Fuelling a Superpower Sustainably: Clean Energy in the United States of America

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Abstract

The United States has made significant commitments to expanding sustainable energy, seeking to achieve ecological gains, growth in GDP and jobs, and increased national security. The American Recovery and Reinvestment Act of 2009 (ARRA) provided vast support for residential and commercial renewable energy and energy conservation projects through tax credits and grants. The Department of the Interior (DOI) has also acted to open federal land for renewable energy development. Yet clean energy achievements have not yet met U.S criteria. The U.S electricity system is dominated by domestically available fuels, meaning renewable electricity has not affected energy imports. Clean electricity has increased GDP and created jobs, while lowering emissions, but only very slightly. Debate continues over whether GDP growth can lead to greater sustainability. Significant political and economic barriers suggest the future of U.S clean energy is unclear. The majority of clean energy programs supported by ARRA will expire by 2016, while federal support for cheap natural gas continues to challenge other options. Nonetheless, Canada must pay attention to American clean energy advances. Significant U.S progress in reducing emissions would almost certainly bring trade measures impacting Canadian exports. Ensuring this progress occurs demands increased legislative consistency and support, and some sort of emissions pricing mechanism.

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Foreword

The large appetite for energy in the United States is well known. This makes their recent efforts to create a more sustainable energy system using renewable energy and energy conservation a very interesting area of study. While the U.S has made important progress towards increasing clean energy capacity, significant challenges will need to be overcome before new energy paradigms can emerge. Nonetheless, the substantial political and economic barriers currently facing the future growth of cleaner energy can provide invaluable insight to decision-makers and researchers, both in and outside the U.S.

This paper examines U.S progress building a more sustainable electricity system, by providing an in-depth examination of the implementation and evaluation stages of policy development. By maintaining a focus on post-2009 events, including the financial crisis and subsequent stimulus funding, controversial links between economic growth and renewable energy have been studied. The paper has also demonstrated the importance of federal support through strong and consistent policy. Indeed, one of the most pressing issues currently facing U.S clean energy growth is the upcoming expiration of many of the programs supported by stimulus spending.

By examining both the implementation and assessment stages of policy development, this paper has been able to contribute to all components of my Plan of Study, titled *Policy and Business in Sustainable Energy Development.* This paper gave careful attention to the definition of sustainable energy, using work published by Robert Gibson and Mark Winfield, while simultaneously exploring U.S clean energy criteria that emphasized growth in GDP and jobs, ecological health, and national security. The paper also focused extensively on the policy and politics surrounding energy decisions, by examining U.S clean energy grants and tax credits aimed at both residential and commercial markets.

The paper developed knowledge around clean energy and business, and explored the relationship between private developers and federal policies and programs. With many of these programs soon expiring, it remains unclear at what rate private investment in sustainable energy will continue.

By examining the recent American clean energy experience, this paper has uncovered issues central to clean energy development in many countries, including the need for political and economic decisions that are focused on long-term sustainable outcomes. By uncovering and exploring some of these themes, this paper seeks to provide valuable information concerning the challenges associated with sustainable energy, so that these challenges may be overcome.

Chapter 1: The United States, Clean Energy, and the Environment

1.1. Introduction: sustainability, energy, and the state of the union

In his first 2013 State of the Union address, freshly re-elected President Barack Obama described numerous policy priorities, as he hoped to define not only the direction of U.S government during the following four years, but also legacy in his second and final term as president. These remarks - diverse and mostly predictable - were delivered to a country still very much affected by economic upheaval and job losses, making it unsurprising that Obama emphasized employment and economic gains since his first election in January of 2009, and efforts to reduce the U.S deficit through a combination of spending cuts and new revenues – a formula that has so far remained elusive.[1] While focusing on economic growth, job creation and deficit reduction remains safe territory for many politicians, President Obama's significant focus on energy issues and sustainability during the speech was perhaps more surprising, and certainly more original.

During the 2013 State of the Union, the President called for an urgent response to mitigate climate change impacts, and insisted that any future climate strategy needed to involve the development of renewable energy and energy conservation programs, in effect challenging Congress to act by promising to "direct my Cabinet to come up with executive actions we can take, now and in the future, to reduce pollution, prepare our communities for the consequences of climate change, and speed the transition to more sustainable sources of energy."[2] Similarly, the President argued that recent climate events, including wildfires, droughts, and Hurricane Sandy were not just unusual coincidences, appealing to Americans to "believe in the overwhelming judgment of science - and act before it's too late."[3] Yet the Obama administration's 2013 public commitment to so-called sustainable energy systems was not the first time this issue had been raised by U.S politicians.

Commitments to sustainable energy systems at the federal level in the United States, or at least certain aspects of a cleaner system, have existed to varying degrees before 2009, put forward by Republican and Democratic Administrations. The Energy Policy Act of 2005, signed into law by George W. Bush in August of that year, set out numerous clean energy targets for federal buildings and vehicle fleets – although the legislation simultaneously exempted oil and gas companies from the Safe Drinking Water Act during hydraulic fracturing operations, and unsurprisingly received significant criticism for this and other environmental weaknesses.[4] Nonetheless, the 2005 Act mandated hourly energy metering in all federal buildings by October 2012, in addition to energy efficient product procurement standards, and stricter building performance codes, again in federal buildings.[5] The Energy Policy Act of 2005 also attempted to encourage the development of renewable energy through federal properties and facilities, requiring that that the Federal Government use at least 3% renewable energy during 2007-2009, 5% by 2010-2012, and finally, 7.5% from 2013 onwards.[6]

The Energy Independence and Security Act of 2007 built upon the Energy Policy Act of 2005 with stricter energy conservation requirements for federal buildings, by mandating a 30% reduction in energy consumption by 2030. While the 2007 Act mentioned renewable energy, it did so within the context of biofuels and directed federal vehicles to increase overall biofuel usage by 10% by 2015, measured from a 2005 baseline.[7] Importantly, the Energy Independence and Security Act of 2007 demonstrated through both its content and title the government's eagerness to frame sustainable energy issues as ones of national security and resilience, rather than focusing only on ecological concerns.

This focus on energy security and independence alongside economic growth was adopted and expanded upon by President Obama after his 2009 election victory, who utilized his first State of the Union address on January 27th 2010 to advocate for job creation and economic growth through clean energy focused research and development.[8] The president stated "even if you doubt the evidence [of climate change]… the nation that leads the clean energy economy will be the nation that leads the global economy."[9] This focus on sustainable energy as a strategy to remedy both American ecological health and economic health was continued in Obama's 2011 and 2012 State of the Union Addresses, and of course, in his 2013 address described above.

In January of 2011, the President declared that a new "Sputnik moment" had arrived, demanding that America invest in "biomedical research, information technology, and especially clean energy technology."[10] During the same address, the President ambitiously declared that by 2035, 80% of American electricity would come from clean energy sources.

The 2012 speech added further complexity to the relationship between clean energy and economics by framing sustainable energy as a strategy to reduce American's dependence on oil imports, with Obama proclaiming that "last year [2011], we relied less on foreign oil than in any of the past 16 years."[11] It is therefore clear that commitment to sustainable energy at the federal level has existed for some time, at least through rhetoric. Yet 'clean energy' has remained broadly defined, including renewable energy generation, electricity conservation, energy efficiency, and reduced oil and gas imports.

1.2. Understanding Sustainable Energy: report scoping & definitions

The imprecise definition of sustainable energy used throughout speeches and policy means that much less is known about the actual effectiveness of these programs, and questions thus remain concerning clean energy in the U.S. This paper will attempt to explore critical uncertainties surrounding clean energy programs by briefly clarifying current American definitions of sustainable energy systems, followed by a more in-depth examination of the implementation and effectiveness of these initiatives. Lastly, substantial barriers associated with U.S federal sustainable energy policies will be analyzed, and implications for Canada as a trading partner will be addressed. Before further exploring the structure and methodology used in this analysis it is important to review current American definitions of sustainable energy systems and to clarify the scope of this report.

It is apparent that sustainable energy systems in the United States are generally defined as those that achieve traditional economic goals, principally growth in jobs and GDP, while simultaneously reducing American dependence on energy imports. Finally, sustainable energy is further expected to provide significant ecological benefits, including pollution reduction and climate change prevention. These requirements have been explicitly expressed in the March 2011 *Blueprint for a Secure Energy Future,* which outlined American energy strategy to reflect the triad of economic, security and ecological pillars described above. The *Blueprint* proposes developing and securing domestic oil and gas resources, finding gains in energy conservation and efficiency, and developing renewable electricity generation through innovation and investment.[12]

The first component of the *Blueprint* - developing and securing domestic energy - calls for increased oil and gas development, greater nuclear capabilities, and more clean energy technology, including biofuels, electric vehicles, renewable generation, and low and zero emissions fossil fuel generation.[13] The second component - increasing efficiency and conservation - demands higher fuel efficiency standards for vehicles, as well as reduced energy use in residential, commercial, and industrial buildings. Finally, the 2011 *Blueprint's* third component - clean energy development - is to be achieved by siting wind and solar projects on public land, initiating Atlantic offshore wind development, smart grid investments, carbon capture and storage investments, and loan guarantees for new nuclear projects.[14] So while the programs and strategies recommended in the *Blueprint for a Secure Energy Future* are predictably diverse, we again see the themes of energy security, economic growth, and ecological health.

Publications from the U.S Department of Energy's *Energy Efficiency & Renewable Energy* (EERE) office confirm American sustainable energy priorities.[i] Specifically, the EERE states that U.S clean energy programs "facilitate deployment of energy efficiency and renewable energy technologies and market-based solutions that *strengthen U.S. energy security, environmental quality, and economic vitality* [emphasis mine]."[15]

The wide range of potential technologies and fuels mean this report cannot practically examine all sections of the U.S energy system. It will therefore instead focus on renewable electricity, and electricity conservation and efficiency programs – referred

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[i] The EERE office focuses on renewable electricity development, sustainable transportation, and energy efficiency and conservation programs for residential, commercial, and industrial applications.

to throughout this report as 'clean energy.' While renewables, conservation and efficiency may not be the only components of sustainable energy systems, they nonetheless contribute greatly to the conversation. Winfield et al.'s 2010 paper evaluated sustainability in Ontario's energy strategy and determined that renewables and conservation do indeed contribute significantly to this outcome.[16] By applying Robert Gibson's 2006 framework for sustainability, the paper concluded that renewable energy and energy efficiency promote sustainability by maximizing conservation and efficiency gains, bringing fewer lifecycle risks, reduced path dependency, and minimized economic risks – largely by avoiding the higher capital costs associated with more centralized electricity generation technologies such as nuclear.[17]

Examining renewable energy remains an interesting topic considering the very significant potential for renewable energy development in the country. A recent National Renewable Energy Laboratory (NREL) report examined the technical potential for renewable energy technologies, and determined that while all U.S states consumed approximately 3,754 TWh of electricity, total U.S renewable energy generation potential is 481,800 TWh.[18] Table 1.1 illustrates the U.S potential for various renewable energy technologies using data from this NREL report.

Table 1.1 - Technical Generation Potential for Renewable Energy Technology[19]:

Technology	U.S Generation Potential (TWh)
Urban utility-scale PV	2,200
Rural utility-scale PV	280,600
Rooftop PV	800
Concentrating solar	116,100
Onshore wind	32,700
Offshore wind	17,000
Biopower	500
Hydrothermal	300
Geothermal	31,300
Hydro	300

A clearer understanding of federal programs promoting renewables and conservation is also important considering global advances in these technologies, specifically in China and Germany. President Obama in 2011 called for greater efforts to keep up with the Chinese, insisting that the development of the world's largest private solar research facility in China meant the U.S was falling behind.[20] He again made reference to China in 2013, this time asserting "as long as countries like China keep going all in on clean energy, so must we."[21]

China has become the world's largest producer of wind energy and could potentially reach an unprecedented 1000 GW of capacity by 2050 – although this would require continued and significantly accelerated development; shorter term projections see China reaching 200 GW by 2020.[22] This implementation is especially relevant given the increasingly large amount of electricity being consumed in the county. While China in 1973 accounted for only 2.8% of the world's electricity demand, the country was in 2009 consuming 18.6% of the world's electricity supply, or more that the rest of Asia, Africa and Latin America combined.[23]

In Germany, efforts to reduce green house gas emissions to 40% below 1999 levels by 2020, and 80% below 1999 year by 2050 have meant significant investments in renewable energy. Unsurprisingly, renewable energy growth in the country between 1999 and 2010 outpaced the OECD average by ten times, and Germany currently generates 20% of its electricity from renewable sources.[24] Sustainable energy, specifically renewables, conservation and efficiency, therefore continue to play a substantial role internationally: where the United States fits into this picture requires further clarification.

This report will contribute to this goal by examining federal level implementation of wind, solar, small hydro, biomass, renewable energy storage, smart grids, and residential and commercial energy efficiency projects. Nonetheless, without a complete understanding of current and future U.S commitments to oil, gas and nuclear development and deployment, it will not be possible to fully discuss American progress towards a sustainable energy system. A more detailed analysis of fossil fuels and nuclear developments, and their impacts on sustainability in the United States, shall be the topic of future research.

1.3. Methodology & Analytical Framework

Taking the form of a policy analysis, the paper will use the policy cycle framework proposed by Hessing, Howlett and Summerville to broadly understand the background and context surrounding U.S renewable and efficiency initiatives. The paper will briefly focus on the agenda setting, formulation, and decision-making stages, before providing a much more detailed examination of the implementation and assessment stages.[25] The assessment section will also examine significant political, economic, and institutional barriers to U.S clean energy developments. Finally, the paper will move away from the policy cycle model to examine future directions for U.S clean energy policy, and the likely implications for Canada, a large trading partner.

To ensure that analytical consistency is provided during the agenda setting, policy formulation, and decision-making policy stage analyses, a modified institutional-ideological evaluative framework will be utilized. This approach, proposed and utilized by Mark Winfield in *Blue-Green Province: The Environment and the Political Economy of Ontario,* allows for a targeted inquiry into material, normative, institutional, and societal factors.[26] This analytical structure will facilitate inquiry into energy security, economic trends and impact on employment, climate and pollution concerns, and the role of federal institutions in the sustainable energy sector.

In the paper's assessment section, sustainable energy programs already implemented will be tested against the energy goals defined through U.S federal policy and described above – energy security, job and economic growth, and improved ecological health. It is important to note that these U.S policy objectives do not meet the comprehensive sustainability requirements used to define clean energy in this paper.

While the U.S objectives focus on employment and ecological health, both components of Robert Gibson's framework described above, the Gibson framework also demands that sustainable projects and policies incorporate a clear focus on intra and intergenerational equity, requirements missing from the U.S criteria. The framework further calls for the immediate and long-term integration of all sustainability components simultaneously.[27] Even with these important differences, it is nonetheless critical to understand how effectively the U.S programs have performed against their own objectives, as current and future political decisions will likely reflect the U.S criteria. While the Gibson framework restricts this paper's clean energy analysis to renewable energy and energy conservation, the less stringent U.S criteria helps to explain why the current U.S energy strategy calls for fossil fuel and nuclear expansion.

It must also be noted that numerous commentators have challenged the notion that economic growth, included in the U.S criteria, is required for environmental health.

While a detailed sustainability analysis is out of the scope of this paper, it is nonetheless important to clarify the controversy associated with using clean energy to achieve increased GDP growth.

