provided for the creation of a nationwide cap-and- trade program with an intensity-based emissions- reduction target for major emitters.[xcviii] **2005 - Canada Emission Reduction Incentives Agency Act, SC 2005, c 30, s 87:** This Act establishes the Canada Emission Reduction Incentives Agency. Preamble: "Recognizing that the reduction or removal of greenhouse gases is necessary to fight climate change and can also result in cleaner air, achieve other environmental objectives and advance the competitiveness and efficiency of Canadian industry;"[xcix] **2005 - Greenhouse Gas Technology Investment Fund Act (S.C. 2005, c. 30, s. 96):** An Act to establish the Greenhouse Gas Technology Investment Fund for the reduction of greenhouse

	increasing international cooperation in climate research, monitoring, analysis, and data dissemination; (7) mechanisms for intergovernmental climate-related research and services, including participating by universities and the private sector; (8) experimental climate forecast centers; and (9) biennial revisions for the final five-year plan.[xxvi] **<u>1978</u> – Public Utilities Regulatory Policies Act:** Sought to promote domestic use of renewable energy technologies by ending promotional rate structures by utilities and encouraging co-generation.[xxvii] **<u>1980</u> – The Energy Security Act:** was signed into law by U.S. President Jimmy Carter on June 30, 1980. It consisted of six major acts: U.S. Synthetic Fuels Corporation Act; Biomass Energy and Alcohol Fuels Act; Renewable Energy Resources Act; Solar Energy and Energy Conservation Act; Solar Energy and Energy Conservation Bank Act; Geothermal Energy Act; Ocean Thermal Energy Conversion Act (Energy Security Act, Pub. L. No. 96-294, S. 932, 96th Cong. (1980). **Renewable Energy Resources Act:** Established incentives to promote the use of renewable energy technologies; improve and coordinate information to the public about renewable energy technologies; mandate use of certain conservation measures by the Federal government; procurement and development of RE projects.[xxviii] **<u>1990</u> - Amendments to the Clean Air Act of 1970:** Authorized programs for Acid Deposition Control; Authorized a program to control 189 toxic pollutants, including those previously regulated by the National Emission Standards for Hazardous Air Pollutants;	gas emissions and the removal of greenhouse gases from the atmosphere.[c] **<u>2007</u> (<u>repealed 2012</u>)- Kyoto Protocol Implementation Act** **S.C. 2007, c. 30 [Repealed, 2012, c. 19, s. 699]. Act to ensure Canada meets its global climate change obligations under the Kyoto Protocol[ci]** **<u>2007</u> - Turning the Corner: An Action Plan to Reduce Greenhouse Gases and Air Pollution:** The plan only proposed to set intensity- based reduction targets for major emitters and indicated that Canada's overall target would be a 20 percent reduction from 2006 levels by 2020. Reductions form emissions to come from implemented regulations on large final emitters, including: fossil-fuel electricity generation, oil and gas, forest products, smelting and refining, iron and steel, iron ore pelletizing, potash, lime and chemical production, and cement. Plan based on emission intensity targets and applies on a differential basis to existing and new facilities. Also included longer term target for GHG reductions between 60-70% below 2006 levels by 2050.In practice the framework suffered from implementation shortcomings.[cii] **<u>2008</u> - Federal Sustainable Development Act -** Under the Federal Sustainable Development Act (FSDA), the Minister of the Environment is responsible for developing the Federal Sustainable Development Strategy, setting out goals and targets for all federal departments. The first federal strategy was adopted in 2010, and the Minister of

	Established permit program requirements; Expanded and modified provisions concerning the attainment of National Ambient Air Quality Standards; Expanded and modified enforcement authority; Established a program to phase out the use of chemicals that deplete the ozone layer. The CAA Amendments relied largely on elements of the CCAA, and required a number of new programs aimed at curbing urban ozone, rural acid rain, stratospheric ozone, toxic air pollutant emissions and vehicle emissions, and establishes a new, uniform national permit system. Related to transportation - Those urban areas that were classified as "Non-attainment areas" had to undertake a series of transportation actions that accumulated with the degree of severity. Includes emissions inventories, revised state implementation plans (some with VMT forecasting), adoption of I&M programs, clean fuel programs, employer trip reduction programs, and measures for heavy duty vehicles during peak hours. The "conformity" provisions in the 1990 Act were expanded from the Clean Air Act Amendments of 1977. A conformity determination was required to assure that federally approved or financially assisted projects or actions conform to a SIP. The 1990 provisions shifted the emphasis from conforming to a SIP to conforming to a SIP's purpose of eliminating and reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of the standards. In addition, no activity could cause or contribute to new NAAQS violations, nor increase the frequency or severity of any existing violations of any standard, nor delay the timely attainment of any required NAAQS. Under the 1990 provisions, there	Environment must provide progress reports every three years.[ciii] **2010 – Climate Change Action Plan 2010:** **2012 - Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations (SOR/2012-167):** These Regulations establish a regime for the reduction of carbon dioxide (CO2) emissions that result from the production of electricity by means of thermal energy using coal as a fuel, whether in conjunction with other fuels or not. A responsible person for a new unit or an old unit must not, on average, emit with an intensity of more than 420 tonnes CO2 emissions from the combustion of fossil fuels in the unit for each GWh of electricity produced by the unit during a calendar year.[civ] **2015 - UNFCCC Intended nationally determined contribution:** To contribute to the achievement of the Paris Agreement, Canada is committed to reduce greenhouse gas emissions by 30 percent below 2005 levels by 2030. In addition to addressing gases covered under the UNFCCC, Canada is taking action to reduce black carbon – a short-lived climate pollutant of particular significance in the Arctic due to its contribution to Arctic warming.[cv] **2016 - North American Climate, Clean Energy, and Environment Partnership:** On June 29, 2016, Prime Minister Justin Trudeau, US President Barack Obama, and Mexican President Enrique Peña Nieto announced the North American Climate, Clean Energy, and Environment Partnership, which is supported by an action plan

	were two mandatory sanctions. They were withholding approval of federal-aid highway projects, and a two-for-one emissions offset for new or modified stationary sources. Areas had 18 months to correct the deficiency before the sanctions took effect. Previously, sanctions could only be applied to the non-attainment area. The 1990 provisions expanded the application of sanctions to any portion of the state that EPA determined reasonable and appropriate. The 1990 Act also expanded the list of projects that were exempt from the sanctions. These project types included: safety demonstrations, transit capital, HOV lanes and other HOV incentives, traffic flow improvements which would reduce emissions, fringe parking, single occupant vehicle disincentives including pricing, and incident management. [xxix] **1993 - The Global Climate Action Plan:** contained nearly 50 initiatives designed to return US greenhouse emissions to their 1990 levels by the year 2000 (Clinton and Gore 1993).[xxx] **1997 - Kyoto Protocol** **2004 – Regulations under the Clean Air Act:** The EPA issued five Clean Air Rules to further improve air quality. Three of the rules specifically addressed the transport of pollution across state borders (the Clean Air Interstate Rule, Clean Air Mercury Rule and Clean Air Nonroad Diesel Rule). In April 2004, EPA announced nonattainment designations under the Clean Air Ozone Rules for those areas that exceeded the health-based standards for 8-h ozone. EPA designated 474 counties in 31 states as nonattainment under the 8-h ozone standard. State, tribal, and local governments had to prepare a plan which described their efforts to	that details the activities to be pursued by the three countries in order to achieve a "competitive, low-carbon and sustainable North American economy". The plan, which builds on the Memorandum of Understanding on Climate Change and Energy Collaboration signed by the energy ministers from Canada, the US and Mexico on February 12, 2016, sets out a range of initiatives including a target to achieve 50% clean power generation by 2025 through clean energy development and deployment, clean energy innovation and energy efficiency.[cvi] **2016 - Joint Statement on Climate, Energy, and Arctic Leadership:** was issued which sets out specific commitments on energy development, environmental protection, and Arctic leadership. In particular, Canada and the US have made commitments to reduce methane emissions by 40-45% below 2012 levels by 2025 from the oil and gas sector, finalize and implement the second phase of an aligned GHG emission standard for post-2018 model year on-road heavy duty vehicles, phase out fossil fuel subsidies, accelerate clean energy development and foster sustainable energy development.[cvii] **2016 - The Pan-Canadian Framework on Clean Growth and Climate Change:** It is a comprehensive plan to reduce emissions across all sectors of the economy, accelerate clean economic growth, and build resilience to the impacts of climate change. The Government of Canada has outlined a benchmark for pricing carbon pollution that will build on existing provincial systems and

	reduce ground-level ozone. States had until 2007 (3 years from the date of designation) to submit State Implementation Plans (SIPs) to EPA. The SIP must outline the control strategies and technical information to demonstrate how and when the area would achieve attainment of the standard.[xxxi] **2005 - Energy Policy Act of 2005:** The Act was a comprehensive energy plan to encourage conservation and energy efficiency; expand the use of alternative and renewable energy; increase the domestic production of conventional fuels; and invest in modernization of the nation's energy infrastructure. Several of the provisions related to the transportation sector.[xxxii] **2009 - Executive Order 13514: Federal Leadership in Environmental, Energy, and Economic Performance:** The Order aims to make GHG emission management a priority for federal agencies, thus establishing reporting requirements with detailed targets and deadlines. The focus is on transportation, overall energy use and procurement policies. All federal agencies are required to develop, implement and annually update a Strategic Sustainability Performance Plan that prioritises agency actions based on life-cycle return on investment. It also directs agencies to work on climate change adaptation. Supersedes E.O.13423: Strengthening Federal Environmental, Energy, and Transportation Management. The Order requires all Federal agencies to: – Improve electronic product/service efficiency and stewardship as well as to follow pollution prevention and waste reduction requirements	ensure a minimum price of $10 per tonne is in place across Canada by 2018, rising to $50 per tonne by 2022. Provinces and territories will continue to have the flexibility to implement either an explicit price on carbon or cap-and-trade systems and will retain all revenue generated by carbon pricing. Actions in the transportation sector include continuing to set increasingly stringent standards for light- and heavy-duty vehicles, as well as taking action to improve efficiency and support fuel switching in the rail, aviation, marine, and off-road sectors; developing a zero-emissions vehicle strategy by 2018 and investing in infrastructure to support zero-emissions vehicles; and investing in public transit and other infrastructure to support shifts from higher- to lower-emitting modes of transportation. **2017 - Bill C-44, Budget 2017, Accelerating the Replacement of Coal-Generated Electricity:** The Government has set an ambitious goal of attaining 90 per cent of electricity generation from non-emitting sources by 2030. To help meet this goal, Budget 2017 proposes to provide $11.4 million over four years, starting in 2018–19, to Environment and Climate Change Canada to support the accelerated replacement of coal-fired electricity generation by 2030 and set leading performance standards for natural-gas-fired electricity generation.[cviii] **2017 - Bill C-44, Budget 2017, A More Energy Efficient Transportation Sector:** Budget 2017 proposes to develop greenhouse gas regulations in

	– Improve fleet and transportation management – Enhance efforts towards sustainable buildings and communities. **2014 - Joint Announcement on Climate Change:** The world's two biggest emitters – China and the United States (US) – have made significant commitments in recent years to reducing their GHG emissions. In November 2014, the two countries issued a Joint Announcement on Climate Change, pursuant to which the US set an economy-wide emissions reduction target of 26%-28% below 2005 levels in 2025 and committed to make best efforts to reduce its emissions by 28%, while China will achieve peak emissions around 2030 and will make best efforts to peak early. In addition, China plans to launch its national cap-and-trade program in July 2017 (covering 4 billion tonnes of CO2e from major industrial sectors) and has committed US $3.1 billion to help developing countries adapt to climate change.[xxxiii] **2015 - UNFCCC Intended nationally determined contribution:** The United States intends to achieve an economy-wide target of reducing its greenhouse gas emissions by 26%-28% below its 2005 level in 2025 and to make best efforts to reduce its emissions by 28%.[xxxiv] **2015 - The Clean Power Plan:** developed under the Clean Air Act, sets state targets for carbon emissions reductions, and offers a flexible framework under which states may meet those targets. The aim is to reduce national electricity sector emissions by an estimated 32 % below 2005 levels by 2030 (nearly 870 million tons), in particular in two subcategories of fossil fuel-fired electric generating units: fossil fuel-	the marine, rail, aviation and vehicle sectors. These efforts will be led by Transport Canada, with a proposed investment of $56.9 million over four years, starting in 2018–19. Budget 2017 also proposes to provide $17.2 million over five years, starting in 2017–18, to Environment and Climate Change Canada and Transport Canada to develop and implement heavy-duty vehicle retrofit and off-road regulations, as well as a clean fuel standard to reduce emissions from fuels used in transportation, building and industrial sectors. **2018 – Bill C-74, Federal Greenhouse Gas Pricing Act, S.C. 2018, c. 12:** requires a price of $10/tonne in 2018 to increase to $50/tonne in 2022 on carbon pollution with revenues to be returned to the province where the price is imposed. This price is not imposed if a province has an existing equivalent pricing scheme. **PROVINCE:** **1958 - Air Pollution Control Act:** AIR pollution as defined in The Air Pollution Control Act, 1958, means "the presence in the outdoor atmosphere of any air contaminant in quantities that may cause discomfort to or endanger the health or safety of persons, or that may cause injury or damage to property or to plant or animal Life. The Province passed an Air Pollution Control Act in 1958 which delegated control of all types of air pollution to the municipalities. This was amended in 1963 with the Province assuming control of industrial sources of air pollution and the municipalities retaining control of combustion sources. The right to control the products of combustion remaining with the

	fired electric steam generating units (mostly coal- and oil-fired power plants), and natural gas-fired combined cycle generating units.Targets differ across states because of each state's unique mix of electricity-generation resources, as well as technological feasibilities, costs, and emissions reduction potentials. States are free to combine any of the options in a flexible manner to meet their targets or join together in multi-state or regional compacts to reduce their carbon emissions through the lowest cost options, including through emissions trading programs. States must submit a final plan, or an initial plan with a request for an extension (potentially until September 2018), by September 6, 2016. Compliance period starts in 2022. The Clean Power Plan also provides incentives for early deployment of renewables and efficiency measures benefiting low-income communities, as well as tools to assist states in implementing market-based approaches. **2016 - North American Climate, Clean Energy, and Environment Partnership:** On June 29, 2016, Prime Minister Justin Trudeau, US President Barack Obama, and Mexican President Enrique Peña Nieto announced the North American Climate, Clean Energy, and Environment Partnership, which is supported by an action plan that details the activities to be pursued by the three countries in order to achieve a "competitive, low-carbon and sustainable North American economy". The plan, which builds on the Memorandum of Understanding on Climate Change and Energy Collaboration signed by the energy ministers from Canada, the US and Mexico on February 12, 2016, sets out a range of initiatives	municipalities. This amendment provided for the passing of regulations to require approval of plans and specifications prior to construction, and for prohibiting or regulating and controlling the emission of air contaminants.[cix] **1967 - Air Pollution Control Act:** Repealed previous legislation and Provided for provincial control and regulation of air pollution. Predecessor to the Environmental Protection Act. Enforcement of regulations relating to incinerator standards, air contaminants from motor vehicles, and for nonferrous smelters was in effect in 1970 with further provisions planned.[cx] **1972 - Act to Provide for the Reorganization of the Government of Ontario, Statutes of Ontario 1972, Chap. 1:** Established the Ministry of the Environment in Ontario with the merging of the Department of the Environment with the Ontario Water Resources Commission. The Ministry was responsible for ensuring that acceptable standards with respect to the air, water and land quality of the province, were maintained. Activities included: air quality management and auto emission controls; waste management; water management; provision of sewage and water facilities and regulation of septic tanks; meteorology; environmental assessment; and the operation of laboratories for environmental research.[cxi] **1990 - Environmental Protection Act, R.S.O. 1990, c. E-19:** Ontario's principal omnibus environmental statute Governing a wide range of topics including: waste management, spills reporting, ozone-depleting substances and litter.

	including a target to achieve 50% clean power generation by 2025 through clean energy development and deployment, clean energy innovation and energy efficiency.[xxxv] **2016 - Joint Statement on Climate, Energy, and Arctic Leadership:** was issued which sets out specific commitments on energy development, environmental protection, and Arctic leadership. In particular, Canada and the US have made commitments to reduce methane emissions by 40-45% below 2012 levels by 2025 from the oil and gas sector, finalize and implement the second phase of an aligned GHG emission standard for post-2018 model year on-road heavy duty vehicles, phase out fossil fuel subsidies, accelerate clean energy development and foster sustainable energy development.[xxxvi] **STATE:** **1947 - Air Pollution Control Act:** June 10, 1947, California Governor Earl Warren signs into law the Air Pollution Control Act, authorizing the creation of an Air Pollution Control District in every county of the state.[xxxvii] **1967 - the Mulford-Carrell Air Resources Act:** California's comprehensive air pollution control legislation, concentrates all state air resource activities into one state agency, the Air Resources Board (ARB).ss The ARB promulgates the standards and plans required by the Federal Air Quality Act for the federal air quality control regions,s" supports local control agencies, 0 and retains secondary enforcement powers.[xxxviii]	The main focus is prevention of harm to the environment, broadly defined as “the air, land and water, or any combination or part thereof, of the Province of Ontario”.[cxii] **1993 - Environmental Bill of Rights, 1993, S.O. 1993, c. 28:** The Environmental Commissioner is to report annually to the Speaker of the Assembly on the progress of Ontario's greenhouse gas emissions. s.58.2(2) "Each report under subsection (1) shall include a review of any annual report on greenhouse gas reductions or climate change published by the Government of Ontario during the year covered by the report under subsection (1). 2009, c. 12, Sched. F, s. 1"[cxiii] **1995 – Voluntary Challenge and Registry:** Program under the National Action Program on Climate Change that challenged industrial and commercial businesses and various other institutions to voluntarily reduce their GHG emissions. The Government set its goal to reduce emissions from its own operations by 40% below 1990 levels by 2000. By 1997, the VCR had failed to achieve any meaningful emission reductions and the Ontario government stopped making submissions to the program.[cxiv] **1998 - Electricity Act and the OEB Act:** In recognition that replacing the province’s coal-fired power plants would provide the largest potential GHG reductions, and that a fundamental restructuring of the electricity market would help promote a wider range of generation options, these acts were brought into force. Amongst other things, these Acts directed the use of market-based

	<u>1970</u> - California Environmental Quality Act: The California Environmental Quality Act (CEQA) is California's broadest environmental law. CEQA helps to guide the Department during issuance of permits and approval of projects. Courts have interpreted CEQA to afford the fullest protection of the environment within the reasonable scope of the statutes. CEQA applies to all discretionary projects proposed to be conducted or approved by a California public agency, including private projects requiring discretionary government approval.[xxxix] **<u>1974</u> - The Warren-Alquist Act:** created the Energy Resources Conservation and Development Commission (later called the California Energy Commission), with authority to carry out research, forecast energy demand, decide plant siting, regulate appliance energy consumption, set standards for energy use in new buildings, and promote the development of alternative energy technology.[xl] **<u>1988</u> - Assembly Bill 4420 (Sher, Chapter 1506, Statutes of 1988):** The California Energy Commission (CEC) was statutorily directed to prepare and maintain the inventory of greenhouse gas emissions (GHG) and to study the effects of GHGs and the climate change impacts on the state's energy supply and demand, economy, environment, agriculture, and water supplies. The study also required recommendations for avoiding, reducing, and addressing related impacts - and required the CEC to coordinate the study and any research with federal, state, academic, and industry research projects.[xli] **<u>2000</u> - Diesel Risk Reduction Plan:** In 2000, CARB adopted the Diesel Risk Reduction Plan, following an	instruments like emissions trading to achieve reductions at the lowest cost.[cxv] **<u>2003</u> - O. Reg. 397/01: EMISSIONS TRADING:** under Environmental Protection Act, R.S.O. 1990, c. E.19. (Along with the Ontario Emissions Trading Code) Establishes emission trading system for nitrogen oxide and sulphur dioxide from electricity generators. Emissions from generators with more than a 25MW capacity and that generate more than 20,000 MWh of electricity, emitting more than trace NOx or SO2 are capped. Also established a limited offset market allowing non-capped entities to apply for emission reduction credits in connection with renewable energy or conservation projects that reduce NOx or SO2 emissions in Ontario or certain Northeastern or Midwestern U.S. states.[cxvi] **<u>2004</u> - Memorandum of Understanding for Cooperation on Addressing Climate Change:** Agreement between Ontario and the federal government to explore cooperation on a host of relevant issues, including electricity supply and renewables; energy efficiency, conservation and fuels; and innovation and technology. Particular focus on reducing emissions from Ontario's steel industry.[cxvii] **<u>2005</u> - O. Reg. 419/05: AIR POLLUTION - LOCAL AIR QUALITY:** Primary legislation (under EPA R.S.O. 1990) under which the Provincial Ministry of the Environment and Climate Change regulates air contaminants, including GHG emissions. Requires certain facilities to model the dispersion of their emissions

	extensive 10-year scientific assessment process that identified particulate matter from diesel-fueled engines as a toxic air contaminant (TAC). The Diesel Risk Reduction Plan recommended many control measures to reduce the risks associated with diesel particulate matter in order to achieve a goal of 85 percent PM reduction by 2020.[xlii] **2000 - Senate Bill 1771 (Sher, Chapter 1018, Statutes of 2000):** SB 1771 establishes the creation of the non-profit organization, the California Climate Action Registry and specifies functions and responsibilities to develop a process to identify and qualify third-party organizations approved to provide technical assistance and advice in monitoring greenhouse gas emissions, and setting greenhouse gas (GHG) emissions baselines in coordination with CEC. Also, the bill directs the Registry to enable participating entities to voluntarily record their annual GHG emissions inventories. Also, SB 1771 directs CEC to update the state's greenhouse gas inventory from an existing 1998 report and continuing to update it every five years.[xliii] **2001 - Senate Bill 527 (Sher, Chapter 769, Statutes of 2001):** This bill revises the functions and duties of the California Climate Action Registry and requires the Registry, in coordination with CEC to adopt third-party verification metrics, developing GHG emissions protocols and qualifying third-party organizations to provide technical assistance and certification of emissions baselines and inventories. SB 527 amended SB 1771 to emphasize third-party verification.[xliv] **2002 - Senate Bill 1078 (Sher, Chapter 516, Statutes of 2002):** This bill establishes the California	and limits the concentration of these emissions at various points of impingement (usually where emissions cross the facility property boundary). Currently, CO2 is not regulated but other GHGs are, like methane compounds.[cxviii] **2005 - O. Reg. 194/05: INDUSTRY EMISSIONS - NITROGEN OXIDES AND SULPHUR DIOXIDE:** Establishes a cap-and-trade systems for industrial emissions of nitrogen oxides and sulphur dioxide. Covers seven large industrial sectors)base metal smelting, carbon black, cement, flat glass, iron and steel, petroleum and pulp and paper).[cxix] **2007 - Bill 200, Ontario Climate Change Act:** The Bill enacts the Ontario Climate Change Act, 2006, the purposes of which are to ensure that greenhouse gas emissions are reduced in Ontario in proportion to Canada's emissions reduction obligations under the Kyoto Protocol and that Ontario contributes to the stabilization of greenhouse gas concentrations in the atmosphere. Section 3 of the Act requires the Executive Council to ensure that greenhouse gas emissions are reduced to no less than 6 per cent below their 1990 level by 2012 and to no less than 25 per cent below their 1990 level by 2020. If emissions are not reduced to the required level by 2012, the Executive Council is required to ensure that emissions are further reduced by 2016 in an amount that is proportionately equal to further reduction requirements that would be imposed on Canada for failing to meet its 2012 emissions reduction obligations under the Kyoto Protocol. The Minister of the Environment is required to prepare a plan for

	Renewables Portfolio Standard Program, which requires electric utilities and other entities under the jurisdiction of the California Public Utilities Commission to meet 20% of their renewable power by December 31, 2017 for the purposes of increasing the diversity, reliability, public health and environmental benefits of the energy mix.[xlv] **2004 - Secretary of Cal/EPA to Coordinate Climate Change Activities:** Under SB 1107 (Chapter 230, Statutes of 2004), the Secretary of Cal/EPA was given the responsibility to coordinate climate change activities in state government. The Secretary convened a climate change working group comprised of agency and department heads to address greenhouse gas reduction strategies.[xlvi] **2005 - EO 3-05 -:** Reduce emissions 80% below 1990 levels by 2050. EO-S-3-05 establishes greenhouse gas emission reduction targets, creates the Climate Action Team and directs the Secretary of Cal/EPA to coordinate efforts with meeting the targets with the heads of other state agencies. The EO requires the Secretary to report back to the Governor and Legislature biannually on progress toward meeting the GHG targets, GHG impacts to California, Mitigation and Adaptation Plans. AB 32 codified the 1990 GHG reduction emission targets as express limits to be met by 2020 under Health and Safety Code section 38550. AB 32 further authorized the use of emission reductions measures, including a market-based declining annual aggregate emission limits for sources or categories of sources that emit greenhouse gas emission (i.e., cap-and-trade) from January 1, 2012, to	the reduction of greenhouse gas emissions in Ontario and the plan must, among other things, include a strategy for the reduction of such gas emissions for the periods 2008 to 2012, 2013 to 2016 and 2017 to 2020 and set a greenhouse gas emissions target for every year from 2008 to 2020. The Minister is also required to prepare a yearly report that sets out measures taken in that year by the Executive Council to meet its obligations to reduce greenhouse gas emissions in Ontario and proposed measures to be undertaken in the following year. The Environmental Commissioner must review the Minister's yearly report and prepare and publish a response in which the Commissioner gives his or her opinion as to whether the measures described in the report are sufficient to ensure that greenhouse gas emissions are reduced to the levels required under section 3. The Lieutenant Governor in Council is empowered to make regulations that relate broadly to the reduction of greenhouse gas emissions, including regulations that limit the amount of greenhouse gases that may be released into the environment and that require permits or approvals for the release of any greenhouse gas.[cxx] **2007 - Go Green: Ontario's Action Plan On Climate Change:** sets ambitious targets for GHG emission reductions for all sectors, including industrial, commercial, residential, transportation and power generation: By 2014: a reduction of Ontario's GHG emissions to six per cent below 1990 levels (reduction of 11 megatonnes (Mt) of carbon dioxide equivalents (CO2e) relative to 1990

	December 31, 2020 under Health and Safety Code section 38562.[xlvii] **2006 - AB 32 - The Global Warming Solutions Act:** Reduce GHG emissions to 1990 levels by 2020. Gives legal authority for CARB to set policy to meet target including Cap and Trade - formally launched 2013 transportation fuels to be covered by 2015..[xlviii] **2006 - Senate Bill 107 (Simitian, Chapter 464, Statutes of 2006):** SB 107 directs California Public Utilities Commission's Renewable Energy Resources Program to increase the amount of renewable electricity (Renewable Portfolio Standard) generated per year, from 17% to an amount that equals at least 20% of the total electricity sold to retail customers in California per year by December 31, 2010.[xlix] **2006 - Senate Bill 1 (Murray, Chapter 132, Statutes of 2006):** California's Million Solar Roofs plan is enhanced by PUC and CEC's adoption of the California Solar Initiative. SB1 directs PUC and CEC to expand this program to more customers, and requiring the state's municipal utilities to create their own solar rebate programs. This bill would require beginning January 1, 2011, a seller of new homes to offer the option of a solar energy system to all customers negotiating to purchase a new home constructed on land meeting certain criteria and to disclose certain information.[l] **2007 - Creation of Western Climate Initiative:** **"**Through a Memorandum of Understanding five founding partner jurisdictions created the Western Climate Initiative (WCI) to collaborate on programs and policies to mitigate greenhouse gas emissions. The WCI is a collaboration of independent jurisdictions	levels);By 2020: a reduction of Ontario's GHG emissions to 15 per cent below 1990 levels (reduction of 27 Mt of CO2e relative to 1990 levels); and By 2050: a reduction of Ontario's GHG emissions to 80 per cent below 1990 levels. By 2020 13% reduction goal for passenger transportation. 13% reduction expected by 2020 from passenger vehicle sector.[cxxi] **2007 - Cessation of Coal Use Regulation:** sets end date for coal use for Dec. 31, 2014.[cxxii] **2009 - Green Energy and Economy Act, 2009, S.O. 2009, c. 12:** enacted to bring more solar, wind, hydro-electric and biomass to the province, promote conservation and create clean energy jobs. Ontario becomes the leading province in wind and solar capacity as a result.The Energy Conservation and Demand Management Plans regulation under the Act has also established a requirement that public sector agencies routinely develop and update five-year plans for energy conservation. legislation facilitated the replacement of coal-fired generation in the province with renewable electricity generation by introducing a FIT program, and a procedure whereby renewable energy projects would only need one primary environmental approval, known as the Renewable Energy Approval, in place of various other provincial permit and municipal by-law requirements. The Act created a series of financial incentives for the development of renewable energy such as wind, solar and biomass, including the creation of a feed-in tariff program. The Energy Conservation and Demand Management Plans regulation under the

	who commit to work together to identify, evaluate, and implement policies to tackle climate change at a regional level."[li] **2007 - Senate Bill 97 (Dutton, Chapter 187, Statutes of 2007):** Directs Governor's Office of Planning and Research to develop CEQA guidelines "for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions."[lii] **2008 - SB-732 Environment:** establishes the Strategic Growth Council. The Council is a cabinet level committee that is tasked with coordinating the activities of state agencies to: Improve air and water quality; Protect natural resources and agriculture lands; Increase the availability of affordable housing; Promote public health and equity; Improve transportation; Encourage greater infill and compact development; Strengthen the economy; Promote water conservation; Revitalize community and urban centers; Assist state and local entities in the planning of sustainable communities and meeting AB 32 goals; Advance the priorities developed in Safeguarding California, the State's climate adaptation strategy; administer the Transformative Climate Communities Program.[liii] **2010 - AB-2514 Energy storage systems:** created the first storage procurement requirement in the world. The requirement is modest, requiring 1300 megawatts by 2020 in a system with a peak of about 65,000 MW. Nonetheless, it has started yet another revolution, with dozens of companies and individuals with different storage solutions (from batteries to forced air to pumped water and beyond) vying in California for initial contracts.[liv]	Act has also established a requirement that public sector agencies routinely develop and update five-year plans for energy conservation.[cxxiii] **2009 - Bill 185, Environmental Protection Amendment Act (Greenhouse Gas Emissions Trading):** The Bill re-enacts section 176.1 of the Environmental Protection Act, which authorizes the making of regulations relating to emissions trading and other economic and financial instruments and market-based approaches. Amends EPA to more clearly define existing authority to make market-based regulations, explicitly authorizing regulations governing how environmental credits are created, allocated, traded and retired; how credits created in other jurisdictions could be traded into and used in Ontario; how emissions are attributed to a regulated entity; and how such entities must monitor and report their emissions.[cxxiv] **2009 - Greenhouse Gas Emissions Reporting, O Reg 452/09:** This regulation applies to a person that generates greenhouse gases from designated sources (s.2(1)). If a facility generates 25,000 or more tonnes of CO2e from all sources in the reporting period, the person must submit an emissions report for the reporting period. Contents of emissions report: S.6 "An emissions report mentioned in clause 5 (1) (a) shall set out the following information in writing: (...) 12. The quantity of each greenhouse gas set out in Table 1 that was generated from each of the sources mentioned in subsection 2 (1) at the facility. (...) 15. The amount of each greenhouse

