RESILIENCE THROUGH ELECTRIC MICROGRID POLICY:

DRIVERS, DEMOCRACY, AND LEARNING

A dissertation presented
by
Joshua Ariel Laufer

to

School of Public Policy and Urban Affairs

In partial fulfillment of the requirements for the degree of
Doctor of Philosophy

In the field of

Law and Public Policy

Northeastern University
Boston, Massachusetts
December 2019
RESILIENCE THROUGH ELECTRIC MICROGRID POLICY:

DRIVERS, DEMOCRACY, AND LEARNING

by

Joshua Ariel Laufer

ABSTRACT OF DISSERTATION

Submitted in partial fulfillment of the requirements for the degree of
Doctor of Philosophy in Law and Public Policy
in the College of Social Sciences and Humanities of
Northeastern University
December 2019
ABSTRACT

Electric microgrids have become an increasingly attractive technology solution for states looking to enhance the resilience of critical infrastructure to extreme weather events and climate change. Although most states have pursued their development, there are significant differences between states in terms of levels of policy support and planning. What is driving the observed differences in policy outcomes for states across the U.S.? Furthermore, whether current policies and patterns of electric microgrid development are working towards or against a more democratic energy future, and whether state and local governments are learning from each other in implementing these policies have been underexplored. This dissertation addresses these three lines of inquiry.

Chapter 1 defines how the electric grid is vulnerable, what electric microgrids are and how they can mitigate the hazards facing the electric grid, what ownership models exist for them, and what research questions drive this dissertation. Chapter 2 combines a quantitative analysis of drivers of adoption and strength of electric microgrid policy with policy sequencing theory. Chapter 3 explores comparisons of the electric microgrid policies in Massachusetts, New York, and the largest city within each state to better understand whether they are consistent with the goals of energy democracy. Chapter 4 takes the same cases in Chapter 3 but compares their electric microgrid policies to better understand the development of their policies using the analytical lenses of policy diffusion and policy learning. The combination of locations and technologies studied herein are unrepresented in their respective literatures. The conclusion revisits the findings of these chapters, contextualizes them in their respective literatures, and makes recommendations for future research topics on electric microgrid policy.
ACKNOWLEDGMENTS

I wish to thank my family, friends, and colleagues for all of their support over the years-long journey that has culminated with this dissertation. My committee members, Professors Joan Fitzgerald, Jennie Stephens, Laura Kuhl, and Alan Clayton-Matthews all deserve enormous credit for their guidance, patience, and efforts to make this undertaking possible. In particular, I want to acknowledge my advisor and chair of my committee, Professor Joan Fitzgerald, for the countless hours of meetings, conversations, and time spent reviewing my work from start to finish.

I cannot give enough credit to my loving parents and brother. They were the true unofficial committee members that served as my sounding board for ideas and helping me through challenges I faced along the way. The honorable gentlemen of Blue House must be acknowledged here; you guys are the best. Finally, I want to give a shout out to my girlfriend for being there for me. You saw in me a tiny potato that could do the thing. My grandfather would tell me as I grew up that if it couldn’t be done, do it. I hope this serves as evidence of doing it. I look forward to my post-student life, finding my way to professionally and personally confront the climate crisis and make the world a more sustainable and loving place for all.
# Table of Contents

ABSTRACT ................................................................................................................................................. 3

ACKNOWLEDGMENTS ................................................................................................................................. 4

CHAPTER 1: Introduction .............................................................................................................................. 8

Electric Grid Vulnerabilities ......................................................................................................................... 8

Electric Microgrid Definition, Operational Considerations, Costs and Benefits, and Ownership Models .................................................................................................................................................................................. 10

Research Questions ................................................................................................................................... 17

Methodology ............................................................................................................................................... 17

Policy Contexts of Cases Studied in Chapters 3 and 4 ................................................................................. 22

State Policy Context-Massachusetts and New York .................................................................................. 22

City Policy Context-Boston and New York City ......................................................................................... 33

Dissertation Policy Outline ......................................................................................................................... 42

CHAPTER 2: Energy Resilience: An Analysis of Drivers of State Electric Microgrid Policy .............. 43

Abstract ...................................................................................................................................................... 43

Keywords .................................................................................................................................................. 43

Introduction .............................................................................................................................................. 43

Methodology ........................................................................................................................................... 51

Results and Discussion ............................................................................................................................... 55

Conclusions and Policy Implications .......................................................................................................... 62

CHAPTER 3: Energy Democracy and Electric Microgrid Policy ............................................................... 65

Abstract ...................................................................................................................................................... 65

Keywords .................................................................................................................................................. 65

Introduction .............................................................................................................................................. 66

Energy Democracy as an Analytical Lens and Frame .............................................................................. 69

Methods .................................................................................................................................................. 75

Results ..................................................................................................................................................... 76

Conclusion .............................................................................................................................................. 84


Abstract ...................................................................................................................................................... 89

Keywords .................................................................................................................................................. 89
Introduction ........................................................................................................................................... 89
A Review of Policy Learning, Diffusion, and Measuring These Concepts ............................................ 93
Methods ................................................................................................................................................ 103
Results .................................................................................................................................................. 105
Conclusion .......................................................................................................................................... 114
CHAPTER 5: Concluding Analysis ........................................................................................................ 116
Bibliography ......................................................................................................................................... 119
Appendix A: Chapter 3 Interview Protocol Template ........................................................................... 135
Appendix B: Chapter 4 Interview Protocol Template ............................................................................ 136
List of Tables and Figures

Table 1. 1: Interviewee Demographics .............................................................................................................. 19
Figure 2. 1: 2009 .................................................................................................................................................. 52
Figure 2. 2: 2014 .................................................................................................................................................. 53
Figure 2. 3: 2018 .................................................................................................................................................. 53
Table 2. 1: Models 1-5 Results ......................................................................................................................... 55
Table 2. 2: Population Density and Policy Level ............................................................................................... 58
Table 3. 1: Energy Democracy Frameworks and Dimensions ........................................................................... 72
Table 3. 2: Energy Democracy Analysis ......................................................................................................... 83
Figure 4. 1: Structure of the Policy Diffusion Concept, based on Goertz (2006, 27-67), Maggetti and Gilardi (2016), Problems (and solutions) in the measurement of policy diffusion mechanisms, Journal of Public Policy, Volume 36, Issue 1, Page 92, Reproduced with permission ........................................................................................................................................... 101
CHAPTER 1: Introduction

This dissertation research focuses on the relationships between policy and the potential role for electric microgrids in mitigating the disruptive impacts of climate change and extreme weather events on the electric grid. Electric microgrids provide the unique potential for combining environmental benefits, enhanced infrastructure resilience, and uninterrupted service during macrogrid outages into a single system, thus avoiding the risks of exclusively grid-connected renewable energy, fossil fuel, and energy storage systems that cannot island themselves (K. B. Jones, James, and Mastor 2017; Smith and Ton 2013; Vine, Attanasio, and Shittu 2017). Given the vulnerabilities of the current electric grid to extreme weather events and outages, cities need to implement solutions like microgrids to enhance the resilience of their critical infrastructure and communities (Campbell 2012; EOP 2013; Panteli and Mancarella 2015). However, electric microgrids are sufficiently expensive systems, relative to conventional grid-tied generation, that states have enacted policies to help cities plan and pay for their deployment (Cook et al. 2018; Kema Inc. 2014).

Electric Grid Vulnerabilities

The US electric grid has over 5,800 major power stations that provide energy to over 144 million end-use customers via more than 450,000 high voltage transmission lines (EOP 2013). The fact that much of the electric grid is above ground makes it vulnerable to extreme weather events (EOP 2013; Panteli and Mancarella 2015). Age amplifies the fragility of the system to severe weather; 70 percent of the transmission lines and transformers are over 25 years old, and the average age of power generating facilities exceeds 30 years (EOP 2013; Panteli and Mancarella 2015). Extreme weather is a major threat to energy system operations, as 80 percent of the significant outages between 2003 and 2012 in the US were due to severe weather events.
Such weather-related blackouts annually cost on average between $18 to $32 billion between 2003 and 2012, and have been increasing in frequency over the last 30 years (Campbell 2012; EOP 2013; Panteli and Mancarella 2015). Outages of this type will likely increase further due to climate change. With so much infrastructure exposed to the elements, particularly hurricane-force winds, it follows that approximately 90 percent of outages occur along transmission and distribution systems (EOP 2013; Panteli and Mancarella 2015).

Climate-driven increases in water and air temperatures, reduced water availability in some areas, and increasing intensity and frequency of storm events, sea level rise, and flooding all pose risks to the energy sector in the US (EOP 2013; Panteli and Mancarella 2015; Zamuda et al. 2013). One study developed a global hydrological-electricity modelling framework consisting of a physically based hydrological and temperature model connected to hydropower and thermoelectric power models, and found that due to a combination of projected rising global water temperatures and overall reduced streamflow, 5-22 percent of the 24,515 hydropower plants globally (included in the study) in the general circulation models’ (GCM) ensemble mean for representative concentration pathways (RCP) 2.6-8.5 will experience reductions in monthly usable capacity exceeding 30 percent by the 2050s (van Vliet et al. 2016). This compares with thermoelectric power usable capacity production reductions of 81-86 percent under the same climate assumptions for the 1,427 plants included in the study. Thus, the generating capacity of hydropower and thermoelectric powerplants will decrease in the future relative to their current capacities due to reduced streamflow and increased water temperatures in the absence of adaptation or technological innovation. Rising air temperatures due to climate change will likely affect the number of cooling degree days and heating degree days, as well as peak demand patterns (Wilbanks 2014). Other types of severe weather and natural phenomena that are
hazardous to energy infrastructure include: cold snaps, ice storms, snow, lightning strikes, fire, earthquakes, and heat waves (Hines, Apt, and Talukdar 2009; Panteli and Mancarella 2015).

