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New York State's Zero Emission Credits: Exploring the Drivers and Significance of Nuclear Energy Subsidization in the Empire State

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by

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Abstract

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This thesis reviews New York State's recently announced subsidization of nuclear energy, which has been a subject of dissent due to its cost, propagation of nuclear activity, and potential unlawfulness in its influence on competition within wholesale energy markets. Examining the structure and recent trends within New York's energy market and their effect on the state's nuclear energy industry will provide insight into the necessity of such subsidization in preserving in-state nuclear generation.

Through an analysis of the expected costs, economic impact, and influence on statewide carbon emissions, the true significance of this legislation and New York's motivations behind its implementation can be realized. Additionally, an exploration of the subsidy's regulatory framework and the findings of applicable court cases will provide insight into the legal debate surrounding the legislation, allowing for an analysis of its legality and its potential significance to future state energy policies and the wider nuclear energy industry.

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I would like to recognize the guidance and support of Professor J. Douglass Klein. The insights and advice provided by Professor Klein throughout this endeavor were essential to its completion. I would also like to thank him for fostering my interest in the field of energy from New York to New Zealand. It has been an absolute pleasure working with him and I wish him all the best.

Chapter One

Introduction

In the United States, nuclear technology has been the subject of an ongoing debate relating to its utilization as an electricity generating resource. In recent years, increased concerns over energy security and climate change have caused many people to reconsider the merits and drawbacks of further involving nuclear generation in the energy mix. As these issues become increasingly prominent in energy policies at both national and state levels, the debate over nuclear energy has intensified as policymakers struggle to determine where the resource should fit in our rapidly transforming energy landscape. In the summer of 2016, New York State addressed these issues through passing the Clean Energy Standard. This order mandates aggressive reductions in greenhouse gas emissions from electricity generating resources and controversially subsidizes nuclear energy by requiring all generators to purchase "zero emission credits" from nuclear generators, citing them as necessary to meeting future energy and emissions demands.

By providing a detailed evaluation of its causes and effects, this paper will assess the appropriateness and justifiability of New York's nuclear energy subsidization. In addition, it will describe the performance and regulatory treatment of nuclear energy on the federal, state, and international levels to place this statute into the wider context of nuclear energy policy. Furthermore, investigation into the legal dissent surrounding the subsidization will determine if the actions of New

York State set a precedent for other states to preserve and promote nuclear energy resources and general emissions reduction strategies. Ultimately, examining such topics will draw out the strengths and shortfalls of the order, as well as highlight its larger significance to energy policy and the nuclear energy industry in the United States.

The remainder of this thesis is organized as follows. The following chapter serves to outline the goals, statutes, and working parts of New York State's newly enacted Clean Energy Standard as well as the wider Reforming the Energy Vision initiative that it is a component of. The Clean Energy Standard stands to heavily impact the state's nuclear energy generation industry, and clarifying each of its components will help to illustrate the mechanisms by which the regulation will do so. To place New York State's treatment of nuclear energy in a broader context, this chapter will recount the history of federal regulation and market performance of nuclear energy in the United States, as well as provide examples of nuclear energy policies in individual states and other nations. This will place New York's Clean Energy Standard within the wider regulatory and market landscape in which it stands and will serve to both highlight the significance of the legislation and explain the basis of controversy behind its treatment of nuclear energy.

The third chapter will serve to explain the basis of New York's nuclear subsidization by discussing current trends in the state's energy market and their effect on the nuclear industry. This discussion will provide an overview of energy market structure to help explain how these trends are altering the state's energy market. Additionally, it will explore how the subsidization of New York's nuclear facilities stands to impact the state, utilizing projections of how their closure would have on its economy, emissions targets, and energy system. Such analysis will reveal the reasoning and merit behind New York's subsidy program. This chapter will also give a detailed review of the framework by which subsidy prices are set in order to show how the program stands to financially impact nuclear facilities.

Chapter four will discuss the ongoing legal dissent surrounding the subsidy program, paying particular attention to its legality in respect to state and federal jurisdiction over energy markets. This discussion will include an examination of a prior court case concerning this matter to explain the legal context of this dissent and how it will influence its outcome. With this context in mind, this chapter will provide an analysis of the legality of New York's actions and its potential implications for future state-level energy policies. In addition, it will examine how New York's program has already begun to influence other states in their efforts to protect their nuclear assets amid changing energy market conditions.

Chapter Two

The Clean Energy Standard and Wider State of Nuclear Affairs

2.1 Summary

This following chapter will provide an overview of New York's various initiatives and statues that have formed and later mandated statewide goals in emissions reductions. This will show how the subsidization of nuclear energy is incorporated into such regulation, and explain what entities and rules are involved in such a program. Additionally, this chapter will seek to place New York's nuclear subsidization in the wider context of nuclear energy policy. This discussion will include a historical recount of federal policy and market performance of nuclear energy in the United States, as well as an overview of current state regulations and overall stances on nuclear energy. To display how treatment and utilization of nuclear energy in the United States fits within the wider international community, the chapter will conclude by exploring foreign nations that are major generators of nuclear power, namely France, China, and Russia, and how their actions and experiences can inform American energy policy.

2.2 New York State's Reforming the Energy Vision & Clean Energy Standard

On April 24, 2014, Governor Andrew Cuomo announced plans for an energy modernization initiative to restructure energy markets and fundamentally shift utility regulation in the state of New York (NYDPS, 2016). Dubbed Reforming the Energy Vision (REV), this comprehensive initiative aims to align the market and regulatory landscape with a set of New York state policy objectives, including increasing ratepayer knowledge of demand-side energy management, market animation and leverage of ratepayer contributions, fuel and resource diversity, and system-wide efficiency, reliability, and resilience. In addition, REV aims to modernize the power grid to take full advantage of advances in clean energy and energy efficiency technologies and to transform the market to allow these technologies to flourish. This effort is highlighted by REV's State Energy Plan (SEP), which sets bold targets of a statewide forty percent reduction in greenhouse gas emissions from 1990 levels by 2030 and an eighty percent reduction by 2050. In addition, it calls for fifty percent of energy consumed in New York State to come from renewable resources and for a twenty-three percent reduction in energy consumption in buildings, which is equal to six hundred trillion British thermal units in energy efficiency gains, by 2030. The aggressive transformative goals of REV have made New York a national leader in state energy reform, and if successfully implemented could radically alter the way in which energy is viewed both within and well beyond state borders.

The strikingly lofty goals of REV were given legs to stand on with the passing of the Order Adopting a Clean Energy Standard (CES). Under instruction from Governor Cuomo and the New York Public Service Commission (NYPSC) to convert the SEP targets into mandated requirements, the New York Department of Public Service (NYDPS) developed a white paper on CES and issued it in January 2016 for consideration at the NYPSC session in June 2016. With its adoption on August 1, 2016, the CES works toward the policy objectives of increasing the supply of renewable electricity, supporting the construction of in-state renewable generation facilities, preventing premature closure of upstate nuclear facilities, and promoting the progress of REV market objectives. Additionally, the CES establishes a Renewable Energy Standard (RES), which mandates the prior SEP goal of reaching fifty percent of New York's electric load to be generated by renewable sources by 2030, also known as the "50 by 30" goal. Along with mandating "50 by 30", the CES outlines the way that New York State will achieve the goal, which will be done through the implementation of annual renewable targets for each load-serving entity (LSE) operating within the state.

2.2.1 Load-Serving Entities

Before going into the specifics of the annual renewable targets, it would be helpful to first provide a definition of LSEs, as they are the organizations being charged with reaching these targets. Under the CES Order, LSEs are defined as "all entities serving retail load within a regulated utility territory… This includes investor-owned distribution utilities, energy service companies (ESCO), Community Choice Aggregation programs (CCA) not served by ESCOs, and jurisdictional municipal utilities. Retail customers self-supplying through the New York Independent System Operator will also be considered LSEs for this purpose" (NYPSC, 2016). Utilities are entities that have the responsibility of providing essential public services, such as electricity, natural gas, and water, along with necessary infrastructure needed to provide those commodities. An ESCO is a commercial or non-profit business that provides a broad range of energy solutions related to increased efficiency and conservation of energy. A CCA is a system that allows cities and counties to pool their electricity load in order to secure alternative energy supply contracts or develop power on their own behalf, and are only found in a handful of states including New York.

2.2.2 Renewable Energy Credits and Zero Emission Credits

Through the RES, renewable targets will be met by requiring LSEs to procure a minimum percentage of their total load served in a calendar year from renewable energy resources. These minimum percentages are specified for the years 2017 through 2021 (0.6%, 1.1%, 2.0%, 3.4%, 4.8%), and are to be incrementally adopted from 2022 to 2030. The procurement of load from qualifying renewable resources will be evidenced by acquiring Renewable Energy Credits (REC). A REC represents and is created for each renewable MWh generated, and may be purchased by an LSE to demonstrate compliance at the price of $21.16 per MWh. An LSE that fails to procure its obliged portion of RECs will be charged with an Alternative Compliance Payment (ACP), which will be equal to the published cost of an REC plus ten percent.

Along with RECs, the CES establishes Zero Emission Credits (ZEC), which, like RECs, must be procured in a minimum percentage of total load served annually by each LSE. Also similar to RECs, a ZEC is created for each MWh of nuclear electricity generated. The initial price of ZECs was set at $17.48 per MWh for the first two years of the program, and will be readjusted every two-year period during its duration. While RECs are mandated for the ultimate purpose of reaching the SEP's renewable energy targets, ZECs are meant to support the SEP's aggressive greenhouse gas emissions reduction goals by serving the dual purpose of awarding existing nuclear facilities for their zero emission attributes and monetarily assisting these facilities, which have been struggling recently due to historically low energy prices. Due to the fact that the six nuclear power facilities in New York State provide 31.6% of the state's electric generation and produce zero emission, base load electricity, the state's nuclear generation is seen as a vital resource to reaching the SEP emission goals (Figure 1). Overall, the mandates installed by the CES make the aspirations of the SEP a calculable possibility, and is a linchpin of the REV initiative as a whole.

The New York State Energy Research and Development Authority (NYSERDA) will act as the central administrative entity for RECs and ZECs, making it responsible for the valuation, procurement, and monitoring of credits. The specific pricing methodology behind ZECs, and their wider impact on nuclear facilities, will be discussed in Chapter 3. To track, verify, and transfer ownership of credits to LSEs, NYSERDA will use the New York Generation Attribute Tracking System, or NYGATS, which is an online system that manages credit sales and trading.

Figure 1: New York Electricity Generation Fuel Mix, 2014

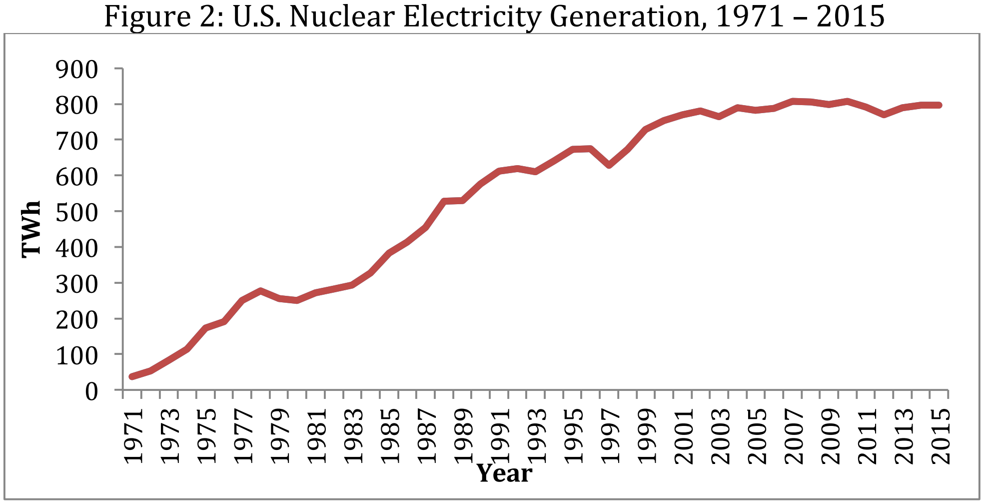
Source	**Percentage**
Natural Gas	39.6
Nuclear	31.6
Hydroelectric	18.4
Renewable & Other	5.5
Coal	3.4
Oil	1.6

Source: Nuclear Energy Institute, 2014

2.3 A History of Nuclear Energy Market Performance and Federal Policy in the United States

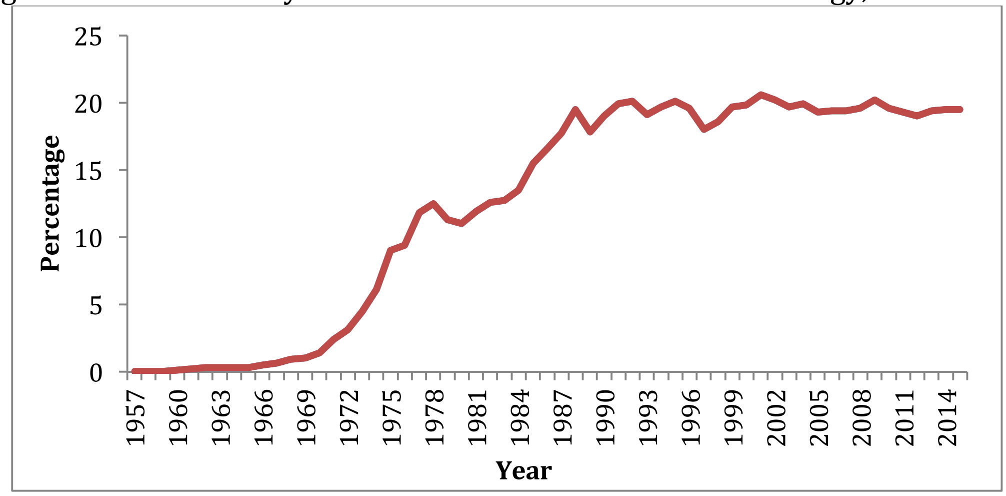
Nuclear energy has seen sporadic fits of federal support and development since its genesis (Figures 2 & 3). In the wake of World War II and the Manhattan Project, the rapid technological advancement of nuclear technology under the United States government brought to light the considerable potential for nuclear power to generate electricity. Hoping to explore this opportunity and stay ahead of other nations in nuclear capability, Congress quickly passed the Atomic Energy Act of 1946. This act placed the national nuclear energy program under the control of the United States military and established the Atomic Energy Commission to oversee the development of nuclear science and technology. Less than a decade later, this act was amended with the passing of the Atomic Energy Act of 1954. This act allowed for increased involvement of the private sector in nuclear energy production by allowing for the dissemination of previously classified information on nuclear technology to private entities. It also legalized private investment in

Figure 2: U.S. Nuclear Electricity Generation, 1971 – 2015



Source: Nuclear Energy Institute, 2016C

Figure 3: U.S. Electricity Generation Fuel Share of Nuclear Energy, 1957 – 2015



Source: Nuclear Energy Institute, 2016C

commercial nuclear development and the patenting of nuclear technologies. This significantly increased the likelihood of a commercial nuclear energy market, and it was famously proclaimed that the act would make it so that "electricity generated by nuclear power would be 'too cheap to meter'" (Volpe, 2015).

