**Reshaping Cities Through Sustainable Urban Planning Strategies and Creating
Healthy, Equitable and Sustainable Communities Addressing
the United Nations Sustainable Development Goals**

By: Mariyan Boychev

Supervised by: Professor José Etcheverry Ph.D.

A Major Paper
submitted to the Faculty of Environmental and Urban Change
in partial fulfillment of the requirements for
the degree of Master in Environmental Studies
York University, Toronto, Ontario, Canada

July 30, 2021

ABSTRACT

Entering the third decade of the 21st century, humanity is facing multiple disasters. These encompass climate change and its consequences, the COVID-19 health pandemic, as well as increased social, economic, and environmental inequalities. These emergencies must all be addressed, in every aspect of our lives, together with better urban planning, to create future sustainable, equitable, and healthy communities and cities, and preserve the planet. The "15-minute city" model that unifies many urban strategies is key for the COVID-19 recovery and for developing sustainable cities. It focuses on meeting all the requirements that a person needs within a 15-minute radius of their household with minimal travel. As well, the strategy to reshape cities addresses the United Nations Sustainable Development Goals (UN SDGs) that lead to global development towards wellbeing for all. It is recognized that going back to the previous "normal" is not an option and we should move away from the unsustainable way of life in our cities. Adopting the "15-minute city" model in Toronto can be a significant tool for better urban planning to create a post-COVID-19 sustainable and healthy community, to address efficiency and resilience of the city, while simultaneously contributing to climate change mitigation. Toronto must follow the examples of Paris, Seattle, and other global cities and implement the 15-minute neighbourhoods' strategy for creating sustainable, equitable, and socio-economically prosperous communities, as well as meet its goal to become a carbon neutral city.

Key words: sustainable communities, urban planning, mixed-use, compact development, affordability, accessibility, sustainability, transit-oriented development, socio-economic justice, the 15-minute city, climate change, sustainable development, UN SDGs

FOREWORD

This Major Research Paper is written to fulfil the requirements of the Master of Environmental Studies (MES) Program with a specific emphasis on planning. My MES research is based on my area of concentration underlined in my Plan of Study (POS): *Climate change mitigation through sustainable urban planning*. Climate change is the biggest issue that humanity has ever faced. The Intergovernmental Panel on Climate Change calls attention to the irreversible increases in temperature, the change of the climate and weather systems, damaging all of Earth's ecosystems and human societies.

This paper engages with the planning perspective and solutions of the issues of the current time including climate change, socio-economic injustice, and the recovery from the COVID-19 pandemic. My research questions and research design helped me to achieve my learning objectives outlined in my POS. Generally, my research is guided by three main components and learning objectives based on climate change mitigation: urban planning, sustainability and land use, and energy efficiency.

I accomplished all the POS components and objectives by taking relevant courses in the MES program. Additionally, I excelled in my Internship with the City of Toronto North York Transportation Planning and this helped me gain experience in the field of urban planning including transportation, as well as it increased my knowledge and curiosity in the planning sector.

This Major Paper contributes to the field of planning as it provides recommendations for reshaping cities through sustainable urban planning during the recovery from the pandemic to create more prosperous and sustainable communities while addressing the United Nations 17 Sustainable Development goals.

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

LIST OF ACRONYMS

CO_2	Carbon dioxide
CO_2eq.	Carbon dioxide equivalent
GHG	Greenhouse gases
GIS	Geographic Information Systems
GTA	Greater Toronto Area
HAIs	Housing Affordability Indices
IPCC	Intergovernmental Panel on Climate Change
MT	Megatonnes
$MtCO_2$eq.	Megatonnes of carbon dioxide equivalent
OPCD	Office of Planning and Community Development
SCD	Sustainable Community Development
SDGs	Sustainable Development Goals
tCO_2eq.	Tonnes of carbon dioxide equivalent
TOD	Transit-Oriented Development
TTC	Toronto Transit Commission
UN	United Nations
UNCA	United Nations Climate Action

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

1.1. Background

Anthropogenic climate change is the defining and existential issue of the current time. The Intergovernmental Panel on Climate Change (IPCC) (2013) defines climate change as a change in the composition of the global atmosphere due to the increase in greenhouse gas (GHG) emissions owing to human activity. Scientists who study environmental problems and climate solutions warn us that humanity faces a global crisis, which could destabilize the health and security, as well as sustainability of our current civilization (Foley, 2015). The IPCC (2019) underlines that we must rapidly reduce GHG emissions and limit the changes in the ocean and cryosphere in order to preserve the planet's ecosystems, the lives and livelihoods that depend upon them. Furthermore, future generations will face immense challenges and climate related risks if urgent action is delayed. Also, under the 2015 Paris Agreement, all countries must work towards the goal of keeping global warming well under a 2-degree Celsius increase while pursuing efforts to further limit warming to below 1.5 degrees Celsius (IPCC, 2018). However, in May 2021, the concentration of carbon dioxide in the atmosphere reached almost 420 parts per million which is the highest level ever measured (National Oceanic & Atmospheric Administration, 2021). Therefore, it is critical to address climate change and take action in order to solve it at all scales; that is, as citizens, neighbourhoods, regions, cities, and countries (Hawken, 2017).

Cities are particularly important when considering climate change because of their rapid growth. More than half of the world's population now lives in cities, which are characterized by their density of human settlement patterns, population size, and social activity (Rosen & Walks, 2013). Even before the COVID-19 pandemic, rapid urbanization meant that four billion people

lived in cities "facing worsening air pollution, insufficient infrastructure and services", as well as unplanned urban sprawl (United Nations, 2020a, p. 46). Furthermore, cities are built in an unsustainable way, and cars dominate urban areas taking up a lot of space and producing a lot of GHG emissions. As well, urban settlements and cities play a major role in the amount of energy that is consumed. Urban areas, along with buildings and infrastructure, contribute to an increase in energy use and electricity consumption, raw materials use, waste output, as well as water consumption (Myerson, 2007).

Moreover, Joy and Vogel (2013) underline that cities' economic restructuring results in reshaping urban areas leading to substantial spatial consequences and significant inequality among a city's residents. Considering the growth of cities and their intense impact on our natural environment, urban planning strategies to alter the built environment are critically important. We need sustainable cities that incorporate compact development, transportation, housing, renewable energy, and green infrastructure to achieve a safe, low-carbon world. Sustainable development is recognized as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations, 2021). In addition, sustainable practices support and balance environmental, economic and human health and vitality.

Therefore, it is essential to focus on the solutions, including sustainable urban planning, and to act now, in order to avoid catastrophic climate change and its associated impacts while we simultaneously create healthy, equitable, and sustainable communities. According to Fainstein (2020) "urban planning, design and regulation of the uses of space focus on the physical form, economic functions, and social impacts of the urban environment and on the location of different activities within it". When planning cities by incorporating compact neighbourhoods and mixed-use areas, they can become sustainable and equitable places to live. Furthermore, planning for

sustainability can reorganize a city's landscape in very fundamental ways. Urban planning presents important opportunities to rethink and reshape the way land, energy and the environment are used, as well as invent and create the kinds of places that will sustain and enhance the planet.

1.2. Purpose of the Study

This study is guided by the research question: What does a post-COVID-19 sustainable and healthy community in Toronto, Ontario look like and how can urban planning strategies work to create this sustainable and healthy community in order to address socio-economic inequalities and deal with climate change? My sub-questions include: What are the main sources of GHG emissions in cities? How can large cities such as Toronto be reshaped through urban strategies to become carbon-free cities? How do urban strategies work to address the UN SDGs?

The main goal of this research is to appraise the adoption of the "15-minute city" model in Toronto as a significant tool for better urban planning to create a post-COVID-19 sustainable and healthy community, address efficiency and resilience of the city, while all at once contributing to climate change mitigation. This research will examine the implementation of the "15-minute city" model in Toronto, Ontario based on the discussion of two case studies presenting the implementation of the strategy in Paris, France in Europe and Seattle, the United States in North America.

This study looks at the 15-minute city model incorporating energy-efficient, sustainable and affordable housing, improved transit, micro mobility, amenities, and pedestrian and green spaces. The model will be examined and considered as a tool to create post-COVID-19 efficient, sustainable, resilient, and economically prosperous cities for all. The 15-minute city urban development is a "complementary approach" to mixed-use transit-oriented development, which comprises compact development, smart and strategic growth, "people-friendly, 'complete' and

connected neighbourhoods", as well as it "promotes affordable housing in each neighborhood" (C40 Cities, 2020). This focuses on meeting all the requirements that a person would need within a 15- to 20-minute radius of their household, reduces GHG emissions and energy loss, and simultaneously puts emphasis on improving the lives and health of city residents by making the cities more accessible to every citizen (Appleton, 2020).

In addition, this research addresses climate change mitigation through sustainable urban practices by incorporating the United Nations (UN) Sustainable Development Goals (SDGs). Adopted in 2015, the SDGs "provide an established framework for evaluating the links between global warming of 1.5°C or 2°C and development goals that include poverty eradication, reducing inequalities, and climate action" (IPCC, 2018, p. 18). According to the United Nations (2020b),

> The Sustainable Development Goals are the blueprint to achieve
> a better and more sustainable future for all. They address the global
> challenges we face, including poverty, inequality, climate change,
> environmental degradation, peace and justice (para. 1).

Also, the UN 17 SDGs (Figure 1) offer a "novel approach to global governance, where goal-setting features are a key strategy" (Biermann et al., 2017, p. 26).

Figure 1. The United Nations Sustainable Development Goals; Source: United Nations, 2015

In addition, the UN Sustainable Development Goals with the approval of the 2030 Agenda for Sustainable Development, comprise guidelines designed to lead global development towards wellbeing for all, while simultaneously assuring that these enhancements can be maintained over time in all domains: social, economic, and environmental (United Nations, 2015, 2020a).

Cities are at the centre of attention of the UN strategy as their current development can significantly contribute to accomplishing the UN SDGs. This is a critical time to reshape cities and create sustainable communities to benefit both the environment and human beings. According to Benfield (2011), sustainable communities "share a common purpose: places where people thrive to enjoy good health and create a high quality of life", and where the consumption of fossil fuels, GHG emissions, water resources, and pollution are minimized. Additionally, and ideally transportation, housing, and conservation of resources are managed in ways that retain the economic, ecological, and picturesque values of the environment. Moreover, a sustainable community encourages nonpolluting forms of transportation, particularly walking or cycling, and an urban form that supports those activities.

This is the time to build adaptable and resilient zero carbon communities in order to address climate change, as well as socio-economic and environmental injustice. Green cities and sustainable communities are related concepts that can minimize the environmental impact and the consumption of natural resources. A green and sustainable recovery for Canada and its large cities, such as Toronto, means investing in and developing affordable, sustainable, healthy communities and transportation networks. By incorporating sustainable land-use, urban design, building design, and transportation, we create significant opportunities to combat climate change and reshape cities while recovering from the pandemic.

2. RESEARCH METHODOLOGY

In order to answer my research questions, I applied qualitative and quantitative methods of research. The use of a mixed methods approach allowed me to extend my understanding and respond to my research questions with the benefit of multiple perspectives.

Good qualitative research aims to address emerging topics, and simultaneously can build on previous research done on the topic (Ritchie et al., 2014). The qualitative method consisted of a literature review and the analysis of case studies. The literature review allows for a robust research design and, at its core, has the goal of evaluating all that has been discovered related to the topic of interest (Ritchie et al., 2014). Furthermore, by conducting a thorough literature review of the topic, the researcher is able to decide what gap they want to fill in expanding the literature.

The literature review done in this Major Paper allowed me to examine the most recent findings that are relevant to my topic of interest and to explore what is known about the planning strategies connected to sustainable cities and communities. Additionally, the review of the literature enabled me as a researcher to find out what already exists to ensure that I do not recreate work that has already been done, to make a historical overview of the topic at study to examine the concepts, as well as what others have said about the tropic. In addition, through a literature review I focused on the main concepts and practices that form the basis of my research. This was incorporated in a table outlining how the urban strategies fulfill the UN 17 SDGs. The academic literature, scientific reports, municipal government documents, provincial documents, university reports, books, recent news reports and relevant documents on the topics related to climate change and urban planning were all important aids for my research base design.

The case study design as a part of my qualitative research method was a good approach to compare and conduct an in-depth exploration of the phenomenon that I examined in detail in this context (Ritchie et al., 2014). The Paris and Seattle case studies helped me to look at the best practices, the main outcomes, and what must be done so that the model of the 15-minute city may be applied in Toronto.

I used quantitative research methods and statistical data to evaluate the current conditions and trends that guided my research. These included data regarding GHG emissions in Paris, Seattle, Canada, Ontario, and Toronto, as well as housing prices in the city of Toronto, which I used to create charts and diagrams.

Also, to answer my research questions, I used open data from the City of Toronto to create Geographic Information Systems (GIS) maps to analyze the general patterns, research findings, and provide general insight into what is needed and what is missing in Toronto's neighbourhoods. As well, the maps helped me to outline the possible areas of Toronto where the 15-minute city model could be successfully applied.

In addition, I incorporated the city-wide perception study questionnaire in my major research. I used already available data from a questionnaire with interviews performed with the citizens of Toronto on the topics of climate change and lifestyle changes to address its consequences. I analyzed the results and incorporated them in my research. The secondary analysis was a valuable approach which provided an opportunity for me to use elements from the data to convey a new perspective and to form a base for comparison (Ritchie et al., 2014). As well, it can become a base for further investigation and research.

3. LITERATURE REVIEW

3.1. Theories and Historical Context

According to the Sustainable Community Development (SCD) (2018), the way we plan and use urban space is critical for creating sustainable infrastructure and healthy communities. Moreno et al. (2021) argue that throughout the stages of cities' planning, it is important to focus on sustainability and accessibility rather than on the transportation features. Cities must be planned in a sustainable way that minimizes the consumption of non-renewable resources, while also minimizing the use of land, and ensuring the limitation of wastes and emissions.

According to O'Sullivan and Bliss (2020), in the 20th century, cities were developed based on automobile transportation, as well as on zoning codes, which resulted in the outward spread of cities with outskirts industry, commercial zone in the core, and residential areas making rings around the centre, eliminating the previous hundreds of years norm, before the invention of automobiles, of having villages and walkable neighbourhoods. This led to the increase of private transportation, often over great distances, and resulted in an increase in energy consumption and GHG emissions. O'Sullivan and Bliss (2020) emphasize that it was a long-time city dream to disintegrate this last-century-dominated car-oriented urban planning, and planners

> have been advocating for the preservation or return of walkable, socially mixed neighbourhoods at least since the 1961 publication of Jane Jacobs's paean to Manhattan's Greenwich Village in *The Death and Life of Great American Cities* (para. 9).

According to the Sustainable Community Development (2018), in North America, "New Urbanism" and "Smart Growth" are two approaches that have been used to support more sustainable decisions in planning as well as to reassure the integration of high-density

neighbourhood development and different kinds of land-uses, types of housing, and transport options. The New Urbanism approach focuses on walkability, connectivity, mixed-use, diversity, mixed housing, smart transportation, sustainability, quality architecture, and urban design, contributing to the increase in efficiency. Furthermore, the New Urbanism urban planning template of the 1980s and 1990s was used to create row houses and apartments including walkable tree-lined streets incorporating a vigilant distribution of schools, stores, and parks instead of detached houses and therefore reducing the need to drive gas-powered cars (O'Sullivan & Bliss, 2020). It was first implemented in Seaside, Florida.

The Smart Growth approach targets city centres to regenerate and make them a better place for communities to live combining mixed-land uses, transit, and pedestrian spaces. In addition, the mixed-land use principle of Smart Growth planning promotes the combination of business, residential, commercial and retail uses eliminating the need for cars and travel. Furthermore, walkability is promoted by mixing land uses and results in greater social interaction, health improvement, and lower transportation costs, as well as benefits the environment (SCD, 2018). Mixed-land use promotes the creation of high-density neighbourhoods with further potential benefits of "local employment, commerce, retail, and leisure", which ultimately reduce the distances that people need to travel to access all of these facilities (Steemers, 2003, p. 5). Moreover, mixed-use development allows for balance of heat and power to be used optimally where the energy demand is not localized but also mixed, "combining housing with other commercial activities" (Steemers, 2003, p. 5). Otherwise, when urban planning produces urban sprawl, it requires more energy to move people, goods and services, resulting in an inefficient use of energy (SCD, 2018).

Mixed-use development delivers advantages for people and municipalities providing

alternative modes of transportation such as bike sharing, cost savings on maintenance for roads and gas for cars, as well as reductions in the carbon footprint that enhances public health and accessibility (SCD, 2018). Additionally, mixed-land uses and walkable neighbourhoods, along with highly differentiated street design, prioritize diverse and healthy travel modes, and increase efficiency. Copenhagen, Denmark, made their downtown streets pedestrian-only shopping areas in 1962, becoming the first of many other densely constructed European cities to make their downtown shopping areas pedestrian-only zones (O'Sullivan & Bliss, 2020).

According to O'Sullivan and Bliss (2020), since the end of the 20th century and the beginning of the 21st century, the heightened concerns around air pollution and climate change have led to innovation in cities such as London, United Kingdom, introducing a congestion charge in 2003 for cars driving into the centre of the city, as well as a massive expansion of public transportation networks in big cities around the world "from Moscow to Medellín".

In the late 1980s and early 1990s the concept of Transit-Oriented Development (TOD) emerged (Carlton, 2009). According to Carlton (2009), in 1993, TOD became a "fixture of modern planning" when Peter Calthorpe published "*The New American Metropolis*" (p. 1). TOD is generally defined as "a mixed-use community that encourages people to live near transit services and to decrease their dependence on driving" private vehicles (Carton, 2009, p. 1). It is based on "a neo-traditional guide" of a sustainable and equitable community design and it can also be looked at as a theory of community design that addresses many social issues and is an easily clear solution for city and regional growth. Moreover, TOD is a type of urban development that encourages mixed-use and compact development, and results in environmental, socio-economic and cultural benefits, promotes walking, cycling, and the use of public transit. It also endorses affordable housing, jobs, services, and amenities near public transportation hubs, reduces car

dependency, improves energy efficiency, and helps mitigate climate change.

In 2016, the 15-minute city approach in urban development was proposed as an interrelated model to the mixed-use and TOD, incorporating compact development, smart and strategic growth, and pedestrian-oriented neighbourhoods. The 15-minute city concept has been key to the future plans of many cities for years, but thanks to COVID-19 it has gained unprecedented traction becoming a vibrant part of creating livable and sustainable cities around the globe (CGTN, 2020). Sisson (2020) argues that the general idea is not really new, but that it builds on principles of New Urbanism and TOD, and also has origins in the idea of the 'neighbourhood unit', advanced in the early 1900s by the American planner, Clarence Perry.

Furthermore, in the past decade similar visions known as the 30-minute city or neighbourhoods arose in Australian cities of Melbourne, Sydney, Perth, and Brisbane (Newman, 2016, Sisson, 2020). Newman (2016) points out that the model has become very useful for the planning of those cities as it helped to develop strategic concepts for where development should occur or not. Moreover, the strategic plans from that model guided the increase of and assisted in redevelopment, and also proved that infrastructure can support density.

According to Li et al. (2019), a similar model was adopted in Asia. Li et al. (2019) outline that the Shanghai Master Plan advanced the idea of a "15-minute community life circle" in 2016, as the living platform foundation to arrange a friendly, comfortable, as well as a safe community, where citizens can access all their basic services and activity space within a pleasant walking distance (p. 593). That concept was used to refine the definition of a "15-minute pedestrian-scale neighbourhood" (Li et al., 2019, p. 593).

Furthermore, Li et al. (2019) draw attention to that research done in Japan in the 1960s which also addressed planning for a life circle. The Ministry of Construction and the Ministry of

Land Affairs of Japan, in 1969, established the concept of a "settlement or local life circle and settled circle" (Li et al., 2019, p. 593). In this concept, the settlement circle was dominated by the residents' demands for different activities and a spatial planning unit that defined all of the needs for residents' daily lives including shopping, employment, medical needs, education, and enjoyment. Other countries in Asia progressively adopted the model as well. For example, South Korea developed their residential areas according to this model and they allocated space for community facilities organized in life circles at different levels. In Taiwan, this concept was proposed in 1979 in order to encourage balanced regional development (Li et al., 2019).

The 15-minute city or community concept was proposed in Europe by French-Colombian professor Carlos Moreno. It had wide media coverage after Paris' adoption at a policy level progressing to other global cities all representing the philosophy of "chrono-urbanism" that supports the need to incorporate "proximity-based indicators" to improve services in urban areas (Moreno et al., 2021, pp. 96-97). Moreno et al. (2021) point out that the chrono-urbanism approaches are linked with theories that outline the significance of urban rhythms in order to comprehend the quality of citizens' lives in cities. According to Sisson (2020), Moreno states that "the work of Jane Jacobs, the urbanist saint, figured into his plans". Furthermore, Sisson (2020) discusses that the idea of creating the concept was developed "in pursuit of *amour des lieux*, or attachment to place", to enhance the urban rhythms which create more healthy, sustainable, and equitable communities.

The current situation of the COVID-19 pandemic as well as climate change highlight the role of urban development in creating the 15-minute city or community which "pledges to return humans to a slower way of life and to a more local community where commuting time is better spent in building relationships with what is nearby" avoiding the use of cars (O'Sullivan & Bliss,

2020). According to Sisson (2020), professor Moreno underlines that in order to achieve the 15-minute city, urban planning is required to deconstruct the city and in particular to incorporate as many diverse urban uses as possible.

In addition, it is important for the model to be looked at as "anti-zoning" that "would undo decades of urban-planning orthodoxy and industrial-era economic development" based on placing activities in separate parts of the city, isolated from each other (Sisson, 2020). Also, it suggests decentralizing the city by adding more options for cycling, walking, active mobility, and public transit, with emphasis on creating economic development in all corners of the city, making it multicentric.

In 2020, the concept of the 15-minute city was a primary focus of the successful reelection campaign of the now Paris Mayor, Anne Hidalgo, built on work done to promote cycling, pedestrianization, restricting of cars, building new green areas and parks, as well as adding "people-first infrastructure to the City of Light" (Sisson, 2020).

Moreno et al. (2021) underline that since the proposal of the 15-minute city model and it's growing recognition and approval at the policy level by the city of Paris, this has led to its discussion and adoption in many other global cities. According to O'Sullivan and Bliss (2020), Paris is not alone in endeavoring this sort of city transformation and for a growing number of cities around the world this urban strategy has become "a powerful brand for planners and politicians desperate to sell residents on a carbon-lite existence". They point out that cities such as London, Manchester, Barcelona, Detroit, Seattle, Milan, and Melbourne are some examples of global cities where leaders and urban planners are working towards similar visions to create healthy, socially and economically equitable, and sustainable post COVID-19 cities and communities.

Illustrations of the model include Manchester's plans for a "zero-carbon city centre" and

"low-traffic neighbourhoods" in London (Nanda, 2020). O'Sullivan and Bliss (2020) outline

that London's model focuses on creating "Mini Hollands" importing the Dutch planning ideas that

aim to reduce the number of vehicles from accessing shopping centres in neighbourhoods.

Very similar plans have been made in Madrid to follow this approach to make it "a city of

15 minutes" as a planning strategy during the recovery from the COVID-19 pandemic. Planners

and politicians in Milan hope to keep their COVID-19 bike lanes and sidewalks and make those

changes permanent as the city's economy re-stabilizes and recovers after the pandemic. If the 15-

minute city model is to truly become a global movement, it will need it to overcome the

predominance of the cars which O'Sullivan and Bliss (2020) discuss as "a big battle over a core

urban tension".

While the concept is more commonly known as a 15-minute city, there are other famous

variations to the model. In the city of Melbourne, it is known as "20-minute neighbourhoods"

(Appleton, 2020). The City of Melbourne has been working on the "long-term planning blueprint"

around creating 20-minute neighborhoods since 2017 (O'Sullivan & Bliss, 2020). The city's goals

are similar to those of the city of Paris, but it will be more difficult to implement the model

especially in areas with poor public transportation. However, some of the middle suburbs that are

well-served by public transit are already experiencing densification.

In Barcelona, the concept is commonly known as the green "Superblocks Project" (Dublin

Chamber, 2020). O'Sullivan and Bliss (2020) explain that Barcelona has been working to turn 400-

by-400-meter portions of road conquered by apartment towers areas into mostly "car-free

superblocks". Nanda (2020) underlines that Barcelona proposes a great example of city areas and

neighbourhoods' transformation to reduce pollution, improve air quality, and to increase access to

green space. The "superblocks" model of "neighbourhoods of nine blocks" was first introduced in

2016 as a part of Barcelona's urban planning where the streets within the blocks are only for cyclists and pedestrians while vehicular traffic was restricted to the main arterial roads around the superblocks (Nanda, 2020).

In spite of technology enabling the opportunity to move fast between cities and countries and empowering people's work or study from home, the reality is that a large number of journeys to work, study, medical centres, or shops still "take at least one hour of travel time and are highly dependent on the carbon economy" (Euklidiadas, 2020). This leads to the consideration of the urban strategy of "the 15-minute city" and its variances as a solution for friendlier cities built on comfort of travel, walkability and public services, with more quality time for its citizens, as well as more healthy and sustainable city environments with less noise and pollution.

3.2. The "15-minute city" Model as a Way to Achieve the UN 17 SDGs

Entering the third decade of the 21st century humanity is facing multiple crises. They encompass the COVID-19 health pandemic, climate change and its associated consequences, as well as increased social, economic and environmental inequalities, and "record numbers of unemployment around the world" (Moreno et al., 2021). All of these emergencies need to be addressed in every aspect of our lives together with better urban planning to create future sustainable, equitable, and healthy communities and cities preserving the planet. In addition, these crises demonstrate the possibilities in rediscovering proximity to necessities, goods, and services (O'Sullivan & Bliss, 2020).

Sisson (2020) outlines that the only pathway forward for cities to recover from the COVID-19 pandemic is to introduce green stimulus plans creating employment opportunities for economic stabilization, as well as focusing on the "pillars of progressive urbanism". These include investment in renewable energy, energy efficient affordable and sustainable housing, improved

transit and creating walkable areas, new parks and open green spaces. Taking into account that cities are the "engines of the recovery", we need to invest in their future resilience as the best and only way to avoid economic and environmental catastrophe (Sisson, 2020).

Moreno et al. (2021) underline that the challenges associated with the pandemic and cities' lock-downs have led to our need to fundamentally re-think the city. This led to the re-emergence of the "15-Minute city" concept proposed five years ago (Moreno et al., 2021). It is one of the most talked-about and discussed urban development models of transforming cities after COVID-19 into smarter ones by introducing 15-minute neighborhoods in cities.