In addition to climate change and severe weather, physical and cyber terrorism represent threats to national electric infrastructure (Quadrennial Energy Review Task Force 2015; National Research Council 2012; Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack 2008; H. Yin, Xiao, and Lv 2015). Solar and geomagnetic storms are further threats to the functionality of the electric grid in the United States and globally (Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack 2008). The centralized design of the electric grid, in part manifest via long-range transmission lines, exacerbates the risk of major outages as these lines serve a large number of customers compared to local distribution lines (Campbell 2012).

Electric Microgrid Definition, Operational Considerations, Costs and Benefits, and Ownership Models

One technology that can address some of the vulnerabilities of the electric grid is a microgrid, which is:

- a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island mode (Smith and Ton 2013, 22).

The composition of microgrids as both an energy supply source and electric infrastructure to distribute the energy generated on-site allows them to operate independent from the macrogrid. Hirsch et al. (2018) asserts that microgrids in industrialized countries must be contextualized as operating in parallel to a mature “macrogrid” featuring gigawatt-scale generation facilities and up to hundreds of thousands of miles of high voltage lines, little energy
storage, and powered primarily by fossil fuels (Farzan et al. 2013; Hirsch, Parag, and Guerrero 2018; E. R. Morgan et al. 2016). The independence of both generation and distribution systems from the macrogrid can also be referred to as a power island, or “an energized section of circuits separate from the larger system” (von Meier 2006, 152; K. B. Jones, James, and Mastor 2017). The island, upon being disconnected from the macrogrid, transitions from being a redundant set of infrastructures to the main source of power for users connected to the islanded area (K. B. Jones, James, and Mastor 2017; von Meier 2006, 153).

Stability, or maintaining a balance between generation and load, is the most significant operational challenge for microgrids (Kema Inc. 2014). Energy storage and responsive generation like combined heat and power (CHP) can accommodate for load variation. Other types of distributed energy resources (DER) are unable or less capable of modifying electricity output to improve stability. Smart inverter development, among other technologies, will likely improve the economics of variable supply as they become more available. Load management systems are also experiencing advancements that enhance their responsiveness and capacity to modulate loads. Storage technologies like batteries, which absorb or discharge energy, continue to grow in value at both macrogrid and microgrid scales.

Microgrids generally have fewer resources, which makes maintaining stability more difficult when the microgrid is islanded from the macrogrid (Kema Inc. 2014). Stability of a microgrid is usually resolved when it is connected to the macrogrid because the macrogrid supports the microgrid. However, the microgrid must use its own DER when the macrogrid is down to maintain stability. If electricity is oversupplied by the sources within the microgrid, a generator might trip-off and lead to loss of power. Rebooting generation and incrementally increasing load to restore equilibrium can take time. On the other hand, if power is under-
supplied, the equipment can get malfunction, become damaged, and may also result in instability that can shutdown generation. These concerns highlight the need for advanced control systems for microgrid stability. While technology is making microgrid stability easier to maintain, experienced distribution system engineers are still essential to appropriate design and effective operation of microgrids. Large microgrids generally have full-time engineering staff who have experience operating and maintaining the stability of microgrids. Small microgrid owners may not have the capital to hire a veteran engineer, especially since the need to operate microgrids islanded from the macrogrid is generally infrequent.

Understanding when microgrids need to operate independently of the macrogrid represents another operational challenge (Kema Inc. 2014). A brief outage or drop in generation from the macrogrid may be restored almost instantaneously while local generation ramps up. However, if the generation does not respond quickly enough, the energy loss within the microgrid can lead to outages that may require a lengthy “black start” process to restore power. Relays and monitoring systems that make these decisions automatically, as well as switches to enact different types of transitions, can vary enormously in terms of cost. Having a comprehensive knowledge of the requirements for undergoing operational transitions between the microgrid and macrogrid is crucial in selecting the equipment specifications when designing and buying a microgrid.

The modeling and engineering expense to develop the appropriate microgrid specifications, depending on how complicated the loads are as well as the types and quantity of generation within the microgrid, can range between $10,000 to over $1,000,000 for larger and more complex installations (Kema Inc. 2014). For a hypothetical 5MW microgrid with multiple DERs, there are several different categories of components needed totaling in cost between $1-
2.5 million. Three different components are needed for microgrid isolation and stability: a main transfer switch, a master controller, and a switchgear. For distribution automation, when both critical and non-critical loads are present, there are at least four pieces of equipment required. Distribution automation needs a sectionalizing switchgear, a remote switchgear control, automatic fault protection, and smart meters. There are also costs associated with smart grid enabled substation communication infrastructure up to the utility transformer or point of common coupling.

There are a variety of economic, environmental, reliability and power quality, and security and safety benefits of microgrids, some of which the macrogrid or DERs alone are unable to provide (Kema Inc. 2014). There are multiple economic benefits that can be realized from microgrid development. Microgrids can potentially reduce the cost of energy for facilities connected to them. Microgrids can participate in ancillary services markets and sell surplus electricity generated to the macrogrid in jurisdictions with net metering policies. Microgrids can also work with demand response programs. Furthermore, they can optimize assets given real time energy markets and pricing signals. Microgrids can decrease electric transmission and distribution losses and diminish or defer the need for additional electric transmission and distribution capacity investment. Microgrids can also facilitate the deployment of renewable energy generation.

Microgrid power quality, reliability, and environmental performance can benefit their developers and facility owners (Kema Inc. 2014). Facilities connected to a microgrid gain the ability to operate in the absence of the macrogrid, can decrease power interruptions they experience, improve the quality of the power delivered, and in combination enhance the reliability of electricity for connected facilities. Microgrids also provide the capability of
functioning without pre-existing gas or electric infrastructure. When microgrids have renewable DERs connected to them, they can reduce greenhouse gas (GHG) emissions and air pollutants of the electricity generated and delivered to the connected facilities. Microgrids can even provide safety and security as well in the form of safe havens during macrogrid outages, and community support when such outages are protracted over longer periods of time.

There are multiple models of microgrid ownership (Emmett Environmental Law & Policy Clinic 2014; Kema Inc. 2014). One such model places ownership in the hands of a distribution company (Kema Inc. 2014). The company would own a microgrid in parallel to the macrogrid, and because distribution companies are generally responsible for design and maintenance of the macrogrid, their expertise and inclusion in planning and implementing microgrids to improve grid stability and reliability logically follows. They also would not have to coordinate with multiple other entities in this process, thereby simplifying the management and governance aspects of ownership. However, this model is only possible in states that allow distribution companies to directly own and operate generation assets. A second ownership model involves a single private owner and participant. The one user would have full control over performance benchmarks for critical load support capacity and stability of the microgrid. If the combined user and owner of the microgrid had enough expertise in-house to operate and maintain it, additional expense in contracting out maintenance could be avoided.

Another model is a hybrid microgrid, which is a combination of private and distribution company ownership and operation (Kema Inc. 2014). Generation is owned or contracted for on behalf of the microgrid users whose load is controlled by the microgrid, while the individual service meters and distribution system are owned and serviced by the distribution company. Microgrid control and interconnection points are managed by the distribution company, as well
as when the microgrid is islanded from the macrogrid on both ends of the interconnection point. However, during the time that the microgrid operates in isolation from the macrogrid, the cost of management would be borne by the microgrid users. This model leverages private investment capital and the existing expertise of distribution companies regarding grid operations.

Multi-user, non-utility microgrid ownership represents yet another possible arrangement (Kema Inc. 2014). Multi-user microgrids allow business organizations to operate or own a microgrid serving multiple customers, their respective meters, and facilities. The business owning and operating a microgrid would need proficiency in efficiently and safely generating and distributing energy to its users. Access to private capital and sharing of private capital costs are two possible features of this ownership model. Multi-user microgrids require utility companies to grant an exception to utility franchise rules to allow their development. Working with multiple entities, meters, and facilities can increase the complexity of these projects.

Military bases, hospitals, university campuses, and critical community facilities during emergencies have been the focus of early microgrid development because they demanded higher reliability than was provided by the macrogrid (Grimley and Farrell 2016; K. B. Jones, James, and Mastor 2017). These entities generally were single-owner and did not cross many public right-of-way areas, thus avoiding some of the challenges that prospective microgrid customers currently face. Furthermore, the upfront costs and complexities of these systems, both technically and legally, have inhibited more rapid development.

Microgrids have also served completely independent of macrogrids to electrify rural villages and small islands (K. B. Jones, James, and Mastor 2017; Schnitzer et al. 2014). Lower operational costs, superior environmental performance of energy supply, and enhanced system reliability and resilience are among some of the reasons that microgrid development has been
undertaken (K. B. Jones, James, and Mastor 2017; Smith and Ton 2013, 13).

DERs, generally recognized as a crucial aspect of microgrids, are smaller-scale generation, efficiency, or storage resources that are typically sited on the customer end of the electric meter. Over their lifetime, DERs are hypothetically cleaner, more reliable, more efficient, and possibly even cheaper than the centralized macrogrid. There are at least two distinct reasons why microgrids can yield significant environmental benefits to customers (Vine, Attanasio, and Shittu 2017). Microgrids have the capacity to utilize renewable and zero-emission sources of generation, such as wind turbines and solar photovoltaic panels, which are less polluting and greenhouse gas intensive than fossil fuel-based ones like natural gas or coal. The other is the potential to more fully utilize the heat generated on-site for space heating and hot water relative to centralized generating facilities, as well as reducing the efficiency losses associated with long transmission distances from centralized power plants.