Initially, exposure to liabilities related to nuclear energy posed as a strong deterrent to private investment in commercial nuclear development. To remove this barrier, Congress signed into law the Price-Anderson Act of 1957, which granted limited liability to utility providers in the event of a nuclear catastrophe. The result of this act was an explosion in development of nuclear facilities, dubbed the "Great Band Wagon Market" (US Power, World Nuclear Association, 2016). By the end of 1967, the United States nuclear industry went from just a handful of power plants that all received subsidies from the Atomic Energy Commission to seventy-five unsubsidized plants either in operation or in various stages of development (Adams, 2000; Figure 2).

However, the Great Band Wagon Market slowed down considerably in the 1970s due to a number of factors. Most notably was the infamous Three Mile Island accident in 1979, which caused many to be skeptical of the safety and stability of nuclear technology. The timing of the accident was particularly unfortunate for the nuclear industry as it came shortly after the rise of the environmental movement, which was highlighted by the passing of the National Environmental Policy Act in 1969 and the founding of the Environmental Protection Agency (EPA) in 1970. The actual real damage caused by Three Mile Island was economic, due to astronomical cleanup and decommissioning costs and the subsequent loss of revenue and jobs. Despite the negligible dose of radiation released due to the incident, which was comparable to about one sixth of the radiation experienced from a chest x-ray, "anti-nuclear environmentalists used this opportunity to mislead the world about the impacts of radiation on human health" (U.S. NRC, 2014; Walden, 2013). While anti-nuclear environmentalism was already strong at the time, the accident provided this faction with a reason to further substantiate their message.

In response to public safety concerns even prior to Three Mile Island, increased government oversight and regulation was brought to the nuclear industry (US Power, World Nuclear Association, 2016). Such regulations took form through the Energy Reorganization Act of 1974, which established the Nuclear Regulatory Commission (NRC). After its founding, the Nuclear Regulatory Commission "made an effort to be an aggressive a foresighted regulator" (Rosenbaum, 2002). It implemented a slew of additional regulations on nuclear generation facilities, such as design and equipment requirements, increased surveillance and staff training measures, and the establishing of a policing group to enforce these mandates called the Institute of Nuclear Power Operations, among others (U.S. NRC, 2014). Such broad and robust regulations placed increased strain on the already withering industry. Due to environmentalist fear mongering, the economic blow of the Three Mile Island accident spread from that sole facility to the entire national industry. The resultant skepticism and public backlash against nuclear technology was enough to cancel or suspend numerous nuclear projects (US Power, World Nuclear Association, 2016).

Another occurrence that made the rising skepticism over the safety of nuclear generation particularly untimely was the OPEC Oil Embargo in 1973. While this period of plummeting imports of foreign oil and soaring oil prices had the potential to highlight the capability of nuclear technology as an energy resource, nuclear development remained stagnant in the face of intense public opposition. The resultant energy shortage in the United States can therefore be partially attributed to societal adversity to nuclear energy, as increased nuclear generation at this time could have partially abated the impacts of the oil crisis. Thus, in a way that is somewhat ironic, the American public traded a misguided sense of safety for tangible economic downturn. Public feelings against nuclear generation carried through the end of the century, sustained largely in part by the nuclear accident in Chernobyl in 1986 as well as psychological tensions over nuclear technology resultant of the Cold War. During this period, there was a near halt in construction of new nuclear facilities, while electrical output from existing facilities increased due to improved capacity and load factors (US Power, World Nuclear Association, 2016; Figure 1).

After a thirty-year "dark age" in nuclear power plant construction, interest in new development returned in response to the passing of the Energy Policy Act of 2005. This act provided tax credit incentives to nuclear generation facilities through an addition to the Internal Revenue Code titled "The Credit for Production from Advanced Nuclear Power", which gives a tax credit of up to 2.1 cents per kWh for the first six thousand kWh in the first eight years of operation for new nuclear facilities (US Policy, World Nuclear Association, 2016). It also provided federal loan guarantees for nuclear facilities through the Department of Energy (DOE) through a program titled "Incentives for Innovative Technologies". In this program, the DOE would take over a generation facility and assume all financial responsibilities if the owner defaults on previously approved loans. Additionally, the act expanded the risk assurance for nuclear facility owners under the Price-Anderson Act by establishing a pooled insurance fund. Under this policy, facility owners are required to carry a minimum amount of insurance and contribute to the pooled fund. In return, the fund will cover all damage costs in the event of a nuclear disaster at a participant facility. Due to the favorable conditions established by the Energy Policy Act of 2005, the nuclear generation industry saw a strong resurgence, with sixteen applications for new facilities filed to the NRC between 2005 and 2008 (Volpe, 2015; US Policy, World Nuclear Association, 2016).

While federal policy has been successful in addressing many concerns relating to the nuclear industry, it has yet to solve the problems surrounding nuclear waste disposal and storage. As of 2011, the United States had sixty-five thousand metric tons of spent nuclear fuel, an amount that is expected to double by 2055, yet remains without a permanent site to store it all (Northey, 2011). This issue continues to plague the industry, as determining "where, and how, to dispose of the enormous, highly toxic, and mounting volume of nuclear wastes in the United States… has been especially difficult to solve because reactor wastes incite great public fear and chronic conflict among federal, state, and local officials concerning where to put them" (Rosenbaum, 2002).

A federal attempt at solving this problem begun in 1982 through the passing of the Nuclear Waste Policy Act, which made the DOE responsible for selecting, through the creation of a "meticulously detailed, impartial, and open process", a list of potential repository sites to be later chosen from (Rosenbaum, 2002). In December 1987, through this act, Congress selected Yucca Mountain, Nevada to be the nation's first permanent nuclear waste repository (Rosenbaum, 2002). However, the project was continuously delayed due to severe political backlash, where "Nevada continued to resist development of the Yucca Mountain facility with every political resource it had available", along with technical quality and safety issues surrounding the its development (Rosenbaum, 2002). In 2010, the DOE terminated the project, which remained incomplete after accumulating over twelve billion dollars in project costs (Northey, 2011). The absence of a federal repository remains a hindrance to the nuclear industry, as many states have enacted restrictions on development of nuclear facilities due to concerns over waste storage (Figure 5).

2.4 Recent U.S. Nuclear Energy Policies: The Clean Power Plan and the Transition to State-Level Nuclear Support

Since the Energy Policy Act in 2005, federal policies have not further promoted the nuclear power industry. The last major piece of federal energy legislation, the EPA's Clean Power Plan (CPP), which was finalized in August 2015, remained consistent with this laissez-faire treatment of nuclear generation. The CPP, which charged states to submit either individual or aggregated plans to cut carbon emissions from power plants by September 2018, seeks to reduce the carbon footprint of the national electricity sector by an estimated thirty-two percent below 2005 levels by 2030 (EPA, 2015A). To achieve state level carbon reductions, the CPP provides a number of outlets for states to reduce their emissions by providing incentives to certain energy resources and technologies, including nuclear, which individual states can select or combine based on what is most sensible with their unique mix of generation resources. New York's embracement of the CPP is displayed by its implementation of the CES.

While these incentives express a preference for renewable energy development and a desire to transition from coal to natural has, nuclear generation did not receive the treatment that many in the industry had hoped for (Segal 2016). The CPP, through limiting only nuclear generation from newly constructed or expanded facilities to count toward state emissions reduction goals, labels existing, original nuclear facilities as non-assets in terms of state power plans. This means that existing facilities must be updated to expand their generating capacity to be counted toward state compliance. If not counted, a facility will not be eligible to receive any subsidies from their respective state, such as allowances or credits depending on the state's compliance structure. In this way, the CPP left existing nuclear facilities to "sink or swim in their own prospective economic performance", leaving some facilities likely to face early closure due to marginal economic conditions in the present market (Bradford, 2015; US Power, World Nuclear Association, 2016).

2.5 Current State Policies and Stances on Nuclear Energy

While New York's nuclear subsidization program establishes the staunchest state-level support for nuclear generation, numerous other states maintain or have recently passed statues to protect and promote the growth of their nuclear assets. Many of the states that have taken such a stance, understandably, rely on nuclear resources for a significant portion of their electricity generation. While such policies widely vary in their designs and organization, they are consistent in their function of reducing the economic risks of constructing and or operating nuclear facilities. Additionally, other states with little or no reliance on nuclear generation have begun to explore their potential for development of nuclear assets. Currently, thirty states operate one or more nuclear facilities that supply them with varying amounts of electricity generation (Figure 4).

For example, in 2015 Florida established a financing mechanism for utilities to recover certain costs associated with the premature retirement of nuclear facilities. Georgia passed a legislative amendment in 2009 that permits utilities to recover from ratepayers the costs of financing associated with the construction of

Figure 4: State Use of Nuclear Facilities

State	Number	Total Capacity (MW)	Total State Power (%)
Alabama	2	5,067	27.4
Arkansas	1	3,937	24.9
Arizona	1	1,820	28.7
California	1	2240	9.3
Connecticut	1	15.8	46.2
Florida	2	3,572	11.8
Georgia	2	4,061	26.4
Illinois	6	11,564	50.1
Iowa	1	601	9.2
Kansas	1	1,175	18.9
Louisiana	2	2,133	14.2
Maryland	1	1,708	40.2
Massachusetts	1	677	15.5
Michigan	3	3,982	25.7
Minnesota	2	1,594	20.9
Mississippi	1	1,409	18.1
Missouri	1	1,193	12.5
Nebraska	1	764	26.3
New Hampshire	1	1,246	47
New Jersey	3	4,110	44.2
New York	4	5,432	31.9
North Carolina	3	5,095	32.9
Ohio	2	2,134	14.2
Pennsylvania	5	9,781	37.3
South Carolina	4	6,556	55.1
Tennessee	2	4,551	33.1
Texas	2	4,960	8.7
Virginia	2	3,568	33.3
Washington	1	1,158	7.4
Wisconsin	1	1,193	15.0

Source: Nuclear Energy Institute, 2016C

nuclear facilities. In 2008, Kansas passed a similar bill allowing nuclear facilities to qualify for the recovery of preconstruction and construction based expenditures in rates, a treatment which it was previously exempt from (Nuclear Energy Institute, 2016A). In 2016, Illinois passed the Future Energy Jobs Bill, which established a subsidy program to support two of its struggling nuclear facilities (Lyderson, 2016). This particular legislation will be discussed in further detail in Chapter Four.

Some other states with less mature nuclear infrastructure have sought to explore the potential for development in their respective markets. In 2014, Virginia passed a bill establishing the Virginia Nuclear Energy Consortium Authority to serve as an interdisciplinary study, research, and information resource on nuclear energy. Also in 2014, Washington established a similar organization, the Joint Select Task Force on Nuclear Energy. In 2013, Arkansas established an Institutional Energy Research Committee, which was tasked with researching the costs of additional energy production facilities, including nuclear, and other information such as its environmental challenges and possible policies and tax incentives to promote production increases. In 2010, Iowa passed a bill requiring utilities to analyze and prepare for possible reconstruction of new nuclear facilities. A 2011 bill in Wyoming formed a task force to study ways to encourage nuclear power development in the state (Nuclear Energy Institute, 2016A).

Despite cases of increased advocacy for nuclear development in some states, many others uphold restrictions of varied severity on the construction and operation of new nuclear facilities (Figure 5). Minnesota passed a 2016 statute enacting an outright ban on constructing and relicensing nuclear facilities, as did New York in 2014 for the operation of nuclear facilities on Long Island, largely due to concerns over the population density and logistical difficulties in evacuating the area in the event of a facility mishap (NCSL, 2016). Many other state moratoriums,

Figure 5: Current State Restrictions on Nuclear Power

State	Condition(s)
California	Waste disposal capability
Connecticut	Waste disposal capability
Hawaii	Legislative approval (two-thirds vote in each house of the legislature)
Illinois	Waste disposal capability OR legislative approval
Kentucky	Waste disposal capability
Maine	Waste disposal capability & Voter approval
Massachusetts	Majority voter approval & Legislative approval (with certain waste disposal, emergency preparedness, and other certain conditions are met)
Minnesota	Outright ban
Montana	Voter approval
New Jersey	Waste disposal safety
New York	Outright ban (limited to the counties of Suffolk and Nassua)
Oregon	Waste disposal capability & Voter approval
Rhode Island	Legislative approval
Vermont	Legislative approval
West Virginia	Waste disposal capability & Demonstrated economic feasibility & Compliance with environmental protection laws, rules, and requirements

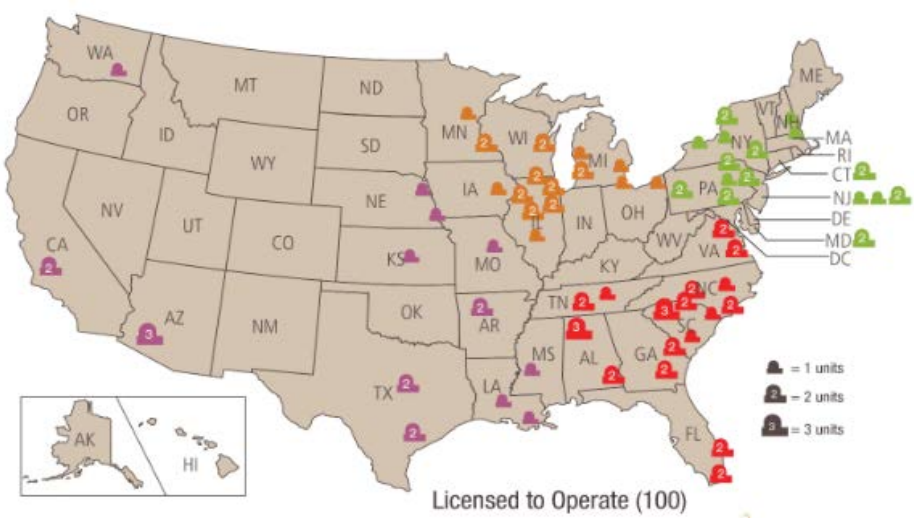
Source: NCSL, 2016

such as those in California, Maine, Connecticut, Illinois, Kentucky, New Jersey, Oregon, and West Virginia, are either entirely or largely founded on the issue of nuclear waste and the requirement of "the identification [of] a demonstrable technology or a means for high level waste disposal or reprocessing" (NCSL, 2016). Other states, namely Massachusetts, Illinois, Hawaii, Rhode Island, and Vermont, require varying levels of legislative support for new nuclear projects, while some, such as Massachusetts, Maine, Montana, and Oregon, also require majority voter approval to go forth with such projects (NCSL, 2016).