	2011- SBX1-2: requires California Public Utilities Commission to increase share of renewable energy as apart of total electricity sold to retail customers - 20% by Dec. 31, 2013 - 25% by Dec. 31, 2016 - 33% by Dec. 31, 2020. Applies to all electricity retailers in the state.[lv] **2012 - Senate Bill 1018 (Budget and Fiscal Review Committee, Chapter 39, Statutes of 2012):** established the Greenhouse Gas Reduction Fund as the account to receive auction proceeds and established accountability requirements to help ensure that all GGRF expenditures achieve GHG reductions and further the purposes of AB 32. SB 1018 requires State agencies that have been appropriated monies from the GGRF to prepare an expenditure record. An expenditure record is a document that provides five pieces of information documenting use of the monies. The agency preparing the expenditure record must describe: The proposed use of GGRF monies; How a proposed expenditure will further the regulatory purposes of AB 32; How a proposed expenditure will contribute to achieving and maintaining GHG emission reductions; How the State agency considered the applicability and feasibility of other non-GHG reduction objectives; and How the State agency will document the result achieved from the expenditure.[lvi] **2012 - Assembly Bill 1532 (Pérez, Chapter 807, Statutes of 2012):** establishes procedures for deposit and expenditure of regulatory fee revenues derived from the auction of greenhouse gas allowances pursuant to the cap and trade program adopted by the Air Resources Board pursuant to AB32. 3 year investment plans required by Dept. of Finance in	gas quantified for each source identified under subsection 4 (3), reported in tonnes.[cxxv] **2010 - Bill 6, Climate Change Awareness Act:** The Bill names April 21 in each year Climate Change Awareness Day. The Bill also requires the preparation of a report card on the effects of climate change to be distributed to students in grades 5 through 12 in Ontario schools and private schools to facilitate educational activities on or around Climate Change Awareness Day.[cxxvi] **2010/2013/2017(expected update) - Ontario's Long-Term Energy Plan:** The LTEP is a road map setting out the direction for Ontario's energy future for the next 20 years. The Climate Change Action Plan will play a key role in the development of the 2017 LTEP, as it intends to share many of the same goals. The proceeds from the cap and trade auctions will be used to fund programs that reduce energy use and greenhouse gas (GHG) emissions. In light of the province's emission reduction goals, the 2017 LTEP should take a broader view of the province's energy needs and consider how the uses of electricity and fossil fuels influence each other. For example, because Ontario's electricity supply is largely emissions free, commitments in the Climate Change Action Plan foresee a switch from conventional fossil fuels to the use of electricity for heating and cooling buildings and powering transportation. In addition, electric vehicles are becoming a more prominent focus of this discussion.[cxxvii] **2014-16 - Large Renewable Procurement Program:** Ontario cancelled the large FIT

	consultation with state entities. Plans, amongst other things, IDs priority investments that are feasible and cost effective re: reducing emissions. Proceeds from the Cap-and-Trade Program facilitate comprehensive and coordinated investments throughout California that further the State's climate goals. The State's portion of the Cap-and-Trade auction proceeds are deposited in the Greenhouse Gas Reduction Fund (GGRF), and used to further the objectives of the California Global Warming Solutions Act of 2006 (Assembly Bill 32 (AB 32); Núñez, Chapter 488, Statutes of 2006). To date, more than $8 billion dollars have been appropriated by the Legislature to State agencies implementing GHG emission reduction programs and projects.[lvii] **2012 - (SB) 535 (De León, Chapter 830, Statutes of 2012)** directs State and local agencies to make investments that benefit California's disadvantaged communities. Requires the California Environmental Protection Agency to identify disadvantaged communities; requires that 25% of all funds allocated pursuant to an investment plan for the use of moneys collected through a cap-and-trade program be allocated to projects that benefit disadvantaged communities and 10 those 25% be use within disadvantaged communities; and requires the Department of Finance to include a description of how these requirements are fulfilled in an annual report.[lviii] **2014 - SB 605 (Lara) Short-Lived Climate Pollutants Chapter 523:** Requires ARB to complete a comprehensive strategy to reduce emissions of short-lived climate pollutants by January 1, 2016. In the process of developing the strategy, the bill requires	(generating capacity over 500 kilowatts ("kW")) part of the program in June 2013, and replaced it with the Large Renewable Procurement ("LRP") program in 2014. The LRP program was a competitive process for procuring renewable electricity projects larger than 500 kilowatts, and was designed to proceed in multiple phases. Phase one concluded in April 2016 with the execution of approximately 454-MW of renewable power contracts. Ontario announced that it was proceeding with phase two of LRP ("LRP II") in the summer of 2016. However, on September 27, 2016 the Minister of Energy issued an unexpected Directive suspending all further procurement of renewable generation under LRP and putting an end to the LRP II request for qualifications process.[cxxviii] **2015 - Bill 9 - Ending Coal for Cleaner Air Act:** stipulates that coal cannot be used in future to generate electricity in Ontario.[cxxix] **2015 - Under 2 MOU** **2015 - Canadian Energy Strategy:** As agreed under the Vancouver Declaration and building on the Quebec Summit on Climate Change in 2015, federal, provincial, and territorial energy ministers are collaborating on specific actions through the Canadian Energy Strategy, to contribute to the Pan-Canadian Framework on Clean Growth and Climate Change. Actions include energy conservation and efficiency, clean energy technology and innovation, and deployment of energy to people and global markets.[cxxx]

	ARB to: (1) complete an inventory of sources and emissions of short-live climate pollutants, (2) identify research needed, (3) identify existing and potential new control measures, (4) prioritize new measures that offer cobenefits to community health and disadvantaged communities, and (5) coordinate with other State agencies to develop measures to reduce emissions of short-lived climate pollutants.[lix] **2014 - Senate Bill 862 (Senate Budget and Fiscal Review Committee, Chapter 36, Statutes of 2014):** SB 862 establishes requirements for agencies receiving GGRF monies and provides continuous appropriations of future GGRF monies for transportation, transit, land use, housing, and agricultural land preservation programs. In addition to specific agency and program requirements, SB 862 requires that ARB develop over-arching guidance on investments for disadvantaged communities, SB 1018 expenditure record preparation, reporting, tracking, and quantification approaches, and other guidance to be used by all agencies that receive appropriations from the fund.[lx] **2014 - SB 605 (Lara, Chapter 523, Statutes of 2014),** While California must continue to steadily reduce CO2 emissions for long-term climate stability, we also need a global commitment and near-term actions to dramatically reduce short-lived climate pollutant emissions over the next 10 to 15 years. SB 605 directs the ARB to develop a comprehensive short-lived climate pollutant strategy by January 1, 2016. The strategy proposes targets to reduce emissions of methane and HFCs by 40 percent below 2013 levels by 2030, and anthropogenic (i.e., non-forest) black carbon	**2015 - Ontario's Climate Change Strategy:** Ontario's Climate Change Strategy was released in November 2015, setting the government's vision to 2050 for how it would grow a prosperous, low-carbon and resilient society and economy (Government of Ontario 2017f). The Strategy justified the case for climate action and proposed actions that were wide in scope, with carbon pricing making up the cornerstone of the plan (Government of Ontario 2016). Five areas were highlighted as key pillars of the Strategy: A prosperous low-carbon economy with world-leading innovation, science and technology; government collaboration and leadership; reducing GHG emissions across key sectors; a resource-efficient, high productivity society; adaptation and risk awareness (Government of Ontario 2016). High level measures were outlined under each key area of transformation[cxxxi]. **2016 - Bill 172 - Climate Change Mitigation and Low Carbon Economy Act, 2016, S.O. 2016, c. 7:** Establishes in law Ontario's greenhouse gas reduction targets of 15% below 1990 levels by 2020, 37% below 1990 levels by 2030 and 80% below 1990 levels by 2050 and provides a framework for reviewing and increasing the stringency of targets, and establishing interim targets. Laid foundation for Cap-and-Trade program to begin in 2017. Provides the legal foundation for the cap and trade program that will help reduce greenhouse gas emissions across the economy directs all cap and trade auction proceeds to a new Greenhouse Gas Reduction Account to

	emissions by 50 percent below 2013 levels by 2030. [lxi] **2014 - Senate Bill 852 (Leno, Chapter 25, Statutes of 2014):** SB 852, the Budget Act of 2014, provided funding appropriations from the GGRF to multiple agencies for projects that reduce GHG emissions and provide investments in and for the benefit of disadvantaged communities.[lxii] **2015 - EO B-30-15:** Reduce GHGs by 40% below 1990 levels by 2030. Directs state agencies to implement GHG reduction programs to meet this interim goal and incorporate climate change into all planning and investment, including to account for current and future climate change impacts in all infrastructure projects included in State's 5 year Infrastructure Plan.[lxiii] Governor Brown further identified key climate change strategy pillars for California in his January 2015 inaugural address to help achieve the 2030 target and establish a model for other states and nations to follow. These strategy pillars include: • up to a 50 percent reduction in petroleum use; • increasing the amount of electricity derived from renewable sources to 50 percent; • doubling the efficiency savings achieved at existing buildings; • reducing emissions of short-lived climate pollutants; • managing natural and working lands so they can store carbon; and • safeguarding California through climate adaptation strategies.[lxiv]	fund green initiatives that reduce or support reduction of greenhouse gas emissions. Requires a comprehensive climate change action plan , which includes an assessment of potential greenhouse gas emission reductions and cost per tonne of those potential reductions. The Act also allows for linkage between Ontario's cap-and-trade program with programs in other jurisdictions through the **Western Climate Initiative.** To date, Ontario has committed to connecting its cap-and-trade program with Québec and California, which will enable Ontario to partake in shared auction processes and mutual trading opportunities with these associated jurisdictions, thereby significantly expanding the carbon market. The act also includes strong compliance and enforcement provisions for the province's cap and trade program, and would facilitate linking Ontario's program with other jurisdictions, including Quebec and California.[cxxxii] **2016 - O. Reg. 144/16: THE CAP AND TRADE PROGRAM under Climate Change Mitigation and Low-carbon Economy Act, 2016:** establishing the caps for emission allowances over the first compliance period (2017-2020) and the dates for subsequent compliance periods to follow (2021-2023 and each subsequent three-year period). The regulation also sets out the rules relating to registration and participation as a mandatory participant, voluntary participant and market participant. Mandatory participants are facilities that emit over 25,000 tonnes of CO2 in a year; voluntary participants are facilities that emit between 10,000 and 25,000 tonnes of CO2 in a

	<u>2015</u> - SB 350 - Clean Energy and Pollution Reduction Act (Chapter 547): establishes 2030 GHG reduction target of 40% by 1990 levels by setting ambitious targets for renewables and energy efficiency among other actions to meet target. Requires the California Public Utilities Commission to establish Integrated Resource Planning process to ensure all electric utilities are procuring electricity consistent with state goals.[lxv] "SB 350 increases California's renewable electricity procurement goal from 33 percent by 2020 to 50 percent by 2030. This will increase the use of Renewables Portfolio Standard (RPS) eligible resources, including solar, wind, biomass, geothermal, and others. In addition, SB 350 requires the state to double statewide energy efficiency savings in electricity and natural gas end uses by 2030. To help ensure these goals are met and the greenhouse gas emission reductions are realized, large utilities will be required to develop and submit Integrated Resource Plans (IRPs)."[lxvi] **<u>2015 -</u> Under 2 MOU:** "California initiated a first-of-its-kind agreement with international leaders from 11 other states and provinces, to limit the increase in global average temperature to below 2 degrees Celsius. Since May, other governments continue to join the MOU. If the signatories represented a single country, it would be the second largest economy in the world behind only the United States."[lxvii] **<u>2016</u> - SB-32:** Reduce GHGs by 40% below 1990 levels by 2030 - directs all state agencies to implement programs to this end and integrate CC objectives into	year and choose to opt-in to the program; and market participants are those that choose to trade in the market. Additionally, the regulation governs the establishment and administration of cap-and-trade accounts and provides details on the creation/distribution of emission allowances. Cap-and-trade proceeds are expected to be about $478 million in fiscal 2016/17 and $1.9 billion the year after. [cxxxiii] **<u>2016</u> - O. Reg. 143/16 Quantification, Reporting and Verification of Greenhouse Gas Emissions under Climate Change Mitigation and Low-carbon Economy Act, 2016:** setting out the details for quantifying, reporting and verifying GHG emissions. Crucially, the regulation elaborates on the types of activities that trigger quantification, reporting, and verification obligations. Regulated entities captured by the Act include industrial/institutional emitters, natural gas distributors, petroleum product distributors, and electricity importers.[cxxxiv] **<u>2016</u> - Climate Change Action Plan 2016-2020:** The Plan sets out specific commitments to meet the province's near-term 2020 emissions reduction targets. Addressing a broad spectrum of sectors, some of the key components of the Plan include: (i) establishing a "green bank" to assist homeowners and businesses finance energy-efficient technologies; (ii) increasing the availability of zero-emission vehicles and substantially increasing transit; (iii) providing incentives for the installation and retrofit of clean-energy systems; and (iv) implementing new rules and regulations to increase

	planning and investment in addition to account for future CC impacts for all infrastructure projects under the Five-Year Infrastructure Plan.[lxviii] **2016 - AB 32 State Air Resources Board: Greenhouse Gases: Regulations:** Requires the Air Resources Board, when adopting rules and regulations to achieve GHG reductions beyond the statewide emissions limit and to protect the state's most vulnerable and disadvantaged communities, to prioritize rules and regulations that result in direct emission reductions at large stationary sources of GHG emissions sources and from mobile sources. AB 197 is intended to ensure ARB is also responsive to the Legislature. The bill also adds two new legislatively appointed non-voting members to the ARB Board, increasing the Legislature's role in the ARB Board's decisions.[lxix] **2016 - AB 1550 (Gomez) Greenhouse Gases: Investment Plan: Disadvantaged Communities:** Requires the investment plan to allocate a minimum of 25% of the available moneys in the fund to projects located within, and benefitting individuals living in, disadvantaged communities and a separate and a minimum of 20% to projects that benefit low-income households, with a fair share of those moneys targeting households with incomes at or below 200% of the federal poverty level.[lxx] **2016 - AJR 43 (Williams) Climate Change:** Makes findings and declarations regarding the need for national action on climate change and the benefits of a national carbon tax. The resolution urges the United States Congress to adopt a national carbon tax, with	energy efficiency in new buildings. The Plan will provide people and businesses with tools and incentives to accelerate the use of clean technology that exists today. Through this plan, the province will continue to reduce greenhouse gas pollution to fight climate change.For transportation key elements: • Transportation – Increasing the use and availability of lower carbon fuels, providing incentives for electric vehicles (EVs), installing more EV charging stations, investing in GO Regional Express Rail and active transportation infrastructure.[cxxxv] **2017 - Ontario-Quebec Electricity Trade Agreement:** Ontario and Quebec sign electricity trade agreement between Hydro-Québec and the Independent Electricity System Operator (IESO) to import hydroelectric power to replace natural gas use. Under this agreement, the IESO will purchase a total of 14 terawatt hours (TWh) of electricity from Hydro-Québec over a seven-year period from 2017 to 2023. According to the government, the agreement is expected to reduce the cost to electricity consumers by $70 million. However, it will only reduce Ontario emissions by 1 million tonnes annually (less than 1% of Ontario's annual total).[cxxxvi] **2017 - Treasury Board releases its Statement of Environmental Values (SEV):** which includes a commitment to consider climate change mitigation and adaptation as part of the government decision-making process (Environmental Registry # 012-8645). Treasury Board's SEV now states that it will consider climate change in its decision-making

	proceeds being returned to middle-income and low-income Americans.[lxxi] **2016 - SB 1464 (De Leon) California Global Warming Solutions Act of 2006: GHG Emissions Reduction:** Requires that the investment plan assess how proposed investments interact with current state regulations, policies, and programs, and evaluate if and how the proposed investments could be incorporated into existing programs. » Requires the investment plan to recommend metrics that would measure progress and benefits from the proposed programmatic investments.[lxxii] **2016 - SB 1383 (Lara) Short-Lived Climate Pollutants:** Requires ARB to approve and begin implementing its Short-Lived Climate Pollutant Reduction Strategy by January 1, 2018 in order to achieve a 40 percent reduction in methane, 40 percent reduction in hydrofluorocarbon gases, and 50 percent reduction in anthropogenic black carbon by 2030, relative to 2013 levels. In addition, the bill sets targets for reducing organic waste in landfills and reducing methane emissions from dairy and livestock operations, and sets requirements for ARB and relevant State agencies to meet before adopting or implementing measures to achieve those targets.[lxxiii] **2017 - AB-398 California Global Warming Solutions Act of 2006: market-based compliance mechanisms: fire prevention fees: sales and use tax manufacturing exemption:** extends state cap-and-trade program to 2030. Also included in package - AB 617 (addressing local air quality concerns) and ACA1 - puts a measure on the 2018 ballot concerning control over cap-and-trade revenue spending. Requires our	processes. While SEVs do not impose substantive or binding obligations on ministries, it is possible that this change could lead to more targeted and effective spending on climate change initiatives.[cxxxvii] **2018 - Green Energy Repeal Act, 2018, S.O. 2018, c. 16:** Repeals the Green Energy Act (S.O. 2009, c. 12). The Bill also amends various other Acts. Some of those amendments are consequential to the repeal of the *Green Energy Act, 2009*. In addition, the *Environmental Protection Act* is amended to authorize the Lieutenant Governor in Council to make regulations prohibiting the issue or renewal of renewable energy approvals in prescribed circumstances, which may include circumstances in which the demand for the electricity that would be generated as part of engaging in the renewable energy project has not been demonstrated in accordance with the regulations. **2018 - Cap and Trade Cancellation Act, 2018, S.O. 2018, c. 13:** An Act respecting the preparation of a climate change plan, providing for the wind down of the cap and trade program and repealing the Climate Change Mitigation and Low-carbon Economy Act, 2016.

	office to annually report on the economic impacts and benefits of California's statutory GHG emission goals—statewide emissions to 1990 levels by 2020 and to 40 percent below 1990 levels by 2030. **AB 617: Non Vehicular air pollution: criteria air pollutants and toxic air contaminants.** "The policies in AB 398 and AB 617 include a cap on global warming polluters, a substantial cut on offsets, protection of billions of dollars for community and clean energy investments, and enhanced protection for programs that directly reduce air and global warming pollution like the Sustainable Freight Action Plan, Low Carbon Fuel Standard and Clean Cars plan. Without these measures California would be hard-pressed to stay on track to reduce global warming emissions by 2030. Additionally, Californians in the most affected communities can look forward to strongly enhanced monitoring, enforcement, penalties and retrofits of the polluting facilities covered under the cap and trade program."[lxxiv] **<u>2017</u> - AB 151 (BURKE & COOPER) GLOBAL WARMING SOLUTIONS ACT OF 2006: MARKET-BASED COMPLIANCE MECHANISMS:** This bill would require the state board to report to the appropriate policy and fiscal committees of the Legislature to receive input, guidance, and assistance before adopting guidelines and regulations implementing the scoping plan and a regulation ensuring statewide greenhouse gas emissions are reduced to at least 40% below the 1990 level by 2030. This bill would require the state board, no later than January 1, 2019, and in conjunction with	

	specified stakeholders, to report to the Legislature on the need for increased education, career technical education, job training, and workforce development in ensuring that statewide greenhouse gas emissions are reduced to at least 40% below the 1990 level no later than December 31, 2030, and as a result of the scoping plan, as specified. This bill would establish the Compliance Offsets Protocol Task Force for the purpose of investigating, analyzing, and providing guidance to the state board in approving new offset protocols for a market-based compliance mechanism with a priority on the development of new urban offset protocols, as specified. The bill would require the state board, in conjunction with the task force, to develop a multitiered incentive system for compliance offset credits, as specified.[lxxv] **2017 - AB 378 (GARCIA & HOLDEN & GARCIA) GREENHOUSE GASES, CRITERIA AIR POLLUTANTS, AND TOXIC AIR CONTAMINANTS:** This bill would additionally require the state board to consider and account for the social costs of the emissions of greenhouse gases when adopting those rules and regulations. The bill would authorize the state board to adopt or amend regulations that establish a market-based compliance mechanism, applicable from January 1, 2021, to December 31, 2030, to complement direct emissions reduction measures in ensuring that statewide greenhouse gas emissions are reduced. The bill would authorize the state board to adopt no-trade zones or facility-specific declining greenhouse gas emissions limits where facilities' emissions contribute to a cumulative pollution burden that creates a significant health	

	impact. This bill would require the state board, in consultation with affected air pollution control and air quality management districts, to adopt air pollutant emissions standards for emissions of criteria air pollutants and toxic air contaminants at industrial facilities that are subject to a market-based compliance mechanism. The bill would prohibit the state board from allocating allowances as part of a market-based compliance mechanism to industrial facilities that do not meet the air pollutant emissions standards for criteria air pollutants and toxic air contaminants. This bill would require the state board, in ensuring that statewide greenhouse gas emissions are reduced, to adopt the most effective and equitable mix of emissions reduction measures and ensure that emissions reduction measures collectively and individually support achieving air quality and other environmental and public health goals.[lxxvi] **2017 - AJR 20 (Gonzalez Fletcher) Climate Change:** This measure would declare that California will continue to lead in its efforts to reduce emissions of greenhouse gases and fight global climate change and would encourage other state legislatures and cities in the nation to continue to support and follow the United Nations Framework Convention on Climate Change Paris Agreement. This measure would request that the United Nations create a category for the recognition and participation of subnational jurisdictions whose parent countries are not part of or have withdrawn from the Paris Climate Agreement.[lxxvii] **2018 – EO B-55-18:** commits California to full, economy-wide carbon neutrality by 2045.[lxxviii]	

	<u>2018</u> - SB-100 (Chapter 312) California Renewables Portfolio Standard Program: emissions of greenhouse gases: goal of generating 100 percent of the state's electricity from carbon-free sources by 2045. new law significantly accelerates its emissions-reduction timeline by requiring the state to get 50 percent of its electricity from renewable sources by 2025 and 60 percent by 2030 — the latter target being 10 percent higher than California's previous clean energy commitments.[lxxix] **<u>2018</u> - SB 700, Wiener. Self-generation incentive program:** This bill would extend the collection for the self-generation incentive program to December 31, 2024, and the administration of the program to January 1, 2026. The bill would require the commission to adopt requirements for energy storage systems to ensure that eligible energy storage systems reduce the emissions of greenhouse gases. The bill would specify that generation technologies using nonrenewable fuels are not eligible for incentives under the program on and after January 1, 2020.[lxxx] **<u>2018</u> - SB-1013 Fluorinated refrigerants:** SB 1013 helps cement California's leadership in phasing down emissions of HFCs. It supplements existing authority under which the California Air Resources Board has adopted initial rules to stop cut HFC use in applications where safer alternatives are available. The new law also initiates an incentives program to encourage businesses' early adoption of climate-friendly cooling systems, an especially important part of transforming the cooling market away from harmful HFCs. The California Cooling Act adopts into state law a set of HFC use limits originally adopted by the	

	Environmental Protection Agency and coming into effect (depending on the use) between 2016 and 2025.[lxxxi] **<u>2018</u> - SB-1131 Electrical and gas corporations: energy efficiency: financing options: industrial and agricultural processes: custom projects:** streamlines the state's energy efficiency programs for industrial and agricultural customers (who make up a significant amount of state GHGs). Commencing July 1, 2019, this bill would require the PUC to authorize electrical corporations and gas corporations to provide incentives, rebates, technical assistance, and support to their customers to increase energy efficiency, pursuant to separate procedures applicable only to custom projects and other custom programs for industrial, agricultural, commercial, residential, and public sector customers.[lxxxii] **<u>2018</u> - SB 1339, Stern. Electricity: microgrids: tariffs:** This bill would require the PUC, in consultation with the State Energy Resources Conservation and Development Commission and the Independent System Operator, to take specified actions by December 1, 2020, to facilitate the commercialization of microgrids for distribution customers of large electrical corporations. The bill would require the governing board of a local publicly owned electric utility to develop and make available a standardized process for the interconnection of a customer-supported microgrid, including separate electrical rates and tariffs, as necessary.[lxxxiii] **<u>2018</u> - SB-1136 Electricity: load-serving entities: resource adequacy requirements:** Requires the California Public Utilities Commission (CPUC), in	

	establishing resource adequacy (RA) requirements, to additionally advance, to the extent possible, the state's goals for clean energy, reducing air pollution, and reducing emissions of greenhouse gases. This bill would additionally require the CPUC to minimize the need for backstop procurement by the California Independent System Operator (CAISO). This bill will require that the resource adequacy requirements also facilitate development of new nongenerating and hybrid capacity and retention of existing nongenerating and hybrid capacity that is economic and needed.[lxxxiv] **2018 – SB 237:** The Public Utilities Act requires the Public Utilities Commission to authorize and facilitate direct transactions between electricity suppliers and retail end-use customers, but suspends direct transactions except as expressly authorized. Existing law expressly requires the commission to authorize direct transactions for nonresidential end-use customers, subject to an annual maximum allowable total kilowatthour limit established, as specified, for each electrical corporation, to be achieved following a now completed 3-to 5-year phase-in period. This bill would require the commission, on or before June 1, 2019, to issue an order specifying, among other things, an increase in the annual maximum allowable total kilowatthour limit by 4,000 gigawatthours and apportion that increase among the service territories of the electrical corporations.[lxxxv] **2018 - SB-1072 Regional Climate Collaborative Program: technical assistance:** establishes a program to build and support existing regional climate collaboratives across the state that will assist "under-	

	resourced communities" to access state funding for climate change mitigation and adaptation projects. California's Strategic Growth Council is required to develop best practices and technical assistance guidelines, and will award annual grants to collaboratives for capacity building. Once selected by the Council, a collaborative will provide capacity building services to assist under-resourced communities in identifying resources and accessing public funding for climate change mitigation and adaptation projects.[lxxxvi]	
Cleaner Vehicles		

Fuel standards and alternative fuel subsidies	**FEDERAL:** **1988 - Alternative Motor Fuels Act of 1988:** To incentivize alternative fuel vehicle development, the Alternative Motor Fuels Act of 1988 established vehicle manufacturer incentives in the form of CAFE credits. AMFA fuel economy provisions were extended by the Automotive Fuel Economy Manufacturing Incentives for Alternative Fueled Vehicles Rule of 2004. AMFA also requires the creation of an alternative fuels education and data resource center. As a result, the Alternative Fuels Data Center was established in 1991 at DOE's National Renewable Energy Laboratory. **1990 - 2011 - Small Ethanol Producer Credit:** Established: 1990 by the Omnibus Budget Reconciliation Act of 1990, §11502 (P.L. 101-508); extended by the American Jobs Creation Act of 2004, §301 (P.L. 108-357); expanded by the Energy Policy Act of 2005, §1347 (P.L. 109-58); amended by the Energy Improvement and Extension Act of 2008 (P.L. 110-343, Division B), §203; extended by the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 (P.L. 111-312), §708. The small ethanol producer credit is valued at 10 cents per gallon of ethanol produced through the end of 2011. The credit may be claimed on the first 15 million gallons of ethanol produced by a small producer in a given year Qualified applicant: Any ethanol producer with production capacity below 60 million gallons per year.[cxxxviii] **2005 Energy Policy Act & 2007 - US Energy Independence and Security Act:** The Energy Policy Act of 2005 established the **Renewable Fuel**	**FEDERAL:** **1995 - Alternative Fuels Act:** The federal Alternative Fuels Act mandates that 75% of all vehicles operated by federal departments, agencies and crown corporations must be capable of burning alternative motor fuels where cost effective and operationally feasible beginning in 2004. Eligible fuels specified in the Act include: ethanol, methanol, propane gas, natural gas, hydrogen and electricity.[cliii] **1999 - Canadian Environmental Protection Act:** An Act respecting pollution prevention and the protection of the environment and human health in order to contribute to sustainable development. includes regulations for vehicle, engine and equipment standards especially (SOR/2003-2; SOR/90-247) found under division five and fuel regulations (division 4).[cliii] **2008 – Bill C-33 An Act to amend the Canadian Environmental Protection Act, 1999:** A renewable fuels bill amending the 1999 Canadian Environmental Protection Act receives Royal Assent. This follows up on the Harper government's promise to mandate minimum renewable fuels content in transportation fuels and heating oil. These provisions had previously been included in a revised version of bill C-30 (known as the Clean Air Act) but were reintroduced separately after the initial bill died on the order paper.[cliv] **2010/2011 - Federal Renewable Fuels Regulation:** The Regulations require fuel producers and importers to have an average

	Standard Program (RFS), which was revised by the Energy Independence and Security Act in 2007 to RFS2. Transportation suppliers are required by RFS2 to sell 36 billion gallons (bgal) of biofuels annually by 2022. At least 21 bgal must be advanced biofuels, including 16bgal cellulosic biofuel and 1bgal biomass-based diesel. No more than 15bgal can be starch-based (e.g. corn ethanol). Fuel requirements are codified as the Renewable Fuel Standard and have GHG reduction thresholds for each category of biofuels.[cxxxix] **2005 - 2011 - Biodiesel Tax Credit:** Established: 2005 by the American Jobs Creation Act of 2004, §302 (P.L. 108- 357); extended by the Energy Policy Act of 2005, §1344 (P.L. 109-58); amended by the Energy Improvement and Extension Act of 2008 (P.L. 110-343, Division B), §202-203; extended by the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 (P.L. 111-312), §701. Biodiesel producers (or producers of diesel/biodiesel blends) can claim a per-gallon tax credit through the end of 2011. The credit is valued at $1.00 per gallon. Before amendment by P.L. 110-343, the credit was valued at $1.00 per gallon of "agri-biodiesel" (biodiesel produced from virgin agricultural products such as soybean oil or animal fats), or 50 cents per gallon of biodiesel produced from previously used agricultural products (e.g., recycled fryer grease). The tax credit had expired at the end of 2009 and was not extended until the passage of P.L. 111-312, which retroactively applies the extension to fuel produced in 2010.[cxl]	renewable content of at least 5% based on the volume of gasoline that they produce or import commencing December 15, 2010. A further 2% renewable content requirement is based on the volume of diesel fuel and heating distillate oil that they produce or import commencing July 1, 2011. The Renewable Fuels Regulations (Regulations) is being implemented under the Canadian Environmental Protection Act, 1999. [clv] In Canada, fuel producers and importers are required by federal regulation to have minimum renewable fuel content levels of 5% for gasoline and 2% for diesel and heating oil.[clvi] **PROVINCE:** **2007 - Ethanol in Gasoline Regulation - Renewable Fuel Standard: O. Reg. 535/05: ETHANOL IN GASOLINE under Environmental Protection Act, R.S.O. 1990, c. E.19 :** increase ethanol use to 750 million litres starting in 2007 and minimum 5% renewable Content in Gasoline and provides a regulatory incentive for cellulosic ethanol (1 litre cellulosic ethanol is equivalent to 2.5 litres of ethanol). Last amendment: O. Reg. 477/16T. Revoked and replaced in 2018 by O. Reg. 227/18: ETHANOL IN GASOLINE.[clvii] **2014 - O. Reg. 97/14: GREENER DIESEL - RENEWABLE FUEL CONTENT REQUIREMENTS FOR PETROLEUM DIESEL FUEL:** In 2014/15, 2% of the total volume of diesel fuel must be bio-based. The bio-based diesel component of this blend must have