Community microgrids build upon the islanding and environmental benefits of single-owner microgrids by sharing their distributed energy resources and associated resilience benefits with the communities they serve (Wu, Ortmeyer, and Li 2016). Community microgrids can link multiple distributed energy resources and critical loads via utility-owned distribution lines. Community microgrids provide regulation over frequency and voltage, the capacity for fast load shedding, economic and emergency demand response, and power flow control. New York City and Boston are two examples of cities, bolstered by state policies, that are funding and building electric microgrids that will serve their communities and neighborhoods (BNL 2017; NYSERDA n.d.; Wood 2018).

These different models of ownership and use of electric microgrids demonstrate that multiple approaches exist for their development. What models work best for a given community
often depends on their legal and policy context (K. B. Jones, James, and Mastor 2017; Kema Inc. 2014). There has not been much research on how cities and states decide which models of microgrid development are best suited for them. Do communities and states learn from each other’s experiences with electric microgrid policies and projects? What is driving states and cities to pursue this technology and policies that support their development? My dissertation research questions address those above.

Research Questions

The overarching research question for this dissertation is what factors influence state electric microgrid policy, and how do they affect policy implementation? This question is broken down into three sub-questions that serve as the focus of Chapters 2-4. The first is what are the key drivers of state electric microgrid policy adoption, and is there a correlation between these factors and the strength of those policies? The second is how do policies and regulations related to microgrid development align with or run counter to the goals of energy democracy? The third set of questions ask whether policy diffusion occurred in the case of electric microgrid adoption? If diffusion did occur, what was the mechanism of diffusion? And how did policy innovation come from within the polity in cases where policy diffusion was not responsible for policy change?

Methodology

The methodology of the quantitative analysis in Chapter 2 is a combination of linear fixed effects and random effects ordered probit models that are described in greater detail within that chapter. Since Chapters 3 and 4 use the same methodology and cases but ask different questions, I describe the methodology and cases for both chapters here.

To address my research questions and assess the explanatory propositions for the cases
studied, a comparative case study approach was adopted in both Chapters 3 and 4. These case studies utilize both interviews and a review of existing documents and literature on these policies to address the research questions. Explanation building as a case study methodology is an iterative process in which a tentative initial theoretical statement or explanatory proposition is made, and is subsequently contrasted with the data collected (R. K. Yin 2017). Revisions are then applied to the proposition or statement as needed, which is then compared against other details of the case, and then with data from other cases since it is a multiple-case study. These studies utilize a multiple-case embedded case study design because the two states are the cases, and the two subunits of analysis are the actions taken by the state and the actions taken by a municipality within each state (R. K. Yin 2017). The subunits were sufficiently connected that neither could be considered as merely context for the other, but rather were intertwined as co-equal subunits worthy of further investigation. The analytic technique I use in data collection is explanation building, which stipulates set of causal sequences about ‘how’ or ‘why’ an outcome occurred (Yin 2017, 179-181). The explanation is built by articulating an explanatory proposition, and then comparing the data from the case study against the proposition. This is an iterative process and is compatible with the multiple case study design chosen. Entertaining plausible alternative or rival explanations is an essential component of the process of explanation building.

The cases were selected after completing preliminary research into which states were pioneering electric microgrid policy. Both states had produced major reports on developing microgrids and established microgrid grant programs with budgets in the tens of millions of dollars. Both states also passed legislation for economy-wide greenhouse gas emission reduction and renewable energy production targets, which created policy environments favorable to
electric microgrids integrating renewable energy sources. Prior knowledge of some of the stakeholders in the Massachusetts case, discovering that NY was a first mover in electric microgrid policy, and their regional proximity and similarities in governance all contributed to the selection of Massachusetts, New York, and their analytical subunits. There are several differences between the states that enabled comparisons between them. One such difference is that NY funds every stage of development with NY Prize, while MA primarily funds feasibility studies to assist recipients in attracting private investment capital for the remaining financing. Unlike MA, NY received post-Hurricane Sandy support from the federal government that was allocated by the state to programs investing in microgrid development that had an emphasis on communities devastated by the storm. NY also has a significantly larger population size than MA. The role of federal policy in advancing electric microgrids in these cases is minimal beyond block grant distribution, does not substantially affect energy democracy in these cases, and for these reasons is not explored in Chapter 3. Similarly, since the discussion of policy diffusion in Chapter 4 is between states, the role of federal policy in the diffusion and innovation of electric microgrid policy is not investigated.

Table 1.1: Interviewee Demographics

<table>
<thead>
<tr>
<th>Organization Type</th>
<th>MA</th>
<th>NY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Quasi-Public/Public Benefits Corp</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Nonprofit</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Private Utility</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

The data were collected between November 2018 and February 2019 via 15 semi-structured interviews conducted over the phone or in-person. The interviewees represent officials
of the governments of the jurisdictions, as well as quasi-public and nonprofit agencies advocating for electric microgrid implementation. These sectors were the focus of my data collection because policy formulation and implementation are primarily done in the public domain. Nonprofits were specifically interviewed in part because they were recipients of policy benefits and were arguably the next closest representation of the general outside of elected government officials. Efforts to schedule interviews with utility companies were unsuccessful, and private non-utility stakeholders were not targeted for inclusion in the study because the focus of the research was to study policy and the dynamics between policymakers and nonprofit sector microgrid advocates.

Interviewees were selected based on a combination of: internet-based research or prior knowledge of individuals connected to either an organization administering or receiving electric microgrid-targeted funds, and in the case of nonprofits demonstrated advocacy and campaigns specifically focused on microgrids in the cases studied. Having these criteria for participant identification and selection makes this a purposeful sample because the participants included met characteristics that directly related to my research question (Lichtman 2014). Snowball sampling was also used to expand the list of interview participants; snowball sampling is a sampling method where interviewers ask interviewees for recommendations for who else they should talk to (Lichtman 2014). The combination of purposeful and snowball sampling yielded the final 15 participants that were interviewed; seven from purposeful sampling and eight were added later by snowball sampling. Fourteen of the fifteen interviews were completed in a single session, ranging in length from thirty minutes to over an hour (for one interviewee it took two sessions to complete going through the protocol due to scheduling constraints). The number of interviews conducted was sufficient because at both the state and municipal level governments, quasi-public
entities, and nonprofits were represented, often with more than one individual interviewed, and enabled discussion of both the explanatory proposition as well as rival propositions. As Yin (2017) highlights, ensuring a case is complete does not require the impossible task of gathering all possible evidence, but rather that readers are satisfied that a comprehensive treatment of the critical pieces was achieved (Yin 2017, 244-245). The “completeness” of a case study is challenging to operationally define but is important in an analogous fashion to finishing a musical composition or painting; there are three aspects of completeness discussed in Yin (2017). The first is to clearly distinguish the phenomenon being studied with the its context by identifying case boundaries. The second is through sufficient data collection as referenced above, and the third is the absence of artifactual conditions that arbitrarily constrain the researcher’s ability to finish the study.

The policy context analyses involved reviewing and synthesizing gray literature (digitally available government reports press releases, websites, news and peer-reviewed) and journal articles. Energy and climate change plans, reports, and policies that directly or indirectly address electric microgrids at state and municipal levels and from their respective governments or quasi-public entities served as the scope of policies included in the policy context analysis. The analysis of interview data was based on a combination of notetaking during the interviews, reviewing recordings for recorded interviews, and synthesizing details into a spreadsheet organized by interviewee and summaries of their responses with regards to the explanatory proposition. The contextual background research and interview data for each case together comprise the case-level analyses detailed in Chapters 3 and 4.
Policy Contexts of Cases Studied in Chapters 3 and 4

Massachusetts and New York are two states in the U.S. Northeast with large cities (Boston and NYC respectively); both are home rule states that have deregulated their electricity sectors. Massachusetts and New York, and Boston and NYC all have ambitious GHG emission reduction goals, and all have been early adopters of electric microgrid policy. New York is one of the first to have implemented a competitive microgrid incentive program, and it funds all stages of the project development process for winning applicants. Projects that relate to storm recovery in New York and New York City also receive federal financial support. Massachusetts also has competitive microgrid incentive programs, but they only fund feasibility studies using state and local money. The programs studied in both states focus on critical infrastructure resilience and serving vulnerable populations. New York has allowed NYC to develop hybrid ownership models for electric microgrids despite electric sector deregulation, while Massachusetts has yet to permit Boston to pursue the same ownership model given similar legal constraints.

State Policy Context-Massachusetts and New York

Both state and urban analytical subunits of electric microgrid development and policy in these cases are influenced by state policy and thus it is important to understand the extent to which state requirements versus local decisions affect the policy approaches observed. This section reviews the policy context in Massachusetts and New York.

Massachusetts Policy Context

M.G.L. Chapter 164: Massachusetts Electric Industry Restructuring Act of 1997 changed the electric utility industry in Massachusetts such that electric supply be sold to customers through a competitive market, rather than exclusively owned and sold from utility companies
(Commonwealth of Massachusetts 1997). This gave customers the option, for the first time, to select which electric supply company they purchase their energy from. This was enacted into law for multiple reasons, including consumer protection, lowering electric rates, reduction in monopoly power of utility companies, and giving suppliers the opportunity to offer more environmentally friendly options to customers than were previously offered by the utility companies. It is the latter goal that could potentially positively impact the development of renewable energy-fueled microgrids.