While standing moratoriums or restrictions on new nuclear facilities exist across fifteen states, others have recently created opportunities for new nuclear generation. The Alaska Sustainable Energy Act, enacted in 2010, repealed the state's prior moratorium on nuclear facilities, and allowed for small-scale reactor development to be potentially funded by the state's Power Project Fund (Nuclear Energy Institute, 2016). In 2016, Wisconsin repealed its thirty-three year old moratorium by passing a bill that withdrew requirements on nuclear waste disposal and other economic factors (Nuclear Energy Institute, 2016A**;** NCSL, 2016). This bill also included nuclear generation in the state's broader energy policy, creating potential for state loans and grants for the construction of new nuclear facilities.

Figure 6 provides an illustrative presentation of the distribution of nuclear facilities across the United States, indicative of state and regional stances and utilization of nuclear energy.

Figure 6: U.S. Operating Commercial Nuclear Facilities



Source: U.S. NRC, 2015

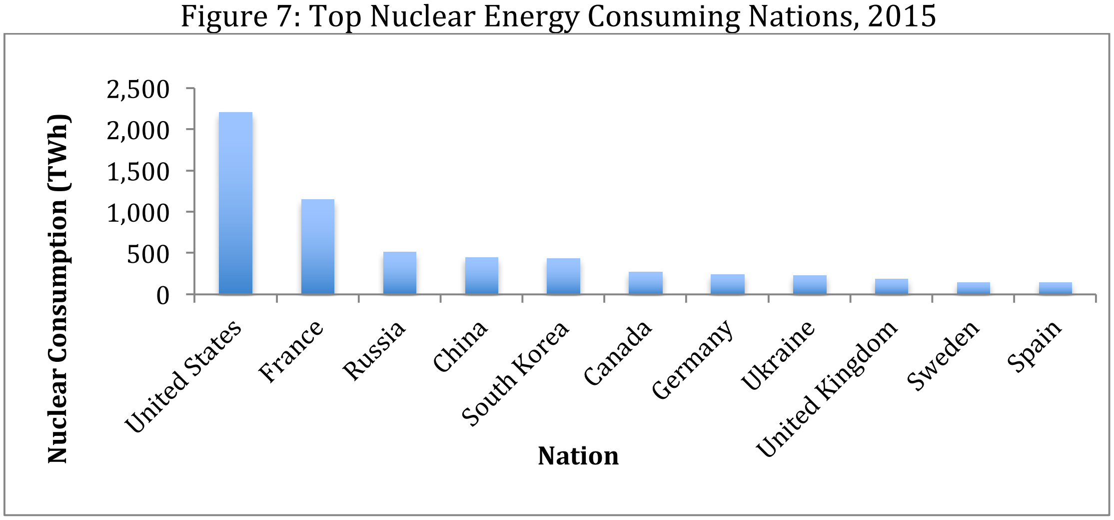
2.6 Nuclear Energy Generation, Policy, and Strategy in Foreign Nations

While the United States commandingly leads the international community in raw nuclear electricity generation, it is far from the global leader in its utilization of the technology in fulfilling its electricity demand (Figure 7; Figure 8). By analyzing the treatment of nuclear generation in the leading nations in both nuclear load share and recent nuclear development, the policies and market strategies have successfully promoted such production, and the way in which such practices differ from those in the United States, can be identified.

2.6.1 France

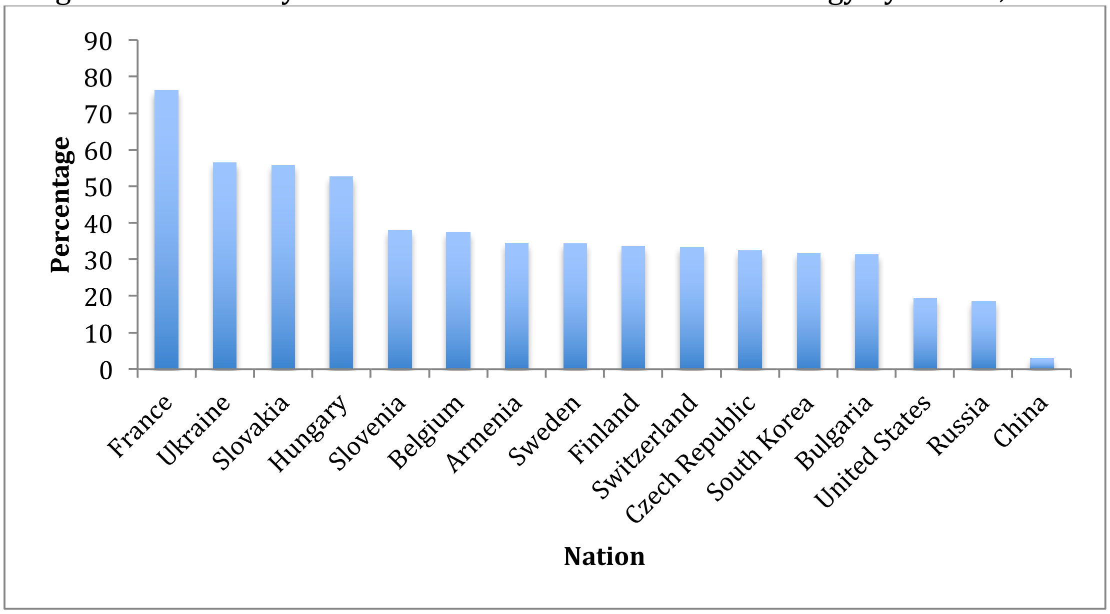
With fifty-eight reactors that account for approximately seventy-seven percent of its total electricity generation, France boasts the most impressive nuclear generation capacity of any nation (France, World Nuclear Association, 2016). Along with providing the nation with reliable, low-emissions electricity, France's robust nuclear capabilities have made it the "largest electricity exporter on Earth", allowing

Figure 7: Top Nuclear Energy Consuming Nations, 2015



Source: BP, 2016

Figure 8: Electricity Generation Fuel Share of Nuclear Energy by Nation, 2015



Sources: Nuclear Energy Institute, 2016C; World Nuclear Association – Nuclear Power in Russia, 2016; World Nuclear Association – Nuclear Power in China, 2016

it to sell electricity to neighboring nations such as Italy, Switzerland, Belgium, the United Kingdom, and Spain, with 65.1 TWh exported in 2014 (Irfan 2015; France, World Nuclear Association, 2016). The abundance of nuclear electricity in France mainly stems from the 1973 OPEC Oil Embargo. While France's economy was not significantly impaired by the embargo due to the nation's nonintervention in the conflict that spurred it and the resultant uninterrupted supply of oil from OPEC states, it crudely illustrated the risk in reliance on foreign energy sources through its crippling impact on the Western world (Vangrevelinghe, 1982). At the time, France's lack of domestic natural energy resources and commensurate reliance on imported fossil fuels made it equally vulnerable to such price shocks (Palfreman 1997; France, World Nuclear Association, 2016). To provide France with energy independence and security, the French government responded by enacting "the most comprehensive national nuclear energy program in history", which resulted in the installation of fifty-six nuclear reactors in the following fifteen years (Palfreman, 1997). Surprisingly, this expeditious switch to nuclear met little backlash due to a number of societal, political, and economic forces.

The precariousness of energy reliance from unstable regions, evidenced by the 1973 energy crisis, brought many to accept that nuclear development was a necessity in providing France with energy security. Secondly, French society trusts scientists and engineers much more so than in the United States, resulting in the viewing of such professionals as a technocratic elite and the existence of a wide cultural popularity and acceptance of expansive government projects (Slovic et al. 2000; Palfreman, 1997). The French government has strengthened this cultural acceptance of nuclear through advertising campaigns that "reinforce the link between nuclear power and the electricity that makes modern life possible", as well as public engagement initiatives by Électricité de France, the largely government owned utility that manages France's nuclear fleet, which have attracted about six million French people to tour various nuclear facilities (Palfreman, 1997).

In 2014, the tide began to turn against nuclear energy as the French government enacted a bill, titled the Energy Transition for Green Growth, that mandated a reduction in nuclear generation to account for fifty percent of the nation's electricity supply by 2025, along with a forty percent reduction in greenhouse gas emissions by 2030 compared to 1990 levels (France, World Nuclear Association, 2016; World Nuclear News, 2014). This bill came in response to rising public concern over the unavoidable, unsolved issue of nuclear waste disposal, as well as a desire to transition the nation's energy mix toward renewable generation.

While seeking to phase out nuclear, France's ambitious goals toward carbon reduction and development of renewables would not be possible without its wealth of nuclear generation, which was accredited by Ségolène Royal, France's energy minister, when stating, "It is thanks to nuclear energy that we can make this energy transition in an unperturbed way" (World Nuclear News, 2014).

2.6.2 China

Unlike France, in China, nuclear development is in an embryonic stage with great potential to assist the rapidly developing nation. China's enormous, unmet demand for energy, paired with its reliance on fossil fuels, makes nuclear development an important way to help reduce carbon emissions. While accounting for only three percent of China's electricity generation in 2015, nuclear experienced the largest generation growth of all energy resources at twenty-nine percent (China, World Nuclear Association, 2016; BP, 2016). This growth can be largely attributed to China's commitment to greenhouse gas reduction and the selection of nuclear technology to aid in achieving related goals. In 2015, China's submission of its Intended Nationally Determined Contribution to the United Nations pledged a twenty percent increase in fuel share from non-fossil fuels, including annual average increases in new nuclear capacity of 3.4 GWe per year from 2005 to 2020 and of 9.0 GWe per year from 2020 to 2030 (C2ES, 2015; China, World Nuclear Association, 2016). In addition, China's Thirteenth Five-Year Plan, submitted in 2016, mandated that six to eight new nuclear reactors be approved each year in part of an effort to reduce coal's fuel share from sixty-four point four percent in 2015 to sixty-two percent in 2020 (China, World Nuclear Association, 2016).

Despite the high cost of nuclear facility construction, China's high demand for energy and strong economic growth, along with preferential federal treatment toward nuclear, has ensured investment in nuclear development. Much of the federal partiality toward nuclear comes in the form of tax policies, such as a seventy-five percent tax rebate for reactors during their first five years of operation, a tax waiver for imports on nuclear energy equipment and raw materials that cannot be domestically produced, land-use tax rebates on land associated with nuclear facilities, and a reduced fifteen percent income tax rate for nuclear energy companies (Zhou et al., 2010). Other federal assistance includes liability assistance for nuclear facility operators, which was established in a 2007 bill that serves to "partially indemnify the nuclear industry against liability claims arising from nuclear accidents… [through] a no fault insurance-type system" where operators annually pay into a trust fund that assures financial coverage for all potential damages resulting from such an incident (Zhou et al., 2010).

Due to the combined factors of preferential government treatment through regulatory incentives and financial stimulus and a growing market demand for domestic electricity generation, Chinese nuclear generation has progressed beyond expectation. However, numerous requisites surrounding China's nuclear program, such as ensured quality and safety of its facilities, apt technological research and development, and adequate workforce size to match the speed of its growth, remain a hindrance to having full confidence in its persisting development. While only time will tell if China can continue such rapid development while addressing these concerns, nuclear generation is positioned to beneficially and substantially impact China's energy future.

2.6.3 Russia

Russia's recent strides in nuclear energy development have made it a global leader in the field. Unlike China, where nuclear is incentivized by its ability to abate carbon emissions and pollution, the Russian transition to nuclear has been entirely driven by economics. As the supplier of twenty seven percent of the European Union's natural gas, Russia is seeking to increase its gas exports to the European Union since it can earn roughly five times the revenue by exporting it compared to domestic sales (Russia, World Nuclear Association, 2016). With about sixty percent of Russia's natural gas being sold within its borders, the Russian government has expressed intent to halve this by 2020 in order to increase availability for export, and to replace that portion of domestic electricity through rapid deployment of nuclear and hydroelectric facilities (Russia, World Nuclear Association, 2016, World Nuclear News, 2016). On top of five reactors currently under construction, the Russian government in August 2016 published a plan to construct eleven new reactors by 2030 and also approved of four separate disposal facilities for nuclear waste (Russia, World Nuclear Association, 2016**;** World Nuclear News, 2016). Nuclear production in Russia accounted for just 18.6% of total electricity generation in 2015, but such rapid unit development, along with widespread uprating and the licensing of twenty-four units for operational life extensions, has brought most recent federal estimates to 20%-30% nuclear share in electricity supply by 2030, 45%-50% in 2050 and 70%-80% by 2100 (Russia, World Nuclear Association, 2016; Andreeva-Andrievskaya, 2015).