Whittle (2020) highlights that the 15-minute city or community theory was created with research into how city residents' use of time can be reorganized in order to enhance their living conditions and the environment as a whole. Furthermore, Whittle (2020) discusses that this recent model was proposed and advanced by Professor Carlos Moreno at the Sorbonne University in Paris. Moreno's vision of "*la ville du quart d'heure*" is based on providing all the daily necessities in urban areas within a 15-minute walk or bike ride (Figure 2).
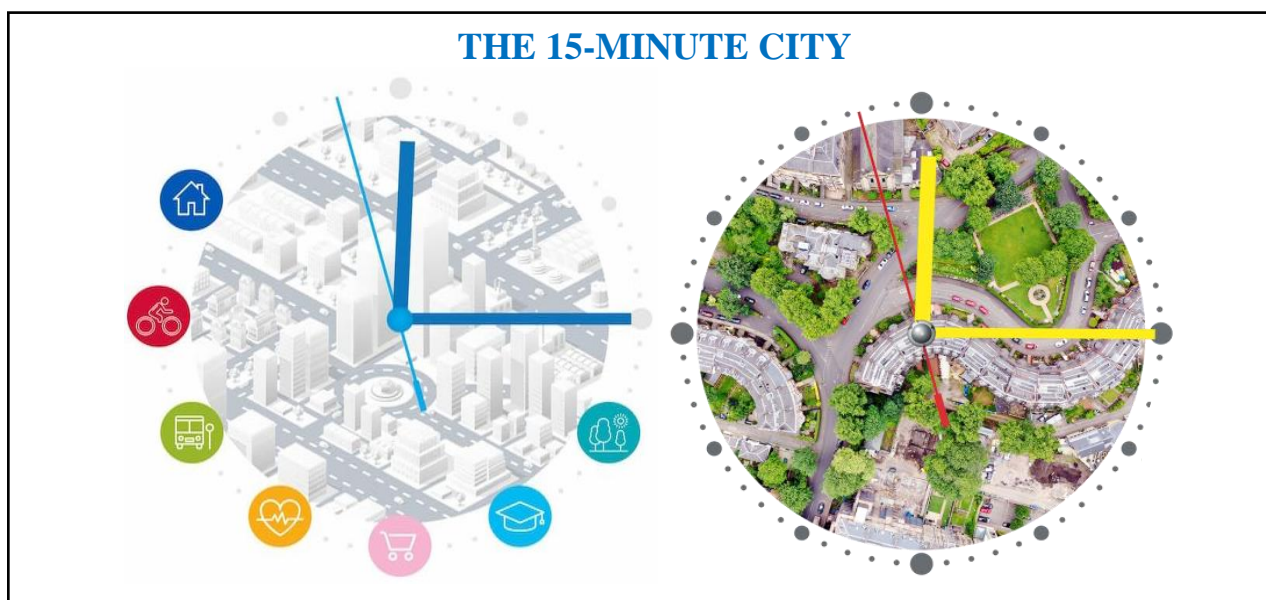
Figure 2: The "15-minute city" model with all its aspects;
Adapted from Dublin Chamber, 2020 and Whittle, 2020

Whittle (2020) suggests that Moreno's 15-minute city concept is discussed as a paradigm shift away from a car-oriented city design, where people can live, work, learn, shop, entertain, play, and access healthcare within the same time a commuter could "wait on a railway platform".

This strategy focuses on meeting all the requirements that a person would need within a 15- to 20-minute radius of their household. This incorporates having housing, schools, shops, leisure facilities, workplaces, health care facilities, restaurants, parks, and green space where everything needs to be based on equity and accessibility. Willsher (2020) underlines that the key to creating 15-minute cities and neighbourhoods is to phase out vehicles encouraging "more self-sufficient communities", transforming citizens' relationship with time and nature while at the same time reducing the economic burden for housing and travel. The 15-minute city is used to create more equitable opportunities, communities, neighbourhoods, and cities.

In addition, this reduces the desire for land for parking spaces, allowing that space to be transformed into green open space. It also eliminates the urban heat island effect, reducing the impact of extreme weather events due to climate change. Moreover, creating 15-minute cities or communities can help cities recover economically and socially from the COVID-19 pandemic and simultaneously reach the emission reduction targets set out by the 2015 Paris Agreement (Vansynghel, 2020).

Appleton (2020), outlines that the 15-minute city concept is full of benefits and possibilities. In addition to the perceptible advantages of citizens being able to appreciate and enjoy all the aspects of their daily lives within a short walk or bike ride from home, there are numerous other benefits. Many resources, reports, and articles discuss the social, economic, cultural, and environmental benefits of creating a 15-minute city or community. These benefits and features of the 15-minute city are visualized by the city of Melbourne, where the concept is known as a

20-minute neighbourhood, as already explained above (Figure 3).

Figure 3: The features of the 15-minute city visualized by the city of
Melbourne, where it is known as a 20-minute neighbourhood
Source: Appleton, 2020

According to Moreno et al. (2021), the 15-minute city concept displays the proposed framework, depicting the four identified dimensions of density, proximity, diversity, and digitalization that must be incorporated in cities (Figure 4). The model considers density in terms of optimal people per square kilometres, addressing sustainable urban service delivery, as well as the consumption of resources. This puts forward the equality and the precise needs of communities of different economic status, and simultaneously provides opportunities for the disadvantaged ones, particularly through the equitable distribution of the cities' civic services, specifically fulfilling SDGs #1, #5, #8, #10, and #11 (see Figure 1). The proximity aspect of the model is essential for supporting cities to reduce the commuting time lost, while also reducing the environmental and economic costs of this activity. The 15-minute city concept includes providing basic amenities in close convenience to urban centres with the result that no disadvantaged people

are left out with respect to socio-economic status or age. This approach pledges to achieve SDGs #14, #15, and #16 (see Figure 1).
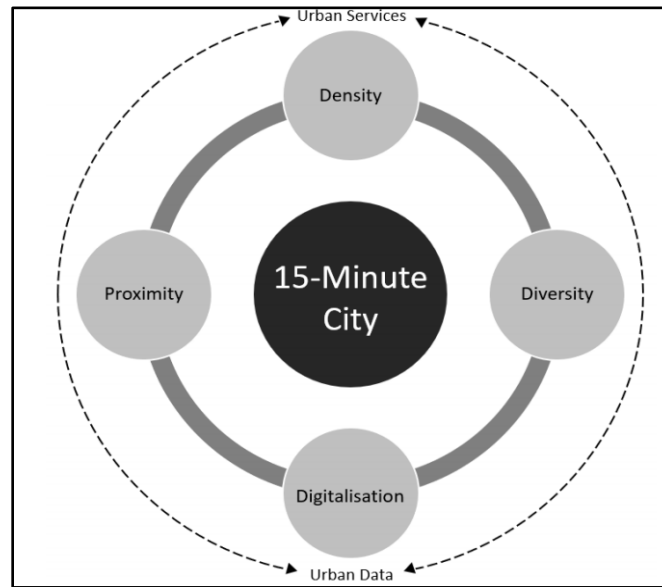
Figure 4: The 15-minute city framework
Source: Moreno et al., 2021

Diversity in the model's framework addresses the need for mixed-use communities which are the main component in providing a strong mix of commercial, residential, and entertainment uses, as well as supporting diversity in culture and people. Incorporating mixed-use neighbourhoods in cities is vital to sustaining economically lively urban areas, confirming sufficient housing for all citizens, ensuring that educational facilities are nearby, as well as encouraging inclusive and sustainable practices, fulfilling SDGs #1, #3, #4, #5, #8 and #12 (see Figure 1).

Furthermore, the diversity aspect of the model contributes to the reduction of automobile use and promote the use of e-bikes and bike sharing making cities more resilient, as well as reducing GHG emissions, which is the way to achieve SDGs #11, #13 and #15. This dimension also describes the effectiveness of the digitalization that is emphasized by the Smart City concept, which is important for work and job creation, virtual studying and communication, and even online

shopping. Additionally, Appleton (2020) argues that technology and data are essential building blocks for creating a Smart City. By presenting projects focused on improving the lives of citizens and communities, Smart Cities can help cities become resilient. Smart Growth encourages community and stakeholder collaboration (SCD, 2018). As well, the support for Smart Growth increases by engaging with the community in the planning process.

Moreno et al. (2021) highlight that it is critical for urban planning to ensure that ideal service delivery within intended ranges of proximity is achieved. Furthermore, proximity and digitalization are imperative for making cities and neighbourhoods sustainable by encouraging the adoption of mixed energy options, helping to reduce the reliance on non-renewable resources assisting with achieving SDG #7. Adopting Smart Growth principles and regulatory standards based on it can help manage land and reduce the demand for energy and associated costs while simultaneously achieving benefits for the community (Keeley & Frost, 2014).

The dimensions of the 15-minute city theory outline SDG #11, connected to resilience and inclusivity, safety and sustainability, as well as the availability of technology, which result in a better quality of life (Moreno et al., 2021). According to Moreno et al. (2021) the promotion of proximity within the 15-minute city model is in line with embracing walkability and social interactions within cities. Additional benefits are created because of the improvement of citizens' health from lower pollution levels and better air quality created by increased efficiency levels and the reduced use of private gas-powered vehicles. As well, citizens' health is improved by having easy access to green spaces, walking, and cycling. An active life including moving, cycling or walking is essential to improve our overall health, achieving SDG #3.

Moreno et al. (2021) suggest that it is important to underline that the 15-minute city which incorporates walkable neighbourhoods enhances the physical health of local residents and

eradicates non-communicative diseases including obesity, as well as improving people's mental health. Yeung (2021) underlines that people more and more turn out to be an urban species, but unfortunately urban environments can worsen our mental health. According to Yeung (2021), research shows that feeling a sense of belonging to the neighbourhood is an immense protector of everyone's mental health and that the more people interact with their neighbours, the better. It is a great benefit of the 15-minute cities as it "could strike this balance, then maybe a happy urban future for the human species is possible" (Yeung, 2021).

Furthermore, the 15-minute city model will create community benefits from the reduced stress and time commuting, more time spent with family and in community involvement, as well as participating in sustainable community projects, such as gardening, which contribute to social inclusion and mental well-being (Appleton, 2020, Willsher, 2020), addressing SDGs #2 and #3.

As well, the concept is based on sustainable urban planning that addresses sustainable infrastructure, and is efficient, fulfilling SDG #9. This "helps support or create closer knit neighbourhoods and the sense of community with them" (SCD, 2018, p. 2).

Many resources point out that today cities face enormous challenges from increased urbanization, climate change, and housing affordability. An important component of creating a sustainable and healthy community, as well as a significant element in the features of the 15-minute city model are housing diversity and affordable housing (Figure 3). Litman (2020) outlines that affordability refers to the ability of residents to purchase essential goods and services including food, shelter, and healthcare. In addition, affordable housing is defined as housing expenses that cost less than 30 percent of a household's income or budgets for "rents or mortgages, and sometimes property taxes, insurance, maintenance, and basic utilities" (Litman, 2020, p. 10).

Suttor (2007) points out that current development patterns in global cities have promoted

displacement of low-income residents from developed neighbourhoods, which can be discussed as a process of gentrification. "Gentrification is a double-edged sword", and it is important that residents are not forced out by rising house prices (Appleton, 2020). Generating affordable, sustainable, and accessible housing for everyone is a central aspect of urban planning and the 15-minute city model to develop sustainable communities and simultaneously mitigate climate change, fulfilling SDGs #6, #11, and #13. Furthermore, a primary ambition of the UN SDGs is the ending of poverty and hunger in the world by 2030, which includes providing adequate housing for everyone, highlighted by the SDGs #1, #2 and #10 (see Figure 1).

Recently, as a possible response to the global goal of achieving sustainable development attention to creating environmentally sustainable housing has risen substantially (Pullen et al., 2010). According to the City of Toronto Housing T.O. 2020-2030 Action Plan (2019), affordable housing of good quality is "the cornerstone of vibrant and healthy neighbourhoods and supports the environmental and economic health of the city, region and the country as a whole" (p. 8).

Additionally, opportunities for affordable housing coupled with renewable energy will result in benefits for people and the environment, mitigating climate change, which achieves SDGs #7 and #13. Moreover, renewable energy and increase in energy efficiency will result in sustainable energy production and consumption, addressing SDG #12 (see Figure 1).

Planning better cities, necessitates policies that consider their ecological and environmental impact on city design (Willsher, 2020). Reshaping cities to enable and encourage walkability and cycling would, in turn, inspire the creation of parks and green spaces, squares and public places within neighborhoods, which "would help to bridge the social inequality in accessing such facilities, which are not always available for everyone in a car-dependent city" (Moreno et al., 2021), addressing SDGs #10 and #16 (see Figure 1).

It is very important to realize our interconnectivity with and dependence on nature in order to build and recover from COVID-19 through sustainability and initiate action to change people's behaviour to lower our ecological footprint and preserve natural ecosystems existing in the area before the development. Considering the ecological aspects, the 15-minute city concept can be recognized as "being a proponent in the prospects of achieving sustainability and resilience in cities" (Moreno et al., 2021, p. 99).

Furthermore, Appleton (2020) points out that the model of the 15-minute city creates financial benefits, where "environmentally-conscious neighbourhoods are able to command higher property values than those in less-desirable areas". Also, economic benefits are created by the money that people save on gas for cars, and create sustainable energy efficient buildings, saving money for electricity and heating in the process. In the 15-mnute city model, "residents and businesses alike will enjoy improved economic circulation and business within neighbourhoods" (Appleton, 2020), addressing SDGs #2 and #8. It is proven during the lock-downs that, by producing car-free, pedestrian- and cyclist-only streets business is improved. Bliss (2021) underlines that a study carried out in 14 pedestrian and cycling corridors in six American cities shows that positive effects were reported for businesses both improving their sales and employment, especially proving economic benefits for restaurants.

According to Sisson (2020), there is already convincing evidence that the 15-minute city model can work. The model based on replacing residents' long commutes in cities and replacing "car-first transit with bikes and walking would slash vehicle emissions, increase resident health and free up roads and parking spaces for other uses" (Sisson, 2020). Moreover, integration is required at all levels of sustainability governance, from global to national and local levels, accelerating agreements across sectoral borders, fulfilling the UN SDG #17 (Biermann et al., 2017).

The 15-minute city model is a vital urban planning strategy that addresses socio-economic and environmental justice and the 5P's of the SDGs that aim to transform society fulfilling the main pillars outlined by the UN SDGs (Figure 5). These include sustainable development for people and the planet achieving prosperity and peace by incorporating partnership between local and national governments, non-governmental organizations, citizens and community groups ensuring a better future for all.
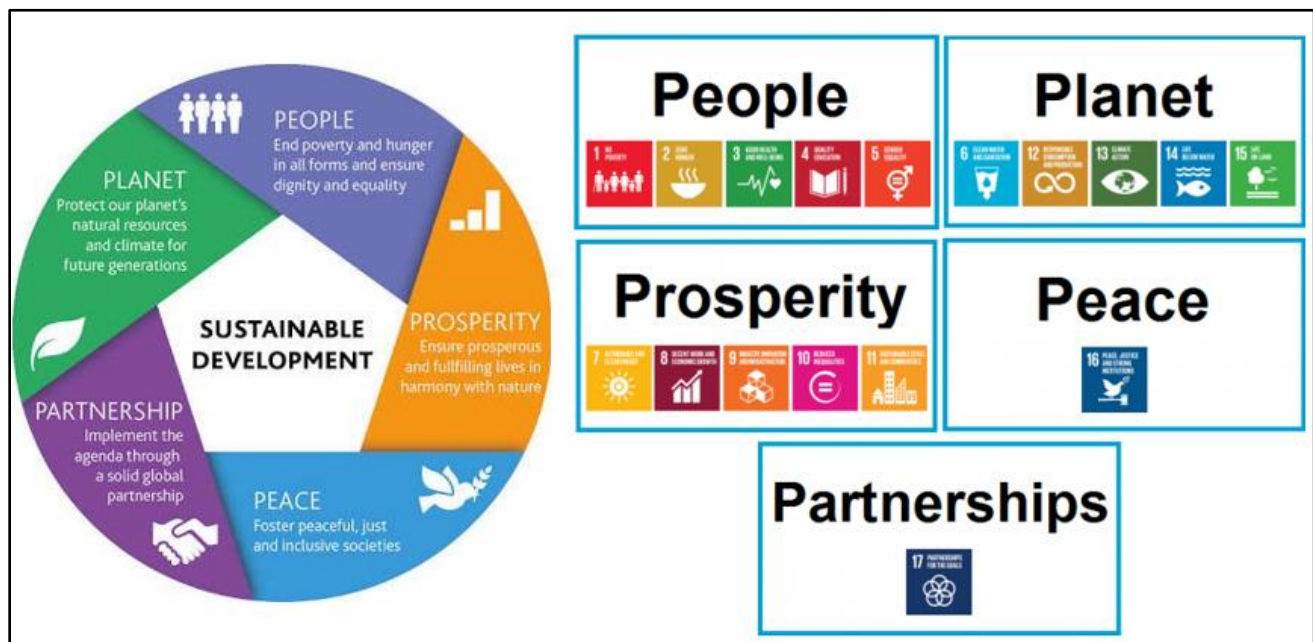
Figure 5. The 5P's of sustainable development of the UN 17 SDGs; Modified by the author from UNESCAP, 2015 and WCYD Earth CIC, 2021

All the benefits of creating 15-minute cities incorporating smart growth, smart city, mixed-use, transit-oriented development, as well as pedestrian-friendly and complete neighbourhoods that address the 17 UN SDGs are shown in Table 1 in Appendix A.

In order for the UN SDGs to be successfully implemented, the adaptability of the governance arrangement must deal with social, economic, and ecological changes that might occur during the next couple of decades (Biermann et al., 2017). Over the next decades, the 15-minute city can become a guideline, a standard, and a prospect for transforming the paradigm of the way

we live, regaining the useful time that we lose, allowing all to live in sustainable, equitable, and healthy cities (O'Sullivan & Bliss, 2020).

4. RESULTS AND DISCUSSION

4.1. CASE STUDIES

4.1.1. Paris, France

The city of Paris, France is the first and most significant example of an urban region implementing the 15-minute city model. Paris is the capital of France and it is the largest city in the country with an estimated population of almost 2.2 million people and over 11 million people with its surrounding suburbs (Population Stat, 2021). Paris is ranked as the world's seventh most densely populated city with more than 21,000 citizens per square kilometre on average (University of Paris, 2021).

The City of Paris is working towards implementing policies and strategies to combat climate change and at the same time addressing the quality of life of its citizens. According to C40 Cities (2021), in 2014, the carbon footprint of Paris and its surrounding areas was determined by a consumption-based approach with significant GHG emissions related to buildings, transportation, services, and food consumption (Figure 6). Paris's Climate Action Plan pledges to cut the city's energy consumption in half by implementing renewable energy, renovating buildings, as well as encouraging citizens to change their consumption and transportation choices (C40 Cities, 2020). During the next decade, the City of Paris will initiate an operational action plan

to achieve the objective of reducing GHG emissions by 50 percent, reducing the city's energy consumption by 35 percent, and accomplishing a 45 percent renewable energy generation (C40 Cities, 2021).
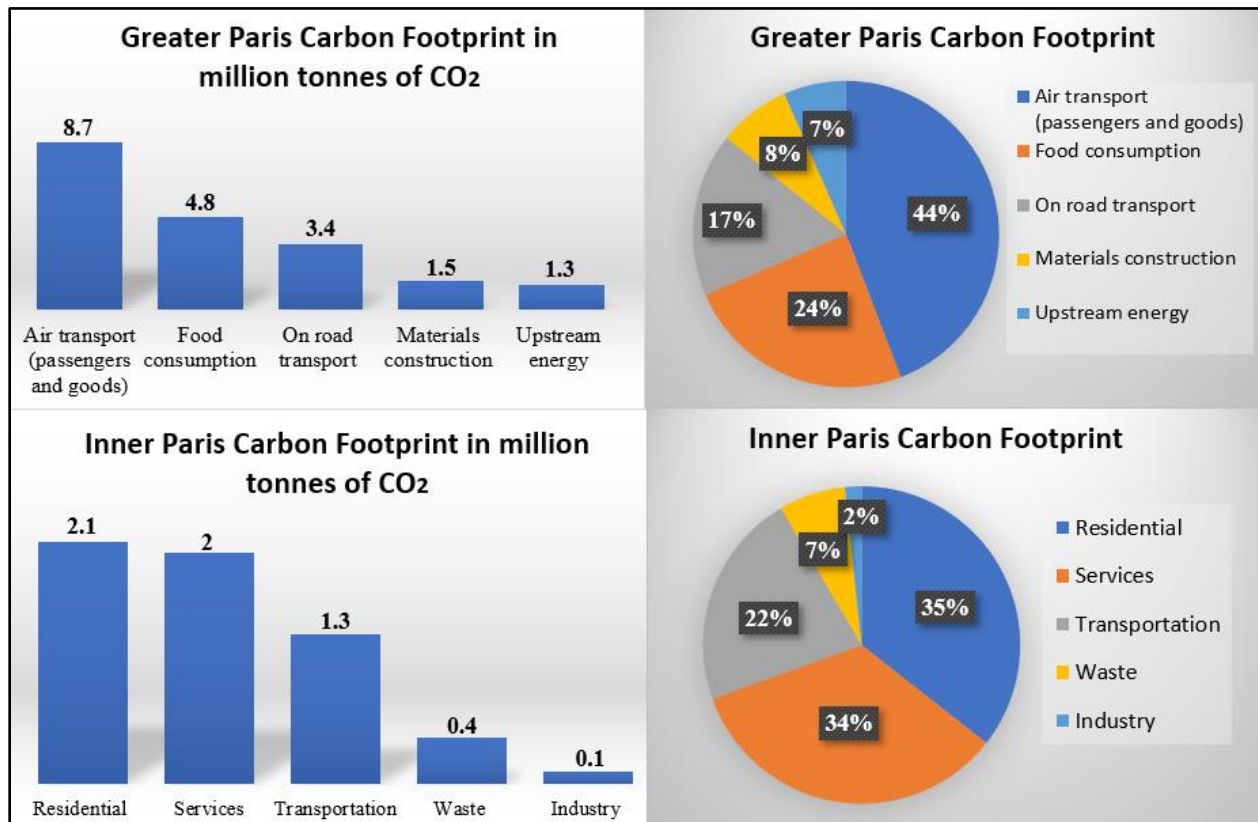
Figure 6. Carbon footprint of Paris in 2014 in millions of tonnes of CO_2 and percentages; Created by the author; Data modified from C40 Cities, 2021

Paris aims to become a carbon neutral city by 2050 by cutting air pollution and improving the quality of life of Parisians (C40 Cities, 2021). The French capital has created the Paris Climate Action Charter to generate cooperation with different metropolitan institutions and companies. Françoise (2019) underlines that the City of Paris allocated 500 million Euros between 2014 and 2019 as Parisians spoke out to implement the climate action strategy, where at least 20 percent of the initiatives would be put towards climate issues, including the Greening Paris program, soft mobility, cool island solutions, and solar panel citizen cooperatives.

As part of its climate action, the city of Paris is moving in the direction of implementing

the 15-minute city model and it is transforming the entire city. Currently, Paris is working towards turning its neighbourhoods into places where citizens can find everything that they need within a 15-minute distance from their home (Figure 7). Paris has already massively scaled-up construction of protected pedestrian and cycle ways and aims to turn the city into many 15-minute neighbourhoods.
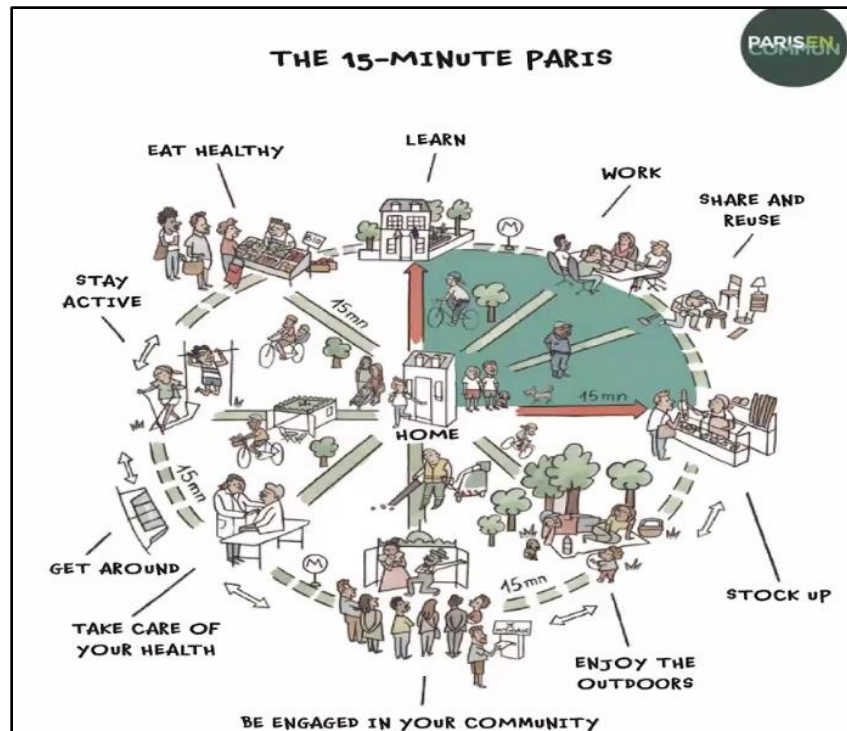
Figure 7. The 15-minute city model in Paris, France
Source: The Municipal Art Society of New York, 2021

In 2020, the mayor of Paris, Anne Hidalgo, grouped all the city's urban policies into the 15-minute city model, picking the term from academic settings and making it a political urgency (O'Sullivan & Bliss, 2020). The 'hyper-proximity' of Paris and the 15-minute city concept were a key pillar of Mayor Hidalgo's successful 2020 re-election campaign (Reid, 2020). The 'more-people first' plan aims to create more space for people by flipping the urban space pyramid of the current urban design prioritizing vehicles (see Figure 8 [A]) into an urban design prioritizing people of all ages and abilities (see Figure 8 [B]) (Euklidiadas, 2020). The mayor unveiled the

space that would be required to produce a 15-minute city and make Paris into a cyclist- and people-friendly place, limiting the space used for cars in order to make more space for pedestrians and cyclists (Reid, 2020). The effectiveness and efficiency of these policies have already been proven as only in 2019 car traffic in the city was reduced by 8 percent (Euklidiadas, 2020). In addition, the city has an extensive subway system confirming that a car-free city is possible.
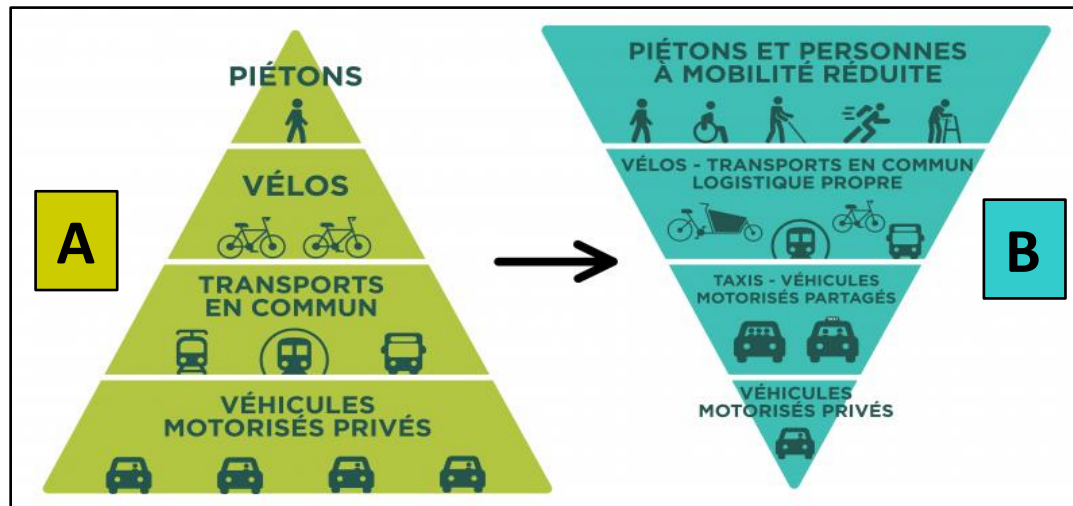
Figure 8. Converting Paris from prioritizing cars to prioritizing people
Source: Euklidiadas, 2020

According to Reid (2020), a study done in 2019 shows that Paris has approximately 83,500 on-street and 621,600 in total motor vehicle parking spaces, and under the city's plan, 60,000 or 72 percent of on-street car parking spaces will be removed. Furthermore, every street in Paris will be made to incorporate cycling infrastructure and paths, as well as all of the bridges in the city will be designed to include protected cycleways. Moreover, proposals include creating hundreds of kilometres of new bicycle lanes across the city (Euklidiadas, 2020). Recent research shows that making cities cyclist and pedestrian friendly and phasing out cars is a major way to reduce transportation GHG emissions. For example, if an average person shifts from driving a car to cycling for only one day per week this will reduce their carbon footprint by 3.2kg of CO_2, which is equal to the emissions produced by driving a car for 10km and one bike trip per day over a year

saves the equivalent carbon emissions of a one-way flight from New York to London or a half a tonne of CO_2 (Brand, 2021).