However, (M.G.L. c. 164, § 1B(a)), also known as the “franchise clause,” could potentially constrain non-utility owned microgrid development (Emmett Environmental Law & Policy Clinic 2014). The franchise clause has been summarized, according to one analysis, as stated below:

Except with the written consent of the distribution company, no person other than a distribution company shall deliver electricity over lines operating between 110 and 69,000 volts from points on the transmission system or from a generating plant to a customer within the distribution company’s service territory. (Emmett Environmental Law & Policy Clinic 2014)

M.G.L. c. 164, § 1A and M.G.L. c. 164, § 1A(c) collectively prohibit a distribution company from owning, operating, or acquiring generating facilities, which greatly constrains the ability of utility companies to build or develop their own microgrids (Emmett Environmental Law & Policy Clinic 2014).

GHG emission reduction targets pressure electric microgrid developers, in addition to electric supply companies more generally, towards prioritizing renewable energy over fossil fuel energy. Massachusetts passed the Global Warming Solutions Act (GWSA) in August 2008 (EOEEA 2012). GWSA is one of the first regulatory programs to directly address climate change enacted in the nation. GWSA mandated the Massachusetts Executive Office of Energy
and Environmental Affairs (EOEEA), in collaboration with the public and other state agencies, to establish GHG emission reduction targets for the state across all economic sectors. The state must achieve reductions between 10-25% below 1990 statewide GHG levels by 2020, and 80% below 1990 statewide GHG levels by 2050. The act mandates the state take multiple steps to achieve these objectives. One such step orders the creation of regulations requiring reporting of GHG from the state’s biggest emitters. The state needed to produce a baseline evaluation of GHG emissions statewide in 1990 to serve as a benchmark against which progress was measured. GWSA required the state to establish a projected “business as usual” scenario for 2020 in the absence of government intervention as another variable to help estimate required emission reductions by that year (EOEEA 2012). The act mandated the state set target emission reductions for 2020, as well as a roadmap for accomplishing them by January 1, 2011. The state also needed to analyze approaches and provide recommendations for climate change adaptation by December 31, 2009 via an advisory committee. EOEEA created two advisory committees for the purpose of informing GWSA implementation. EOEEA formed the Climate Protection and Green Economy Advisory Committee to advise EOEEA on how to achieve GHG emissions in compliance with GWSA. The second committee EOEEA developed is called the Climate Change Adaptation Advisory Committee, and they analyze and prescribe climate change adaptation solutions for the state.

Massachusetts created the Community Clean Energy and Resiliency Initiative (CCERI), a $40 million grant program administered by the Massachusetts Department of Energy Resources as part of its broader efforts to mitigate and adapt to climate change (EOEEA 2014). The grant’s funds support municipal resilience by utilizing clean energy technologies to prevent energy service disruption due to severe weather events exacerbated by climate change. Three rounds of
funding transpired beginning in 2014, with particular emphasis on critical facilities, and among the technologies receiving funding from the grant program were microgrids. CCERI funding applications had four major requirements (The Cadmus Group, Inc. 2015). The first was that the project needed to be submitted by one or more municipalities, regional planning agency, or public-private partnership. The second requirement was that the project would serve a critical facility. The third requirement was that the proposed project had to incorporate storage, clean energy generation, or energy management technologies. The final requirement was that the project had to provide a minimum of three days of electric power autonomously in the event of a power outage. Critical facilities were defined by the program as “buildings or structures where loss of electrical service would result in disruption of a critical public safety life sustaining function,” which could include community, lifeline, or life safety resources (McGuire 2014).

The Massachusetts Clean Energy Center, in accordance with a 2014 order from the Massachusetts Department of Public Utilities for public utilities to develop 10-year grid modernization plans, created and executed an electric microgrid feasibility study grant program (MassCEC 2017b). The goals of the program were to accelerate the development of community microgrids to reduce energy costs for customers, lower greenhouse gas emissions, and enhance energy system resilience. Community microgrids were defined in the Request for Expressions of Interest (REOI) as “…multi-user microgrids, which provide electrical and/or thermal energy to multiple site owners and have broad support from the local community, relevant utility(ies), and building or site owners” (MassCEC 2017a). Eligible microgrids had to be located in Massachusetts, be a multi-user microgrid, serve a minimum of one critical facility, and integrate renewable energy. According to the REOI,

A critical facility is a structure that – because of its function, size, service area, or uniqueness – has the potential to cause serious bodily harm, extensive property
damage, or disruption of vital socioeconomic activities if it is destroyed or damaged or if its functionality is impaired. It is incumbent upon respondents to adequately justify that a facility included in the response serves a vital function to the community in the event of an emergency and is thus a “critical facility” (MassCEC 2017a).

Additional project guidelines from the REOI were that proposed microgrid projects have no more than a dozen buildings in close proximity, have symbiotic loads, include a significant thermal component to take advantage of CHP, were located in an area or community with a minimum population density of around 4,500 people per square mile, serve at least one vulnerable population, and have demonstrable local government and utility support (MassCEC 2017a). Both financial and non-financial metrics for indicating local government support were acceptable, including providing city-owned space for generation assets, designating staff to support the project, or developing policies that facilitate microgrid deployment. Requests for Expressions of Interest and Proposals were sent out in 2017, and in February 2018 14 multi-user community microgrid projects, including multiple projects in and close to Boston, each received $75,000 for feasibility studies with the hope of attracting private investment (MassCEC 2017b; Wood 2018). According to Steve Pike, CEO of the Massachusetts Clean Energy Center (MassCEC) and organization administering the microgrid program,

These assessments will provide critical insight into the potential benefits community-based microgrids could deliver to ratepayers across the Commonwealth… While increasing resilience and lower the cost of energy in these communities, we expect these projects will help to identify market barriers and provide models that can be replicated in cities and towns across the state. (Wood 2018).

The microgrids that received feasibility study funding intend to serve hospitals, fire and police departments, public schools, affordable housing facilities for low-income and senior citizens, grocery stores, emergency shelters, and water and wastewater treatment plants (MassCEC 2017a; Rubenoff 2018; Wood 2018). While applicants self-selected what projects
they applied for, MassCEC had the sole authority to select winning projects (MassCEC 2017a). Seven of the fourteen winning project summaries list “affordable housing” as among the infrastructure served by their respective proposed microgrids (MassCEC 2018).

State policies in Massachusetts establish the importance of reducing greenhouse gas emissions, increasing critical infrastructure resilience, and funds feasibility studies of projects in municipalities within the state that contribute to these goals. The cost premium of electric microgrids over conventional grid-tied systems makes state incentives vital for a number of projects to become viable. The policies also define what constitute eligible microgrids, applicants, technologies, and deadlines for submission among other project elements.

**New York State Policy Context**

In 1996, the New York Public Service Commission (PSC) issued an electric industry restructuring order that mandated utilities to submit restructuring plans that articulated how they would fully divest from generation assets (NYSERDA, NYS DPS, and NYS DHSES 2014). In 1998, the PSC issued the Vertical Market Power Policy Statement (VMPP) of 1998, which stipulates specific conditions under which utility ownership of generation assets may be permitted, including demonstrable ratepayer benefits and market power mitigation measures from utility ownership.

The PSC is granted the authority to regulate electric and steam corporations under Article 4 of New York State Public Service Law (PSL) (NYSERDA, NYS DPS, and NYS DHSES 2014). Electric corporations are any corporation or analogous entity that owns, operates, or manages any electric plant subject to certain exemptions. Private microgrid developers, if they are unable to secure an exemption may receive a reduced regulatory requirement based on a “realistic appraisal” test that gives the PSC discretion over the appropriate degree of regulation
(NYSERDA, NYS DPS, and NYS DHSES 2014). If a microgrid is regulated by the PSC as a utility, Article 4 delineates the regulatory powers the PSC would apply to the project. Such PSC regulatory powers include: general supervision, determine rates, quality of service, billing, public reports and administration, corporate structure and finance, incorporation, certificates, and franchises, and residential service. Perhaps the most critical of these powers, with regards to microgrid development, are the incorporation, franchises, and certificates; an electric corporation may not build a plant without PSC consent and approval. Similarly, a corporation may not utilize a privilege or right under a granted franchise without PSC permission and approval; the PSC can grant permission and approval after a hearing and determination that building or exercising a right, privilege, or franchise is convenient or necessary to serve the public.

Microgrids that cross a public right of way, including the development of transmission or distribution facilities over public streets, must receive permission by the municipal authority via a franchise or lesser consent depending on the scope of the development (NYSERDA, NYS DPS, and NYS DHSES 2014).

As provided by N.Y. Gen. City Law § 20(10), every city is empowered to grant franchises or rights to use the streets, waters, waterfront, public ways, and public places of the city. “Use” encompasses occupying public rights-of-way and operation of the provider’s built infrastructure to provide the public service. Individual franchises—contracts between a company and the municipal authority—require specific legislative authority and are granted for a limited term of years after a public bidding process (NYSERDA, NYS DPS, and NYS DHSES 2014).

Franchises are often nonexclusive, and the territory where a facility installation is permitted under a franchise is where the public service is provided (NYSERDA, NYS DPS, and NYS DHSES 2014). Unless a grant is exclusive in its terms, the grantor wields the authority to grant future competitive franchise without violating the first franchisee’s constitutional or contractual rights. Monopoly is not a critical feature or state requirement of a franchise.
Municipalities can administer special permissions for small encroachments of public space that provide an alternative to large-scale franchise via permits, right of way permits, revocable consents, revocable licenses among other legal instruments. If a municipality does not utilize a standardized permitting process for granting such a property right, an authorized party must give permission on an individual basis.

The 2015 New York State Energy Plan articulates a vision for New York’s energy future, including policy recommendations (NYSEPB 2015). The plan coordinates Governor Andrew Cuomo’s Reforming the Energy Vision (REV) and other policies in a comprehensive roadmap. It outlines three goals for the state by 2030: a 40% reduction in greenhouse gas emissions from the energy sector from 1990 levels, providing 50% of electricity generation from renewable energy sources, and a 600 trillion Btu gain in energy efficiency.