Along with pursuing nuclear development for economic gain in natural gas exports, Russia has begun utilizing its expanding nuclear capabilities to gain market share in the $500 billion global nuclear energy construction market, with 37% of new nuclear facilities under construction worldwide being built by Russia (David, 2014; Lecavalier 2015). The success of Russia's international nuclear development has been driven in pair by the growing desire for quick, easy energy supplies among nations that are technologically and financially incapable of developing nuclear facilities and the implementation of programs to assist such nations in the financing and operation of nuclear facilities. Such programs include financing of nuclear development in host countries with costs recovered in energy sales, management of facilities, supplying of facilities with uranium fuel, and disposal of nuclear waste. This approach, dubbed "build-own-operate" or "BOO", provides nations with a convenient "one-stop-shop" approach that is not offered by any other nation (Lecavalier, 2015).

Russia's rapid advancement and global dissemination of nuclear energy has been made possible by the prioritization of nuclear development under the Russian government. Russia's governmental centralization of nuclear assets under a single entity, The Rosatom State Energy Corporation, provides its government with complete autonomy and legislative expediency in national nuclear development. This has been expressed in the government's $55 billion investment, named the

Proryv "Breakthrough" Initiative, to support research and development of nuclear energy by Rosatom with the goal of making Russia the global leader in nuclear technology (Lecavalier, 2015; Russia, World Nuclear Association, 2016). As a 2016 statement from Rosatom claimed that "Russia's GDP gained three rubles for every one ruble invested in building nuclear power plants domestically, as well as enhanced socio-economic development of the country as a whole", it is likely that Russia will continue on its track toward nuclear superiority (David, 2014; Russia, World Nuclear Association, 2016).

2.6.4 Takeaways for the United States

These cases of the foreign involvement in nuclear energy in France, China, and Russia provide numerous lessons to be learned for the United States in terms of finding success with nuclear energy development. The French proactivity toward energy independence through nuclear development and the resultant abundance of domestically produced, low-carbon electricity shows the tangible benefits of nuclear development for economic and security purposes. While the United States is not bestowed with the cultural conditions in France that produced a favorable societal opinion of nuclear energy, it can examine the mechanisms by which this sentiment has been reinforced, such as advertisement and public engagement, to foster a wider acceptance of nuclear energy within its own society. The case of rapid nuclear development in China provides a more concrete proscription by displaying the merits of incentivizing new nuclear facilities through favorable federal tax policies.

While the United States does not posses the same governmental autonomy over nuclear development and energy market manipulation as seen in Russia, its comparable status in technological nuclear capability enables it to seriously examine Russia's strategies within the global nuclear energy market. As the United States "currently lacks accords with key demand hubs in Asia and the Middle East – areas where nuclear power is expected to soar, and ripe targets for Russian financing", it stands to fall severely behind in the global market for nuclear energy development (David, 2014). In addition to this being a missed economic opportunity, the lack of involvement by the United States in international nuclear development stands to diminish its role in international nuclear relations and control of nuclear materials (David, 2014). This situation would decrease overall national security for the United States due to the inherent tie between nuclear energy and the development of nuclear weapons, in which "every known route to bombs involves either nuclear power or materials and technology which are available, which exist in commerce, as a direct and essential consequence of nuclear power" (Lovins, 1981). Given the current landscape of international relations and tensions over nuclear weapons, the United States should weigh this factor into the overall cost of its inactivity in the international nuclear energy market.

Chapter Three

Causes and Motives Behind New York's Nuclear Subsidization

3.1 Summary

This chapter explores the causes and expected results of New York's subsidization of nuclear generation, and the impact that the subsidies will have on the state's nuclear industry. This discussion will examine the structure and trends occurring in the state's energy market to determine why the program is necessary in preserving nuclear generation. Also, it will explore the potential impacts that a closure of New York's nuclear facilities would have on its economy and emission output to explain the state's motivations behind this subsidization.

3.2 The Economics of Struggling Nuclear Facilities

Various trends within the energy industry and broader economy have resulted in significant fiscal difficulties for the four nuclear facilities operating in New York State. In response to these trends, the owners of these facilities, Exelon and Entergy, declared that they would be forced to prematurely close them, prompting the New York State government to provide these facilities with financial assistance to avoid the associated impacts of these closures (Walton, 2016). In this way, it can be seen that these economic forces are substantially responsible for the extensive nuclear subsidization program being examined in this paper. Exploring these trends and their expected impact on the New York power market and its nuclear facilities will explain the economic causes and necessity of these subsidies.

3.2.1 Primer on Electric Power Markets

Before examining the market forces threatening New York's nuclear facilities, which has resulted in the subsidy program, it is important to first discuss the general structure of power markets to understand how such forces have arisen. This discussion will explain the organizational differences between regulated and deregulated markets, the structure and relationship of wholesale and retail markets, and the jurisdictional differences between these market structures in order to explain how electricity generating entities are impacted by the organization of the markets in which they operate.

3.2.1.1 Regulatory Market Structures

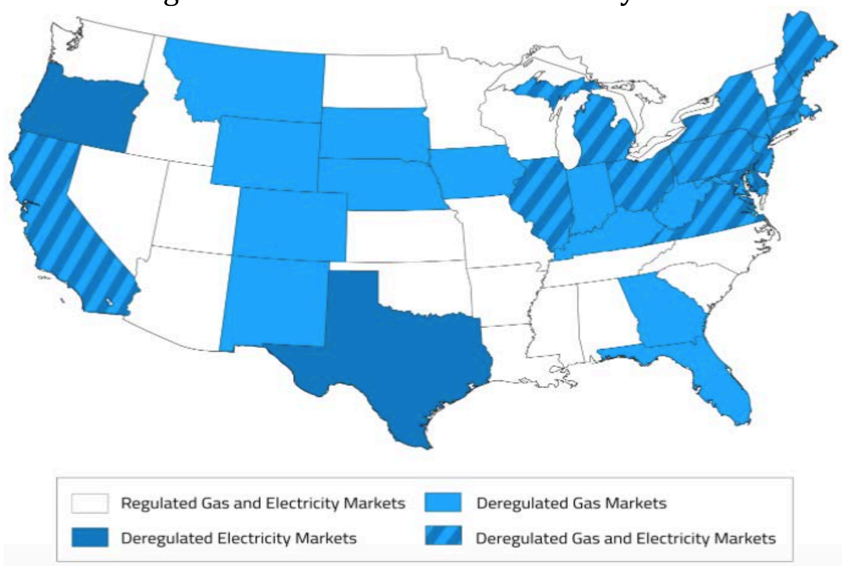
Power markets in the United States fall under two categories: regulated and deregulated markets. Regulated, or traditional, markets are characterized by vertically integrated utilities that are responsible for the generation, transmission, and distribution of electricity within a certain geographical area (Deliso, 2014). By controlling all three levels of the supply chain, a utility is given ultimate authority and obliged with meeting all electricity demand within their domain (Michaels 2006). In this structure, the flow of money is unidirectional, with utilities charging their ratepayers an aggregated fee that accounts for costs accrued along the three stages of service (Warwick, 2002). While this structure provides organizational simplicity and efficiency, its monopolistic attribute holds ratepayers captive to utility rates and makes them vulnerable to complications with utility-run generation facilities. To address these concerns and promote competition within power markets, a succession of federal rules, namely the Public Utilities Regulatory Policies Act of 1978, the Energy Policy Act of 1992, and FERC's Open Access Policy in 1996, opened up power generation to privately held "independent power producers" (IPPS) and allowed for the emergence of deregulated power markets (Cain & Lesser, 2007; Deliso, 2014).

In deregulated, or liberated, markets, utilities divest ownership of generation and transmission, and are only responsible for billing ratepayers and for the distribution, operations, and maintenance from the interconnection at the grid to the meter (Deliso, 2014). Another differentiating characteristic of deregulated markets is that they feature regional transmission operators (RTOs), which are federally regulated entities that coordinate, control, and monitor the sale of electricity from IPPs into the grid via regional wholesale auctions (US Power, World Nuclear Association, 2016). This auction process and the role of RTOs will be discussed in further detail shortly. Currently, seventeen states, including New York, and the District of Columbia operate with a deregulated electricity market (Figure 9), with roughly forty-five percent of the national generating capacity being made up by IPPs (Michaels, 2006).

3.2.1.2 Wholesale and Retail Power Markets

By turning over the responsibility of power generation to private entities, market deregulation allows for market competition to dictate which resources meet power demand within a grid. This market system operates through an auctioning

Figure 9: Power Market Structure by State

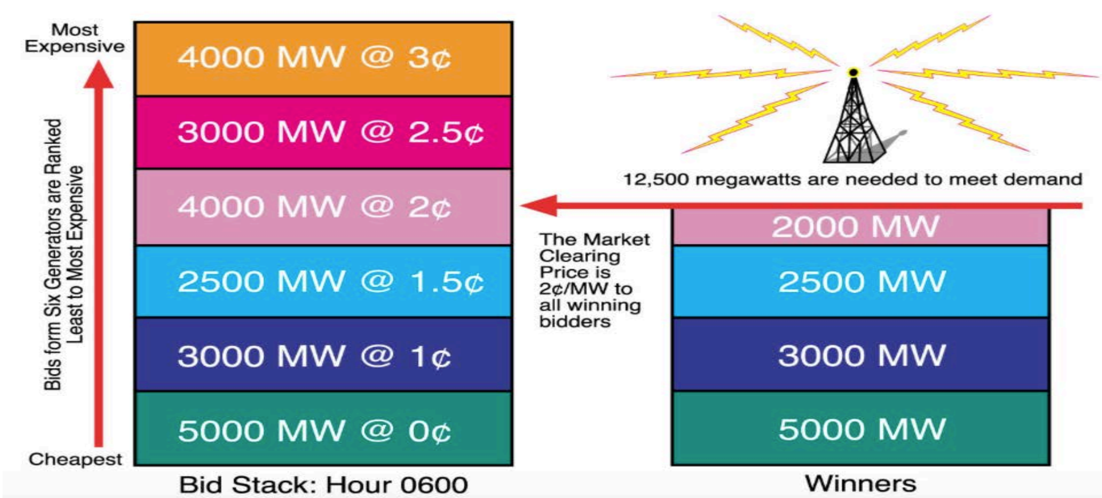


Source: Electric Choice, 2017

process called the power exchange that "determines which plants operate and what they are paid for power" (Warwick, 2002). In this process, which is managed by the respective RTO, the exchange itself acts as the single buyer of power with multiple sellers. The chosen sellers and price are determined in a "single bid" system wherein the winning, or highest, bid sets the price earned for all sellers, which is called the "market clearing price" (MCP), thus producing a least-cost result by giving market entry on a lowest-cost-first basis (Warwick, 2002). It is through this power exchange system, where IPPs compete to offer their services at the lowest possible price, in which wholesale power is sold into the grid (Michaels, 2006). Figure 10 provides a helpful visualization of this wholesale power auctioning structure.

Conversely, retail markets exist after the dispatch of power by RTOs, where residential, commercial, and industrial customers purchase power from LSEs for use at the meter (Cain & Lesser, 2007). Pricing in retail markets is largely dependent on wholesale market prices and utility operations. To determine retail electricity prices, wholesale prices are combined with transmission charges, which include the cost of moving high-voltage electricity from a generation facility to a distribution station, “wire charges”, which are utility fees related to the distribution of power to end-use customers, and state charges, which include sales tax and public benefits programs, such as low-income assistance or resource subsidies (Warwick, 2002). The transmission component typically accounts for less than ten percent of a typical total retail bill, while wire charges usually account for one-half to two-thirds, with state charges largely varying (Warwick, 2002).

Figure 10: Power Exchange Auctioning Process



Source: Warwick, 2002

3.2.1.3 Regulatory Jurisdiction: Framework and Shortfalls

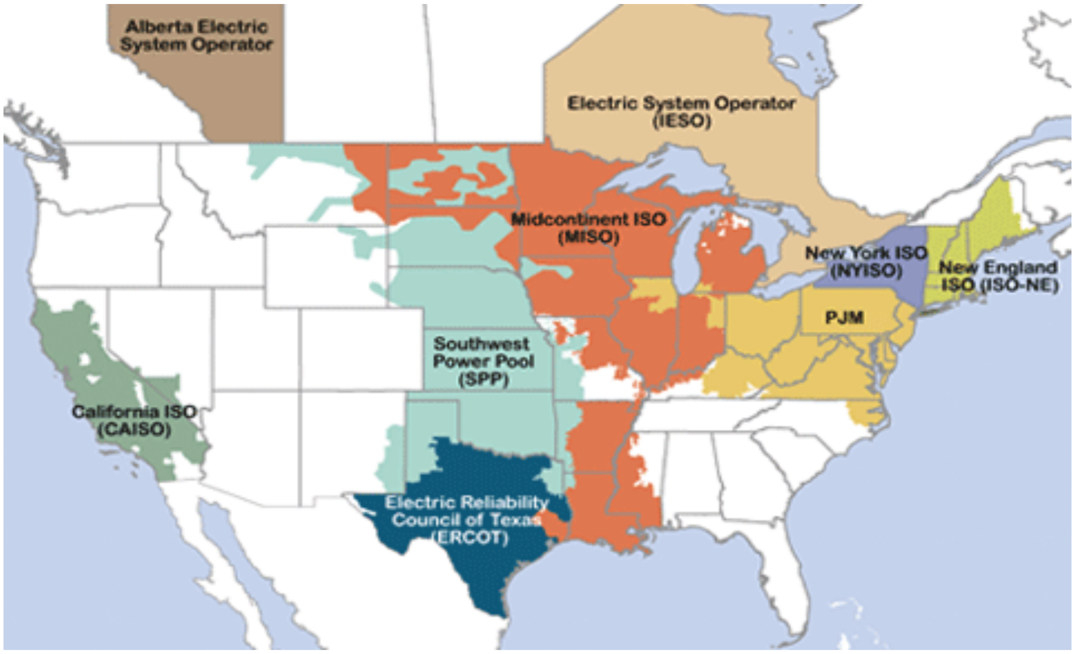
In managing the deregulation of power markets, the Federal Energy Regulatory Commission (FERC) conceptualized RTOs as entities to create an "operational separation of generation and transmission services and a surrender of control of the power grid" (Michaels, 2006). The formation of RTOs effectively prevented utility market manipulation by creating separation between ownership and operation of regional transmission systems (Cain & Lesser, 2007). However, as independent organizations that singlehandedly manage wholesale markets, FERC stressed that RTOs were to be highly regulated to ensure that the power exchange was administered in an unbiased manner so that "competitive wholesale markets are truly competitive" (Michaels, 2006; Cain & Lesser, 2007). The founding statutes of RTOs, FERC Order 888 and 2000, involved numerous oversight stipulations related to ensuring integrity in wholesale markets, including the establishment of market-monitoring institutions (MMIs), which are independent entities charged with scrutinizing bidding behavior, employing FERC-approved mitigation techniques, and reporting to RTOs and FERC on activity within a regional power exchange (Michaels, 2006; Cain & Lesser, 2007). FERC's enforcement capabilities were significantly expanded through the Energy Policy Act of 2005, which bolstered its civil and criminal penalty authority in penalizing wholesale market manipulation (Cain & Lesser, 2007).