Reid (2020) underlines that the mayor of Paris would like to perform an ecological transformation and alteration of the city achieved by a new street configuration (Figure 9). The streets will become the main setting for the testing of new sporting, cultural and recreational activities and programs that are being initiated with the input of local residents (University of Paris, 2021). Simultaneously, the streets that are next to schools will be over time converted to prioritize pedestrians and will have green spaces.
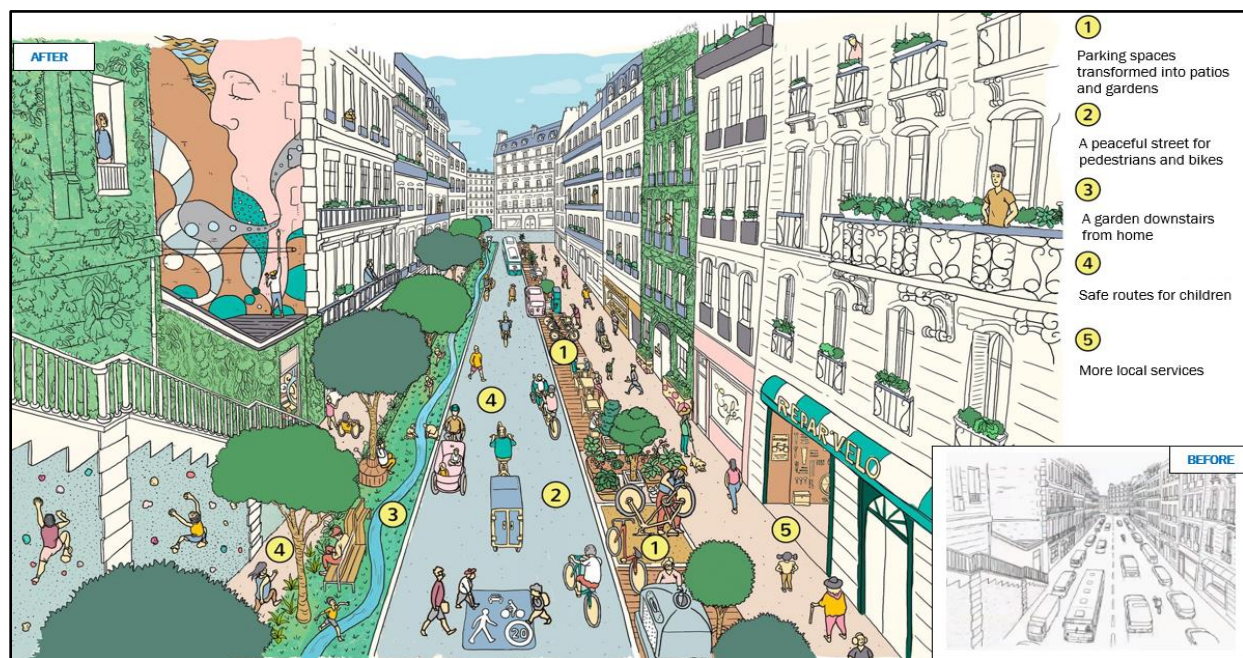
Figure 9. Alteration of the street configuration in Paris, France; Modified from the Municipal Art Society of New York, 2021

According to C40 Cities (2020), Paris will apply the core principles of constructing a 15-minute city ensuring that the residents in every part of the city, in each of its neighbourhoods, have easy and adequate access to the goods and services they would require, especially fresh food, groceries and healthcare. As well, citizens of each city neighbourhood will be able to enjoy green spaces and parks, and breathe clean air with no harmful air pollutants.

Furthermore, each of the city's main neighbourhoods should have access to a variety of housing types with different sizes and levels of affordability to accommodate diverse types of households, permitting more people to live near where they work and therefore improving efficiency and eliminating the need to travel long distances. Under the leadership of the mayor, the City has already put policies in place to ban GHG emitting vehicles which has transformed its streets into linear parks and created socially mixed communities. This policy aims to create public housing in richer areas of the city as well. The city government of Paris emphasizes that those policies have been created to improve the quality of housing and its overall accessibility, to be comprised of 25 percent social housing, 20 percent affordable, and 45 percent free housing, as well as the establishment of basic policies will focus on the city's residents' well-being and activity (University of Paris, 2021). In addition, the City of Paris will work collaboratively with local sporting and cultural venues to establish new and diverse uses for buildings within the city of Paris and create active, people-friendly, and sustainable ground floors for each building.

For Paris to become a true 15-minute city, the city must make multiple uses of the same space and create spaces and places that can change over a day and a week (University of Paris, 2021). Carine Rolland, a deputy mayor in charge of culture and the 15-minute city and Patrick Bloche, a deputy mayor of Paris in charge of education and early childhood, families and new apprenticeships, discuss in University of Paris (2021) that a pilot project policy is on now in Paris's 17 city districts to open up schools and their green spaces to provide different programs and activities by working with local neighbourhood associations. These spaces will be designated as public spaces, which will be just a few short steps from every building, and kids supervised by their parents will be able to play in a safe setting. As well, people will have spaces to read, play sports, rest in, and enjoy the natural environment within an urban location. Additionally, the area

around schools will produce a system of community-scale infrastructure and services required to sustain each local territory (University of Paris, 2021).

The main goal of the policy is to make schools including their neighbouring environments more peaceful and actively incorporating spaces, sharing open green spaces, where all people, families, seniors, isolated and young people can come together to spend time. This is seen as the first major step towards creating a 15-minute Paris. The schools of the capital of France in each neighbourhood are the symbol of making everything happen. This policy shift was ushered in by Anne Hidalgo and it is a complete paradigm shift. During the past years, the City of Paris has been working to use schools for other purposes as a small part of its overall strategy to combat climate change and Paris has named schools and their green spaces as oases or islands of fresh air. In addition, the model creates office space and co-working hubs in neighbourhoods, which currently lack these spaces, and expands the uses of infrastructure and buildings outside their normal operational hours. To accomplish this, Paris will remove concrete and replace it with vegetation, as well as creating places for creativity such as paintings on the ground, and making outdoor seating spaces. These green spaces will be accessible for all people to use. As well, the model encourages citizens to use their local stores (C40 Cities, 2020).

People must be inspired to feel a sense of ownership, and to care for these spaces, so they will be opened progressively and policies will be constructed to include consultation and cooperation with local residents. It is important to emphasize that the community and neighbourhood businesses must have a voice in implementing the 15-minute city vision and participate in the design of local projects. It is critical to ensure that everyone, especially those that are hit the hardest by the COVID-19 pandemic, including low-income and marginalized communities, as well as small businesses are consulted when implementing the 15-minute city

urban strategy elements. The City of Paris used 10 percent of the City's budget to implement participatory practices at the neighbourhood level which is recognized as one of the largest participatory budgets in the world in designing the 15-minute city model (C40 Cities, 2021).

By implementing the 15-minute city strategy, the city will be able to cut air pollution and hours lost in commuting for city residents, improve Parisians' quality of life, and ultimately achieve the city's plan to become a carbon neutral city by 2050. Additionally, the city of Paris can be made so that more people can work close to home and remotely due to the creation of smaller-scale offices, small retail stores and businesses, as well as co-working environments. Transforming the city and implementing the urban strategy will eliminate congestion of urban streets, reduce GHG emissions and produce active travel, and a healthier lifestyle for residents.

The COVID-19 pandemic has caused cities to think differently about the way people move, consume, and live. With the city of Paris leading the way in transforming cities, other cities all over the world have been encouraged by the model to create resilient, healthy, equal, and vibrant communities. Images that visualize some of the benefits of the implementation of the 15-minute city model in some of the neighbourhoods in Paris are included in the Appendix B.

4.1.2. Seattle, the United States

Seattle is the largest city in Washington State, the United States (U.S.), and in the north-west American coast area. The latest population statistics from the Washington State Office of Financial Management shows that in 2020 the population of Seattle was over 761,100 people and the greater metropolitan area of the city reached a population of more than 4.2 million residents (Fesler, 2020).

In September 2020, the City of Seattle released its *Plan to Build Back Better During the COVID-19 Recovery* and the Office of Planning and Community Development (OPCD)

announced it would consider the 15-minute city concept as a potential guide to develop the principles for the next version of the city's Comprehensive Plan (Vansynghel, 2020). It is the city's urban planning script that sets the guidelines for what the city will look, function, and feel like in the future. In addition, the City of Seattle has initiated a Climate Action Plan that has a goal of producing a climate-neutral city by 2050 through the reduction of GHG emissions.

In 2018, Seattle's total annual emissions were 5,766,042 metric tonnes of CO_2eq (Government of Seattle, 2021). The transportation sector in Seattle is the largest source of GHG emissions, responsible for almost 60 percent of them, mostly accounted for by passenger vehicles and trucks and the building sector was the second largest emitter, accounting for 23 percent of the total emissions in 2018 (Figure 10) (Government of Seattle, 2021).
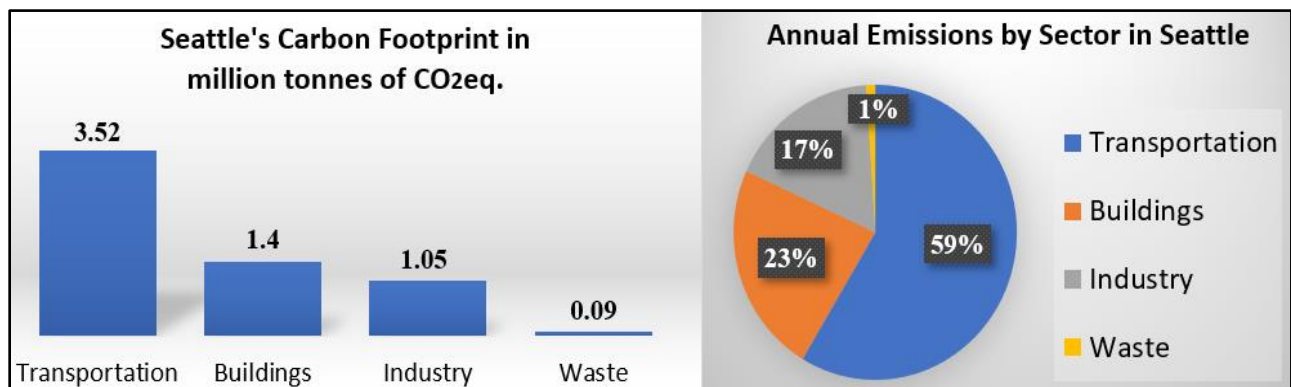
Figure 10. Seattle's annual emissions by sector and in total percentages in 2018; Created by the author; Data modified from Government of Seattle, 2021

When the U.S. was hit by the COVID-19 pandemic, Seattle was one of the first cities that tried to adapt by exploring what a radical change in peoples' lifestyle means regarding the use of city's streets, sidewalks, and public spaces (Weinberger, 2020). In addition to the COVID-19 pandemic, the city of Seattle is dealing with racial reckoning and catastrophic wildfires that are increasing in frequency and intensity due to climate change. These are the reasons for the city to consider a different approach in initiating the 15-minute city model.

Seattle is applying a new revised vision of the 15-minute city which promotes increasing equity and inclusivity in the city (Bicknell, 2020). Seattle is a member of C40 Cities. As part of this organization, it signed onto the C40 Mayors' Agenda to transform cities and to urge social change, change in societies living conditions, and sustainability during the COVID-19 recovery. The mayor of the city, Jenny A. Durkan, along with other C40 City mayors, has pledged to improve the health of city dwellers, reallocate road space for walking and cycling, and advance green infrastructure. As well, she established a task force that is responsible for researching strategies to make the necessary transitions to a more equitable, just, sustainable, low-carbon and healthy economy to provide benefits for people and the environment. The urban fabric of Seattle is right for producing a 15-minute city. Seattle is an urban area that has many neighbourhood clusters all over the city which already have available services and the requirements for the 15-minute city model (Figure 11) (Vansynghel, 2020).
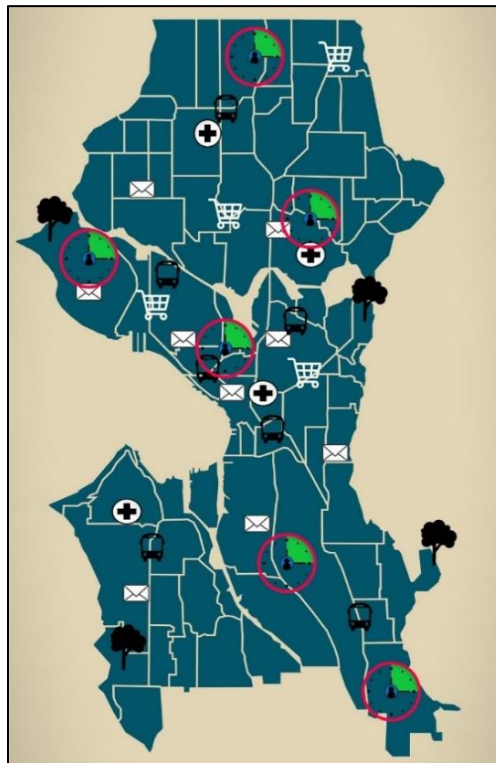
Figure 11. Seattle's neighbourhoods creating the 15-minute city model
Source: Vansynghel, 2020

As underlined by the Mayor of Seattle, Jenny Durkan, the city is starting to construct the infrastructure and amenities that are required to make Seattle a true 15-minute city, to recover from the pandemic, and the OPCD is the main city department responsible for implementing the 15-minute city model. The Growth Strategy and the transportation changes promote the development that prioritizes feasible options for more people including walking, cycling, and the use of public transit to reduce the reliance on private automobiles responsible for an overwhelming majority of carbon emissions (Seattle OPCD, 2020).

The COVID-19 pandemic has immensely affected marginalized communities. The City of Seattle is committed to responding to this issue with full support for building a racially equitable future. The Seattle Comprehensive Plan aims to support equity (Seattle OPCD, 2020, Government of Seattle, 2020).

The Seattle OPCD directs Mayor Jenny A. Durkan's vision for planning a sustainable and more equitable city. The vision addresses the core problems that were revealed by the COVID-19 pandemic. For example, the City of Seattle has initiated the Seattle Stay Healthy streets program which makes more spaces for on-street dining, retail, and bicycle infrastructure.

In 2019, the mayor organized meetings with neighbourhood residents and industrial-maritime participants to discuss increasing the availability of family-wage jobs in the seaside and manufacturing divisions. According to the Seattle OPCD (2020), the main purpose of the meeting was to strengthen and reinforce the protections for the maritime and industrial businesses. As well, the goal was to fit them within the Sound Transit's newly planned light rail stations and to enhance the environmental conditions of the industrial areas that are close to residential communities.

An example is the planned new station-area around the upcoming 130th Street Sound Transit rail station which will support the creation of jobs. It will be committed to a racially just

COVID-19 recovery and generate 15-minute communities, focusing on creating affordable housing near parks and green spaces (Seattle OPCD, 2020). As a part of the new Lynnwood Extension, Seattle Sound Transit is constructing light rail stations. Partnership between the City of Seattle and the surrounding community played an important role in the development of the 130th and 145th Station Area Planning projects. In 2021, education and collaboration with the community has continued and the goal of creating more walkable and transit-oriented communities has also continued.

Widespread subsidized affordable housing is vital for the 15-minute city model to succeed. It is evident that many low-wage workers are not able to use online platforms to work remotely, so it is vital to provide affordable housing in order for them to live near where they work. The City of Seattle took action and created policies to allow for more housing to be constructed near transit stations such as the new 130th Street Station (Government of Seattle, 2021).

Seattle OPCD (2020) points out that Seattle does not have the zoning laws to make density that is required to produce 15-minute communities and approximately 80 percent of Seattle's land area is zoned for single-family homes. So, the City of Seattle must create more mixed-use areas including retail stores and services in order for the city to deal with economic fluctuations and produce a big customer base in each neighbourhood. Constructing a real model in Seattle will need more than making a couple of 15-minute areas. It will take an entire cultural change for the city and its residents. The concept applies a tool for looking at what is missing in a neighbourhood such as fresh food and parks. For the City of Seattle, it is important to look at the reasons for why some regions are very close to becoming 15-minute communities while others lack safety, accessibility, and walkability. It must also be understood that some areas have been suffering from disinvestment.

An important strategy for advancing the 15-minute model in Seattle is the city's Urban Village Strategy which has created neighbourhood hubs that are ringed by single-family homes (Figure 12) (Bicknell, 2020). The Seattle Urban Village Strategy aims to accommodate future population growth in an arranged and expected manner, to support business wards and to promote the efficient use of city investment (Government of Seattle, 2020).
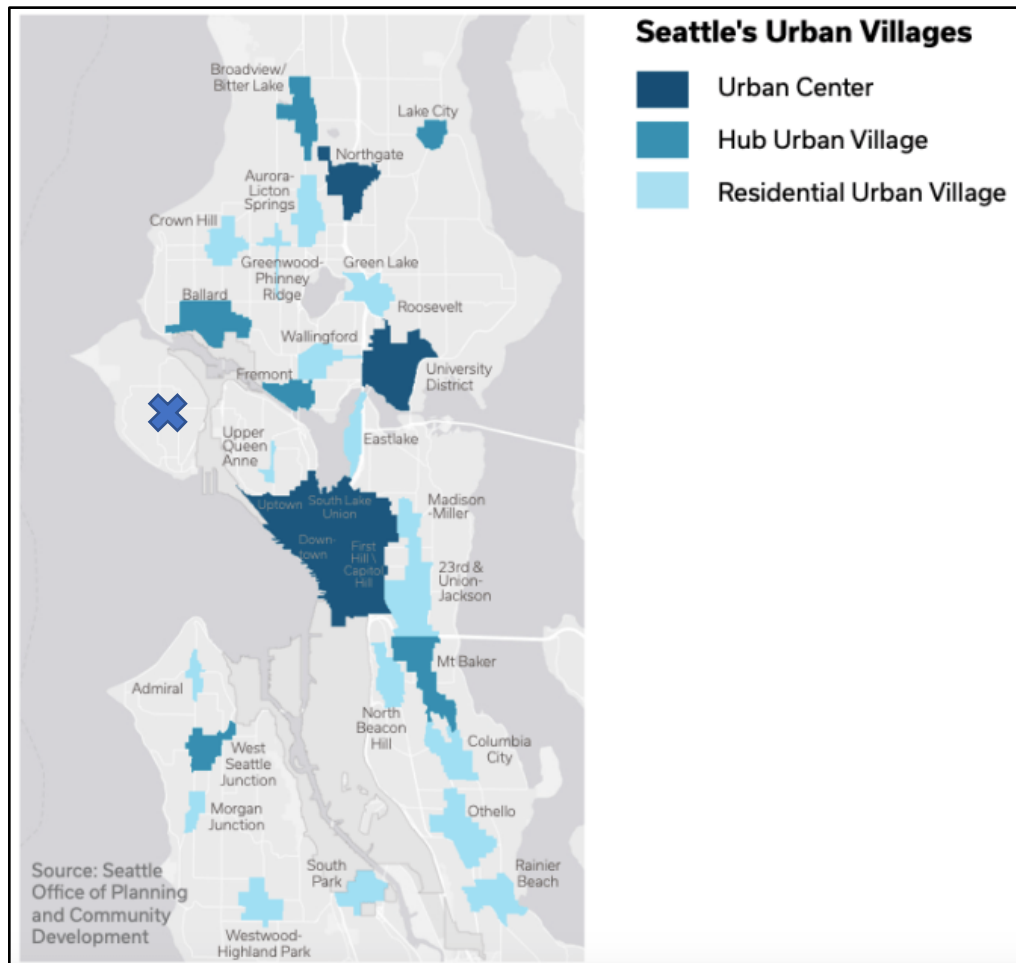
Figure 12. Urban Villages in Seattle; Source: Bicknell, 2020

One of Seattle's neighbourhoods that is planned to become a 15-minute neighbourhood is Magnolia (at **X** shown in Figure 12) (Bicknell, 2020). Magnolia is seen as an island of walkability because of its mix of land uses separated from the surrounding areas. One section of the land area is a commercial centre with amenities such as public parks and an elementary school, planned to

be close to transit and to be walkable. Adding dense housing and more commercial spots would transform this neighbourhood of Seattle into a 15-minute community. Changes in land codes and additional policy changes are required to make Magnolia into a complete multi-centric 15-minute neighbourhood. Additionally, Seattle's Planning Commission has established the "*Neighborhood for All*" and the "*Evolving Seattle Growth*" strategies responsible for increasing affordability for people and reducing the city's dependence on fossil-fuel-based-transportation (Bicknell, 2020).

Applying the 15-minute city model in Seattle presents some challenges, but policies such as the *Neighbourhoods for All* offer a way for moving ahead with Seattle's transformation. The city of Seattle also needs to invest in and increase the size of its urban villages and add new urban villages to the city. The Seattle Planning Commission also proposes to create a new type of urban village called an urban hamlet with the purpose of offering modest increases in dense housing that are close to commercial areas, parks, and schools. The neighbourhood of Magnolia is recognized as an area that can be the base for developing an urban hamlet (Bicknell, 2020). Some of the other areas that are recognized as able to support the development of urban hamlets are Delridge, Madison Park, Seward Park, Sand Point, and South Beacon Hill.

For Seattle to become a 15-minute city, the everyday needs of its inhabitants need to be met locally, in less time and with no reliance on fossil fuels. By incorporating some creative thinking and pledging to change its policies including zoning Seattle can become a 15-minute city. By making zoning changes, this will allow for more housing, offices, and co-working environments with restaurants and other amenities to co-exist in a wide-range of communities across the city. By producing areas or communities that have essential services within a short walk or bike ride, the city of Seattle can recover from the COVID-19 pandemic and fight climate change simultaneously. Images that visualize the implementation of the 15-minute model in some of the

neighbourhoods in Seattle are included in Appendix C.

Paris, as a city in Europe, and Seattle, as a city in North America, provide important insights into and policies exploring how the 15-minute city model can be applied in different geographic areas with different populations, to achieve their goals. Both cities' governments have plans to create healthy, resilient, accessible, affordable, and equitable post–COVID-19 communities. Furthermore, both case studies can be used as examples of how cities can shift their understanding and thinking to hit the targets to tackle climate change. By implementing sustainable urban planning strategies, the goal is to reduce GHG emissions and become carbon neutral cities by 2050, while simultaneously improving citizens' lives. Through reshaping cities during the COVID-19 recovery, Paris and Seattle are both implementing the model that addresses all the UN SDGs (see Figure 1 and Table 1 in Appendix A) and are making their cities safe, resilient, more inclusive, and sustainable.

4.2. GREENHOUSE GAS EMISSIONS AND TRENDS

Before studying the possible implementation of the 15-minute city model, it is important to review and consider the sources of GHG emissions and analyze what the 15-minute city model proposes for their limitation and elimination. Climate change is a fundamental global problem and there are clearly urban aspects to the issue. It is critical to emphasize that cities are responsible for the overwhelming majority of global GHG emissions due to their population growth and economic activity (Hoornweg et al., 2020). Climate change faced by humanity and urbanization are inextricably linked. According to the United Nations Climate Action (UNCA) (2021), cities account for only two percent of our planet's surface but at the same time they produce more than

60 percent of the total GHG emissions worldwide and consume 78 percent of the world's energy, which makes them a major contributor to climate change. In addition, projections show that by 2050 another 2.5 billion people are expected to reside in urban areas (UNCA, 2021).

Furthermore, the GHG emissions and sources in cities reflect the activity and their nature which produces most of the GHG emissions (Hoornweg et al., 2020). In urban areas, the level of socio-economic activity along with the structures and systems that permit this activity, determine the quantities of GHG emissions produced, offering a strong connection between people's daily lives and the resulting climate change. Hoornweg et al. (2020) outline that more than 80 percent of the world's total GHG emissions are accounted for by the lifestyle of urban residents and their interrelated habits. Additionally, different economic sectors, including buildings, transportation, electricity generation, and waste, are responsible for certain amounts of GHG emissions. Therefore, in order to reduce GHG emissions and mitigate climate change, cities need to consider and understand the sources of emissions and their impacts to best direct their mitigation efforts.

City governments must also update and monitor the effects of their urban policy strategies as they possess jurisdiction over more than one-third of GHG emissions worldwide (Hoornweg et al., 2020). For example, Hughes (2017) states that the Federation of Canadian Municipalities estimates that over 44 percent of Canadian GHG emissions are directly or indirectly controlled by city governments. Although some countries have not taken drastic action to reduce GHG emissions, many cities around the world have demonstrated that cities are able to take leadership in addressing climate change, citizens' wellbeing, sustainable development, as well as socio-economic inequality. Moreover, Hughes (2017) highlights that in December 2015, city governments were legitimately recognized by the Conference of the Parties in Paris as significant partners in the global effort to reduce pollution and GHG emissions.