On July 28, 2019, Governor Cuomo built upon NY REV by passing the Climate Leadership and Community Protection Act (CLCPA) (Governor’s Press Office 2019). CLCPA mandates the state achieve 70% of the state’s energy come from renewable energy resources by 2030 and is carbon neutral by 2040. CLCPA also requires the State to reduce its overall greenhouse gas emissions by 40% by 2030 and by 85% by 2050 relative to a 1990 baseline. The Climate Action Council will create a plan to offset the last 15% of emissions by capturing carbon or using other technologies.

New York State’s Energy Research and Development Authority’s (NYSERDA) 2010 report, “Microgrids: An Assessment of the Values, Opportunities, and Barriers to Deployment in New York State,” explored the potential value of deploying electric microgrids and opportunities and barriers to their implementation. The report detailed a typology of microgrid ownership and service models, case studies of existing and planned projects, and NY legal and regulatory
frameworks for electric microgrids. It also studied microgrids elsewhere in the U.S. and their value streams. The research for the report was based on a combination of legal analysis and literature review on microgrids and distributed energy resources, and semi-structured interviews with state energy regulators and microgrid developers from eleven U.S. jurisdictions outside of NY (Arizona, California, Connecticut, Delaware, Illinois, Maryland, Minnesota, Oregon, Pennsylvania, Texas, and Washington DC). The interviews were conducted to answer four questions: whether microgrids were legally defined in administrative rules or state law, whether microgrids could legally exist and under what conditions, whether policymakers thought about microgrids, and whether existing distributed generation policies like interconnection standards and net metering might apply to microgrids. The report ended with policy recommendations to encourage microgrid investment in the state. Thus, the report was based upon learning about policies from elsewhere, and articulated recommendations in response to that data formulated to the context of NY.

Following the 2010 report and Hurricane Sandy in 2012, the NY State Legislature in 2013 directed NYSERDA, NYS Department of Public Service (DPS), and the NYS Division of Homeland Security and Emergency Services (DHSES) to craft recommendations for developing microgrids in the state. (NYSERDA, NYS DPS, and NYS DHSES 2014). The result was a report published in 2014 that evaluated the feasibility of electric microgrids for enhancing resilience of critical facilities that provide public security, health, and safety when the electric grid goes down for more than three days due to manmade or natural hazards. The enabling legislation for the interagency team (Project Team) defined what a microgrid was and mandated responses from the Project Team on eight topics. These topics were: whether critical facilities with a mission in disaster relief and recovery want to collaborate on microgrids, what geographic areas should be
prioritized for microgrid development, the types of microgrid projects that were possible, how microgrid operation would work within utility requirements for safe and adequate service provision to ratepayers, the regulatory environment microgrids would be operating under, both technical and regulatory aspects of how microgrids would interconnect, whether microgrids would operate as intended under emergency situations, funding mechanisms that would pay for the entire lifecycle of these technologies, and a cost benefit analysis for microgrid development and implementation. The report made numerous recommendations, particularly that in conjunction with federal and private sector partners, the state should advance microgrid development at critical infrastructure sites only if the benefits exceeded the costs.

NY Prize, a pioneering $40 million competition, offers awards to communities statewide for microgrid projects that began in early 2015 (NYSEPB 2015). The competition consists of three stages of awards: feasibility studies, audit-grade design, and project build. The competition pushes communities, businesses, electric utilities, and entrepreneurs to design and implement community-based microgrids. According to the Stage 2 RFP,

NY Prize seeks to support the development of community grids encompassing no less than one facility providing a critical service to the public that is connected to multiple, uniquely owned/controlled buildings that act as a group of interconnected loads and distributed energy resources, lie within a clearly defined electrical boundary and act as a single controllable entity, which can connect and disconnect from the surrounding utility grid and operate in both grid-connected or island mode (NYSERDA 2016).

NYSERDA administers the program with assistance from the Governor’s Office of Storm Recovery (NYSERDA n.d.). Applicants must include the local electric distribution company and more than one entity that will benefit from microgrid operation, but single-owner “campus-style” microgrids are ineligible (NYSERDA n.d.). Eligible entities can include teams of: universities, counties, utilities, municipalities, property owners, energy service companies,
hospitals, critical facilities, emergency shelters, schools, technology vendors, and energy project developers.

'Critical infrastructure' means systems, assets, places or things, whether physical or virtual, so vital to the State that the disruption, incapacitation or destruction of such systems, assets, places or things could jeopardize the health, safety, welfare or security of the state, its residents or its economy (NYSERDA n.d.).

NY Prize proposals submitted by storm-impacted communities across the state, as well as low and moderate income (LMI) communities, may be supported via funding from the Governor’s Office of Storm Recovery (NYSERDA n.d.). Stage 1 Request For Proposals (RFP) is closed and applications were accepted until May 2015 (NYSERDA n.d.). The NY Prize Selection Committee approved up to $100,000 in funding for 83 feasibility studies across the state in July 2015 (NYSERDA n.d.). Participation in Stage 1 was not required for Stage 2 eligibility, and Stage 1 feasibility studies are complete and uploaded to NYSERDA’s website. Stage 2 RFP is also closed, and the NY Prize Selection Committee approved up to $1,000,000 in funding for 11 designs across the state in April 2017. Stage 2 design RFP studies are underway and anticipated to be finished by spring 2019. For Stage 3, NYSERDA expects a competitive project build-out RFP to be released in 2019 with winners selected and announced by late 2019. Nine of the 83 Stage 1 awards and three Stage 2 awards are located in New York City (NYSERDA n.d.). NY Prize exclusively focuses on electric microgrids and grants money towards audit-grade design and project builds.

Governor Cuomo established the Office of Storm Recovery (GOSR) in response to Hurricanes Irene, Lee, and Sandy to address the needs of affected communities and enhance the resilience of New York State’s critical infrastructure (GOSR n.d.; n.d.). With approximately $4.4 billion in flexible funding from the U.S. Department of Housing & Urban Development (HUD) Community Development Block Grant Disaster Recovery (CDBG-DR) program, and
partnering with NYSERDA, GOSR’s Microgrid Program selected three projects: a downtown microgrid in the Village of Freeport, a microgrid in the Village of Greenport, and a microgrid powering disaster recovery shelters and multiple businesses in Schenectady (GOSR n.d.; n.d.; n.d.). All three projects are in progress with estimated completion dates in 2021 (GOSR n.d.).

State policies in both cases emphasize critical infrastructure, vulnerable populations, and public benefits for project eligibility and criteria for funding consideration. Both cases also highlight new possible ownership models for more distributed and decentralized energy systems under greater degrees of public control. In NY in particular, there is also a focus on recovery from devastating storms that already hit the state, including in some of its more vulnerable communities. Since much of the funding for electric microgrids comes from state policies in both cases, the definitions set by state agencies for eligible microgrids, applicants, technologies, and deadlines for submission among other project elements, shapes the terms within which these cities have to operate if they want to utilize the money and technical assistance set aside by these policies for electric microgrid projects in their municipality. Both states deregulated their electricity sectors, which generally prohibits nearly all forms of utility ownership of generation assets, and by extension utility ownership of electric microgrids.

**City Policy Context-Boston and New York City**

Microgrid development is also affected by municipal policy – this section reviews and analyzes the policy context in Boston and New York City. Municipalities are where microgrids are installed, and require city approval for permitting and siting, making municipal governments important collaborators even if they are not the initiating party developing them. Since these projects are expensive to implement, cities often need exogenous sources of investment to finance them, be it from private stakeholders, utilities, state governments, or a combination of
these. In these cases, state governments have been important collaborators and sources of additional capital to finance electric microgrid projects. Thus, municipal policies have been significantly influenced by this dynamic. In NYC, this also includes federal financial assistance through funds received in response to Hurricane Sandy and other disasters. Legal limitations on municipality authority imposed by the state to execute certain kinds of projects can also constrain municipal electric microgrid policy.

**Boston Policy Context**

The city’s climate action planning officially began with a 2007 Executive Order that established greenhouse gas emission reduction targets 25% below 2005 levels by 2020 and 80% by 2050 for municipal operations, as well as requiring the City preparation and planning for climate change impacts (City of Boston 2014). Four years later, the City published *A Climate of Progress*, which expanded the application of the previously mentioned goals across all of Boston. The 2014 Plan further elaborates and builds upon previous work through numerous strategies and actions in five key areas developed by a Steering Committee and five strategy subcommittees among others: Neighborhoods, Large Buildings and Institutions, Transportation, Climate Preparedness, and achieving the 80% reduction target by 2050. The Large Institutions and Buildings and GHG goal sections of the document specifically mention microgrids. Action 1.73 under Large Buildings and Institutions calls for the facilitation of expanded district energy implementation, which includes microgrids. Other actions under 1.7 deal with interconnection, on-site renewable and CHP energy, and district-level planning. Under the 80% by 2050 goal section, the carbon-neutral and resilient visioning section contains a brief discussion of the City’s efforts towards a pilot microgrid development project, a legal analysis of owning microgrids in the state, and a process for microgrid business models that involve multiple stakeholders. It also
outlines how the City will work with state government, other government agencies, and stakeholders to eliminate barriers to implementing more district energy and renewable generating capacity among other synergistic goals with microgrid development. Greenovate Boston 2014 Climate Action Plan Update represents Boston’s climate action plan. Boston’s Climate Action Plan pressures electric microgrid developers to utilize renewable energy with their GHG emission reduction targets, and explicitly encourages microgrid development as part of their proposed policy solutions.