Herman Daly's *Towards Some Operational Principles of Sustainable Development* challenged notions of sustainable development that have traditionally asserted economic growth is necessary for sustainable outcomes. Instead, he suggested a decline of the 'empty-world' economic model where human and financial capital had been limited, and proposed the replacement of this paradigm with a 'full-world' model where natural capital has now become the limiting factor.[28] As a result, Daly concluded that this natural capital, defined as ecological capacity for regeneration and waste assimilation, should be preserved in part by mandating that non-renewable resource utilization be matched with the development of a renewable substitute resource.[29] It is obvious that significant future increases in consumption and GDP will bring important challenges to Daly's proposal for the preservation of natural capital.

Author John Lintott has also challenged the relationship between increasing consumption and well-being – implicit in arguments for increasing GDP growth - and has stated, "the possibilities for reducing consumption while maintaining welfare, and not illusions about saving the environment while increasing consumption, should be the focus of ecological economics."[30] Even the concept of 'greening' GDP data by including environmental costs into the calculations remains troubling to Lintott. He argues that pricing current externalities into GDP growth still leaves untouched assumptions that expanded consumption leads to greater sustainability and well-being.[31]

Despite these serious issues surrounding GDP growth and sustainability, it remains important to understand whether U.S clean energy programs have been successful at meeting the goals set by federal decision makers, who have demonstrated significant desire for more growth and consumption. So while this paper will clarify GDP trends, further research is certainly required into the relationship between clean energy, consumption, and sustainability in the United States.

The assessment section will lastly investigate barriers surrounding American clean energy programs, again utilizing the modified institutional-ideological analytical approach. This framework will facilitate a rigorous assessment of barriers associated with politics, economics, and federal institutions. The report will also consider likely future directions for clean energy programs in the United States and their implications for Canada, important factors considering the significant U.S - Canada trade relationship. While U.S clean energy development is still in the early phases, significant future success in GHG reduction could lead to similar requirements for countries exporting to the U.S, including Canada.

Although U.S legislation advancing renewable, efficiency and conservation programs has been adopted in various forms prior to 2009, this report will focus on implementation from that year forward. The current President has made numerous commitments to clean energy. Whether these promises demonstrate effective implementation, skillful rhetoric, or perhaps both is important to understand. A post-2009 focus will also clarify the connections between the economic components associated with current U.S clean energy policy and the global economic crisis of 2008 – this is a critical part of the narrative.

1.4. Conclusions

Using the above methodological approaches, it will be possible to summarize and assess the current energy policies and programs being advanced at the federal level in the United States, and their broad environmental impact. Descriptions of the agenda setting, policy formulation, and decision-making policy stages will provide context. Inquiries into the implementation and assessment components will clarify the roles that renewable energy, and energy efficiency and conservation play in American efforts to develop a cleaner energy system. Finally, this analysis will provide insight into the future directions U.S policy could take, and the impacts of these policies on Canada.

Chapter 1 Notes

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Chapter 2: Background and Context - Agenda Setting, Policy Formulation, and Decision-Making

Before examining and assessing the implementation of recent American clean energy developments it is crucial to understand the context in which these policies and programs evolved. Indeed, during each of the agenda setting, policy formulation, and decision-making policy stages, there were significant material, normative, institutional, and societal factors that provided momentum to the policy outcomes examined in this paper.

2.1. Agenda setting: recession, the environment, & American security

Writing about environmental policy development and analysis, Hessing *et al.* state that, "at its most basic, agenda setting is about the recognition of a problem on the part of the government."[1] Growing enthusiasm for clean energy before 2009 indicate that it had been on the U.S policy agenda well before that year. The 2009 American Clean Energy and Security Act – proposing a cap and trade system, renewable electricity standards, and subsidies for clean energy technology - was one product of this trend, even though it did not make it through the Senate.[2] This section will examine the factors that led to a clean energy agenda in the U.S.

Using the modified institutional-ideological framework described, it becomes evident that material factors such as economic development and ecological health influenced the clean energy agenda. Indeed, emission reductions and economic growth figured prominently in energy related White House and EERE literature.[3] The emergence of this agenda, however, occurred well before the 2009 Presidential election. A 2001 IPCC report suggested that climate change in North America could increase temperatures by 1–3°C assuming a low-emissions scenario or 5–7.5°C assuming a high-emissions scenario.[4] The energy and climate change link was also clear. The National Science Board wrote that sustainable energy would "enhance environmental stewardship and reduce energy and carbon intensity."[5] Yet despite these environmental concerns, mounting ecological problems did not create momentum in isolation. Had awareness of ecological damage been sufficient to alone create meaningful policy movement, it should have occurred well before 2009. Instead, energy related CO_2 emissions in the U.S increased 22% between 1990 and 2005, while renewable energy utilization actually declined during this timeframe.[6]

Economic factors appear to have had a more direct impact in shaping the clean energy agenda. During the 2008 global economic crisis the U.S unemployment rate went from 4.7% in October of 2007 to 10% in October of 2009.[7] At the same time, annual U.S GDP growth fell from 1.9% to -3.5%.[8] There is little doubt that these circumstances influenced the American energy agenda, as renewable energy and energy conservation were seen as a strategy to promote growth in jobs and GDP.[9] In a 2009 presentation to MIT students, Barack Obama discussed the $80 billion in clean energy spending under the American Recovery and Reinvestment Act of 2009, stating that the bill "put tens of thousands of Americans to work developing new battery technologies for hybrid vehicles… and doubling our capacity to generate renewable electricity."[10]

Like economic and environmental components, the impacts of normative factors during the agenda setting stage were substantial. While traditional electricity generation technology maintained its dominance in the U.S, attitude changes concerning energy imports did contribute to the clean energy conversation.

America's appetite for imported energy has been well documented. While the U.S met 70% of its energy needs domestically in 2005 – due to coal self-sufficiency and significant natural gas deposits – the country's energy imports nonetheless increased between 1990 and 2005 (the U.S continued to import over 50% of all oil used).[11] While criticisms of this import-reliant system focused on oil, electricity systems still factored into this discussion - the promotion of renewables and energy conservation in the Energy Independence and Security Act of 2007 demonstrated this clearly.[12]

American federal institutions also influenced the clean energy agenda. The United States Department of Energy (DOE), including the Office of Energy Efficiency and Renewable Energy (EERE), the Federal Energy Regulatory Commission (FERC), and the Environmental Protection Agency (EPA) were all heavily involved. The EERE promoted renewables and conservation throughout the 2000's.[13] The EERE budget remained constant throughout 2008, again demonstrating the institution's ability to influence the policy agenda, ultimately leading to the post-2009 renewables and conservation initiatives examined below.[14]

FERC also enjoyed considerable influence during this stage of policy formulation. The organization is responsible for regulating the interstate transmission of oil, natural gas and electricity, and also for reviewing LNG terminal proposals and the licensing of hydropower developments. Under the Energy Independence and Security Act of 2007, FERC updated grid interoperability standards and protocols designed to allow the eventual integration of smart grids into interstate transmission systems.[15]

Finally, the EPA added momentum to the clean energy policy agenda after an April 2007 Supreme Court of the United States ruling defined greenhouse gases as air pollutants, ultimately leading to the EPA having to regulate them as such.[16] The EPA has since tracked and regulated greenhouse gas emissions under the Clean Air Act utilizing a permit system. This has forced the federal government and large emitters to revaluate current and future costs associated with fossil fuel based electricity production, ultimately giving increased exposure and momentum to the clean energy agenda.

Lastly it is important to examine the impact of social factors on the clean electricity agenda. Social components were not able to drive the policy agenda alone, but they did have an impact. Gallup polling from 2007 to 2009 demonstrated weakening support for environmental action in cases where it had potential to limit economic growth. In March 2007, 55% of Americans agreed that environmental protection was necessary even when such action could limit economic growth, while 37% instead stated that economic growth needed to be the first priority. Perhaps unsurprisingly, these numbers had reversed by March 2009, with 51% of Americans then favouring economic growth.[17] It is thus clear that popular opinion was never overwhelmingly in favour of substantial environmental action when it could limit economic growth, and even less so after the 2008 economic downturn. These attitudes help to explain why economic development, defined as job creation and GDP expansion, has remained one of the three pillars of the clean energy agenda defined by the Obama Administration.

2.2. Policy Formulation: responding to economic and environmental concerns

Examining the agenda setting stage illustrated that while all factors in the institutional-ideological model contributed to the gradual development of a clean energy agenda in the U.S, economic considerations were the most significant. During the policy formulation stage, material, institutional, and social factors made important contributions, while normative factors appear to have played a less substantial role.

According to Hessing et al., the policy formulation stage seeks to clarify the actors and interests that determine the solutions to the policy problems identified during the agenda-setting period.[18] Ecological factors certainly played a central role during policy formulation, again demonstrated through the proposed 2009 American Clean Energy and Security Act. The Act clearly established that environmental concerns had the ability to influence energy legislation. In a 2009 analysis, the EPA concluded that the cap and trade policies included in the bill would cost American households between $80 to $111 per year, indicating that at least some decision makers felt ecological protection needed to be solidified through law, even when it would involve slight increases in energy prices.[19]

Similar to the agenda setting stage, economic issues were at the forefront during clean energy policy formulation. The 2009 American Recovery and Reinvestment Act (ARRA) was designed to "create new jobs and save existing ones [and] spur economic activity and invest in long-term growth" and directed billions to energy and environmental programs, along with energy related research, development and infrastructure initiatives.[20]

While normative factors concerning oil imports assisted in developing a new clean energy agenda, these issues were less important during the actual formulation of electricity policy. The policy response to importing energy focused instead on reducing oil demand through increased fuel efficiency standards. In 2011 the President introduced new vehicle fuel economy standards described by the White House as capable of saving "over 4 million barrels a day – nearly as much as we import from all OPEC countries combined."[21] While important links between renewable electricity, and broader energy conservation measures remain, the energy import debate led to the creation of new transportation policy rather than the electricity policy examined in this paper.

U.S institutions certainly played a role in the formulation of clean energy policy. The EPA authored numerous analyses on the environmental and economic impacts of proposed energy legislation throughout and after 2009, including work on the American Clean Energy and Security Act of 2009, the Clean Energy Jobs and American Power Act of 2009, and the American Power Act of 2010. The EPA specifically determined that under the American Power Act, low and zero carbon energy use would grow to make up 43% of all U.S energy use by 2050, instead of only 14% under business as usual scenarios.[22] The EERE also played a substantial role formulating policy. 2010 EERE funding included $120 million for program research, involving policy analysis, support and evaluation to "enable collection and analysis of economic, market, and technology data in support of EERE's programs."[23]

Social factors had an impact on the formulation stage of clean energy policy, albeit one that was smaller than the material and institutional components. Support for renewable energy and conservation was surprisingly strong between 2011 and 2013. In 2011, only 26% of Americans viewed increased oil and gas production as the best strategy to meet U.S energy needs while 66% of respondents believed that emphasis on alternative energy would be more effective. These numbers remained mostly consistent in 2013 with 59% favoring alternative energy and only 31% favoring an increased emphasis on oil and gas production.[24] While economic concerns, defined here as growth, clearly remained the number one priority for most Americans, general support for clean energy remained.

2.3. Decision Making: clarifying policy directions & sources of influence

It is important to lastly examine the decision making stage of the clean energy policy process in the U.S. Hessing et al. describe this stage as the time when "winners" and "losers" are decided, and more final choices are made regarding the ideas and strategies that were brought forward in the previous two development stages.[25] Like the previous two stages, it is apparent that ecological and economic concerns played a prominent role here.

While the American Clean Energy and Security Act of 2009 and closely related American Power Act of 2010 were deemed 'losers' during the decision-making stage, the American Recovery and Reinvestment Act (ARRA) survived to implementation. ARRA directed significant funding to numerous environmentally focused programs including the Stillwater geothermal and solar project in Nevada described as "advancing local economic growth, diversifying the nation's energy mix and reducing pollution."[26]

Economic issues were also important during this stage. The 2011 Blueprint for a Secure Energy Future proclaimed, "Leading the world in clean energy is critical to strengthening the American economy and winning the future."[27] This promotion of economic growth and job creation was common to all energy related policy implemented during the time frame examined in this paper.

Similar to the previous policy formulation stage, changes in normative attitudes concerning energy imports had a significant impact on transportation policy, while having less of an impact on renewable electricity and its conservation. The 2011

Blueprint states that measures to increase transportation efficiency "lower transportation costs by reducing our dependence on oil, [and] provide more transportation choices to the American people."[28] While the document discusses electric vehicles as a strategy to reduce oil usage, linking electricity policy to efforts to reduce energy imports, the general policy separations between clean electricity systems and the reduction of oil imports should not be surprising. U.S natural gas production is quickly growing, producing 19.2% of the world's total natural gas output in 2012. The U.S was also a net exporter of coal during the same year.[29] As the U.S generated 94% of its electricity from coal, natural gas, nuclear, and hydro in 2011, and only 1% from petroleum, it is apparent that oil imports had a minimal impact on clean electricity policy during the decision-making stage.[30]

Federal institutions maintained their influence on program development during the decision-making stage. The existence of the EERE highlights that institutions needed to promote renewable electricity generation are supported – in 2009 EERE funding accounted for 6% of total Department of Energy spending, compared to only 3% being directed towards fossil fuel programs.[31] FERC also continued to advance renewable energy and conservation during the decision-making stage by promoting Energy Efficiency Resource Standards (EERS) – by 2011, 22 states had implemented EERS under FERC guidance.[32]

Despite public support for renewable energy and conservation linked to economic and job growth, social factors do not seem to have been significant drivers of momentum during this stage. While it is worth noting that significant differences in opinion existed between Democratic and Republican voters in 2012 – 75% of Democrats believed clean energy needed expanded development, compared to only 43% of Republicans – these differences existed well before the decision-making stage.[33] While social factors mattered, especially Democratic support for Obama's clean energy programs, they were certainly not the deciding factor.

2.4. Conclusions

In using the modified institutional –ideological framework to analyze the agenda setting, formulation, and decision-making stages, the importance of economic considerations becomes very obvious in all policy stages. Given the explicit connections between renewable energy, conservation and reductions in greenhouse gas emissions, ecological concerns predictably factored into these policy-cycle stages as well. Normative and social attitudes also contributed, especially during the agenda setting stage. Finally, strong institutional capabilities allowed ecological and environmental concerns to be transformed into actual policy, again during all the stages.

Despite the important roles played by ecological, normative, and social factors, concerns over greenhouse gases and a potential over-reliance on energy imports, along with growth focused public support for alterative energy, all existed prior to 2009. The financial crisis of 2008 was most important, and provided an opportunity for the Obama administration to promote clean energy in hopes of addressing these new economic problems.

Chapter 2 Notes

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Chapter 3: Implementing Clean Energy in American – Progress and Projects 2009 – 2013

This chapter will examine the implementation of U.S clean energy initiatives as defined in chapter one, exploring federal level support for wind, solar, hydro, biomass, electricity storage programs, and electricity efficiency and conservation initiatives since 2009. Finally, gas and nuclear components of the U.S sustainable energy strategy will be analyzed to provide better context for understanding the clean energy program in its entirety. According to Hessing et al., the implementation stage of the policy cycle should be understood as the period when decisions are translated into decisive action.[1] This section will therefore analyze how the material, normative, institutional, and social pressures described above were transformed into meaningful changes in federal policy.

3.1. American Recovery and Reinvestment Act 2009: tax initiatives

The first significant and new investments made in renewable energy and conservation after the election of Barack Obama derived from the American Recovery and Reinvestment Act of 2009 (ARRA), commonly referred to as the recovery or stimulus act. While the legislation was initially expected to cost around $787 billion to implement, current estimates conclude the actual cost to be closer to $840 billion.[2] The Recovery Act included funding for both renewable generation, and energy efficiency and conservation programs divided into three categories: 1) tax benefits, 2) contracts, grants and loans, and 3) entitlement programs (Appendix 1).