4.2.1. GHG Emission and Trends in the Canadian Perspective

According to the Government of Canada (2021), in 2016, Canada represented about 1.6 percent of global GHG emissions and Canada's annual per capita production-based GHG emissions were 22.65 $tCO_2eq.$, one of the highest in the world. That represented a 26 percent increase since 1990, rather than decreasing emissions by six percent, as had been agreed to by Canada in the Kyoto Protocol (Government of Canada, 2021).

Furthermore, according to Environment and Climate Change Canada (2020), Canada's GHG emissions increased by 20.9 percent or 126 megatonnes of carbon dioxide equivalent ($MtCO_2eq.$) from 1990 to 2018 and Canada's total GHG emissions in 2018 were 729 $MtCO_2eq.$ (Figure 13), where the emission growth was mainly due to the growth in emissions by the oil and gas production and the transportation sectors.
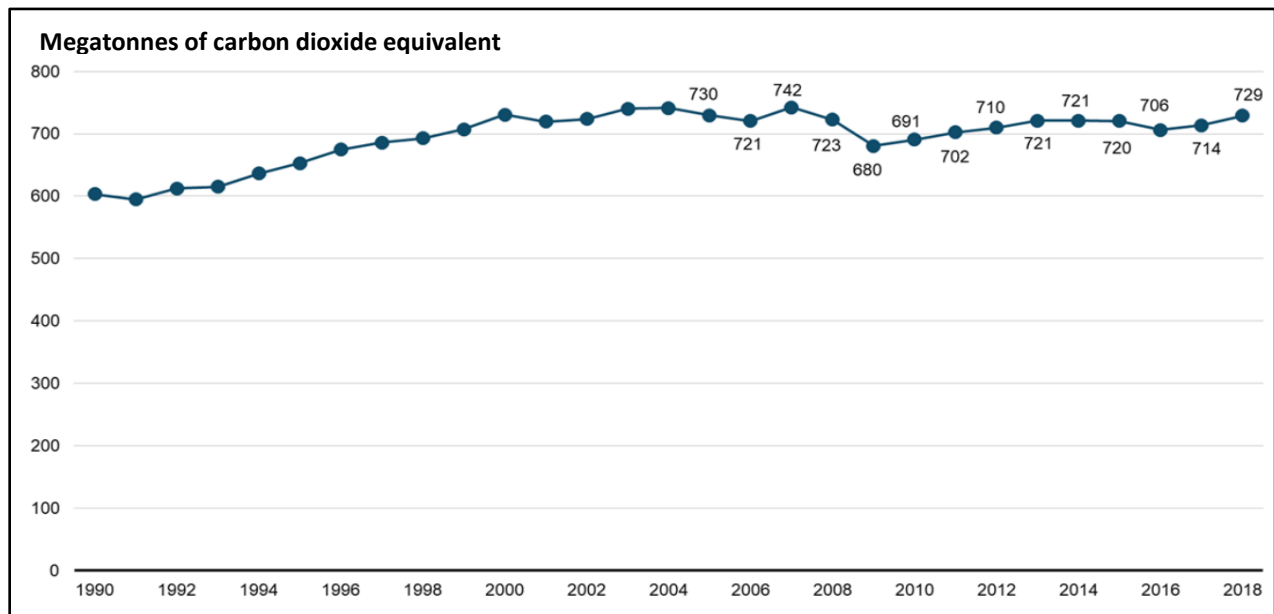
Figure 13: Canada's Greenhouse Gas Emissions in $MtCO_2eq.$ from 1990 to 2018
Source: Environment and Climate Change Canada, 2020

The transportation sector, including passenger, freight, residential and commercial off-road emissions, was the second largest contributor to Canadian GHG emissions, representing 25 percent

of overall GHG emissions or 186 $MtCO_2$eq in 2018 after the oil and gas sector accounted for 193

$MtCO_2$eq. or 26 percent of overall emissions (Figure 14) (Environment and Climate Change

Canada, 2020).

Hoornweg et al. (2020) point out that the data reported by Statistics Canada shows that

more than 80 percent of the Canadian population lives in cities, an important factor to

consider when looking at the increase in Canadian total GHG emissions.
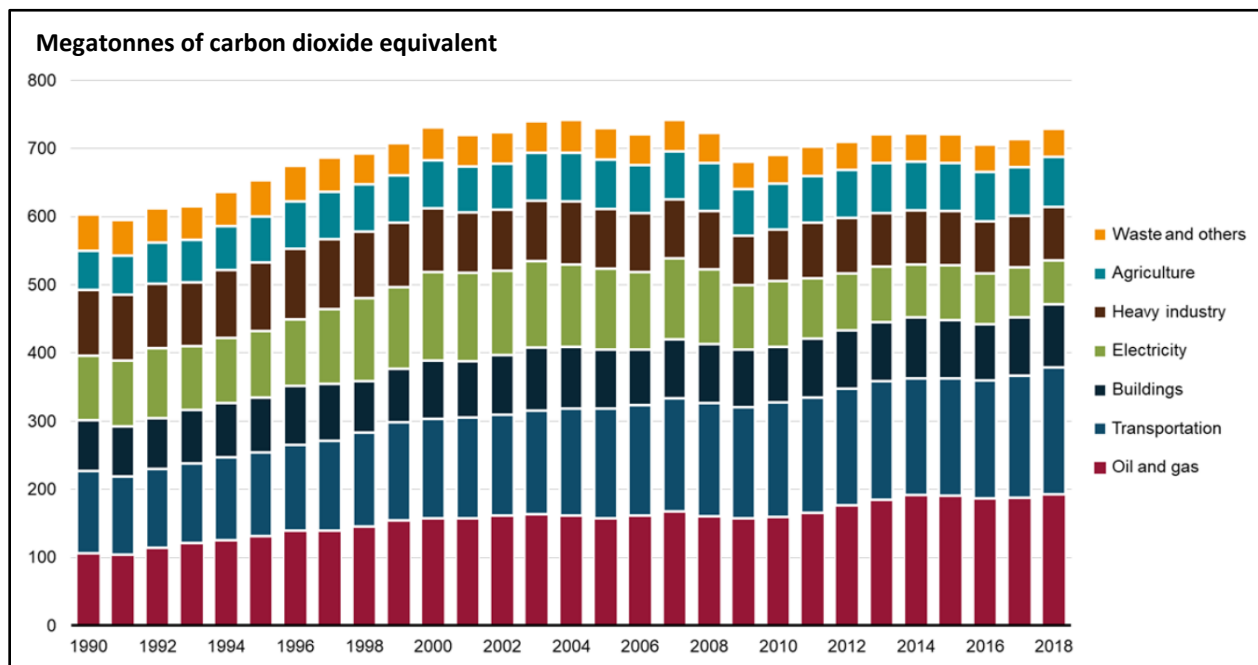
Figure 14: Canada's Greenhouse Gas Emissions by Economic Sector between 1990 and 2018
Source: Environment and Climate Change Canada, 2020

When cities are developed in a way that reduces or eliminates the need for people to travel

this can drastically reduce reliance on fossil fuels for cities leading to climate change mitigation.

According to Le Quéré et al. (2020), the effect of the lockdowns during the COVID-19 pandemic

was to decrease daily global CO_2 emissions by 17 percent between January and April of 2020

measured relative to the mean level of emissions in 2019. For individual countries, the maximum

daily decrease averaged to 26 percent (Le Quéré et al., 2020). Lockdowns across the world resulted

in a decrease in carbon emissions by various sectors, as well (see Figure 15).
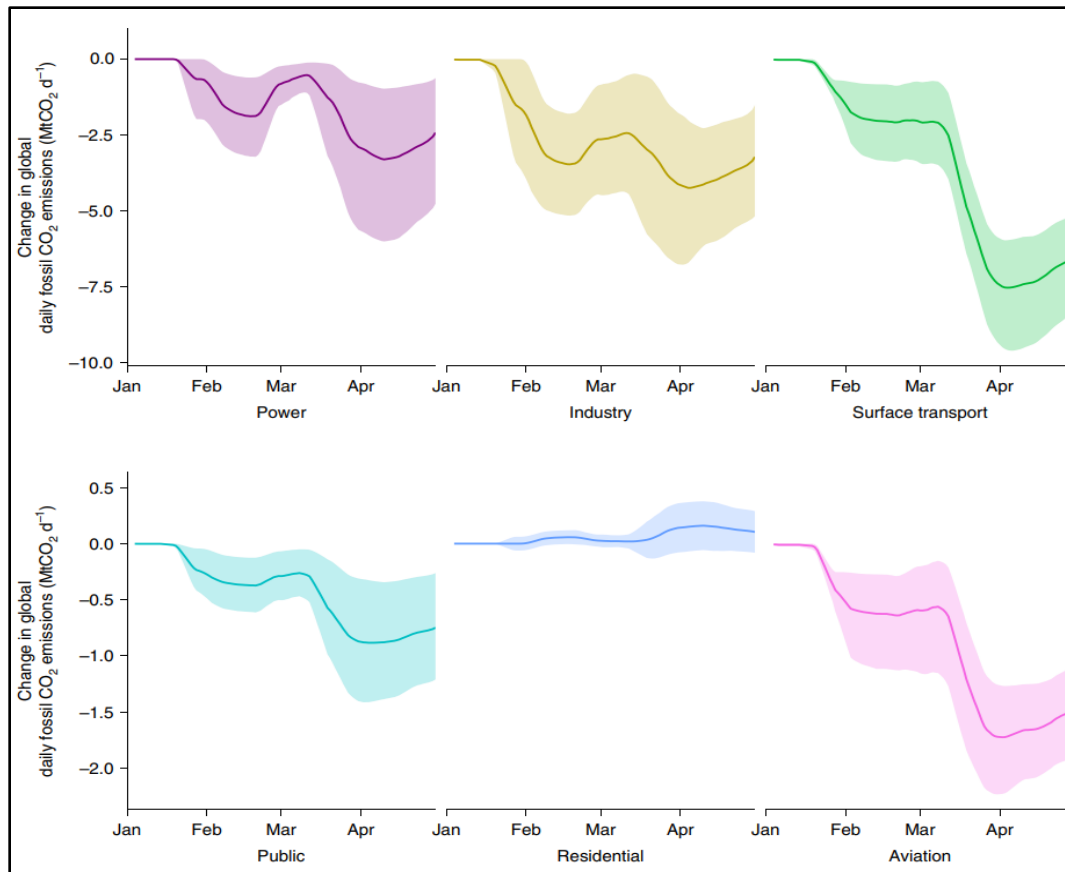
Figure 15: Global carbon emissions by sectors during the lockdowns in 2020
Source: Le Quéré et al. (2020)

It is obvious that the biggest drop in emissions is seen in the transportation sectors including surface transport and aviation. Therefore, reducing the need to travel in general can lead to a drastic decrease in carbon emissions produced by the transportation sector. It is notable that there is also a decrease in carbon emissions by the power sector and therefore, it is important to design cities in a compact way to decrease emissions from buildings and reduce energy loss.

4.2.2. GHG Emissions and Trends in Ontario

According to the Environmental Commissioner of Ontario in the Energy Conservation Progress Report (2019), petroleum fuels for transportation such as gasoline and diesel are considered to be the province's largest energy sources. The economy of Ontario is "still 75 percent

dependent on fossil fuels" and these sources are the main contributors to climate change, air pollution, adverse health impacts, and "will not be sustainable as climate change gathers speed" (Environmental Commissioner of Ontario, 2019).

Today, Ontario is doing little to reduce consumption of these fuels. Instead, government policies are driving up their use by favouring costly and destructive urban sprawl, which also destroys farmland, forests, and wetlands. Data provided by Environment and Climate Change Canada (2020) placed Ontario immediately after Alberta when evaluating GHG emissions by provinces and territories for 2018 (see Table 2).

Table 2. GHG emissions Canada in 1990, 2005, and 2018, by province and territory

Province or territory	1990 greenhouse gas emissions (megatonnes of carbon dioxide equivalent)	2005 greenhouse gas emissions (megatonnes of carbon dioxide equivalent)	2018 greenhouse gas emissions (megatonnes of carbon dioxide equivalent)
Newfoundland and Labrador (NL)	9.8	10.5	11.0
Prince Edward Island (PE)	2.0	2.1	1.7
Nova Scotia (NS)	19.6	23.1	17.0
New Brunswick (NB)	16.2	20.0	13.2
Quebec (QC)	86.7	86.1	82.6
Ontario (ON)	179.3	203.2	165.0
Manitoba (MB)	18.3	20.1	21.8
Saskatchewan (SK)	44.5	68.1	76.4
Alberta (AB)	173.1	232.0	272.6
British Columbia (BC)	51.6	62.0	65.5
Yukon (YT)	0.5	0.5	0.6
Northwest Territories (NT)	1.6[A]	1.6	1.2
Nunavut (NU)[A]	n/a	0.6	0.7

Source: Environment and Climate Change Canada, 2020

Canada Energy Regulator (2021) highlights that Ontario's GHG emissions were 159 MtCO$_2$eq. in 2017 (Figure 16). In Ontario, the largest GHG emitting sector is transportation at 35 percent of GHG emissions, followed by heavy industries including iron, steel, and chemicals at 24 percent, and buildings, including residential and commercial, which account for 22 percent (Canada Energy Regulator, 2021).
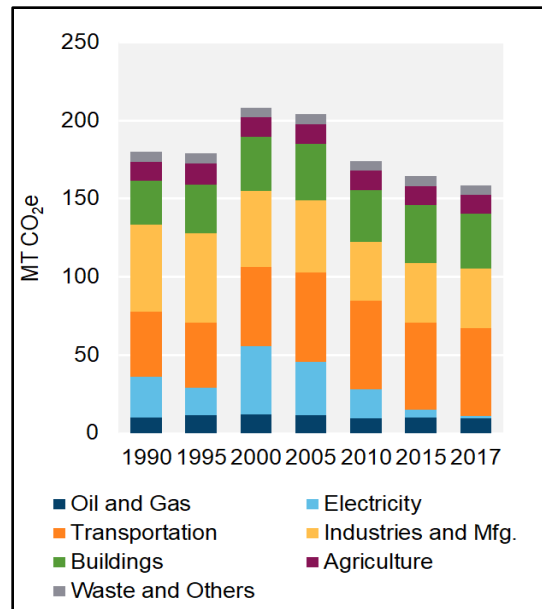
Figure 16: GHG emissions and GHG emitting
sectors in Ontario between 1990 and 2017
Source: Canada Energy Regulator, 2021

4.2.3. GHG Emissions and Trends in Toronto

Toronto is the largest Canadian city and its place within the country is significant (Hoornweg et al., 2020). The first step for large cities such as Toronto to realize their potential to reduce GHG emissions is to identify and measure where their emissions come from and which sectors mostly contribute to producing GHG emissions. Planning for climate action begins with developing a GHG emissions inventory. A city cannot cut GHG emissions unless it counts them. Hoornweg et al. (2020) points out that residents in the city core produce about 6.42 tCO2eq. per capita whereas the residents in the surrounding suburbs produce 7.74 tCO2eq. The existing buildings in Toronto accounted for 52 percent of the total GHG emissions in 2017 and the transportation sector accounted for 38 percent of city emissions (City of Toronto, 2018).

Data gathered by the City of Toronto (2018) indicates that 55 percent of Toronto's GHG emissions come from buildings and homes, mainly from the burning of natural gas to heat indoor spaces and to heat water for different purposes. Additionally, 36 percent of GHG emissions come

from transportation, where 80 percent of these emissions are generated by personal vehicles, and the rest 9 percent is due to waste (see Figure 17).
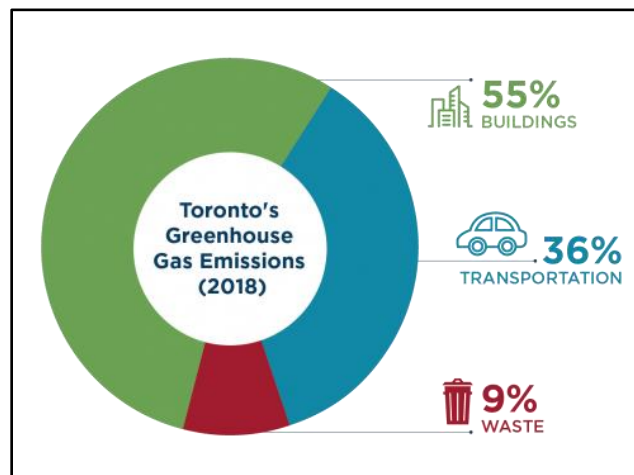
Figure 17. GHG Emissions in Toronto for 2018
Source: City of Toronto 2018

Furthermore, in 2018, the community-wide GHG emissions of Toronto were 16.2 $MtCO_2$eq., an increase in community-wide emissions by seven percent compared to 2017 when the city emitted 15.1 $MtCO_2$eq. Moreover, the City of Toronto (2018) reports that GHG emissions from the residential, commercial, and industrial building sector were about 8.9 MT of the city's total GHG emissions, making this sector the largest source of GHG emissions at 55 percent in 2018. The breakdown of buildings' emissions by building type, residential, commercial and institutional as well as industrial is shown in Figure 18.
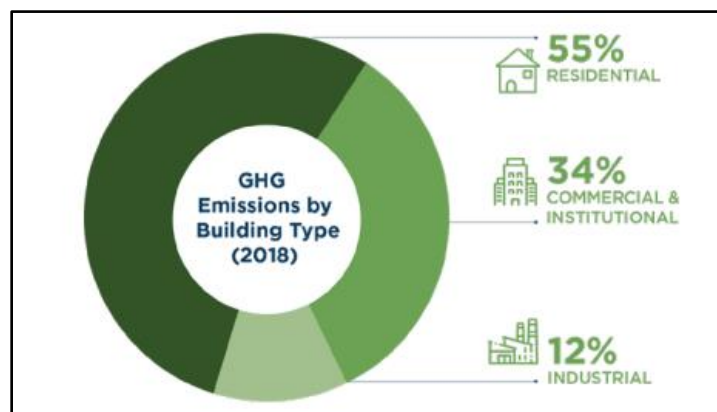
Figure 18. GHG Emissions by building type in Toronto for 2018
Source: City of Toronto, 2018

According to the City of Toronto (2018), the overall building sector emissions increased by 13 percent compared to the levels of 2017 and residential buildings accounted for 30 percent of all community-wide emissions and 55 percent of all building emissions at 4.9 MT in Toronto. Another significant contributor to the city's GHG emission pollution and therefore contributor to climate change, environmental consequences, and community wellbeing is the transportation sector. The GHG emissions produced by the transportation sector in 2018 were around 5.8 MT which accounted for about 36 percent of the city's GHG emission inventory (City of Toronto, 2018). The GHG emission profile of the transportation sector is dominated by on-road vehicles including cars, trucks, vans, and buses accounting for around 97 percent of all transportation emissions and roughly 73 percent of GHG emissions produced are accredited to passenger cars and trucks (Figure 19).
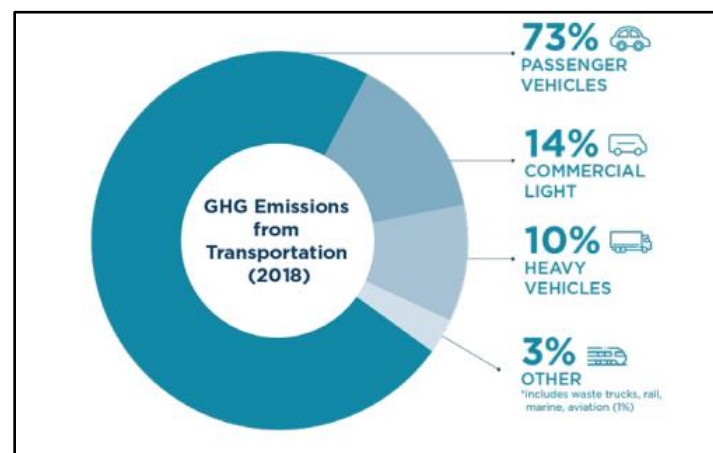
Figure 19. GHG Emissions by type of transportation in Toronto for 2018
Source: City of Toronto, 2018

Furthermore, the City of Toronto (2018) examination models show that approximately 80 percent of all GHG emissions generated from the transportation sector continue to come from gasoline powered vehicles including passenger cars, vans, SUVs, and commercial light trucks. Approximately, 50 percent of on-road vehicles that account for about 12 percent of all GHG emissions in the city of Toronto are passenger vehicles and commercial diesel vehicles, including

commercial delivery vehicles. Between 2017 and 2018 the overall on-road vehicle emissions decreased, which the City of Toronto (2018) explains with the increase of electric vehicles in Toronto. However, the vehicle kilometres travelled increased in general and more significantly for passenger vehicles (Figure 20) which is due to an inefficient urban design.

It is important to consider that GHG emissions may in fact vary at the national, municipal and neighbourhood levels (Hoornweg et al., 2020). For example, the same Toronto residents' per capita emissions are 6.42 tCO_2eq. for their household emissions, 9.5 tCO_2eq. for citywide emissions, 11.6 tCO_2eq. for the Greater Toronto metropolitan area, 16.0 tCO_2eq. as a resident of the province of Ontario and 22.65 tCO_2eq. as an average Canadian (Hoornweg et al., 2020).
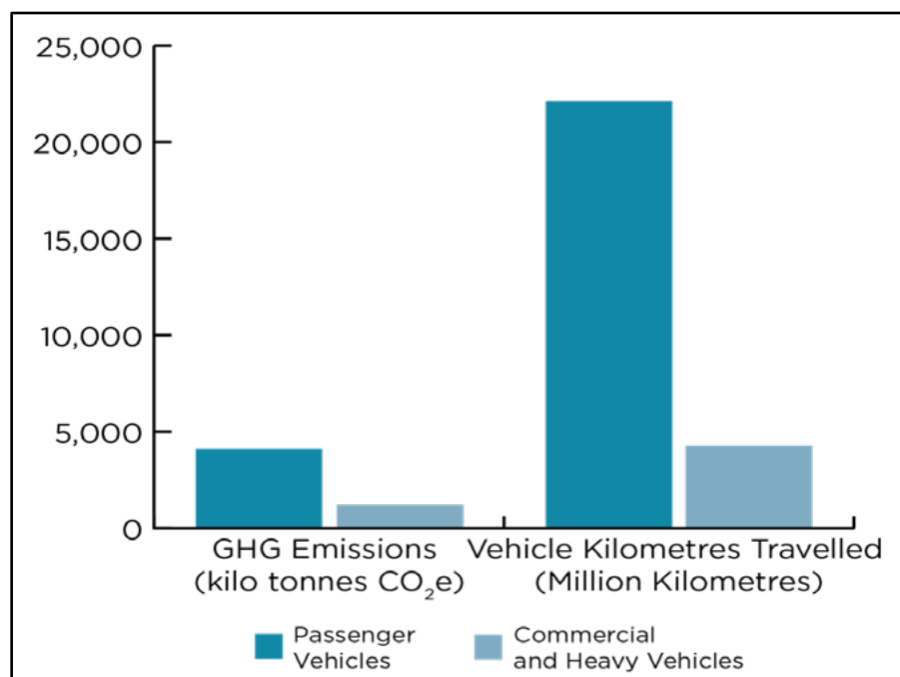
Figure 20. Transportation GHG emissions and vehicle kilometers travelled in Toronto for 2018; Source: City of Toronto, 2018

Additionally, residents living in the city centre produce approximately 6.42 tCO_2eq. per capita compared to 7.74 tCO_2eq. per capita residents living in the surrounding suburbs (Hoornweg et al., 2020). VandeWeghe and Kennedy (2007) provide illustrations of the difference of GHG

emissions produced per capita annually in the city centre and the suburban areas from the transportation and combined residential activities (Figure 21).
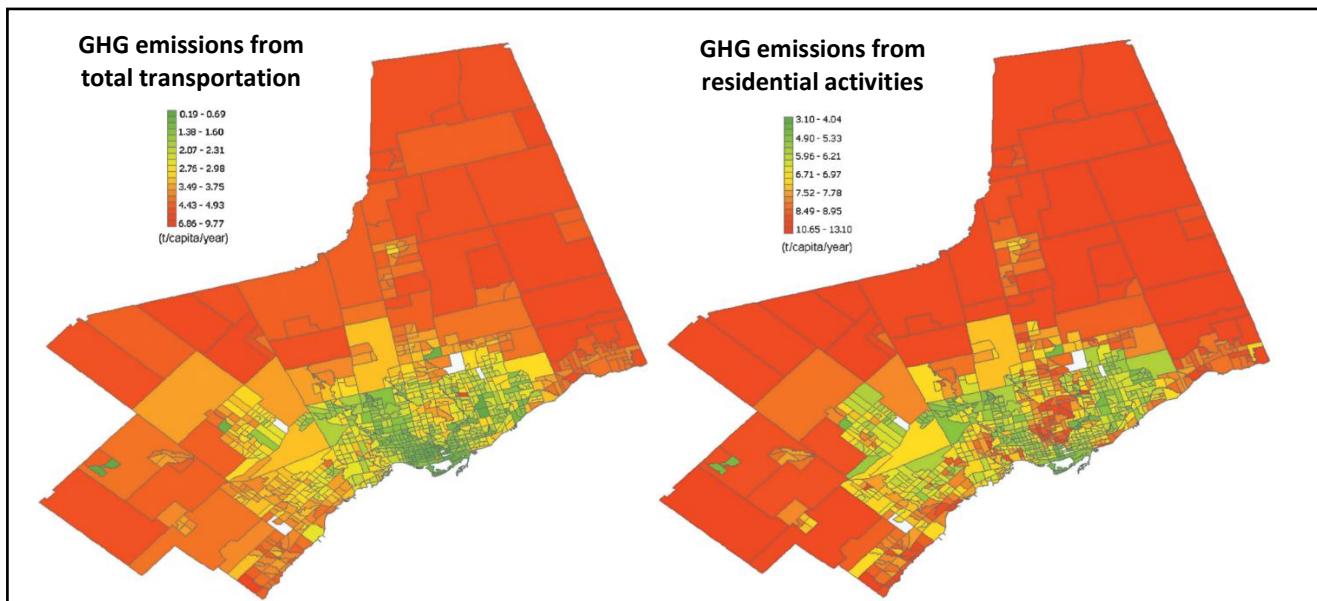
Figure 21. Annual per capita GHG emissions from total transportation and combined residential activities in the Toronto area; Source: VandeWeghe and Kennedy, 2007

However, Hoornweg et al. (2020) affirm that there were areas within the city centre that produced emissions that were as high as those in the suburbs. The census tracts and data represented rich neighbourhoods, categorized by high automobile use as well as older and energy inefficient houses. The lowest emissions recorded "were 1.31 tCO$_2$eq. per capita for the dense inner-city neighbourhoods with good access to public transportation and the highest emissions were 13.02 tCO$_2$eq. per capita in a 'sprawling' distant suburb" (Hoornweg et al., 2020, p. 50).