	2005 - 2011 - Volumetric Ethanol Excise Tax Credit: Established 2005 by the American Jobs Creation Act of 2004, §301 (P.L. 108- 357); modified by the Food, Conservation, and Energy Act of 2008, §15331 (P.L.110-246); further amended by the Energy Improvement and Extension Act of 2008 (P.L. 110-343, Division B), §203; extended by the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 (P.L.111-312), §708. Gasoline suppliers who blend ethanol with gasoline are eligible for a tax credit of 45 cents per gallon of ethanol through the end of 2011. Qualified applicant: Blenders of gasohol (i.e., gasoline suppliers and marketers).[cxli] **2005 - 2011 - Renewable Diesel Tax Credit:** Established: 2005 by the Energy Policy Act of 2005, §1346 (P.L. 109-58); amended by the Energy Improvement and Extension Act of 2008 (P.L. 110-343, Division B), §202-203; extended by the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 (P.L. 111-312), §701. Producers of biomass-based diesel fuel (or producers of diesel/renewable biodiesel blends) can claim $1.00 per gallon tax credit through the end of 2011. Renewable diesel is similar to biodiesel, but it is produced through different processes and thus is ineligible for the (above) biodiesel credits. The tax credit had expired at the end of 2009 and was not extended until the passage of P.L. 111-312, which retroactively applies the extension to fuel produced in 2010.[cxlii] **2005 - 2011 - Small Agri-Biodiesel Producer Credit:** Established: 2005 by the Energy Policy Act	30% lower greenhouse gas emissions than standard petroleum diesel. In 2016, 3% of the total volume of diesel fuel must be bio-based. The bio-based diesel component of this blend must have 50% lower greenhouse gas emissions than standard petroleum diesel. In 2017, 4% of the total volume of diesel fuel must be bio-based. The bio-based diesel component of this blend must have 70% lower greenhouse gas emissions than standard petroleum diesel. Revoked and replaced in 2018 by O. Reg. 226/18: GREENER DIESEL - RENEWABLE FUEL CONTENT REQUIREMENTS FOR PETROLEUM DIESEL FUEL.[clviii] **2018 - O. Reg. 226/18: GREENER DIESEL - RENEWABLE FUEL CONTENT REQUIREMENTS FOR PETROLEUM DIESEL FUEL:** amended the renewable fuel regulations to increase blending requirements, improve the environmental performance of fuels, and recognize emerging low carbon fuel technologies. Amend the regulation to create an incentive for emerging renewable fuel technologies, such as biocrude, by allowing it as a compliance option and assigning a compliance value, to be informed by stakeholder consultation.[clix] **2018 - O. Reg. 227/18: ETHANOL IN GASOLINE:** amended the renewable fuel regulations to increase blending requirements, improve the environmental performance of fuels,

	of 2005, §1345 (P.L. 109-58); amended by the Energy Improvement and Extension Act of 2008 (P.L. 110-343, Division B), §202-203; extended by the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 (P.L. 111-312), §701. The small agri-biodiesel producer credit is valued at 10 cents per gallon of "agri-biodiesel" (see Biodiesel Tax Credit, above) produced. The credit may be claimed on the first 15 million gallons of ethanol produced by a small producer in a given year through the end of 2011. The tax credit had expired at the end of 2009 and was not extended until the passage of P.L. 111-312, which retroactively applies the extension to fuel produced in 2010.[cxliii] **2009 - 2012 - Credit for Production of Cellulosic Biofuel:** Established: January 1, 2009, by the Food, Conservation, and Energy Act of 2008, §15321 (P.L. 110-246). Producers of cellulosic biofuel can claim $1.01 per gallon tax credit. For producers of cellulosic ethanol, the value of the credit is reduced by the amount of the volumetric ethanol excise tax credit and the small ethanol producer credit (see above)—currently, the value is 46 cents per gallon. The credit applies to fuel produced after December 31, 2008.[cxliv] **STATE:** **2000 -title 13, California Code of Regulations, sections 1956.1, 2020, 2023, 2023.1 & 2023.4 Fleet Rule:** the Air Resources Board adopted the Fleet Rule for Transit Agencies and more stringent exhaust emission standards for new Urban Bus engines and	and recognize emerging low carbon fuel technologies. Amendments: 1. Require gasoline suppliers to maintain an average of at least 10% ethanol in regular grade gasoline (88 octane or less), by volume per calendar year starting in 2020. 2.Require ethanol used for compliance to emit significantly fewer (e.g. 35%) greenhouse gas (GHG) emissions on a lifecycle basis than petroleum gasoline starting in 2020. 3.Expand the existing incentive/multiplier for advanced renewable fuel technology to emerging technologies, including renewable gasoline and biocrude and include a compliance value for renewable gasoline and biocrude, to be informed by consultations. 4.Calculate the lifecycle GHG performance of a fuel in carbon intensity (CI) using GHGenius version 4.03a, or a subsequent model adopted by the Director. 5.Require that a professional engineer certify that primary data used in the carbon intensity calculations are reasonable and the calculations are correct.[clx]

	vehicles. At least 85% of annual UB purchases shall be fueled by alternative fuel.[cxlv] **<u>2005</u> - AB 1007 - State Alternative Fuels Plan**: (Pavley, Chapter 371, Statutes of 2005) required the California Energy Commission to prepare a state plan to increase the use of alternative fuels in California (State Alternative Fuels Plan). The Energy Commission prepared the plan in partnership with the California Air Resources Board, and in consultation with the other state, federal, and local agencies. In preparing the State Alternative Fuels Plan, the Committee incorporated and builds on the work currently underway within the Bio-Energy Interagency Working Group, the work of other agencies, and also examined the broader suite of alternative fuels that could benefit California's transportation market."[cxlvi] **<u>2007</u> - EO-S-01-07 - Low Carbon Fuel Standard:** Reduce overall carbon intensity of fuel within transport sector by 10% by 2020 and establishes the low carbon fuel standard. "This first-of-its kind standard will support AB 32 emissions targets as part of California's overall strategy to fight global warming, reduce greenhouse gas (GHG) emissions and lower California's reliance on foreign oil. Executive Order S-01-07 mandated establishing a groundbreaking Low Carbon Fuel Standard (LCFS) for transportation fuels sold in California. By 2020, the standard will reduce the carbon intensity of California's passenger vehicle fuels by at least 10 percent."[cxlvii] Since the start of the LCFS in 2011, low-carbon and renewable fuels in California have replaced more than	

	5.3 billion gallons of gasoline and 1.2 billion of diesel fuel. For 2015, the compliance rate with the LCFS was 98%.[cxlviii] **2009** - **adoption of Low Carbon Fuel Standard (EO-01-07) by Air Resources Board:** reduce fuel carbon intensity by 10% by 2020. Based on lifecycle assessments of GHGs - applies to all current and potential transport fuels. Implemented by ARB in 2010[cxlix] **2015 - AB 692 (Quirk) Low-Carbon Transportation Fuels Chapter 588:** Requires three percent of the aggregate amount of bulk transportation fuel purchased by the State to be procured from very low carbon transportation fuel sources, as defined, beginning January 1, 2017. This percentage increases by one percent every year until January 1, 2024. The bill also requires the Department of General Services to coordinate with State agencies that are buyers of transportation fuel and submit an annual progress report to the Legislature on actions taken pursuant to the bill.[cl] **2015 - AB 808 (Ridley-Thomas) Automotive Fuels and Products Chapter 591:** Expands the definition of motor vehicle fuel to include a broader range of fuels and in doing so, extends existing requirements regarding signage, labeling, and terms of sale to those fuels. The bill also designates the international specifications that some alternative fuels are required to meet and specifies that others must meet the latest standards issued by international standards organizations. If no specification exists for an alternative fuel, the bill allows CDFA to adopt an	

	interim specification until an international standards organization adopts one; it then requires CDFA to adopt that standard by reference. The bill adds non-fuel automotive products to the list of products subject to CDFA's authority. Finally, the bill makes clean-up and conforming changes that modernize the code to reflect the growing types of alternative fuels.[cli]	
Vehicle standards	**FEDERAL:** **1965 - Motor Vehicle Air Pollution Control Act:** Federal Clean Air Act of 1963 was amended by the Motor Vehicle Air Pollution Control Act of 1965. Direct regulation of air pollution by the federal government is provided for, and the Department of Health, Education, and Welfare was directed to establish auto emission standards.[clxi] **1970 - Clean Air Act:** In 1970, Congress passed the Clean Air Act, which called for the first tailpipe emissions standards. The pollutants controlled are carbon mon-oxide (CO), volatile organic compounds	**FEDERAL:** **1976 - Company Average Fuel Consumption (CAFC) targets:** Government of Canada established voluntary targets, by agreement with the motor vehicle industry, were set to represent an equivalent level of vehicle fuel-efficiency as provided by the CAFE standards in the U.S.[clxxix] **1971 – Motor Vehicle Saftey Act:** Environment Canada (EC) implements the Government of Canada's environmental agenda. Authority to regulate emissions from internal combustion engines other than those used in aircraft, railway

	(VOC), and oxides of nitrogen (NOx). The new standards go into effect in 1975 with a NOx standard for cars and light-duty trucks of 3.1 grams per mile (gpm).[clxii] **1977/1981 - Clean Air Act:** In 1977, Congress amends the Clean Air Act and tightens emission standards again in two steps. First, between 1977 and 1979, the NOx standard becomes 2.0 gpm for cars. Then in 1981, the NOx standard for cars is reduced to 1.0 gpm. Effective in 1979, pursuant to the Clean Air Act requirements, EPA tightens standards for light-duty trucks to 2.3 gpm. Effective in 1988, EPA then sets the first tailpipe standards for heavier trucks at 1.7 gpm and revises the standard for lighter trucks to 1.2 gpm.[clxiii] **1975 - Energy Policy and Conservation Act, Corporate Average Fuel Economy (CAFE) standards,** which were required to be met by each manufacturer or importer, averaged across vehicle sales in each year. The standards for passenger vehicles were set by the U.S Congress and, in 1979, separate standards for light trucks were introduced by the U.S. Department of Transportation. The Act includes the **Manufacturing Incentive for Flexible Fuel Vehicles program** where Automakers are required to meet Corporate Average Fuel Economy (CAFE) standards for their passenger cars and light trucks. Manufacturers may gain credits for the sale of alternative fuel vehicles, including ethanol/gasoline flexible fuel vehicles (FFVs). However, the credits are limited—the maximum fuel economy increase allowed through the use of these credits is 1.2 miles per gallon through model year (MY) 2014. The credits	locomotives and commercial marine vessels in Canada currently rests with EC. Emission standards for engines and vehicles, including emission standards for greenhouse gas (GHG) emissions, are established by EC.[clxxx] **1982 - Motor Vehicle Fuel Consumption Standards Act:** The Act establishes the legal authority to regulate fuel consumption for prescribed classes of motor vehicles. However, the Government did not proclaim the act due to a voluntary commitment by manufacturers to continue to provide vehicles that meet U.S. standards. In **2007,** the federal government finally implemented the 1982 MVFCSA in a shift to mandatory fuel economy standards.[clxxxi] **1999 - Canadian Environmental Protection Act:** An Act respecting pollution prevention and the protection of the environment and human health in order to contribute to sustainable development. includes regulations for vehicle, engine and equipment standards especially (SOR/2003-2; SOR/90-247) found under division five and fuel regulations (division 4).CEPA prescribes a fleet average NOx standard that is slightly tighter than the 2004 US standard but not as tight as the Tier II standards being phased in (Canada Gazette, 2003). CEPA also allows firms that go beyond the required standards in one model year to count that as a credit towards its fleet average in a subsequent year.[clxxxii] **1999 - Sulphur in Gasoline Regulations (SOR/99-236):** By limiting the sulphur content in

	are phased out after MY2014 and are completely eliminated after MY2019.[clxiv] **<u>1990</u> - Clean Air Act:** In 1990, Congress again amends the Clean Air Act, further tightening emission standards. The NOx standard is set at 0.6 gpm for cars, effective in 1994. The new standard — called "Tier 1"—is a 40 percent reduction from the 1981 standard. For trucks, the new standard ranges from 0.6 to 1.53 gpm, depending on the weight of the vehicle.[clxv] **<u>1998</u> - Voluntary Agreement For Cleaner Cars:** In 1998, the Clinton Administration with the auto industry and the Northeast states strike an innovative, voluntary agreement to put cleaner cars on the road before they could be mandated under the Clean Air Act. The new cars are called National Low Emission Vehicles (NLEV). The first NLEV cars under the agreement reach consumers in New England in 1999 and the rest of the country in 2001. NLEV cars operate with a NOx standard of 0.3 gpm, a 50 percent reduction from Tier 1 standards. The NLEV agreement also calls for a 0.5 gpm NOx standard for lighter trucks only, a 17 percent reduction from Tier 1 requirements for these vehicles.[clxvi] **<u>2012</u> - CAFE and emissions of greenhouse gases (GHG) for Model Years 2012-2016:** The U.S. Environmental Protection Agency (EPA) and the Department of Transportation's National Highway Traffic Safety Administration (NHTSA) are issuing final rules extending the National Program to further reduce greenhouse gas (GHG) emissions and improve fuel economy for model years (MYs) 2017 through 2025 light-duty vehicles. EPA is establishing national	gasoline and diesel, not only are the tailpipe SO2 and other sulphur compounds emissions reduced, but also the performance efficiency of a vehicle's catalytic converters and other advanced emission control systems are improved resulting in reduction of VOC, NOx, and CO emissions.[clxxxiii] **<u>2003</u> - On-Road Vehicle and Engine Emission Regulations (SOR/2003-2):** The On-Road Vehicle and Engine Emission Regulations introduce more stringent national emission standards for on-road vehicles and engines and a new regulatory framework under the Canadian Environmental Protection Act, 1999 (CEPA, 1999). These Regulations for controlling emissions from on-road vehicles and engines came into effect on January 1, 2004.[clxxxiv] **<u>2010</u> - Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations (SOR/2010-201):** This was the Government of Canada's first ever GHG regulation and was a major milestone for Environment and Climate Change Canada's transportation regulatory work. The Regulations establish progressively more stringent GHG emission standards for new light-duty vehicles of model years 2011-2025, in alignment with the U.S. national standards. The applicable standards for a given model year are based on prescribed CO2 equivalent emission "target values" that are a function of the "footprint" (Figure 1) and quantity of the vehicle models in each company's fleet of passenger automobiles and light trucks. These standards are performance-based which allow companies to choose the most

	GHG emissions standards under the Clean Air Act, and NHTSA is establishing Corporate Average Fuel Economy (CAFE) standards under the Energy Policy and Conservation Act, as amended by the Energy Independence and Security Act (EISA). EPA's standards apply to passenger cars, light-duty trucks, and medium-duty passenger vehicles, in MYs 2017 through 2025. The final standards are projected to result in an average industry fleetwide level of 163 grams/mile of carbon dioxide (CO2) in model year 2025, which is equivalent to 54.5 miles per gallon (mpg) if achieved exclusively through fuel economy improvements.[clxvii] **STATE:** **1959 -** Legislation established the ability for California to develop ambient air standards and controls for motor vehicles. First ambient air standards established based on observations of health.[clxviii] **1961 -** First automotive emission control technology requirements mandated in California (first in nation) by the California Motor Vehicle Pollution Control Board.[clxix] **1966 -** first tailpipe emissions standards adopted by the California Motor Vehicle Pollution Control Board for hydrocarbons and carbon monoxide.[clxx] **1971 -** tailpipe emissions standards adopted by the California Motor Vehicle Pollution Control Board for oxides of nitrogen.[clxxi] **1982 -** tailpipe emissions standards adopted by the California Motor Vehicle Pollution Control Board for particulate matter from diesel-fueled vehicles.[clxxii]	cost-effective technologies to achieve compliance.[clxxxv] **2018 - the Regulations Amending the Heavy-duty Vehicle and Engines Greenhouse Gas Emissions Regulations and Other Regulations Made Under the Canadian Environmental Protection Act, 1999:** The Government of Canada has adopted new regulations reinforcing greenhouse gas ("GHG") emissions standards for heavy-duty vehicles and engines. These regulations will come into force in November 2018. The Regulations introduce more stringent GHG emission standards that begin with the 2021 model year for on-road heavy-duty vehicles and engines. These vehicles are generally defined as on-road vehicles weighing more then 3 856 Kg, or having a basic frontal area of more then 4.2m2, and the engines designed to power such vehicles. In practice, this definition includes most commercial trucks, buses, and school buses, but excludes passenger vehicles designed to carry 15 passengers or fewer.[clxxxvi] **PROVINCE:** **1998 - O. Reg. 361/98: MOTOR VEHICLES under Environmental Protection Act, R.S.O. 1990, c. E.19:** The Motor Vehicles Regulation sets out maximum permissible emission levels for operating vehicles, including maximum levels of hydrocarbons, carbon monoxide and visible emissions.[clxxxvii]

	<u>1988</u> - California Clean Air Act: instructed CARB to "achieve the maximum degree of emission reduction possible from vehicular and other mobile sources" (Cal. Health & Safety Code § 43018(a)). In response to this new legislative mandate, CARB approved an ambitious new rulemaking in 1990 to regulate vehicle emissions.[clxxiii] **<u>1990</u> - Low Emission Vehicle Standards (LEV):** The ARB first adopted LEV standards in 1990. These first LEV standards run from 1994 through 2003. These regulations require automobile manufacturers to introduce progressively cleaner light- and medium-duty vehicles with more durable emission controls. The regulations established stringent emission standards for four new classes of light- and medium-duty vehicles. Also, for the first time, an increasingly stringent annual fleet average emission requirement was established to provide a flexible mechanism for phasing-in low-emission vehicles.[clxxiv] **<u>1999</u> LEV II Regulations:** the Air Resources Board (ARB) amended California's Low-Emission Vehicle (LEV) regulations. The new amendments, known as LEV II, will advance the state's clean air goals through improved emission reduction standards for automobiles. LEV II regulations, running from 2004 through 2010, represent continuing progress in emission reductions. Amendements are as follows: Extension of passenger car emission standards to heavier sport utility vehicles and pickup trucks (with gross vehicle weight up to 8,500 pounds) which formerly had been regulated under less stringent emission standards;	

	Extension and tightening of the fleet average emission standards during 2004-2010 (a fleet includes all new vehicles from an automaker) Creation of a new super-ultra low emission vehicle (SULEV) category for light-duty vehicles (SULEV's will only emit a single pound of hydrocarbons during 100,000 miles of driving-about the same as spilling a pint of gasoline); Significantly lower oxides of nitrogen emission standards for the low and ultra-low emission vehicle categories, a reduction of 75% from the current LEV standards; Increased emission control durability standards from 100,000 miles to 120,000 miles for passenger cars and light trucks; Further reduction of evaporative emissions; Creation of partial zero-emission vehicle (ZEV) credits for vehicles that achieve near zero emissions. Changes in how the smog index is calculated; Amendments to the zero-emission and hybrid electric vehicle test procedures; And Removal of a less stringent emission standard that would have resulted in increased sales of new diesel cars, pickups, and SUVs.[clxxv] **<u>2002</u> - AB 1493 - "Pavley law" (Chapter 200):** reduce average new vehicle GHG emissions by 40% by 2016. This bill requires the state board to develop and adopt, by January 1, 2005, regulations that achieve the maximum feasible reduction of greenhouse gases emitted by passenger vehicles and light-duty trucks. First state in the nation to set its own standards for GHGs from private cars. [clxxvi]	

	<u>2005</u> - title 13, California Code of Regulations, sections 2020, 2023, 2023.2 & 2023.4 Transit Fleet Vehicle Rules: Reduce public exposure to diesel particulate matter (PM) and nitrogen oxide (NOx) emissions from Transit Fleet Vehicles. A transit agency shall make percentage reductions in the total diesel PM emissions of its diesel transit fleet vehicles (TFV) relative to its January 1, 2005, total TFV fleet diesel PM baseline. PM 40% reduction by 2007, 80% reduction by 2010. NOx reduce to 3.4 (grams/bhp-hr) by 2007, 2.4 (grams/bhp-hr) by 2010.[clxxvii] **<u>2012</u> - Low Emission Vehicle Standards (LEV III), Advanced Clean Car Standards:** additional GHG reductions from passenger vehicles years 2017-2025. This Program represents a new approach to passenger vehicles – cars and light trucks -- by combining the control of smog-causing pollutants and GHG emissions into a single coordinated package of standards known as Low Emission Vehicles (LEV) III. The new approach also includes efforts under the Zero-Emission Vehicle Program. Greenhouse gas standard for cars and light trucks, model years 2017-2025. The new rules strengthen the greenhouse gas standard for 2017 models and beyond. The new standard drops greenhouse gas emissions to 166 grams per mile, a reduction of 34 percent compared to 2016 levels. This will be achieved through existing technologies, the use of stronger and lighter materials, and more efficient drivetrains and engines.[clxxviii]	

Mandated Inspection and Maintenance	**<u>1982</u> - SB 33 (Presley, Chapter 892, Statutes of 1982) Smog Check California:** mandated biennial smog inspection testing for vehicles implemented in 1984. Needed in order to register vehicles. SB 33 authorized BAR to implement, maintain, and enforce the Smog Check Program, which licenses Smog Check stations and technicians in an effort to reduce air pollution from vehicles through mandatory testing of vehicle emission control components.[clxxxviii] **<u>1994</u> - Smog Check II** signed into law following lengthy negotiations with the USEPA, designed to meet the requirements of the Federal Clean Air Act as amended in 1990. This program targeted vehicles which pollute at least 2 to 25 times more than the average vehicle and requires repairs and retesting of offending vehicles.[clxxxix] **<u>2010</u> - Tire Inflation Requirement (Reference California Code of Regulations Title 17, Section 95550)**: The California Air Resources Board (ARB) enforces regulations to reduce greenhouse gas emissions from vehicles operating inefficiently with under inflated tires. These regulations apply to vehicles with a gross vehicle weight rating of 10,000 pounds or less. Automotive service providers performing or offering to perform automotive maintenance or repair services in the state must: Check and inflate vehicle tires to the manufacturer recommended tire pressure rating, with air or nitrogen as appropriate, using a tire pressure gauge with a total permissible error of no more than plus/minus two pounds per square inch, when performing maintenance or repair; Indicate on the vehicle service invoice that a tire inflation service was completed and specify the	**<u>1999</u> -Ontario Regulation 361/98 (Motor Vehicles), Drive Clean:** mandated emissions tests for in-use, on-road, light-duty vehicles. Drive Clean reduces smog-causing pollutants by requiring polluting vehicles to be repaired. Vehicles that are seven years and older need to pass an emissions test before renewal of registration and licence plates. Roughly 2.3 million vehicles per year tested. By 2003 the Program had reportedly reduced approximately 47 kt of CO2 emissions since its inception. The fee for the test has been eliminated as of 2017.[cxciv]

	resulting pressure measurements; Have access to a tire inflation reference published within the last three years; and Keep a copy of the service invoice for at least three years and make the invoice available to ARB or an authorized representative upon request.[cxc] **2013 – AB 8 Alternative fuel and vehicle technologies: funding programs:** This bill would establish compensation for replacement vehicles for low-income vehicle owners at not less than $2,500, would make this compensation available to an owner in addition to the compensation for a retired vehicle, and would prohibit compensation for all other motor vehicle owners from exceeding the compensation for low-income motor vehicle owners. The bill would instead authorize an increase in the compensation under these programs for either retired or replacement vehicles only for low-income motor vehicle owners as necessary to balance maximizing air quality benefits of the program while ensuring participation by low-income motor vehicle owners, as specified. This bill would extend the current authorization for the Carl Moyer program to fund a broader range of projects that reduce emissions until January 1, 2024, and would make other conforming changes in that regard. The bill also would delete obsolete references and make conforming changes to the Carl Moyer program.[cxci] **2017 - AB 582 (GARCIA) VEHICLES: EMISSIONS: CERTIFICATION, AUDITING, AND COMPLIANCE:** Existing law requires a manufacturer of a new motor vehicle to allow the State Air Resources Board to conduct surveillance	

	emissions testing at its assembly facilities or at any other location where the manufacturer's assembly line testing is performed and testing records are kept. Existing law authorizes the state board to impose a fee on the manufacturers of new motor vehicles to recover the state board's costs associated with this surveillance. This bill would require the state board to enhance its certification, audit, and compliance activities for new motor vehicles to detect defeat devices or other software used to evade emissions testing, as specified. The bill would authorize the state board to impose a fee on the manufacturers of new motor vehicles to cover the state board's costs associated with the state board's certification, audit, and compliance activities. The bill would authorize the state board to impose a penalty on the manufacturers of new motor vehicles relating to the state board's certification, audit, and compliance activities if specified conditions are met. The bill would create the Certification Fund and the Certification Penalty Account, with the moneys in both the fund and account available upon appropriation.[cxcii] **2017 - AB 1274 (O'Donnell):** This bill would, beginning January 1, 2019, and except as provided, exempt motor vehicles that are 8 or less model-years old from being inspected biennially upon renewal of registration. The bill would assess an annual smog abatement fee of $25 on motor vehicles that are 7 or 8 model-years old. The bill would require a certain amount of the fee to be deposited into the Air Pollution Control Fund and to be available for expenditure, upon appropriation by the Legislature, to fund the Carl Moyer Memorial Air Quality Standards	

	Attainment Program. The bill would require the balance of the fee to be deposited into the Vehicle Inspection and Repair Fund.[cxciii]	
Alternative Vehicle Standards and Mandates	**FEDERAL:** **1992 - The Energy Policy Act (EPAct) of 1992 (Public Law 102-486):** aims to reduce U.S. dependence on petroleum and improve air quality by addressing all aspects of energy supply and demand, including alternative fuels, renewable energy, and energy efficiency. EPAct 1992 encourages the use of alternative fuels through both regulatory and voluntary activities and approaches the U.S. Department of Energy (DOE) carries out. It requires federal, state, and alternative fuel provider fleets to acquire alternative fuel vehicles.[cxcv] **STATE:** **1990 - Zero Emission Vehicle Mandate:** California embarked on a plan to reduce vehicle emissions to zero through the introduction of the Zero Emission Vehicle (ZEV) Program. At that time, the Board required that in 1998, 2% of the vehicles that large manufacturers produced for sale in California had to be ZEVs, increasing to 5% in 2001 and 10% in 2003.[cxcvi] **1996 - Zero Emission Vehicle Mandate:** The ZEV mandate was adjusted to eliminate the "ramp up" years but left in place the 10% ZEV requirement for 2003, and again in 1998 to allow partial ZEV (PZEV)	**FEDERAL - June 2017 - EV30@30:** The EV30@30 campaign redefines the ambition of the CEM's Electric Vehicles Initiative (EVI), setting the objective to reach a 30% sales share for EVs by 2030. This will be the benchmark against which progress achieved by all members of the EVI will be measured (i.e., total electric vehicle sales in all EVI countries / total vehicle sales in all EVI countries) and can be met through targets that differ across modes and jurisdictions.[ccv] **ONTARIO** **2016 - ZEV Sales Target:** The Government of Ontario recently adopted of a ZEV sales target requiring that electric vehicle sales constitute at least 5% of all vehicles sold in Ontario by 2020[ccvi]

	credits for extremely clean vehicles that were not pure ZEVs. The underlying goal, however, never changed. California remained committed to seeing increasing numbers of ZEVs in the vehicle fleet. The challenge was determining how to reach this goal.[cxcvii] **2001 - Zero Emission Vehicle Mandate :** The challenge at this time was to maintain progress towards commercialization of ZEVs, while recognizing constraints due to cost, lead-time, and technical challenges. The 2001 modifications allowed large manufacturers to meet their ZEV requirement with 2% pure ZEVs, 2% Advanced Technology PZEVS and 6% PZEVs. Due to a lawsuit filed against the Board, a federal district judge issued a preliminary injunction that prohibited the Board from enforcing the 2001 ZEV amendments with respect to the sale of new motor vehicles in model years 2003 or 2004. Once the Board adopted the 2003 Amendments to the ZEV regulation, the parties to the lawsuits agreed to end the litigation. **2012 - EO-B-16-12 ZEV Mandate:** orders State agencies to facilitate the rapid commercialization of zero-emission vehicles (ZEVs). The Executive Order sets a target for 1.5 million ZEVs in California by 2025 and for infrastructure to accommodate 1 million EVs by 2020. Also the Executive Order sets as a target for 2050 a reduction of GHG emissions from the transportation sector equaling 80 percent less than 1990 levels. State ZEV Action plan released in 2013 includes actions that apply directly to the funding categories of the ARFVTP. For instance, the ZEV Action Plan calls for develop infrastructure networks and community readiness plans for both plug-in	

	electric vehicles and fuel cell electric vehicles, which have been priorities in the ARFVTP.[cxcviii] **2012 - Advances Clean Cars Program, ZEV Regulation:** requires manufacturers to produce an increasing number of pure ZEVs (meaning battery electric and fuel cell electric vehicles), with provisions to also produce plug-in hybrid electric vehicles (PHEV) in the 2018 through 2025 model years. The 2012 amendments increase requirements which push ZEVs and PHEVs to over 15-percent of new vehicle sales by 2025. This will ensure ZEV volumes are at a level sufficient to reduce incremental ZEV costs and reach commercialization.[cxcix] [cc] **2013 - ZEV Action Plan:** California also made a concerted effort to address all barriers to ZEV adoption, with Governor Jerry Brown enacting a ZEV Action Plan in 2013 that required all state agencies to work together to support ZEV commercialization and use.[cci] **2014 - SB 1275 - Charge Ahead California Initiative: "**Establishes a state goal of 1 million zero-emission and near-zero-emission vehicles in service by 2020. Amends the enhanced fleet modernization program to provide a mobility option. Establishes the Charge Ahead California Initiative requiring planning and reporting on vehicle incentive programs, and increasing access to and benefits from zero-emission vehicles for disadvantaged, low-income, and moderate-income communities and consumers."[ccii] **2018 - Sb 1014 (Skinner) Zero-Emission Vehicles:** Would require the CPUC to establish the California Clean Miles Standard and Incentive Program for zero-emission vehicles used by participating drivers to	

	provide prearranged transportation services for compensation for a transportation network company with the goal to increase the percentage of passenger miles provided by zero-emission vehicles used on behalf of transportation network companies so that 20% of the passenger miles are provided by zero-emission vehicles by December 31, 2023, and 50% of the passenger miles are provided by zero-emission vehicles by December 31, 2026. Would require the commission to establish quarterly targets for the portion of vehicle miles traveled by zero-emission vehicles on behalf of a transportation network company. Would require, beginning January 1, 2030, that 100% of the vehicles that are purchased, leased, owned, or contracted for by a transportation network company be zero-emission vehicles.[cciii] **2018 - AB 2061 (Frazier) Near-Zero-Emission And Zero-Emission Vehicles:** Authorizes a near-zero-emission vehicle or a zero-emission vehicle to exceed axle, tandem, gross, or bridge formula weight limits, up to a 2,000 pound maximum, by an amount equal to the difference between the weight of the vehicle attributable to the fueling system carried by that vehicle and the weight of a comparable diesel tank and fueling system.[cciv]	
Alternative vehicle charging infrastructure development	**FEDERAL:** **2005 - 2011 - Alternative Fuel Station Credit:** Established: 2005 by the Energy Policy Act of 2005 §1342 (P.L. 109-58); extended by the Energy Improvement and Extension Act of 2008, §207 (P.L. 110- 343, Division B); expanded by the American Recovery and Reinvestment Act, §1123 (P.L. 111-5);	**FEDERAL:** **2016 - Funding under the Pan-Canadian Framework:** $21.9 billion to support green infrastructure, including for electricity, renewable energy, reducing reliance on diesel in Indigenous, northern and remote communities, electric vehicle charging and natural gas and hydrogen refuelling

	extended by the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 (P.L. 111-312), §711. A taxpayer may take a 30% credit for the installation of alternative fuel infrastructure, up to $30,000, including E85 (85% ethanol and 15% gasoline) infrastructure through the end of 2011. Residential installations qualify for a $1,000 credit (biofuels pumps are not generally installed in residential applications).[ccvii] **2015 - The Fixing America's Surface Transportation (FAST) Act:** continues CMAQ, but also adds new provisions related to alternative fuels, including the establishment of national alternative fuel station corridors and authorization for federal agencies to install electric vehicle supply equipment for employee use, subject to certain conditions.[ccviii] **2018 - Section 25D Investment Tax Credit (ITC) for fuel cells:** In February 2018, Congress reinstated the Section 48 and Section 25D Investment Tax Credit (ITC) for fuel cells for businesses and residential installations. The reinstatement was part of the Bipartisan Budget Act of 2018. Owners of stationary and material handling fuel cell systems can claim the ITC as a percentage of total system equipment and installation costs. The ITC is calculated by taking the lesser of: $3,000/kW installed capacity OR 30% of project cost. The reinstatement established a tiered phase-out of the credit, based on when construction commences (includes a retroactive reinstatement for 2017): 1/1/2017 through 12/31/2019: 30% of costs 1/1/2020 through 12/31/2020: 26% of costs 1/1/2021 through 12/31/2021: 22% of costs	stations, new building codes, and disaster mitigation and adaptation. Specifically, $120 million to deploy infrastructure for electric vehicle charging and natural gas and hydrogen refuelling stations, as well as to support technology demonstration projects.[ccxxiii] The government has committed $46.1 million for the demonstration of next-generation charging stations for EVs and $16.4 million to support expanded infrastructure using commercially available technologies, including electric, natural gas and hydrogen-charging stations along significant transportation corridors.[ccxxiv] **2016 - Fast charging infrastructure 2016:** allocated investment to electric vehicles and alternative transportation fuel infrastructure of $62.5M over the next two years. The federal government made this announcement following the launch of our Roadmap for Accelerating the Deployment of Electric Vehicles in Canada (2016 to 2020).[ccxxv] **PROVINCE:** **2015 - Electric Vehicle Chargers Ontario (EVCO) program:** Last fall, Ontario announced the creation of a $325 million Green Investment Fund (GIF), which would fight climate change and create jobs. It was billed as a down payment on cap-and-trade revenue, which will eventually net the province nearly $2 billion each year to invest in climate action. Among other projects such as helping businesses and homeowners reduce