The regulation of RTOs by MMIs can vary in organizational structure. In some RTO's, such as NYISO, the respective MMI is a partially internal entity that includes members of the RTO itself. In addition to their in-house staff, MMIs can include external monitoring from members of the private sector, such as distinguished academics, lawyers, or contracted firms. For example, NYISO, along with ISO-NE, MISO, and ERCOT, have contracts with the consulting firm Potomac Economics to perform this duty (Michaels, 2008).

In some cases RTOs can be subcategorized as independent system operators (ISOs), which vary little in function apart from the typically smaller geographical range in which they operate (Figure 11). While FERC demonstrates total jurisdictional authority over wholesale markets, interstate transmission, and the RTOs that oversee these processes, utility distribution and retail sale of power is regulated at the state level by respective state commissions (Federal Power Act, 2015; Warwick, 2002).

Despite its apparent straightforwardness, the current jurisdictional framework of power markets has resulted in a significant gray area surrounding regulatory influence on power exchange access and wholesale rates (Warwick, 2002). This issue can be attributed in part to the general novelty of this jurisdictional framework, which has created a situation in which "much of U.S. electricity is now governed by organizations for which there are no precedents in any industrial context as important as electricity" (Michaels, 2006). Additionally, it can be blamed on the policy-creation process behind this framework, which could be identified as "a politically expedient compromise rather than a thoughtfully planned institution", resulting in a failure to address "the difficulties in governance that such an organization [RTO] might actually encounter" when implemented

Figure 11: North American RTO Service Territories



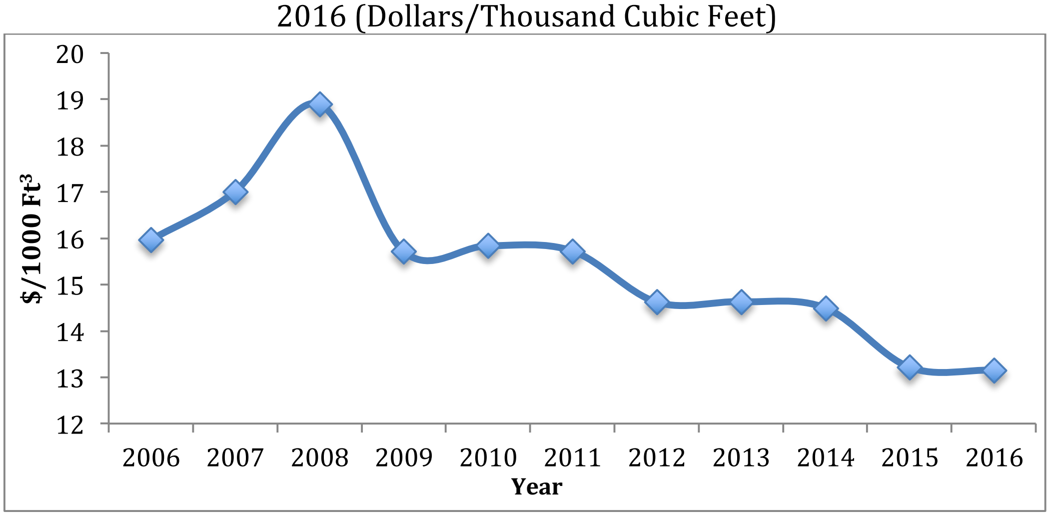
Source: https://www.ferc.gov/industries/electric/indus-act/rto.asp

(Michaels, 2006). Regardless of their causes, the resultant policy imperfections in the distribution of jurisdictional authority across deregulated power markets have created several uncertainties over the legality of state-level market manipulation initiatives, spurring disagreement between FERC and state commissions. The relevance of this unperfected framework to New York State's proposed subsidization of nuclear energy and the transformative impact that this program could have on the wider debate of jurisdiction over wholesale power markets will be further investigated in Chapter Four when discussing the legality of using ZECs to financially preserve New York's nuclear facilities.

3.2.2 Falling Natural Gas Prices

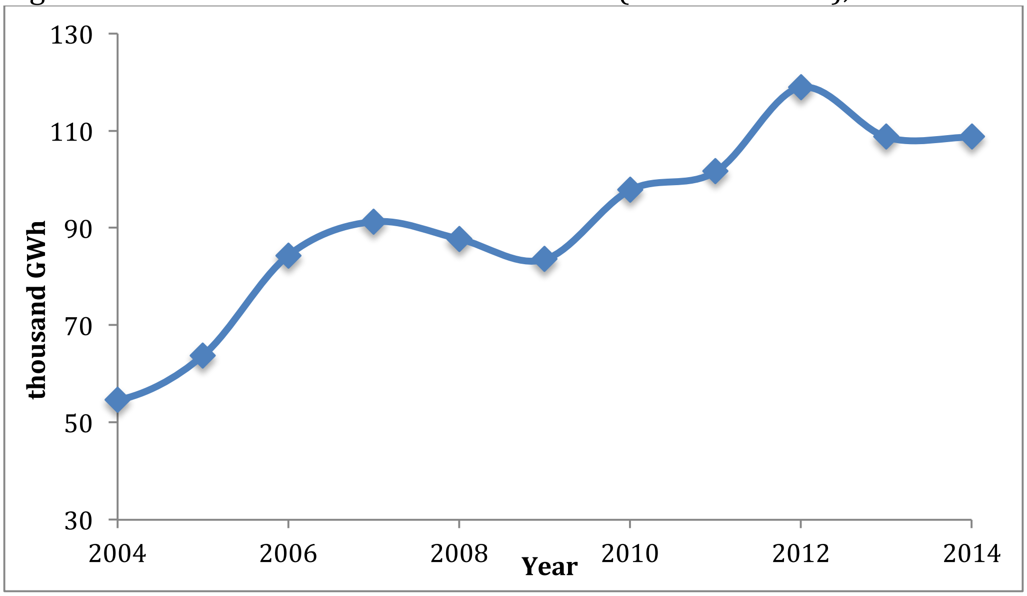
Natural gas prices in New York, much like elsewhere in the United States, have substantially decreased over the past decade (Figure 12). This trend is due to a host of factors, particularly technological improvements in horizontal drilling and hydraulic fracturing and the abundance of natural gas within the nearby Marcellus and Utica shale formations, which have jointly accounted for about eighty-five percent of growth in U.S. natural gas production since 2012 (Kern & Characklis, 2017; Ausick 2015). In result, electricity generation from natural gas roughly doubled in New York between 2004 and 2014, and now about forty percent of its electricity comes from natural gas, making it the state's largest generation resource (Figure 13; Nuclear Energy Institute, 2014). Due to its deregulated structure, the New York power market has been profoundly impacted by this influx of inexpensive natural gas, as its increasingly low, competitive price "is allowing gas-fired plants to undercut [nuclear] power prices" (US Power, World Nuclear Association, 2016).

Figure 12: Price of Natural Gas Delivered to New York Residential Customers, 2006-2016 (Dollars/Thousand Cubic Feet)



Source: EIA 2017

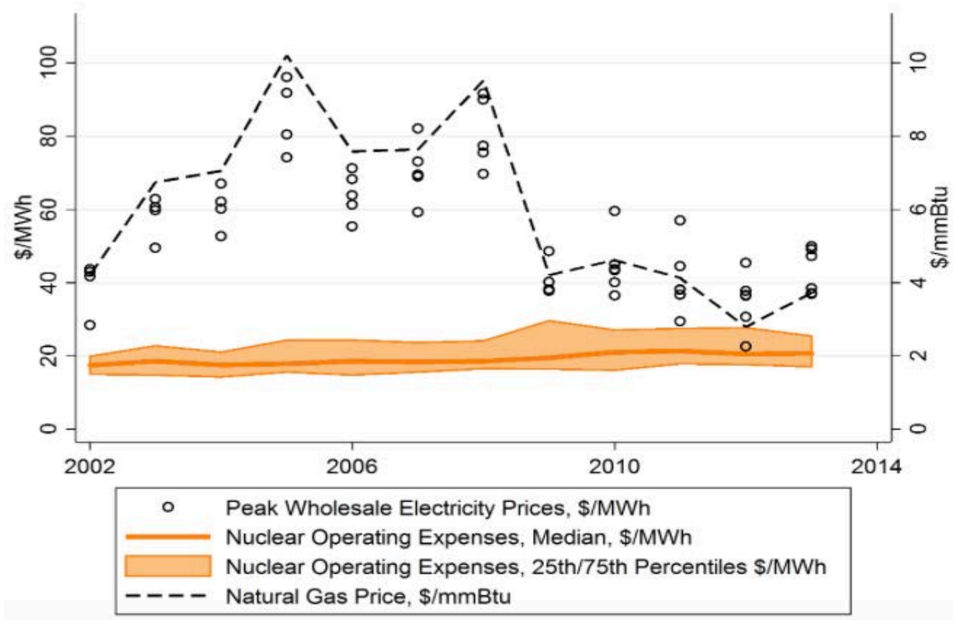
Figure 13: New York Natural Gas Generation (thousand GWh), 2004 – 2014



Source: EIA, 2017

This situation is particularly troublesome for nuclear facilities, as they are designed to continuously produce base load power regardless of market conditions, making them "have among the greatest exposure to gas and power price volatility, as they are price takers" (Davis & Hausman, 2016). The referenced price in the term "price taker" is the MCP of wholesale power markets, which is driven down in response to cheap natural gas available in the power exchange and the resultant decrease in wholesale prices. This relationship is demonstrated in Figure 14 in the context of average national peak wholesale electricity prices. Lower MCPs translate directly to decreased profitability and a potential deficit for nuclear facilities, as they reduce "the ability of hour-to-hour net revenues to cover the fixed costs of keeping a nuclear plant open", which is already challenging "because of their high operations and maintenance costs" (Davis & Hausman, 2016).

Figure 14: Natural Gas and Peak Wholesale Electricity Prices, 2010-2014

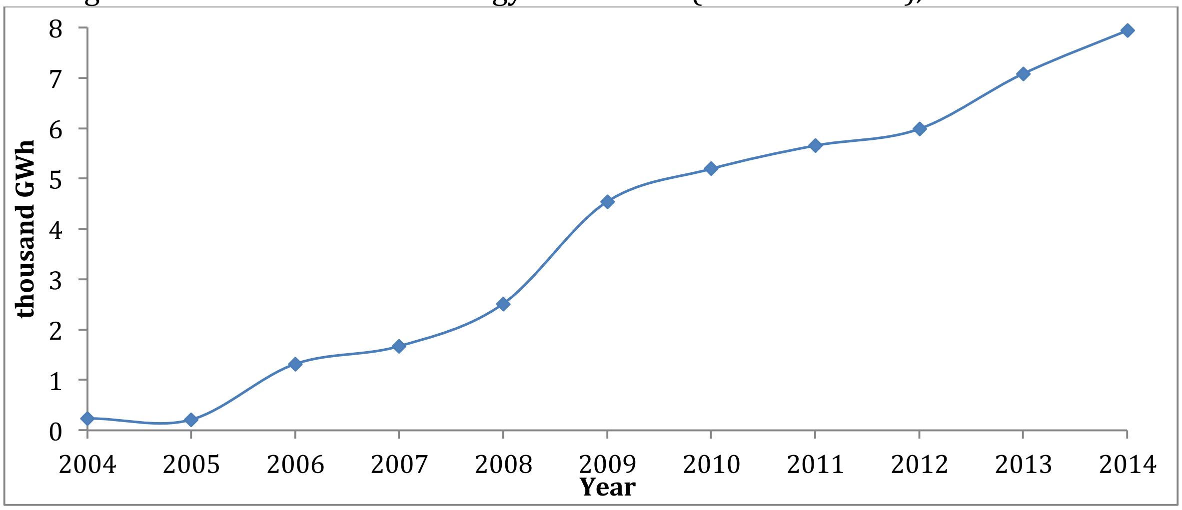


Source: Davis & Hausman, 2016

3.2.3 Growth of Renewables

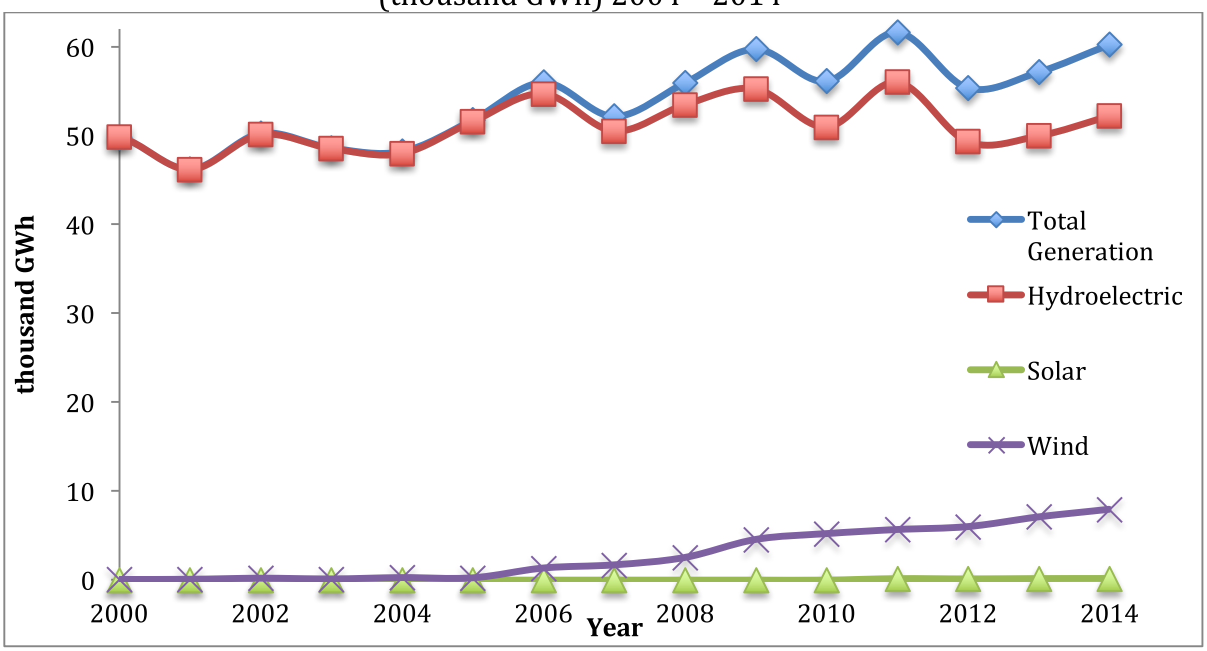
While far more modest than that of natural gas, New York has also experienced an increase in renewable energy, which grew from twenty to about twenty five percent of total electricity generation from 2010 to 2014 (Nuclear Energy Institute, 2014; NYSERDA, 2014). The majority of this generation capacity comes from hydroelectric sources, which makes up just over eighteen percent of statewide electricity generation (Nuclear Energy Institute, 2014). The uptick in renewables is mainly due to growth in wind energy generation, which multiplied by about four hundred from 2004 to 2014 (Figure 15). Additionally, it is partly due to increases in solar power capacity, which more than quadrupled in New York from 2010 to 2014 (NYSERDA, 2014). The recent growth of these three resources and their contribution to New York's renewable generation is illustrated in Figure 16.