We need to point out that there is a noticeable difference between cities' relative GHG contribution and it varies depending on economic sectors (Hughes, 2017). For example, comparing Toronto and New York City, transportation in Toronto is "responsible for 41 percent of the city's GHG emissions, while in New York City transportation is responsible for only 21 percent of the total" GHG emissions (Figure 22) (Hughes, 2017, p. 1-2).
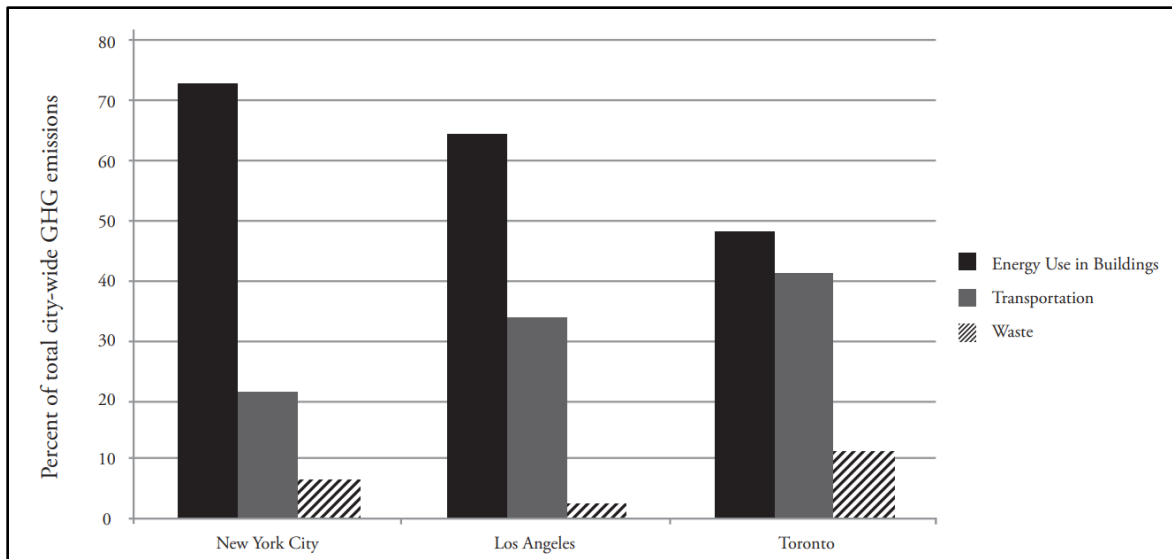
Figure 22. The relative contribution to GHG emissions of energy use, transportation, and waste management in New York City, Los Angeles, and Toronto
Source: Hughes, 2017

4.2.4. GHG Emission Reduction Targets

According to the United Nations Climate Action (2021), IPCC reports suggest that limiting global warming to 1.5 degrees Celsius will require all countries and cities to adopt "far-reaching" transformations in energy uses, land, and infrastructure, incorporating transportation, buildings, and compactness of built form. The Government of Canada (2019) emphasizes that "under the 2015 Paris Agreement, Canada has committed to reduce its GHG emissions by 30 percent below 2005 levels by 2030 and under the 2009 Copenhagen Accord, Canada committed to reduce its emissions by 17 percent below 2005 levels by 2020" (see Table 3).

Table 3. Canada's emission reduction targets

Target year	Base year	% reduction	Mt target	Established
2020	2005	17%	606	Copenhagen Accord
2030	2005	30%	511	Paris Agreement

Source: Government of Canada, 2019

The 2030 goal could be achieved by setting five-year emission-reduction milestones which will be legally-binding based on advice from experts and consultations with residents of Canada. The goal will be devised and supported by placing a price on carbon emissions in Canada and prioritizing the creation of green communities which include clean electricity, technologies, and nature-based solutions (Government of Canada, 2021).

When analyzing the reduction targets, it is important to discuss the provincial targets as well. Langer (2018), underlines that more than half of Ontario's GHG emissions originate in its cities as cities are "creatures of the province". This is determined by decisions we make about the energy we use in our homes and buildings, how we move people and goods around our cities, how we manage our waste, and how we plan and build for tomorrow. Furthermore, cities depend considerably on provincial laws, programs, policies, and investments in order to achieve their science-based targets for carbon reduction. The proposed climate change plan of the province, would significantly impede Toronto's and all provincial cities' ability to mitigate climate change in fundamental ways. They include the lowering of the 2030 carbon reduction targets pressuring cities to reduce their ambition and goals as well. In addition, the province reduced the funding available for urban climate solutions radically as well as the key strategies for reducing GHG emissions.

The current 2030 carbon emission reduction targets proposed by the Ford Government are 19 percent below the 1990 baseline compared to the previous Wynne Government's carbon reduction targets of 37 percent below the 1990 baseline. Toronto's carbon emission reduction targets are 65 percent below the 1990 baseline (Figure 23) which is the highest carbon emission reduction targets set and all the city's emissions must be cut to reach net zero by 2050 (City of Toronto, 2018, City of Toronto, 2021c).
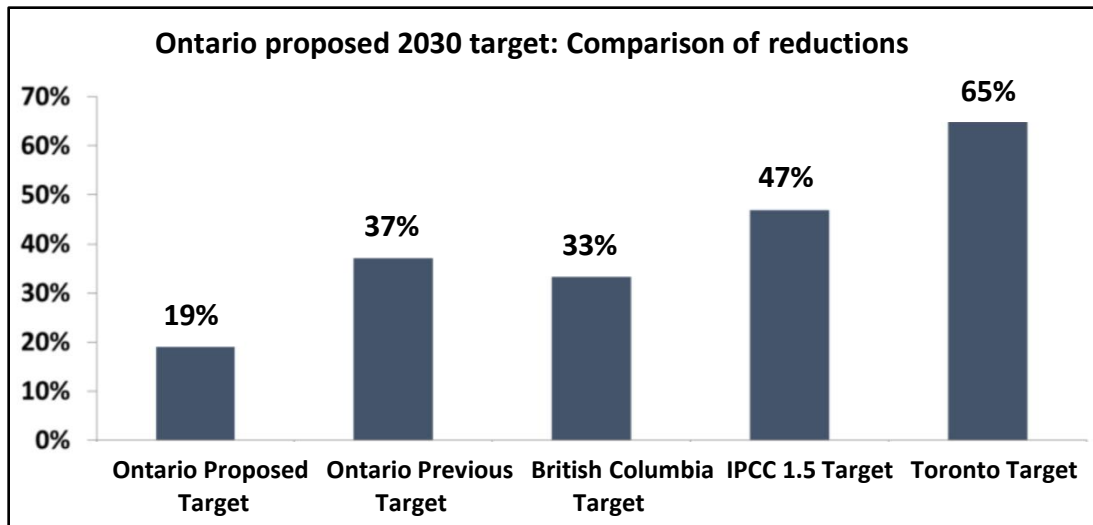
Figure 23. Ontario's and Toronto's proposed 2030 carbon reductions targets below 1990 baseline; Source: Langer, 2018

Cities are considered "ground zero" for the associated effects of climate change, which can be one main reason that cities have taken leadership positions in advancing a low-carbon agenda within their authority such as developing and implementing public transit plans and organics collection (Langer, 2018).

In addition, there are challenges which cities such as Toronto are facing due to the lack of the "key provincially-controlled tools and levers" for advancing urban development (Langer, 2018).

Reducing GHG emissions in urban environments is a multifaceted issue. In order to deal with the problems identified, cities including Toronto must rely deeply on their municipal authorities such as zoning, building permit approvals, as well as transportation planning and address funding issues by efficiently allocating the federal carbon tax funds to focus on municipal sustainable projects. Furthermore, actions and investment need to be coordinated accordingly to reduce GHG emissions from buildings by retrofitting them and using zero-carbon alternatives, and the transportation sector requires investment in affordable and equitable mass public transportation

(Hughes, 2017). Lui (2021) underlines that discouraging car ownership and encouraging greener transportation could reduce GHG emissions remarkably as predictions show that 460 metric tonnes of GHG emissions would be reduced per year if there are just 100 people that switch to biking. Prediction models show that a family living in New York City could save more than 14 thousand dollars per year just by switching to the use of public transit, "taking away the financial burden and restoring some economic freedom for families" (Lui, 2021).

It is critical for cities to address equality, sustainability, affordability, and accessibility through urban strategies when developing the plans and targets to reduce GHG emissions, which at the same time will comply with the UN SDGs and improve conditions created for communities with a significant effect on citizens' quality of life.

4.3. TORONTO CITY-WIDE CLIMATE PERCEPTION STUDY

It is critical to look at the perception that the residents of Toronto have about climate change. How would citizens like to change their lifestyle to limit their carbon footprint? This must be taken into account when developing urban strategies to deal with climate change, and to advance equitable and sustainable communities. In 2018, between October 11 and October 18, a total of 404 interviews (n=404) were performed online for 10 minutes by Electronics Research (2018) for the City of Toronto. The participants were adults, all were over the age of 18 years, living in Etobicoke-York, North York, Toronto/East York and Scarborough. According to the Electronics Research (2018) City-Wide Climate Perceptions Study, 92 percent of Toronto's residents agree that climate change threatens their personal health and well-being, and 78 percent are concerned

about climate change impacts on the city (Figure 24), but almost half of residents do not know what they can do to address it.
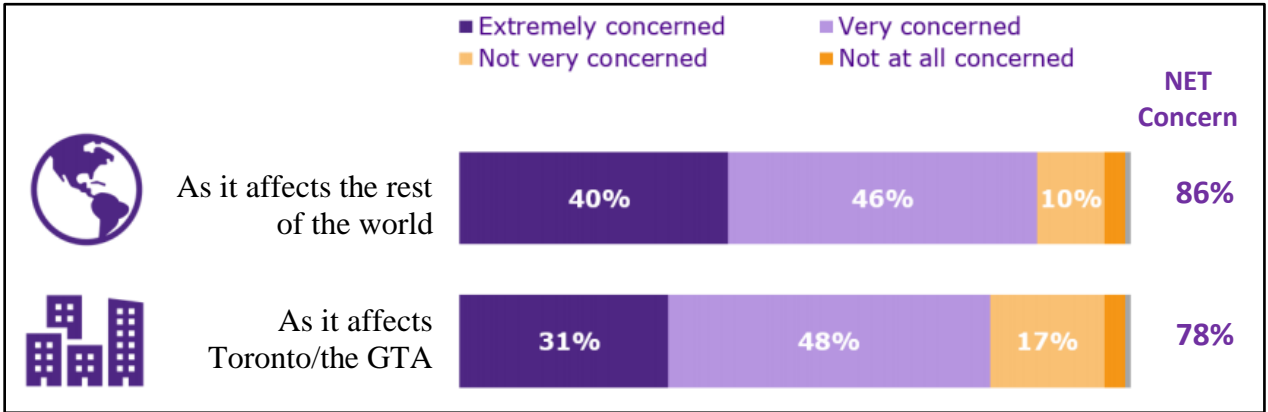
Figure 24. How concerned are Torontonians about climate change?
Source: Electronics Research, 2018

According to the study, most of Toronto's residents, 87 percent, are aware of the fact that their transportation choices have an impact on climate change. Also, 82 percent and 79 percent are aware that their energy use at home and at work or school, respectively, have an influence on climate change in Toronto (Figure 25).
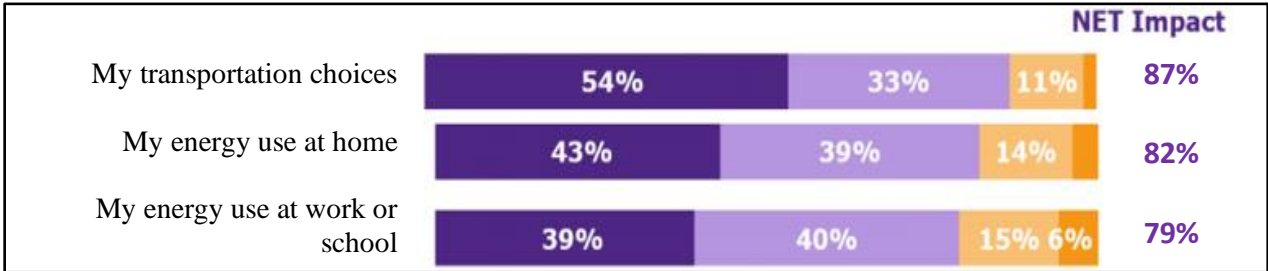
Figure 25. To what extent do Torontonians feel that lifestyle choices have an impact on climate change?
Source: Electronics Research, 2018

The residents reported how likely they are to take actions to address climate change (Figure 26).
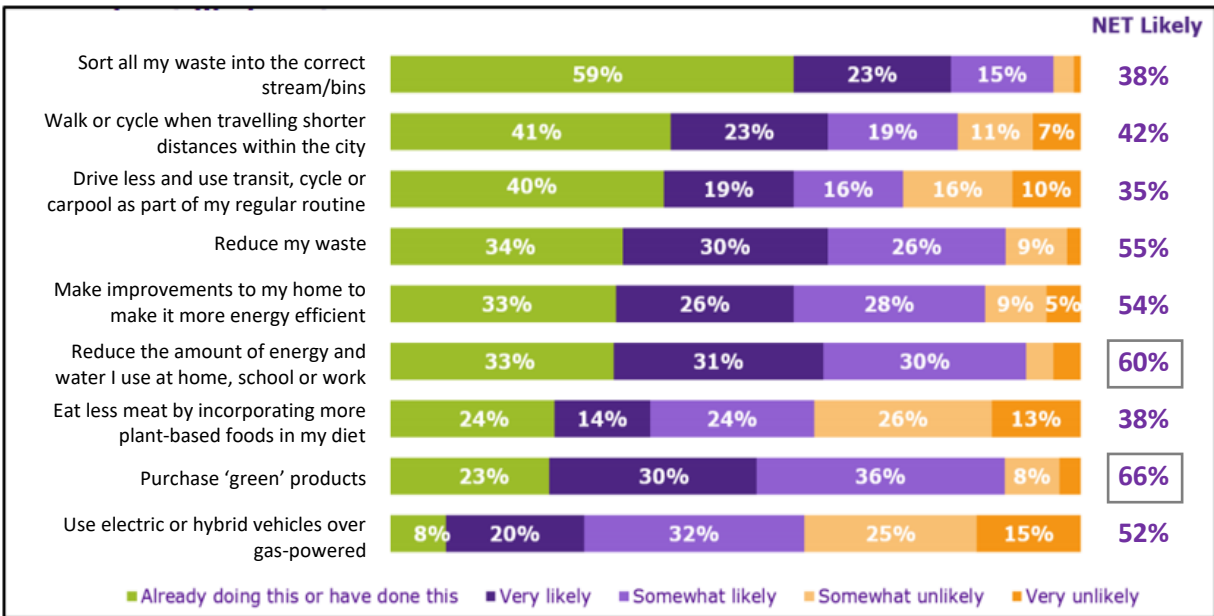
Figure 26. How likely are Torontonians to take action to address climate change?
Source: Electronics Research, 2018

Furthermore, the study included some possible barriers among residents that are unlikely to take the above actions to address climate change. These included the barriers to driving less (Figure 27), barriers to walking and cycling more (Figure 28), and barriers to home energy improvements (Figure 29) shown below.
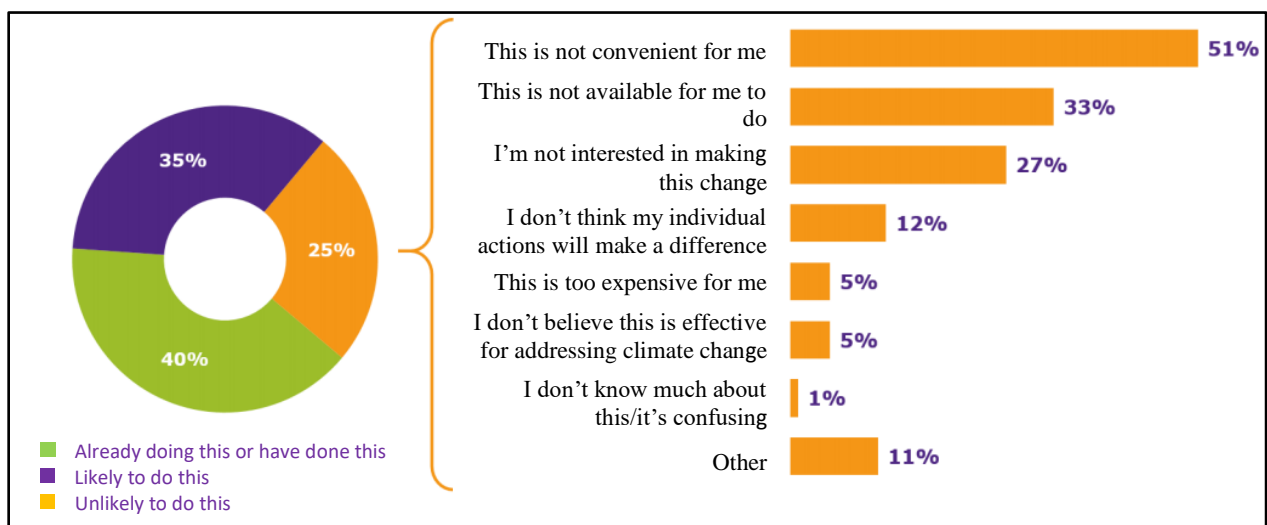
Figure 27. Barriers for Torontonians to driving less
Source: Electronics Research, 2018
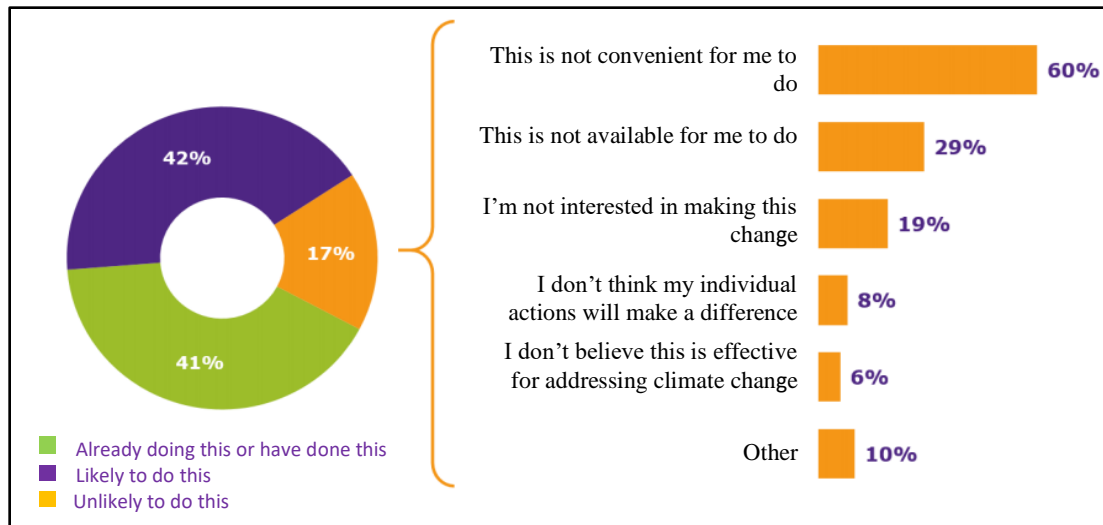
Figure 28. Barriers for Torontonians to walking or cycling more
Source: Electronics Research, 2018
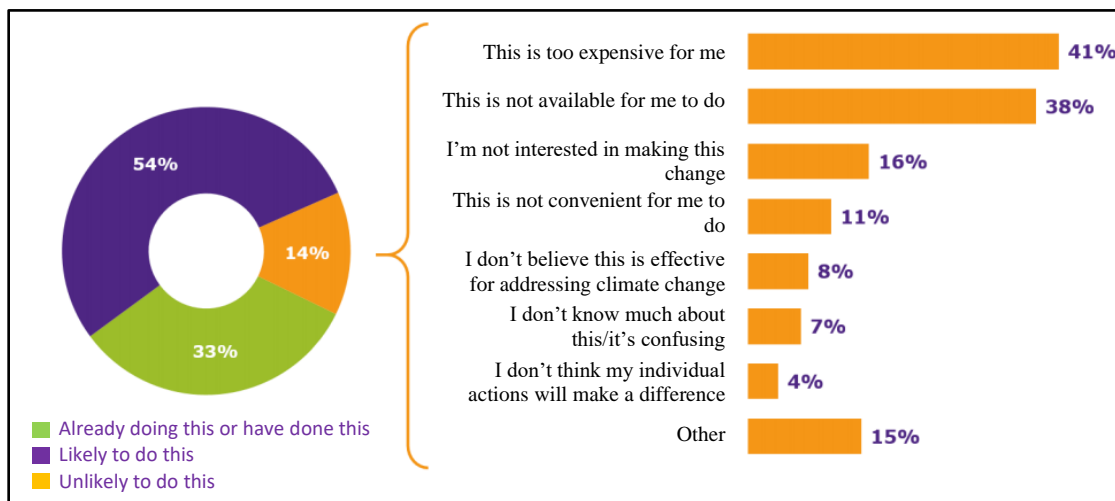
Figure 29. Barriers to home energy improvements
Source: Electronics Research, 2018

The city-wide study shows that most of the city dwellers are very concerned about climate change and its associated impacts on the world, Toronto, and the Greater Toronto Area (GTA). In addition, the majority of Torontonians agree that their lifestyle choices linked to the use of transportation and energy at home, work, or school influences climate change and GHG emissions. Furthermore, the inhabitants of the city are concerned and ready to take action to limit their carbon footprint by reducing their waste, energy, and water use; walk or cycle, and drive less; purchase

green products or buy a green vehicle. As well, they are willing to make home improvements. However, there are major barriers preventing people from making changes to their lifestyle, walking and cycling more or using public transit, and making their homes energy efficient to reduce the city's GHG emissions. The biggest barriers include the lack of convenience for them, or the lack of any other available choices. It is vital for the City of Toronto to make changes and provide its residents with alternatives to help achieve a green and sustainable environment for everyone, and to achieve the city's 2050 targets.

4.4. IMPLEMENTATION OF THE "15-MINUTE CITY" MODEL IN TORONTO

The GTA is the largest metropolitan area in Canada located on the traditional territories of the Mississaugas of the Credit, the Huron-Wendat, the Haudenosaunee, and many diverse First Nations, Inuit, and Métis Peoples (City of Toronto, 2021a). The Greater Toronto area has a population of more than 6.3 million people and the city of Toronto is currently home to more than 2.9 million people (City of Toronto, 2021b). It is the largest and the most populous city in Canada and the fourth largest city in North America.

The City of Toronto (2018) aims to create long-term, low-carbon goals and strategies to reduce local GHG emissions, grow the local economy, improve citizens' health, and support social equity in Toronto. Using the baseline from the 1990 levels, Toronto's goal is to reduce GHG emissions by 65 percent by 2030 (Figure 23) and to reach net-zero emissions by 2050 or sooner (City of Toronto, 2021c). To hit this target, the city needs to make transformative changes to the way people build, use energy, and travel.

Adopting the 15-minute city model in Toronto is a significant tool for better urban planning to create post-COVID-19 sustainable and healthy communities, to address social justice, efficiency, and resilience of the city, while at once contributing to climate change mitigation and fulfilling the UN SDGs according to the indicators and goals associated with them (Figure 1 and Table 1 in Appendix A).

To succeed in adopting this model, the city should follow through and implement more fundamental strategies addressing housing and infrastructure needs that many other large cities around the world such as Paris, Seattle, Barcelona, and Melbourne are currently applying.

According to the framework of the 15-minute city strategy, Toronto needs to create neighbourhoods that enact diversity, proximity, density, and digitalization (Figure 4). Furthermore, the city neighbourhoods need to contain the model's requirements, including an affordable and diverse range of housing, schools, community centres, stores and services, health care centres, parks and green spaces, and also well-designed bicycle and pedestrian networks and access to good quality transit, all within close immediacy, seen in Figure 2 and Figure 3.

This section of the paper will focus on the requirements for the implementation of the 15-minute city model and possible areas of Toronto that may be candidates for becoming 15-minute neighbourhoods.

4.4.1. Affordable, Accessible, and Sustainable Housing

A green and sustainable recovery for Toronto means investing in and developing affordable, sustainable, and healthy communities. The pandemic should be a starting point to create affordable housing in a close proximity to services and other amenities in order to create 15-minute communities. Affordable housing is the foundation of healthy and vigorous

neighbourhoods, as well as it supports the city's environmental, social, and economic health (City

of Toronto, 2020).

The affordable housing crisis affects everyone. Housing is described as affordable for

citizens, if less than 30 percent of their income goes towards housing (Litman, 2020). However, in

the city of Toronto, the number of households that rent is 476,966 and 43.5 percent of those renters

pay more than 30 percent of their after-tax income for rent (City of Toronto, 2021b). Furthermore,

the Toronto Regional Real Estate Board data outlines that the average price for homes sold in

Toronto have constantly risen since 2014 and in December 2020 it hit $932,000, which made them

13.5 percent higher than in 2019 (Figure 30) (Altstedter, 2021).

Figure 30. The average home prices in Toronto between 2014 and 2020
Source: Altstedter, 2021

Also, the average rental apartment and condo prices in Toronto have started to go up after

declining in 2020. In March of 2021 they increased to more than $2,000 per month (Katawazi,

2021). In addition, the average annual income of social housing residents is $18,130 and the federal

government's social housing contribution shrank by $4.7 million in 2014, by $9 million in 2015,

and it is expected that it will reach zero by 2031 (City of Toronto, 2021b).

Furthermore, the latest data shows that the current pandemic is intensively widening the gap between average home prices and people's incomes in many cities across Canada, including Toronto (Alini, 2021). O'Neil (2021) points out that the latest housing affordability data of the National Bank of Canada illustrates that the current annual average income needed to afford a house in Toronto is approximately $183,594 for a home with a cost of $1,069,111 in the real estate market in the greater metropolitan area from January to April of 2021 (O'Neil, 2021). Oxford Economics (2021) ranks Toronto as the second least affordable city out of 20 North American cities in the latest data presented regarding affordability based on the Housing Affordability Indices (HAIs) (see Table 4).