Of the $290.7 billion in total tax credits awarded under ARRA, $10.9 billion would eventually be spent in the '*energy incentives*' category. Interestingly, $12.9 billion was initially allocated to this category. But since $2 billion of this funding was instead paid as grants (Appendix 1 & 3), only $10.9 billion was actually paid as tax credits.[3]

The largest amount of tax-focused renewable energy and energy conservation funding went towards diverse credits for residential renewable energy, efficiency, and conservation projects. This area was initially allocated $11 billion in funding, although as noted above, approximately $2 billion of these funds were ultimately paid out as grants instead.[4] Another $602 million was directed towards a residential credit for alternative energy projects, while $647 million supported tax credits for electricity produced from renewable resources.[5] Finally, $1.4 billion was allocated to tax credits for the 'advanced energy facilities' program under '*manufacturing & economic recovery, infrastructure refinancing, other,*' another category of ARRA's tax benefit component (Appendix 1).[6]

Funding utilized for residential conservation and efficiency improvements went towards the extension and expansion of Bush-era tax credits put in place through the Energy Policy Act of 2005 including the 'Residential Energy Property Credit' found under Section 25C of the Internal Revenue Code (IRC).[7] Specifically, ARRA expanded the 'Residential Energy Property Credit' program for 2009 and 2010, while simultaneously increasing the tax credit available for homeowners to 30% of the total cost of the upgrades (focused on building envelope modifications and efficient heating technology). It also raised the maximum credit allowed to $1500.00 (Appendix 3).[8]

This expanded program scoping clearly had a significant impact. In 2007, 4.3 million tax returns included claims under this program, each averaging $233.00. In 2009, 6.7 million tax returns included claims under section 25C, each averaging $868.00.[9] Since the ARRA extension of section 25C tax credits only included 2009 and 2010, the program was once again extended for 2011 – importantly, this extension re-enacted the credit structure that had been utilized under the Energy Policy Act of 2005.[10]

Although renewed through 2011, the future of this tax credit remains uncertain. It expired at the end of 2011 only to be again reactivated through the American Taxpayer Relief Act of 2012 until December 31st 2013.[11] The 'Residential Energy Property Credit' program boost from the 2009 stimulus funding therefore resulted in significantly more Americans taking advantage of the program. Even so, the reversion to 2005 program standards in 2011, combined with the planned 2013 expiration, has left significant uncertainty surrounding the long-term impact these tax credits will have and raises questions concerning the current administrations long-term commitment to clean energy.

Alongside the section 25C 'Residential Energy Property Credit,' ARRA also expanded the 'Residential Energy Efficient Property Credit' under section 25D of the IRC. The 'Residential Energy Efficient Property Credit' (section 25D) applies to solar photovoltaics, small wind development, solar water heating, fuel cells, and geothermal heat pumps.[12] Like the Section 25C provisions, Section 25D was originally enacted in the Energy Policy Act of 2005.[13] The Emergency Economic Stabilization Act of 2008 added small wind capacity and geothermal heat pumps to the program. Finally, ARRA extended these tax options into 2009 and 2010 (they would have otherwise expired) and eliminated the credits caps for all technologies. The 'residential energy efficient property credit' is currently available until December 31st 2016 (Appendix 3).[14]

As the two tax credit programs described above apply to residential homeowners, ARRA also expanded renewable energy and conservation tax benefit programs for commercial applications. This included the 'federal renewable electricity production tax credit' (PTC), first introduced in the Energy Policy Act of 1992, and paid out on a per-kilowatt-hour basis.[15] Specifically, ARRA extended the PTC deadline allowing projects under construction by December 31st 2013 to remain eligible for these benefits. ARRA also provided energy developers increased flexibility by permitting projects eligible for the PTC credit to instead opt for the 'federal business energy investment tax credit' (ITC) (Appendix 3).[16]

The ITC tax credit, currently available until 2016, provides eligible renewable energy producers a one-time tax credit of between 10% and 30% of total cost. The ITC was expanded by ARRA to include renewable energy technologies previously only covered under the PTC tax credit program, in effect giving developers the option to receive the one-time 10-30% ITC investment credit rather than the 1.1 – 2.3¢/kWh credit alternatively offered under the PTC program.[17]

ARRA directed $125 million to both these programs. More importantly, ARRA sent $18.2 billion towards the 1603 grant program allowing project proponents to claim their PTC and ITC benefits as cash grants.[18] More information about this option is found below. It is thus apparent that both the PTC and ITC tax credit programs represented important components of the U.S energy strategy. By allowing developers to choose between either the PTC and ITC credits, and by extending the PTC deadline to the end of 2013, opportunities to engage in these federal programs increased significantly post-2009. These tax programs will continue to impact future U.S clean energy developments, as the ITC credit will remain available until December 31st 2016.[19] Nonetheless, the current plan to eliminate the PTC and ITC in the next three years raises important issues regarding the future of clean energy in the U.S, as discussed below.

The 2009 stimulus act also introduced tax credits for property used for manufacturing renewable energy and energy conservation equipment, known as the 'advanced energy facilities credit' under ARRA guidelines.[20] This tax credit was created in 2009 through the Recovery Act and provides tax credits of up to 30% for projects that create, expand, or reequip manufacturing facilities for qualifying clean energy projects. (Appendix 3).[21]

The ARRA therefore enacted important modifications to the U.S tax code post-2009 that impacted individual homeowners, commercial organizations, and manufacturers associated with renewables and conservation. Despite this increased funding however, even more ARRA renewable energy and conservation investments were directed through grants, contracts, and loans.

3.2. American Recovery and Reinvestment Act 2009: grants, contracts and loans

In total, $250 billion was allocated to the grants, contracts, and loans section of ARRA, with $29 billion going to the '*energy and the environment*' category – although not all energy and environment grants went towards renewable energy and conservation (Appendix 1). Nonetheless, significant investments were directed to clean energy through this section - just under $15 billion went to the Department of Energy's Energy Efficiency and Renewable Energy (EERE) office, the largest amount delivered to any department in this category.[22]

EERE divided the ARRA funding they received into two categories: energy efficiency projects and renewable energy developments (Appendix 2).[23] The largest energy efficiency program supported by EERE's stimulus money was the weatherization assistance program (WAP) that received $4.89 billion.[24] The WAP was expanded under

ARRA to provide energy efficiency enhancements to the homes of low-income Americans, with the ultimate goal of reducing energy costs and improving resident health and safety.[25] While this program was first initiated by the Department of Energy in 1976, the Recovery Act increased the eligible income level thereby allowing more homeowners to qualify as low-income, and increased the maximum per-household benefit (Appendix 3).[26] ERRE directed this stimulus money into the WAP program for a three years period beginning in 2009, leading to a significant increase in the amount of low-income homes weatherized. Between 2009 and 2011 377,655 homes were weatherized using ARRA funding, while only 135,787 were weatherized using non-stimulus EERE funding.[27]

EERE, using ARRA funds, also provided $2.8 billion to the 'Energy Efficiency and Conservation Block Grant Program' originally created by the Energy Independence and Security Act (EISA) of 2007 (Appendix 3). The funding directed to this program went to cities, counties, states, and Indian Tribes through formula and competitive grants.[28] The permitted use of these funds was broad, ranging from the development of community energy conservation and efficiency planning to renewable energy development in government buildings. The stimulus act also funded a similar program administered by EERE known as the 'State Energy Program' that provided $3.1 billion to individual states, again to finance an extremely broad range of energy conservation and efficiency initiatives initiated at the state level.[29]

The EERE office spent significantly less money on renewable energy production. EERE forwarded $21.23 million towards community energy developments throughout five cities in Vermont, Wisconsin, Colorado, and California.[30] While this community energy program is expected to produce enough renewable energy to power 10,700 homes, the overall dollar amount remained relatively small.[31]

EERE used approximately $100 million of their ARRA grants on solar development and research to support private companies developing early stage and higher risk technology, including technology necessary to integrate solar within existing electricity grids, and the training of solar installers.[32] Another $115 million of stimulus funding was utilized to support wind power research and development. This money went towards the creation and expansion of wind turbine design and testing facilities at Clemson University, Illinois Institute of Technology, University of Maine, and University of Minnesota. Finally, EERE spent $9.95 million in stimulus funds to the National Renewable Energy Laboratory (NREL) used for expanding their wind power technology design and testing capabilities.[33]

While the above EERE programs were significant, the institution was not the only organization or initiative to receive money through stimulus grants in the 'energy and environment' category (Appendix 1.)[34] The section 1705 Loan program, administered by the DOE, was enacted through the 2009 Recovery Act and expired on September 30th 2011. The 1705 loan program combined ARRA funding with pre-existing DOE funds to provide $34.4 billion in loans to projects developing renewable energy, new electricity transmission systems, and biofuels projects.[35] As an example, Caithness Shepherds Flat utilized a $1.3 billion 1705 loan to develop an 845-megawatt wind farm in eastern Oregon.[36] Unfortunately, this program has since expired.[37]

In addition to the renewable and conservation stimulus funding categorized under the *'energy and environment'* section, ARRA directed funds under the '*infrastructure'* component (Appendix 1). The stimulus act specifically provided $4.7 billion to the General Services Administration's (GSA) federal buildings fund program.[38] $4.5 billion of the GSA's ARRA funding was used to 'green' federal buildings through energy efficiency modifications.[39] While numerous examples of GSA's 'high-performance green buildings' (HPGB) projects exist, specific cases include the Mariposa Land Port of Entry new-build project in Arizona that achieved a LEED gold rating utilizing a rooftop photovoltaic system, solar hot water, and advanced lighting and buildings automation systems.[40]

It is clear that ARRA provided significant funds through the grants, contracts and loans section of the Act. Like the stimulus support of tax credits however, the elimination of grants such as the 1705 loan program again raise questions surrounding long-term commitments to clean energy in the U.S. These issues are discussed in the following chapters.

3.3. American Recovery and Reinvestment Act 2009: entitlement programs

The ARRA lastly directed renewable energy and conservation funding through its 'entitlement program' category by forwarding $18.2 billion in grants into the 1603 'specified energy property' program.[41] The 1603 program essentially provided renewable energy and energy conservation project developers of the option to receive equivalent cash grants in lieu of the tax credit offered through the ITC program.[42] This ability to receive cash grants instead of tax credits was crucial with many renewable energy development firms being start-ups with little income tax liability.

The post-2008 recession severely limited the tax equity market, and simultaneously increased the cost for start-up renewable energy developers to access it.[43]

The 1603 program thus allowed developers to avoid this predicament by providing access to federal incentive programs even without tax liability. The deadline for applications for this program was 2012, once again raising questions concerning the long-term impacts of stimulus funding.[44] The end of the 1603 program is especially troublesome considering that so many proponents used this program to claim their PTC and ITC benefits.

3.4. Clean Energy Development on Federal Lands: beyond the stimulus

Post-2009 clean energy initiatives go well beyond stimulus measures. Indeed, the White House's 2013 "Clean and Secure Energy Future" report outlined a federal policy focus on increasing renewable energy developments on public lands.[45] Much of the responsibility for increasing clean energy development on public lands has gone to the Department of the Interior (DOI), responsible for land leasing to potential renewable energy, oil, and gas projects. The DOI has jurisdiction over one-fifth of the U.S mainland, 35,000 miles of coastline, and 1.76 billion acres of the Outer Continental Shelf.[46] Their 2010 budget included approximately $50 million directed towards developing the environmental assessment procedures and regulations required to increase renewable energy development on federal lands.[47]

This growing focus on renewables development on federal land is documented in then DOI Secretary Ken Salazar's February 2010 'Secretarial Order on Developing Renewable Energy.' The policy specifically called for the creation of an 'Energy and Climate Change Task Force," charged with determining specific locations within the U.S appropriate for solar, wind, geothermal, biomass and small hydropower developments (referred to as renewable energy zones). The task force was also asked to collaborate with other U.S federal agencies to develop clean energy ready infrastructure and transmission systems, while simultaneously creating grid protocols prioritizing renewable energy developments for transmission system right-of-way (ROW) applications.[48]

It is clear that efforts to increase renewable energy production on Bureau of Land Management (BLM) property (the institution responsible for managing land under DOI jurisdiction) have had measurable impact.

Table 3.1 – BLM Clean Energy Approvals, Before and After 2009[49]:

Period	Wind	Geothermal	Solar
Pre-2009	566 MW	942 MW	0 MW
Post-2009	4,063 MW	495 MW	7,566 MW

In July 2012 the DOI released the Solar Programmatic Environmental Impact Statement (PEIS) in response to Ken Salazar's Secretarial Order calling for the establishment of land use and environmental assessment guidelines needed to develop solar energy on federal lands.[50] The document identified 17 solar energy zones located on BLM administered land prioritized for future development in the following states: Arizona; California; Colorado; Nevada; New Mexico; and Utah. The BLM estimates that these 17 zones, totalling 285,000 acres of public land, can produce 23,700 MW of solar electricity when fully developed.[51]

The BLM has additionally classified another 19 million acres of federal land as 'variance' areas, land not as ideal for solar development as the solar energy zones, but nonetheless appropriate under the correct circumstances. Finally, the Solar PEIS identified land protected from solar development, in an effort to balance the energy development and land protection mandates given to the BLM. [52] [ii]

[ii] Using Arizona as an example, the Solar PEIS classified 5,801,301 acres as protected from solar development, another 3,380,877 acres under the 'variance' program for potential development on a case-by-case basis, and finally 5,966 acres planned for development as 'solar energy zones'.

Given this significant policy emphasis aimed at increasing BLM approvals for solar projects, it is not surprising that solar has enjoyed the largest capacity expansion on BLM land since 2009. The organization has approved 17 different solar developments that when completed will have as capacity of 4634MW. Some of these projects are expected to become operational between June 2013 and January 2015 (Appendix 4-A).[53]

The DOI and BLM have also promoted wind development on federal lands with the introduction of the wind PEIS in June of 2005. The wind PEIS amended 52 land use plans to allow for approval of wind developments on federal land previously unavailable.[54] These policy developments have had clear impacts on wind farms approvals since 2009, including the approval of five projects currently planned that will have a capacity of 3594MW.[55] Three additional wind projects approved since 2009 are already operational, having an installed capacity of 469MW (Appendix 4-B).

Increased development of geothermal facilities has also been emphasized in recent DOI and BLM policy. The geothermal PEIS amended 114 land use regulations put in place by the BLM. These amendments allocated 111 million acres of federal land for future geothermal land leases, and additionally opened 79 million acres of National Forest System land for potential geothermal leases.[56] This opening of land had a significant impact. Since the release of the 2008 geothermal PEIS, the BLM has used a competitive process to lease over one million acres of federal land in Utah, Oregon, Idaho, California, Nevada, and Colorado. The BLM currently manages 818 leases for geothermal facilities, although only 59 of these are producing energy at present.[57]

Geothermal project approvals by BLM since 2009 have also been significant. Five geothermal projects currently planned and approved will have the capacity to generate 292MW when they are completed between November 2013 and December 2014. Five additional geothermal projects with an installed capacity of 202MW are already operational (Appendix 4-C).[58]

In addition to working with the DOE to increase renewable energy approvals, the DOI has also collaborated with federal institutions to develop the transmission infrastructure required to bring renewable electricity to market. An October 23, 2009 memorandum of understanding (MOU) between the Federal Energy Regulatory Commission (FERC), the DOE and the DOI, among others, specifically addressed the issue of increasing cooperation between federal agencies to coordinate the development of renewable energy and its transmission infrastructure over private and public land.[59]

The memorandum outlined which federal agency would be responsible for decision-making concerning high voltage transmission projects and infrastructure.[60] The MOU states that the DOE is required to designate the 'lead agency' responsible for coordinating proposed transmission projects.[iii] The lead agency is then responsible for project pre-application planning including communications with Tribes and states, and the creation of the project timelines. By shifting planning control of transmission line development to the federal agencies already heavily involved in renewable energy development, such as the DOI, DOE, and BLM, it is expected that these projects will receive faster approvals.[61]

[iii] The DOE will generally assign 'lead agency' to the organization responsible for the land most impacted by the project. In the case of a transmission line crossing DOI land, for example, the DOI would become the lead agency.