	Projects that commence construction before December 31, 2021 are eligible for a 22% credit if commissioned by January 1, 2024.[ccix] **STATE:** **1990 - 2013 - Advanced Clean Cars Program, Clean Fuels Outlet:** This regulation is designed to support the commercialization of zero-emission hydrogen fuel cell vehicles planned by vehicle manufacturers by 2015, which will require increased numbers of hydrogen fueling stations. Construction of the new stations will provide a convenient fueling infrastructure, first within the major metropolitan areas, but ultimately throughout the state. The number of stations will grow as vehicle manufacturers sell more fuel cell vehicles.[ccx] **2009 - SB 626 Electrical infrastructure: plug-in hybrid and electric vehicles:** This bill would require the PUC, in consultation with the Energy Commission, the state board, electrical corporations, and the motor vehicle industry, to evaluate policies to develop infrastructure sufficient to overcome any barriers to the widespread deployment and use of plug-in hybrid and electric vehicles and, by July 1, 2011, to adopt rules that address specified matter.[ccxi] **2013 – Assembly Bill 8 (AB 8, Perea, Chapter 401, Statutes of 2013):** directed the California Energy Commission to allocate up to $20 million annually from the Alternative and Renewable Fuel and Vehicle Technology Program for development of light duty hydrogen refueling stations for fuel cell electric vehicles (FCEVs). AB 8 also directed the Energy Commission and California Air Resources Board	emissions, this fund will support the installation of EV charging stations across the province. Currently, the province is working with 24 public and private partners to install almost 500 charging stations at over 250 locations across the province.[ccxxvi] **2013 Electric Vehicle Charging Incentive Program (EVCIP):** an initial $20 million investment is supporting the purchase and installation of public fast chargers, both for in-city and inter-city network locations. All network charging stations are expected to be in-service by March 31, 2017. Provides a financial incentive to support the purchase and installation of eligible, new, Level 2 (208V or 240V AC) electric vehicle charging stations for home or business use. The value of the incentive is 50% of purchase costs up to a maximum of $500 and 50% of the installation costs up to a maximum of $500 (including electrical inspection) up to a total maximum of $1,000. The ministry is proposing to offer additional rounds of funding (up to $80 million) to expand on and also improve upon the first round of the EVCO Program.[ccxxvii] **2017 - O. Reg. 139/17: BUILDING CODE (filed under Building Code Act, 1992, S.O. 1992, c. 23):** sets out a series of amendments to Ontario's Building Code. The new Building Code provisions will require all new houses with parking to be built EV-ready (i.e., minimum 200 amp panel and installation of a conduit to facilitate future installation of EV charging equipment). Other buildings (except for multi-unit apartment

	(ARB) to conduct a series of annual assessments. AB 8 further directs the Energy Commission and ARB to determine the remaining cost and timing to establish a network of 100 publicly available hydrogen refueling stations. **2013 - Assembly Bill 1092 (Levine, Chapter 410, Statutes of 2013) Building standards: electric vehicle charging infrastructure:** Requires the Building Standards Commission to adopt mandatory building standards for the installation of future electric vehicle charging infrastructure for parking spaces in multifamily dwellings and nonresidential development.[ccxii] **2014 - AB 2414 (Ting) Parking Facilities: Electric Vehicle Charging Chapter 215:** Specifies that the use of electricity to charge an electric vehicle in a State-owned or operated parking facility is not a gift of public funds that would violate the Constitution of the State of California.[ccxiii] **2014 - AB 2565 (Muratsuchi) Electric Vehicle Charging Chapter 529:** For residential lease agreements executed, renewed, or extended after July 1, 2015, this bill requires a property owner, with some exceptions, to approve a written request by a tenant to install an electric vehicle charging station if the tenant agrees to meet specified requirements and comply with the property owner's procedural approval process for modification to the property. For commercial leases executed, renewed, or extended after January 1, 2015, the bill bars prohibitions or unreasonable restrictions against the installation or use of electric vehicle charging equipment, and specifies the requirements and obligations tenants must comply	buildings) with parking in the building (e.g., attached or underground garages) would need to be equipped with EV charging equipment in 20% of the parking spots, with the other 80% of spots made EV-ready. The primary intent of these changes is to facilitate workplace charging for EV users.[ccxxviii] **2018 - O. Reg. 114/18: GENERAL:** Condo residents and condo boards now face fewer obstacles when looking to install an EV charger. Amendments to *the Condominium Act* regulations will prevent a condo board from rejecting an owner's application to install an EV charger so long as the owner meets certain conditions, including that the proposed installation: Is not contrary to any act or regulation, including the Electrical Safety Code; Will not adversely affect the structural integrity of the condo property; and Will not pose a serious risk to the health and safety of an individual or damage any of the property or assets of the corporation; The amendments also permit a condo board to install EV chargers without obtaining certain requirements under the Condominium Act where: The estimated total cost of the installation is 10% or less of the annual budget for common expenses; and Owners will not experience a significant reduction in the use or enjoyment of their units, the common areas or assets of the condo corporation.[ccxxix] **2018 - Workplace Electric Vehicle Charging Incentive Program :** the government announced the creation of the Workplace Electric Vehicle Charging Incentive Program this year, providing 80% of capital costs (up to $7,500 CAD per level 2

	with when installing charging equipment and associated infrastructure.[ccxiv] **2015 - AB 1236 (Chiu) Local Permitting for EV Charging Stations Chapter 598:** Requires local permitting agencies to administratively approve an application to install an EV charging station if it meets applicable health and safety standards, to adopt an ordinance that provides an expedited streamlined permitting process, and to adopt a checklist of requirements to install a charging station. Denial of a permit must be based on substantial evidence of a specific adverse effect on public health or safety and may be appealed if the adverse impact can be mitigated.[ccxv] **2015 - Clean Energy and Pollution Reduction Act of 2015:** Part of this law requires the PUC, in consultation with the Energy Commission and state board, to direct electrical corporations to file applications for programs and investments to accelerate widespread transportation electrification to reduce dependence on petroleum, meet air quality standards, achieve the goals set forth in the Charge Ahead California Initiative, and reduce emissions of greenhouse gases to 40% below 1990 levels by 2030 and to 80% below 1990 levels by 2050. The PUC is required to approve, or modify and approve, programs and investments in transportation electrification, including those that deploy charging infrastructure, through a reasonable cost recovery mechanism, if they are consistent with the above-described purposes, do not unfairly compete with nonutility enterprises, include performance accountability measures, and are in the interests of ratepayers.[ccxvi]	charger) to employers and commercial building owners to further promote the uptake of EVs in the province[ccxxx]

	2017 - AB 33 (QUIRK) TRANSPORTATION ELECTRIFICATION: ELECTRIC VEHICLE SERVICE EQUIPMENT: ELECTRICAL CORPORATIONS: RATES: This bill would require the PUC, by March 30, 2018, in consultation with the state board and the Energy Commission, to consider authorizing electrical corporations to offer programs and investments that support customers who purchase a used electric vehicle. If authorized by the PUC, the bill would require that the programs and investments be designed to accelerate widespread transportation electrification, achieve ratepayer benefits, reduce dependence on petroleum, meet air quality standards, and reduce emissions of greenhouse gases. If authorized, the bill would require the PUC to review, modify if appropriate, and decide whether to approve each proposal to offer these programs and investments that is filed by an electrical corporation within one year of the date of filing of the completed proposal. If the program is approved, the bill would provide that a participant in the program would receive electrical service for charging their electric vehicles at a grid-integrated rate, as defined. The bill would require that a program approved by the PUC include a reasonable mechanism for cost recovery by the electrical corporation.[ccxvii] **2017 - AB-1452 Parking: exclusive electric charging and parking on public streets:** This bill would authorize a local authority, by ordinance or resolution, to designate stalls or spaces on a public street within its jurisdiction for the exclusive purpose of charging and parking a vehicle that is connected for electric charging purposes. The bill would also	

	authorize the removal of a vehicle from a designated stall or space on a public street if the vehicle is not connected for electric charging purposes, under specified conditions. By expanding the scope of a crime, the bill would impose a state-mandated local program.[ccxviii] 2018 - AB 2127 (TING) ELECTRIC VEHICLE INFRASTRUCTURE: ASSESSMENT AND ROADMAP: **Requires The California Energy Commission (CEC), To Prepare A Statewide Assessment Of The Electric Vehicle (EV) Charging Infrastructure Needed To Support The Levels Of EV Adoption Necessary For The State To Meet The Following Two Goals:** A) Putting At Least 5 Million Zeroemission Vehicles On The Road By 2030 And B) Reducing Emissions Of Greenhouse Gases (Ghgs) To 40% Below 1990 Levels By 2030. Directs The CEC, In Preparing The Assessment, To Work With The Air Resources Board (ARB) And The California Public Utilities Commission (CPUC).[ccxix] **2018 - SB 1000 (Lara) Transportation Electrification: Electric Vehicle Charging Infrastructure:** Requires the California Energy Commission (CEC) to evaluate the extent to which charging infrastructure is proportionately deployed, and upon finding disproportionate deployment, to more proportionately deploy new charging infrastructure. Also requires the CEC to develop minimum charging speed recommendations for direct current fast charging stations and electric vehicle batteries. Requires the California Public Utilities	

	Commission (CPUC) to consider facilitating the development of technologies tracking the use of charging infrastructure and the deployment of sub-metering for chargers.[ccxx] **2018 - AB 1796 Electric Vehicle Charging Stations:** This bill modifies Civil Code §1947.6 with regard to the installation of electric vehicle charging stations. Existing law required that landlords approve written requests for residents, at their cost, to install electric vehicle charging stations in their allotted parking space(s), but specifically excluded properties with fewer than five parking spaces, or properties subject to a local rent control ordinance. This bill eliminates the exemption for properties subject to a rent control ordinance, and requires that landlords allow resident installation of electric vehicle charging stations for any lease executed, extended, or renewed on and after January 1, 2019, or immediately, if the property is in a jurisdiction that on or before January 1, 2018, previously passed an ordinance requiring a landlord to approve a resident's written request to install an electric vehicle charging station.[ccxxi] **2018 - AB-2145 Vehicular air pollution:** This bill would add as eligible projects for the California Clean Truck, Bus, and Off-Road Vehicle and Equipment Technology Program those projects that support grid integration and integrated storage solutions and charging management demonstration and analytics. The bill would additionally require the energy commission, as part of the guidance developed for the program, to advise the state board on to how to allocate moneys for vehicle charging infrastructure consistent with the energy commission's investment	

	plan strategies on charging infrastructure that is part of the California Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act of 2007.[ccxxii]	
Tax on transportation fuels	**FEDERAL:** **1932 - Federal Fuel Excise Tax:** 1932 started at 1 cent per galllon. CURRENT RATE: The Internal Revenue Service collects this tax—18.4¢/gallon gasoline and 24.4¢/gallon diesel fuel–and deposits it into the Highway Trust Fund (HTF). About 85% of the HTF account goes into the Highway Account. FHWA appropriates funding to each state for specific purposes (Chart 21). The remaining 15% of the HTF account goes into the Transit Account. The FTA allocates this funding to regional agencies and local transit providers in each state for specific transit purposes (Chart 22). California receives a majority of its federal tax contributions through the Federal Obligation Authority (OA).[ccxxxi] **STATE:** **1923 – The Motor Vehicle Fuel License Tax Law**: this law introduced a tax on distributors of motor vehicle fuels initally at 2 cents per gallon. **1937 – Use Fuel Tax Act of 1937**: introduced a three cent per gallon tax on deisel fuel. **2017 - SB 1 Transportation Funding:** 12 cent increase of the base gasoline excise tax, increasing it from 18 cents to 30 cents per gallon. Introduced a new transportation improvement fee based on vehicle value	**FEDERAL:** **1985 - Excise Tax Act (R.S.C., 1985, c. E-15):** The federal government charges an excise tax at a flat rate of 10 cents per litre on gasoline (in effect since 1995) and 4 cents per litre on diesel (in effect since 1987). Furnace oil, natural gas and propane are exempt from this tax. As of 2017 – 4 cents/litre diesel and 10 cents/litre gasoline.[ccxxxiv] **2003 – Budget 2003 tax exemption on bio-diesel:** The 2003 Canadian federal budget introduces a federal fuel excise tax exemption of $0.04/litre for bio-diesel, including the bio-diesel portion of blended diesel fuel and the ethanol / methanol portion of blended diesel fuel. Prior to this, the excise tax exemption had applied only to the ethanol/methanol portion of blended gasoline.[ccxxxv] **PROVINCE:** **1925 – Gasoline Tax Act:** Introduces a tax directly on consumers for the consumption of gasoline.[ccxxxvi] **1956 - Motor Vehicle Fuel Tax Act:** Differentiates between gasoline and diesel fuel with respect to taxation. Prior to this the tax for both was 11 cents/gallon. This Act raised the tax on gasoline

	ranging from $25 to $175 - the existing DMV base registration fee is $53. New charges on diesel and ZEVs. Existing diesel base excise tax is 16 cents per gallon and will increase to 36 cents per gallon. ZEVs will be subject to a $100 road improvement fee.. [ccxxxii] **2017 - ACA-5 fees and taxes: restriction on expenditures: appropriations limit:** Adds an article to the state Constitution to require revenues derived from vehicle fees imposed under a specified chapter of the Vehicle License Fee Law to be used solely for transportation purposes. Prohibits these revenues from being used for the payment of principal and interest on state transportation general obligation bonds. Restricts portions of the sales and use tax on diesel fuel to expenditure on certain transportation planning or mass transportation purposes.[ccxxxiii]	to 13 cents per gallon in 1957 and the tax on diesel fuel to 20 cents per gallon that year. The diesel tax was reduced to 18.5 cents per gallon the following year after a government study.[ccxxxvii] **1990 - Fuel Tax Act, R.S.O. 1990, c. F.35:** Every purchaser shall pay to the Minister a tax at the rate of 14.3 cents per litre on all clear fuel received or used by a purchaser in Ontario other than clear fuel received or used by a purchaser to operate railway equipment operated on rails in connection with a public transportation system. With the introduction of the Ontario Cap and Trade program, a regulatory charge has been added to the price of fuel and gasoline purchases in the province. **2017 Amendment:** In support of renewable fuels such as biodiesel, the Fuel Tax Act was amended effective May 17, 2017, to add a new category of registered dyers who can dye biodiesel that has not been blended, mixed or combined with any other type or grade of fuel. This new category of registered dyers are exempt from the fuel transportation requirements currently imposed on all registered dyers. This enables more companies to offer coloured biodiesel products while assisting Ontario's transition to a low-carbon economy.[ccxxxviii] **1990 - Gasoline Tax Act, R.S.O. 1990, c. G.5: Tax on gasoline:** sec 2. (1) Every purchaser of gasoline shall pay to the Minister a tax at the rate of, (a) 13.0 cents per litre on all gasoline purchased by, or delivered to, the purchaser before the 1st day of January, 1992; and (b) 14.7 cents per litre on all

		gasoline purchased by, delivered to or used by, the purchaser after the 31st day of December, 1991. 1992, c. 9, s. 2 (1); 1994, c. 18, s. 3 (5); 1996, c. 10, s. 5 (1). **2002 – Budget 2002:** Ontario exempts biodiesel from the provincial diesel fuel excise tax of $0.143/L.[ccxxxix]
Tax on inefficient vehicles	**1978 - Gas Guzzler Tax:** Established a tax on the sale of new vehicles that failed to meet a minimum fuel economy standard set federally.[ccxl]	**FEDERAL** **2007 - "Green Levy" Excise Tax on Fuel-inefficient Vehicles:** replaced a heavy vehicle tax in 2007. The fuel-inefficient vehicle tax will apply to automobiles (including station wagons, vans, and sport utility vehicles) designed primarily for use as passenger vehicles, but not including pickup trucks, vans equipped to accommodate 10 or more passengers, ambulances and hearses, in accordance with the vehicle's fuel-efficiency rating. Canada's federal tax on fuel-inefficient vehicles, in effect since 2007, is comparatively weak, with the highest threshold for triggering the tax >13L/100 km and the lowest tax rate (starting at $1,000 and rising to a maximum of $4,000[ccxli] With the high purchase prices of these vehicles, the tax is unlikely to alter purchasing decisions. Further, the tax does not capture many vehicles that are among the worst emitters in their category as they fall just below the threshold of 13 litres per 100 km. The exemption of pickup trucks is also problematic, as these cars represent some of the best-selling vehicles in Canada.[ccxlii]

Feebates		**<u>1991</u> - Tax for Fuel Conservation:** Ontario introduced North America's first automobile feebate in 1991. Born out of the 1989 Tax on Fuel-inefficient Vehicles, the Tax for Fuel Conservation (TFC) provided a rebate of $100 for passenger cars with fuel consumption of less than 6.0 litres per 100 kilometres (/100km), and an increasing tax for vehicles with fuel consumption above 6.0 litres/100km. The tax was higher for passenger vehicles than SUVs with an equal fuel consumption (see Table 3). It was a modest application of the concept. A large proportion (approximately 90 percent) of vehicles sold in Ontario were subject to a flat tax of $75 (Bregha and Moffet 1995). This tax and the rebate ($100) for fuel-efficient vehicles were small, relative to the price of new vehicles. They are unlikely to have influenced vehicle sales significantly.[ccxliii] **<u>2000-2011:</u> Ontario Feebate Program:** All hybrid passenger cars with regenerative braking; hybrid SUVs eligible 2002 PST rebate, up to $1,000, for cars bought after 10 May 2001. Hybrid SUVs and trucks included 18 June 2002. Point-of-sale reduction of all PST up to $2,000 after 23 March 2006**.** [ccxliv] **<u>FEDERAL:</u>** **<u>2007-2009:</u> EcoAuto Rebate Program:** The current subsidy, the ecoAUTO Rebate Program, offers a rebate of between $1,000 and $2,000 for cars with fuel-efficiency levels of better than 6.5 litres per 100 km or light trucks achieving better than 8.3 L/100km.[ccxlv]

Subsidies for clean vehicles and retirement of old vehicles	**FEDERAL:** **1998 - Clean Fuels Grant Program:** The Transportation Equity Act for the 21st Century (TEA-21) of 1998 (Public Law 105-178 (PDF)) continues the CMAQ program and establishes the Clean Fuels Grant Program, which allows transit systems to apply for and receive grants to purchase or lease clean fuel buses, related equipment or facilities, and use biodiesel.[ccxlvi] **2005-2016: Alternative Fuel Motor Vehicle Credit:** Established under the Energy Policy Act of 2005, starting in 2006 this program subsidizes the purchase of qualified clean vehicles (hybrids, fuel cell, alternative fuel motor vehicles). The credit depends on the vehicle technology and increases in some cases for fuel conservation or fuel economy. The program expired in 2016. A tax credit up to $4,000 for brand new hybrid, electric or diesel fuel vehicles based on fuel economy. A tax credit of up to $8,000 for the purchase of light duty fuel cell vehicles, depending on fuel economy.[ccxlvii] **2008: Qualified Plug-In Electric Vehicle (PEV) Tax Credit (Reference Public Law 112-240, Section 403; and 26 U.S. Code 30D):** A tax credit is available for the purchase of a new qualified PEV that draws propulsion using a traction battery that has at least five kilowatt-hours (kWh) of capacity, uses an external source of energy to recharge the battery, has a gross vehicle weight rating of up to 14,000 pounds, and meets specified emission standards. The minimum credit amount is $2,500, and the credit may be up to $7,500, based on each vehicle's traction battery capacity and the gross vehicle weight rating. The	**PROVINCE:** **2001-2010 -** Start: May 2001 End: July 2010 PST rate: 8% All hybrid passenger cars with regenerative braking; hybrid SUVs eligible 2002 PST rebate, up to $1,000, for cars bought after 10 May 2001. Hybrid SUVs and trucks included 18 June 2002. Point-of-sale reduction of all PST up to $2,000 after 23 March 2006.[cclxi] **2010 - Electric Vehicle Incentive Program:** support EV adoption by providing monetary incentives for eligible vehicle purchases. Originally a rebate of up to $8,500 was offered for the purchase or lease of new EVs based on vehicle battery capacity. Updated incentive in 2016 to offer between $3,000 and $14,000 for vehicles based on battery capacity, seating, and vehicle price. The Climate Change Action Plan extended the rebate to 2020. On March 9, 2018, the Electric Vehicle Incentive Program (EVIP) became the Electric and Hydrogen Vehicle Incentive Program. The modernized program: • Increased the current incentive range for EVs from $5,000 - $8,500 to $6,000 - $10,000 • Provided an opportunity to receive an additional $3,000 incentive for vehicles with larger battery capacities • Provided an additional $1,000 incentive for vehicles with five or more seats In addition, the modernized EVIP included two caps. Firstly, the incentive amount was capped at $3,000 if the MSRP of the vehicle was over $75,000. Second, the incentive value was capped

	credit will begin to be phased out for each manufacturer in the second quarter following the calendar quarter in which a minimum of 200,000 qualified PEVs have been sold by that manufacturer for use in the United States. This tax credit applies to vehicles acquired after December 31, 2009.[ccxlviii] **2009 - Alternative Fuel Tax Exemption:** Alternative fuels used in a manner that the Internal Revenue Service (IRS) deems as nontaxable are exempt from federal fuel taxes. Common nontaxable uses in a motor vehicle are: on a farm for farming purposes; in certain intercity and local buses; in a school bus; for exclusive use by a non-profit educational organization; and for exclusive use by a state, political subdivision of a state, or the District of Columbia. This exemption is not available to tax exempt entities that are not liable for excise taxes on transportation fuel. (Reference 26 U.S. Code 4041).[ccxlix] **STATE:** **1998 - AB-1571 Carl Moyer Memorial Air Standards Attainment Program:** Since 1998, the program has cost-effectively reduced smog-forming and toxic emissions. Approximately $1 billion has been allocated to date and the Program continues to provide over $60 million in grant funding each year to clean up older polluting engines throughout California. The regulatory, technological and incentives landscape has changed significantly since the creation of the Moyer Program and to address evolving needs, the Legislature has periodically modified the Program to better serve California. Bill includes reporting requirements.[ccl]	such that its value would not exceed 30% of the MSRP.[cclxii] **2017 - Electric School Bus Pilot Program:** provides funding to school bus operators to determine if ESBs can operate reliably and cost effectively in Ontario in a range of weather conditions. The ESB Pilot also aims to determine lifecycle costs as well as any potential constraints for school bus operators, as well as the potential of ESBs to reduce greenhouse gas emissions and improve air quality. The ESB Pilot is a competitive, application-based program that provides funding to eligible school bus operators to add a new 100% battery electric school bus to their fleet as well as charging infrastructure (referred to as Electric Vehicle Supply Equipment or EVSE) and coverage of installation costs.[cclxiii] **2018 - The Electric and Hydrogen Vehicle Incentive Program:** On March 9, 2018, the Electric Vehicle Incentive Program (EVIP) became the Electric and Hydrogen Vehicle Incentive Program, with the following changes: Incentives of up to $14,000 will be provided for eligible hydrogen fuel cell vehicles (HFCVs); Incentives for eligible battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) are now determined based on each vehicle's all-electric range and seating capacity. The updated incentives vary from $5,000 to $14,000; Incentives will no longer be provided for PHEVs or BEVs with a Manufacturer's Suggested Retail Price (MSRP) of $75,000 or more; and Incentives will no longer be provided for PHEVs or BEVs leased for less than

	2007 – AB 118 Enhanced Fleet Modernization Program: The Enhanced Fleet Modernization Program (EFMP) is a voluntary vehicle retirement (scrap) and replacement incentive program. The goal of the program is to incentivize lower-income California motorists to scrap their older, high-emitting vehicles and replace them with newer, cleaner and more fuel efficient vehicles. The Retire and Replace program goes one step further than the retirement-only program by providing up to $4,500 to lower-income drivers who scrap an old vehicle and buy a cleaner and more fuel-efficient replacement vehicles. Alternative transportation mobility options, such as transit passes, are also available in lieu of a replacement vehicle purchase. Plus-Up pilot program launched in 2015 to increase access for low-moderate income households to vehicle retire and replace incentives.[ccli] **2009 - Clean Vehicle Rebate Project (CVRP):** provides consumer rebates of $5,000 for fuel cell vehicles, $2,500 for battery electric vehicles, and $1,500 for plug-in hybrid electric vehicles. The federal government also provides a $7,500 tax credit to purchasers of qualifying electric vehicles. As ZEV sales increase, the amount of funding needed to provide rebates would need to increase as well at a cost to taxpayers under the current incentive structure. As of June 30, 2017, only qualified lower-income applicants, as described **here**, will receive rebates. CVRP reserved $8 million for qualified lower-income applicants, thereby prioritizing payments to low- and moderate-income applicants in accordance with	three years.[cclxiv]

	program requirements. This program is funded by the ARB's Low Carbon and Air Quality Improvement Program.[cclii] **Public Fleet Pilot Project:** The Public Fleet Pilot Project is a set-aside within the Clean Vehicle Rebate Project (CVRP) that provides increased incentives for public entities that own and operate vehicles in disadvantaged communities. Offers up to $15,000 in rebates for the purchase of new, eligible zero-emission and plug-in hybrid light-duty vehicles. The Project replaces standard CVRP rebates with increased incentives for public agencies operating in California's most vulnerable and pollution-burdened areas.[ccliii] **<u>2014</u> - SB 1275 De Léon Electric Vehicle Incentives Chapter 530:** Places several requirements on ARB including: (1) incorporating into the Air Quality Improvement Program Funding Plan a forecast of projected funding needs for the two subsequent fiscal years and a vehicle market and technology assessment; (2) implementing new programs targeted at expanding electric transportation mobility options in disadvantaged communities; and (3) adopting a number of programmatic changes to the Clean Vehicle Rebate Project and the Enhanced Fleet Modernization Program by June 30, 2015.[ccliv] **<u>2015</u> - Senate Bill (SB) 513 (Beall) Carl Moyer Program:** Bill provides new opportunities for the Program to contribute significant emission reductions alongside implemented regulations, advance zero and near-zero technologies, and combine program funds with those of other incentive programs. These changes – cost-effectiveness limits that recognize technology	

	and regulatory costs, the ability to leverage Moyer dollars with project co-funding, added eligibility for infrastructure projects – enable the Moyer Program to fully support emission reductions within the changing landscape of clean air technology.[cclv] **2017 - AB 1259 (CALDERON) CAPITAL ACCESS LOAN PROGRAM: ELECTRIC VEHICLES:** Expands the Capital Access Loan Program at the California Pollution Control Financing Authority, which normally assists small businesses in financing the costs of complying with environmental mandates and the remediation of contamination on their properties, to include the purchase of an electric vehicle by low- and middle-income consumers and families.[cclvi] **2017 - AB-188 Vehicle retirement and replacement:** Existing law creates the enhanced fleet modernization program to provide compensation for the retirement and replacement of passenger vehicles and light-duty and medium-duty trucks that are high polluters. This bill would require the State Air Resources Board, no later than July 1, 2019, to update the guidelines for the enhanced fleet modernization program to make applicable to light-duty pickup trucks the same standard for miles per gallon that is applicable to minivans, as specified.[cclvii] **2017 - AB 615 (COOPER) AIR QUALITY IMPROVEMENT PROGRAM: CLEAN VEHICLE REBATE PROJECT:** Existing law, until July 1, 2017, requires the state board, for the purposes of the Clean Vehicle Rebate Project, to, among other things, offer rebates only to applicants who purchase an eligible vehicle and have a specified maximum	

	gross annual income; increase rebate payments by $500 for low-income applicants, as defined; and prioritize rebate payments for low-income applicants. This bill instead would extend the applicability of these provisions to until January 1, 2019. This bill would require the state board to work with, and contract with, either the University of California or the California State University to prepare and submit to the Legislature a report on the impact of the Clean Vehicle Rebate Project on the state's zero-emission vehicle market no later than December 31, 2018. The bill would require the Department of Finance to submit to the Legislature a report evaluating the fiscal impacts of the Clean Vehicle Rebate Project no later than July 1, 2018.[cclviii] **2017 - AB 630 (COOPER) VEHICLES: RETIREMENT AND REPLACEMENT:** This bill would establish the Clean Cars 4 All Program to be administered by the State Air Resources Board to focus on achieving reductions in the emissions of greenhouse gases, improvements in air quality, and benefits to low-income state residents through the replacement of high-polluter motor vehicles with cleaner and more efficient motor vehicles or a mobility option, as specified. The bill also would require the state board, no later than July 1, 2018, to update the guidelines for the Clean Cars 4 All Program and the enhanced fleet modernization program, as specified. The bill would require the state board, beginning no later than July 1, 2019, and every year thereafter, to collect and post on its Internet Web site specified information on both programs. This bill would authorize the state board to allocate moneys,	

	upon appropriation, for the expansion of the replacement component or mobility option component of both programs from the Enhanced Fleet Modernization Subaccount, the High Polluter Repair or Removal Account, and the Vehicle Inspection and Repair Fund. The bill also would authorize the state board to allocate moneys, upon appropriation, from the Greenhouse Gas Reduction Fund to the Clean Cars 4 All Program. **2018 - AB 2006 (Eggman) Agricultural Worker Clean Transportation Investment Program:** Would establish the Agricultural Worker Clean Transportation Investment Program, which would be administered by the state board to fund the deployment of near-zero-emission and zero-emission vehicles, as defined, used for agricultural vanpools, as defined, serving disadvantaged or low-income communities, as defined, to reduce greenhouse gas emissions. Would authorize moneys from the Greenhouse Gas Reduction Fund to be available, upon appropriation, for allocation under the provisions of the program.[cclix] **2018 - AB 193 (Cervantes) Zero-Emission Assurance Project:** Pursuant to its existing statutory authority, the state board has established the Clean Vehicle Rebate Project, as a part of the Air Quality Improvement Program, to promote the production and use of zero-emission vehicles by providing rebates for the purchase of new zero-emission vehicles. This bill would require the state board, until July 31, 2025, to establish the Zero-Emission Assurance Project to provide rebates for the replacement of or a vehicle service contract, as defined, for a battery, fuel cell, or	

	related components for an eligible used vehicle. The bill would require the state board to submit a specified report on the Zero-Emission Assurance Project to the Legislature no later than January 1, 2024.[cclx]	
Non financial clean vehicle incentives	**FEDERAL:** **2015 - HOV Lane Exemption:** States are allowed to exempt certified alternative fuel vehicles (AFVs) and plug-in electric vehicles (PEVs) from HOV lane requirements within the state. Eligible AFVs are defined as vehicles operating solely on methanol, denatured ethanol, or other alcohols; a mixture containing at least 85% methanol, denatured ethanol, or other alcohols; natural gas, propane, hydrogen, or coal derived liquid fuels; or fuels derived from biological materials. PEVs are defined as vehicles that are recharged from an external source of electricity and have a battery capacity of at least 4 kilowatt-hours. States are also allowed to establish programs allowing low-emission and energy-efficient vehicles to pay a toll to access HOV lanes. Vehicles must be certified by the U.S. Environmental Protection Agency (EPA) and appropriately labeled for use in HOV lanes. The U.S. Department of Transportation (DOT) is responsible for planning and implementing HOV programs, including the low-emission and energy-efficient vehicle criteria EPA established. States that choose to adopt these requirements will be responsible for enforcement and vehicle labeling. The HOV exemption for AFVs and PEVs expires September 30,	**PROVINCE** **2005 - Transportation Statute Law Amendment Act, 2005, S.O. 2005, c. 26 Bill 169:** New section 154.1 allows the Minister to designate any lane as a high occupancy vehicle lane and to limit the use of that lane to prescribed classes or types of vehicles with a specified number of occupants.[cclxxx] **2009 - Ontario Green License Plate Program:** Vehicles with green licence plates have ongoing access to High Occupancy Vehicle (HOV) lanes and no-cost access to High Occupancy Toll (HOT) lanes on 400-series highways and the Queen Elizabeth Way (QEW), even if there is only one person in the car. he following vehicles are eligible for green licence plates: Plug-in hybrid electric vehicles (PHEV) and battery electric vehicles (BEV) eligible for the Electric Vehicle Incentive Program (EVIP); Used 2010 or later model year PHEVs and BEVs; and PHEVs, BEVs and hydrogen fuel cell vehicles (HFCVs) currently operating in Ontario in limited numbers as part of a pilot study or test program.[cclxxxi] **2010 - EV use of HOV lanes:** EVs granted unrestricted access to HOV lanes in the province.