Table 4. Housing Affordability in 20 North American Cities in May 2021

Ranking North American metros by housing affordability			
Most affordable		Least affordable	
City	HAI (Q1 2021)	City	HAI (Q1 2021)
Chicago	0.60	Vancouver	1.67
Columbus	0.62	Toronto	1.53
Quebec City	0.64	Hamilton	1.50
Atlanta	0.65	San Jose	1.49
Raleigh	0.67	LA	1.40
Edmonton	0.67	Ottawa	1.29
Dallas	0.67	Seattle	1.06
Winnipeg	0.68	NYC	1.00
Nashville	0.76	Montreal	1.00
Calgary	0.78	Miami	0.99

Source: Oxford Economics, 2021

Moreover, the average home price in Toronto had been hovering around eight times the average local income pre-pandemic and now it has reached an average of 10 times a Torontonian's income (Figure 31) (Alini, 2021).

Figure 31. How many times the average household income does it take to buy an average home? Source: Alini, 2021

On top of that, the pandemic has severely impacted our economy and our livelihood with low-income and racialized residents being the most disproportionately affected (Altstedter, 2021). According to Jones (2021) thousands of people in Toronto experience homelessness each year. Only, in 2018, the total estimated homeless population in Toronto was 8,715 and of them 38 percent identified as Indigenous, 11 percent identified as LGBTQ2S, 13 percent were veterans, 10 percent were seniors, and 10 percent were youth (City of Toronto, 2021b). In Toronto, Indigenous people make up a disproportionate number of people experiencing homelessness (Boisvert, 2021).

In addition, socio-economic inequality is highlighted by the pandemic. Homelessness has made people even more vulnerable during this time. The people who live in encampments in city parks state that they have been under siege from the city's government during the pandemic, which is a very disturbing situation considering the overcrowded shelters. There were over 1,000 COVID-19 cases connected to outbreaks in the city's shelter system (Jones, 2021).

Therefore, there is a need to focus on investing in communities both on the public and private side and to build in a green, affordable, accessible, and sustainable way to address socio-

economic and environmental issues which the city is faced with today.

Toronto's Housing T.O. 2020-2030 Action Plan and the Key Strategic Actions have the goal of providing good access to safe, quality, and affordable housing in order to improve the housing situation for people struggling to remain in their existing homes (City of Toronto, 2020). A few months ago, the federal government announced that it will initiate its Rapid Housing Initiative which is a one billion dollars program to rapidly build new affordable housing units in response to the COVID-19 pandemic (Boisvert, 2021). As a result of the program, the government of Toronto will receive $203 million and it has already confirmed the construction of 540 affordable housing units. Hundreds of new affordable housing units are expected to open in 2021, a large portion of which will be designated for Indigenous Peoples (Boisvert, 2021). These affordable housing units can contribute to the creation of 15-minute city communities if they are built close to transit, services, and schools.

Affordability, equity, and maintenance related to housing access should be addressed by creating policies, enforcement mechanisms and regulations addressing human rights at their centre. The Action Plan recognizes that affordable, safe and quality housing is important for the health and wellbeing of every citizen and can improve the economic and social status of every Torontonian.

Addressing affordability, sustainability and accessibility will make the living conditions and the daily lives of citizens easier. It is critical to recognize the sustainable ways to make existing housing stocks sustainable and affordable, as well as constructing new green, affordable, and accessible buildings. This will lead to a reduction of energy bills for residents, will improve living conditions, and make housing more efficient and healthier. Also, buildings will become more resilient and they will have a lower environmental impact, as well as lower operational costs. An

additional description of affordable and sustainable housing is provided in Appendix D outlining the implementation in the Regent Park neighbourhood in Toronto.

Pachner (2021) highlights that the COVID-19 pandemic has accelerated the City of Toronto's efforts to create affordable housing, but this is not close to the magnitude of the response we need to address housing affordability in the city. All of the actions are still not enough to meet the challenges of the affordable, sustainable, and accessible housing crisis in Toronto. Addressing affordability as a major component of creating a 15-minute Toronto will fulfill the UN SDGs and play a role in developing a more equitable, healthy, sustainable, livable and a polycentric city.

4.4.2. Micro-Mobility, Active Transportation, and Public Transit

Micro-mobility and active transportation, as well as their associated infrastructure are a major component of creating a 15-minute city in Toronto. As well, another essential component of creating the model in Toronto is having a quality public electric rail-based transportation system. Toronto lacks the availability of this type of public transportation which makes the city very car-oriented contributing to socio-economic inequalities, pollution, health problems, and GHG emissions (Figure 19). In order for the city of Toronto to truly become a 15-minute city, all residents must have access to transit. Additionally, bicycle and pedestrian infrastructure need to be well-coordinated with transit, jobs, housing, and services, with the aim of creating 15-minute neighbourhoods.

It is essential to declare that Toronto's current public transportation and bike infrastructure are very unequally distributed, as seen in Figure 32.
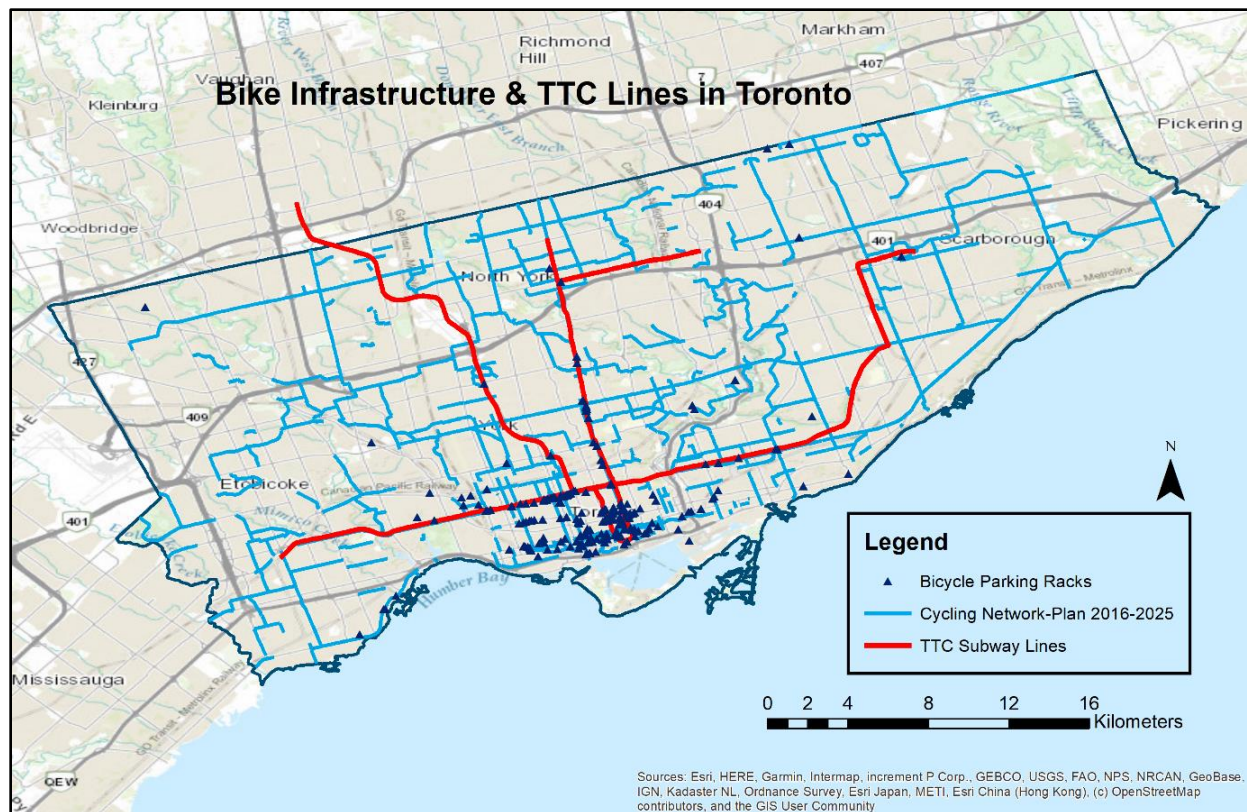
Figure 32. Toronto bike network, bike racks, and the TTC transit lines
Created by the author using City of Toronto Open Data

Currently, there is no adequate way for a person living in the suburbs to go to different places and this also affects the implementation of the 15-minute city strategy. Furthermore, the COVID-19 pandemic has underlined the stark inequities in transit access in Toronto and the issue of overcrowding on some major routes.

When observing the Toronto bicycle network, it is vital to show that the city's cycling network is very fragmented, with a very unequal distribution, especially in the suburban areas such as Etobicoke, Scarborough, and North York (Figure 32). During the COVID-19 pandemic the City of Toronto has built 40 kilometres of bicycle lanes throughout the city (Pachner, 2021). Data used by the University of Toronto (2021) to examine and analyze the city's cycling network incorporating new routes implemented during the pandemic, found that, by adding cycling and walking infrastructure, low-stress road access to food, stores, and jobs was increased by between

10 and 20 percent, while at the same time improving access to parks and green spaces by an average of 6.3 percent. The bike lanes constructed during the summer of 2020 had a big impact on increasing the access to these places as well as the access to 100,000 jobs (University of Toronto, 2021). During the pandemic, the influence of adding bike lanes was the strongest in parts of the city where the new added lanes were joined and added to the already existing bike network located close to a high cluster of jobs and stores such as the areas in the downtown core.

The new cycling infrastructure that was installed on the north and east sides of the city had less of an impact because of the restricted links with other cycling routes. In the new cycling infrastructure areas, this can be a base point for constructing a new future network, because adding new bike lanes multiplies the impact of the previously existing ones. The increased availability of bike lanes and infrastructure do not only increase the access to employment, but also can increase the access to restaurants, venues, and movie theaters, and can be a representative for places where people would want to travel. The effect of new cycling paths shows everyone how constructing some bike lanes and infrastructure can go a long way (University of Toronto, 2021). The city must initiate fast and effective strategies to make more spaces for cyclists and pedestrians.

In addition, the creation of bike lanes and electric micro-mobility, including e-scooters and e-bikes, and more green space are all significant strategies to achieve and create a sustainable city. Moreover, providing a continuous network of high quality and protected bicycle lanes delivers the greatest level of safety for cyclists on busy streets. Active transportation that is well-planned throughout the entire city in a coordinated network along transit corridors as a part of creating a 15-minute city in Toronto will improve citizen's health, access to jobs, schools, services, and create healthy communities, as well as reducing GHG emissions and contributing to sustainable development based on the UN SDGs. The tools used to measure the impact of the newly

established bikeways will be very useful for evaluating the impact of future projects that will expand the cycling network used in other cities such as Paris and Seattle.

4.4.3. Pedestrian and Green Spaces

Walkable areas and pedestrian public spaces, including parks and green spaces, are crucial for people of all ages and abilities. Contact with nature and access to extensive open and green spaces, as well as to sports, leisure, and relaxation has emerged as a great need with benefits for all, exclusively during the COVID-19 pandemic (Broudehoux, 2021). Furthermore, walking is critical as it became one of the core forms of exercise that is accessible to all citizens during the pandemic. As well, going to the park and walking provide many people with the possibility to escape from confinement and to get some fresh air, as well as exposure to sunshine, refining, and boosting their physical and mental health.

The pandemic also has shown the necessity for wider sidewalks and the benefits of converting major cities' streets into car-free zones and pedestrian walkways, even for only a limited time in some cities including Toronto. Keesmaat et al. (2020) point out that Toronto has begun to demonstrate that we could create a city that prioritizes public space and infrastructure over driving a car. However, the City of Toronto (2017) TransformTO Report states that the only car-free zones created through the time until the year of 2050 will be those highlighted in purple in Figure 33. This is inadequate for a city that is the size and scope of Toronto.

To reduce the use of vehicles, limit GHG emissions from the transportation sector, and to achieve its goal of becoming a zero-carbon city by 2050, the city must create more car-free and walkable areas around the city. This will accelerate the adoption of the 15-minute city model in many neighbourhoods throughout the city following the models of other C40 cities including Paris and Seattle.

Figure 33. Car free zones in Toronto according to TransformTO Plan 2017 - 2050
Source: City of Toronto, 2017

Green spaces are essential as they provide goods and services for people. Also, green space

is very important for generating the urban planning 15-minute city model. Although the City of

Toronto has created public spaces along the lakeshore area during this pandemic, there are limited

amounts of green spaces or parks in the city's neighbourhoods, as seen in Figure 34.
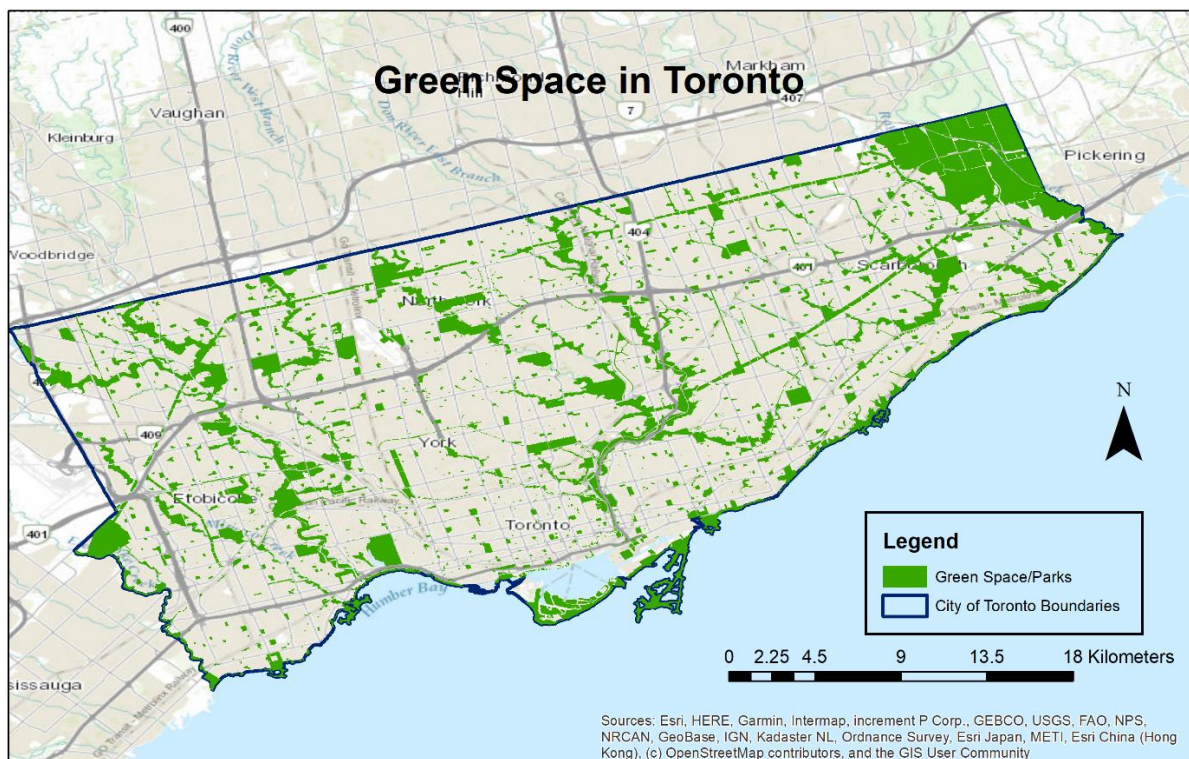
Figure 34. Green Space in Toronto; Created by the author using City of Toronto Open Data

In Toronto, the parks system only covers 13 percent of the city's land area and includes around 1,500 named parks (Brockbank, 2020). The long-term parks planning framework describes those areas with less than 12 square metres of park space per person as having low park provision, which is not sufficient for citizens, compared to the size of a standard parking space which is around 15 square meters. (Brockbank, 2020). Brockbank (2020) confirms that almost 40 out of 140 of Toronto's neighbourhoods fall even below this threshold. As well, there are some places in the downtown areas that do not have access to green space at all. Some examples of these areas include the Danforth, the Annex, Kensington-Chinatown, and the Little Portugal neighbourhoods.

Furthermore, in Toronto, the Parkland Strategy shows that small parkettes account for one percent of the city's park area, and 59 percent of the total number of parks and legacy parks such as Trinity Bellwoods Park and High Park, account for only 10 percent of the total number of parks in the city, even though they cover 76 percent of the city's total park area (Brockbank, 2020). The total amount of green space in square metres per capita is not enough and shows the inequality for citizens (Figure 35).
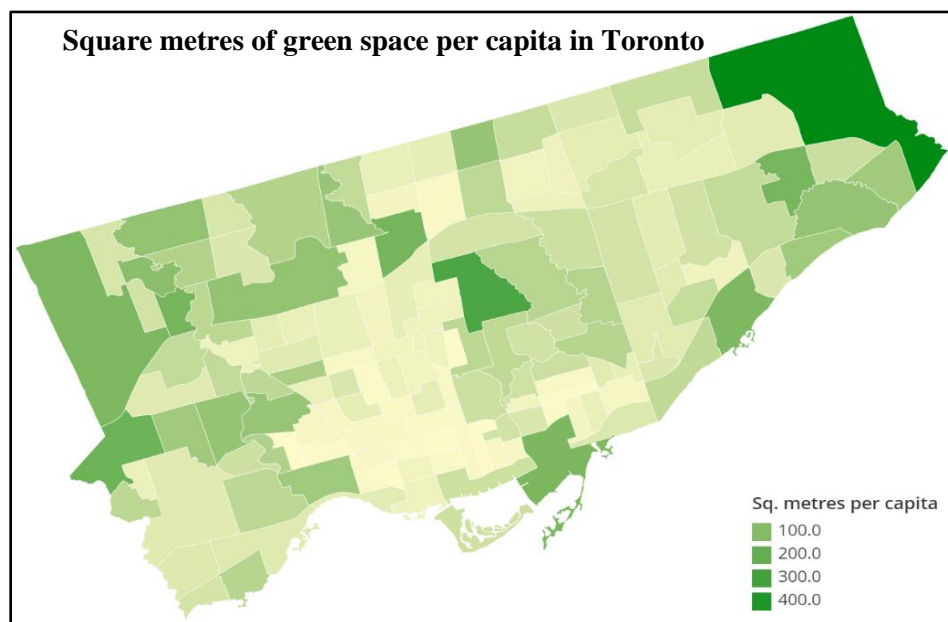
Figure 35. The total amount of green space in Toronto per capita in square meters; Source: Brockbank, 2020

The lack of park space in Toronto has two main reasons: parkland was not historically planned as a part of communities when they were built, and there has been a huge growth in population across the city, specifically in downtown areas.

Due to the pandemic, existing injustices have truly been noticed in terms of access to parks across Toronto, which can impact the mental and physical health of residents. As 90 percent of the city's population growth is happening because of condominiums that are high-rise in nature, more and more people in Toronto are using parks as an extension of their daily living space (Brockbank, 2020). Furthermore, additional green space in neighbourhoods and more trees lining every block could substantially benefit people's health with the potential reduction of illnesses such as cardiovascular diseases, respiratory diseases, and depression.

The establishment of more green spaces and parks in Toronto will also reduce the intensity of extreme weather events due to climate change and improve the air quality, contributing to community well-being and fulfilling many of the UN SDGs.

4.4.4. Amenities

To determine whether the application of the 15-minute city urban strategy is possible in Toronto we need to look at the availability of local amenities or amenity-dense areas throughout neighbourhoods. Bozikovic et al. (2020) explains that an area within a city can be called "amenity-dense" when people in that area have adequate access and can walk to public transit stops, pharmacies, and grocery stores, childcare facilities, and libraries within a one-kilometre distance, and elementary schools within a 1.5-kilometre distance. The location of schools including the Toronto District School Board schools and the Catholic District School Board schools and their distribution throughout the entire city is shown in Figure 36, which can be seen as an opportunity to start implementing the 15-minute city model following the Paris example.

Figure 36. School locations in Toronto; Created by the author using City of Toronto Open Data

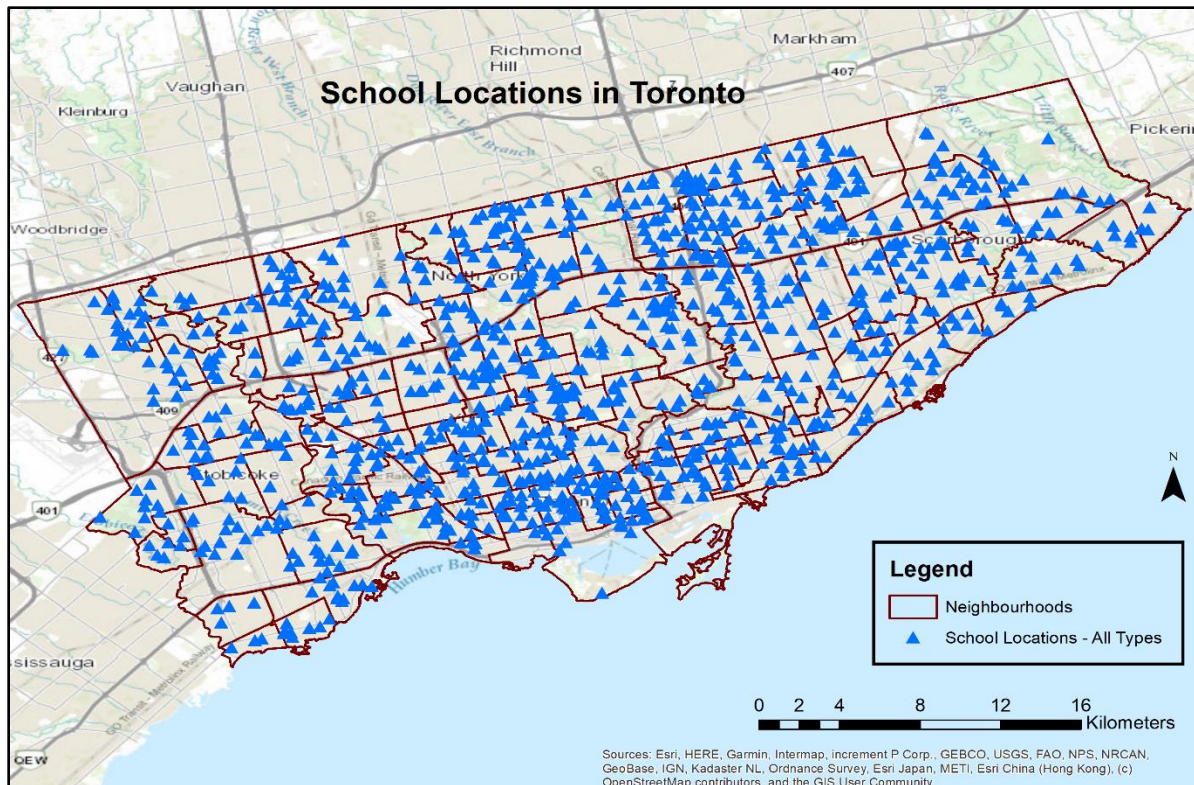It is important to point out that most amenity-rich areas in Toronto are located within the city's downtown core but as we look at the suburban regions of the city, the density changes (Figure 37).
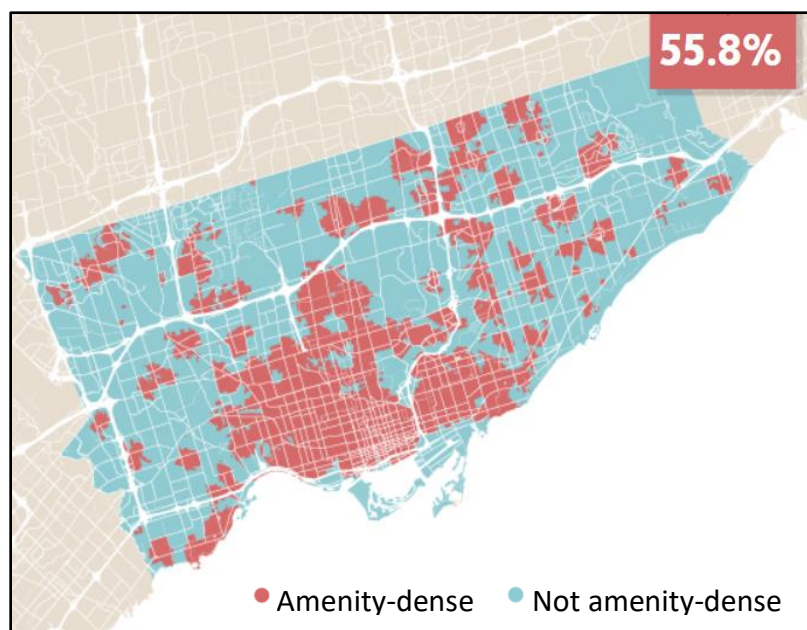
Figure 37. Amenity-dense vs. non-amenity-dense neighbourhoods in Toronto
Source: Bozikovic et al., 2020

In Toronto, only 50.58 percent of areas are considered amenity-dense blocks and a bit more than half of the population or 55.8 percent lives in amenity-dense blocks (Bozikovic et al., 2020). In the inner suburban regions such as North York, Scarborough, and Etobicoke there are some areas with relatively large populations of more than 1,000 residents which only contain some amenities (Bozikovic et al., 2020). In addition, most of the large health care facilities and hospitals in Toronto are located in the downtown core leaving behind the suburban areas.

Furthermore, the suburban regions of Toronto are inhabited by more low-income and racialized populations. Residents in the low-income areas at the fringes of the city are less likely to own cars, which makes it all that more important to have local services and mixed-use areas. It is much more difficult for these populations to access essential services, which affects the population's quality of life, health, and income.

It is recognized that populations often view the access to amenities in the area where they live as a possible measure of how the city values its citizens. Bozikovic et al. (2020) describes this: "when you have folks feeling they have concrete evidence in front of them that their neighbourhoods, their lives, and their health are not as important as others, that is how we end up with a really polarized and divided city". Toronto must allow for more people to live in the downtown core and make additional changes to the city's suburbs. The affordability of areas of the city needs to be coordinated with density as well.

4.4.5. Areas of Toronto That Can Become 15-minute Neighbourhoods

To become part of the 15-minute city urban tactic in Toronto, neighbourhoods must examine the requirements that can support the implementation of the model and eliminate the need for cars. According to the Ontario Ministry of Municipal Affairs and Housing (2020) *Growth Plan for the Greater Golden Horseshoe*, the major permitted growth areas in Toronto include

Downtown Toronto, Etobicoke Centre, Yonge-Eglinton Centre, North York Centre and Scarborough Centre. If the city of Toronto is to become a 15-minute city it should intensify its urban growth centres and be able to create areas of 400 residents and jobs combined per hectare for each of the city's urban growth centres (Ontario Ministry of Municipal Affairs and Housing, 2020, p. 17). This will improve energy efficiency, result in benefits for society at large, and help to mitigate climate change.

One of the main projects proposed in Toronto to make mixed-use and car-free zones in the city is the YongeTOmorrow project in Downtown Toronto. The City of Toronto had initiated a plan to revitalize Yonge Street between College Street and Queen Street with the implementation of car-free areas (Gilson, 2021). The Toronto City Council announcement that was made in February, 2021 approves the project to transform the street into an urban centre (Gilson, 2021). The project design is making Yonge Street more pedestrian-friendly. The plan for revitalization includes planting more trees along the street and creating more green spaces. In addition, the sidewalks will be widened, more patios, public art space, benches, and car-free areas will be created. The operation of Yonge Street will be focused on improving the experience of pedestrians, cyclists, and transit users. When the project is completed and combined with a diverse mix of housing, this will allow for the area to be converted into a 15-minute neighbourhood, where people have access to everything that they need without the need of a car.