3.5. Sustainability in Context: Gas & Nuclear Development

While this paper has purposely focused on the renewable energy and energy conservation, it is important to touch on some key electricity associated nuclear and natural gas developments since 2009. The 2011 *Blueprint for a Secure Energy Future* emphasized not only conservation and renewables, but also expanded gas (domestically produced), new nuclear technology and capacity, and carbon capture and storage (CCS) investments.[62] The updated 2013 White House energy blueprint again confirmed this so called 'all of the above' approach.[63]

Considering the significant and growing role of natural gas in the U.S electricity system (described in greater detail below) it is not surprising that the country has moved forward with plans to increases gas production on federal lands. Perhaps more surprising, gas development received very little money from ARRA. Under the 'tax benefits' category, absolutely none was directed exclusively towards gas (or nuclear), although small amounts may have been directed to these sectors through business tax credits.[64] The 'Contracts, Grants and Loan Programs' category also saw very little ARRA money go towards gas, although $384.2 million went towards nuclear power security and clean up costs.[65] Lastly, the 'Entitlement Programs' section of ARRA again sent no money directly towards nuclear or gas developments. While the DOE's Bonneville Power Administration Fund (BPA) received $1.2 billion in funding through ARRA, Pacific Northwest-based BPA's nuclear capacity makes up only 8.7% of its projected 2014 energy portfolio.[66] This money should thus not be viewed as a substantial nuclear subsidy through the ARRA.

Opening new federal lands to increased exploration has been the primary approach taken by the Obama administration to expand natural gas production. The U.S became the world's largest producer of gas in 2009 and passed its previous 1973 production record in 2011.[67] The Bureau of Ocean Energy Management (BOEM) recently announced their five-year Outer Continental Shelf (OCS) Oil and Gas Leasing Program for 2012-2017 that identified 15 potential leasing sites in six different regions for development.[iv] Most importantly, this five-year plan opens up 75% of currently undeveloped but technically recoverable oil and gas resources in the entire U.S OCS.[68] The U.S DOE has additionally moved forward with significant oil and gas lease offerings on federal lands onshore. In 2011, the office offered 1,755 parcels of land (4.4 million acres) for lease. Of this offering, 1,296 parcels were actually leased, representing a 20% increase in lease revenue over 2010.[69]

Like natural gas, nuclear generation was not a significant recipient of funding under the stimulus act. Nonetheless, significant amounts of federal money have been directed to nuclear technology under the Obama administration. The DOE's Section 1703 Loan Program (separate from the DOE 1705 clean energy focused program funded by ARRA) provided $8.33 billion in loans for a new-build nuclear plant in Burke, Georgia. This Georgia-based project included the installation of two new 1,100 MW reactors. The White House press releases quoted the President as stating "to meet our growing energy needs and prevent the worst consequences of climate change, we need to increase our supply of nuclear power and today's announcement helps to move us down

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[iv] The Western Gulf of Mexico (GOM), the Central GOM, the Eastern GOM, (and in Alaska) the Chukchi Sea, the Beaufort Sea and the Cook Inlet.

that path."[70] The same DOE 1703 Loan Program provided an additional $2 billion to AREVA Enrichment Services in Idaho Falls, Idaho to produce enriched uranium for the nuclear generation industry.[71]

The DOE 1703 program was created by the Energy Policy Act of 2005, alongside other key federal supports for nuclear energy.[72] The 2005 legislation also introduced tax credits for new build nuclear reactors, offering 1.8 ¢/kWh with a credit cap of $125 million per year.[73] The Energy Policy Act of 2005 also extended the Price-Anderson Act until 2025, providing federally supported liability coverage that the nuclear industry would not have been able to acquire through the private insurance markets. This extension thus made new build nuclear possible, at least until 2025.[74] It is interesting to note however, that even with this federal support, the Burke, Georgia reactors currently under construction represent the first new build nuclear capacity in the U.S in over 30 years.[75]

It is therefore apparent that while ARRA did not direct large amounts of money towards nuclear, the federal government has given significant support to both the nuclear and gas sectors. A more detailed assessment of nuclear and gas progress is provided in Chapter four.

3.6. Conclusions

It is clear that the U.S federal government has implemented substantial policy measures since 2009 aimed at implementing renewable energy and energy conservation programs. Under ARRA, clean electricity programs directed towards addressing the issues of climate change, energy security, and economic growth, received significant amounts of funding. Utilizing tax measures, ARRA was able to provide important credits for residential renewable energy and efficiency projects, while the PTC and ITC programs extended these initiatives to commercial clean energy facilities. The 'advanced energy facilities credit' provided additional tax benefits to commercial manufacturers of clean energy technology.

The ARRA provisions that funded grants, contracts and loans were even more significant, with billions being sent towards low-income home weatherization, alongside clean energy grants to communities, Indian Tribes, states, and the General Services Administration. Finally, ARRA funding for entitlement programs directed approximately $20 billion to the 1603 program, allowing commercial operators the option to claim cash grants instead of the standard tax credits for clean energy developments.

The ARRA generally focused on increasing funding to existing programs rather that attempting to create entirely new ones.[v] Nonetheless, ARRA did create important and original clean energy programs including the 'advanced energy facilities credit' (IRC Section 48C), the General Services Administration's federal buildings fund program, and the section 1603 'specified energy property' tax benefit program.[76] Regardless of whether ARRA's renewable energy and conservation programs involved new legislation, or simply new investments into existing policies, it is obvious that the $90 billion put

[v] Tax code initiatives, including the 'Residential Energy Property Credit' and the Residential Energy Efficient Property Credit' (IRC Section 25C and 25D respectively) for example, originated in the Energy Policy Act of 2005. The 'federal renewable electricity production tax credit' (PTC) was originally enacted in 1992 and was modified by both the Energy Policy Act of 2005 and the Emergency Economic Stabilization Act of 2008 while the 'federal business energy investment tax credit' (ITC) also existed prior to ARRA, and was expanded by the Energy Improvement and Extension Act of 2008.
The weatherization assistance program (WAP) was initially enacted in 1976 by the Department of Energy, while the 'Energy Efficiency and Conservation Block Grant Program' was also initiated prior to 2009. The section 1705 loan program was created by the stimulus act, yet it nonetheless built off legislation enacted through the Energy Policy Act of 2005's section 1703 loan program – a program that unlike the 1705 program, still exists (see Appendix 3 for more details).

towards clean energy had the potential to have a significant impact on the U.S electricity system.[77]

ARRA was not the only federal clean energy initiative to occur after 2009. The DOI and the BLM, along with the DOE and EERE, made significant efforts to increase the development of renewable energy on public lands through the creation of Programmatic Environmental Impact Statements for solar, wind, and geothermal technology. While only the solar PEIS was created post 2009, the data above demonstrates that wind, solar, and geothermal project approvals have all increased during the post 2009 time period, likely as a response to the increased availability of renewable energy and conservation tax credits, loans, grants, and entitlement programs introduced post-2009.

Despite the large amounts of funding offered for clean energy through the ARRA, and the increase in public lands available for renewable energy development, it is clear that significant past and present support for domestic oil, gas and nuclear production will continue to challenge future clean energy growth and momentum. This is especially evident as numerous ARRA funded programs have already expired (1603 specified energy property credit and 1705 Loan program) or are set to expire between December 31st 2013 and 2016 (Section 25C Residential Energy Property Credit, Section 25D Residential Energy Efficient Property Credit, Federal Renewable Electricity Production Tax Credit (PTC), and the Federal Business Energy Investment Tax Credit (ITC)). Considering that gas production on federal land is expanding while many of these stimulus related programs are ending, there is little doubt that important barrier face future clean energy expansion in the U.S.

Chapter 3 Notes

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Chapter 4: Assessing American Clean Energy Developments

Part 1 – Evaluating Security, Economic Growth, & Ecological Health

It is critical to assess how the programs and policies explored in the previous chapter have contributed to the American definition of energy sustainability. Utilizing the analytical framework introduced previously, Hessing et al. have described the policy evaluation stage as part of a dynamic development process where "the results of the previous four stages of the cycle are examined along with the resulting policy itself."[1] This section focuses on evaluating the programs and policies outlined above in terms of the U.S criteria that have emphasized energy security, job and economic growth, and improved ecological health (Appendix 5).

4.1. Contributions to Security: importing and exporting energy

The U.S sustainable energy literature reveals a consistent emphasis on renewable energy and conservation to promote domestic security by reducing the country's need for imported energy. There is little doubt that energy generally, and sustainable energy specifically, plays a significant role in conversations surrounding domestic security, both in the U.S and elsewhere. Yet U.S sustainable energy policies have been defined not only by electricity generation and conservation programs, but also by developments in nuclear, oil and gas, and transportation policy. Chapter two indicated that while policies to reduce the reliance on imported energy created momentum around electricity and energy conservation, when it came time to formulate these policies, the perceived energy import problem was addressed mostly through transportation, oil, and gas programs, and less by electricity policy. It is thus not surprising that the implementation of renewable energy and electricity conservation programs appear to have done little to reduce the U.S dependence on imported fossil fuels.

Electricity generation in the United States has long been dominated by coal, natural gas, and nuclear sources, with liquid and coke petroleum contributing very little to this mix.[2] While the data demonstrates the overall usage of coal has declined, this has little significance concerning energy imports as the U.S remains a net exporter of coal, exporting 47 million short tons in 2008 and then 116 million short tons in 2012.[3] The United States is currently a net importer of natural gas, importing 1.516 trillion cubic feet in 2012, although net gas imports are declining. Despite this decline in gas imports, it seems unlikely that renewable energy and conservation development during the 2009 – present period were the cause.[4]

Table 4.1 - U.S generation by source as a percentage, 2008 - 2012[5]:

	Coal	Natural Gas	Nuclear
2008	48%	21%	20%
2009	44%	23%	20%
2010	45%	24%	20%
2011	42%	25%	19%
2012	37%	30%	19%

The overall gains in renewable energy production, excluding conventional hydro, were relatively small despite the programs described in the previous chapter. Between 2008 and 2012, renewable energy was responsible for 3.1%, 3.7%, 4.1%, 4.7%, and 5.4% of electricity production. So far in 2013, the EIA has reported renewable energy is responsible for 6.8% of net electricity generation (this number increases to 13.9% when including conventional hydroelectric).[6] Natural gas was responsible for 20-30% of electricity generation during this same time period. It is clear that the renewable energy gains, while significant, still lagged well behind fossil fuel generation and could therefore not be responsible for the decrease in natural gas imports.

Instead, the net natural gas import decreases between 2007 and 2011 (from 3.785 trillion cubic feet to 1.948 trillion cubic feet) were caused by increased domestic production and exports.[7] Indeed, U.S natural gas exports went from 963 billion cubic feet in 2008 to 1.619 trillion cubic feet between 2008 and 2012.[8] Due to significant advances in shale gas drilling, the Annual Energy Outlook 2013 predicts that the United States will become a net exporter of LNG in 2016 and an overall net exporter of natural gas in 2020.[9] It is therefore apparent that growth in renewable energy and conservation will do little to reduce natural gas imports in a country that is not expected to import this fuel type for very much longer.

Nuclear fission remains the third most common fuel type for generating electricity in the United States, but like coal and natural gas, growth in renewables and conservation has done little to reduce nuclear usage during the 2009 – present period examined in this paper. Instead, electricity generated from nuclear remained almost the same during these years, while the Energy Information Agency expects nuclear usage to actually increase 14% between 2011 and 2040, from 790 billion kWh to 903 billion kWh, citing new construction and refurbishments.[10] Considering the federal investments in nuclear amounting to approximately $10 billion described in chapter three, it is apparent that the

Obama administration has no desire for renewables and conservation to take-over current or future nuclear production.[i]

The only remaining sources of electricity generation in the U.S between 2009 and 2013 of any (limited) noteworthy amount were liquid and coke petroleum, but these sources combined for less than 1% of U.S generation, meaning that increases in renewables and conservation had little impact on reducing U.S oil imports during this time. American petroleum imports did decline between 2008 and 2012 (they peaked in 2005 and have been declining ever since) but this was caused by increased domestic production and the economic downturn.[11] While using renewable electricity to power the transportation sector could in the future link renewable energy to reduced energy imports, this has not happened yet.

Instead, the elements of energy policy currently aimed at reducing imports have predominately focused on increasing domestic fossil fuel production and promoting more stringent transportation sector efficiency standards, along with some support for biofuels. So while implementing the polices described in the previous chapter could reduce the amount of fossil fuels used to generate electricity in the United States, they will largely reduce the use of coal, a fossil fuel that America has plenty of.

4.2. Economic Impact: job creation and growth

Economic growth and job creation were major drivers of post-2009 renewable energy and energy conservation policy in the United States. This section aims to evaluate U.S progress against the county's own definition of sustainable energy. It will

[i] The current administration has provided loans for new build nuclear capacity in Burke, Georgia (currently under construction, see pg. 40), yet this is the first new build nuclear project in the U.S in over 30 years. It is therefore very unclear whether the EIA's 14% growth by 2040 projection is realistic.

specifically examine the impact of clean energy on GDP and employment levels. It is important to note that measuring GDP growth (and thus increases in consumption) to assess sustainability is a controversial topic. This debate is discussed in more detail in the scoping section.

Part A: job creation

It is clear that the unemployment rate in the United States has not yet recovered to per-2008 levels, even with the significant stimulus spending directed towards clean energy programs. While the average unemployment rate was 4.6% in 2007 and 5.8% in 2008, is has remained significantly higher since those years. Nonetheless, Table 4.2 demonstrates an important trend towards more Americans working. It is thus crucial to clarify how clean energy developments may have contributed to these slowly improving numbers.

Table 4.2 – U.S civilian workforce unemployment rate, 2009 – 2013[12]:

Year	Unemployment Rate
2009	9.3%
2010	9.6%
2011	8.9%
2012	8.1%
2013*	7.7%

***(Expected average from available data)**

Since most post-2009 U.S clean energy investments came from ARRA stimulus funding, sometimes creating new programs and policies, but more often funding programs initiated prior to 2009, expectations were that this initiative would create significant job growth while simultaneously strengthening the electricity system. As part of the accountability and transparency provisions that were included into the ARRA legislation, the Council of Economic Advisors (CEA) was required to provide congress with quarterly updates concerning job and economic growth resulting from the program.[13]

A January 2010 second quarterly report published by the CEA specifically focused on the clean energy impacts from the stimulus act and determined that the legislation would create 719,600 job years[ii] between 2009 and 2012 through clean energy initiatives.[14] Not all of these job years were related to renewable electricity and energy conservation, as the figure encompassed categories including vehicles and transportation fuel technologies, high-speed rail, and carbon capture and storage. Still, out of the 719,600 job years created through ARRA's clean energy spending, 496,900 job years were related to renewable energy and energy conservation.[15]

Table 4.3 – ARRA renewable energy and energy conservation job creation[16]:

Job Category	Total Job Years Created
Renewable energy generation	192,900
Energy efficiency	179,000
Grid modernization	80,600
'Green' innovation and job training	32,200
Clean energy equipment manufacturing	9,500
'Other'	2,700

Not all clean energy employment was created through ARRA.[iii] Numerous other programs and pieces of legislation, including the American Taxpayer Relief Act of 2012 and the Department of the Interior and Bureau of Land Management federal lands development initiatives, created employment related to renewable electricity and conservation.