	2025 and low-emission and energy-efficient vehicle toll-access to HOV lanes expires September 30, 2019. (Reference Public Law 114-94 and 23 U.S. Code 166).[cclxv] **STATE:** **2010 - SB-535 Vehicles: high-occupancy vehicle lanes:** Senate Bill 535 provided that starting in 2012, 40,000 HOV access stickers could be issued to early purchasers of Enhanced AT PZEVs. The first vehicles to qualify are super clean plug-in hybrid vehicles, however certain hydrogen powered internal combustion engines may also qualify. As with all HOV programs, stickers are issued on a first come first served basis to delivered qualifying vehicles.[cclxvi] **2013 - AB 266 CH 405-Vehicles: high-occupancy vehicle lanes. An Act to Amend Section 21655.9 and 5205.5 Of the Vehicle Codes:** Existing state law authorizes the Department of Transportation to designate certain lanes for the exclusive use of HOVs, which lanes may also be used, until January 1, 2015. This bill would extend the operation of those provisions for certain low-emission vehicles to January 1, 2019, or until federal authorization expires, or until the Secretary of State receives that specified notice, whichever occurs first. The bill would until January 1, 2015, or until the Secretary of State receives that specified notice, authorize the department to issue a valid identifier to a vehicle that meets California's transitional zero-emission vehicle (TZEV) standard.[cclxvii] **2014 - SB 1298 (Hernandez, E.) High-Occupancy Toll Lanes Chapter 531:** Deletes the January 15,	

	2015 sunset on the authority for the Los Angeles County Metropolitan Transportation Authority to operate high-occupancy toll lanes on State Highway Routes 10 and 110 in Los Angeles County, and revises and recasts those provisions.[cclxviii] **2014 - AB 1721 Linder High-Occupancy Toll Lanes Chapter 526:** Allows transportation authorities to charge tolls, in addition to free passage, to clean air vehicles (denoted with a white or green sticker) when traveling in specified high occupancy toll lanes in the State.[cclxix] **2014 - AB 1811 Buchanan High-Occupancy Toll Lanes Chapter 94:** Authorizes the Alameda County Transportation Commission, for purposes of enforcing access to high occupancy toll lanes, to require high-occupancy vehicles to have an electronic transponder in order to access high-occupancy toll lanes in its jurisdiction.[cclxx] **2014 - AB 2013 (Murtasuchi) High-Occupancy Vehicle Lane Access Chapter 527:** This bill increases the number of green decals, from 55,000 to 70,000, that the Department of Motor Vehicles may issue to transitional zero emission vehicles (e.g., plug-in hybrid electric vehicles such as the Chevrolet Volt).[cclxxi] **2014 - AB 2090 (Fong) High-Occupancy Toll Lanes Chapter 528:** Repeals specific service requirements for high-occupancy toll lanes operated by the San Diego Association of Governments (SANDAG) and the Santa Clara Valley Transportation Authority (VTA), and requires instead that the agencies, with the consent of Caltrans, develop appropriate performance measures for the lanes. The bill also authorizes	

	SANDAG and VTA, for purposes of enforcing access to these restricted lanes, to require high-occupancy vehicles using the high-occupancy toll lanes to have an electronic transponder or other electronic device.[cclxxii] **2015 - AB 194 (Frazier) High-Occupancy Toll Lane Development Chapter 687:** Authorizes CalTrans and regional transportation agencies to develop and operate high-occupancy toll (HOT) lanes or other toll facilities, as specified.[cclxxiii] **2015 - AB 914 (Brown) HOT Facilities: San Bernardino County Chapter 702:** Authorizes the San Bernardino County Transportation Commission to develop and operate a value pricing program on the I-10 and I-15 corridors that may include the use of HOT lanes or other toll facilities, to set and collect tolls, and to issue bonds to finance the project. The bill also authorizes the San Bernardino County Transportation Commission to enter into agreements with transportation agencies in neighboring counties for coordination of connecting toll facilities. The value pricing program may only be implemented if the program and resulting facilities will improve performance of the affected transportation corridors.[cclxxiv] **2016 - SB 838 Ch. 339 HOV lanes:** Removal of cap on 'green decals' for vehicles. This bill would delete the maximum number of identifiers that the DMV is authorized to issue. The bill would extend the operation of the above provisions for super ultra-low emission vehicles and ultra-low emission vehicles, as defined, to January 1, 2019.[cclxxv]	

	<u>2016</u> - AB 1964, High-occupancy vehicle lanes: vehicle exceptions: An act to amend Sections 5205.5 and 21655.9 of the Vehicle Code, relating to vehicle. bill would provide that identifiers issued for partial or transitional zero-emission vehicles on or after January 1, 2018, but before January 1, 2019, would be valid until January 1, 2021. The bill would provide that identifiers issued for those vehicles on or after January 1, 2019, would be valid until January 1 of the 4th year after the year of issuance. The bill would remove the limit of 85,000 identifiers for those vehicles, and would instead prohibit the Department of Motor Vehicles from issuing identifiers if the sale of new vehicles of that category reaches at least 9.2% of the total new car market share for 2 consecutive years, upon notification by the State Air Resources Board, as specified. The bill would impose income restrictions regarding an applicant's ability to qualify for both an identifier and a rebate under the Clean Vehicle Rebate Project, and would require the department to collaborate with the board to establish procedures implementing these restrictions.[cclxxvi] **<u>2017</u> - AB 620 (Hernández, R.) HOT Lane Exemptions:** Requires LACMTA to take additional steps to increase enrollment and participation in the low-income assistance program, as specified, and requires LACMTA and the California Department of Transportation (Caltrans) to report to the Legislature by December 31, 2018, on efforts to improve low-income use of HOT lanes, additional incentives to encourage low-income participation, and the performance of HOT lanes in improving congestion	

	and offsetting the impact to low-income commuters.[cclxxvii] **<u>2017</u> - AB 544 - High Occupancy Vehicle Lanes:** This bill would extend the authority of drivers of specified vehicles to use HOV lanes until the date federal authorization expires, or until the Secretary of State receives a specified notice, whichever occurs first. The bill would authorize the Department of Motor Vehicles to issue identifiers until the date federal authorization expires, or until the Secretary of State receives a certain notice, whichever occurs first. The bill would make certain existing identifiers valid until January 1, 2019, would make certain identifiers issued on or after January 1, 2019, valid until January 1, 2022, and would make other identifiers issued on or after January 1, 2019, valid until January 1 of the 4th year after the year in which they were issued, as specified. The bill would provide, subject to exception, that a vehicle may not be issued an identifier more than once. The bill would additionally condition eligibility for the identifiers on the applicant not having received a rebate pursuant to the Clean Vehicle Rebate Project for a vehicle purchased on or after January 1, 2018, unless the applicant meets certain income restrictions.[cclxxviii] **<u>2018</u> - SB 957 (Lara) Vehicles: Hov Lanes:** Would expand eligibility for the Clean Air Vehicle (CAV) program to allow for the issuance of a decal for a vehicle that had previously been issued a decal, if the applicant's income is at or below 80% of the state median income. The Department of Motor Vehicles (DMV) may issue decals to these applicants from	

	January 1, 2019 until January 1, 2023 that would expire in 2023.[cclxxix]	
Funding and support for research and development and industry partnerships, local industry development	**FEDERAL:** **1978 – Formation of Office of Energy Efficiency and Renewable Energy:** established a dedicated office within the Department of Energy tasked with overseeing investment and coordination of high-risk, high-value research on clean energy technologies.[cclxxxii] **1980 – US Synthetic Fuels Corporation Act:** created a federally funded public corporation to take the lead on developing commercial synthetic fuel manufacturing facilities. Set a goal of producing at least two million barrels per day of synthetic fuels to meet the needs of US consumers and businesses.[cclxxxiii] **1980 – Biomass Energy and Alcohol Fuels Act:** Provided funding and other financial incentives aimed at promoting the production and widespread consumption of biomass and alcohol-based fuels in the US.[cclxxxiv] **2000 - 2012 - Biomass Research and Development:** Established: FY2001 by the Biomass Research and Development Act of 2000, §307 (P.L. 106-224); program extended and mandatory appropriations provided by the Farm Security and Rural Investment Act of 2002, §9008 (P.L. 107-171); program extended and funding authorization expanded by the Energy	**FEDERAL:** **1992 – Energy Efficiency Act:** The legitimacy of NRCan's role in supporting the production and use of alternative transportation fuels is supported by the 1992 *Energy Efficiency Act*, which states that to promote efficient energy use and the use of alternative energy sources, NRCan's Minister may: conduct, or cooperate with persons conducting, research, development, tests, demonstrations and studies; publish information, research or test results; assist, cooperate with, consult and enter into agreements with any person, including any department or agency of the Government of Canada or of any province; make grants and contributions; and undertake such other projects, programs and activities as in the Minister's opinion advance that purpose.[cccv] **2000 – Biomass for Energy Program:** The Biomass for Energy program is introduced to support research and development on the use of biomass as a source of alternative energy. Goals include: identifying new and existing supplies of biomass for energy production; developing new biomass production, collection, harvesting, storage and transportation methods; as well as to

	Policy Act of 2005, §941 (P.L. 109-58); significantly modified by the Food, Conservation and Energy Act of 2008, §9008 (P.L. 110-246). Grants are provided for biomass research, development, and demonstration projects. Eligible projects include ethanol and biodiesel demonstration plants.[cclxxxv] **2001 - Biorefinery Project Grants:** This program provides funds for cooperative biomass research and development for the production of fuels, electric power, chemicals, and other products. Annual funding: Approximately $200 million appropriated annually for the biomass program—not all of this funding will go toward biorefinery project grants.[cclxxxvi] **2003 - National Hydrogen Learning Demonstration Grants:** Grants to fund demonstration projects for hydrogen fuel cell vehicles and infrastructure as well as vehicle infrastructure interfaces.[cclxxxvii] **2004 - Advanced Technology Vehicle (ATV) and Alternative Fuel Infrastructure Manufacturing Incentives (Reference 42 U.S. Code 17013)**: Loan Program where manufacturers may be eligible for direct loans for up to 30% of the cost of re-equipping, expanding, or establishing manufacturing facilities in the United States used to produce qualified ATVs, ATV components, or alternative fuel infrastructure, including associated hardware and software. Qualified ATVs are light-duty or ultra-efficient vehicles that meet specified federal emission standards and fuel economy requirements.[cclxxxviii] **2005 - Energy Policy Act of 2005, Section 706 Joint Flexible Fuel/Hybrid Vehicle Commercialization Initiative:** Directs DOE to establish a research	demonstrate the sustainability of increased biomass supply for energy production. Eligible research must focus on biomass from the agricultural or forestry sectors.[cccvi] **2001 - Canada Foundation for Sustainable Development Technology Act (S.C. 2001, c. 23):** SDTC is a not-for-profit foundation, established by the Canadian Government in 2001, which finances and supports the development and demonstration of clean technologies providing solutions to issues of climate change, clean air, water quality and soil. SDTC aims at creating an end-to-end cohesive innovation chain, from science to commercialisation, and at bridging the funding and cultural gap that prevents news ideas from reaching a market. Two major funds: 1) SD Tech Fund: The SD Tech Fund supports projects that are pre-commercial and have the potential to demonstrate significant and quantifiable environmental and economic benefits in one or more of the following areas: climate change, clean air, clean water and clean soil. Since 2001, the Government of Canada has allocated a total of $965 million for the fund. 2) NextGen Biofuels Fund -The NextGen Biofuels Fund supports the establishment of first-of-kind large demonstration-scale facilities for the production of next-generation renewable fuels. **2016 - Funding under the Pan-Canadian Framework:** Over $2.2 billion in funding for clean technology initiatives, including nearly $1.4 billion in financing dedicated to financing clean technology firms. These investments support Canada's commitment in Mission Innovation to

	program to advance the commercialization of hybrid flexible fuel vehicles or plug-in hybrid flexible fuel vehicles. Requires vehicles to achieve at least 250 miles per petroleum gallon. A total of $40 million is authorized for the program ($3 million in 2006, $7 million in 2007, $10 million in 2008, and $20 million in 2009).[cclxxxix] **2005 - The Title XVII innovative clean energy projects loan program (Title XVII):** provides loan guarantees to accelerate the deployment of innovative clean energy technology. The U.S. Department of Energy is authorized to issue loan guarantees pursuant to Title XVII of the Energy Policy Act of 2005. Loan guarantees are made to qualified projects and applicants who apply for funding in response to open technology-specific solicitations. The U.S. Department of Energy (DOE) provides loan guarantees through the Loan Guarantee Program to eligible projects that reduce air pollution and greenhouse gases and support early commercial use of advanced technologies, including biofuels and alternative fuel vehicles. The program is not intended for research and development projects. DOE may issue loan guarantees for up to 100% of the amount of the loan for an eligible project. Eligible projects may include the deployment of fueling infrastructure, including associated hardware and software, for alternative fuels. For loan guarantees of over 80%, the loan must be issued and funded by the Treasury Department's Federal Financing Bank.[ccxc] **2008 - Alternative Fuel and Advanced Vehicle Technology Research and Demonstration Bonds (Reference 26 U.S. Code 54D):** Qualified state, tribal,	double investment in clean energy research, development and demonstration over the next five years.[cccvii] **2017 - Low Carbon Economy Challenge:** Funded by the Low Carbon Economy Fund. The first is a $600-million Low Carbon Economy Challenge for industry and public sector projects, to be launched this fall and doled out on a merit-based, project-by-project basis. Municipalities, provinces, territories, indigenous governments and organizations, businesses and not-for-profit organizations can all apply for funds, which will be prioritized for projects that provide the biggest emissions reductions for the lowest cost.[cccviii] **PROVINCIAL:** **2005 - The Ontario Ethanol Growth Fund:** Fund to support the production of ethanol fuel in Ontario. The development of ethanol plants in Ontario will also bring new investment, jobs and opportunities to rural communities. (OEGF) provides: Capital assistance to help meet financial challenges; Operating grants to address changing market prices; Support for independent blenders of ethanol and gasoline; A research and development fund to pursue opportunities for research and innovation.[cccix] **2008 - Next Generation Jobs Fund:** The government's $1.15 billion Next Generation of Jobs Fund is an element of the province's Climate Change plan to partner with Ontario industry in its transformation to a low carbon future through the

	and local governments may issue Qualified Energy Conservation Bonds subsidized by the U.S. Department of Treasury at competitive rates to fund capital expenditures on qualified energy conservation projects. Eligible activities include research and demonstration projects related to cellulosic ethanol and other non-fossil fuels, as well as advanced battery manufacturing technologies. Government entities may choose to issue tax credit bonds or direct payment bonds to subsidize the borrowing costs.[ccxci] **2008 - 2012 - Bioenergy Program for Advanced Biofuels:** Established: 2008 by the Food, Conservation, and Energy Act of 2008, §9001 (P.L. 110-246). Provides payments to producers to support and expand production of advanced biofuels. Annual funding: Mandatory funding (to remain available until expended) of $55 million for FY2009, $55 million for FY2010, $85 million for FY2011, and $105 million for FY2012, plus $25 million authorized annually for FY2009-FY2012.[ccxcii] **2008 - 2012 - Biomass Crop Assistance Program (BCAP):** Dollar-for-dollar matching payments for collection, harvesting, storage, and transportation (CHST) of biomass to qualified biofuel production facilities (as well as bioenergy or biobased products), up to $45 per ton.[ccxciii] **2009 - American Recovery and Reinvestment Act of 2009, Division A, Title IV, Energy and Water Development:** Provides $2 billion toward grants for advanced battery systems and electric vehicle components manufacturing. These funds are intended to support domestic manufacturing of advanced lithium ion batteries and hybrid electric systems and	development of clean cars, clean fuels, and clean technologies.[cccx] **2016 - Green Investment Fund, Low-carbon technology for Industry:** Ontario won't be able to achieve its climate targets without encouraging low-carbon industrial activity. Just like the GIF will help save homeowners and communities money on energy bills, it will also help businesses adopt low-carbon technologies to cut costs and carbon pollution. In partnership with the Ontario Centres of Excellence, the GIF invests $74 million to help large industrial facilities adopt clean technology solutions to reduce emissions. It also commits $25 million to energy efficiency programs for small and medium-sized businesses. This will assist existing industries in the low-carbon transition and support the development, demonstration and deployment of made-in-Ontario clean tech innovations.[cccxi] **2017 - Low Carbon Innovation Fund:** The Low Carbon Innovation Fund is a fund to help researchers, entrepreneurs and companies create and commercialize new, globally competitive, low-carbon technologies that will help Ontario meet its GHG emissions reductions targets. The Low Carbon Innovation Fund is part of Ontario's Climate Change Action Plan and is funded by proceeds from the province's carbon market. $25.8 million allocated in 2017.[cccxii] **2017 - Climate Change Action Plan, R&D:** $375-million for research and development into new clean technologies, including $140-million for a Global Centre for Low-Carbon Mobility at an

	components. Approximately 10% of the $787 billion dollars is ultimately devoted to various energy efficiency and renewable energy projects.[ccxciv] Provides $300 million toward competitive grants for alternative fuels and advanced vehicle projects, as authorized by Section 721 of the Energy Policy Act (EPAct) of 2005. The grants are for state governments, local governments, and metropolitan transportation authorities, in partnership with an active and designated Clean Cities coalition.[ccxcv] **2012 - The Moving Ahead for Progress in the 21st Century (MAP-21) Act (Public Law 112-141):** continues and amends existing programs, including CMAQ, and establishes additional funding opportunities for alternative fuel infrastructure and research.[ccxcvi] **2015 - Low and Zero Emission Public Transportation Research, Demonstration, and Deployment Funding:** Financial assistance is available to local, state, and federal government entities; public transportation providers; private and non-profit organizations; and higher education institutions for research, demonstration, and deployment projects involving low or zero emission public transportation vehicles. Funding opportunities include the Public Transportation Innovation Program and the Low or No Emission (Low-No) Vehicle Program. Eligible vehicles must be designated for public transportation use and significantly reduce energy consumption or harmful emissions compared to a comparable standard vehicle. Funding is available through fiscal year 2020 (verified December 2017), but is subject to	Ontario university or college to develop electric and other low-carbon vehicle technology.[cccxiii] **2017 - ONTARIO REGULATION 46/17 made under the DEVELOPMENT CORPORATIONS ACT - ONTARIO CLIMATE CHANGE SOLUTIONS DEPLOYMENT CORPORATION:** the object of the corporation is to stimulate the development of industry, trades and business undertakings in Ontario that further the deployment in Ontario of commercially available technology that reduces greenhouse gas emissions from buildings or from the production of goods, by,(a) providing information; (b) engaging in marketing; (c) providing services and arranging for others to be provided with services; (d) providing incentives and engaging in financing activities, including providing incentives to individuals; (e) stimulating private sector financing; and (f) researching market barriers inhibiting the deployment of that technology and addressing those market barriers[cccxiv] **2017 - The Electric and Hydrogen Vehicle Advancement Partnership:** brings together the automotive sector, environmental advocacy organizations and academic leaders to work alongside government to advance electric and hydrogen-powered vehicle technology and help reduce greenhouse gas emissions. $.09 million allocated in 2017 from the GGRF.[cccxv] **Ontario's Target GHG Collaborative Technology Development Program:** SDTC and the Ontario Centres for Excellence (OCE) have partnered to accept Expressions of Interest (EOIs)

	congressional appropriations thereafter. (Reference Public Law 113-159, Public Law 114-94, 49 U.S. Code 5312, and 49 U.S. Code 5339(c)).[ccxcvii] **STATE:** **1998 – Public Interest Energy Research Program:** In 1996, Assembly Bill 1890 restructured the California electricity industry. Legislation also authorized collection of a surcharge on retail electricity sales to ensure a continuation of public interest energy research, development, and demonstration (RD&D) projects. The PIER program was established at the California Energy Commission in 1998 to implement this provision. California leads the nation in fostering and implementing new sources of electricity to sustain its economy while preserving its natural environment. Awards up to $62 million USD annually to fund research. The government agency funds the Public Interest Energy Research Program, which has invested US$700 million in public funds for research since 1996.[ccxcviii] **2007 - AB 118 California Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act:** The bill would create the Alternative and Renewable Fuel and Vehicle Technology Program, to be administered by the Energy Commission, to provide funding to public projects to develop and deploy innovative technologies that transform California's fuel and vehicle types to help attain the state's climate change policies. Recipients include public and private agencies and businesses, public-private partnerships, vehicle and tech. Consortia, workforce training	from Ontario-based small and medium enterprises (SMEs) who request funding for an innovative technology development and demonstration project for Greenhouse Gas (GHG) reduction technologies. SMEs are responsible for large amounts of innovation and are a source of many new GHG reduction technologies. The SMEs are required to develop Consortium Partnerships, which may include, industrial large emitters, other SMEs, large enterprises and academic institutions. The goal is to accelerate commercialization of technologies that benefit Ontario, Canada and the world through GHG reductions, enterprise development, and economic growth.[cccxvi] **2018 - Ontario's Cleantech Strategy:** Ontario's Cleantech Strategy aims to catalyze the growth of the clean technology market while supporting the Business Growth Initiative, the Climate Change Action Plan and climate change goals. To improve access to capital for cleantech firms, Ontario made an anchor commitment of $55 million to develop new approaches to making equity investments in cleantech firms. In January 2017, the province established the Cleantech Equity Fund initiative, which will focus on providing venture capital to high potential, innovative Ontario-based cleantech businesses. The province has also established the Global Market Acceleration Fund (GMAF) to help Ontario-based cleantech companies mitigate risks of expansion by assisting with the costs associated with scaling-up production, inventory, distribution, and sales to support growing domestic and global

	partnerships and collaboratives, fleet owners, consumers and academic institutions[ccxcix] **2013 – AB 250 (Holden, Chapter 530, Statutes of 2013):** The iHub program improves the state's national and global competitiveness by stimulating partnerships, economic development, and job creation around specific research clusters throughout the state. iHubs are operated through a cooperative agreement between GO-Biz and geographically distinct regions within California. Each iHub represents an independent partnership between local government entities, public universities, research institutions, venture capitalist networks, and economic development organizations. Businesses and potential investors can utilize these regionally-based iHubs to gain greater access to funding opportunities, technology transfers, research relationships, incubator space, and the local workforce. **2014 - SB 1077 (DeSaulnier) Road Usage Pilot Project Chapter 835:** Creates the Road Usage Charge Technical Advisory Committee, and charges the Committee with studying road use charges as an alternative to gas taxes.[ccc] **2017 - SB1 Transportation Funding:** As part of this bill, The bill would continuously appropriate $2,000,000 annually of the funds available for the program to the California State University for the purpose of conducting transportation research and transportation-related workforce education, training, and development, and $3,000,000 annually to the institutes for transportation studies at the University of California.[ccci]	demand. A total of $27 million has been allotted to the GMAF. Through the GreenFIT program, Ontario will commit $10 million towards demonstration projects of new technologies and services.[cccxvii]

	<u>2017</u> - AB 419 (SALAS) GREENHOUSE GAS REDUCTION FUND: REPORT: This bill would appropriate $500,000 from the GHG reduction fund to the state board for the purpose of funding a study by one or more campuses of the University of California to study and assess life cycle emissions profiles.[cccii] **<u>2017</u> - AB-109 Budget Act of 2017 - Climate Investments AND AB 134 (Comm. on Budget, Chapter 254):** created a climate change research program within the Strategic Growth Council (SGC). The legislation allocates $11 million in Greenhouse Gas Reduction Fund revenues to the SGC to develop a research program to support "research on reducing carbon emissions, including clean energy, adaptation, and resiliency, with an emphasis on California." [ccciii] **<u>2017</u> – CalSEED:** CalSEED is one of several initiatives funded by the California Energy Commission to advance energy innovation. This public sector investment helps to accelerate progress against the state of California's clean energy goals and serves as an important avenue for economic development for the state. It is important that innovations supported through CalSEED consider the broad social benefits to residents of California across economic development, access and inclusion. Grants up to $600,000 USD for projects.[ccciv]	

Government procurement and pilot projects	**FEDERAL:** **1992 – Energy Policy Act of 1992:** The Act authorized $50 million a year for 10 years for electric motor vehicle demonstration programs, and $40 million for a 5-year period for electric motor vehicle infrastructure and support systems development program. It authorized $35 million annually for 3 years to demonstrate alternative fuel urban transit buses.[cccxviii] **1992 - The Federal Energy Management Program (FEMP):** Under the Energy Policy Act (EPAct) of 1992, 75% of new light-duty vehicles acquired by covered federal fleets must be alternative fuel vehicles (AFVs). As amended in January 2008, Section 301 of EPAct 1992 defines AFVs to include hybrid electric vehicles, fuel cell vehicles, and advanced lean burn vehicles. Fleets that use fuel blends containing at least 20% biodiesel (B20) may earn credits toward their annual requirements. Federal fleets are also required to use alternative fuels in dual-fuel vehicles unless the U.S. Department of Energy (DOE) determines an agency's vehicle requests qualify for waivers; grounds for a waiver include lack of alternative fuel availability and cost restrictions (per EPAct 2007, section 701). Additional requirements for federal fleets were included in the Energy Independence and Security Act of 2007, including fleet management plan requirements (Section 142), low greenhouse gas (GHG) emitting vehicle acquisition requirements (Section 141), and renewable fuel infrastructure installation requirements (Section 246).[cccxix] **1992 - The State and Alternative Fuel Provider Fleet Program**: Under the Energy Policy Act (EPAct)	**PROVINCE:** **2005 - Transportation Statute Law Amendment Act, 2005, S.O. 2005, c. 26 Bill 169:** New Part XVI (Pilot Projects) is added to the Act. This allows the Lieutenant Governor in Council by regulation to authorize or establish a pilot project for research, testing or evaluation purposes. Any regulation that authorizes or establishes a pilot project must provide that it is revoked within 12 years after it is made..[cccxxxiv] **2010 - GreenFIT Procurement strategy:** Green innovation and technological leadership will be the engines of Ontario's new green economy. The Government of Ontario is committed to leveraging its buying power to make Ontario more competitive, innovative, and sustainable. Through its own purchasing, the government is creating opportunities for new green technology companies as they introduce innovative and sustainable solutions into the local and global marketplace. GreenFIT solutions will contribute to the "greening" of the public sector by helping the Ontario Public Service (OPS) and Municipal, Academic, Schools and Hospitals (MASH) find new green solutions for their purchasing needs.[cccxxxv] **2016 - The Energy Innovation Program (EIP), Electric Vehicle Infrastructure Demonstrations:** has received $46.1 million in funding over 2 years through Budget 2016, to support the demonstration of next-generation electric vehicle (EV) charging infrastructure in Canada. The Electric Vehicle Infrastructure Demonstration component will

	of 1992, as amended, certain state government and alternative fuel provider fleets are required to acquire alternative fuel vehicles (AFVs) as a portion of their annual light-duty vehicle acquisitions. Compliance is required by fleets that operate, lease, or control 50 or more light-duty vehicles within the United States. Of those 50 vehicles, at least 20 must be used primarily within a single Metropolitan Statistical Area/Consolidated Metropolitan Statistical Area, and those same 20 vehicles must also be capable of being centrally fueled for the fleet to be subject to the regulatory requirements.[cccxx] **1998 - Transportation Equity Act for the Twenty-First Century:** Under the Clean Fuels Formula Grant Program, TEA-21 authorized $500 million to help transit operators purchase low-emissions buses and related equipment and to modify garage facilities to accommodate clean-fuel vehicles. TEA 21 also included $250 million, matched by private funding, to develop clean, fuel-efficient trucks and other heavy vehicles.[cccxxi] **2005 - Energy Policy Act of 2005, Section 701 Federal Fleet Dual-Fuel Vehicles: Fuel Use Requirement:** Requires federal fleets to use alternative fuels in dual-fuel vehicles unless the U.S. Department of Energy (DOE) determines an agency qualifies for a waiver. Grounds for a waiver include the lack of alternative fuel availability and cost restrictions. **Section 782 Federal and State Procurement of Fuel Cell Vehicles and Hydrogen Energy Systems** Requires federal fleets to begin leasing or purchasing fuel cell vehicles and hydrogen energy systems no later than January 1, 2010. DOE	undertake Front End Engineering Design (FEED) studies and demonstrations to reduce the costs, understand the impacts and address potential hurdles for the deployment of next-generation charging infrastructure for electric vehicles.[cccxxxvi] **2017 - O. Reg. 215/17: PILOT PROJECT - LOW-SPEED VEHICLES under Highway Traffic Act, R.S.O. 1990, c. H.8:** On July 1, 2017, Ontario launched a new pilot to permit low speed vehicles (LSVs) on Ontario's roads. The Ontario Government is committed to supporting new and emerging technologies that can help move people safely and efficiently while limiting environmental impacts. We are interested in promoting transportation modes that are environmentally friendly, help to reduce air pollution and reduce reliance on conventional fuel. The pilot is intended to evaluate the use of LSVs over a 10-year period to examine their ability to safely integrate with other vehicle types and determine whether existing rules of the road are adequate.[cccxxxvii] **2017 - Electric School Bus Pilot Program:** The ESB Pilot is a competitive, application-based program that provides funding to eligible school bus operators to add a new 100% battery electric school bus to their fleet as well as charging infrastructure (referred to as Electric Vehicle Supply Equipment or EVSE) and coverage of installation costs. The Ministry of Transportation (MTO) will provide funding to implement the ESB Pilot in a minimum of five diverse locations across Ontario, on a variety of route types and with

	will provide incremental cost funding and may provide exemptions if the vehicles are not available or appropriate for fleet needs. Authorizes $15 million in 2008, $25 million in 2009, $65 million in 2010, and such funds as necessary each year for 2011 through 2015.[cccxxii] **2005 - Energy Policy Act of 2005, Sections 721-723 Advanced Vehicles Demonstration and Pilot Program:** Establishes a competitive grant program, administered by Clean Cities, to fund up to 30 geographically dispersed advanced vehicle demonstration projects. Authorizes $200 million (until expended) for this program. Grant recipients will be limited to state and local government agencies and metropolitan transportation authorities. Applications must include a designated Clean Cities coalition. Participants can be public or private entities. Projects are limited to $15 million each and require a 50% cost share. Grant funds may be used for: AFVs (including neighborhood electric vehicles); Fuel cell vehicles; Ultra low sulfur diesel vehicles; Fueling infrastructure acquisition and installation; Vehicle infrastructure and equipment operation and maintenance of vehicles.[cccxxiii] **2005 - Energy Policy Act of 2005, Section 743 Fuel Cell School Buses:** Establishes a DOE demonstration program involving fuel cell school bus manufacturers and at least two local government agencies currently using natural gas school buses. The non-federal cost share is at least 20% of infrastructure and 50% of vehicle costs. Authorizes $25 million for fiscal years 2006 through 2009.[cccxxiv]	operators of different sizes. The pilot program will aim to determine the GHG emissions, noise, air quality and health impacts and co-benefits of switching from diesel to electric buses. However, the program remains limited in scope, and questions remain as to the feasibility of a province-wide roll out.[cccxxxviii]

	2007 - Executive Order 13423: Strengthening Federal Environmental, Energy, and Transportation Management **Executive 2007:** Demands federal agencies to conduct their transportation and energy-related activities in an environmentally, economically and fiscally sound and integrated way. Sets more demanding targets than the Energy Policy Act 2005 and supersedes E.O. 13123 and E.O. 13149. Determines that if an agency operates a fleet of at least 20 motor vehicles it must ensure a 10% annual increase in total fuel consumption that is non-petroleum based relative to 2005. Each agency must equally ensure the use of plug-in hybrid electric (PHEV) vehicles when these are commercially available at a reasonably comparable life-cycle cost to non-PHEV vehicles.[cccxxv] **2009 - 10 U.S.C. 2922G - PREFERENCE FOR MOTOR VEHICLES USING ELECTRIC OR HYBRID PROPULSION SYSTEMS:** The U.S. Department of Defense (DOD) must exhibit a preference for the lease or procurement of motor vehicles with electric or hybrid electric propulsion systems, including plug-in hybrid systems, if the vehicles are commercially available at a cost reasonably comparable to motor vehicles with internal combustion engines. Tactical vehicles designed for use in combat are excluded from the requirement.[cccxxvi] **2012 - Airport Zero Emissions Vehicle and Infrastructure Pilot Program:** The Airport Zero Emissions Vehicle (ZEV) and Infrastructure Pilot Program improves airport air quality and facilitates use of zero emissions technologies at airports. Created	

	in 2012, the program allows airport sponsors to use Airport Improvement Program (AIP) funds to purchase ZEVs and to construct or modify infrastructure needed to use ZEVs.[cccxxvii] **<u>2015</u> - Executive Order 13693: Planning for Federal Sustainability in the Next Decade:** sets a new target for the federal government's GHG emissions to be reduced by 40%, and the share of renewable electricity consumed by the federal agencies to increase to 30% by 2025 (compared to 2008). This is to be done through a broad range of measures that aim to make the federal government's operations more sustainable, efficient and energy-secure. These include: improve agency fleet and vehicle efficiency and management with fleet of at least 20 motor vehicles (reduce fleet-wide per-mile GHG emissions: starting at minimum 4% in fiscal year 2014 and continuously increasing to minimum 30% by 2025; increase the share of zero emission or plug-in hybrid vehicles to 20% of all new passenger vehicle acquisitions by 2020 and 50% by 2025).[cccxxviii] **<u>STATE:</u>** **<u>2000</u> - title 13, California Code of Regulations, sections 1956.1, 2020, 2023, 2023.1 & 2023.4 Zero Emission Urban Bus Fleets:** the Air Resources Board adopted the Fleet Rule for Transit Agencies and more stringent exhaust emission standards for new Urban Bus engines and vehicles. The regulation also promotes advanced technologies by providing for zero-emission bus (ZEB) demonstration projects and requiring ZEB acquisitions applicable to larger transit agencies (more than 200 UBs).[cccxxix]	