In addition, when the Finch West light rail transit and the Eglinton Crosstown light rail transit projects that are currently under construction are completed in 2023, it will allow many more neighbourhoods along the corridors to become 15-minute communities.

Another significant opportunity for applying the model in Toronto is in the West Don Lands neighbourhood. The area is located very close to downtown Toronto with boundaries from

Parliament Street to the Don River and King Street next to the Rail corridor (Waterfront Toronto, n.d.b). The area is proposed to be a mixed-use community with 6,000 new units and it will contain 9.3 hectares of park and public space (Waterfront Toronto, n.d.b). A vital component of the development is affordable housing as a part of the mixed-income community and about 20 percent of units created or 243 units will be affordable rental units with rent prices set at or under the average market rental prices in the city of Toronto (Waterfront Toronto, n.d.a). All three affordable housing buildings constructed will follow a sustainable building design for energy efficiency.

That location of the West Don Lands neighbourhood is within a 15-minute walk to downtown Toronto, on the east side of the Distillery District, which allows for the creation of a large walkable space. A portion of the area was originally developed for the 2015 Pan Am/Parapan Am Games Athletes' Village allowing for the acceleration of further development (Waterfront Toronto, n.d.b). The area is close to the city's amenity-rich core and it will provide a great chance for creating a 15-minute neighbourhood and a community that is focused on people and families, and that is environmentally sustainable and designed for living, working, and pleasure.

When developing 15-minute city communities, an easy way would be to implement the model by starting from scratch. In this way all of the requirements could be added accordingly from the beginning of the development. One possible area of Toronto that can easily be converted into 15-minute neighbourhoods is the Downsview Park area, which will no longer contain an airport. Located at the northwest section of Toronto, it has an area of 520 acres, and is at the geographic centre of the GTA (id8 Downsview, 2020). The creation of 15-minute city neighbourhoods on the lands of Downsview Park are possible due to availability of public transit, including three TTC stations and the GO transit station (Figure 38).
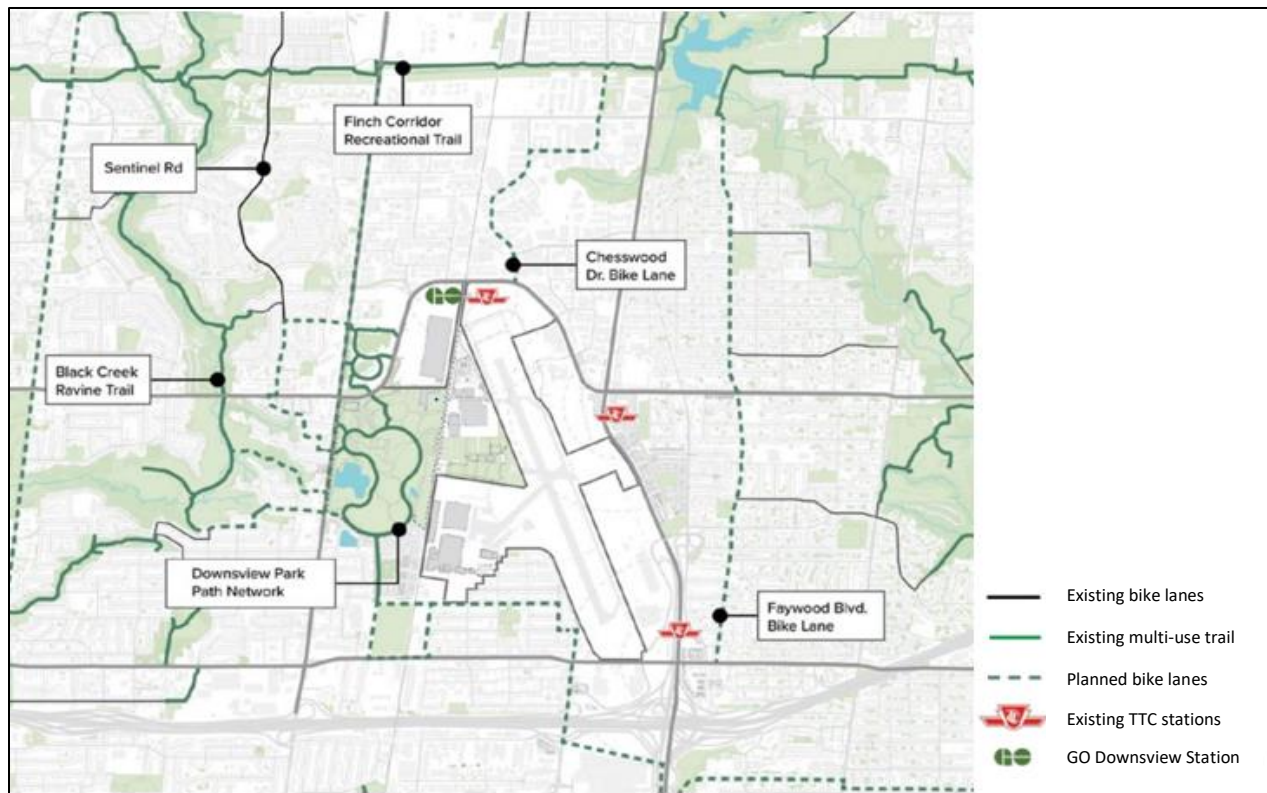
Figure 38. Active mobility and the transit context in the Downsview area
Source: id8downsview, 2020

The future development of the Downsview Park area is proposed to be based on four main principles (id8 Downsview, 2020). First, people and neighbourhoods, where citizens can find everything that they need within a 15-minute radius of their home on foot or by bike, as well as explore ways that density and transit can work together. Second, parks and nature, which will provide green streets, open and recreational space to improve people's health, provide opportunities for urban farming and local food production, as well as contribute to biodiversity preservation and neighbourhoods that are resilient to climate change. Third, getting around and across the site area, and providing a connection to the entire city. The development will explore providing connections north-south and east-west for people walking, cycling, driving, and using all modes to get around. The lands will be used to create a comfortable environment for pedestrians and cyclists and a well-functioning street network. It also will ensure that a compact

neighbourhood and urban design are created. The fourth pillar is based on jobs and employment. The community will be developed in a way that provides employment as it is a major part of the future of the Downsview Park area. It will be a significant area to accommodate people and employment growth. This will create communities where employees would want to live and employers would want to locate. The Downsview Park land provides a great opportunity for the development of the model resulting in healthy, resilient, and equitable communities in the heart of Toronto based on all requirements for creating the 15-minute city strategy (Figure 39).

Figure 39. Downsview Area with 15-minute city elements; Source: id8downsview, 2020

The City of Toronto (2015) in the Downsview Secondary Plan outlines that existing pedestrian links to rapid transit stations will be improved as future development occurs in the area

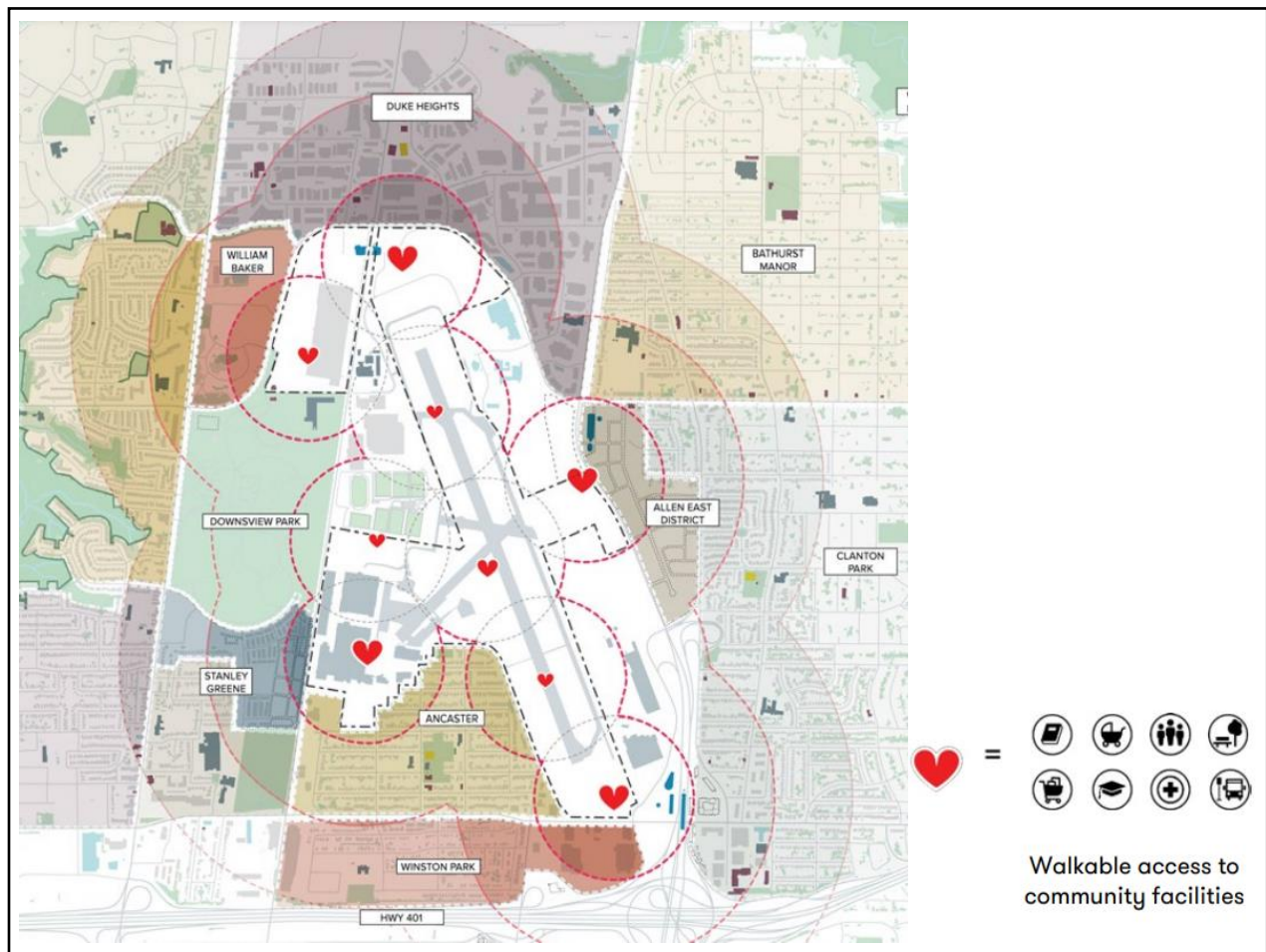to further encourage transit use by existing and future residents and employees. Furthermore, the creation of bicycle sharing stations, especially at the subway stations and major activity centres, will be strengthened as measures in order to reduce private automobile use. The development of the area will also create easy and safe connections from the subway station to the local parks, green spaces, and trails that enable the creation of 15-minute communities.

Options for the future redevelopment on the former airport lands in Downsview Park Toronto were explored by the City of Toronto, the Province of Ontario, the Federal government, and developers, who initiated community stakeholder meetings (id8 Downsview, 2020). The second stage of public consultations with the local community that took place at the end of 2020 shows that the community is mostly interested in seeing the development of housing, new and more community facilities, amenities, recognizing the history, equity, inclusivity, unique design and architecture and providing a holistic perspective (id8 Downsview, 2020).

The City of Toronto (2015), under the Downsview Area Secondary Plan, pledges that the areas designated for residential purposes will be used to create new neighbourhoods containing a mix of housing in terms of type, tenure, and affordability. The development of new housing offers opportunities to construct affordable and rental housing in each of the Downsview Park neighbourhoods. Additionally, pedestrian connections to stations in the area will be improved in order to encourage transit use by residents and employees. Strategies and policies will address the successful development of a just, healthy, and sustainable community that Toronto needs in order to prosper. Images that visualize the benefits of the implementation of the 15-minute model in the Downsview Park neighbourhood in Toronto are included in Appendix D.

Adopting the 15-minute city model as an urban planning strategy in Toronto will promote social inclusion and reinvent urban infrastructure taking into account the requirements of lifestyle

changes during the COVID-19 recovery, as well as address current urban and environmental issues, climate change mitigation and adaptation, and it will help to achieve the UN SDGs.

4.5. CHALLENGES, OPPORTUNITIES, AND RECOMMENDATIONS

The 15-minute city model will transform Toronto. To make it possible neighbourhoods should incorporate better food access and amenities, more housing and better access to housing, more neighbourhood schools, improved walkability and access to public transit, seeing density as more than just adding high-rises and loosening regulations that stand in the way of more-creative, community-centric urban design (Sisson, 2020).

The challenges that Toronto needs to address to create a resilient and sustainable city, especially during the recovery from the COVID-19 pandemic, include equity, climate change mitigation and adaptation, housing, mobility, services, as well as community and neighbourhoods' cooperation, and civic engagement.

Making Toronto a 15-minute city would be a long process. As well, it is important to consider that planning in Toronto has been very downtown centred. Moreover, transforming Toronto would be challenging as a lot of areas of the city are car-dominant areas and transit is not available. Achieving the 15-minute city model requires reshaping the city or, more specifically, mixing as many different uses as possible in diverse areas throughout the urban region. Furthermore, the transportation system in Toronto mainly serves the downtown areas but for almost 20 years the majority of commuting trips have been from Mississauga to Vaughan or from Oshawa to Mississauga (Pachner, 2021). Most areas of Toronto have no rail-based transit, which

is a huge problem for creating true 15-minute neighbourhoods. In Toronto, the transportation infrastructure is underbuilt and that is why the city has a very crowded public transportation system.

In addition, almost all the amenity-dense areas, jobs, bicycle infrastructure, and transit-served areas in Toronto are located and well-connected within the downtown core, which is a big challenge when implementing the model. Conversely, in many areas of downtown there are services and transit available but there is a lack of green spaces, which will present issues when implementing the model in the city core.

A significant challenge for Toronto is the increase in house prices, rent, and the creation of affordable housing. Eviction is a big problem which has been made worse by the COVID-19 pandemic. I believe that housing is a human right and that gentrification and displacement should be eliminated. The urban strategy of the 15-minute-city will provide an opportunity for the city to overcome the challenge of housing and create a healthy housing mix that includes good quality affordable and rental housing that is also accessible and sustainable.

The 15-minute city concept provides opportunities for communities located within urban growth centres to grow at "transit supportive densities" in combination with walkable street arrangements (Ontario Ministry of Municipal Affairs and Housing, 2020, p. 12). Toronto will have significant opportunities provided when the city creates pedestrian-only streets boosting the local economy and providing benefits for small businesses (Bliss, 2021). Furthermore, compact urban development along with intensification supports growth.

These factors are fundamental to create effective public transportation and encourage active mobility. This ensures that transit, homes, jobs and other aspects of daily necessities for people's lives are met along with climate mitigation and adaptation efforts.

Increased modal share, including transit and active transportation, makes intra- and inter-municipal travel convenient, reduces GHG emissions, and improves the health conditions of citizens. Combing land-use and transportation strategies can be a powerful tool in addressing and reversing the increase in GHG emissions.

If a holistic approach is applied to the entire Toronto region by starting from the transportation system, reducing the demand for mobility as well as switching to cleaner and renewable means of transport such as cycling, public transport, walking, trains, and shared vehicles we can cut the city's transport carbon emissions in half (De Gheldere, 2020).

Moreover, the application of the 15-minute city approach presents the opportunity to apply the requirements for the implementation of the Growth Plan. The Growth Plan "will support the achievement of complete communities that" will have "a diverse mix of land-uses including residential and employment uses" and suitable access to local services, stores and facilities, improved social equity, provide a mix of housing options, an appropriate supply of parks and publicly-accessible open spaces, a more compact built form and green infrastructure (Ontario Ministry of Municipal Affairs and Housing, 2020, p. 14).

To build a 15-minute city in Toronto, following Paris and Seattle, I recommend that planners, politicians and developers need to concentrate on providing more of what is missing in each neighbourhood of Toronto, removing parking spaces and turning them into green spaces, initiating green programs and renewable energy projects, as well as applying strategies to create neighbourhood for all and opportunities for people to age in place.

The city of Toronto needs to become more decentralized and create local government hubs that provide a range of services in all areas of the city. The zoning policies in Toronto need to be changed to permit more parts of the city to become mixed-use areas which will limit the use of

private automobiles. Furthermore, the zoning needs to be informed by mapping analysis done by the planning department and must target priority service areas that identify the essential services that are lacking in each neighbourhood. Toronto can also encourage the temporary or flexible use of the spaces that are underutilized to meet these needs just like the city of Paris. Toronto can use the Paris example to make hybrid spaces and use schoolyards as parks and school buildings as civic facilities to provide a range of services, multi-use buildings and cultural spaces that serve different purposes on weekends.

In addition, walkable and bicycle friendly cities are becoming important to create a more livable and sustainable urban environment (Hawken, 2017) and the city of Toronto can adopt the 15-minute city model of Paris to make bicycle and multi-use lanes on all the city's main streets. The city needs to make street alterations and create multi-modal streets including kids' safe zones and peaceful space for everyone (see Figure 9).

Also, Toronto must follow the Paris example and expand green spaces to enhance the carbon sinks, plant trees, make local street gardens, convert parking spaces into green areas and connect green spaces.

Toronto needs to follow the example of Seattle and make zoning changes to allow for the creation of 15-minute communities. Toronto can use the Seattle example and create urban villages or hamlets with affordable housing, jobs and services that are close to transit stations in order to create equitable and sustainable communities.

Gentrification and displacement can be avoided by incentivizing the businesses that are in the neighbourhoods to cater to the people that already live in the neighbourhoods. Subsidizing the creation of affordable housing, specifically around transit stations, will eliminate gentrification when creating the 15-minute city.

The City of Toronto needs to explore the best practices and solutions to reshape the city, including investing in affordable and efficient housing and public transportation, and electric mobility. We can reclaim road space for bike and bus lanes, and create pedestrian and green areas. Rigorous and ambitious policy actions are required in all areas and they can lead to a successful implementation of the 15-minute city model.

As well, the federal and provincial governments need to provide permanent funding for transit in Toronto to make it more affordable for people. The mayor of Toronto, John Tory, should follow his colleagues, Anne Hidalgo, the mayor of Paris, and Jenny Durkan, the mayor of Seattle, to become a leader embracing the 15-minute city strategy to combine all the city's policies to achieve a carbon-zero city and socio-economic equality.

It is also important to work with city council and the planning departments to implement the 15-minute strategy and accelerate the creation of a more sustainable, just, green and livable urban area. Partnership between the lower-tier and upper-tier municipalities, province, and the federal government will be critical for funding the public transit expansion and housing needed to create 15-minute neighbourhoods.

The creation of car-free and transit-oriented neighbourhoods and pedestrian only areas, as outlined in the Ontario Growth Plan, will offer great opportunities to make Toronto more accessible to all people, more inclusive, and a healthy city. When Toronto manages to address all these challenges, it will create a more fair, prosperous, resilient and sustainable city that fulfills the UN SDGs, and mitigate climate change. Toronto can achieve its goal and become a carbon-zero city and an example for other North American cities.

5. CONCLUSION

The climate crisis, global inequalities, and the recovery from the COVID-19 pandemic are urgent issues for countries, governments, and municipalities to invest and create healthy and sustainable communities. Humanity is long past the carrying capacity of the Earth and it is recognized that going back to the previous "normal" is not an option. The increased demand for economic growth and urban expansion has resulted in the extensive exploitation of the planet's resources, causing social and ecological devastation at local and global levels. As well, this has resulted in extreme weather events, influencing peoples' and communities' lives.

It is essential to realize our interconnectivity with and dependence upon nature in order to build and recover through sustainability and to initiate action to change our behaviour and lower our ecological footprint. We should move away from the unsustainable way of life and built form. Considering the growth of cities and their intense impact on our natural environment, urban planning strategies to alter the built environment are critically important. Cities need to be well-designed, more compact and connected with well integrated public transport, support a wide range of diverse uses within a sustainable environment, and be adaptable to change (Steemers, 2003).

The "new normal" starts with reshaping our cities. In addition, the COVID-19 pandemic has fundamentally questioned our understanding of life in cities. Before, people used to commute to an urban core to work in an office, but as commuting was suspended due to the COVID-19-related lockdowns in 2020, global CO_2 emission decreased and this presented many social, economic, and environmental benefits. This global pandemic has directed many cities around the globe to rethink and reshape their cities' design from a different perspective, based on community and citizens' health, equity, and well-being.

Urban planners, politicians, governments and city developers need to evaluate the access to everyday needs in a different sustainable way, making global rapidly growing and segregated cities more inclusive and carbon-free by limiting the use of cars and urban expansion, and by creating more green areas and spaces for people in each neighbourhood. Furthermore, they have the responsibility to develop healthy and sustainable local and regional communities. More specifically, they can provide better infrastructure and mobility options for residents reshaping cities by incorporating better urban strategies. Governments, municipalities and city planners need to put forward action recovery plans and make changes to land-use policies addressing the lack of affordable housing, accessibility, allocating more green and walkable spaces, and as a result transforming cities, neighbourhoods, and communities into safe, healthy, sustainable places to live.

Considering the COVID-19 recovery, cities must be redesigned to prioritize cycling, walking and public transportation as well as increase the green outdoor space that is available for people according to public health guidelines. Rigorous and ambitious policy actions are required in all areas. By using sustainable urban planning such as the 15-minute city model, which combines best practices for building design, transportation, open space, micro-mobility and renewable energy sources, cities could begin to move toward more sustainable urban environments. Creating 15-minute communities inside cities is in the cities' best interest in order to increase mobility, to reduce commuting distances, and create amenity-rich neighbourhoods where simultaneously the city can limit the pollution levels and climate change consequences. By introducing planning policies to create 15-minute neighbourhoods, community challenges and inequalities can be addressed and overcome, creating economic opportunities for all.

All cities around the globe in any geographical region or layout can secure and experience the benefits of the 15-minute city urban strategy, as it basically requires rethinking of the built

environment and considering the centre of urban daily life, not as accessed by cars, but as the people who fill the urban space with life (Lui, 2021). The 15-minute city or community model applied in Toronto can become a leading way to improve the sustainability and accessibility of neighbourhoods around the city, as well as helping to create equitable communities for low-income and marginalized residents. If Toronto manages to successfully implement the model inside its neighbourhoods, this can help the city to become carbon-free by 2050 and act as a leading example for other North American cities.

Creating healthy, equitable, and sustainable communities through the implementation of better urban strategies can improve efficiency, lower GHG emissions, and mitigate climate change. Our cities are the base on which we can build a more just, fair, clean, green, joyful, and livable decarbonized Canadian economy. Moreover, transforming cities through sustainable urban strategies will fulfill the 17 UN SDGs and contribute to improving the quality of life for people around the world and the planet as a whole.

BIBLIOGRAPHY

Alini, E. (2021, April 10). Here's how home prices compare to incomes across Canada. *Global News*.
Retrieved from https://globalnews.ca/news/7740756/home-prices-compared-to-income-across-
canada/

Altstedter, A. (2021, January 6). Toronto home prices hit record in 2020, rising 13.5% to average
$930,000. *Financial Post*. Retrieved from Toronto home prices hit record in 2020, rising   13.5%
to average $930,000 | Financial Post

Appleton, J. (2020). The 15-minute city: Nurturing communities for smarter cities. Retrieved from
https://hub.beesmart.city/en/strategy/the-15-minute-city-nurturing-communities-for-smarter-
cities

Benfield, K. (2011, March 14). What does a sustainable community actually look like? *The Atlantic.*
https://www.theatlantic.com/national/archive/2011/03/what-does-a-sustainable-community-
actually-look-like/72376/

Bicknell, N. (2020, September 18). Seattle's quest to become a 15-minute city. *The Urbanist.*
https://www.theurbanist.org/2020/09/18/seattles-quest-to-become-a-15-minute-city/

Biermann, F., Kanie N., & Kim R.E. (2017). Global governance by goal-setting: the novel approach of the
UN Sustainable Development Goals. *Current Opinion in Environmental Sustainability 26-27*,
26-31

Bliss, L. (2021). Where Covid's Car-Free Streets Boosted Business. Retrieved from
https://www.bloomberg.com/news/articles/2021-05-11/the-business-case-for-car-free-
streets?srnd=citylab

Boisvert, N. (2021, March 21). Federal housing program to deliver new affordable homes for Indigenous
Torontonians. *CBC News.* https://www.cbc.ca/news/canada/toronto/rapid-housing-initiative-
indigenous-1.5957049

Bozikovic, A., Castaldo, J., & Webb, D. (2021, November 23). The 15-minute city aims to build more
liveable neighbourhoods. In Canada, only 23 per cent of urban dwellers live in this type of area.
The Globe and Mail. Retrieved from https://www.theglobeandmail.com/canada/article-when-
it-comes-to-liveable-neighbourhoods-theres-a-wide-divide-in/?cmpid=rss

Brand, C. (2021, March 29). Cycling is 10 times more important than electric cars for reaching net-zero

       cities. *The Conversation.* Retrieved from https://theconversation-

       com.cdn.ampproject.org/c/s/theconversation.com/amp/cycling-is-ten-times-more-important-

       than-electric-cars-for-reaching-net-zero-cities-157163

Brockbank, N. (2020, July 8). Finding a patch of green: COVID-19 highlights inequities in Toronto Park

       space, experts say. *CBC News.* Retrieved from

       https://www.cbc.ca/news/canada/toronto/finding-a-patch-of-green-covid-19-highlights-

       inequities-in-toronto-park-space-experts-say-1.5640852

Broudehoux, A. M. (2021, January 3). Post-pandemic cities can permanently reclaim public spaces as

       gathering places. *The Conversation.* Retrieved from https://theconversation-

       com.cdn.ampproject.org/c/s/theconversation.com/amp/post-pandemic-cities-can-permanently-

       reclaim-public-spaces-as-gathering-places-150729

C40 Cities. (2020). How to build back better with a 15-minute city. Retrieved from

       https://www.c40knowledgehub.org/s/article/How-to-build-back-better-with-a-15-minute-

       city?language=en_US

C40 Cities. (2021). Paris climate action plan: Towards a carbon neutral city and 100% renewable energy.