[ii] Job year is defined as one person employed for one year.

[iii] Nonetheless, the tax relief and grant programs funded and extended through the Recovery Act were so broad that it is likely fair to say that all American clean energy jobs were impacted in at least some manner through the stimulus.

The American Wind Energy Association estimates that the U.S wind industry currently employs 75,000 workers throughout 50 states.[17] Similarly, the solar industry has also grown considerably in the United States, enjoying 13.2% employment growth equal to 13,872 workers between September 2011 and September 2012. The most recent solar jobs census published by the 'The Solar Foundation' determined that there are currently 119,016 U.S workers in the solar industry.[18] Smart grid development also employs a significant and growing number of Americans, as ARRA stimulus funding alone supported 47,000 jobs in this sector between 2009 and 2012.[19]

While the geothermal industry employs significantly less people than the wind and solar industries, it has also expanded. A 2012 Bureau of Labor Statistics paper reports that 5,200 Americans were employed in geothermal related roles in 2010.[20] Biomass, like geothermal, operates at a much smaller scale in the U.S than solar and wind but nonetheless currently employs 15,500 workers, many of them located in rural communities.[21]

While there is no doubt that employment has been created in the U.S clean energy sector since 2009, it is important to note that questions remain over whether new jobs in clean energy actually cause job losses in other sectors. One of the more significant and controversial additions to this conversation came from the 2009 *Study of the Effects on Employment of Public Aid to Renewable Energy Sources* report.[22] The study examined the Spanish experience utilizing federal level investments to create green jobs and concluded that these investments caused the loss of 2.2 jobs for every clean energy job created. Finally, this 2009 study concluded that every 'green' megawatt of electricity developed (defined in the report as solar PV, wind, and small-hydro) caused an average loss of 5.28 jobs.[23] While the report garnered significant attention it was not the first analysis that has suggested U.S federal clean energy investment could lead to net job losses.

In another study out of the University of Illinois College of Law, the authors concluded that public investment in clean energy tends to focus on absolute job numbers rather than productivity leading to 'green' jobs that are generally lower paid than the jobs they replace.[24] Nonetheless, other literature has strongly denied suggestions that U.S clean energy investments have created a net loss of jobs. The National Renewable Energy Laboratory (NREL) published a report specifically refuting the claims made in the Spanish Analysis. The NREL response contended that the Spanish feed-in-tariff model considered in the paper paid much higher rates not comparable to the U.S situation. The NREL also raised EIA projections that demonstrated a national renewable energy standard (RES) of 25% by 2030 would affect U.S electricity prices by less than 1%.[25]

A study completed out of University of California, Berkeley additionally challenged the proposed connection between net job losses and clean energy. In this study, the authors concluded that a RES of 30% by 2030 would create four million job-years. The analysis also noted that many reports critical of clean energy jobs fail to include additional benefits including lower health care costs, options for technology exports, and (perhaps most significantly) mitigation of substantial climate change effects.[26] It will ultimately require more time and research to fully understand the relationship between clean energy and employment (the total share of clean energy production in the U.S is still very low). Clean energy involves new technologies and even new paradigms – like all potentially disruptive technology, long-term impacts will be complex and difficult to predict.

Notwithstanding these debates, it is clear that U.S clean energy investments post-2009 did help to create jobs. The stimulus funding was able to create approximately 496,900 job years between 2009 and 2012, while wind, solar, geothermal, and biomass currently employs approximately 215,000 Americans. Yet considering that 142,469,000 Americans were employed in 2012, it is obvious that renewable electricity and conservation related employment requires continued growth in order to have a more significant impact on future overall U.S employment numbers.[27] As (and if) this growth continues, it will be critical to compare clean energy impacts on net job data while clearly defining and managing security, economic, and environmental expectations.

Part B: growth in GDP & clean energy investment

In addition to employment growth, the American federal government continues to use GDP growth as a metric to quantify economic success related to post-2009 clean energy investments. World Bank data demonstrates that GDP growth in the United States did improve between 2008 and 2011, even surpassing (briefly) levels of growth seen in 2006 and 2007.[28] While there was a general trend of increasing economic activity since 2010, this growth remains variable and certainly not robust. Nonetheless, data shows that stimulus spending generally - and clean energy spending specifically – did contribute to GDP growth during this time.

Table 4.4 – U.S GDP Growth, 2008 - 2011[29]:

Period	GDP Growth
2008	- 0.4%
2009	- 3.5%
2010	3%
2011	1.7%

The 2010 Council of Economic Advisors (CEA) report on ARRA spending determined that all funding provisions combined, including those not related to energy, added 3-4% of GDP growth in the third quarter of 2009, and between 1.5 – 3% in the fourth quarter of that year.[30] In the second quarter of 2011, the entire stimulus act created GDP growth of between 2 – 2.9%, while the third quarter of 2012 saw GPD raised 0.7% as a result of stimulus funding. By 2012, significant amounts of ARRA funding had already begun winding down, explaining the lessening impact after 2011.[31]

Investments in clean energy played a significant role in the overall GDP boost created by ARRA, and often created greater returns on federal investment that other components of the stimulus spending plan. A 2013 U.S Department of Energy report examined the economic impacts of smart grid funding through the stimulus act and determined that the $2.96 billion invested into smart grids resulted in $6.8 billion in total economic output. The report concluded that smart gird investments have a higher GDP multiplier than the majority of other federal investments. For every $1 million in smart grid investments made between 2009 and 2012, GDP increased by between $2.5 and $2.6 million.[32]

The section 1603 grant program also had significant and broad impacts on economic output after the post-2009 increase in U.S clean energy spending. A 2012 analysis of the 1603 program completed by the National Renewable Energy Laboratory (NREL) determined that the economic output resulting from the program between 2009 and 2011 totaled between $26 - $44 billion. This figure included not only ARRA funding to the 1603 program, but also private and state funding that resulted from it. The NREL report additionally analyzed the longer-term impacts from the 1603 grant program, and determined that over a period of the next 20-30 years the program would be responsible for $1.7-$1.8 billion in economic output.[33]

The evidence therefore suggests that clean energy initiatives in the United States post-2009 have created significant economic development. In particular, the $90 billion in clean energy spending introduced under the stimulus act encouraged funding commitments from private organizations, and at the state level. Yet like job creation, the sheer size of the U.S economy means that the impact of renewable electricity and conservation deployment on future GDP growth will be difficult to accurately predict and assess. So while many economists suggest that 7% unemployment and growth rates of around 2% may be the new norm for the United States (and many developed countries), evidence illustrates that U.S clean energy policy at the federal level has nonetheless been able to create tangible progress in employment and economic growth.

4.3. Environmental Impacts: renewable growth & emissions reductions

Ecological health was the final criteria utilized by the Obama administration to justify federal level investments in clean energy – in the case of renewable energy and energy conservation, ecological health was generally meant to mean reducing greenhouse gas emissions. It is not surprising that the environment would play a central role in evaluating clean energy policies, as the association between renewable energy and the environment is perhaps the most obvious one to citizens.

CO_2 emissions in the U.S from the electricity sector have been gradually declining since 2007 with the exception of a slight increase in 2010. Yet this drop in emissions also follows a general drop in electricity produced, and thus cannot be fully attributed to the introduction of renewables over this time period (Table 4.5, 4.6, & 4.7).

Table 4.5 – U.S electricity sector emissions, 2007 - 2012[34]:

Period	CO_2 Emissions (billion metric tons)
2007	2.43
2008	2.37
2009	2.16
2010	2.27
2011	2.17
2012	2.04

Table 4.6 – Change in U.S electricity sector emissions, 2008 - 2012[35]:

Period	Change in CO_2 Emissions
2008 - 2009	- 8.9%
2009 - 2010	5.1%
2010 - 2011	- 4.4%
2011 - 2012	- 6%

Table 4.7 – Change in U.S Net Electricity Generation, 2008 - 2012[36]:

Period	Change in Net Electricity Generation
2008 - 2009	- 4.1%
2009 - 2010	4.4%
2010 - 2011	- 0.6%
2011 - 2012	- 1.1%

Despite the decrease in economic activity during the financial crisis, reducing overall energy use and thus greenhouse gas emissions, the development of renewable energy did have an impact on reducing emissions. The 2008 – 2012 period witnessed renewable energy use growth from a 3.1% share in 2008 to a 5.4% share in 2012.[37] 2013 data shows renewable energy with a 6.8% share of generation.[38] Table 4.8 illustrates total yearly amounts of renewable energy production from 2008 until 2012 (excluding hydro production).

Table 4.8 – U.S Renewable Energy Totals (Geothermal, Wind, Solar, Biomass), 2008 – 2012[39]:

Year	Total (Trillion Btu)
2008	4,693
2009	4,970
2010	5,543
2011	5,971
2012	6,138

Table 4.9 clarifies growth rates for different renewable energy technologies.

Table 4.9 – Growth Rate in U.S Geothermal, Solar PV, Wind, and Biomass Capacity, 2008 – 2012[40]:

	Geothermal	Solar PV	Wind	Biomass
2008 - 2009	4.2%	10.1%	32.1%	2.2%
2009 - 2010	4%	28.6%	28%	8.5%
2010 - 2011	1.9%	35.7%	26.5%	3.1%
2011 - 2012	7.1%	37.4%	16.5%	- 2.4%

The above data is important as it demonstrates that all types if renewable energy use grew between 2008 and 2009 (with the exception of biomass in one year). These increases have meant that the United States currently has 7700MW of installed soar PV capacity with 3,313 MW being installed in 2012.[41] U.S wind capacity currently has a total installed capacity of 60,007 MW with 13,131 MW of capacity being installed in 2012. [42] Geothermal installed capacity is currently much less than solar PV and wind, with 3,386 MW of capacity in 2013, including 147.05MW developed during 2012.[43]

The data above demonstrates the complex relationship between CO_2 emissions and the electricity sector in the United States. While overall emissions have dropped in the country, the most significant decrease occurred during the economic crisis (between 2008 and 2009, decreasing 8.9%), before increasing again by just over 5% between 2009 and 2010. Nonetheless, the overall trend does show decreasing CO_2 in the U.S from the electricity sector. Between 2009 and 2012, CO_2 emissions from the electricity sector decreased 5.6%.[44] While renewables have influenced these reductions, their growth has been accompanied by a decrease in coal-generated electricity, more related to increased gas generation. Between 2008 and 2012, net electricity generated by coal decreased by 26.6%.[45]

Natural gas generated electricity grew from 883 billion kWh in 2008 to 1.2 trillion kWh in 2012, an increase of 39.4%.[46] During the same time, biomass, geothermal, wind, and solar PV net generation grew from 126 billion kWh in 2008 to 219 billion kWh in 2012, an increase of 73.5%.[47] Yet even though renewable generation has grown extremely fast, it still constitutes a very small portion of total U.S electricity generation. It is clear that while renewable energy did influence CO_2 reductions, the economic downturn and increases in natural gas generation, and decreases in coal generation, have had even larger effects. Table 4.9 summarizes the assessment of clean energy success in terms of U.S criteria.

Table 4.10. Summary of U.S Clean Energy Progress:

Evaluating American Clean Energy Success Using U.S Program Goals		
U.S Defined Energy Goals:	**Policy Background:**	**Summary:**
1. Contribute to Security: clean energy should reduce American dependency on energy imports	2011 Blueprint for a Secure Energy Future, 2013 Blueprint for a Clean and Secure Energy Future, & American Recovery and Reinvestment Act of 2009	• *2012 Electricity Generation Mix:* coal (37%), natural gas (30%), petroleum (<1%), & renewables excluding hydro (6.8% in 2013) • *Import and Export Status:* Coal – exported 116 million short tons (2012) Natural Gas - imported 1,516 billion ft^3 (2012), EIA AEO2013 predicts U.S will become overall net exporter (2020) • U.S clean energy progress has therefore had little impact on security through reducing imports: the majority of electricity generation is fuelled by domestically available coal and natural gas – not petroleum.
2. Create Economic Impact: clean energy should spur job creation and growth	2011 Blueprint for a Secure Energy Future, 2013 Blueprint for a Clean and Secure Energy Future, & American Recovery and Reinvestment Act of 2009	• *General Unemployment Rate:* 2007 (4.6%), 2008 (5.8%), 2009 (9.3%), 2010 (9.6%), 2011 (8.9%), 2012 (8.1%), & 2013 thus far (7.7%) • *ARRA's Clean Energy Job Creation:* energy efficiency (179,000 job years), renewable generation (192,900), & grid modernization (80,600) • *U.S GDP Trends:* 2008 (-0.4%), 2009 (-3.5%), 2010 (3%), & 2011 (1.7%)

		• *Section 1603 Grant Program:* economic output of between \$26 - \$44 billion from 2009 to 2011 - includes \$23 to \$39 billion from wind, and \$1.5 to \$1.8 billion from solar • U.S clean energy investments did create jobs and GDP growth between 2009 and 2012. Yet the impact was very small compared to the overall U.S economy and job markets – debate exists concerning relationship between sustainability and GDP growth
3. Positive Environmental Impact: renewable energy growth & emissions reductions	2011 Blueprint for a Secure Energy Future, 2013 Blueprint for a Clean and Secure Energy Future, & American Recovery and Reinvestment Act of 2009	• *U.S Emissions Trends:* CO_2 emissions from the electricity sector have decreased 5.6% (2009 – 2012) • *U.S Renewable Capacity:* Solar PV (7700MW), Wind (60,007 MW), & Geothermal (3,386 MW) • *U.S Renewable & Natural Gas Trends:* natural gas electricity generation growth of 39.4% (2008 – 2012); biomass, geothermal, wind, and solar PV net electricity generation growth of 73.5% (2008 – 2012) • *Overall Electricity Trends:* net electricity generation growth from 2008 and 2009 (-4.1%), 2009 to 2010 (4.4%), 2010 to 2011 (-0.6%), & 2011 to 2012 (-1.1%) • U.S clean energy investments did lead to renewable growth and emissions reductions – yet this occurred alongside broad reductions in electricity usage and significant increases in natural gas production. The overall impact of clean energy has thus so far remained limited.

Part 2 – Evaluating Barriers to Clean Energy Deployment

It is evident that while clean energy still plays a relatively small role in the U.S electricity system, it has nonetheless helped to create and support American jobs while minimizing CO_2 emissions created by the U.S electricity system. Despite these successes, important barriers to the sectors development continue to exist. This section will use the modified institutional-ideological analytical framework to examine normative, economic, and intuitional barriers that have impacted clean energy progress in the U.S

4.4. Political and Ideological Barriers: politics and “all of the above”

The U.S political system is often described as divided, and while divisive politics is not new, nor exclusively American, many have perceived a deepening of these divisions since 2009. Both the Democratic National Committee (DNC) and the Republican National Committee (RNC) profess support for an ‘all of the above’ energy strategy that includes renewables and conservation, with the RNC arguing for an “approach that encourages the responsible production of nuclear power, clean coal, solar, wind, geothermal, hydropower, as well as drilling for oil and natural gas.”[48] While Barack Obama has obviously supported a similar ‘all of the above’ strategy, GOP politicians have generally been vocal critics of the Obama administration’s approach, especially policies and programs related to the 2009 Recovery Act stimulus spending.