Figure 15: New York Wind Energy Generation (thousand GWh), 2004 – 2014



Source: EIA, 2017

Figure 16: New York Renewable Energy Generation by Resource (thousand GWh) 2004 – 2014



Source: EIA, 2017

While positive for statewide emissions, the rapid growth of renewables is foreboding for nuclear facilities as it increases the amount of base load power within the PX. This increase in base load power reduces the amount of generation available to wholesale competition and consequentially drives down the MCP received by nuclear facilities. This paradoxical situation, where renewable growth adds pressure on existing nuclear facilities, has been dubbed "clean energy cannibalism", as expansion of several emission-free technologies is harming another emission-free technology (Pyper, 2017).

Due to New York's promotion of renewables through the "50 by 30" initiative and administration of RECs, this trend is expected to intensify in coming years. Such growth has already begun, with the recent announcement of a 90 megawatt offshore wind farm project to be constructed off the coast of Long Island, which will be the first installment of Governor Cuomo's commitment to reach 2.4 gigawatts of state offshore wind generation by 2030, which will be the largest wind energy project in the United States upon completion (Cardwell, 2017). Additionally, Cuomo announced in his 2017 State of State address that New York will award three hundred seventy million dollars this year to eleven large-scale renewable energy projects across the state, which is expected to result in over two hundred sixty megawatts of new renewable capacity (NYSERDA, 2017).

3.3 Potential Impact of Nuclear Closures

While the fiscal difficulties encountered by New York's nuclear facilities are evident through declining profitability, the rationale behind the state's controversial decision to financially support and prevent the closure of these facilities is more complex and comprehensive. Explaining New York's nuclear subsidization requires consideration of the various impacts that such a closure would entail, particularly its local and statewide economic influence and its impact on state emissions reduction goals. By explaining the potential ramifications that a total shutdown of nuclear facilities would entail, the rationale behind New York's desire to prevent them and its consequent support of nuclear facilities through ZEC's will become evident.

An important aspect of this discussion will be the projected impacts and concerns surrounding the closure of the Indian Point nuclear facility. On January 9, 2017, it was announced that Governor Cuomo and Entergy, the owner of Indian Point, had reached an agreement to fully shut down the facility by April 2021 (McGeehan, 2017). This agreement, which was driven by financial motives for Entergy due to the facility's declining profitability and by political pressures stemming from safety concerns for the state due to the facility's close proximity to New York City, spurred much investigation into the expected impact of the shutdown (US Power, World Nuclear Association, 2017). Information gathered from such analyses can be used to extrapolate on the impact of a hypothetical full-scale shutdown of New York's nuclear facilities.

3.3.1 Economic Outlook

Economic concerns over Indian Point's announced closure are present across municipal and state levels. For the officials and residents of Westchester County, where Indian Point has operated for over fifty years, these concerns mainly stem from the expected loss of local jobs and tax revenue. Currently, Indian Point employs about one thousand fulltime workers, making it one of the largest employers in Westchester County with an annual payroll of about $140 million dollars, and stimulates almost three thousand additional jobs in surrounding counties (McGeehan, 2017; Nuclear Energy Institute, 2015A). In addition, Indian Point is one of the largest contributors to the municipal tax base, as it directly generates roughly four million dollars annually in taxes for Westchester County (Whitman, 2017; Nuclear Energy Institute, 2015A). Most directly impacted by this tax decrease will likely be the local school district, Hendrick Hudson, as it receives twenty-three million dollars of Entergy's annual tax payments, accounting for about one-third of its total budget (Spector, 2017). However, this loss of tax revenue from Indian Point transcends the municipal level, as the facility annually accounts for about seventy million dollars in state and local taxes and about two hundred seventy million in federal taxes (Nuclear Energy Institute, 2015A).

Additional regional and state level economic concerns surrounding Indian Point's closure mainly arise from the cost of decommissioning the facility, which is a lengthy and expensive endeavor that Entergy estimated in 2010 would cost just over one billion dollars to complete (Nearing, 2017). The problem with this billion-dollar estimate is that it greatly exceeds the seven hundred twenty-four million dollar fund reserved for the decommissioning of the facility, which was given to Entergy from New York State in 2000 when Indian Point was purchased from the state-owned New York Power Authority (Nearing, 2017). While this fund remains invested and has grown almost a quarter billion dollars over the past six years, and while Entergy has expressed that the original decommissioning cost estimate needs to be reevaluated, decommissioning funds for Indian Point will remain a worrisome matter until it is settled due to the potential for project cost overruns and the "unanswered question as to the scope of any taxpayer liability as a result" (Whitman, 2017; Nearing, 2017).

Other concerns involve the potential impact that the closure will have on the regional electricity grid and prices. As Indian Point annually supplies New York City and Westchester County with over two gigawatts, roughly a quarter of the power consumed in the area, there is concern over how this substantial base load capacity will be replaced (McGeehan, 2017; Nuclear Energy Institute, 2014). While the state's commitment to expansion of renewables, such as the aforementioned 2.4 gigawatts of offshore wind by 2030, has quelled some of these concerns and even made some optimistic about regional job creation, the developmental progress of such projects remains uncertain (Spector, 2017). The cost of this alteration in the regional energy mix is also uncertain. Although the state has urged that the impact of this process on "ratepayers would be negligible, adding that the governor's office had estimated that, at most, the proposed shutdown would add three dollars a month to electric bills in the New York City area", electricity rates in this area are the highest in the nation, apart from Hawaii, so these rate increases are especially unwelcome (McGeehan, 2017; Spector, 2017).

The fiscal repercussions that are being anticipated due to the announced closure of Indian Point are similar to those being prevented through the subsidization of New York's upstate facilities of Ginna, Fitzpatrick, and Nine Mile. On the municipal level, however, the discrepancy in municipal size and economic conditions between Indian Point's Westchester County, Ginna's Wayne County, and Fitzpatrick's and Nine Mile's Oswego County, which can be seen in Figure 17, would

Figure 17: Discrepancy Between New York's Nuclear Counties

County	Westchester	Oswego	Wayne
Population (July 2015 estimate)	976,396	120,146	91,446
Average Household Income	$81,946	$48,051	$52,601
Unemployment Rate (December 2016)	4.0%	6.7%	5.2%

Source: NYS Department of Labor, 2016; US Census Bureau, 2016; Index Mundi, 2013

increase the severity of local impacts in the event of upstate facility closures. For example, Oswego County, which has the fourth highest unemployment rate out of New York's sixty-two counties and an average household income of only forty-eight thousand dollars, relies heavily on Fitzpatrick and Nine Mile as monetary resources (NYS Department of Labor, 2016; Index Mundi, 2013). Together, the two facilities account for sixteen hundred jobs, with an average annual salary of about one hundred twenty thousand dollars (Klepper, 2017). When speaking on importance of these jobs to the city of Oswego, the Mayor Billy Barlow remarked, "These aren't just normal jobs. These are high paying jobs, the people who eat in our restaurants, shop in our stores, who make our community what it is" (Klepper, 2017). In Wayne County, Ginna employs about seven hundred people, and adds another eight hundred to one thousand jobs during maintenance and refueling periods (Nuclear Energy Industry, 2015B). An additional significance of these facilities is their creation of secondary jobs in industries that provide goods and services related to the operation of the facilities, such as jobs in construction, food services, and sales (Berkman & Murphy, 2015). Altogether, the three upstate facilities account for about twenty-five thousand in-state fulltime jobs, meaning that their closure would likely raise the region's already high unemployment rates (Berkman & Murphy, 2015).

Additional importance of these facilities stems from their production of significant local and state tax revenues and economic output through both direct and secondary economic activity. From the years 2015 to 2024, they are estimated to produce an average annual tax revenue of 144.5 million dollars and 576.4 million on the state and federal level, respectively (Berkman & Murphy, 2015). While these figures only account for a small fraction of state and federal tax revenues, this impact is amplified at the local level. For instance, Ginna is the largest taxpayer in Wayne County, directly contributing over ten million dollars in state and local property and sales taxes in 2014 (Nuclear Energy Institute, 2015B). Additionally, these facilities contribute over three billion dollars to the state GDP through the direct and secondary economic activity that they create (Berkman & Murphy, 2015).

Through these amounts, it can be seen that closure of Indian Point stands to severely impact Westchester County, and that similar impacts would be expected in the respective communities of New York's upstate facilities as a result of their closure. Due to the drastic importance of these facilities to upstate New York, an area already experiencing financial downturns, and the overall economic benefit that the subsidization program stands to have, Cuomo remarked during his announcement of the program that he believes that "the state has a moral obligation, a financial obligation and a civic obligation to step in" (Klepper, 2017).

Another impact of these facilities worth considering is their role in curbing electricity prices. In the absence of upstate nuclear generation, it is estimated that

New York's wholesale electricity prices would rise ten dollars per MWh, which translates into an annual increase of over 1.7 billion dollars on state ratepayer bills (Berkman & Murphy, 2015). If these estimates are correct, the subsidy program stands to prevent over twenty billion dollars in total bill increases over its twelve-year duration. With its anticipated cost of 7.6 billion dollars, to be covered through an increase of two dollars per month on retail electricity bills, the subsidization makes financial sense due to its overall impact on ratepayer savings alone (Klepper, 2017). Along with the local and statewide benefits of preserving upstate nuclear generation through the retention of tax revenues, jobs, and economic output, it can be seen that New York's decision to implement a nuclear subsidy is both financially sound and profitable.

3.3.2 Emissions Abatement

The ability of nuclear technology to generate electricity without the resultant carbon emissions associated with traditional forms of energy production is another important factor in New York's decision to preserve its upstate nuclear generation. As upstate nuclear accounts for over thirty-seven percent of carbon-free electricity generation in New York, avoiding around sixteen million tons of carbon dioxide (CO_2) emissions annually, preserving it is a crucial step in achieving the states aggressive emissions reduction goals outlined in the SEP (Nuclear Energy Institute, 2015A; Berkman & Murphy, 2015). By maintaining the CO_2 savings provided by these plants, the state will be able to pursue further emissions reduction through expansion of renewables and energy efficiency.

The importance of nuclear generation in limiting CO_2 emissions, and the challenges in replacing its carbon-free generation when lost, can be displayed through the emission-related concerns surrounding the closure of Indian Point. As Indian Point is the single largest provider of carbon-free generation in the state, providing over two gigawatts of electricity annually, replacing its power to the New York metropolitan area without increasing CO_2 emissions will require "a combination of energy efficiency, demand response programs and new high-voltage transmission infrastructure that will bring new and existing renewable energy resources" (Anderson, 2017; Nuclear Energy Institute, 2015A). Along with the state's aforementioned commitment to over two gigawatts of offshore wind by 2030, an additional renewables project expected to be a major part of this energy replacement solution is the Champlain Hudson Power Express, a two billion dollar venture that would bring one gigawatt of hydropower from Quebec to New York City via high voltage transmission lines by its expected completion date of 2021, effectively replacing about half of Indian Point's generation with renewables (St. John, 2017; Anderson, 2017). Wider initiatives, such as NY-Sun, which seeks to add three gigawatts of solar power by 2023, will play a smaller role in this replacement, as the generation will be spread across the state, while smaller, locally significant demand-side projects, such as energy efficiency, demand response, and on-site generation will be comparably significant (St. John, 2017).

While New York's commitment toward renewable development and demand-side improvements creates an optimistic outlook, the timeliness and proper execution of such projects is vital in ensuring that Indian Point's generation is replaced without increasing CO_2 emissions. The failure to achieve this task would have grave consequences in terms of state emissions levels. Such a predicament is currently being experienced in New England due to the closure of the Vermont Yankee nuclear facility, with ISO-NE experiencing an increase of about twenty pounds of CO_2 per MWh generated between 2014 and 2015 as the regional generation void left by nuclear is being filled by natural gas (Walton, 2017). This misfortune shows that Indian Point's closure "puts pressure on New York to find carbon-neutral alternatives to replace nuclear generation in the next five years" (St. John, 2017).