       Retrieved from https://www.c40knowledgehub.org/s/article/Paris-Climate-Action-Plan-

       Towards-a-carbon-neutral-city-and-100-renewable-energy?language=en_US

Carlton, I. (2009). Histories of transit-oriented development: Perspectives on the development of the

       TOD concept. *UC Berkeley: Institute of Urban and Regional Development*. Retrieved from

       https://escholarship.org/uc/item/7wm9t8r6

Canadian Energy Regulator. (2021). Energy production. Retrieved from https://www.cer-

       rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-

       territorial-energy-profiles-ontario.html

CGTN. (2020). How the '15-minute city' can create a sustainable future. Presentation. Retrieved from

       https://newseu.cgtn.com/news/2020-10-11/How-the-15-minute-city-can-create-a-sustainable-

       future-UsmmwI2FTq/index.html

City of Toronto. (2015). Downsview Area Secondary Plan. Retrieved from https://www.toronto.ca/wp-

       content/uploads/2017/11/902d-cp-official-plan-SP-7-Downsview.pdf

City of Toronto. (2017). TransformTO climate action for a healthy equitable, prosperous Toronto.
Retrieved from https://www.toronto.ca/wp-content/uploads/2018/02/9490-TransformTO-
Report-2-Attachment-B-Results-of-Modelling-GHG-Emissions-to-2050-Apr17-Revised-
Compressed.pdf

City of Toronto. (2018). 2018 Greenhouse Gas Emissions Inventory. Retrieved from
https://www.toronto.ca/wp-content/uploads/2020/12/9525-2018-GHG-Inventory-Report-Final-
Published.pdf

City of Toronto. (2019). HousingTO 2020-2030 Action Plan. Retrieved from HousingTO 2020-2030 Action
Plan (toronto.ca)

City of Toronto. (2020). HousingTO 2020-2030 Action Plan. Retrieved from
https://www.toronto.ca/legdocs/mmis/2020/ph/bgrd/backgroundfile-156646.pdf

City of Toronto. (2021a). Land acknowledgement. Retrieved from https://www.toronto.ca/city-
government/accessibility-human-rights/indigenous-affairs-office/land-acknowledgement/

City of Toronto. (2021b). Toronto at a Glance. Retrieved from https://www.toronto.ca/city-
government/data-research-maps/toronto-at-a-glance/

City of Toronto. (2021c). TransformTO. Retrieved from https://www.toronto.ca/services-
payments/water-environment/environmentally-friendly-city-initiatives/transformto/

De Gheldere, S. (2020). 15-minute cities: a clear path to zero-emissions. Retrieved from
https://blog.futureproofed.com/15-minute-cities

Dublin Chamber. (2020). Dublin: The 15-minute city. Retrieved from
https://www.dublinchamber.ie/DublinChamberofCommerce/media/banners/Dublin_The-15-
Minute-City.pdf

Euklidiadas, M. (2020). Paris wants to become "a 15-minute city". Retrieved from
https://www.smartcitylab.com/blog/governance-finance/paris-15-minute-city/

Electronics Research. (2018). City-wide climate perceptions study prepared for the City of Toronto.
Retrieved from https://www.toronto.ca/wp-content/uploads/2019/03/97b6-City-of-
Toronto_City-wide-Climate-Perceptions-Study_Full-Report.pdf

Environment and Climate Change Canada. (2020). Canadian environmental sustainability indicators: Greenhouse gas emissions. Retrieved from https://www.canada.ca/content/dam/eccc/documents/pdf/cesindicators/ghg-emissions/2020/greenhouse-gas-emissions-en.pdf

Environmental Commissioner of Ontario. (2019). A healthy, happy and prosperous Ontario. *Energy Progress Report.* Retrieved from https://irp.cdn-website.com/26237149/files/uploaded/why-energy-conservation.pdf

Fainstein, S. S. (2020). Urban planning. *In Encyclopedia Britannica online*. Retrieved from https://www.britannica.com/topic/urban-planning

Fesler, S. (2020, July 9). Seattle tops 761,100 residents, four-county Region Grows to 4,264,200. *The Urbanist* Retrieved from https://www.theurbanist.org/2020/07/09/seattle-tops-761100-residents-four-county-region-grows-to-4264200

Foley, J. (2009). The other inconvenient truth: The crisis in global land use. *Yale University.* Retrieved from https://e360.yale.edu/features/the_other_inconvenient_truth_the_crisis_in_global_land_use

Françoise, Y. (2019). How to be carbon neutral by 2050? Paris' strategy for a fairer, inclusive and resilient city. *City of Paris.* Retrieved from https://unfccc.int/sites/default/files/resource/Session4BG1%20Yann%20Paris.pdf

Gilson, P. J. (2021). Toronto is officially transforming parts of Yonge Street into car-free zones. Retrieved from https://www.narcity.com/toronto/yonge-street-is-being-transformed-into-a-pedestrianonly-zone-photos

Government of Canada. (2019). Canada's fourth biennial report on climate change. Retrieved from https://unfccc.int/sites/default/files/resource/br4_final_en.pdf

Government of Canada. (2021). Progress towards Canada's greenhouse gas emissions reduction target. Retrieved from https://www.canada.ca/content/dam/eccc/documents/pdf/cesindicators/progress-towards-canada-greenhouse-gas-reduction-target/2020/progress-ghg-emissions-reduction-target.pdf

Government of Seattle. (2020). Citywide planning report. Retrieved from
http://www.seattle.gov/Documents/Departments/OPCD/OngoingInitiatives/SeattlesComprehen
sivePlan/CouncilAdopted2020_CitywidePlanning.pdf

Government of Seattle. (2021). Understanding our emissions. Retrieved from
https://www.seattle.gov/environment/climate-change/climate-planning/performance-
monitoring

Hanes, T. (2020, September 16). New townhomes in Regent Park will set a sustainable, green tone.
Toronto Star. Retrieved from https://www.thestar.com/life/homes/2020/09/16/new-
townhomes-in-regent-park-will-set-a-sustainable-green-tone.html

Hawken, P. (2017). *Drawdown: The most comprehensive plan ever proposed to reverse global
warming.* New York, Penguin Books.

Hoornweg, D., Sugar, L., & Gomez, C. L. T. (2020). Cities and Greenhouse Gas Emissions: Moving
Forward. *Urbanisation*, *5*(1), 43–62. https://doi.org/10.1177/2455747120923557

Hughes, S. (2017). Reducing urban greenhouse gas emissions: Effective steering strategies for city
governments. *Institute on Municipal Finance and Governance Perspectives 16*, 1-17.
Retrieved from
https://munkschool.utoronto.ca/imfg/uploads/371/imfgperspectives16_shughes_feb_2017.pdf

id8 Downsview. (2020). Engagement round two: Feedback report. Retrieved from https://44e0cc70-
0fba-43fa-98a1-
d99b0274c6c3.filesusr.com/ugd/4ea6e4_d401f726a4ea4ecf92d40c54342b838e.pdf

id8downsview. (2020). Public engagement meeting #2 communities and neighbourhoods. Retrieved
from https://44e0cc70-0fba-43fa-
98a1d99b0274c6c3.filesusr.com/ugd/4ea6e4_a079f0fac62c480d8df9d4d9f1dbf75c.pdf

IPCC Intergovernmental Panel on Climate Change. (2013). Fifth Assessment Report: Summary for
Policymakers. Retrieved from WG1AR5_SPM_FINAL.pdf (climatechange2013.org)

IPCC The Intergovernmental Panel on Climate Change. (2018). Summary for policymakers. *IPCC.*
Retrieved from
https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf

IPCC The Intergovernmental Panel on Climate Change. (2019). Choices made now are critical for the
      future of our ocean and cryosphere. Retrieved from
      https://www.ipcc.ch/site/assets/uploads/2019/09/srocc-P51-press-release.pdf

Jones, A. M. (2021, March 21). Shelter outbreaks leave people experiencing homelessness even more
      vulnerable during COVID-19. *CTV News.* Retrieved from
      https://www.ctvnews.ca/canada/shelter-outbreaks-leave-people-experiencing-homelessness-
      even-more-vulnerable-during-covid-19-1.5356600

Joy, M., & Vogel, R. (2015). Toronto's governance crisis: A global city under pressure. *Cities* 49, 35-52

Katawazi, M. (2021, April 14). Toronto rent prices begin to go back up after plummeting for more than a
      year. *CTV News*. Retrieved from https://toronto.ctvnews.ca/toronto-rent-prices-begin-to-go-
      back-up-after-plummeting-for-more-than-a-year-1.5387285

Keeley, C., & Frost, D. (2014). Land use and energy: Connecting the dots to enhance communities.
      University of New Hampshire Information Brief 6, 1-4. Retrieved from
      https://extension.unh.edu/resources/files/Resource004822_Rep6855.pdf

Keesmaat, J., McKenzie, K. & Florida, R. (2020, May 23) Canadas new normal begins in our cities. *The
      Globe and Mail.* Retrieved from https://www.theglobeandmail.com/opinion/article-canadas-
      new-normal-begins-in-our-cities/

Langer, J. (2018). Cities can't lead from behind: TAF reviews Ontario climate plan. *The Atmospheric Fund.*
      Retrieved from https://taf.ca/cities-cant-lead-from-behind-taf-reviews-ontario-climate-plan/

Le Quéré, C., Jackson, R.B., Jones, M.W., Smith, A. J. P., Abernethy, S., Andrew R. M…., Peters, G.
      P. (2020). Temporary reduction in daily global CO_2 emissions during the COVID-19 forced
      confinement. *Nature Climate Change 10*, 647–653. https://doi.org/10.1038/s41558-020-0797-x

Li, Z., Zheng, J., & Zhang Y. (2019). Study on the layout of 15-minute community-life circle in third-tier
      cities based on POI: Baoding city of Hebei province. *Engineering 11*, 592-603.
      https://doi.org/10.4236/eng.2019.119041

Litman, T. (2020). Affordable-Accessible Housing in a Dynamic City. *Victoria Transport Policy
      Institute*. Retrieved from https://www.vtpi.org/aff_acc_hou.pdf

Lui, B. (2021). The '15-Minute City' Model: Encouraging Sustainable Cities. Retrieved from
       https://earth.org/15-minute-city-model/

Moreno, C., Allam, Z., Chabaud, D., Gall, C., & Pratlong, F. (2021). Introducing the "15-Minute City":
       Sustainability, resilience and place identity in future post-pandemic cities. *Smart Cities* 4(1):
       93-111. https://doi.org/10.3390/smartcities4010006

Myerson, D. L. (2007). Community catalyst report. *Urban Land Institute.* Retrieved from
       http://uli.org/wp-content/uploads/2012/07/Report-7-Environmentally-Sustainable-Affordable-
       Housing.ashx_.pdf

Nanda, A. (2020). Can Barcelona provide the blueprint for green cities after COVID-19? *World Economic*
       Forum Retrieved from https://www.weforum.org/agenda/2020/12/sustainable-cities-covid-19-
       barcelona-green-zones-coronavirus

Newman, P. (2016). "The 30-minute city": how do we put the political rhetoric into practice?. *The*
       Conversation. Retrieved from https://theconversation.com/the-30-minute-city-how-do-we-put-
       the-political-rhetoric-into-practice-56136

National Oceanic & Atmospheric Administration. (2021). Trends in Atmospheric Carbon Dioxide.
       Retrieved from https://gml.noaa.gov/ccgg/trends/

O'Neil, L. (2021). Here's how long it would take the average person in Toronto to save up for a house.
       Retrieved from https://www.blogto.com/real-estate-toronto/2021/05/heres-how-long-average-
       person-toronto-save-for-house/

Ontario Ministry of Municipal Affairs and Housing. (2020). *Growth Plan for the Greater Golden*
       Horseshoe. Retrieved from https://files.ontario.ca/mmah-place-to-grow-office-consolidation-en-
       2020-08-28.pdf

O'Sullivan, F. & Bliss, L. (2020, November 12). The 15-Minute city-No cars required-is urban
       planning's new utopia. *Bloomberg.* Retrieved from https://www.msn.com/en-
       us/money/realestate/the-15-minute-city-no-cars-required-is-urban-%20planning-s-new-
       utopia/ar-BB1aYcG9

Oxford Economics. (2021). Research briefing: North America affordable housing will get increasingly
       harder to find. Retrieved from
       https://resources.oxfordeconomics.com/hubfs/Content%20Hub%20RBs/open20210518012500.pdf

Pachner, J. (2021, January 9). In first person: Jennifer Keesmaat on what kind of job Tory is doing, how the pandemic has changed Toronto and the secret to affordable housing. *Toronto Star*. Retrieved from https://www.thestar.com/business/2021/01/09/sustainability-affordability-of-cities-a-post-pandemic-priority.html

Population Stat. (2021). Paris France, Population. Retrieved from https://populationstat.com/france/paris

Pullen, S., Arman, M., Zillante, G., Zuo, J., Chileshe, N., & Wilson, L. (2010). Developing an Assessment Framework for Affordable and Sustainable Housing. *The Australasian Journal of Construction Economics and Building*, *10*(1/2), 48-64. https://doi.org/10.5130/AJCEB.v10i1-2.1587

Reid, C. (2020, January 21). Every street in Paris to be cycle-friendly by 2024, promises mayor. Forbes. Retrieved from https://www.forbes.com/sites/carltonreid/2020/01/21/phasing-out-cars-key-to-paris-mayors-plans-for-15-minute-city/?sh=c7d8cdd69521

Richie, J., Lewis, J., McNaughton Nicholls, C., & Ormston, R. (2014). Qualitative Research Practice. A Guide for Social Science Students and Researchers, Second Edition. SAGE Publications Ltd.

Rosen, G. & Walks, A. (2013). Rising cities: Condominium development and the private transformation of the metropolis. *Geoforum, 49*. 160-171.

Seattle OPCD, Office of Planning and Community Development. (2020). Seattle's planning plan to build back better during COVID-19 recovery. Retrieved from https://dailyplanit.seattle.gov/seattles-plan-to-build-back-better-during-covid-19-recovery/

Sisson, P. (2020). How the "15-minute city" could help in a post-pandemic recovery. Retrieved from https://www.bloomberg.com/news/articles/2020-07-15/mayors-tout-the-15-minute-city-as-covid-recovery

Steemers, K. (2003). Energy and the city: Density, buildings and transport. *Energy and Buildings 35*(1), 3–14. https://doi.org/10.1016/S0378-7788(02)00075-0

Suttor, G. (2007). Growth management and affordable housing in greater Toronto. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=BF3372AA827C23AD2D86E9D197AAE77B?doi=10.1.1.368.9583&rep=rep1&type=pdf

Sustainable Community Development. (2018). Sustainable infrastructure. Land-use planning. Retrieved from https://www.crcresearch.org/sustainable-infrastructure/land-use-planning

The Municipal Art Society of New York. (2021, February 25). The 15-minute city presentation. https://www.facebook.com/masnyc/videos/432350711517548/?so=channel_tab&rv=playlists_card

United Nations. (2015). Sustainable development goals kick off with start of new year. Retrieved from https://www.un.org/sustainabledevelopment/blog/2015/12/sustainable-development-goals-kick-off-with-start-of-new-year/

United Nations. (2020a). The sustainable development goals report 2020. Retrieved from https://unstats.un.org/sdgs/report/2020/The-Sustainable-Development-Goals-Report-2020.pdf

United Nations. (2020b). Take action for the sustainable development goals. Retrieved from https://www.un.org/sustainabledevelopment/sustainable-development-goals/

United Nations. (2021). What is sustainable development? Retrieved from https://www.un.org/sustainabledevelopment/development-agenda/#1b1981a30bdd8fde2

United Nations Climate Action. (2021). Cities and Pollution. Retrieved from https://www.un.org/en/climatechange/climate-solutions/cities-pollution

UNESCAP, UN Economic and Social Commission for Asia and the Pacific. (2015). Retrieved from https://twitter.com/ossap_sdgs/status/980729203288170497

University of Paris. (2021). A Collection Dedicated to the 15-minute City. *Chaire-ETI*. Retrieved from http://chaire-eti.org/wp-content/uploads/2021/01/15-minute-city-collection.pdf

University of Toronto. (2021). Toronto's COVID-19 bike lane expansion boosted access to jobs, retail, study finds. Retrieved from https://phys-org.cdn.ampproject.org/c/s/phys.org/news/2021-02-toronto-covid-bike-lane-expansion.amp

VandeWeghe, J., & Kennedy, C. (2007). A Spatial Analysis of Residential Greenhouse Gas Emissions in the Toronto Census Metropolitan Area. *Journal of Industrial Ecology 11*(2), 133–144. https://doi.org/10.1162/jie.2007.1220

Vansynghel, M. (2020, Nov. 17). Seattle could become the next 15-minute city. *Crosscut*. Retrieved from https://crosscut.com/focus/2020/11/seattle-could-become-next-15-minute-city

93

Waterfront Toronto. (n.d.a). Affordable Housing in the West Don Lands. Retrieved from

        https://waterfrontoronto.ca/nbe/portal/waterfront/Home/waterfronthome/projects/affordabl

        e+housing+in+the+west+don+lands

Waterfront Toronto. (n.d.b). West Don Lands. Retrieved from

        https://www.waterfrontoronto.ca/nbe/portal/waterfront/Home/waterfronthome/precincts/we

        st-don-lands

WCYD Earth C.I.C. (2021). What can you do Earth? The 5P's. Retrieved from

        https://whatcanyoudo.earth/selecting-the-sdg-for-your-action/the-5-ps/

Weinberger, H. (2020). Pandemic streets showed the promise of car-free Seattle. Retrieved from

        https://crosscut.com/focus/2020/11/pandemic-streets-showed-promise-car-free-seattle

Whittle, N. (2020). Welcome to the 15minute city. Retrieved from

        https://investmentmoneycnn.com/wp/welcome-to-the-15-minute-city/

Willsher, K. (2020, February 7) Paris mayor unveils "15-minute city" plan in re-election campaign.

        The Guardian. Retrieved from https://www.theguardian.com/world/2020/feb/07/paris-mayor-

        unveils-15-minute-city-plan-in-re-election-campaign

Yeung, P. (2021, January 4). A new urban planning model will change the French capital – and could

        provide a template for how to create stronger local communities and make residents happier.

        BBC. Retrieved from https://www.bbc.com/worklife/article/20201214-how-15-minute-cities-

        will-change-the-way-we-socialise

APPENDICES

APPENDIX A

Table 1: The "15-minute city" model: A way of achieving the UN 17 SDGs;
Created by the author

United Nations Sustainable Development Goals		Urban strategies for sustainable community development: "15-minute city" incorporating Mixed-use / TOD / Smart Growth
1 NO POVERTY	To end poverty in all its forms everywhere by 2030	Affordable housing coupled with an equitable urban environment created by the 15-minute city or community concept reduces poverty and eliminates socio-economic inequalities.
2 ZERO HUNGER	To end hunger, achieve food security and improved nutrition and promote sustainable agriculture	The 15-minute city or community incorporates green space which can be used for community gardening, promoting sustainable urban agriculture, and eliminating hunger.
3 GOOD HEALTH AND WELL-BEING	To ensure healthy lives and promote well-being for all at all ages	The 15-minute city or community creates an environment that encourages and facilitates walking and cycling, improving physical and mental health, enhances the connectivity between people, reduces greenhouse gas emissions and pollution.
4 QUALITY EDUCATION	Ensure inclusive and quality education for all and promote lifelong learning	The 15-minute city incorporates having schools close to where people live and transit making it easier for people to access education, and facilitating technology for accessible education.
5 GENDER EQUALITY	To achieve gender equality and empower all women and girls	The 15-minute city incorporates mixed-use development which serves everyone equally, encouraging inclusive and sustainable practices.
6 CLEAN WATER AND SANITATION	To ensure access to safe water sources and sanitation for all	The 15-minute city concept helps to reduce greenhouse gas emissions, ensuring that water is clean; incorporates having all the services needed including clean water and sanitation.

7 AFFORDABLE AND CLEAN ENERGY	To ensure access to affordable, reliable, sustainable and modern energy for all	The 15-minute city complements zero carbon buildings and clean energy, can incorporate renewable energy alongside buildings, which provides energy to all people.
8 DECENT WORK AND ECONOMIC GROWTH	To promote inclusive and sustainable economic growth, employment and decent work for all	Decent work and economic growth are provided by the 15-minute city by incorporating local employment opportunities and jobs and services well-connected to public transportation within the community. Pedestrian-friendly zones create benefits for local businesses.
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	To build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	The 15-minute city promotes the investment in and improvement of local infrastructure, helping to make areas more resilient; the creation of spaces that facilitate walking and cycling and incorporating green spaces will foster innovation and provide equitable opportunities.
10 REDUCED INEQUALITIES	To reduce inequalities within and among countries	The 15-minute city or community model creates economic opportunities locally, affordable housing, and eliminates gentrification and promotes the creation of inclusive socio-economic opportunities and growth.
11 SUSTAINABLE CITIES AND COMMUNITIES	To make cities inclusive, safe, resilient and sustainable	The model incorporates improvement of local infrastructure, services, sustainable mobility, bike lanes; provides affordable housing, recreational facilities and transit-oriented mixed-use development; eliminates private car use and stops unplanned urban sprawl.
12 RESPONSIBLE CONSUMPTION AND PRODUCTION	To ensure sustainable consumption and production patterns	The 15-minute city or community as a strategy to recover from COVID-19 offers an opportunity to develop plans that will reverse the current unsustainable production and consumption patterns to create more sustainable ones.
13 CLIMATE ACTION	Taking urgent action to tackle climate change and its impacts	The concept improves the energy efficiency of urban environments, provides opportunities to develop renewable energy, more green spaces and enhances carbon sequestration, as well as reducing greenhouse gas emissions, spaces for parking, and urban heat island effect.

14 LIFE BELOW WATER	To conserve and sustainably use the world's ocean, seas and marine resources	The 15-minute city reduces greenhouse gas emissions, therefore preserving the world's oceans, helping to mitigate climate change, and eliminating ocean acidification.
15 LIFE ON LAND	To sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss	The 15-minute city or community eliminates deforestation and facilitates the creation of more green spaces to support biodiversity; creates better connections between and among green spaces in urban areas and around the world.
16 PEACE, JUSTICE AND STRONG INSTITUTIONS	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	The 15-minute model promotes the creation of an inclusive society, peace, justice and strong institutions; creates opportunities for everyone, providing socio-economic and environmental justice, good housing, and services close to where people live.
17 PARTNERSHIPS FOR THE GOALS	To revitalize the global partnership for sustainable development	The 15-minute city model helps communities to be self-sustaining and fosters a stronger partnership within and among communities, cities, regions, and countries, facilitating a sustainable future for all living organisms on Earth.

Note: UN Goals images and description adapted from United Nations, 2020

APPENDIX B

Visuals of the implementation of the "15-minute city" model in Paris

Photo 1: Walkable area with pedestrian and green spaces in a 15-minute neighbourhood in Paris; Source: O'Sullivan & Bliss, 2020
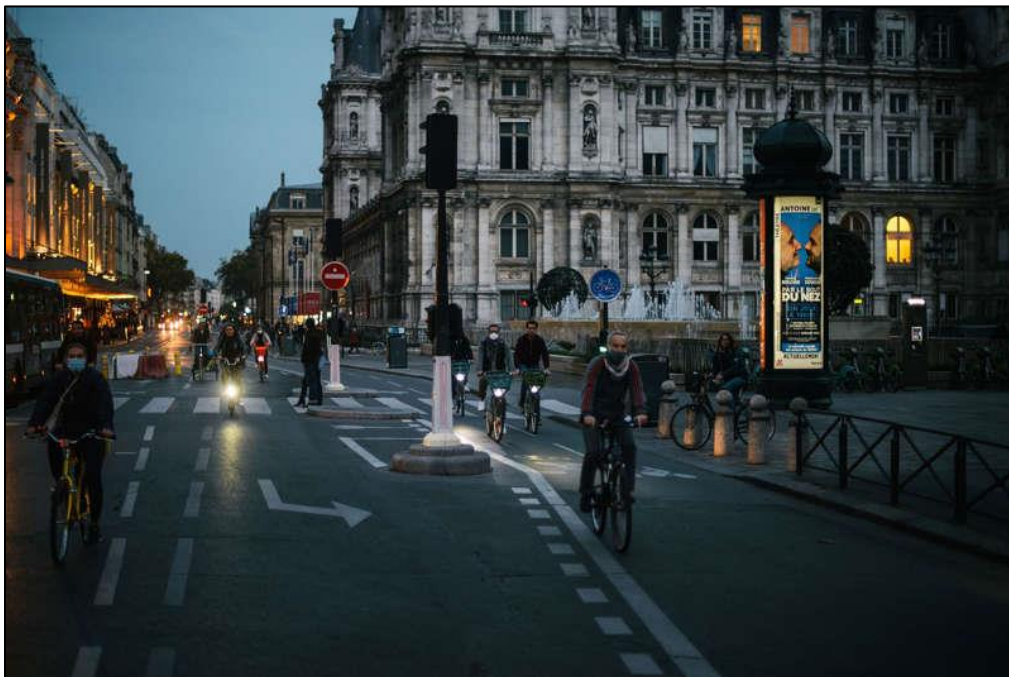

Photo 2: Cyclists on the streets of Paris; Source: O'Sullivan & Bliss, 2020

Photo 3: In a 15-minute city, neighbourhoods should satisfy six social functions: living, working, caring, supplying, learning, and enjoying; Source: Yeung, 2021

Photo 4: Pedestrian and green spaces in a 15-minute neighbourhood in Paris; Source: Yeung, 2021

APPENDIX C

Visuals of the implementation of the 15-minute city model in Seattle

Photo 5: Pedestrians at a crosswalk and a transit stop along Broadway on Capitol Hill, Seattle. Most vital services and amenities are within a 15-minute walk or ride in this neighbourhood; Source: Vansynghel, 2020.

Photo 6: Pedestrian and green spaces in Seattle's neighbourhood; Source: Vansynghel, 2020.

APPENDIX D

Affordable and Sustainable Housing in Regent Park, Toronto

Affordability, accessibility, and sustainability are all important for future housing development in Toronto. The development of green or sustainable housing can include solar photovoltaic panels, green roofs, solar hot water heating systems, small wind turbines, biofuel, energy efficient building insulation, and more efficient lighting and appliances. According to Hanes (2020) during the last 10 years developers in partnership with Toronto Community Housing have transformed the neighbourhood of Regent Park, Toronto and created a mix of market and affordable condominium units along with community amenities such as stores, sports fields and a community art, and cultural hub. In order to make the buildings sustainable and reduce the carbon emissions produced by the buildings, as well as improve their energy efficiency, the design incorporates green roofs, solar panels on the roofs and awning structures, and triple-paned windows (Photo 7). In addition, the townhouses also include electric heating supplied by heat pumps, drain water heat recovery pipes, and Energy Recovery Ventilators to provide fresh air.

This home design model can be replicated in other neighbourhoods in Toronto.

Photo 7: Affordable and sustainable homes in the Regent Park neighbourhood, Toronto
Source: Hanes, 2020

APPENDIX E

Visuals of converting the Downsview Park Area into a 15-minute neighbourhoods

 Photos: Ideas identified for prioritization in the design of the Downsview Park neighborhood; Sources:id8downsview, 2020; id8 Downsview, 2020