	<u>2012</u> – Electric Program Investment Charge: The California Public Utilities Commission established the purposes and governance for the Electric Program Investment Charge in Decision 12-05-037 for Rulemaking 11-10-003 on May 24, 2012. The portion of the EPIC Program administered by the Energy Commission will provide funding for applied research and development, technology demonstration and deployment, and market facilitation for clean energy technologies and approaches for the benefit of ratepayers of Pacific Gas and Electric Company, San Diego Gas & Electric Company, and Southern California Edison Company through a competitive grant solicitation process.[cccxxx] **<u>2017</u> - SB-498 Vehicle fleets: zero-emission vehicles:** (1) Requires the Air Resources Board to review all programs affecting the adoption of zero-emission vehicles and report to the Legislature by January 1, 2019, and make policy recommendations for increasing the use of zero-emission vehicles in the state. (2) Also requires the Department of General Services, beginning no later than the 2024–25 fiscal year, to ensure at least 50% of the light-duty vehicles purchased for the state vehicle fleet are zero-emission vehicles.[cccxxxi] **<u>2017</u> - AB 739 State vehicle fleet: purchases:** This bill would, except as provided, require, beginning December 31, 2025, at least 15% of newly purchased vehicles with a gross vehicle weight rating of 19,000 pounds or more purchased by the department and other state entities for the state fleet to be zero emission, and beginning December 31, 2030, at least 30% of those vehicles to be zero emission.[cccxxxii]	

	2017 - AB 1083, Burke. Transportation electrification: electric vehicle charging infrastructure: state parks and beaches AND AB-1082 Transportation electrification: electric vehicle charging infrastructure: school facilities and other educational institutions: The California Public Utilities Commission (PUC) will provide funding for pilot utility programs to install EVSE at a school facilities, other educational institutions, and state parks or beaches. Priority will be given to locations in disadvantaged communities, as defined by the California Environmental Protection Agency.[cccxxxiii]	
Information measures	**FEDERAL:** **2005 - Energy Policy Act of 2005, Section 759 Fuel Economy Incentive Requirements:** Requires automobile manufacturers to label all dual-fuel (bi-fuel and flex-fuel) vehicles to inform owners that the vehicle can be operated on an alternative fuel. If any dual-fuel automobile is not labeled, it is ineligible to receive the fuel economy incentives included in 49 U.S. Code 32906. This requirement applies to dual-fuel automobiles manufactured on or after September 1, 2006.[cccxxxix] **2011 - Revisions and Additions to Motor Vehicle Fuel Economy Label:** Code of Federal Regulations Citations 40 CFR Part 85, 40 CFR Part 86, 40 CFR Part 600. The redesigned Fuel Economy and Environment Labels will provide the public with new information on vehicles' fuel economy, energy use, fuel costs, and environmental impacts. For the first time, comparable fuel economy and	**FEDERAL:** **2007 - ecoTECHNOLOGY for Vehicles:** The Government of Canada has launched the ecoTECHNOLOGY for Vehicles Program to help Canadians make informed choices when purchasing a vehicle. The program includes in-depth testing and publishing of the safety and environmental performance of a range of emerging technologies for use in light-duty vehicles. The program showcases green technologies at auto shows across the country, provides consumers with information, fosters partnerships with the automobile industry across the country to help identify and take action on barriers to the introduction of environmental technologies.[cccxlvi] **Natural Resources Canada Fuel Consumption Guide:** The information can be used to compare the fuel consumption of different models and help

	environmental ratings will be available for all new vehicles, including advanced technology vehicles such as electric cars. Starting with model year 2013, the improved fuel economy labels will be required to be affixed to all new passenger cars and trucks – both conventional gasoline powered and "next generation" cars, such as plug-in hybrids and electric vehicles. Automakers may also voluntarily adopt the new labels earlier for model year 2012 vehicles.[cccxl] **STATE:** **Drive Clean Buying Guide:** DriveClean.ca.gov is a web site of the California Air Resources Board developed as a resource for car buyers to find clean technology vehicles.[cccxli] **1995** - Since 1995, California has required all new vehicles to be labeled with information about a vehicle's smog emissions.[cccxlii] **2005 - Assembly Bill 1229 (Nation) Environmental Performance Label:** The new Environmental Performance (EP) Label is required on all new vehicles manufactured after January 1, 2009.Since 1978, California's Smog Index Label has helped consumers assess the relative smog emissions from new cars. The most recent amendments to the program create a more user friendly scoring system for determining the Smog Score and adds a Global Warming Score. Both scores are based on a scale of 1 -10 with 10 being the cleanest and 5 representing an average new car. The EP Label also provides the Air Resources Board's (ARB) DriveClean.ca.gov Web site to promote clean vehicle options to new car buyers.[cccxliii]	consumers to select the most fuel-efficient vehicle that meets their everyday needs.[cccxlvii] **EnerGuide Label for Vehicles:** EnerGuide is the official Government of Canada mark for rating and labelling the energy consumption or energy efficiency of products including new vehicles, appliances, heating and cooling equipment, and houses that have had an energy efficiency evaluation. The EnerGuide Label for Vehicles provides model-specific fuel consumption information for new light-duty vehicles available for retail sale in Canada, including passenger cars, vans, pickup trucks and SUVs. Use the EnerGuide label to compare new vehicle fuel consumption information and identify the most fuel-efficient new vehicle that meets your everyday needs.[cccxlviii] **PROVINCE:** **2017 - Plug'n Drive Discovery Centre:** The Ontario government is supporting Plug'n Drive's new EV Discovery Centre (EVDC) in north Toronto. Opening in May 2017, the EV Discovery Centre is the first facility of its kind in the world focused entirely on providing an experiential learning environment for electric vehicles. At this one-stop-shop, visitors will learn about Ontario's Climate Change Action Plan and the role electric cars play in reducing greenhouse gas (GHG) emissions. Visitors will learn about the environmental and economic benefits of EVs and the electricity system that powers them. Finally, visitors will have the opportunity to test drive EV models from leading manufacturers in a family-

	California Laws - Public Resources Code **DIVISION 15. ENERGY CONSERVATION AND DEVELOPMENT** **CHAPTER 3. STATE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT** **COMMISSION (25227): Plug-In Electric Vehicle (PEV) Infrastructure Information Resource:** The California Energy Commission, in consultation with the Public Utilities Commission, must develop and maintain a website containing specific links to electrical corporations, local publicly owned electric utilities, and other websites that contain information specific to PEVs, including the following: Resources to help consumers determine if their residences will require utility service upgrades to accommodate PEVs; Basic charging circuit requirements; Utility rate options; and Load management techniques.[cccxliv] **2018 - AB 2885 (Rodriguez) Air Quality Improvement Program: Clean Vehicle Rebate Project:** Beginning January 1, 2019, would instead require the Air Resources Board, for purposes of the Clean Vehicle Rebate Project, to provide outreach to low-income households and low-income communities to increase consumer awareness of the rebate project and to prioritize rebate payments to both low-income applicants and applicants that have eligible vehicles registered in low-income communities.[cccxlv]	friendly sales-free environment, to see first-hand how an EV can fit into their life.[cccxlix]
Transportation Demand Management		

Transit-Integrated land-use planning, sustainable development/"s mart growth" policies	**FEDERAL:** **1924 - A Standard State Zoning Enabling Act (SZEA):** was developed by an advisory committee on zoning appointed by Secretary of Commerce (and later President) Herbert Hoover in 1921. After several revisions, the Government Printing Office published the first printed edition in May 1924, and a revised edition in 1926. The SZEA had nine sections. It included a grant of power, a provision that the legislative body could divide the local government's territory into districts, a statement of purpose for the zoning regulations, and procedures for establishing and amending the zoning regulations. A legislative body was required to establish a zoning commission to advise it on the initial development of zoning regulations.[cccl] **1928 - A Standard City Planning Enabling Act (SCPEA):** In March 1927, a preliminary edition of the second model, A Standard City Planning Enabling Act (SCPEA), was released, and a final version was published in 1928. The SCPEA covered six subjects: the organization and power of the planning commission, which was directed to prepare and adopt a "master plan" the content of the master plan for the physical development of the territory provision for adoption of a master street plan by the governing body provision for approval of all public improvements by the planning commission control of private subdivision of land provision for the establishment of a regional planning commission and a regional plan[ccli]	**PROVINCE:** **1946 (original)The Planning Act:** The Planning Act sets out the ground rules for land use planning in Ontario and describes how land uses may be controlled, and who may control them. **1983 – An Act to Revise the Planning Act, 1983. S.O. 1983, c. 1.:** The new provincial Planning Act of 1983 gave the Province the authority to delegate planning powers to municipalities if it wished, but it did not give municipalities the right to acquire those powers. What the new 1983 Act did do is introduce the concept of "provincial interests" to the planning system. The Act specifies nine areas of interest that the provincial government was obliged to protect, and states that the Province could, at any time, issue "policy statements" to carry out this protection. Provincial Policy Statements have evolved over time to increasingly integrate environmental objectives into land-use planning decisions. [ccclxxxi] The statute, among other things, is designed to both promote sustainable economic development and to integrate matters of provincial interest into provincial and municipal planning decisions, requiring that all such decisions be consistent with the Provincial Policy Statement (2005). The act contains sections where climate change can potentially be addressed by local governments[ccclxxxii]: **Sec. 28 (Community Improvement Plans)** - Promote neighbourhood revitalization by incorporating a range of energy conservation approaches (e.g. community energy, green roofs

	<u>1962</u> - Federal-Aid Highway Act of 1962: created a federal mandate for a comprehensive urban transportation planning process, carried out cooperatively by states and local governments with federal funding. The 1962 Highway Act, specifically in Section 134: and subsequent regulations, had made federal transportation spending in urban areas contingent on a transportation planning process that was "continuing, cooperative and comprehensive" ("3-C's") in character, and that involved the state and local communities (Sciara, 2015). [ccclii] **<u>1967</u> - Instructional Memorandum (IM) 21-13-67, "Reserved Bus Lanes,":** issued by the Federal Highway Administration (FHWA). Reiteratied the warrant for reserving of lanes for buses and the the warrant for preferential use of lanes by buses. Under preferential use, other vehicles would be allowed to use the lane but only in such numbers that they do not degrade the travel speeds of the buses. The total number of persons using the preferential lanes was to be greater than would be accommodated by opening the lanes to general traffic. Expenditures for bus priority projects on arterial highways, including loading platforms and shelters, became eligible for federal-aid highway funds under the **Traffic Operations Program to Improve Capacity and Safety (TOPICS),** which was initiated as an experimental program in 1967.[ccliii] **<u>1968</u> - The Federal-Aid Highway Act of 1968:** In addition to launching the TOPICS program, the Federal-Aid Highway Act of 1968 incorporated several provisions designed to protect the environment	and walls, solar panels, landscaping, etc.); Help improve and develop new stormwater facilities to make communities more resilient to extreme weather events; Support the building of bike lanes and related facilities. **Section 34 - Zoning By-Laws** - Can ensure mixed-use and compact development, thus reducing greenhouse gas emissions; Can place buildings and arrange building mass in a way that frames the public realm and promotes the use of renewable energy and energy conservation; Can set a minimum building height which can contribute to safer, more compact, well- designed, walkable and vibrant streetscapes; Can reduce development pressures on agricultural and resource areas; May create shorter trip distances to employment and nearby services, and improve the viability of walking and cycling through mixed-use, compact form and reduced parking **Sec. 41/114 City of Toronto Act (Site Plan Control)**- May require sustainable design features to support energy efficiency, sustainable transportation options, water conservation, and improved air and water quality; **Section 34(3) and 113 City of Toronto Act (Min/Max Standards in Zoning)** Can support intensification and transit supportive goals, thus reducing development pressure on green and open spaces and promoting active transportation. **Section 37 (Height and Density Bonusing)** - A municipal council must pass a zoning by-law to authorize increases in height and density of a development in return for the provision of facilities,

	and reduce the negative effects of highway construction. The Act repeated the require- ment in Section 4(f) of the Department of Transportation Act of 1966 on the preser- vation of public park and recreation lands, wildlife and waterfowl refuges, and historic sites to clarify that the provision applied to highways. Moreover the Act required public hearings on the economic, social, and environmental effects of pro- posed highway projects and their consistency with local urban goals and objectives.[ccliv] **1973 - The 1973 Highway Act:** made the organizational requirements more specific by requiring that, in order to receive federal transportation funds, states must establish MPOs in urban areas with populations of 50,000 or more, and provide planning funds to them (Solof, 1998).[cclv] **1977 – Clean Air Act Amendments of 1977:** From 1978 to 1980, the DOT and EPA, after long negotiations, jointly issued several policy documents to implement the Clean Air Act's transportation requirements. In January 1981 DOT issued regulations on air quality conformance and priority procedures for use in federal highway and transit programs. The regulations required that transportation plans, programs, and projects conform with the approved SIPs in areas that had not met ambient air quality standards, termed "nonattainment areas." In those areas, priority for transportation funds was to be given to "transportation control measures" (TCMs) that contributed to reducing air pollution emissions from transportation sources. Where an area's transportation plan or program was not in conformance with the SIP, "sanctions" were to be applied that prohibited the use	services, or matters of community benefit. While this section provides the authority to utilize density bonuses it is up to the local government on how to implement the policy. This has resulted in a varied and often arbitrary implementation by individual municipalities. **Sec. 51 (Plan of Subdivision)** - Planning approval authorities may assess subdivision design and layout having regard to matters such as street connectivity to support transit, cycling and walking, the conservation of natural resources, and the size, shape and orientation of lots to facilitate the efficient use and conservation of energy. **1994 - Ontario Planning and Development Act, 1994, SO 1994, c 23, Sch A:** This Act enables the establishment, as a development planning area, any area of land defined in an order and consequently the creation of a Development Plan. A development plan may contain: the identification of land use areas and the provision of parks and open space and the policies in regard to the acquisition of lands; the control of all forms of pollution of the natural environment; the location and development of transportation systems; and the development and maintenance of recreational and health facilities.[ccclxxxiii] **1985/2017(most recent update): Niagara Escarpment Planning and Development Act, R.S.O. 1990, c. N.2:** established a regulatory framework and planning process to protect the Escarpment from incompatible land use activities that might compromise its ecological integrity. The

	of federal funds on major transportation projects (US Dept. of Transportation 1981b).[cccLvi] **<u>1991</u> - Intermodal Surface Transportation Efficiency Act of 1991:** Passage of the Intermodal Surface Transportation Assistance Act of 1991 and the Clean Air Act Amendments of 1990 opened a new era in planning and decision- making concerning urban transportation projects. The acts provided greater flexibility while mandating new institutional arrangements, and stronger environmental constraints. The Intermodal Surface Transportation Efficiency Act of 1991 required states and metropolitan areas to develop and implement six systems for managing: highway pavement (PMS), bridges (BMS), highway safety (SMS), traffic congestion (CMS), public transportation facilities and equipment (PTMS), and intermodal transportation facilities and systems (IMS). These management systems were intended to be tools that provided information to assist state and local decision-makers in selecting cost-effective policies, programs, and projects to protect and improve the nation's transportation infrastructure. ISTEA required that the states establish these transportation management systems in fiscal year 1995 and certify that they had done so by January 1, 1995. Failure to do so could result in 10% of the funds apportioned to the state to be withheld.[cccLvii] **<u>1993</u> - Regulations under Clean Air Act Amendments of 1990:** The US Environmental Protection Agency issued regulations for the transportation conformity provisions of Section 176 of the Clean Air Act Amendments of 1990 (CAAA) in November 1993. "Conformity" was defined in the	Niagara Escarpment Plan (NEP), considered by many to be Canada's first, large-scale environmental land-use plan, followed from the Act. Originally approved by the Province in 1985 (and revised as a result of a review initiated in 1990). [cccLxxiv] **<u>2001/2017(most recent update)</u> - O. Reg. 140/02: OAK RIDGES MORAINE CONSERVATION PLAN under Oak Ridges Moraine Conservation Act, 2001, S.O. 2001, c. 31:** In May 2001, the Minister of Municipal Affairs and Housing introduced the Oak Ridges Moraine Protection Act, 2001 , establishing a six-month moratorium on development on the Moraine in order to allow the government to consult on how to protect the Moraine. The Plan is an ecologically based plan established by the Ontario government to provide land use and resource management direction for the 190,000 hectares of land and water within the Moraine. The decisions of provincial ministers, ministries and agencies made under the Planning Act or the Condominium Act, 1998 or in relation to a prescribed matter, are required to conform with this Plan.[cccLxxxv] **<u>2004</u> - Bill 26, Strong Communities (Planning Amendment) Act:** The purpose of the Bill is to change the criteria that must be met when any decision, comment, submission or advice is made or provided by a municipality, local board, planning board, the provincial government or a board, commission or agency of the provincial government that affects a land use planning matter. The decisions, comments, submissions and advice

	CAAA as the assurance that transportation plans and programs aim to meet the same goals set forth for air quality improvements in state Implementation Plans (SIPs) for cleaner air. The regulations established the procedures and criteria for conformity determinations on transportation plans, programs, and projects. Conformity determinations must be made in nonattainment areas and maintenance areas (areas previously in nonattainment but now in attainment). To achieve conformity, plans must be analyzed to assure that the resulting air quality emissions would be within the level established by the SIP. The conformity analysis must include all region- ally significant transportation projects. The conformity requirements significantly changed the process for developing transportation plans, programs, and projects, and increased the emphasis on demand management strategies and operational improvements to the existing transportation infrastructure. The conformity requirements increased the demands on travel and air quality forecasting procedures to be more accurate and more sensitive to travel demand management strategies. They also caused a greater level of cooperation between the transportation and air quality agencies.[cccLviii] **<u>1993</u> – Regulations under the Intermodal Surface Transportation Efficiency Act of 1991:** Regulations implementing the statewide and metropolitan transportation planning provisions of the Intermodal Surface Transportation Efficiency Act of 1991 was issued in October 1993 (US Dept. of Transportation 1993b). These regulations closely followed the legislative requirements. The regulations addressed the	must be "consistent with" policy statements issued by the Minister. This is a change from the current criteria which requires those bodies to have "regard to" policy statements issued by the Minister in exercising any authority that affects a planning matter or when providing comments, submissions or advice. (Section 2 of the Bill).[cccLxxxvi] **<u>2005</u> - Bill 135, Greenbelt Act -** enables the creation of a Greenbelt Plan to protect about 1.8 million acres of environmentally sensitive and agricultural land in the Golden Horseshoe from urban development and sprawl. The legislation authorizes the government to designate a Greenbelt Area and establish a Greenbelt Plan. It sets out the main elements and objectives for the Greenbelt, which are addressed in the Plan. It also requires planning decisions to conform to the Greenbelt Plan. Nearly 2 million acres of environmentally sensitive areas and agricultural lands become protected in perpetuity under law.[cccLxxxvii] **<u>2004/2017(most recent update)</u> - Greenbelt Plan:** The Greenbelt Plan, together with the Growth Plan, the NEP and the ORMCP, builds on the Provincial Policy Statement (PPS) to establish a land use planning framework for the GGH that supports a thriving economy, a clean and healthy environment and social equity. These plans work in concert with Ontario's Climate Change Strategy, 2015, the government's commitment to meet its long-term targets to reduce greenhouse gas emissions. Protecting agricultural lands, water resources and natural areas, supporting the achievement of complete communities that are compact, walkable

	integration of the management systems into the overall planning process, and the linkage between transportation and air quality planning in the conformity requirements.[cccix] **<u>1998</u> - The Transportation Equity Act for the twenty-first century (TEA-21):** signed into law on June 9, 1998 by President Clinton, built and expanded upon the successful Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) policies and programs. It continued all the major ISTEA programs, and added a number of new programs to meet specific safety, economic, environmental, and community challenges. Although TEA-21 retained the basic structure established by ISTEA, it did include some important changes. Two of the most significant achievements of TEA- 21 were: the guaranteed funding and the continuation and expansion of the environ- mental programs created by ISTEA. TEA-21 also strengthened the planning requirements, expanded the flexible funding provisions, and placed a stronger emphasis on safety. TEA-21 created a new program, the Transportation and Community and System Preservation Pilot Program to help state and local governments plan environmentally friendly development. This program was created in response to the increasing interest in "smart growth" policies that encouraged investments in maintaining existing infrastructure rather than supporting new construction. The key purpose of this pilot program was to devise innovative neighborhood, local, metropolitan, state, or regional strategies that improve the efficiency of the transportation system, minimize environ- mental	and, where appropriate, transit-supportive will help reduce greenhouse gas emissions and work towards low-carbon communities, and the long-term goal of net-zero communities. Greenhouse gas emissions can be offset by carbon sinks found in the Greenbelt, which can include agricultural lands, green infrastructure and other natural areas.[ccclxxxviii] **<u>2005</u> - Places to Grow Act, 2005, S.O. 2005, c. 13:** This legislation allows for the identification and designation of growth plan areas and the development of strategic growth plans for those communities, in discussion with local officials, stakeholders, residents, and other public groups. This comprehensive approach puts Ontario at the forefront of growth planning and environmental protection.[cccclxxxix] **<u>2006</u> - Bill 104, Greater Toronto Transportation Authority Act:** The Bill establishes the Greater Toronto Transportation Authority, referred to in the Bill as the Corporation. The objects of the Corporation are to provide leadership in the coordination, planning, financing and development of a multi-modal transportation network that conforms with the transportation policies of growth plans prepared and approved under the Places to Grow Act, 2005 and complies with other provincial transportation policies and plans and to be the central procurement agency for Ontario municipalities of local transit system vehicles and related equipment, technologies, facilities, supplies and services.[cccxc] **<u>2006/2017(update)</u> - O. Reg. 311/06: TRANSITIONAL MATTERS - GROWTH**

	impacts, and reduce the need for costly public infrastructure investments. [cccxlx] **<u>2009</u> - "Partnership for Sustainable Communities":** DOT, HUD, and EPA, announced the creation of an interagency "Partnership for Sustainable Communities" to help promote affordable housing, more transportation options, and lower transportation costs while protecting the environment in the nation's communities. There were six guiding "livability principles" to be used to coordinate federal transportation, environmental protection, and housing investments at their respective agencies. The three agencies were determined to work together to ensure that these housing and transportation goals were met while simultaneously protecting the environment, promoting equitable development, and helping to address climate change. The agencies agreed that communities must offer a range of transportation options to their residents including walking, biking, and mass transit, in addition to private vehicle ownership. Reducing vehicle miles traveled was critical to help improve air quality. By the second year, the agencies had dedicated more than $2.5 billion in assistance to more than 200 communities in 48 states to help meet housing and transportation goals while simultaneously protecting the environment, promoting equitable development, and addressing the challenges of climate change.[cccxlxi] **<u>STATE:</u>** **<u>1965</u> - The California Land Conservation Act of 1965:** commonly referred to as the Williamson Act--enables local governments to enter into contracts with	**PLAN FOR THE GREATER GOLDEN HORSESHOE:** Minister's regulation under the Places to Grow Act, 2005 that prescribes transition provisions for growth plans under that Act. In accordance with subsection 14(1) of the Places to Grow Act, 2005, all decisions made under the Planning Act and Condominium Act, 1998 shall conform with a growth plan that applies to that growth plan area. Subsection 3(5) of the Planning Act provides that decisions in respect of planning matters shall conform with provincial plans, including growth plans, that are in effect on the date of decision. The plan works to support the achievement of complete communities, curb sprawl, protect the natural environment, support economic development, and ensure that land to accommodate forecasted population and employment growth will be available when needed, now and in the future.[cccxci] **New policy direction in the Growth Plan for the Greater Golden Horseshoe, 2017 (Policy 4.2.10.2)** made under the Coordinated Provincial Plans Review encourages municipalities to develop GHG reduction plans, through official plan conformity, to develop strategies to reduce greenhouse gas emissions within their communities, to complete greenhouse gas inventories for a range of sources, and to establish interim and long- term greenhouse gas reduction targets that support provincial targets and reflect the goal of low-carbon communities and to monitor progress towards the achievement of these targets.[cccxcii]

	private landowners for the purpose of restricting specific parcels of land to agricultural or related open space use. In return, landowners receive property tax assessments which are much lower than normal because they are based upon farming and open space uses as opposed to full market value.[ccclxii] **2000 – AB 94 -** In 2000 California adopted an innovative program to make it easier for willing landowners to donate their valuable open space and habitat land to the state for ongoing public benefit. The Natural Heritage Preservation Tax Credit combined a 55% state tax credit, paid from bond funds dedicated to resource land acquisition, not the General Fund, with a federal tax deduction to allow landowners to be compensated at close to fair market value. Unfortunately, the program sunsetted in 2008. AB 94 (Evans) restores the tax credit until 2015, lifts the $100 million cap on total credits and allows local governments to receive donated land. **2008 - SB 375 - Sustainable Communities Law:** calls for coordinated transportation and land use planning with the goal of more sustainable communities, e.g. reduce sprawl and reduce vehicle use. CARB established 2020 and 2035 targets tailored to all 18 metropolitan areas applies to metropolitan planning organizations who develop regional transportation plans consistent with overall plan. Targets range from 6-8% reduction for 2020 and 13-16% for 2035.[cccLxiii] **2008 - Deputy Directive on Accommodating Non-Motorized Travel (DD-64):** The policy and definition/background sections are as follows:	**2009 - Bill 163, Greater Toronto and Hamilton Area Transit Implementation Act, 2009:** An Act to amend the Greater Toronto Transportation Authority Act, 2006 and to make consequential amendments to another Act. Key changes with regards to the environment: Changes to the Corporation's objects - amendment to clause 5 (1) (a) is the added requirement that the transportation network support a high quality of life, a sustainable environment and a strong, prosperous and competitive economy. **2010 - Far North Act:** Provides for the establishment of joint bodies (First Nations and the Minister of Natural Resources) to discuss land use planning. s.7(7) Far North policy statements "If the joint body recommends a statement to the Minister under clause (4) (a), the Minister shall submit the statement to the Lieutenant Governor in Council and, with the approval of the Lieutenant Governor in Council, issue the statement as a Far North policy statement if the Minister is of the opinion that the statement takes into account the objectives set out in section 5 and if the statement relates to any of the following matters: 1. Cultural and heritage values. 2. Ecological systems, processes and functions, including considerations for cumulative effects and for climate change adaptation and mitigation. 3. The interconnectedness of protected areas. 4. Biological diversity. 5. Areas of natural resource value for potential economic development. 6. Electricity transmission, roads and other infrastructure. 7. Tourism. 8. Other matters that are relevant to land

	"POLICY: The Department fully considers the needs of non-motorized travelers (including pedestrians, bicyclists and[cccLXIV] persons with disabilities) in all programming, planning, maintenance, construction, operations and project development activities and products. This includes incorporation of the best available standards in all of the Department's practices. The Department adopts the best practice concepts in the US DOT Policy Statement on Integrating Bicycling and Walking into Transportation Infrastructure.[cccLXV] **2013 - SB-743 Environmental quality: transit oriented infill projects, judicial review streamlining for environmental leadership development projects, and entertainment and sports center in the City of Sacramento:** under SB 743, new projects need to evaluate their impact on vehicle miles traveled, which should promote in-fill development. **2013 - ZEV Action Plan (EO-B-16-12) Zero-Emission Vehicles in California: Community Readiness Guidebook:** This guidebook helps local planning and permitting agencies familiarize themselves with ZEVs and support these vehicles in their communities. The guidebook includes an overview of ZEV technologies, specific suggestions for how these agencies can better prepare for ZEVs, as well as a collection of tools that can help streamline ZEV infrastructure permitting, prepare for increased electricity demand, and develop ZEV-friendly building codes.[cccLXVI] **2014 - SB-486 Department of Transportation: goals and performance measures:** This bill follows a recent report, issued by the State Smart Transportation	use planning under this Act if the Minister and the joint body agree to the matters. 2010, c. 18, s. 7 (7)."[CCCXCIII] **2011 - The Growth Plan for Northern Ontario:** a 25-year plan that guides provincial decision-making and investment now and in the future. The Growth Plan aims to strengthen the economy of the North by: Diversifying the region's traditional resource-based industries; Stimulating new investment and entrepreneurship; Nurturing new and emerging sectors with high growth potential. The Growth Plan focuses on the sustainable development of natural resources, environmental protection and conservation and the continued development of renewable energy sources.[CCCXCIV] **2012 - Transit Supportive Guidelines:** These guidelines are a distillation of transit-friendly land use planning, urban design and operational practices, drawing from experiences in Ontario, elsewhere in North America and abroad. Their aim is to assist urban planners, transit planners, developers and others, working in communities of all sizes, in creating an environment that is supportive of transit and developing services and programs to increase transit ridership.[CCCXCV] **2014 - Provincial Policy Statement, sec. 3 *Planning Act*:** The Provincial Policy Statement provides policy direction on matters of provincial interest related to land use planning and development. As a key part of Ontario's policy-led planning system, the Provincial Policy Statement sets the policy foundation for regulating the development and use of land. The statement calls