Beyond the potential for increased CO_2 emissions, Indian Point's closure has resulted in an unfortunate situation for New York, where a substantial portion of the efforts, funding, and resources that could be contributing toward reducing statewide emissions are instead being used to ensure that emissions levels do not rise. If this situation were exacerbated by the closure of upstate nuclear facilities, New York would undoubtedly have a tougher time in decreasing or maintaining its overall emissions levels. However, the preservation of upstate nuclear facilities will avoid such an issue, allowing the state to pursue its aggressive emissions targets. This rationale is evident in the CES Order itself, when stating that the nuclear subsidization program "has the considerable benefit of ensuring that the zero-emissions attributes will be preserved for a considerable period of time to give the RES program an opportunity to provide new renewable resources on a scale necessary to prevent backsliding on carbon emissions" (NYS PSC, 2016). A similar sentiment has been voiced by the Nuclear Energy Institute when pointing out that even the shutdown of the state's smallest nuclear facility, Ginna, "would undo all of the renewables investment made by New York in the past decade" (Nuclear Energy Institute, 2015B).

An additional quality of nuclear energy worth mentioning is its prevention of increased emission of "criteria pollutants", such as sulfur dioxide (SO_2), nitrous oxide (NO_x), and particulate matter (PM), whose impacts are often regional because air pollution impacts can cross state borders" (Berkman & Murphy, 2015). Annually, New York's upstate facilities are estimated to prevent the emission of over three thousand tons of SO_2, over thirteen thousand tons of NO_x, and over two thousand tons of PM from the state power sector (Berkman & Murphy, 2015).

3.4 ZEC Pricing and Facility Impact

By obligating all LSEs to purchase ZECs, the CES ensures financial backing of upstate nuclear to preserve its operation for the next several years. Over its twelve-year duration, spanning from 2017 to 2029, the program is estimated to direct 7.6 billion dollars to upstate nuclear facilities (Klepper, 2017). Exploring the formulation of the ZEC program and the financial structure of nuclear power plant operations will provide insight into the basis of its estimated cost and its foreseeable impact of these upstate facilities.

Over its twelve-year span, the ZEC program is segmented into six two-year segments, called tranches. The ZEC price, which is initially set for "Tranche 1" at $17.48, will be adjusted every two years for Tranches 2 through 6 in accordance with the established pricing formula for ZECs. ZEC price-setting methodology takes into account three components: the social cost of carbon (SCC), benefits received from the Regional Greenhouse Gas Initiative (RGGI), and the amount by which the sum of New York's Zone A Forecast Energy Price and Rest of State (ROS) Forecast Capacity Price exceeds $39 per MWh. The ZEC price formula using these factors is displayed below (Figure 18).

Figure 18: ZEC Price Formula

Social Cost of Carbon - **Baseline RGGI Effect** - **Amount Zone A Forecast Energy Price and ROS Forecast Capacity Price combined exceeds $39/MWh** = **ZEC Price ($/MWh)**

Source: NYPSC, 2016

Basing the ZEC price on SCC, which "is an estimate of the cost of economic damages associated with a small increase in carbon dioxide emissions, conventionally one metric ton, in a given year", links the financial support of nuclear facilities to their carbon-abating attribute (EPA, 2015B). The values used in the ZEC formula were adopted from an analysis by the U.S. Interagency Working Group, which has been used in numerous state and federal rulemakings since its publication in July 2015 (EPA, 2015B). The SCC values for each tranche, displayed in Figure 19, are an average of the projected SCC for its respective time frame. For example, Tranche 1 will run from April 1, 2017 to March 31, 2019, so the SCC value used for this period is the projected average SCC for April 2017 through March 2019 (NYPSC, 2016).

Figure 19: ZEC Pricing Components per Tranche

Tranche Number	SCC	RGGI	ZEC Price (prior to Zone A & ROS forecast subtraction)
1	$42.87	$10.41	$32.46
2	$46.79	$10.41	$36.38
3	$50.11	$10.41	$39.70
4	$54.66	$10.41	$44.25
5	$59.54	$10.41	$49.13
6	$64.54	$10.41	$54.13

Source: NYPSC, 2016

The subtraction of effects from RGGI, a mandatory cap-and-trade based program for CO_2 emissions across a coalition of nine Northeastern and Mid-Atlantic states, including New York, stems from the fact that nuclear facilities already receive some SCC-based benefits due to this program. In RGGI states, CO_2 emissions allowances are distributed to power plants, which enables nuclear facilities to sell their allowances and benefit due to their emission-free generation. The value assigned to this baseline RGGI price of $10.41, which will remain constant across all tranches, is based on the average forecasted RGGI allowance prices embedded in the Congestion Assessment and Resource Integration Study Phase 1 Report for April 2017 through March 2019 (NYPSC, 2019).

The second subtraction of the ZEC price formula accounts for the revenues received by nuclear facilities for selling power to wholesale markets and "the change in forecasts over time" of energy market prices (NYPSC, 2016). The value of this variable is equal to the amount that the sum of forecasted energy prices in NYISO Zone A and forecasted NYISO Rest of State capacity prices exceed thirty-nine dollars per megawatt hour. The thirty-nine dollar baseline value is an average of a forecast done by Intercontinental Exchange of NYISO Zone A energy prices from

April 2017 through March 2019 and a forecast done by New York Mercantile Exchange of NYISO ROS Capacity for April 2017 through March 2018, which represents “a forecast for long-term avoided power costs” (Walton, 2017; NYPSC, 2016). Although the upstate nuclear facilities are located in NYISO Zone B and C, Zone A and ROS are used as proxies for market conditions in this variable due to their ability to provide “liquidity and available data” and because “the same quality of independent forecasts is not available in Zones B and C” (NYPSC, 2016).

Additionally, a total maximum cap of 27,618,000 credits is placed on the sale of ZECs annually. This figure is based on the MWh generation output of upstate nuclear facilities over the period of July 2015 through June 2016, as this was the most recent 12-month production period during the creation of the ZEC price formula, making it the most practical estimate of their future annual generation. As one MWh of generation produces one ZEC credit with a value of $17.48 during Tranche 1, the total revenue received by these facilities through ZEC sales during this period will total to $965,525,280, assuming consistency in their generation output.

Due to costs administrative costs associated with the ZEC program, an additional $0.0594 will be added to the price of each ZEC (NYPSC, 2016B). This adder was determined by the estimated overhead and salary costs to be incurred by NYSERDA divided by the maximum number of credits to be sold during the first tranche of the program. While LSEs will bear this additional cost, payments received by nuclear facilities for the sale of ZECs will remain at the amount calculated by the original pricing formula.

Due to the aforementioned factors that have driven down wholesale electricity prices in New York, the state experienced the lowest wholesale electricity market prices in its history, averaging 44.09 dollars per MWh (NYISO, 2016). The average total generating costs for single-reactor nuclear facilities in the United States exceeding this price at an estimated 44.52 per MWh suggests that New York's upstate nuclear facilities have been recently operating under negative profit margins (Nuclear Energy Institute, 2016B). The exceptional seniority of these facilities has worsened this situation due to the significant maintenance measures necessary for their continued operation. For example, at Fitzpatrick, which has been operating for more than forty years, "Entergy recently spent millions of dollars replacing tubes in the main condenser at Fitzpatrick, and the company faces other required upgrades if it wants to keep operating the reactor" (Nuclear Information and Resource Center; Alliance for a Green Economy, 2015). From this, it can be seen that the ZEC program is necessary in enabling these facilities to undergo upgrades and remain financially adequate in increasingly competitive markets.

Chapter Four

Legality and Policy Implications of the ZEC Program

4.1 Summary

This chapter explores the legal discourse surrounding New York's subsidization of nuclear facilities, specifically regarding the jurisdictional authority of states in influencing wholesale power markets. This discussion will explore a prior legal conflict surrounding state manipulation of wholesale markets and its relevant legislation to assist in understanding the argument against, and New York's defense of, the ZEC program. The legal precedent set by this program, particularly through its use of SCC, will be of particular interest as it stands to pave the way for the promotion of nuclear generation across deregulated markets. Analyzing more recent programs supporting nuclear facilities in other deregulated states, such as Illinois and Connecticut, will serve to show how the precedent set by New York's subsidization has externally impacted state energy policy.

4.2 ZEC Litigation

As previously mentioned when discussing power market structure in Chapter 3, jurisdiction over power markets is split between federal and state entities, with FERC administering federal oversight of wholesale markets, and state PSCs controlling their respective retail markets. Due to the ZEC program's design of assisting nuclear facilities through state-ordered payments in order to retain base load nuclear generation in the NYISO market, the NYPSC was accused of infringing on FERC's jurisdiction on interstate wholesale markets. While the power sold into NYISO is only sold within New York, its auctions are considered interstate wholesale markets, as some of the generators bidding into the PX are located outside of state borders (U.S. District Court, Southern District of New York, 2016B). On October 19, 2016, this accusation materialized through *Coalition for Competitive Electricity, et al. v. Audrey Zibelman, in her official capacity as Chair of the New York Public Service Commission et al.* (CCE v. Zibelman), a lawsuit filed in the U.S. District Court for the Southern District of New York against the NYPSC by a coalition of IPPS that was formed to combat the ZEC program (Anderson, 2016; U.S. District Court, Southern District of New York, 2016A). In its opening statement, the lawsuit asserts that the ZEC program "invades FERC's 'regulatory turf' by 'adjusting an interstate wholesale rate' with a price supplement to a favored generator… and should be deemed unconstitutional" (U.S. District Court, Southern District of New York, 2016A). Through this, it can be seen that the CCE, for the sake of this lawsuit, charged that the NYPSC overstepped its jurisdictional authority by adjusting wholesale rates through preventing base load nuclear to be competitively priced out of the market, therefore compromising its true competitiveness. Before delving into the specifics of this lawsuit and case, it is helpful to first view another hallmark ruling that has largely shaped the legal space with which it concerns.

4.2.1 Hughes v. Talen

In 2011, due worries that its lack of in-state generation capacity was putting the reliability of its power grid at risk, Maryland underwent an effort to promote development of new in-state power plants (Farmer, 2016). To do so, the Maryland Public Service Commission (MDPSC), sought out proposals for a new natural-gas power plant, eventually selecting Competitive Power Ventures (CPV) to construct a 661 MW facility (Farmer, 2016). In order to solicit interest from developers, due to concerns that wholesale electricity prices in the PJM Interconnection, the RTO that serves Maryland and several other states, were "failing to encourage development of sufficient new in-state generation", MDPSC proposed a program to make such a development more financially attractive (Supreme Court of the United States, 2016). In this program, MDPSC would require all LSEs operating in Maryland to enter twenty-year pricing contracts with CPV at a price specified in the CPV proposal. With these contracts, CPV would sell its capacity into PJM through the PX, but would receive the contract price rather than the MCP "through mandated payments from or to LSEs" to make up the difference, the costs of which would be recovered through ratepayer bills (Supreme Court of the United States, 2016).

Due to the adverse impact that this program stood to have on their earnings, a group of incumbent generators filed a lawsuit against MDPSC in the Maryland District Court. The lawsuit, *Hughes, Chairman, Maryland Public Service Commision, et al. v. Talen Energy Marketing LLC, FKA PPL EnergyPlus, LLC, et al*. (Hughes v. Talen), claimed that the program "intruded into FERC's exclusive jurisdiction over wholesale energy markets", and was therefore unlawful (Farmer, 2016). After the District Court ruled that the program was unlawful on these grounds, a decision that was upheld by the United States Court of Appeals for the Fourth Circuit, the case was brought before the Supreme Court of the United States in February 2016 (Supreme Court of the United States, 2016).

The Supreme Court's decision, delivered on April 19, 2016, upheld the decisions of the lower courts in an eight to zero vote (Supreme Court of the United States, 2016). This touchstone of the Supreme Court's decision was the Federal Power Act, specifically the Act's decree that FERC is responsible in ensuring that "all rates and charges made, demanded, or received by any public utility for or in connection with the transmission or sale of electric energy subject to the jurisdiction of the Commission… shall be just and reasonable, and any such rate or charge that is not just and reasonable is hereby declared to be unlawful" (Federal Power Act, 2015). In its decision, the Supreme Court pointed to this statute, stating that Maryland "has acted to guarantee CPV a rate different than FERC's 'just and reasonable' rate and has thus contrived the goals of the Federal Power Act" (Supreme Court of the United States, 2016). Through this, it can be seen that MDPSC, by guaranteeing contract prices to CPV and encouraging full participation of its new natural-gas facility in the PX regardless of MCP, is altering wholesale prices governed by FERC and was deemed unlawful because of it.

In concluding its decision, the Supreme Court added clarification that is crucial to the legal debate surrounding New York's ZEC program, in stating, "our holding is limited… we need not and do not address the permissibility of various other measures States might employ to encourage development of new or clean generation… through measures 'untethered to a generator's wholesale market participation'" (Supreme Court of the United States, 2016). The vagueness of this conclusion poses difficulties in defining which state measures are truly “untethered” to wholesale market participation, making the relationship between ZEC prices and the market participation of the nuclear facilities receiving them paramount to determining the programs legitimacy.

4.2.2 Legal Defense of ZECs

Despite the accusations made against its lawfulness, the ZEC program is “carefully designed not to conflict with Federal jurisdiction” through the methodology by which ZEC prices are determined and how their pricing formula reflects the overall intent of the program (Barber, 2016). In this formula, which was discussed in Chapter 3, SCC is used as the baseline value for which ZEC prices are determined. By primarily using SCC to valuate ZECs, the formula establishes that “they are credits reflecting the environmental attributes associated with the production of energy using particular technology... that are not valued by market revenues, to induce the generators to continue to produce those attributes for the benefit of the customers” (NYPSC, 2016C). Proving that ZEC prices are determined by their emission-related attributes displays that the ZEC program was created for the purpose of achieving the statewide emissions reduction mandated by the SEP, which is crucial in supporting its legality as preservation of the environment and public health, both of which are improved through reduced emissions, is delegated to NYPSC through New York Public Service Law (PSL) (NYPSC, 2016C).