The Republican Party, along with 2009 presidential candidate John McCain, made it very clear during and after the 2008 financial downturn that they did not support significant sections of the Recovery Act, including many of renewable energy and conservation provisions, and instead claimed that much of the bill was unnecessary and wasteful. The ARRA stimulus bill passed the House of Representatives on January 28th 2009 with all House Republicans, and eleven House Democrats, voting against the legislation.[49] The bill passed the Senate February 10th 2009 with all Democrats and only three Republicans voting in favour – one of the three Republicans voting for the ARRA later joined the Democratic Party.[50] It is thus clear that the stimulus related renewable electricity and conservation provisions would not have emerged from a GOP dominated House of Representatives or Senate.

2012 GOP presidential contender Mitt Romney was especially critical of post-2009 clean energy investments, and in the first presidential debate with Obama challenged clean energy funding by stating:

> *"You put $90 billion — like 50 years worth of breaks — into solar and wind, to — to Solyndra and Fisker and Tesla and Ener1. I mean, I — I had a friend who said, you don't just pick the winners and losers; you pick the losers. All right? So — so this is not — this is not the kind of policy you want to have if you want to get America energy-secure."*[51]

Yet despite GOP anger and opposition concerning stimulus related clean energy investments, it would be incorrect to conclude that the GOP has always, and will always, oppose clean energy.

The Energy Policy Act of 2005 significantly expanded the renewable electricity Production Tax Credit (PTC), and created the 'Residential Energy Property Credit' and the 'Residential Energy Efficient Property Credit' (IRC Section 25C and 25D respectively) described earlier. This 2005 legislation passed the House of Representatives with 208 Republicans voting for it and only 22 against, before passing the Senate.[52] [53] The 1703 loan program, designed to provide federal loans to higher risk clean energy projects, was also introduced through the Energy Policy Act of 2005.[54] In a recent interview with the Globe and Mail, Jigar Shah, founder of SunEdison, currently the world's largest solar-power services company, stated that "the people who did lead were George W. Bush and Dick Cheney, and they don't get enough credit for it. They actually wrote a plan in 2001 that included solar and wind, and then in 2005 they passed the tax credit act that actually spurred wind and solar."[55]

Voting records make it clear that a Republican President in 2009 would not have initiated the clean energy spending that occurred post 2009. Current GOP politicians continue to be highly critical of U.S clean energy investments and have moved to block spending plans that would see increased funding go towards renewable energy. Despite this, the GOP has supported clean energy in the past, especially through tax reduction initiatives. In the present however, GOP distrust of clean energy spending means that future federal support for these programs will be difficult to predict with any sort of accuracy. This issue is particularly relevant considering the majority of clean energy programs created in 2005 and funded by the ARRA are due to expire between 2013 and 2016. This uncertainly will therefore challenge clean energy investors looking for long-term stability in the sector, and will continue to be a barrier to future clean energy growth.

4.5. Economic: facing natural gas, deficits & externalities

The continued development of renewable electricity faces serious material barriers including economic and financial uncertainties. Renewable energy and energy conservation options are well known to enjoy low or even zero fuel costs, but these same technologies have high capital costs. These higher capital costs, alongside significant government deficits in the United States and elsewhere, have combined to generate economic obstacles. As developers seek confidence through consistent policy signals from government, governments simultaneously seek to keep costs low, often planning around a four-year election cycle timeframe.

In a 2013 U.S Energy Information Administration (EIA) report examining costs for new electricity generation technologies, the estimated levelized costs were calculated for electricity plants entering service in 2018.[56] [iv]

Table 4.11 – Levelized Cost of generation for plants entering service in 2018[57]:

Technology Type	Levelized Cost ($/MWh)
Solar Thermal	261.5
Offshore Wind	221.5
Solar PV	144.3
Coal & CCS	135.5
Biomass	111.0
Nuclear	108.4
Conventional Coal	100.1
Advanced combined cycle natural gas & CCS	93.4
Large Hydro	90.3
Geothermal	89.6
Onshore Wind	86.6
Advanced combined cycle natural gas	65.6

This data suggests that decision-makers focus on onshore wind, geothermal, and hydro (although large scale hydro deployment still poses significant environmental risks unrelated to CO_2 emissions) when looking to develop more cost effective renewable energy projects. Yet these technologies still cost more than natural gas generation. Considering the cost effectiveness of natural gas (even with CCS technology, gas still remains cheaper than many renewable energy options), it is evident that it will remain a barrier to continued and expanded renewable development – especially as long as governments fail to internalize environmental damages into their long-term costs of generation estimates.

In the case of the United States, disagreements over federal deficit spending and strategies to reduce it have also created uncertainty in the clean energy sector. The

[iv] Levelized cost estimates take into account capital costs, fixed & variable operations and maintenance costs (O&M), transmission costs, financing costs, and capacity factors, assuming a 30-year project lifecycle.

March 2013 budget sequester legislated in the Budget Control Act of 2011, but delayed two months by the American Taxpayer Relief Act of 2012, set out significant spending cuts aimed at programs thought to be critical to both the Republican and Democratic Parties, specifically defense spending and domestic program spending.[58] While it was believed that the threat of these cuts would encourage a bipartisan deficit deal, this was not the case. Critically, the sequester has led to cuts to the Section 1603 grant program that provided grants in lieu of tax credits for specified energy properties related to clean energy. While the Section 1603 program funding has not disappeared for those who applied before the 2012 deadline, grant recipients paid out during the sequester will have their grant amount reduced by 8.7%.[59] This reduction is by no means massive, but it still adds uncertainty for developers of renewable energy and energy conservation projects, especially significant considering the grant is generally utilized by early stage organizations without tax liability.

Serious economic barriers clearly challenge current and future clean energy expansion. While the price of clean energy technology is certainly decreasing with greater utilization, and the economies of scale that accompany it, the fact remains that natural gas will continue to be cheaper at least for the short and medium term. The clean energy cuts accompanying the budget sequester were relatively minor, yet the U.S federal deficit means it is not impossible to imagine future cuts to these programs. It is true that properly comparing the costs of natural gas and renewables requires an examination of all costs and risks, including those associated with emissions and fracking. Yet governments do not currently internalize all environmental costs when making electricity system decisions. Until they do so, significant economic barriers will continue to challenge further implementation of renewable energy and energy conservation and efficiency.

4.6. Institutional: accountability amid decentralization

The United States is fortunate to currently have numerous federal organizations with substantial experience with renewable energy and conservation deployment. As a result, institutional obstacles concerning growth in the clean energy sector will prove less challenging than the political and economic ones described above. Specifically, the Department of Energy's Energy Efficiency and Renewable Energy office (DOE EERE), the Department of the Interior's Bureau of Land Management (DOI BLM), the Department of the Treasury, the Environmental Protection Agency (EPA), the Internal Revenue Service (IRS), and the Federal Energy Regulatory Commission (FERC) have worked separately and in partnership with each other to assist in the implementation of grant and tax programs, research and development, regulation setting, and transmission development. Despite this mostly positive institutional momentum, barriers concerning clean energy continue to exist.

An interesting issue arising out of the residential tax credits extended and expanded in 2009 through stimulus funding was the partial inability of the IRS to adequately ensure fraudulent claims were not made. Both the 'Residential Energy Property Credit' and the 'Residential Energy Efficient Property Credit', focused on energy conservation and efficiency modifications, and small renewable generation respectively, require that the individual claiming the return own and occupy the residence where the upgrades occurred.

Yet a 2011 program audit by the Treasury Inspector General for Tax Administration (TIGTA) determined that 30% of those receiving these returns had no record of owning a home. The audit also found 262 claims made by prisoners, and another 100 claims made by underage individuals.[60] The audit called for the strengthening of IRS protocol surrounding application documentation sent in by proponents, and more thorough examination of the application forms. While the issue of tax fraud is by no means exclusive to clean energy, it does illustrate the challenges associated with using tax instruments to promote diverse clean energy technologies. This significant diversity of technology, combined with the rapid program expansion under ARRA made it difficult for the IRS to accurately access applications. Considering the focus on deficits, and vocal criticisms of clean energy from more conservative branches of the GOP, addressing this institutional weakness will be important.

Dealing with new and diverse clean energy technology, and fast paced implementation, have affected numerous U.S institutions on a broader scale. Implementing complex renewable energy, conservation and efficiency systems requires higher levels of institutional cooperation than is needed for more centralized electricity systems. Specifically, integrating renewable energy on a large scale requires significant innovation concerning utility grid systems and power transmission. These issues generally arise from the intermittent and geographically diverse nature of renewable electricity resources.

Solar PV generation is similar to wind technology in that electricity produced is intermittent – indeed, research done in Arizona has demonstrated that even sunny days can bring 20% differences in solar irradiance over a ten-minute time period.[61] Wind power technology also suffers from intermittency, as well as challenges related to long-distance transmission. Many of the strongest wind resources are located substantial distances away from large cities and other demand centers.[62] The literature suggests that solutions to the issues of intermittency and longer-distance transmission do exist. Rapidly variable fossil fuel generating plants can back-up renewables, wind and solar technologies can be deployed over a greater geographical range, and energy storage and demand management systems can be developed.[63] Yet these solutions have put significant pressure on institutions.

FERC remains responsible for the interstate transmission of oil, natural gas and electricity, and has been required to address barriers related to the deployment of demand response and smart grid infrastructure.[64] In a 2012 report, the FERC reported that the potential peak reduction capacity in the country had increased between 2010 and 2012 from 53,062 to 66,351 MW.[65] Despite this growth in potential, FERC additionally reported that only 31% of these potential peak demands resources were actually utilized in 2012, emphasizing the difficulties with integrating demand response participants within current electricity grids.

FERC has identified key barriers to increased demand response deployment.[66] Firstly, there are few American electricity customers who purchase electricity using time-based rates, providing little incentive to participate in load reduction programs. Secondly, a lack of consistency concerning measurements and verification of demand response programs currently exists among different states and utilities. Thirdly, inconsistency surrounding demand response technology and IT systems again make it difficult for FERC to regulate programs across state and utility jurisdictions. Lastly, issues of customer engagement, and the lack of forecasting and estimation tools act as barriers to demand response program development.[67] Despite these challenges, the United States is again fortunate to have institutions mandated to address these barriers. The Federal Smart Grid Task force for example, created under the Energy Independence and Security Act of 2007, involves eleven federal institutions including the DOE, EERE, FERC, USDA, DOD, and the NOAA.[68] So while institutional barriers do exist, they are not as serious as the political or economic barriers. Instead, U.S institutions will be required take advantage of their relative strength to ensure that political and economic issues are overcome. Table 4.11 summarizes barriers to U.S clean energy development.

Table 4.12. Summary of U.S Clean Energy Barriers:

Evaluating Barriers to Clean Energy Deployment	
U.S Clean Energy Barriers:	**Summary:**
Political and Ideological: party differences and changing GOP attitudes concerning clean energy and roles of the federal government	• Both the Democratic and Republican Parties have called for "all of the above" energy strategies including renewables and conservation - key GOP members have been vocal opponents of clean energy stimulus funding. • *American Recovery and Reinvestment Act of 2009:* passed the House of Representatives with no GOP support, passed the Senate receiving only three GOP votes. • GOP did support the *Energy Policy Act of 2005* creating clean energy tax credits: passed the House of Representatives with 208 GOP votes for, passed Senate with only five GOP votes against. • Clean energy has in the past enjoyed support from both political parties, yet recent GOP opposition to federal level investment has been significant. Future federal clean energy programs thus face significant political barriers and uncertainty.

Economic: cheap, domestic natural gas and external environmental costs	• *2013 U.S Energy Information Administration (EIA) estimated levelized costs:* Offshore wind: $221.5/MWh Solar PV: $144.3/MWh Biomass: $111.0/MWh Nuclear: $108.4 MWh Conventional coal: $100.1 MWh Hydro: $90.3/MWh Geothermal: $89.6/MWh Onshore wind: $86.6/MWh Combined cycle natural gas: $65.6 MWh • Substantial economic barriers thus exist: until environmental costs of electricity generation are internalized, cheap and domestically available natural gas will continue to be a significant barrier to further renewable generation and conservation deployment.
Institutional: adapting to the diverse nature of clean energy technology, and the importance of strong institutions	• *U.S Energy Related Institutions:* Department of Energy (DOE), Energy Efficiency and Renewable Energy office (EERE), Department of the Interior (DOI), Bureau of Land Management (BLM), Department of the Treasury, Environmental Protection Agency (EPA), Internal Revenue Service (IRS), & Federal Energy Regulatory Commission (FERC) • *Fraud Related to Tax Credits (i.e. 'Residential Energy Property Credit' and 'Residential Energy Efficient Property Credit'):* 30% of energy tax credits claimed by those without a home, in addition to claims made by underage and imprisoned Americans. • Nonetheless, U.S institutions related to energy have played a positive role in the implementation of clean energy. Issues have arisen concerning the diverse and decentralized nature of clean energy projects, but strong institutional capabilities involving emissions management and regulation (EPA), grid modernization (FERC), and clean energy generation research and implementation (DOE, EERE, DOI, BLM) continue to aid cleaner energy development in the country.

4.7. Conclusions

The United States has made important gains in achieving their clean energy goals, but it is still too early to see substantial security, economic, and environmental impacts related to the post-2009 clean energy programs. The U.S electricity system is currently dominated by domestically available coal and natural gas, meaning renewable electricity and conservation has not largely impacted U.S energy imports. Clean energy initiatives have led to increases in jobs and GDP, but these impacts have so far been very small. Much more time will be needed to fully access economic impacts from recent clean energy spending. Likewise, it is still too early to fully assess the ecological impacts. Electricity sector CO^2 emissions have decreased, but this was mostly caused by economic slowdowns and the replacement of coal generation with natural gas generation. Renewable electricity still only makes up approximately 6.8% of U.S capacity, and totaled 6,138 billion Btu in 2012.[69]

Meeting U.S energy goal therefore demands further progress and time, yet barriers continue to pose serious challenges. The most substantial barriers are political and economic. While the Republican Party has in the past supported clean energy through tax and grant programs, a new GOP administration would not make federal support for clean energy a priority. This is critically important since so many clean energy programs will need to be renewed or left to expire before 2016. Economic barriers have also proven to be substantial, as the current low-cost of natural gas generation will restrict future clean energy growth. Finally, while institutional barriers to cross-jurisdictional grid development exist, U.S institutions stand in a relatively strong position to deal with these problems. They will also be called upon to navigate the above political and economic barriers.

Chapter 4 Notes

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Chapter 5: Future American Directions & Canadian Implications

The United States has taken meaningful steps since 2009 to increase the production of renewable energy, and to accelerate the implementation of energy conservation and efficiency technology. Despite this progress, clean energy still only accounts for around 6.8% of total electricity generation in the U.S. Including large-scale hydro, this figure rises to approximately 13.9%.[1] Simultaneously, the amount of electricity generated with natural gas continues to grow, and the increases in domestic production suggest that gas prices will remain low for at least the medium term.

Considering the progress so far, and the barriers described in chapter four, it is important to clarify how the future U.S development of clean energy is likely to occur. Finally, as the U.S continues to possess superpower status, it is worthwhile to explore how the country's clean energy developments may affect its trading partners. Since this report is written in Canada, and the U.S remains Canada's largest trading partner, the chapter will specifically examine how renewable energy and energy conservation in American could impact Canada in the short and medium term.