	Initiative (SSTI), which was commissioned by the California State Transportation Agency (CalSTA) to assess Caltrans' performance and to make recommendations for improvements. In short, the SSTI report found that Caltrans is "significantly out of step" with best practices in the transportation field and with many of the state's policy expectations. SSTI asserted that the state would be better served by a stronger state transportation department that is better aligned with California's overarching policy goals, particularly those related to Sustainability. SB 486 intends better align state priorities with Caltrans' planning processes and to ensure the department's investments reflect these priorities. SB 486 relies on CTC to provide greater, independent oversight of the department's efforts.[ccclxvii] **2015 – AB 744:** AB 744 will help achieve the state's climate goals and improve housing affordability by reducing parking regulations for special needs, senior, and transit-oriented affordable housing. Excessive parking requirements encourage driving, reinforce sprawled development patterns, and increase housing costs. Parking is expensive to build and takes up valuable space which could be used to house people, not cars. **2016: SB 1386 (Wolk) Resource Conservation: Working and Natural Lands:** Declares it to be the policy of the state that the protection and management of natural and working lands are a key strategy in meeting the state's GHG reduction goals. Require all state agencies, departments, boards, and commissions to consider this policy when revising, adopting, or establishing policies, regulations, expenditures, or	for sustainable transit oriented development: Transportation systems should be provided which are safe, energy efficient, facilitate the movement of people and goods, and are appropriate to address projected needs. 1.6.7.2 Efficient use shall be made of existing and planned infrastructure, including through the use of transportation demand management strategies, where feasible. 1.6.7.3 As part of a multimodal transportation system, connectivity within and among transportation systems and modes should be maintained and, where possible, improved including connections which cross jurisdictional boundaries. 1.6.7.4 A land use pattern, density and mix of uses should be promoted that minimize the length and number of vehicle trips and support current and future use of transit and active transportation. 1.6.7.5 Transportation and land use considerations shall be integrated at all stages of the planning process.[cccxcvi] Section 1.8.1 states "Planning authorities shall support energy conservation and efficiency, improved air quality, reduced greenhouse gas emissions, and climate change adaptation through land-use and development patterns." Municipalities or planning authorities are required to amend their official plans to be consistent with PPS policies including policies on climate change.[cccxcvii] **2015 - Bill 6, Infrastructure for Jobs and Prosperity Act:** The purpose of this Act is to establish mechanisms to encourage principled, evidence-based and strategic long-term infrastructure planning that supports job creation and training opportunities, economic growth and

	grant criteria relating to the protection and management of natural and working lands. **2016 - AB 2722 Transformative Climate Communities Program:** Creates the Transformative Climate Communities Program, which will award competitive grants to specified eligible entities for the development of plans, and projects that implement plans, that contribute to the reduction of GHG emissions and demonstrate potential climate, economic, workforce, health, and environmental benefits in disadvantaged communities that have a demonstrated need for these benefits.[ccclxviii] **2016 - AB 2800 Climate Change: Infrastructure Planning:** Requires state agencies to take into account the expected impacts of climate change when planning, designing, building, and investing in state infrastructure. Requires the Natural Resources Agency to establish a Climate-Safe Infrastructure Working Group to examine how to integrate scientific data concerning projected climate change impacts into state infrastructure engineering, and to make specified recommendations to the Legislature and the Strategic Growth Council.[ccclxix] **2016 - AB 2442 (Holden) Density Bonuses:** Requires a local government to provide a density bonus to a developer that agrees to construct a housing development that includes at least 10 percent of the total units for transitional foster youth, disabled veterans, or homeless persons, among other provisions.[ccclxx] **2016 - AB 2501 (Bloom) Housing Density Bonuses**: Requires that local governments adopt procedures and	protection of the environment, and incorporate design excellence into infrastructure planning. Infrastructure planning and investment should minimize the impact of infrastructure on the environment and respect and help maintain ecological and biological diversity, and infrastructure should be designed to be resilient to the effects of climate change.[cccxcviii] **2015 - Bill 73, Smart Growth for Our Communities Act:** Amends the Planning Act and Development Charges Act. Legislation to give the province's residents a greater say in how their communities grow and to provide municipalities with more opportunities to fund community services like transit and recycling.[cccxcix] **2017 - the Building Better Communities and Conserving Watersheds Act, 2017 (Bill 139):** It will require that all municipal official plans shall contain climate change policies that identify goals, objectives and actions to mitigate greenhouse gas emissions and to provide for adapting to a changing climate, including through increasing resiliency. Amends existing legislation to give communities a stronger voice in land use planning. This would include supporting government priorities on climate change. Gives municipalities broader powers in the land use planning process, including by allowing municipal leaders to develop transit projects with fewer barriers.[cd] **2017 - Bill 68 Modernizing Ontario's Municipal Legislation:** The recent amendment of the Planning Act through Bill 68 (Modernizing Ontario's Municipal Legislation Act, 2017)

	timelines for processing a density bonus application, among other provisions.[cccLxxi] **<u>2017</u> - SB-150 Regional transportation plans:** Requires the Air Resources board to update and revise the greenhouse gas emission reduction targets consistent with the scoping plan and an assessment of the portion of the state's overall climate targets that is anticipated to be met by reductions in vehicle miles traveled. The bill, beginning on July 1, 2018, would require the state board to provide an assessment of currently available and historical vehicle miles traveled. The bill, beginning on September 1, 2018, would require the state board to prepare a report that assesses progress made by each metropolitan planning organization on a set of data-supported metrics, with future assessments to be completed every 4 years thereafter.[cccLxxii] **<u>2017</u> - AB 805 (Gonzalez Fletcher) Transportation Program Guidelines:** States the intent of the Legislature that the San Diego Association of Governments, in updating its regional comprehensive plan, address the regional GHG reduction targets set by CARB. The plan must also include strategies that provide for mode shift to public transportation, identify disadvantaged communities, and include strategies to reduce pollution exposure in such communities. The bill makes numerous changes to the organization and governance of the San Diego Association of Governments, the San Diego Metropolitan Transit System, and the North County Transit District.[cccLxxiii] **<u>2017</u> - AB 1568, The Neighborhood Infill Finance and Transit Improvement Act of 2017 (NIFTI):**	includes as a matter of provincial interest "the mitigation of greenhouse gas emissions and adaptation to a changing climate". Clarifying that municipalities may pass climate change by-laws and participate in long-term energy planning, which could help to lessen and address the impacts of climate change in their communities.[cdi]

	provides local jurisdictions with the authority to finance infrastructure and affordable housing using new sales and use and transactions and use taxes, in addition to property tax increment within qualifying districts. The NIFTI districts must be located in qualified infill locations, meeting the SB 375 definition of infill.[cccclxxiv] **2017 - SB 263 (LEYVA) CLIMATE ASSISTANCE CENTERS:** Existing law creates the Transformative Climate Communities Program, which is administered by the Strategic Growth Council. This bill would require the council, among other things, to establish no less than 10 regional climate assistance centers, as specified, and award competitive grants to eligible entities through an application process, as specified. The bill would require the climate assistance centers to provide to target user groups technical assistance in applying for moneys, provide to target user groups assistance and training in project management and implementation, and work with local organizations to formulate policies and programming that accomplish specified goals. The bill would authorize the council and climate assistance centers to solicit and accept nonstate money. The bill would require the council and the State Air Resources Board to make a specified report to the Legislature.[ccclxxv] **2017 - Budget 17-18, Increased funding to Local Planning Grants:** Local Planning Grants—$25 million in grants available to regional transportation planning agencies to update regional transportation plans consistent with the sustainability and greenhouse gas reduction requirements of Chapter 728, Statutes of 2008 (SB 375.)[ccclxxvi]	

	<u>2017</u> - AB 179 (CERVANTES) CALIFORNIA TRANSPORTATION COMMISSION: This bill would additionally require the Governor, in appointing members, to use every effort to ensure that the California Transportation commission has a diverse membership with expertise in transportation issues, taking into consideration factors including, but not limited to, socioeconomic background and professional experience, which may include experience working in, or representing, disadvantaged communities. This bill would require the commission and the State Air Resources Board to hold at least 2 joint meetings per calendar year to coordinate their implementation of transportation policies.[cccLxxvii] **<u>2017</u> - AB-1218 California Environmental Quality Act: exemption: bicycle transportation plans:** Extends exemptions from the requirements of the California Environmental Quality Act for bicycle transportation plans for an urbanized area for restriping of streets and highways, bicycle parking and storage, signal timing to improve street and highway intersection operations, and related signage for bicycles, pedestrians, and vehicles under certain conditions, and for projects consisting of restriping of streets and highways for bicycle lanes in an urbanized area as part of a bicycle transportation plan.[cccLxxviii] **<u>2018</u> - SB-1227 Density bonuses:** Under current state law, builders who opt to include affordable units in their residential projects are allowed to increase the total number of housing units in the project to cover the costs of the affordable units. Known as the state density bonus, this incentive allows housing developments to potentially include up to 35 percent	

	more housing units. Under existing state law, it is nearly impossible to apply the density bonus to new housing that caters exclusively to students even if it includes affordable units. SB 1227 fixes these obstacles by making two changes: allowing 100 percent student serving housing projects to apply the density bonus based on the number of bedrooms or beds instead of the number of housing units and allowing students to submit financial aid documents as the documentation to qualify for affordable units.[cccLxxix] **2018 - AB 2753 (Friedman) Density Bonuses: Density Bonus Application:** This bill would require that if a city or county does not determine whether a density bonus application is complete within 30 calendar days after it was submitted, or within 10 days in the case of a resubmitted application, then that application is deemed approved. It would also require that a city or county, within 60 calendar days after determining an application is complete, act to approve or disapprove the density bonus, and would provide that if the city or county fails to do so within that time period the application is deemed complete and the requested bonus is granted. [cccLxxx] **2018 (WATCH - not yet passed) SB-827 Planning and zoning: transit-rich housing bonus** https://leginfo.legislature.ca.gov/faces/billStatusClient.xhtml?bill_id=201720180SB827	

Enhanced public transportation services (paying for new, improved transportation or subsidies for transit)	**FEDERAL:** **1970 - The Urban Mass Transportation Assistance Act of 1970:** landmark act for federal financing for mass transportation. It provided the first long-term com- mitment of federal funds. Until the passage of this act, federal funds for mass transportation had been limited. The 1970 act implied a federal commitment for the expenditure of at least $10 billion over a 12-year period to permit confident and continuing local planning and greater flexibility in program administration. The act authorized $3.1 billion to finance urban mass transportation beginning in fiscal year 1971. It permitted the use of "contract authority" whereby the Secretary of Transportation was authorized to incur obligations on behalf of the USA with Congress pledged to appropriate the funds required to liquidate the obligations. This provision allowed long-term commitments of funds to be made.[cdii] **1973 - The Federal-Aid Highway Act of 1973:** contained two provisions that increased the flexibility in the use of highway funds for urban mass transportation. First, federal-aid urban system funds could be used for capital expenditures on urban mass transportation projects. Second, funds for Interstate highway projects could be relinquished and replaced by an equivalent amount from the general fund and spent on mass transportation projects in a particular state. This opening up of the Highway Trust Fund for urban mass transportation was a significant breakthrough sought for many years by transit supporters. These changes provided completely new	**FEDERAL:** **2005 – Gas Tax Fund:** to ensure a predictable and permanent source of infrastructure funding support for municipalities. The GTF was launched with Budget 2005, which announced an allocation of $5 billion over five years, starting in fiscal year 2005-2006. Budget 2007 announced that the federal government would extend the GTF to provide $2 billion per year to municipalities from 2010-2011 to 2013-2014, for a total of $8 billion. In Budget 2008, the federal government announced that the GTF would be extended beyond 2013-2014 and would be made permanent to ensure stable, long-term funding to municipalities. Budget 2011 announced the federal government's intention to legislate a permanent annual investment of $2 billion through the GTF. In Budget 2013, the federal government introduced amendments to the enabling legislation to increase the GTF payments at a set rate of 2% per year, starting in 2014-2015, with increases to be applied in $100 million increments. Most recently, in Budget 2016, the federal government announced that it would be transferring uncommitted funds from older existing infrastructure funds to municipalities through the GTF in 2016-2017 to ensure that funds are directed toward municipal infrastructure priorities in the near term.[cdxxxv] **2006 Public Transit Tax Credit:** the Canadian federal government introduced an income tax credit, the Public Transit Tax Credit, covering 15% of the annual (eligible) cost of public transit. In 2012, the total cost to government of transit

	avenues of federal assistance for funding urban mass transportation.[cdiii] **1974 - The National Mass Transportation Assistance Act of 1974:** authorized for the first time the use of federal funds for transit operating assistance. The act authorized $11.8 billion over a 6-year period. Under the Section 5 Formula Grant program, almost $4 billion was to be allocated to urban areas by a formula based on population and population density. The funds could be used for either capital projects or operating assistance.[cdiv] **1978 - The Surface Transportation Assistance Act of 1978:** was the first act that combined highway, public transportation and highway safety authorizations in one piece of legislation. It provided $51.4 billion for the fiscal years 1979 through 1982, with $30.6 billion for highways, $13.6 billion for public transportation, and $7.2 billion for highway safety. The eligibility of federal funds for carpools and van- pools was made permanent. The amount of $20 million annually for fiscal years 1979 through 1982 was authorized for bicycle projects.[cdv] **1987 - Surface Transportation and Uniform Relocation Assistance Act of 1987 - Title III, the Federal Mass Transportation Act of 1987:** With five titles and 149 sections, the Surface Transportation and Uniform Relocation Assistance Act of 1987 (STURAA) was the most complicated piece of legislation up to that time on surface transportation matters. Title III, the Federal Mass Transportation Act of 1987, authorized $17.8 billion for federal mass transit assistance for fiscal years 1987 through 1991. The act continued the Section 3 Discretionary Grant	expenses claimed under the program was over $1.38 billion at a cost over $280million per year in foregone tax revenues (Canada Revenue Agency, 2014). Recent research demonstrates that this income tax credit is costly and ineffective in promoting transit use in Canada. Moreover, it is a regressive tax credit, available only to those with income tax owing. We recommend that the Public Transit Tax Credit be eliminated starting in budget 2017. There are better ways to incentivize public-transit use than subsidizing transit passes.[cdxxxvi] **2016 - Funding under the Pan-Canadian Framework:** $20.1 billion to support urban public transit[cdxxxvii] **2016 - Budget 2016, Public Transit Infrastructure fund & Budget 2017, Infrastructure Canada, Canada's New Infrastructure Plan:** Through the Public Transit Infrastructure Fund, Budget 2016 focused on making immediate investments of $3.4 billion over three years, to upgrade and improve public transit systems across Canada. To support the next phase of ambitious public transit projects, the Government will invest $20.1 billion over 11 years through bilateral agreements with provinces and territories, with provincial and territorial allocations determined using a formula based on ridership (70 per cent) and population (30 per cent). This funding will make it possible for Canadian communities to build the new urban transit networks and service extensions that will transform the way that Canadians live, move and work. Phase 1 of the Government's infrastructure plan included $11.9

	program at graduated authorization levels of $1.097 billion in FY 1987 rising to $1.2 billion in FY 1991 funded from the Mass Transit Account of the Highway Trust Fund. The program was to be split: 40% for new rail starts and extensions, 40% for rail modernization grants, 10% for major bus projects, and 10% on a discretionary basis.[cdvi] **1991 – Livable Communities Initiative:** created by the Federal Transit Administration to promote transit as the means to strengthen the link between transportation and communities. The LCI was intended to provide an alternative to low density sprawl development patterns served primarily by automobiles with higher density, mixed use development reinforced with travel demand and parking management policies (US Dept. of Transportation 1996a, b) The LCI was designed to promote and support transit-oriented design (TOD) or neo-traditional urban design (Beimborn et al. 1991 ; Rabinowitz et al. 1991) . The objectives of the LCI were to (1) strengthen the link between transit and community planning including supportive land use policies and urban design; (2) stimulate active and diverse participation by the community in the decision-making process; (3) increase access to employment, education, and other community facilities an services; and (4) leverage resources from other federal, state, and local programs. Under the LCI, 16 projects were funded for a total cost of $68.9 million with $35.0 million covered by FTA. [cdvii] **1991 - The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 (Public Law 102-240):** establishes the **Congestion Mitigation and Air**	billion to be invested over five years, starting in 2016: $3.4 billion over three years to upgrade and improve public transit systems across Canada. 744 public transit projects have been approved to date, including 214 projects that will make public transit more accessible for people with disabilities. Investments made will expand 132 transit systems across the country and help communities acquire more than 1,000 new buses, among other improvements. Together, these investments will deliver faster, more reliable service and help reduce traffic congestion and pollution. [cdxxxviii] **PROVINCE:** **2000 - Green Municipal Fund:** The Fund was established as a long-term, sustainable source of financing, providing low-interest loans and grants to support municipal governments and their partners. GMF-supported initiatives aim to improve air, water, and soil, and reduce greenhouse gas emissions. The Government of Canada endowed the Federation of Canadian Municipalities (FCM) with $550 million to establish the Green Municipal Fund. An additional $125 million top-up to this endowment was also announced in Budget 2016 and will be added to the Fund in 2017-18. Most recently (2017), $72 million has been dedicated by the Federal Government to support capital projects, pilot projects, feasibility studies and plans that will directly or indirectly cut greenhouse gas (GHG) emissions and address climate change challenges.[cdxxxix] **2007 - MoveOntario 2020:** MoveOntario 2020 – We're launching the largest transit investment in

	Quality (CMAQ) Improvement Program, which provides funding for projects and programs in air quality non-attainment and maintenance areas to reduce transportation-related emissions. Administered by FHWA, the CMAQ program has been reauthorized under every successive Transportation Bill up to and including the FAST Act in 2015. Through the close of the MAP-21 period in 2015, the CMAQ program has provided more than $30 billion to fund over 30,000 transportation related environmental projects for State DOTs, metropolitan planning organizations, and other sponsors throughout the US. [cdviii] **1992 - Energy Policy Act of 1992:** The Act increased the limit on tax-exempt transit benefits to $60 per month for those transit riders receiving the benefits.[cdix] **1995 - Section 350 of the National Highway System Designation Act of 1995:** authorized the U.S. DOT to establish the State Infrastructure Bank (SIB) Pilot Program. A SIB is a revolving fund mechanism for financing a wide variety of highway and transit projects through loans and credit enhancement. SIBs were designed to complement traditional Federal-Aid Highway and transit grants by providing States increased flexibility for financing infrastructure investments by supporting certain projects that can be financed—in whole or in part—with loans, or that can benefit from the provision of credit enhancement. As loans were repaid, or the financial exposure implied by a credit enhancement expired, a SIB's initial capital was replenished, and it could support a new cycle of projects. In this way, SIBs represented an important new strategy for maximizing the purchasing power of Federal surface transportation funds. The	Canadian history – a $17.5 billion plan that includes 52 rapid transit projects in the GTA and Hamilton, the country's largest urban area. It calls for 902 kilometres of new or improved rapid transit, creating 175,000 jobs during construction. MoveOntario 2020 includes 902 kilometres of new or improved rapid transit that will move people efficiently around the region. It will result in 800 million new transit trips per year, taking 300 million car trips off GTA roads. This will cut smog and reduce carbon dioxide emissions by 10 megatonnes by 2020. The Province is funding two-thirds of this plan (roughly $11.5 billion) and is asking the Government of Canada to contribute one-third of the capital costs (about $6 billion). The 12-year construction program will be financed over 50 years. Municipalities will be responsible for the operating costs associated with these projects. Eventually consolidated under The Big Move and Regional Transportation Plan.[cdxl] **2008 - Bill 38, Public Transportation and Highway Improvement Amendment Act (Assistance to Municipalities):** The Bill amends the Public Transportation and Highway Improvement Act. If the Minister, under section 116 of the Act, enters into an agreement with a municipality to provide a rebate of tax under the Gasoline Tax Act to the municipality for the purpose of constructing, maintaining or operating a rapid transit or public transportation system, the Minister shall not refuse to enter into an agreement to provide a rebate of tax under that Act, on the

	Transportation Equity Act for the twenty- first century extended the pilot program for four states: California, Florida, Missouri, and Rhode Island by allowing them to enter into cooperative agreements with the U.S. DOT to capitalize their banks with Federal-aid funds provided in FY 1998 through FY 2003.[cdx] **1998 - The Transportation Equity Act for the twenty-first century (TEA-21):** signed into law on June 9, 1998 by President Clinton, built and expanded upon the successful Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) policies and programs. Although TEA-21 retained the basic structure established by ISTEA, it did include some important changes. Two of the most significant achievements of TEA- 21 were: the guaranteed funding and the continuation and expansion of the environmental programs created by ISTEA. TEA-21 authorized a record $198 billion in surface transportation investment for highways, highway safety, transit, and other surface transportation pro-grams from fiscal years 1998 through 2003. It continued all the major ISTEA programs, and added a number of new programs to meet specific safety, economic, environmental, and community challenges. Tax-free employer-paid transit benefits were increased from $65 to $100 per month, promoting transit ridership and putting it on a more equal footing with the benefits provided to those driving automobiles.[cdxi] **2005 - Safe, Accountable, Flexible, Efficient Transportation Equity Act:** SAFETEA-LU authorized a total $52.6 billion for mass transportation programs over the 6 year period 2004–2009 compared to $36 billion authorized by TEA-21. Just over 80% of	same per capita basis, to any other municipality for the purpose of constructing, maintaining or operating public highways in that municipality.[cdxli] **2008 - The Big Move:** A new plan targets expanding GO train, subway, light rail and bus rapid transit to better connect one of the largest and fastest growing urban regions in North America, the Greater Toronto Hamilton Area.[cdxlii] **2008 - O. Reg. 231/08: TRANSIT PROJECTS AND METROLINX UNDERTAKINGS (under Environmental Assessment Act, R.S.O. 1990, c. E.18):** Will aid in the timely completion of key transit projects by exempting all public transit projects from the *Environmental Assessment Act's* environmental assessment requirements, provided the projects follow an alternative, expedited review process.[cdxliii] **2008 - TDM Municipal Grant Program:** ON Ministry of Transportation provides grants to municipal governments to implement TDM projects. The TDM Grant Program is a voluntary, competitive grant program open to all Ontario municipalities.[cdxliv] **2010 - Bill 42, Taxation Amendment Act (Public Transit Expense Tax Credit):** An Act to amend the Taxation Act, 2007 to provide for a tax credit for expenses incurred in using public transit. The Bill permits taxpayers to obtain a non-refundable income tax credit for expenses that they incur and pay for using public transit after December 31, 2009. The tax credit is a share of the tax credit offered by the Income Tax Act (Canada). If another person pays the expenses on behalf of the taxpayer,

	the funds were derived from the Mass Transit Account, with only New Starts, Research and FTA Administration coming from the General Fund. All existing programs were continued, with two new programs added beginning in 2006: the New Freedom Program and the Alternative Transportation in National Park and Public Lands Program.[cdxii] **2008 - The Passenger Rail Investment and Improvement Act of 2008 (PRIIA):** reauthorized the National Railroad Passenger Corporation (Amtrak), and strengthened the US passenger rail network by tasking Amtrak, USDOT, States, and other stakeholders in improving service, operations, and facilities. PRIIA focused on intercity passenger rail, state-sponsored corridors throughout the Nation, and the development of high-speed rail corridors (US DOT 2009b). PRIIA authorized funds to the US DOT for fiscal years 2009–2013 to award grants to Amtrak to cover operating costs, capital investments.[cdxiii] **2013 - The Moving Ahead for Progress in the 21st Century Act:** (MAP-21) funded these programs at $54.6 billion annually which was basically level with funding in SAFETEA-LU with a slight increase for inflation. SAFETEA-LU average annual funding was $50.1 billion. MAP-21 maintained transit funding for the next 2 years. In addition, it continued the practice of funding major transit programs from the Highway Trust Fund and a limited number of programs from the General Fund. Transit programs were funded at about $10.6 billion for FY 2013 and about $10.7 billion for FY 2014. The New Starts Program was funded at $1.9 billion in each fiscal year. MAP-21 enabled more bus rapid transit projects to be funded. Also authorized a	that other person is entitled to the tax credit, except if the person makes the payment as part of the taxpayer's remuneration.[cdxlv] **2014 - Green Bond Program:** Green Bonds are debt securities where the issue proceeds are utilized to fund projects with specific environmental benefits. Green Bonds are a new funding tool to help Ontario finance transit and other environmentally friendly projects across the Province. First round of funds raised went to the Toronto Eglinton Crosstown Light Rail Project. Ministry of Finance issues third green bond and raises $800 million, some of which will be used for transportation infrastructure. According to the government, proceeds from the bond will support 12 projects, from LEED certification for various buildings to rapid transit expansion. Emissions from the transportation and building sectors account for more than 50% of Ontario's GHG emissions.[cdxlvi] **2017 - Bill 127, Stronger, Healthier Ontario Act (Budget Measures), dedicated transit funding :** The Province is leading the renewal and expansion of transportation and other critical infrastructure for Ontarians. A signature component is the **Moving Ontario Forward plan**, which includes investments for public transit, transportation and other priority infrastructure projects throughout the province. 56 Billion to public transit infrastructure projects including: Rapid transit projects in Toronto, Ottawa, Hamilton, Brampton, Waterloo and Mississauga; GO Transit expansions and extensions; regional express rail.[cdxlvii]

	new “core capacity” funding criteria that gives existing systems some additional spending flexibility.[cdxiv] **<u>STATE:</u>** **<u>1971</u> - Transportation Development Act (TDA):** enacted by the California Legislature to improve existing public transportation services and encourage regional transportation coordination provides funding to be allocated to transit and non-transit related purposes that comply with regional transportation plans. The TDA provides two funding sources:Local Transportation Fund (LTF) - The LTF is derived from a ¼ cent of the general sales tax collected statewide. The sales tax collected in each county is returned to the county from where the tax was generated. State Transit Assistance fund (STA) - The STA is derived from the statewide sales tax on gasoline and diesel fuel. Statute requires that 50% of STA funds are allocated according to population and 50% be allocated according to operator revenues from the prior fiscal year.[cdxv] **<u>1990</u> - Proposition 116 - Clean Air and Transportation Improvement Act of 1990:** Proposition 116 of 1990 enacted the Clean Air and Transportation Improvement Act (CATIA), designating $1.99 billion for specific projects, purposes, and geographic jurisdictions, primarily for passenger rail capital projects. Of this amount, Proposition 116 authorized $1.852 billion for the preservation, acquisition, construction, or improvement of rail rights-of-way, rail terminals and stations, rolling stock acquisition, grade separations,	**<u>2017</u> - Bill 127, Stronger, Healthier Ontario Act (Budget Measures), Increased Gas Tax Funding to Municipalities:** Ontario will increase the share of revenue municipalities receive from the provincial gas tax from $334 million in 2016–17 to an estimated $642 million by 2021–22, from the existing provincial gas tax. This will be achieved by doubling the municipal share of the gas tax from two cents to four cents per litre by 2021–22. Municipalities can use gas tax funds toward local transit priorities, such as making infrastructure upgrades, buying transit vehicles, adding more routes, extending hours of service, implementing fare strategies and improving accessibility. Gas tax allocations are calculated through a formula based 70 per cent on ridership and 30 per cent on population. Through the province’s Gas Tax Program, in 2015-16, 95 transit systems in 130 communities received $332.9 million in funding that can be used towards service improvements. These communities represent nearly 90 percent of the total population of Ontario. [cdxlviii] **<u>2017</u> - Ontario Trillium Trust, Moving Ontario Forward:** In March 2017, the government credited the Trillium Trust with an additional $538 million in net revenue gains from the sale of Hydro One shares in 2016. The government remains on track to meet its target to dedicate $5.7 billion to the Trillium Trust. the Trillium Trust is projected to be drawn down by about $250 million in 2016–17 and about $400 million in 2017–18 to help support initiatives, such as GO RER, the Hurontario LRT and the OCIF. Moving Ontario Forward is part of

	rail maintenance facilities, and other capital expenditures for rail purposes; $73 million for 28 nonurban counties without rail projects, apportioned on a per capita basis, for the purchase of paratransit vehicles and other capital facilities for public transportation; $20 million for a competitive bicycle program for capital outlay for bicycle improvement projects that improve safety and convenience for bicycle commuters; another $30 million to a water-borne ferry program ($20 million competitive and $10 million to the City of Vallejo) for the construction, improvement, acquisition, and other capital expenditures associated with water-borne ferry operations for the transportation of passengers or vehicles, or both.[cdxvi] **<u>1990</u> - Passenger Rail and Clean Air Bond Act of 1990:** This act provides for a bond issue of one billion dollars ($1.000.000,000) to provide funds for acquisition of rights-of-way, capital expenditures, and acquisitions of rolling stock for intercity rail, commuter rail, and rail transit programs. Appropriates money from state General Fund to pay off bonds.The measure requires that at least 15 percent of the total bond funds be spent for intercity rail purposes. These funds must be allocated among projects in eligible intercity rail corridors based on the relative populations served by each corridor. The proceeds of bonds issued and sold pursuant to this chapter shall be deposited in the Passenger Rail Bond Fund, which is created by this bill.[cdxvii] **<u>2006</u> - State-local Partnership Program:** Proposition 1B, approved by the voters in November 2006	Ontario's investment of more than $130 billion over 10 years in public infrastructure. Over 10 years, dedicated funding through Moving Ontario Forward will be used to invest in transit, transportation and other priority infrastructure within and outside the Greater Toronto and Hamilton Area (GTHA). [cdxlix] **<u>2017</u> - DRAFT Regional Transportation Plan, The Big Move (update):** The Draft 2041 Regional Transportation Plan includes strategies and actions required to create a transportation system that supports a high quality of life, a prosperous economy and a protected environment for the next 25 years. More than $30 billion is being invested by the Province in rapid transit infrastructure in the GTHA over the next eight years: The Eglinton Crosstown Light Rail Transit (LRT) is under construction in the City of Toronto and the first phase of Viva/YRT Bus Rapid Transit is being built in York Region. By the end of 2017, the extension of the Yonge-University Subway to Vaughan Metropolitan Centre will be complete. The decades-long call for a permanent and fast rail link between Lester B. Pearson International Airport and downtown Toronto was answered with the completion of the UP Express train in time for the 2015 Pan Am/Parapan Am Games. The Regional Express Rail program, our most ambitious program yet, will transform GO Transit and the region with frequent, two-way all-day rail service, more than doubling the number of riders by 2031.

	Authorized the issuance on $19.925 billion in state general obligation bonds for specific transportation programs intended to relieve congestion, facilitate goods movement, improve air quality, and enhance the safety of the state's transportation System, including the State-Local Partnership Program. Authorized $1 billion to be deposited in the State-Local Partnership Program (SLPP) Account to be available, upon appropriation by the Legislature, for allocation by the California Transportation Commission over a five-year period to eligible transportation projects nominated by an applicant transportation agency. The Bond Act required a dollar for dollar match of local funds for an applicant agency to receive state funds under the program.[cdxviii] **2006 - Proposition 1B, the Highway Safety, Traffic Reduction, Air Quality, and Port Security Bond Act:** Created The Public Transportation Modernization, Improvement, and Service Enhancement Account Program (PTMISEA). Of the $19.925 billion available to Transportation, $3.6 billion dollars was allocated to PTMISEA to be available to transit operators over a ten-year period. PTMISEA funds may be used for transit rehabilitation, safety or modernization improvements, capital service enhancements or expansions, new capital projects, bus rapid transit improvements, or rolling stock (buses and rail cars) procurement, rehabilitation or replacement. Funds in this account are appropriated annually by the Legislature to the State Controllers Office (SCO) for allocation in accordance with Public Utilities Code formula distributions: 50% allocated to Local Operators based	Planning and engineering design are well underway for 15 additional projects that are currently in delivery. This includes LRTs, BRTs and subway expansions. Union Station – the hub of the regional transit network – is undergoing an enormous expansion in order to meet the needs of the 200,000 people who use it now every workday and the greater number who will use it in the future. Fare payment has been modernized with the PRESTO fare card.[cdl] **2018 – 2041 Regional Transportation Plan:** MoveOntario 2020 was incorporated in this first comprehensive regional transportation plan, which has now been updated and led to the second draft regional transportation plan for the GHTA, The 2041 Regional Transportation Plan works together with the previously mentioned Growth Plans (Metrolinx 2017; Metrolinx 2018). The 2041 Regional Transportation Plan builds on past progress and continues aggressive expansion of rapid transit in the GTHA, which will see its population increase to roughly 10 million people by 2041: More than $30 billion is being invested in rapid transit infrastructure over the next eight years An extension of the Yonge-University Subway to Vaughan Metropolitan Centre opened in late 2017 Led by Metrolinx, the Eglinton Crosstown light rail transit (LRT) line is under construction in Toronto,

	on fare-box revenue and 50% to Regional Entities based on population.[cdxix] **2008 - Proposition 1A, the Safe, Reliable High-Speed Passenger Train Bond Act of 2008:** This measure authorizes the state to sell $9.95 billion in general obligation bonds to fund (1) pre-construction activities and construction of a high-speed passenger train system in California, and (2) capital improvements to passenger rail systems that expand capacity, improve safety, or enable train riders to connect to the high-speed train system. The bond funds would be available when appropriated by the Legislature. General obligation bonds are backed by the state, meaning that the state is required to pay the principal and interest costs on these bonds.[cdxx] **2008 - High Speed Passenger Train Bond Program (Proposition 1A):** authorized the California Transportation Commission (Commission) upon appropriation by the Legislature to allocate funds for capital improvements to intercity rail lines, commuter rail lines, and urban rail systems that provide direct connectivity to the high-speed train system and its facilities, or that are part of the construction of the high-speed train system as set forth in Streets and Highways Code, Division 3, Chapter 20, Section 2704.04, subdivision (b) or that provide capacity enhancements and safety improvements. Section 2704.095 requires the Commission to program and allocate the net proceeds received from the sale of $950 million in bonds authorized under Proposition 1A for the High-Speed Passenger Train Bond (HSPTB) Program.[cdxxi]	and more Viva/YRT bus rapid transit (BRT) is being built in York Region UP Express has answered the decades-long call for a fast, permanent rail link between downtown Toronto and Lester B. Pearson International Airport Planning and engineering design are underway for 14 projects including expansions of LRT, BRT and subway services The Regional Express Rail program, our most ambitious program yet, will transform the region with frequent, two-way all-day rail service, more than doubling the number of GO Transit riders by 2031 Union Station—the hub of the regional transit network—is expanding to meet the needs of 300,000 people who use it every weekday, and even more who will use it in the future Across the GTHA and Ottawa, fare payment has been modernized with the PRESTO fare card[cdli]

	2014 - Senate Bill (SB) 862 (Chapter 36), modified by Senate Bill 9 (Chapter 710) The Transit and Intercity Rail Capital Program (TIRCP): to provide grants from the Greenhouse Gas Reduction Fund to fund transformative capital improvements that will modernize California's intercity, commuter, and urban rail systems, and bus and ferry transit systems to reduce emissions of greenhouse gases by reducing congestion and vehicle miles traveled throughout California. he goal of the TIRCP is to provide monies to fund transformative capital improvements that modernize California's intercity rail, bus, ferry and rail transit systems to achieve the following objectives:Reduction in greenhouse gas emissions; Expand and improve rail service to increase ridership; Integrate the rail service of the state's various rail operations, including integration with the high-speed rail system; and Improve safety.[cdxxii] **2014 - SB 1204 (Lara) Clean Truck, Bus, and Off-Road Vehicle Program Chapter 524:** Creates the California Clean Truck, Bus, and Off-Road Vehicle and Equipment Technology Program to be funded through the Greenhouse Gas Reduction Fund. The program would fund zero and near-zero emission truck, bus, and off-road vehicle and equipment technologies, with priority given to projects that benefit disadvantaged communities.[cdxxiii] **2014 - SB 628 Beall Williamson Act Chapter 785:** Allows local agencies to form infrastructure financing districts to finance public capital facilities that are of countywide significance, including transportation and transit projects.[cdxxiv]	