The Boston Community Energy Study in 2016 built upon the foundation set by the Greenovate Boston plan by modeling and identifying 42 districts in Boston that would be technically or demographically optimal for community energy solutions, including microgrids (Boston Redevelopment Authority Planning Division 2016). The study was the product of a coalition between the Boston Redevelopment Authority (now the Boston Planning & Development Agency), MIT Sustainable Design Lab and Lincoln Laboratory, and the City of Boston among other partners. This study enabled the City of Boston to begin discussions on the state of existing infrastructure in these districts, the costs of infrastructure installation, and negotiations with property owners to support community energy solutions.

In July of 2017, Boston released two plans that mention microgrids as a focus of future development: Resilient Boston and the city’s comprehensive plan Imagine Boston 2030 (City of Boston 2017a; 2017b). Both plans explicitly promote expanding community microgrids in Boston and highlight Lower Roxbury as a site of particular interest to host a pilot microgrid project given the nexus of critical infrastructure and social vulnerability in the district. Imagine Boston 2030 also references an ongoing effort to implement an electric microgrid at the Raymond L. Flynn Marine Park due to the vulnerability of the location to flooding and
sensitivity of current tenants to electricity quality and prices (City of Boston 2017a; Wood 2017). The U.S. Department of Energy analyzed the site in 2014 and 2016 and found a potential for $500,000-$800,000 in annual cost savings should the marine park install an electric microgrid given the greater efficiency, smarter management, and resiliency provided by the new systems.

Boston City Council in December 2017 approved Docket 0340 to send a home rule petition to the state legislature to allow the city to enter into an energy savings performance contract (ESPC) with a business partner via a request for qualifications for a microgrid project (Wood 2017). The petition was submitted by Boston Mayor Martin Walsh. If the state legislature approves of the proposal, it would allow the city to enter into an ESPC for both private and publicly owned buildings at the Raymond L. Flynn marine park, whereas the law only currently allows the latter. This petition came after years of Boston planning to implement a microgrid at the marine park, only to discover these legal constraints barred further progress. Since Boston also recognized utility opposition as a potential obstacle to completing the project, Boston and Eversource came together early in the process and drafted a memorandum of understanding that governs their relationship. “The city hopes its early efforts will offer lessons learned for others developing microgrids,” and was one of the fourteen projects selected by MassCEC’s Community Microgrid Program for feasibility study funding (MassCEC 2018; Wood 2017). Bradford Swing, Boston’s Director of Energy Policy and Programs, wrote that the feasibility study built upon previous work the city had done to identify end users, eligible technologies, and a preliminary scope for a district energy microgrid project (Swing 2018). According to Swing, a crucial remaining question for the feasibility study was whether a public-private partnership through an ESPC or a utility-driven approach by having the utility either own or procure it would be the most viable strategy for advancing the project.
In 2016, the BPDA and City of Boston began an interdepartmental initiative, in consultation with utility companies, developers, academic and nonprofit institutions, and private stakeholders, called the Smart Utilities Vision project (“SUV project”), whose goal was to create strategies for more affordable, sustainable, resilient, equitable, and innovative utility services in Boston (BPDA n.d.). The SUV project resulted in policy and engineering recommendations for water, telecommunication, energy, and transit infrastructure. These included the promotion of utilities that are: easier to upgrade, maintain, and build, reduce costs and resource consumption, protected against flooding and heat waves, attractive to businesses, and utilize advanced technologies. The SUV project studied the case of the PLAN: South Boston Dorchester Avenue Planning Initiative from December 2016, which called for 12-16 million square feet of new development and 2 miles of new sidewalks and roads which all required new infrastructure to service it. The two products of the SUV project were the Smart Utilities Policy for Article 80 Development Review and the Smart Utility Standards.

The Smart Utilities Policy for Article 80 Development Review was adopted by the BPDA Board on June 14th, 2018, and recommends five of the ten Smart Utilities Technologies (SUTs) studied to be integrated into new Article 80 developments, including district energy microgrids (BPDA n.d.). The Smart Utilities Policy is a two-year pilot that includes educational sessions with engineers, architects, developers, and City of Boston staff. After the two years, staff will evaluate the results and adjust the policy based on technology performance and developer feedback.

Article 80 was adopted in 1996 by the Boston Planning & Development Agency (BPDA) to clarify guidelines for the development review process pertaining to large and small projects, planned development areas, and institutional master plans (BPDA n.d.). The process can include
but is not limited to evaluation of a project’s projected effects on the environment, transportation, the public sphere, and “historic resources” (BPDA n.d.). BPDA Project Managers help developers during the Article 80 process, and public feedback on projects is encouraged throughout the review timeline. District energy microgrids were only one of two technologies that required an Article 80 project size threshold in excess of 1.5 million square feet to have the city recommend their inclusion when cost-effective to do so (BPDA n.d.; 2018).

The Smart Utility Standards established guidelines for integration and planning of SUTs with pre-existing utility infrastructure in both new and existing streets (BPDA n.d.). The guidelines are for developers, engineers, utility providers, and architects that are planning, locating, and designing utilities. The standards are a work-in-progress, with finalization concluding with the adoption of the Smart Utilities Policy for Article 80 Development Review.

In addition to the aforementioned planned and proposed electric microgrid projects, Boston’s existing and forthcoming microgrids include: the Medical Area Total Energy Plant (MATEP) in Longwood, Veolia’s district energy networks in Boston, Longwood, and Cambridge, Veolia’s Kendall Station CHP plant and cogeneration plant for a biotechnology firm in Cambridge, as well as university microgrids at MIT, Tufts, Harvard, and Northeastern Universities (Burger 2017a; 2017b; Emmett Environmental Law & Policy Clinic 2014; Lund 2017; MIT Sustainable Design Lab 2016; Wood 2019).

The policies enacted and plans published guide local development of electric microgrids to specific kinds of projects, and highlights areas of particular interest for future microgrid development. However, state policy greatly affects what types of projects the city can pursue and what ownership models are legally permitted. While Massachusetts is a home rule state, the limitations on local autonomy granted by the state impact Boston’s ability to execute ESPCs
(Barron, Frug, and Su 2004; Wood 2017). The deregulation of the electricity sector also makes it nearly impossible to have utilities own or co-develop microgrids with municipalities like Boston without a waiver from the state (Emmett Environmental Law & Policy Clinic 2014). The expense of electric microgrid systems also hinders municipal microgrid development, leading to greater reliance on financing defined and implemented by the state.

New York City Policy Context

With regards to franchise rights in New York City, the municipal government has a formal and organized system whereby applicants may receive a revocable consent permitting them to build and use infrastructure within public space as a quasi-owner of the property (NYSERDA, NYS DPS, and NYS DHSES 2014). The New York City Department of Transportation (DOT) website indicates that getting a revocable consent necessitates petitioning the Division of Franchises, Concessions and Consents and submitting a petition for DOT evaluation. The DOT then gives the petition to relevant City agencies, which could include the Department of City Planning, Department of Buildings, and other agencies that administer safety, zoning, and landmark preservation rules. The DOT then holds a public hearing about the petition’s merits, followed by a 10-day comment period. In the absence of issues with the petition, the DOT executes a revocable consent agreement with the petitioner subject to Mayoral approval. Similar permit systems exist in other cities in New York State. If a microgrid project tries to provide service within an existing franchise area, any pre-existing franchisee can intervene or be invited to comment on proceedings between the incoming microgrid developer and the municipality on granting new property use permissions.

In September, 2014 the DeBlasio administration released One City: Built to Last, which called for an update to New York City’s climate targets to an 80% reduction GHG by 2050
compared to 2005 levels (City of New York 2014; City of New York Press Office 2014). In April 2015, New York City published *One New York: The Plan for a Strong and Just City* (OneNYC), which represents its strategic plan for tackling climate change, aging infrastructure, population growth, and increasing inequality (City of New York 2018). Among other goals, the plan set forth lowering the City’s GHG emissions by 30% by 2030 and reiterated the longer term 80% by 2050 target all relative to a 2005 baseline (City of New York 2014; 2015). Furthermore, the plan called for smart grid technology adoption and increased development of decentralized renewable energy. OneNYC was the first resilience strategy released in collaboration with the Rockefeller Foundation’s 100 Resilient Cities initiative (City of New York 2018). In April 2018, the Mayor’s Office of Recovery and Resiliency published a report called *Climate Resiliency Design Guidelines*, which in a section on strategies to address electricity outages during heatwaves recommended exploring opportunities to isolate and island critical loads from the larger grid (Mayor’s Office of Recovery and Resiliency 2018).

In response to the damage caused by Hurricane Sandy in 2012, the NYC Economic Development Corporation (NYCEDC) launched a $30 million program with federal disaster recovery funds from the Community Development Block Grant-Disaster Recovery program administered by the U.S. Department of Housing and Urban Development (HUD) in 2014 called Resiliency Innovations for a Stronger Economy (RISE: NYC) (NYCEDC 2015a; 2015b; 2018). It was a global competition to identify resiliency technologies that could help small businesses in NYC for future sea level rise, storms, and other climate change impacts. After nearly 200 applications, 11 technologies were chosen. The types of technologies selected include building systems, telecom networks, and energy solutions. Microgrids were among the energy technologies funded as a result of this competition.
As with the case of Boston, NYC does not have a publicly available comprehensive inventory of existing or proposed electric microgrids exists for NYC. According to a 2015 Navigant study, there are at least five electric microgrids online, two under development, and three proposed projects in NYC (Horne, Asmus, and Stanton 2015). This mostly excludes the ongoing project efforts from NY Prize and RISE: NYC.