5.1. American Clean Energy in the Medium and Long Term

Research demonstrates significant potential to increase renewable energy capacity in the United States. According to a 2012 NREL report, the U.S could create 100GW of biomass capacity by 2030. Utilizing technology already viable today, the U.S has the potential to develop 36GW of geothermal capacity. The figure could expand to over 500GW through emerging technologies such as engineered hydrothermal reservoirs and co-production from oil and gas wells.[2] Potential hydropower resources in the country are also significant, with the ability to provide an additional 152–228 GW of capacity on top of current hydro generation. Finally, the U.S has potential solar and wind resources that far surpass today's exploitation rates. Utility scale PV and rooftop PV have the ability to generate 80,000GW and 700GW respectively, while wind resources are believed to have a potential capacity of 10,000GW.[3]

Despite possessing these clean energy resources, estimates vary significantly concerning likely renewable production rates over different time-periods. The U.S. Energy Information Administration's Annual Energy Outlook 2013 (AEO2013) predicts that in a business as usual scenario, where current demographic, technological, economic, and legislative trends hold true, renewable energy capacity (including large scale hydro) will grow from 13% of the electricity system in 2011 to 16% in 2040.[4] [i] This 2040 base case scenario assumes that coal generation will be reduced to 35% of total generation as the share of natural gas rises to 30%.[5]

These current EIA predictions, however, demonstrate the close relationship between oil and gas prices, their extraction rates, and the potential future development of renewable electricity. In the EIA 'high oil and gas resource case' where natural gas prices remain lower than in the 'business as usual' reference case, renewable generation grows slowly to only a 14% share by 2040. Likewise, the EIA projections suggest that if a price on carbon was enacted of between \$10 and \$25 per metric tonne in 2014, and then rising 5% yearly, renewable generation would make up between 23% and 31% by 2040.[6] These figures demonstrate the importance of carbon pricing to future clean energy development, and confirm that cheaper natural gas will be a significant barrier to future clean energy deployment.

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[i] 65% of this 2040 total is expected to come from non-hydro renewables.

The NREL has also analyzed scenarios and predicts that in a business-as-usual scenario renewable energy will make up 19.5% of U.S generation in 2050. This estimate assumes the system composition seen in Table 5.1.

Table 5.1. NREL Renewable Energy Projections, business-as-usual, 2050[7]:

Clean Energy Technology	Capacity
Hydro	8.4%
Onshore Wind	6.1%
Geothermal	2.8%
Biomass	1%
Solar PV	0.4%
Offshore Wind	0.3%

Additionally, the NREL has completed scenarios to explore how system composition would be altered if renewables provided between 30% and 90% of total U.S electricity capacity. Onshore wind was determined to play the largest role in high renewable energy scenarios. Concentrated solar generation (CSG) was additionally expected to grow faster than PV technology in these scenarios given its ability to both produce and store energy. Finally, biomass was predicted to contribute substantially, while geothermal and new hydro was expected to play a declining role as renewable utilization climbed towards a theoretical 90% of total U.S capacity.[8]

In addition to clean energy generation, the U.S also possesses significant potential to expand electricity conservation and efficiency over the medium and long term. A 2009 McKinsey & Company report concluded that the United States could reduce annual energy consumption by 23% by 2020 as compared to a business as usual scenario.[9] [ii] With a price of $50.00 per ton of CO_2e, the report found the energy savings potential would increase by 13% over the original 23% figure cited. It is therefore clear that the possibility for future growth in efficiency and conservation is substantial, yet the EIA

[ii] The McKinsey & Company analysis assumed a 7% discount rate and no price on carbon.

AEO2013 report again highlights differences between potential energy conservation, and the actual conservation.

The EIA AEO2013 analysis predicts that electricity use will actually grow between 2011 and 2040, although by a small amount. While electricity use grew an average of 9.8% yearly between the post-war boom of 1949 to 1959, and then by only 0.7% between 2000 and 2010, the report concludes use will grow 0.9% yearly between 2011 and 2040.[10] These two reports again illustrate the importance of both carbon pricing and focused federal investments for future clean energy developments. The McKinsey & Company report concluded that the 23% reduction in overall energy use would require $520 billion in upfront investments, in addition to the cost of supporting programs.[11] Considering the current uncertainly surrounding clean energy programs soon to expire, it is clear that serious challenges to sustainable energy deployment remain.

The 2013 REN21 Renewables Global Futures report discussed the importance of legislative consistency allowing for continued clean energy growth. Confirming the political barriers mentioned in the previous chapter, the report specifically cited concern among decision makers over whether the Investment Tax Credit (ITC) and Production Tax Credit (PTC) will continue to be available over the medium and long-term. While the American Taxpayer Relief Act of 2012 extended the ITC until 2016, the credit may expire after this time.[12] The American Taxpayer Relief Act of 2012 also extended the PTC so that projects 5% completed by December 31 2013 would be eligible. However, the program will expire after this time.[13]

The above data and projects demonstrate that while predicting future electricity generation and use trends is challenging, certain themes stand out. Future U.S deployment of renewable energy will likely depend heavily on the price of natural gas and the ability or willingness of decision-makers to put a price on carbon. These two components are related. Introducing carbon pricing to internalize environmental costs that are currently external could increase the costs of natural gas (and coal) reducing the economic barriers facing renewables and conservation today. Yet despite the importance of pricing carbon and natural gas prices to future clean energy development, Chapter three noted that significant portions of the U.S sustainable energy plan has involved increasing production of natural gas (and nuclear power), while many clean energy programs are due to soon expire. Since both gas and nuclear are expected to grow between now and 2050, it seems unlikely that the economic barriers fuelled by cheap natural gas will be overcome anytime soon. And as discussed below, a federally legislated price in carbon also seems unlikely in toady's political and economic climate.

5.2. Regulating and Pricing Carbon & Implications for Canada

Considering the significant political differences surrounding energy policy it is not surprising that no price on carbon has been implemented at the federal level in the U.S. Nonetheless, legislation has been brought forward in the past to price and regulate both U.S emissions, and emissions associated with products imported into the U.S. The potential re-emergence of such legislation has important implications for both expanded clean energy developments in the United States and relationships with trading partners including Canada.

The Supreme Court of the United States ruled in 2007 that greenhouse gases were air pollutants and needed to be regulated as such by the EPA.[14] While the ruling led to initial speculation that new EPA GHG emissions regulation could help to form an eventual cap-and-trade system, this has yet to occur and seems unlikely any time soon. Starting in July 2011, the EPA has required permitting for newly built facilities emitting over 100,000 tons per year of GHG emissions. Permits were additionally required for modifications to existing facilities that increased their GHG emissions by at least 75,000 tons per year.[15] In June of 2012, the EPA released the next stage of this GHG permitting program, which has continued to utilize these same thresholds.[16] Even though EPA GHG permitting during the construction stage of projects (demanding Best Available Control Technology (BACT) implementation) has been viewed as a positive step towards decreasing GHG emissions, it was never seen as a likely path to emissions pricing or cap-and-trade programs.

Policy observers had instead predicted that the EPA's authority to enforce technology and performance standards through New Source Performance Standards (NSPS) guidelines would be the most effective path to either carbon pricing or cap-and-trade program in the U.S. Section 111 of the Clean Air Act allows the EPA to enact technology-based regulations to stationary and specific sources of pollution.[17] Discussing possible EPA regulations in December of 2010 the Pembina Institute stated, "some form of cap-and-trade proposal is widely seen as the best way forward under the NSPS."[18] In 2012 the EPA released their draft NSPS standards that required all new fossil fuel electricity-generating plants over 25MW to cap emissions at 1000 pounds per MWh, essentially forcing coal powered plants to meet the same emissions standards currently achievable with natural gas combined cycle technology.[19] The NSPS attempted to further encourage CCS implementation by allowing generating facilities to comply with the cap using a 30-year average.[20]

These proposed standards have already generated significant controversy and criticisms, and are currently delayed.[21] Opposition to these EPA standards has also come from within the Democratic Party. A March 13, 2013 letter from Senators Joe Manchin III (D-W.Va.), Mary Landrieu (D-La.), Joe Donnelly (D-Ind.) and Heidi Heitkamp (D-N.D.) to President Obama asked that he reconsider the NSPS standards for new power plants arguing, "such a requirement is unprecedented under the Clean Air Act and will have the unfortunate effect of preventing the construction of new coal plants."[22]

Despite the uncertainty surrounding the NSPS fossil fuel generation standards, their impact on clean energy in the U.S would be significant if approved. The Energy Information Administration's 2013 future electricity price estimates the following in Table 5.2. As new coal plants would meet the NSPS cap through CCS development, opportunities for clean energy programs would obviously be greatly expanded.[iii] The passage of these standards would also have significant trade related impacts for Canada.

Table 5.2. EIA Estimated Renewable Energy Pricing, 2018[23]:

Clean Energy Technology	Price ($/MWh)
Coal with CCS	*135.5*
Solar PV	144.3
Biomass	111.0
Hydro	90.3
Geothermal	89.6
Onshore wind	86.6

The Canadian federal government has frequently asserted its desire to harmonize Canadian GHG regulations with the United States and has moved to adopt a sector-by-sector approach to emissions regulation. The Government of Canada has justified Canada's current GHG reduction target of 17% decreased from 2005 emissions levels by 2020, the same as U.S policy, by stating, "given the highly integrated nature of the North

[iii] Economic barriers associated with natural gas ($65.6 MWh) will continue to persist.

American economy, this includes aligning our climate policies with those of the United States."[24] Considering this push for integration it is not surprising that Canada's sector-by-sector approach to electricity sector regulation is quite similar to the proposed EPA NSPS standards. Canada's federal government first introduced plans for greenhouse gas restrictions on newly constructed electricity generating plants at a press conference in June 2010.[25] [iv] Like the NSPS proposal, these requirements essentially meant that coal-fired plants would need to match the emissions levels of gas-fired facilities, therefore necessitating CCS technology.[26]

While the Pembina Institute argued in 2011 that the Canadian electricity sector regulations would be ineffective, writing "the contribution that the proposed regulations make towards achieving the federal government's target of 90% non-emitting electricity generation by 2020 is minimal," the final regulations published in 2012 were even weaker.[27] [28] [v]

During an April 2010 Senate Committee meeting then Minster of the Environment Jim Prentice again raised the issue of Canada and U.S emissions policy and trade arguing, "it makes no sense for Canadian consumers and businesses to strike out to set and pursue targets that will ultimately create barriers to trade and put us at a competitive disadvantage."[29] While current U.S stalling surrounding new EPA emissions standards likely eliminates risks for Canadian trade implications for the time-being, the relationships between U.S clean energy investment, electricity-sector emissions

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[iv] The standards as originally announced limited coal power plants beginning to operate on or after July 1st 2015 to 375 tones of CO_2 per GWh of electricity produced.

[v] On September 5, 2012 Environment Minister Peter Kent introduced final standards for coal generation plants in Canada by announcing that new-build plants will have emissions capped at 420 tons per GWh coming into effect July 1, 2015.

standards, and trade should be very clear to Canadian decision makers. Stronger GHG caps would help to eliminate the economic barriers associated with accelerated renewables and conservation deployment, while growing clean energy production would in turn allow those caps to be more easily achieved by electricity producers, likely reducing opposition to them over time. Assuming the U.S is able to significantly decrease GHG emissions through NSPS standards and clean energy development, they will find themselves in a much-improved position to enact carbon based trade restrictions through legislation.

This potential for U.S legislation bringing forward GHG-based trade measures was illuminated clearly in both the Energy Independence and Security Act of 2007 (EISA) and 2009 American Clean Energy and Security Act (ACESA). The EISA was signed into law December 19, 2007 and addressed numerous issues including federal vehicle and buildings efficiency standards, alongside new requirements for biofuel additives into transportation fuels.[30] The most controversial component of this President Bush-era legislation, at least from the perspective of Canada, was Section 526 of the Act which stated, "No Federal agency shall enter into a contract for procurement of an alternative or synthetic fuel, including a fuel produced from nonconventional petroleum sources, [unless such fuels] be less than or equal to such emissions from the equivalent conventional fuel produced from conventional petroleum sources."[31] The provision meant that U.S federal intuitions (including branches of the U.S military) could not purchase unconventional transportation fossil fuels if they emitted more GHG's than their conventional alternatives. The provision effectively limited the purchases of fuels derived from coal and shale oil, and importantly for Canada, the oil sands.

The Section 526 provisions have attracted predicable opposition and numerous attempts have been made to repeal this component of the EISA. The most recent push to eliminate 526 came in June 2013 with the introduction of Bill S. 1100, known as the "North American Alternative Fuel Act," drafted with the singular purpose of repealing Section 526 of the EISA.[32] [vi]

Continued U.S clean energy development has important implications for Canada. Even though the U.S electricity sector does not depend on Canada's oil sands (or vice-versa), the initiatives on clean electricity examined in this paper have been introduced alongside pushes for cleaner fuels and better efficiency in the transportation sector (measures that do impact Canada). While Section 526 only impacts U.S federal purchases today, it is possible to imagine how future U.S clean energy advances (electricity or otherwise) could give decision-makers renewed confidence to penalize countries exporting products with a higher carbon content.

The 2009 American Clean Energy and Security Act (ACESA) provides another example of future carbon-based trade restriction that could be enacted by the U.S federal government. The original ACESA bill (that did not pass the Senate) involved not only provisions for a cap and trade system, but also sections forcing energy producers and importers to reduce the GHG emissions intensity of their products to 2005 levels by 2022.[33] While these carbon content provisions were ultimately removed from the ACESA version that passed the House of Representatives, they sent a clear message to

[vi] The proposed bill put forward by Senators John Barrasso (R-Wyo.), Joe Manchin (D-W.Va.), Dan Coats (R-Ind.), Heidi Heitkamp (D-ND), Mike Enzi (R-Wyo.), James N. Inhofe (R-Okla.), and John Hoeven (R-ND) also illuminates bipartisan support for fossil fuel development, especially in fossil fuel rich regions such as West Virginia and North Dakota.

energy exporters in Canada that continued U.S investments in clean energy and GHG control could lead to trade restrictions on high carbon-content products.[34] Canadian politicians did not miss this message. Speaking about the ACESA then Minster of the Environment Jim Prentice agreed that the bill "would have trade-related consequences for Canada if we don't have equivalent environmental legislation in place."[35]

There should thus be little doubt that continued development of renewable energy and energy conservation in the U.S has potentially serious trade implications for Canada. The relationship between U.S sustainable electricity policy and programs, and Canadian energy exports is complex and often indirect. Oil sands products, estimated to bring $2.11 trillion in GPD growth between 2010 and 2035 (76% of this impact in Alberta, 20% in the U.S, and 4% in the rest of Canada) are not directly used in the U.S electricity system.[36] Nonetheless, the U.S has clearly defined sustainable energy to include transportation fuels that include Canadian oil. If American clean electricity developments continue to expand into the medium and long term, the Canadian government should expect this success to reinforce and encourage U.S programs aimed at promoting the more efficient use of liquid fuels, and lower carbon content in them. As both the ACESA and EISA bills demonstrated, this would almost certainly mean trade restrictions on Canadian products not meeting the same regulatory standards demanded of their American counterparts.

5.3. Conclusions

Despite the possibility of these serious repercussions for Canada, it is still not certain that the U.S will continue to aggressively implement clean energy programs. Both NREL and EIA energy projections demonstrated that U.S clean energy use depends greatly on continued legislative support at the federal level, alongside the future prices of natural gas and the internalization of environmental costs. The current delay concerning the introduction of EPA NSPS standards and the inability of U.S policy makers to pass the ACESA cap-and-trade and low carbon content measures show that significant opposition to these measures continues to exist. The upcoming elimination of many programs supported by stimulus also casts doubt that legislative consistency will occur.

Canada, no doubt having noticed this U.S hesitancy, has adopted weak coal generation standards and has no current plans for any kind of carbon pricing or cap-and-trade program.[37] Nonetheless, a future with stricter U.S GHG regulation across all sectors, driven in part by clean electricity development, is by no means impossible. Canada must prepare for this possibility by promoting economic diversification and credible polices to reduce GHG emissions. Unfortunately, this does not appear to be occurring currently.