	<u>2014</u> - SB 862 Greenhouse Gas Emission Reductions Chapter 36: Trailer bill to the 2014 Budget Act pertaining to the expenditure of Cap-and-Trade auction proceeds to reduce greenhouse gases. Establishes programmatic frameworks for the expenditure of proceeds from the Greenhouse Gas Reduction Fund. Beginning in the 2015-2016 fiscal year, appropriates 35 percent of annual proceeds from the Greenhouse Gas Reduction Fund to the Transit, Affordable Housing, and Sustainable Communities Program, and continuously appropriates funding to three programs contained within that program: the Affordable Housing and Sustainable Communities Program, the Transit and Intercity Rail Capital Program, and the Low Carbon Transit Operations Program. Continuously appropriates 25 percent of annual proceeds from the Greenhouse Gas Reduction Fund, beginning in the 2015-2016 fiscal year, to High Speed Rail. Requires ARB to develop guidance on greenhouse gas reporting and quantification methods, and develop funding guidelines for administering agencies that receive appropriations from the Greenhouse Gas Reduction Fund.[cdxxv] **<u>2015</u> - SB 767 (De León) Transactions and Use Tax Chapter 580:** Authorizes the Los Angeles County Metropolitan Transportation Authority to impose an additional countywide 0.5 percent transactions and use tax, as long as the existing 0.5 percent tax is in effect, and a maximum 1 percent transactions and use tax thereafter, for a period of time determined by the Los Angeles County Metropolitan Transportation Authority, under specified conditions. The tax will fund specified transportation-related	

	projects and programs and is exempt from the countywide two percent Transactions and Use Tax Law limits.[cdxxvi] **2016 - SJR 24 (Beall) Federal Transportation Funding:** Urges Congress and the President of the United States to fully fund the Transportation Investment Generating Economic Recovery program at a level of $525 million in fiscal year 2017 to provide additional critical investment in California and elsewhere, and to work together to find a long-term, sustainable funding solution to restore the lost purchasing power of the federal fuel excise tax, provide California and the rest of the nation with the resources needed to rebuild its infrastructure, invest in its people through good, well-paying jobs, and restore California's economy.[cdxxvii] **2016 - SB 824 (Beall) GGRF: LCTOP:** Modifies the Low Carbon Transportation Operations Program (LCTOP) to give transit agencies more flexibility, which includes allowing a project to either expand transit or increase mode share and allowing agencies to accumulate funds for four years, transfer funds to another agency, spend funds on the same project for multiple years if GHG emission reductions can be demonstrated, and spend other funds in anticipation of program reimbursement when funds become available.[cdxxviii] **2017 - SB 1 Road Repair and Accountability Act:** This legislative package invests $54 billion over the next decade to fix roads, freeways and bridges in communities across California and puts more dollars toward transit and safety. These funds will be split equally between state and local investments. $2.5	

	billion Congestion Relief; $3 billion Trade Corridor Improvements; $7.5 billion Improved Transit/Rail Travel; $1 billion Pedestrian and Cyclist Safety Projects. The new law will more than double that financial commitment to state and local transportation systems. [cdxxix] Voters have an opportunity in June to prevent the Legislature from diverting transportation funds with Proposition 69. Supported by the League and the Coalition to Protect Local Transportation, the measure adds constitutional protections to new revenues generated by SB 1 and ensures that these funds can be used only for transportation improvement purposes.[cdxxx] **2017 - Budget 2017-18, Increased State Transit Assistance Grants:** $305 million Public Transportation Account to local transit agencies for operations and capital costs. The State Transit Assistance program provides a share of revenues from diesel sales taxes and the new Transportation Improvement Fee, as well as a statutory share of proceeds from Proposition 1B bonds and the sale of cap and trade credits, to fund operating subsidies for local transit agencies. The State Controller distributes these revenues based on a statutory allocation formula.[cdxxxi] **2017 - AB-1 Transportation funding:** A package of revenues and reforms that raise $6 billion annually (plus $706 million in one-time loan repayments) to repair and maintain state and local roads, improve trade corridors, support transit, and fund active transportation. It also adds provisions to streamline	

	projects and increase accountability. This bill would create the Road Maintenance and Rehabilitation Program to address deferred maintenance on the state highway system and the local street and road system. The bill would provide for the deposit of various funds for the program in the Road Maintenance and Rehabilitation Account, which the bill would create in the State Transportation Fund. This bill would annually set aside $200,000,000 of the funds available for the program to fund road maintenance and rehabilitation purposes in counties that have sought and received voter approval of taxes or that have imposed fees, including uniform developer fees, as defined, which taxes or fees are dedicated solely to transportation improvements. The bill would require $80,000,000 of the funds available for the program to be annually transferred to the State Highway Account for expenditure on the Active Transportation Program. Raises $300 million (assuming $2 billion in cap and trade auctions) from an increase the continuous appropriation of cap and trade funds to the Transit and Intercity Rail Capital Program (from 10% to 20%) and Low Carbon Transit Operations Program (from 5% to 10%).[cdxxxii] **2017 - AB-17 Transit Pass Pilot Program: free or reduced-fare transit passes:** Created the Transit Pass Pilot Program to be administered by Caltrans to fund pilot testing of transit pass programs that provide free or reduced fare transit passes to low income students from K-12 public schools, community colleges, the California State University (CSU) and the University of California (UC). Appropriated $20 million from the PTA to Caltrans for the program. The bill would	

	require the department to develop performance measures and reporting requirements to evaluate the effectiveness of the program, and would require the department to submit a report to specified committees of the Legislature on or before January 1, 2020, on the outcomes of the program and the status of transit pass programs statewide. The pilot program would be repealed on January 1, 2022. [cdxxxiii] **<u>2018</u> - SB 1119, Beall. Low Carbon Transit Operations Program:** Existing law continuously appropriates specified portions of the annual proceeds in the fund to various programs, including 5% for the Low Carbon Transit Operations Program, which provides operating and capital assistance for transit agencies to reduce greenhouse gas emissions and improve mobility. Existing law requires, for recipient transit agencies whose service areas include disadvantaged communities, as specified, that those recipient transit agencies expend at least 50% of the total moneys they received as part of the Low Carbon Transit Operations Program. This bill would waive the above requirement if the recipient transit agencies expend the funding provided on certain transit activities.[cdxxxiv]	
Policies aimed at making current public transit systems more effective (funding or requirements for R and D;	**<u>FEDERAL:</u>** **<u>1974</u> - The Service and Methods Demonstration (SMD) Program:** was established to promote the development, demonstration, evaluation, and widespread adoption of innovative transit services and transportation management techniques throughout the USA. The program focused on concepts that used existing technology to create improvements that	**<u>PROVINCE:</u>** **<u>2017</u> -Bill 127, Stronger, Healthier Ontario Act (Budget Measures), Trade and Transportation Information System:** Budget 2017 announced a $50 million investment over 11 years to establish a Trade and Transportation Information System to fill significant information, data and analytical gaps

implementing intelligent traffic control systems	require relatively low levels of capital investment and that can be implemented within a short time frame. The concepts were demonstrated in real- world operational environments and evaluated to determine their costs, impacts, and implementation characteristics.[cdlii] **1991 - The Intermodal Surface Transportation Efficiency Act of 1991:** (ISTEA) established the Federal program to research, develop, and operationally test Intelligent Transportation Systems (ITS) and to promote their implementation. The program was designed to facilitate deployment of technology to enhance the efficiency, safety, and convenience of surface transportation, resulting in improved access, saved lives and time, and increased productivity (U.S. Department of Transportation 2000b).[cdliii] **2004 - Norman Y. Mineta Research and Special Programs Improvement Act:** The purpose of the Act was to provide the DOT with a more focused research organization and establish a separate operating administration for pipeline safety and hazardous materials transportation safety operations. The Act was designed to allow DOT to more effectively coordinate and manage the Department's research portfolio and expedite implementation of cross-cutting, innovative technologies. RITA's functions under the Act were to: coordinate and advance transportation research efforts within DOT; support transportation professionals in their research efforts through grants and consulting services, as well as professional development through training centers; and, inform transportation decision-makers on	in strategic elements of the transportation system. More investments and enhanced collaboration with transportation stakeholders will better inform key strategic public and private decisions on transportation.[cdlxiii]

	intermodal and multimodal transportation topics through the release of statistics, research reports, and a variety of information products via the internet, publications, and in-person venues such as conferences.[cdliv] **2005 - Safe, Accountable, Flexible, Efficient Transportation Equity Act:** SAFETEA-LU authorized $110 million for ITS research from 2005 to 2009, and $122 million for ITS deployment during FY 2005 only. SAFETEA-LU also established a new Real-Time System Management Information Program to provide, in all states, the capability to monitor, in real-time, the traffic and travel conditions of the major highways of the USA and to share that information to improve the security of the transportation system, address congestion problems, support improved response to weather events and surface transportation incidents, and facilitate national and regional highway traveler information.[cdlv] **2013 - Moving Ahead for Progress in the 21st Century Act:** MAP-21 funded research and development, technology deployment, training and education, intelligent transportation system (ITS), and university transportation center activities to further innovation in transportation research. The primary research areas include: improving highway safety and infrastructure integrity; strengthening transportation planning and environmental decision-making; reducing congestion, improving highway operations; and enhancing freight productivity. It provided $400 million annually and authorized 35 competitive grants for University Transportation Centers.[cdlvi] **STATE:**	

	1994 - Intelligent Transportation System Society of California: is a public/private partnership formed to foster the development and deployment of Intelligent Transportation Systems (ITS) in California. Specifically, ITS-CA specializes in facilitating partnership actions that unite technology and commercial product providers and public agencies for creating efficient transportation systems. These partnerships are industry-driven working to establish and maintain California as a world leader in ATS research, development, deployment and commercialization. We hope to add value through these efforts to our targeted constituencies that include transportation agencies, private industry, elected officials, and users, to improve public services and promote opportunities for private investment.[cdlvii] **2014 - AB 1447 Waldron Traffic Signal Synchronization Chapter 594:** Explicitly identifies traffic signal synchronization projects as eligible to receive funding from the Greenhouse Gas Reduction Fund.[cdlviii] **2015 - SB 64 (Liu) California Transportation Plan Chapter 711:** Requires CTC to review recommendations in CalTrans' update to the California Transportation Plan, starting in 2015. Based on this review, CTC must prepare specific, action-oriented recommendations for improving the transportation system and submit a report to the Legislature and Governor by December 31, 2016, and every five years thereafter.[cdlix] **2015 - SB 508 (Beall) Transportation Funds: Pedestrian Safety Chapter 716:** Specifies "pedestrian" safety education programs as one of the	

	eligible uses of Local Transportation Fund monies, simplifies fare box recovery ratio requirements, excludes some expenses from the calculation of fare box recovery ratios, and provides transit operators greater flexibility in the use of local funds to satisfy fare box recovery ratio requirements.[cdlx] **2017 - AB-1579 California Environmental Quality Act: vehicle-miles-traveled database:** This bill would require the office to establish and maintain a vehicle-miles-traveled database containing methodological guidance on which models should be used for particular types of projects and the best sources of trip-length data for various land-use types.[cdlxi] **2017 - AB-496 Transportation funding (section 10 - Office of the Transportation Inspector General):** This bill would create the Office of the Transportation Inspector General in state government, as an independent office that would not be a subdivision of any other government entity, to ensure that all of the above-referenced state agencies and all other state agencies expending state transportation funds are operating efficiently, effectively, and in compliance with federal and state laws. The bill would provide for the Governor to appoint the Transportation Inspector General for a 6-year term, subject to confirmation by the Senate, and would provide that the Transportation Inspector General may not be removed from office during the term except for good cause.[cdlxii]	

Policies encouraging active transportation: walking and the use of bicycles (bike lane infrastructure development, bike-sharing)	**FEDERAL:** **1998 - Transportation Equity Act for the Twenty-First Century:** TEA-21 expanded the provisions to make bicycling and walking safer and more viable ways of travel. Funding sources for construction of bicycle transportation facilities and pedestrian walkways and non-construction projects related to safe bicycle use included the National Highway System (NHS), Surface Transportation Program (STP) Funds, Transportation Enhancement Activities (10% of each State's annual STP funds), Congestion Mitigation and Air Quality Improvement (CMAQ) Program Funds, Hazard Elimination, Recreational Trails, Scenic Byways, and Federal Lands Highway Funds.[cdlxiv] **2005 - Safe, Accountable, Flexible, Efficient Transportation Equity Act:** SAFETEA-LU also established a new Nonmotorized Transportation Pilot program, authorized at a total of $100 million through 2009, to fund pilot projects to construct a network of nonmotorized transportation infrastructure facilities in four designated communities. The purpose was to demonstrate the extent to which walking and bicycling could represent a major portion of the transportation solution in certain communities.[cdlxv] **STATE:** **1993 - California Bicycle Transportation Act [890 - 892] (Article 3 added by Stats. 1993, Ch. 517, Sec. 2.):** **The Bicycle Transportation Account (BTA):** is an annual program providing state funds for city and county projects that improve safety and convenience for bicycle commuters. In accordance with the Streets and Highways Code (SHC) Section 890-892 -	**2008 - Bill 91, Public Vehicles Amendment Act (Improving Bicycle Mobility):** The Bill amends the Public Vehicles Act to exempt public vehicles equipped with bicycle racks or carrying bicycles on bicycle racks from the general restriction against carrying or transporting a load that extends beyond the body limits of the vehicle. Essentially allows public transit vehicles to be equipped to carry bicycles.[cdlxxv] **2014 - CycleON, Ontario's Cycling Strategy:** a series of ongoing, multi-year action plans. The first, #CycleON Action Plan 1.0, identifies clear actions that Ontario government ministries and agencies will be working on in 2014 and beyond to make Ontario a more cycling-friendly province. Ontario's Cycling Strategy provides a route map to support and encourage this growth in cycling over the next 20 years. Twelve Ontario ministries have responsibility for implementing Ontario's Cycling Strategy and Action Plan 1.0.[cdlxxvi] **2015 - Ontario Municipal Cycling Infrastructure Program:** As part of #CycleON Action Plan 1.0, the Ministry of Transportation (MTO) established the $10 million Ontario Municipal Cycling Infrastructure Program, to help municipalities build new and improve existing cycling infrastructure. An evidence-based approach was used to select projects that most closely aligned with program objectives such as developing better cycling networks, promoting safety, encouraging innovation, supporting partnerships, collecting data and enabling cycling to be better recognized as a viable transportation mode.[cdlxxvii]

	California Bicycle Transportation Act, projects must be designed and developed to achieve the functional commuting needs and physical safety of all bicyclists. Local agencies first establish eligibility by preparing and adopting a Bicycle Transportation Plan (BTP) that complies with SHC Section 891.2. The BTP must be approved by the local agency's Regional Transportation Planning Agency. Caltrans anticipates appropriation of $7.2 million annually for projects that improve safety and convenience for bicycle commuters. SHC Section 2106 stipulates the annual BTA funding level in the approved State budget, with awards announced after enactment.[cdlxvi] **2003 - California Blueprint for Bicycling and Walking:** sets goals to increase bicycling and walking trips 50% by 2010, decrease bicycle and pedestrian fatality rates 50% by 2010, and to increase funding for bicycle- and pedestrian-related programs. Caltrans has established a Steering Committee to guide the Blueprint's implementation.[cdlxvii] **2009 - AB-1464 Transportation: California Bicycle Routes of National, State, or Regional Significance Act:** This bill would enact the California Bicycle Routes of National, State, or Regional Significance Act, which would authorize the department to establish a process for identifying and promoting bicycle routes of national, state, or regional significance, as specified. The bill would authorize the department to form an advisory committee to help implement the process for identifying and promoting these bicycle routes. The bill would authorize the department to establish a process for organizations, including, but not limited to, local bicycle	**2016 - Climate Change Action Plan, Cycling Infrastructure:** $200-million to build more cycling infrastructure, including curb-separated bike lanes and bike parking at GO stations.[cdlxxviii] **2017 - Ontario Municipal Commuter Cycling Program:** a four-year program that will provide funding to municipalities to invest in infrastructure for commuter cycling. Funding for this is from the Greenhouse Gas Reduction Account. Across Ontario, 120 municipalities will receive funding from the province for new bike lanes and other cycling infrastructure. Total program funding is $93 million, an increase from the $42.5 million announced earlier this year.[cdlxxix]

	organizations, private entities, or local or state governmental entities, to nominate a route for inclusion in the system of bicycle routes of national, state, or regional significance. The bill would authorize the department to install bicycle route signs identifying these bicycle routes, as specified. The bill would provide that applicants or nominating entities may pay the cost for bicycle route signs, as determined by the department.[cdlxviii] **2013 - Three Feet for Safety Act:** The law requires motorists to give at least three feet of clearance when passing people riding bikes. It went into effect in October of 2014, and our focus since then has been on getting the word out through our Give Me 3 Campaign.[cdlxix] **2013: Senate Bill 99, Chapter 359 and Assembly Bill 101, Chapter 354, Active Transportation Plan:** The purpose of ATP is to encourage increased use of active modes of transportation by achieving the following goals: Increase the proportion of trips accomplished by biking and walking; Increase safety and mobility for non-motorized users; Advance the active transportation efforts of regional agencies to achieve greenhouse gas (GHG) reduction goals, pursuant to SB 375 (0f 2008) and SB 341 (of 2009),; Enhance public health; Ensure that disadvantaged communities fully share in the benefits of the program, and; Provide a broad spectrum of projects to benefit many types of active transportation users.[cdlxx] **2014 - SB 1183 (DeSaulnier) Bicycle Infrastructure Fees Chapter 516:** Authorizes local governments and regional parks districts to impose a motor vehicle	

	registration surcharge for the purpose of funding bicycle infrastructure projects.[cdlxxi] **2014 - AB 1193, The Protected Bikeways Act:** Bill ends the prohibition on protected bikeways, implementing the SSTI recommendation. It will encourage the development of the safest kinds of bikeways and lead to millions more bike trips every day. Specifically, it amends sections 890-891 to do the following: It permits cities and counties to use the best available guidance for bikeways on local streets and roads by removing the requirement to conform to Caltrans' outdated guidelines. It defines protected bikeways in the law by adding a new "class 4" "separated bikeway" to the three existing types: bike paths, bike lanes, and shared bike routes. It requires Caltrans to develop standards for "class 4" bikeways. It makes other minor changes to facilitate appropriate development of protected bikeways including assurances that new designs will not endanger people with disabilities.[cdlxxii] **2016 - Low Carbon Road Program:** $100 million Cap and Trade for Caltrans to implement a new Low Carbon Road Program for local projects that encourage active transportation such as bicycling and walking, and other carbon reducing road investments, with at least 50% of the funds directed to benefit disadvantaged communities. **2017 - Budget 17-18, Expanded Active Transportation Program:** $100 million for pedestrian and bicycle infrastructure projects that will increase access to transit facilities.[cdlxxiii] **2017 - AB 760 (WIENER) TRANSPORTATION FUNDING: ACTIVE TRANSPORTATION:**	

	COMPLETE STREETS: Re-sequences the priorities for the State Highway Account by emphasizing accessibility and safety for all users, public health, and reduced VMT and de-emphasizing capital projects that increase capacity. Also establishes a Division of Active Transportation within the Department of Transportation and require that an undersecretary of the Transportation Agency be assigned to active transportation program matters; require the California Transportation Commission to give high priority to increasing safety for pedestrians and bicyclists and to the implementation of bicycle and pedestrian facilities; updates the Highway Design Manual to incorporate the "complete streets" concept and more specific criteria for bike facilities; and adds complete street, bicycle, and pedestrian elements to all SHOPP projects and the asset management plan.[cdlxxiv]	
Policies aimed at increasing occupancy rate of vehicles (car-sharing; car-pooling; HOV lanes)	**FEDERAL:** **1974 - The Emergency Highway Energy Conservation Act of 1974:** provided that Federal- aid highway funds could be used for ridesharing demonstration programs.[cdlxxx] **1990 - Clean Air Act Amendments:** The 1990 Clean Air Act Amendments authorized the U.S. Environmental Protection Agency (EPA) to restrict FHWA HOV lane funds to those states federally mandated to reduce air pollution and allowed these states to include HOV lanes in their state implementation plans.[cdlxxxi] **1978 - The National Energy Conservation Policy Act of 1978:** extended two state energy conservation programs that required states to undertake specific	**PROVINCE:** **2005 - Transportation Statute Law Amendment Act, 2005, S.O. 2005, c. 26 Bill 169:** New section 154.1 allows the Minister to designate any lane as a high occupancy vehicle lane and to limit the use of that lane to prescribed classes or types of vehicles with a specified number of occupants.[cdxcii] **2005 - O. Reg. 620/05: HIGH OCCUPANCY VEHICLE LANES under Highway Traffic Act, R.S.O. 1990, c. H.8:** 5 HOV lanes.[cdxciii] Ontario has HOV lanes on Highways 403, 404, 417 and the QEW. **Park & Ride/Carpool lots:** The Ontario Ministry of

	conservation actions including the promotion of carpools and vanpools.[cdlxxxii] **<u>1991</u> - The Intermodal Surface Transportation Efficiency Act:** establishes a new vision for surface transportation in America. It represents a victory for the Nation, its citizens, and our economic vitality. The Bill embodies one of the President's top domestic agenda items: the renewal of our surface transportation programs to address the changing needs for America's will create jobs reduce congestion, and rebuild our infrastructure. Encouraged building of HOV lanes - allowed states to use Congestion, Mitigation and Air Quality (CMAQ) funds to develop new HOV lanes at the full federal cost-match ratio for highway infrastructure.[cdlxxxiii] **<u>STATE:</u>** **<u>1959</u> - California Vehicle Code 21655.5:** The Department of Transportation and local authorities, with respect to highways under their respective jurisdictions, may authorize or permit exclusive or preferential use of highway lanes for high-occupancy vehicles. Prior to establishing the lanes, competent engineering estimates shall be made of the effect of the lanes on safety, congestion, and highway capacity.[cdlxxxiv] **<u>1970</u> -** California's first permanent Managed Lane facility began in April of 1970 with the High Occupancy Vehicle (HOV) bypass lane at the San Francisco-Oakland Bay Bridge toll plaza.[cdlxxxv] As of 2016 there was a total of 1,700 lane-miles of HOV lanes in California.[cdlxxxvi] **<u>1998</u> - SB 236 - Mass Transit and Paratransit Vehicles:** Enactment of SB 236 on January 1, 1998,	Transportation runs 80 carpool lots with nearly 6000 spaces.

	permits mass transit vehicles to use the HOV lanes without meeting the occupancy requirement.[cdlxxxvii] **<u>1999</u> - AB 71, Cunneen. High-occupancy vehicle lanes: low-emission:** This bill would require the Department of Transportation whenever it authorizes or permits exclusive or preferential use of highway lanes or highway access ramps for high-occupancy vehicles, to also extend the use of those lanes or ramps to vehicles that have been issued distinctive decals, labels, or other identifiers because the vehicles meet (1) California's ultra low-emission vehicle (ULEV) standards beginning July 1, 2000, and through December 31, 2003, or (2) California's super ultra-low emission vehicle (SULEV) standards on and after January 1, 2004, and through December 31, 2007, for exhaust emissions, as specified, and (3) the federal inherently low-emission vehicle (ILEV) evaporative standard, as defined in federal regulations, regardless of vehicle occupancy or ownership.[cdlxxxviii] **<u>2003</u> -** Enactment of AB 2582 on January 1, 2003, permits clearly marked paratransit vehicles to use the HOV lanes without meeting the occupancy requirement. This section also requires that HOV lane-use comply with posted signs designating the minimum occupancy requirement.[cdlxxxix] **<u>2015</u> - AB 1015 (Bloom) Parking for Car Share Vehicles Chapter 41:** Allows local governments to designate parking spaces for the exclusive or non-exclusive use of vehicles that participate in a car share or rideshare program.[cdxc] **<u>Park & Ride/Carpool</u>**	

	lots: It is estimated that California has 327 park and ride facilities which contain about 34,000 spaces.[cdxci]	
Road pricing	**FEDERAL:** **1982 - The Surface Transportation Assistance Act of 1982**: part of the act raised the highway user charges by five cents (in addition to the existing four cents) a gallon on fuel effective April 1, 1983. Other taxes were changed including a substantial increase in the truck user fees, which were changed from a fixed rate to a graduated rate by weight. Of the revenues raised from the five-cent increase in user fees (about $5.5 billion annually), the equivalent of a four cent raise in fuel user charges was to increase highway programs, and the remaining one cent was for transit programs (Weiner 1983).[cdxciv] **1998 - The Transportation Equity Act for the twenty-first century (TEA-21):** created the Value Pricing Pilot Program. This program replaced the Congestion Pricing Pilot Program that was authorized by the ISTEA. TEA-21 authorized U.S. DOT to enter into cooperative agreements with up to 15 State or local governments or other public authorities, to establish, maintain, and monitor local value pricing pilot pro- grams. Further, it permitted the use of tolls on the Interstate system in HOV lanes if the vehicles were part of a local value pricing pilot program under this section (U.S. Dept. of Transportation 2000d). The	**FEDERAL:** **1985 - Motor Vehicle Transport Act s. 6.:** Where in any province tariffs and tolls for local bus transport are determined or regulated by the provincial authority, the authority may, in its discretion, determine or regulate the tariffs and tolls for extra-provincial bus transport on the like terms and conditions and in the like manner as if the extra-provincial bus transport were local bus transport.[cdxcvii] **PROVINCE:** **1997 - O. Reg. 147/97: TOLL DEVICES under Highway Traffic Act, R.S.O. 1990, c. H.8:** [cdxcviii] **2012 - Highway 407 East Act, ONTARIO REGULATION 175/15 TOLLS:** Highway 407 East tolls, updates O. Reg. 147/97. **2016 - HOT Lane:** First ever HOT lanes on 16.5 kilometres of the QEW. A 15.5 km stretch of dedicated HOT lanes with electronic tolling in both directions on Highway 427 will open in 2021, from south of Highway 409 to north of Rutherford Rd.[cdxcix] **As of 2017 - 2 toll roads in Ontario:** Ontario Highway 412

	Value Pricing Pilot Program, and its predecessor the Congestion Pricing Pilot Program, provided States, local governments, and other public entitles 80% Federal matching funds to establish, maintain, and monitor pricing projects. By 2004, about $29 million had been obligated to 15 States for 36 projects. These funds were in addition to $30 million obligated under the Congestion Pricing Pilot Program. [cdxcv] **2005 - Safe, Accountable, Flexible, Efficient Transportation Equity Act:** SAFETEA-LU enhanced and clarified provisions governing HOV lanes. States were required to establish occupancy requirements for HOV lanes, with mandatory exemptions for motorcycles and bicycles unless they created a safety hazard, and optional exemptions for public transportation vehicles, low-emission and energy- efficient vehicles, and High Occupancy Toll (HOT) vehicles (otherwise-ineligible vehicles willing to pay a toll to use the facility). **STATE:** **As of 2017 - 13 toll roads and bridges in California:**[cdxcvi] 8 Bay Area bridges Orange County toll roads (73, 133, 241, and 261) San Diego "Southbay Expressway" **1947 - The California Toll Bridge Authority Act:** **2014 - SB-1298 High-occupancy toll lanes:**	Ontario Highway 407 (opened 1997)

Insurance schemes	**<u>2009</u> - California Department of Insurance, Pay As You Drive Insurance:** After extensive public consultation the California Department of Insurance introduced a new, green auto insurance option available for California consumers not later than fall 2009. Pay-as-you-drive auto insurance is a way for motorists to more accurately pay for the coverage they need, by linking their premium more closely with the number of miles they drive. This incentive is intended to help reduce greenhouse gases and vehicle accidents.[d]	
Telework and employer-based trip reduction programs	**<u>FEDERAL</u>** **<u>1991</u> – The Intermodal Surface Transportation Efficiency Act of 1991:** authorized federal funding of transportation projects or programs having air quality benefits under the Clean Air Act, which would include a wide range of telecommuting activities (Weiner 1994).[di] **<u>STATE</u>** **<u>1988</u> - Regulation XV:** As part of a long-range plan to achieve the National Ambient Air Quality Standards by 2010, the Los Angeles Southern California Air Quality Management District (SCAQMD) issued Regulation XV. Under Regulation XV, each employer of 100 more employees had to ensure that its workforce achieved a certain "average vehicle ridership" (AVR) for journeys to work which occur between 6:00 am and 10:00 am. The AVR was calculated by dividing the number of employees arriving at the work site by the number of autos arriving at the work site during those hours. Regulation XV went into effect on July 1, 1988, and	

	applied to all or part of six counties in Southern California. The regulation affected almost 7,000 firms, agencies, and institutions employing about 3.8 million workers (Giuliano and Wachs 1991).[dii] **<u>1992 -</u> Assembly Bill 2109, Katz; Chapter 554, Statutes of 1992 - Parking "cash out" law.[diii]** **<u>2016</u> - SB 1128 (Glazer) Bay Area Commuter Benefits Program Chapter 483:** Removes the sunset date on the Bay Area Commuter Benefits Program, thus allowing the Metropolitan Transportation Commission and Bay Area Air Quality Management District to continue a commute benefit ordinance that requires certain San Francisco Bay Area employers to offer alternative-commute benefits to their employees.[div]	

APPENDIX C: Potential Directions for Future Research

Network analysis

Network analysis might provide for a deeper examination of the link between the structure and performance of polycentric governance networks for climate change mitigation in the transportation sector, specifically in terms of policy learning and capacity building. For example, one particular focus of network analysis might look at how institutions (the node) with many weak ties might enhance policy learning in a way that fits with the hypothesis of 'the strength of weak ties' (Granovetter 1973). While the actual mapping and analysis of these networks in each case study would comprise a significant research project, it might allow for deeper insights into how these institutions and the connections between them operate and perform in relation to a set of higher-order overarching rules. Arguably, it would also provide insights into what network structures should be encouraged, initiated or supported by higher-order governance levels.

Climate governance experimentation

This work also forms a solid basis for further extensions of lines of inquiry drawing from governance and innovation studies. In particular, the focus on experimentation and innovation within the polycentric climate governance approach fits well with recent advancements combining these two fields, for example, the recent volume, *Innovating Climate Governance: Moving Beyond Experiments* (Turnheim, Kivimaa and Berkhout 2018). Research on climate governance experimentation has gained increasing attraction from researchers in recent years "as a principle for action in an area that is fraught with uncertainty, complexity, diffuse authority and agency, justified by the need to design provisional goals and to fine-tune through comparative learning" (Turnheim, Kivimaa and Berkhout 2018a, p. 3). Specifically, this research lends itself to analytical extensions in the form of an in-depth case study on the embedding of climate governance experimentation, drawing from empirical research in California presented here.

This kind of work would provide interesting insights into the processes whereby climate governance experiments "influence beyond the initial context within which a new way of doing

things has been configured… and through such a process transforming climate governance itself" (Turnheim et al. 2018a, p. 17). The case of embedding Regional Climate Collaboratives in the State of California is one such example of a climate governance experiment that illustrates the recasting of scope and involvement of new agents in an alternative mode of governing. This dissertation research would also lend itself to further inquiries concerning how subnational climate experiments may unlock decarbonization pathways, specifically in the transportation sector. In particular, the policy/political context analysis provides a starting point for understanding causal mechanisms for transitions operating along the political spectrum, for which recent frameworks for analysis have been developed (Bernstein and Hoffman 2018). In this way, technical innovation-governance/policy insights might be developed alongside arguably the most critical factor for unlocking decarbonization pathways – the political foundations: norms, institutions, capacities and coalitions (Bernstein and Hoffman 2018).

Informal Science-Policy Networks

As discussed, in the case of California, organizational, procedural, and communicative policy tools that vertically and horizontally steer the climate governance system are much more prevalent. However, interviews with experts in California have revealed that informal knowledge networks play a critical role in facilitating communication and coordination between stakeholders in a given region. In particular, at lower levels of government, these informal policy/knowledge networks seem to feature as a key mode of coordination, communication and learning. For example, in Southern California, there is a high level of communication between stakeholders, like LA Metro, the LA Port Authority, the various counties, industry, etc., which takes place via informal networks (G. Giuliano, personal communication, Feb. 21, 2018).

That is not to say that government-led horizontal integration organizations like the Southern California Association of Governments are not also key platforms for coordination and learning, but that these more formal organizations co-exist, and benefit from, robust informal knowledge/policy networks. Other researchers have made this point in the context of environmental governance in California. For example, the importance of these networks was recently highlighted in research around the coproduction of decision-support tools and models for adapting multiuse reservoir and water-energy governance in California (Ziaja 2019). In California,

climate governance experiments have cropped up, in part, to serve the needs of more informal knowledge networks. For example, many of the engaged stakeholders involved in informal knowledge networks are now formally a part of the Los Angeles Regional Climate Collaborative. An in-depth analysis of the exact dynamics between informal and formal sites for communication and learning is outside the scope of this dissertation research but are important and a potential area for future research related to operationalizing polycentric climate governance systems.

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