The policies enacted and plans published in NYC also guide municipal development of electric microgrids, and in the case of RISE: NYC funds microgrid technological innovation and pilot projects. Again, as in the case of Boston, New York State policy greatly affects what types of projects the city can pursue and what ownership models are legally permitted. New York is also a home rule state, and the associated limitations on local autonomy granted by the state affects NYC’s ability to unilaterally develop electric microgrids (NYSBA 2016). The deregulation of the electricity sector poses significant obstacles to having utilities be the sole owner or developer of microgrids; hybrid models of ownership for multi-user microgrids between utilities, municipalities, and private stakeholders have been permitted and represent a path forward for future development in the city (NYSERDA, NYS DPS, and NYS DHSES 2014; Walton 2018). The Hudson Yard electric microgrid, made possible through the partnership between the utility Consolidated Edison and the private developer Related Cos. of the Hudson Yards project, exemplifies how microgrids in NYC can be developed via hybrid ownership. The cost of electric microgrid systems also inhibits municipal microgrid development, resulting in greater reliance on financing defined and implemented by the state and federal government in projects related to disaster recovery.
Dissertation Outline

This dissertation elaborates upon three research inquiries. Chapter 2 addresses what are the key drivers of state electric microgrid policy adoption and asks if there is a correlation between these factors and the strength of those policies. This chapter combines a quantitative analysis of drivers of adoption and strength of electric microgrid policy with policy sequencing theory. Chapter 3 explores how policies and regulations related to microgrid development align with or run counter to the goals of energy democracy. This qualitative study compares the electric microgrid policies in Massachusetts, New York, and the largest city within each state to better understand whether they are consistent with the goals of energy democracy. Chapter 4 analyzes whether policy diffusion occurred in the case of electric microgrid policy adoption, if yes what was the mechanism, and if no how did policy innovation come from within the polity. This qualitative case study compares the electric microgrid policies in Massachusetts, New York, and the two largest cities in these states (Boston and New York City) to better understand the development of their policies using the analytical lenses of policy diffusion and policy learning. Chapter 5 concludes by revisiting the findings of these chapters, contextualizes them in their respective literatures, and makes recommendations for future research topics on electric microgrid policy.
CHAPTER 2: Energy Resilience: An Analysis of Drivers of State Electric Microgrid Policy

Abstract

This study quantitatively evaluates the adoption and strength of U.S. state electric microgrid policies as these metrics relate to potential predictors and drivers of policy adoption and strength. Linear fixed effects and random effects ordered probit models were developed to assess how predictive variables such as population density, real gross state product per capita, and average annual state electricity prices among others were of policy adoption and strength. Policy adoption and strength were operationalized using a 0-3 scale derived from policy sequencing literature, with 0 being no policy and 3 being market expansion and the most supportive of microgrid development. Variables representing geographic policy diffusion, citizen and government ideology (linear models only), average annual electricity prices (ordered probit models only) and population density were statistically significant predictors of policy outcomes observed. Threshold values in the ordered probit analysis increased in size between market preparation and market expansion, which empirically demonstrates policy stacking in the case of electric microgrids.

Keywords

Electric Microgrid Policy, Policy Sequencing, Policy Stacking, Linear Fixed Effects Model, Random Effects Ordered Probit Model

Introduction

Electric microgrid policy is more nascent than policies that specifically address renewable energy like Renewable Portfolio Standards (RPS) (Carley and Miller 2012; Cook et
al. 2018). Since both are potential vehicles for addressing climate change, and the microgrids can also enhance the resilience of critical infrastructure and the electric grid as a whole, understanding the policy environment and drivers for policy adoption and strength is essential. However, while efforts to quantify and identify predictors of policy adoption and strength exist for RPS, the same cannot be said of microgrid policy. Electric microgrid policy is distinct from RPS and other renewable energy policies because the technology can island critical infrastructure during extreme weather events, and is capable of using fossil fuels as an input to the system, which can complicate its measurement towards greenhouse gas emission reduction goals (Campbell 2012; EOP 2013; K. B. Jones, James, and Mastor 2017; Panteli and Mancarella 2015; Vine, Attanasio, and Shittu 2017; Zamuda et al. 2013). These distinguishing features, as well as the urgency of the aforementioned exogenous threats to the electric grid, make studying the drivers of electric microgrid policy adoption and strength worthwhile for understanding ongoing policy efforts.

This study is a quantitative evaluation of the adoption and strength of electric microgrid policies at the state level. Many studies, both domestic case studies and international comparisons, use qualitative methods to discuss microgrid policy barriers, opportunities, and economics (Ali et al. 2017; Emmett Environmental Law & Policy Clinic 2014; Hanna et al. 2017; Hirsch, Parag, and Guerrero 2018; Hyams et al. 2010; K. B. Jones et al. 2014; K. B. Jones, James, and Mastor 2017; Kema Inc. 2014; Soshinskaya et al. 2014). Quantitative analysis already exists in the literature exploring the adoption and strength of other renewable energy-related policies, namely RPS (Carley and Miller 2012). There is categorization of different microgrid policies in the literature (Cook et al. 2018). No study to date has utilized statistical models to identify drivers of electric microgrid policy adoption and strength (in terms of policy
sequencing) at the state-level. The quantitative approach taken here measures differences between variables and observed policy outcomes in all states and Washington DC rather than a subset of states. Some of the models used in this study also quantify and delineate the variation explained by national trends affecting all states equally. These characteristics of my study create a unique national-level view of drivers of state electric microgrid policy.

The research questions for this chapter are: what are the key drivers of state electric microgrid policy adoption, and is there a correlation between these factors and the strength of those policies? To answer these questions, I create statistical models that identify variables that are predictive of electric microgrid policy adoption and strength at the state level. The chapter most closely builds off of the works of Carley and Miller (2012), which asked similar questions but about RPS policies, and a National Renewable Energy Laboratory (NREL) report’s microgrid policy framework and research (Carley and Miller 2012; Cook et al. 2018). The dependent variable is the strength of electric microgrid policy present in a state, which from weakest to strongest is: no policy, market preparation, market creation, and market expansion. This scale for the dependent variable is based upon a policy sequencing framework articulated by NREL (Cook et al. 2018). The independent variables tested include: state average annual electricity price, the percent of Democrats in the lower house of state legislature relative to total representatives, citizen and government ideology scores (0-100) from the Berry/Ringquist/Fording/Hanson (BRFH) indices, whether contiguous states have microgrid policies, the gross state product (GSP) per capita ($/person) in chained 2012 dollars, and state population density in number of people per square kilometer (W. D. Berry et al. 2010; 1998; 2007; Carley and Miller 2012; Cook et al. 2018; NCSL 2018; U.S. BEA 2019; U.S. Census Bureau 2010; 2016; 2018; U.S. EIA 2018). These independent variables collectively represent a
list of statistically and conceptually significant indicators for environmental and energy policy according to state-level policy adoption studies (Carley and Miller 2012; Chandler 2009; Huang et al. 2007; Lyon and Yin 2010; Matisoff 2008; Ringquist and Garand 1999; Stoutenborough and Beverlin 2008; Wiener and Koontz 2010).

While there have been ongoing refinements to policy diffusion theory, geographic models, and learning, the underlying diffusion process has no single unifying theory (F. S. Berry and Berry 2007; Carley and Miller 2012). The nongeographic leader-laggard diffusion model whereby certain states become trend setters, does not appear to apply to the case of RPS and net metering policies, which are the closest proxies in the literature to electric microgrid policy (Carley and Miller 2012; Stoutenborough and Beverlin 2008). There is no obvious consensus for internal determinants that contribute to state energy policy adoption, with conflicting results for the impact of renewable energy potential on RPS and net metering policy adoption (Carley 2009; Carley and Miller 2012; Lyon and Yin 2010; Matisoff 2008; Stoutenborough and Beverlin 2008). Specific policies can vary widely, hindering generalizability across policy domains (Carley and Miller 2012). Factors that multiple researchers found to be significant and positively related to state energy policy enactment include state-level political ideology of citizen preferences and partisan legislative dominance, and state affluence measured by total or per capita GSP (Carley and Miller 2012; Chandler 2009; Huang et al. 2007; Lyon and Yin 2010; Matisoff 2008; Stoutenborough and Beverlin 2008; Wiener and Koontz 2010). However, multiple researchers have found no significance from the presence of coal or natural gas industries upon policy adoption (Carley and Miller 2012; Huang et al. 2007; Matisoff 2008). Since regular and comprehensive polling of state-level political ideology is unavailable, political ideology is most frequently operationalized via proxies like partisan legislative control (Carley
This type of proxy can present problems because the binary nature of the metric can indicate erroneously high degrees of volatility. Thus, as was the case in Carley and Miller (2012), the BRFH indices are included to estimate ideologies, which I hypothesize that both citizen and government ideological liberalism will be significant positive indicators of electric microgrid policy adoption. The BRFH indices comprise complex models that include and weight multiple factors such as ideology estimates of electoral challengers, ratings of congressional representatives from interest groups, a nonlinear distribution of partisanship in legislation, and vote weights by district. The results of the models are expressed numerically with a sliding scale of policy liberalism from 0 to 100. One index covers state-level citizen ideology made with Americans for Democratic Action scores, while another captures state-level government ideology utilizing DW-Nominate scores (W. D. Berry et al. 2010; 1998; F. S. Berry and Berry 2007; Carley and Miller 2012). As a bulwark against omitted variable bias, the percent of Democratic seats in states’ House of Representatives is included (Carley and Miller 2012). While the percentage is a proxy for ideology, party status can track less in parallel with liberalism depending on the state and can express itself differently via party-line voting or caucus-based authority of committee assignments. The two ideology variables, as well as the percent of Democrats in state houses variable are tested to confirm they are not so highly correlated as to lead to multicollinearity.