The specific clause that gives NYPSC its environmental authority states, “the commission shall encourage all persons and corporations subject to its jurisdiction to formulate and carry out long-range programs, individually or cooperatively, for the performance of their public service responsibilities with… the preservation of environmental values and the conservation of natural resources" (New York PSL §5). This law makes environmentally related goals and actions related to them "well within the regulatory authority of states", which can be shown through the commonality and lack of contention against renewable portfolio standards across the United States (Goldberg, 2016). In respect to public health and the electric system, New York's PSL also gives NYPSC the authority "to order such reasonable improvements as will best promote the public interest, preserve the public health and protect those using gas or such electricity (New York PSL §66). Through these established laws, ZECs are supported by NYPSC's duty to preserve aspects of the electric system that promote environmental and public.

As its opponents have pointed out, the subsidization of upstate nuclear generation will have an effect on wholesale markets by preserving base load generation that would otherwise be lost. However, this impact is inherent as state energy policy of any kind is "acting concurrently with respect to electricity markets and so it is unavoidable that state actions will impact the wholesale markets" (Goldberg, 2016). As established by *Hughes v. Talen*, such consequential impacts are permissible, as long as the state actions are not tethered to a generator's wholesale market participation. This decision reserved a range of options for states to pursue in subsidizing existing generation while still staying in their own jurisdiction, with valuing environmental attributes being one of these options. While CCE v. Zibelman is still held up in federal court, NYPSC's use of this option should protect it against accusations of infringement on FERC jurisdiction.

4.3 ZEC Snowball Effect

After the announcement of the ZEC program, several other states wishing to preserve their nuclear assets have looked toward New York to model such policies after. These states, namely Illinois, Connecticut, and New Jersey, are at various stages of implementing, proposing, and considering similar legislation that would establish state-level support of nuclear facilities in a way similar to the Order Adopting a Clean Energy Standard. As these states are comparable to New York in that they have deregulated energy markets and are in the same general geographic region, their nuclear facilities are facing financial difficulties driven by similar market trends impacting those in New York.

In Illinois, such legislation occurred through SB 2814, named the Future Energy Jobs Bill, which was signed into law on December 7, 2016 and is set to take effect on June 1, 2017 (Maloney, 2016). The large-scale legislation, which also includes initiatives to promote renewables, energy efficiency, and low-income energy programs, establishes a subsidy program that provides two nuclear facilities owned by Exelon with up to two hundred thirty-five million dollars per year for the next ten years, with a possibility of renewal at the end of the program (Lyderson, 2016; Maloney, 2016). Like those in New York, Exelon facilities in Illinois have been negatively impacted due to recent energy market trends, experiencing losses over the past seven years to the tune of about eight hundred million dollars (Maloney, 2016). In a way that seemingly mimics New York's legislation, the Future Energy

Jobs bill seeks to assist these facilities in establishing “zero emissions credits”, defined as “a tradable credit that represents the environmental attributes of one megawatt hour of energy produced from a zero emission facility… [which is] a facility that is fueled by nuclear power” (Rita, 2016). The similarity in their designs shows that “the DNA of the Illinois law is the New York Clean Energy Standard”, as both use environmental attributes of nuclear generation to carefully avoid intrusion into FERC jurisdiction over wholesale markets (Maloney, 2016).

Also similar to New York’s CES, the Illinois legislation is involved in a federal lawsuit due to its nuclear subsidization component. The lawsuit, which was filed on February 14, 2017 in U.S. District Court in Chicago by a group of competing power companies and coalitions, charges that the law “intrudes on federal authority to regulate wholesale energy prices” (Marotti, 2017). Due to their similar design, it can be assumed that the legal outcome of the CES will foreshadow that of the Future Energy Jobs bill, making it so that “if New York stands, they all stand; if New York fails, they all fail” (Maloney, 2016).

Connecticut legislators are currently drafting a bill, SB 106, which seeks to make nuclear energy eligible to receive the same payments as renewables for their carbon-free attributes (Maloney, 2017). These payments would come in the form of RECs that were already established in the state’s RPS, which has the goal of reaching twenty percent carbon-free electricity generation by 2020, and works similarly to that of New York in that it requires “electric providers to obtain a specified percentage or amount of the energy they generate or sell from renewable sources” (DEEP, 2016). In order to make nuclear eligible for REC payments, SB 106 seeks to classify nuclear power as a “Class I renewable energy resource”, putting in the same category as solar, wind, hydroelectric, geothermal, wave, tidal, biomass, and other generation sources (Maloney, 2017; DEEP, 2016).

While not specified by law, the single beneficiary of this bill would be the Milestone Nuclear Power Station, which is owned by Dominion Energy, as it is the state’s only nuclear facility. As Milestone alone accounts for about ninety-eight percent of Connecticut’s carbon-free electricity and about forty-six percent of Connecticut’s total electricity, Connecticut lawmaker’s will likely make the argument that SB 106 is necessary in ensuring that the state’s RPS and is achieved and that its electric system remains reliable (Dominion Energy, 2017; Maloney, 2017). While Milestone is still operating profitably, recent decreases in its revenue are creating concern over its future market performance (Maloney, 2017). This sentiment is best summarized by Senator Paul Formica, one of the sponsors of SB 106, when stating, “We know the nuclear industry has problems around the country. Do we want to wait until it’s a huge problem in front of our noses, or do we want to solve it ahead of time?” (Dominion Energy, 2017).

New Jersey, which receives about half of its electricity from three nuclear facilities, is also showing signs of interest in nuclear subsidization (Johnson, 2017). While these facilities are still profitable despite current market trends, PSEG, which owns and operates them, has reportedly been “having extensive discussions” with lawmakers about financial incentives to protect the facilities due to the belief that such profitability will not last if market trends persist (Johnson, 2017). PSEG’s concerns with this matter can be summarized by their communications director, Kathy Fitzgerald, who stated, "If that trend continues or worsens, our nuclear plants could cease being economically competitive which may cause us to retire such units prior to the end of their useful lives. It's important to get ahead of the issue here in New Jersey before we reach the point of no return" (Giambusso, 2016).

FirstEnergy, which owns two nuclear facilities in Ohio and one in Pennsylvania, has also expressed corporate interest for state regulators to support their nuclear fleet. In Ohio, these two struggling facilities account for about ninety percent of the state's emission-free electricity and about eleven percent of total electricity generation (Kowalski, 2017). A similar situation is being experienced at Beaver Valley, FirstEnergy's Pennsylvania facility, which is one of five nuclear facilities in the state that account for about a third of its electricity generation (EIA, 2017). The president and CEO of FirstEnergy announced in early March 2017 that a bill to implement a "Zero-Emission Nuclear" program "will be introduced soon" to the Ohio state legislature (Kowalski, 2017). While no such action has been announced for Pennsylvania, a spokesperson for FirstEnergy, Jennifer Young, has stated, "we are closely following developments related to the CES [in New York] as we consider what might be appropriate for Beaver Valley" (Litvak, 2016).

While the anatomy and success of legislation to promote nuclear generation remains uncertain in New Jersey, Pennsylvania, and Ohio, it is clear that New York's ZEC program has motivated other corporations to seek assistance for their nuclear assets that are currently or are likely to become financially burdensome. Both in Illinois and Connecticut, signed and pending legislation to support nuclear facilities also shows strong influence from New York, as the language and design of both bills compensates facilities for their emission-free attributes, allowing the states to provide subsidies without breaking federal-state jurisdictional rules. Overall, these cases display that New York's likely success in establishing a nuclear subsidy program has encouraged other states to follow suit, and that the benefits to Entergy in New York have created momentum for other companies to pursue similar legislation to protect their nuclear assets in other deregulated states.

Overall, this situation is congruent with a wider pattern in energy policy development, in which "states have long been incubators of policy ideas that ultimately swept across regions" (Rabe, 2004). As New York's ZEC program has initiated similar regulatory measures in nearby states, it can be seen that New York, through this novel policy, has become the incubator of state-level subsidization of nuclear energy. If trends within energy markets persist, it can be expected that such policies will be of growing necessity to preserve nuclear generation in deregulated states, leading to increased adoption of such policies in these states. Due to the fact that "in some cases, there is sufficient activity among multiple states that the federal government attempts to model its own efforts after earlier state experiments", and that this pattern "has only intensified in recent decades as state policymaking capacity has risen steadily alongside an attendant decline at the federal level", it is can be seen that New York's ZEC program would likely be the model of federal support of nuclear generation if such a program was implemented (Rabe, 2004). While the ZEC program's influence on federal policy is largely speculative, given the unpredictability of energy markets and politicized nature of energy policy, its growing influence on state-level policy is displayed in these cases.

Chapter Five

Conclusion

Exploring New York's ZEC program in the wider context of nuclear energy policy and energy markets provides numerous insights into its causes, purposes, and implications. Through this, the economic and environmental merit, regulatory legitimacy, and significance toward state-level energy policy become evident.

New York's nuclear facilities have been experiencing significant declines in profitability due to rising trends in its energy market. These trends, namely increasingly inexpensive and abundant natural gas and, to a lesser extent, the expansion of renewable energy generation, have lowered wholesale electricity prices and consequentially lowered the revenue received by nuclear facilities for their base load electricity generation. This financial situation, if unchanged, would soon force the closure of these nuclear facilities. Due to the severe harm that such closures stand to have on upstate local economies and mandated statewide emissions reduction goals, New York was compelled to preserve their operations for economic and environmental reasons. While upstate facilities were preserved, the lesser economic importance and heightened operational risk of the single downstate facility, Indian Point, led to its exclusion from such efforts and announced closure.

Comparing the estimated cost of subsidizing New York's upstate nuclear facilities with that of their closure, which accounts for loss of tax revenues, jobs, and economic output, shows that the ZEC Program is a financially responsible decision on the behalf of the New York State government. Additionally, the considerable challenge New York would face in replacing upstate nuclear generation without increasing carbon emissions can be displayed through its efforts to do so with Indian Point. Through this example, it can be seen that a complete loss of nuclear generation would make reaching the aggressive emissions reduction targets mandated in New York's SEP a nearly impossible task. By preserving much of its emission-free nuclear generation, New York will be able to pursue these targets rather than backslide on carbon emissions. Through this, it can be seen that New York nuclear generation will serve as a bridge to reach a renewable-dominant state electricity system, and retaining nuclear for the program's duration will help the state increasingly lower emissions until prepared to live without it.

Beyond its economic and environmental impact in New York, the ZEC program stands to have wider implications for state-level energy policy due to its carefully crafted framework. Basing ZEC prices primarily on the SCC effectively establishes that the ZEC program was created to credit nuclear facilities for their positive environmental attributes. By doing so, the New York is avoiding issues experienced by Maryland in *Hughes v. Talen*, as promotion of environmental quality is within state jurisdiction and is untethered to wholesale market participation. CCE v. Zibelman remains in federal court, but the ZEC's pricing structure will likely insulate the CES against charges related to encroachment on federal jurisdiction.

While still under challenge, the presumed success of New York has ushered in a slew of efforts and interest in state-level nuclear subsidy programs. Additionally, the similarity in the design of the ZEC program and these various drafted and hypothetical bills, which seek to reward nuclear power for its emission-free attribute, displays the strong influence that New York has had on them. Most notable of these bills have been Illinois's Future Energy Jobs Bill, which mirrors the CES in creating zero emission credits for nuclear facilities, and Connecticut's proposed SB 106, which takes a slightly different approach in seeking to include nuclear energy as a renewable resource in its RPS. Other instances of nuclear subsidy support driven by corporate interests, seen in lobbying efforts in New Jersey, Ohio, and Pennsylvania, can be attributed in part to the ZEC program as these corporations are seeking to benefit from the environmental attributes of their nuclear assets the same way Entergy stands to in New York.

5.1 Suggestions for Future Work

The research undertaken for this thesis has highlighted a number of areas in which further research would be beneficial.

One major topic that was out of the scope of this discussion, and for that reason was largely set aside, is the potential for nuclear energy technology to have an adverse impact on environmental and human health. A discussion on this would include the challenges surrounding spent nuclear fuel, water usage of nuclear facilities and their impact on local waterways and ecosystems, and the risks of radiation and nuclear accidents. This discussion would also benefit from research on the discrepancies between societal perception and actual prevalence of these impacts. Such research could entail research on the overall politicization of nuclear energy, including the divide in the environmentalist movement over it and how societal fears over nuclear weapons and proliferation have impacted its public approval.

Due to the undecided nature of *CCE v. Zibelman*, this thesis would benefit from a retroactive discussion of the court's ruling, paying special attention to any information that clarifies the jurisdictional boundaries between FERC and states in manipulating energy markets beyond what is known from the decision of *Hughes v. Talen*. While the decision of this case would essentially determine the legality of the Future Energy Jobs Bill in Illinois, a similar discussion may be of interest if there is any discrepancy between the two rulings. Also of interest would be research into the progression, or lack thereof, of nuclear subsidy programs in New Jersey, Ohio, and Pennsylvania, as well as programs in other states that have enacted them by the time of research.

The cost estimate of the ZEC program is founded on projected future energy market conditions, which are highly unpredictable and influenced by numerous complex factors. After the program is finished an interesting topic to examine would be how accurate these initial estimates were, and what major trends or events created any discrepancy with the actual final cost. Additionally, this discussion could include an overview of New York's performance in reaching its CES mandated emissions reduction targets, and how necessary nuclear energy was to reaching them after all.

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Appendix: List of Acronyms

CCA	Community Choice Aggregation
CCE	Coalition for Competitive Energy
CES	Clean Energy Standard
CPP	Clean Power Plan
CPV	Competitive Power Ventures
DOE	Department of Energy
EPA	Environmental Protection Agency
ESCO	Energy Service Company
FERC	Federal Energy Regulatory Commission
IPP	Independent Power Producer
ISO	Independent System Operator
LSE	Load-Serving Entity
MCP	Market Clearing Price
MDPSC	Maryland Public Service Commission
NYDPS	New York Department of Public Service
NYPSC	New York Public Service Commission
PSL	Public Service Law
PX	Power Exchange
REC	Renewable Energy Credit
RES	Renewable Energy Standard
REV	Reforming the Energy Vision
RTO	Regional Transmission Organization
RGGI	Regional Greenhouse Gas Initiative
ROS	Rest of State
SCC	Social Cost of Carbon
SEP	State Energy Plan
ZEC	Zero Emission Credit