Chapter 5 Notes

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Chapter 6: Conclusions – Impacts In & Beyond American Borders

There has so far been no energy revolution in the United States. Renewable electricity and energy conservation measures still account for very small portions of the U.S energy mix. More traditional technologies such as nuclear and natural gas continue to expand, with significant policy and financial support from the current U.S administration. Despite all this, important progress has been made.

The 2009 stimulus act created new clean energy initiatives while also expanding policies that had been put in place by previous administrations. These included the Residential Energy Property Tax Credit, the Residential Energy Efficient Property Credit, the Federal Renewable Electricity Production Tax Credit (PTC), the Federal Business Energy Investment Tax Credit (ITC), and the 1603 Specified Energy Property Credit (Appendix 3).

The Department of the Interior and the Bureau of Land Management (BLM) have moved ahead to open large amounts of federal land to renewable energy production. Prior to 2009, the BLM had approved only 556 MW of wind and 0 MW of solar production on its land. Since 2009, they have approved 4063 MW of wind and 7566 MW of solar generation on federal lands (Table 3.1). Yet despite this progress, U.S clean energy objectives have not yet been met. As domestically available coal and natural gas continue to dominate the fossil fuel component of the U.S electricity system, it is unlikely that current or future clean energy developments will reduce U.S fossil fuel imports, despite energy security being a central objective.

The ARRA stimulus funding created over 400,000 job years in the renewable energy, energy efficiency, and grid modernization industries, yet the long-term impact on employment remains uncertain as stimulus funded clean energy programs begin to expire (Table 4.9). The environmental impacts of U.S clean energy development have been important, but again, long-term impacts are uncertain. The share of renewable energy production in the U.S electricity system rose from 3.1% in 2008 to 6.8% in 2013.[1] Total production of renewable energy in the country has increased from 4,693 trillion Btu in 2008 to 6,138 trillion Btu in 2012 (geothermal, solar, wind, biomass) (Table 4.8). Between 2009 and 2012, overall CO_2 emissions from the U.S electricity sector dropped by 5.6% (Table 4.6). Yet continued and long-term commitments to clean energy will need to occur for more significant environmental benefits to emerge. This is especially apparent considering the significant potential for U.S clean energy outlined above.

Significant barriers will need to be overcome before clean energy can break through its current 6.8% share of U.S generation. Political barriers exist along party lines, but they also transcend them. So far, politicians from both parties representing coal-producing states have found it impossible to support legislation that would restrict coal generation facility emissions, including the proposed EPA NSPS standards. Political differences also make it uncertain whether critical programs supported through stimulus funding will continue to exist after their current 2016 deadlines.

Important economic barriers to cleaner electricity also exist. If electricity produced from renewables remains more costly than other fossil fuels, broad implementation will be extremely difficult, especially without the consideration of environmental externalities. Even if the updated NSPS standards are eventually adopted forcing coal facilities to implement CCS technology, this will do little to mitigate the impact of cheap, domestically available natural gas supported through increased production on federal land and hydraulic fracturing technology.

The relationship between clean energy expansion and natural gas illuminates an interesting contradiction in U.S sustainable energy policy. While the country has spent close to $90 billion to deploy more renewable and conservation technologies, they have at the same time moved to significantly increase domestic natural gas production, leading to its low price. Ultimately then, the U.S must refocus, or at least better define, their sustainable energy objectives. If the U.S favours cheaper electricity production in the short and medium term, then natural gas can likely meet these goals. But if the U.S favours ecological health and regeneration, and the reduction of the economic risks associated with climate change, natural gas extraction and nuclear, then renewables and conservation should be the favoured method of production.

Canadians should pay close attention while the United States grapples with questions of how exactly sustainable energy should be understood and developed. As this analysis demonstrated, U.S clean energy programs could have important trade implications for Canada, seen clearly in both the Energy Independence and Security Act of 2007 and the 2009 American Clean Energy and Security Act. While current delays in the United States surrounding GHG related legislation seem to have assured Canadian decision makers that trade restriction are unlikely, they should be more cautious.

As the U.S economy continues to recover from the 2008 downturn, citizens may become more accepting of new legislation aimed at protecting the environment. Perhaps the biggest barrier currently to more renewables and conservation, cheap natural gas, is also by no means guaranteed over the medium and long-term. A recent article in the Globe and Mail for example, highlighted the growing competition for water between fracking operations and agriculture in the U.S.[2] The Pembina Institute noted in a recent briefing that U.S clean energy developments go well beyond the electricity sector. Reinforcing the fact that clean electricity progress will come side-by-side with broader GHG restrictions, the note stated "such a move [increased U.S clean energy progress] would not only make projects like Keystone XL highly unlikely, it would increase pressure on Canada to re-position itself as a supplier of clean energy."[3] It is not at all clear that Canada is ready for such a re-position.

The U.S has made important progress towards generating cleaner electricity. But if it hopes to create a true energy revolution, it is time to define in much more detail what sustainable energy actually is. If the country decides to prioritize reducing economic risks associated with climate change and other ecological impacts, the future for renewables remains bright. If American citizens instead choose to focus on maximizing GDP growth over shorter time-scales, then renewable energy and energy conservation will likely continue to play a secondary role providing electricity.

Chapter 6 Notes

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Appendix.

Appendix 1. Recovery Act Spending Categories:

American Recovery and Reinvestment Act of 2009 (ARRA)		
Tax Benefit Programs ($290.7B):		
Energy Incentives:	Residential Energy Credit	$11 billion
	Residential Credit for Alternative Energy	$602 million
	Credits for Electricity Produced from Renewable Resources	$647 million
	Business Credits for Renewable Energy Properties	$144 million
	Electric Vehicles Tax Credit	$115 million
Manufacturing & Economic Recovery, Infrastructure Refinancing, Other:	Advanced Energy Facilities Credit	$1.4 billion
Grants, Contracts and Loans ($250B total):		
Energy and the Environment:	DOE's Energy Efficiency and Renewable Energy (EERE) office	$15 billion
	Title 17 Innovative Technology Loan Guarantee Program	$1.2 billion
	DOE's Energy Transformation Acceleration Fund	$317 million
	Department of Housing and Urban Development's Green Retrofit Program	$171 million in grants & $68 million in loans
Infrastructure:	GSA Federal Buildings Fund Program	$4.7 billion
Entitlement Programs ($247.5B)	Grants for 'Specified Energy Property, 1603'	$18.2 billion

Appendix 2. ERRE Allocation of Recovery Act Funding:

American Recovery and Reinvestment Act of 2009 (ARRA) - Energy Efficiency and Renewable Energy (EERE) office[1]		
Project Categories:		
Building Technologies:	High-Efficiency Solid-State Lighting Development and Manufacturing	$46.2 million
	Advanced Energy-Efficient Building Technologies and Commercial Building Training Programs	$74.64 million
Industrial Technologies:	Information and Communications Technology (Data Centers)	$47.02 million
	Industrial Energy Efficiency Projects	$160.1 million
Federal Energy Management:	Federal Energy Management Program	$21.73 million
State and Local Energy Programs:	Energy Efficiency and Conservation Block Grants	$2.8 billion
	State Energy Program	$3.1 billion
	Betterbuildings	$452.04 million
Weatherization Assistance:	Weatherization Assistance Program	$4.98 billion
Vehicle Technologies:	Heavy-Duty Truck and Passenger Vehicle Efficiency	$106.06 million
	Alternative Fueled Vehicles Pilot Grant Program (Clean Cities)	$298.5 million
	Advanced Battery and Electric Drive Component Manufacturing Grants	$1.99 billion
	Transportation Electrification Projects	$386.23 million
Other Projects:	Small Business Clean Energy Innovation Projects	$20.3 million
Crosscutting Energy Projects:	Community Renewable Energy Deployment	$21.23 million
Biomass:	Advanced Biofuels Research and Fueling Infrastructure	$106.89 million
	Advanced Biorefinery Projects	$591.14 million
Geothermal Technologies:	Geothermal Energy Projects	$368.24 million
Fuel Cells:	Fuel Cell Market Transformation	$41.55 million

Solar Energy:	Concentrating Solar Power	$24.13 million
	High-Penetration Solar Deployment	$42.05 million
	Photovoltaic Systems Development	$50.67 million
Water Power:	Hydropower Infrastructure	$30.63 million
Wind Energy:	Wind Turbine Design Facility	$44.56 million
	University Wind Energy Research Facilities	$22.98 million
	Wind Technology Development (28 projects)	$16.2 million
	Massachusetts Wind Blade Testing Center	$24.75 million
	NREL National Wind Technology Center	$16.2 million

Appendix 3. Summary and Details of Key U.S Clean Energy Legislation, 1976- 2016:

Time Frame	U.S Clean Energy Legislation & Programs
1976 - 2000	**1. 1976:** • Department of Energy enacts **Weatherization Assistance Program (WAP)** to provide energy efficiency enhancements to the homes of low-income Americans. [2]
	2. Energy Policy Act of 1992: • Introduces **Federal Renewable Electricity Production Tax Credit' (PTC).** [3]
2001 – 2010	**1. Energy Policy Act of 2005:** • **Residential Energy Property Credit, Section 25C:** The 2005 legislation allows homeowners to claim 10% of the project costs undertaken, with yearly claims capped at \$50.00 to \$300.00 depending on the technology used – for example, a \$200.00 maximum for windows and a \$300.00 cap for electric or geothermal heat pumps. [4] • **Residential Energy Efficient Property Credit, Section 25D:** offers tax credits of up to 30%, with a \$2000.00 cap for solar photovoltaic installations and the same \$2000.00 cap for solar water heating. [5]
	2. Energy Independence and Security Act of 2007: • **Energy Efficiency and Conservation Block Grant Program:** The 2007 legislation created this program to give broad clean energy grants to cities, counties, states, and Indian Tribes. [6]
	3. Emergency Economic Stabilization Act of 2008: • Extends **Residential Energy Property Credit, Section 25C** for 2008 & 2009. [7] • Expands **Residential Energy Efficient Property Credit, Section 25D:** added small wind capacity and geothermal heat pumps with a \$4000.00 cap for wind energy and a \$2000.00 cap for geothermal projects. Eliminates credit cap for solar photovoltaic projects. [8]

	4. American Recovery and Reinvestment Act of 2009: • Increases **Weatherization Assistance Program** maximum per-household benefit from $2500.00 to $6500.00, and increases qualifying income level. [9] • Expands **Residential Energy Property Credit, Section 25C** program for 2009 and 2010 - Removes the technology-specific credit caps previously utilized; specifically, the $200.00 cap for window upgrades was removed for the 2009 and 2010 tax years.[10] • Expands **Residential Energy Efficient Property Credit, Section 25D** *to* include small wind generation, geothermal, and solar water heating, and eliminates credit caps for remaining technologies - small wind generation, geothermal, and solar water heating.[11] Solar photovoltaic & fuel cell credits - equipment must be installed on the property owner's principle residence between 2006 – 2016. Small wind & geothermal credits - equipment must be installed between 2008 – 2016, equipment does not need to be on the owner's principal residence.[12] • Expands **Federal Renewable Electricity Production Tax Credit' (PTC)** deadline to allow projects under construction by December 31st 2013 to remain eligible. Tax credit provides 2.3¢/kWh for wind, geothermal, and biomass, and 1.1¢/kWh for landfill gas, municipal solid waste, small hydro, and tidal projects greater than 150kW.[13] • Expands **Federal Business Energy Investment Tax Credit' (ITC)** to allow PTC eligible projects to instead claim the ITC. [14] Solar and fuel cells remain eligible for tax credits of 30% of total project expenditures with no limit on solar claims, and a $1,500 per 0.5 kW of capacity limitation on fuel cell developments. Small wind turbines (up to 100 kW) also receive this 30% credit - these projects were originally subject to a $4000.00 cap, the ARRA removes this cap.[15] Both geothermal and microturbine systems are eligible for tax returns of 10% of total project expenditures, with no credit limit for geothermal systems. Microturbine systems (required to be smaller than 2MW) have a credit limit capped at $200 per kW of capacity. Program provides a 10% credit for combined heat and power (CHP) systems with no credit limitation for these developments. To qualify for the ITC, CHP systems cannot be larger than 50MW and must be at least 60% efficient.[16] • Creates **Advanced Energy Facilities Credit, Section 48C:** Property eligibility guidelines – can be 1) purchased primarily for energy production from renewable resources (solar, wind, geothermal and others), 2) used to manufacture fuel cells, microturbines, electric and hybrid car batteries, and components of smart grids, 3) used to capture and store CO_2 emissions, or 4) used in relation to the creation of biofuels.

	Legislation broadly allows "other advanced energy property designed to reduce greenhouse gas emissions as may be determined by the Secretary" to receive the credit.[17] • Creates **1705 Loan program:** provides grants to renewable electricity, electricity transmission, and biofuels projects.[18] • Creates **1603 specified energy property credit:** The U.S treasury began accepting applications for completed projects in 2009 and the final deadline for projects was October 1st 2012. Applying projects needed to have begun construction in 2009, 2010 or 2011.[19] Specified energy properties needed to be tangible and capable of allowing depreciation and amortization, although buildings did not count as energy property.[20] In practice, the same technology that qualified for the 10 -30% ITC tax credit remained eligible for the 1603 grant. Solar, fuel cells, and small wind turbines (up to 100 kW) were able to receive 30%, while geothermal, microturbines, and combined heat and power (CHP) were qualified to receive grants up to 10% of the total project cost.[21]
2011 – 2016	**1. September 30th 2011:** • **1705 Loan program** expires.[22]
	2. American Taxpayer Relief Act of 2012: • **Residential Energy Property Credit, Section 25C** extended until December 31st 2013.[23] • Redefines December 31st 2013 **Federal Renewable Electricity Production Tax Credit' (PTC)** deadline so projects only need to be 5% completed by the deadline. Extends the option to claim the ITC instead of the PTC until 2013.[24]
	3. October 1st 2012: • **1603 specified energy property credit** deadline.[25]
	4. December 31st 2013: • **Residential Energy Property Credit, section 25C** set to expire.[26] • **Federal Renewable Electricity Production Tax Credit' (PTC)** set to expire.[27]
	5. December 31st 2016: • **Residential Energy Efficient Property Credit, Section 25D** set to expire.[28] • **Federal Business Energy Investment Tax Credit' (ITC)** set to expire.[29]

Appendix 4-A. Select U.S Department of the Interior & Bureau of Land Management Solar Approvals (located on BLM land)[30]:

Project Name	Capacity (MW)	Operational Date
Genesis Solar Energy Project	250	March 2014
Silver State Solar Energy Project (North)	50	May 2012
Abengoa Mojave Solar	250	2014
Desert Sunlight Solar Farm	550	November 2014
McCoy Solar Project	750	2014
Quartzsite Solar	100	2015

Appendix 4-B. Select U.S Department of the Interior & Bureau of Land Management Wind Approvals (located on BLM land) [31]:

Project Name	Capacity (MW)	Operational Date
West Butte Wind	104	2014
Tule Wind	186	December 2013
Echanis Wind	104	December 2013
Chokecherry and Sierra Madre Wind Energy Project	3000	2014
Searchlight Wind	200	2014
Lime Wind Energy development	4	November 2011
Spring Valley Wind	150	June 2012
Ocotillo Express Wind Energy Facility	315	December 2012

Appendix 4-C. Select U.S Department of the Interior & Bureau of Land Management Geothermal Approvals (located on BLM land) [32]:

Project Name	Capacity (MW)	Operational Date
Salt Wells Project	18	In operation (date unspecified)
Blue Mountain Development	49	In operation (date unspecified)
Jersey Valley Project	30	In operation (date unspecified)
Hot Sulfur Springs Project	15	In operation (date unspecified)
McGinness Hills Development	90	June 2012

Appendix Notes

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