Electricity prices are included as an independent variable because the author concurs with Carley and Miller’s (2012) hypothesis that higher energy prices from existing sources could increase public acceptance of investment into alternative options, which could include the installation of microgrids (Carley and Miller 2012). Some prior analyses have included total GSP as an independent variable measuring state economic activity and affluence, but utilizing GSP
per capita standardizes for potentially large discrepancies between states of different sizes that may not represent relative affluence disparities (Carley and Miller 2012; Chandler 2009; Matisoff 2008). All else held equal, states with more financial resources may possess greater public resources for electric microgrid development and thus be more likely to adopt policies that promote their development than states with less financial means (Carley and Miller 2012). The justification for including population density is the hypothesis that states with higher population densities may experience commensurately greater energy demand placed upon more centralized grid infrastructure, and thus have either actual or perceived greater need for investment and policy in energy systems, including electric microgrids.

The geographic diffusion variable, measuring the percentage of contiguous states that have electric microgrid policies, is included to ascertain whether an observable relationship exists between policy actions of one state and the pre-existing policies of neighboring states (Carley and Miller 2012). This variable could yield mixed outcomes; if a positive coefficient results, one could deduce policy diffusion from state to state, but a negative coefficient means a state became less likely to adopt a policy if neighboring states already have that policy (Carley and Miller 2012; Hays and Glick 1997).

Policy sequencing, also known as policy stacking, is a concept in the theoretical literature whereby policymakers adopt market reforms in a step-wise fashion, thus incrementally addressing barriers (Cook et al. 2018; Demont and Rizzotto 2012; Krasko and Doris 2013; Meckling, Sterner, and Wagner 2017; Nsouli, Rached, and Funke 2005). Lower cost and lower impact policies are pursued first to open a potential market before passing more complicated policies with a greater impact that advance their goals. Policy stacking has been applied in energy, financing, economic reform, and agriculture markets (Asiedu-Saforo 1989; Cook et al.
The efficacy of policy sequencing has varied based upon the policy area addressed (Cook et al. 2018; Nsouli, Rached, and Funke 2005). Krasko and Doris (2013) applied policy stacking to distributed solar policy, and concluded it had a significant positive effect on overall deployment, with subsequent tests corroborating the correlation (Cook et al. 2018; Krasko and Doris 2013; Steward et al. 2014; Steward and Doris 2014). More recent work contended policy stacking assisted policymakers in reaching their goals for more widespread energy markets by diminishing technical and political barriers (Cook et al. 2018; Meckling, Sterner, and Wagner 2017).

Policy stacking has also been applied to microgrid policy (Cook et al. 2018). The microgrid policy-specific application established three categories for microgrid policy: market preparation, creation, and expansion. Market preparation policies work towards diminishing institutional barriers that could limit market access to a technology, such as interconnection standards that specify how microgrids can connect to the electric grid, regulations that allow the deployment of electric microgrids, and energy or resilience planning efforts. Examples of market preparation include New York State’s Energy Research and Development Authority’s (NYSERDA) report “Microgrids: An Assessment of the Value, Opportunities and Barriers to Deployment in New York State,”1 KEMA’s “Microgrids-Benefits, Models, Barriers and Suggested Policy Initiatives for the Commonwealth of Massachusetts”2 report supported by the Massachusetts Clean Energy Center, and Connecticut’s Public Act 13-2983 that legally defines

---

2 http://files.masscec.com/research/Microgrids.pdf
electric microgrids and relevant utility regulations. Market creation policies encourage private investment in microgrids, which could be accomplished through mandating the deployment of microgrids for particular facilities, pilot projects either funded by the state or partnering with public institutions, or requiring utility procurement of electric microgrids. An example of market creation is Duke Energy’s McAlpine microgrid pilot project\(^4\) in Charlotte, North Carolina that provides resilience and grid benefits for a fire station. Market expansion policies are intended to lower investment costs and enable widespread deployment, with tax incentives that offset technology costs, financing mechanisms including subsidies and grants, advancing research and development for the technology, and regulatory reform of the energy market all exemplify market expansion policy. NYSERDA’s NY Prize\(^5\) microgrid grant competition and the state’s Reforming the Energy Vision (REV)\(^6\) initiatives are both policies that qualify as market expansion for electric microgrids. This order, preparation, creation, and then expansion is highlighted as being potentially more successful for achieving state policy goals than states who do not follow this sequence or adopt only parts of it (Cook et al. 2018; Krasko and Doris 2013). There are, as of this writing, no studies that utilize the policy stacking concept in a quantitative model of U.S. state electric microgrid policy. This is precisely the gap in the literature my study addresses. Thus, the dependent variable for the random effects ordered probit and linear fixed effects models described below utilize this policy stack to analyze whether certain independent variables are predictive of observed outcomes in state microgrid policy.

\(^4\) https://microgridknowledge.com/green-microgrids-duke/
\(^5\) https://www.nyserda.ny.gov/All-Programs/Programs/NY-Prize
\(^6\) https://rev.ny.gov/
Methodology

This analysis utilized random effects ordered probit and linear fixed effects models to assess adoption and strength of electric microgrid policies across the U.S. in relation to a series of independent variables. The ordered probit models implemented Chamberlain’s correlated random effects model, which enables the random effects to be correlated with the model’s independent variables (Wooldridge 2010). These models are essentially fixed-effect counterparts to the linear fixed-effect models that acknowledge that the dependent variable is an ordered censored variable. The dependent variable of this study was the adoption and strength of a state microgrid policy. The dependent variable was an ordered variable, with 0 being no policy, 1 being market preparation-only, 2 being market creation (in addition to market preparation if applicable), and 3 being market expansion (in addition to market creation and preparation if applicable). Thus, the policy that was most advanced along a policy sequence within a state was what determined the coding for a state. For example, if a state had policies that qualify for 1 and 2, but not 3 or 0, the state was coded a 2. To construct the dataset for the dependent variable, I completed a combination of searches using Google and Microgrid Knowledge. For the former, I used keywords “___ state electric microgrid policy” and searched through the top 30 website hits. For the latter, I searched every page that came up, and would only type in the state name as it was already a website specializing in microgrids and energy. Information on these webpages that described state policies and projects that fit the three policy categories, as well as pilot projects that were approved, funded, and built were all counted in the dataset as long as they were public (including state universities) rather than private and were civilian and not military. The 50 U.S. states and Washington D.C. between 2009-2018 were the cases and timeframe considered in the scope of the study. Figures 2.1-2.3 illustrate the evolution of electric microgrid
policy over the time period considered in my study using the policy sequencing concept and database created for this analysis. Only Texas and Florida had electric microgrid policies in 2009, but by 2018 a majority of states did. For the random effects ordered probit model, Between variables were created for each independent variable to capture the correlation between the random effects and the independent variables, removing the bias that could otherwise be present in the independent variable coefficient estimates due to this correlation. For one of the two random effects ordered probit models, time dummies were created to account for time fixed effects that affect every state the same but capture other factors.

Figure 2. 1: 2009
Figure 2. 2: 2014

Electric Microgrid Policy Landscape (0-3)

Figure 2. 3: 2018

Electric Microgrid Policy Landscape (0-3)
The independent variables were introduced to the model simultaneously via standard selection. The independent variables tested include: state average annual electricity price, the percent of Democrats in the lower house of state legislature relative to total representatives, citizen and government ideology scores (0-100) from the Berry/Ringquist/Fording/Hanson (BRFH) indices, whether contiguous states have microgrid policies, the real gross state product per capita ($/person) in chained 2012 dollars, and state population density in individuals per square kilometer (W. D. Berry et al. 2010; 1998; 2007; Carley and Miller 2012; Cook et al. 2018; NCSL 2018; U.S. BEA 2019; U.S. Census Bureau 2010; 2016; 2018; U.S. EIA 2018).

Electricity price is the average price across all sectors paid by end user electric customers in each state in cents/kWh in a given year (Carley and Miller 2012; U.S. EIA 2018). The geographic diffusion variable was created with the policy environment data from NREL and a social accounting matrix that records which states share borders (Carley and Miller 2012; Cook et al. 2018; U.S. Census Bureau 2010). Electric microgrid policy presence was counted from a contiguous state matrix and divided by the total quantity of contiguous states (Carley and Miller 2012). Hawaii was treated as sharing borders with California, while Alaska with no other states. The variable ranged from 0, when no adjacent states have an electric microgrid policy, to 100 percent when they all did.

Average electricity price data was only available through 2017, while the latest citizen and government ideology score data collected was available through 2016. Extrapolation of the data point from the final year of these three variables through 2018 was necessary to increase the statistical power of the model. Thus, for average electricity price, the 2017 prices were used for 2018, and the 2016 citizen and government ideology scores were used for 2017 and 2018.

Several other variables were initially considered for inclusion but were excluded in the
final analysis due to statistical insignificance or other problems. These included renewable energy potential in individual states, national energy storage costs and capacity volumes, national number of net metering customers by capacity and technology, the percentage of the population that lived in urban areas in each state, and average construction cost of installed generation capacity in dollars per kWh of nameplate capacity installed. Electric and natural gas sector deregulation variables were perfectly collinear as neither varied within states between 2009 and 2018, and thus were dropped from the model.

Results and Discussion

Table 2. 1: Models 1-5 Results

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>AvgPrice</td>
<td>-0.001</td>
<td>0.027</td>
<td>.0267945</td>
<td>.3494174***</td>
<td>.1934094*</td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.036)</td>
<td>(.036211)</td>
<td>(.0869567)</td>
<td>(.1021847)</td>
</tr>
<tr>
<td>CitizenIdeology</td>
<td>0.018**</td>
<td>0.017**</td>
<td>.016554**</td>
<td>.017156</td>
<td>-.000354</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.007)</td>
<td>(.00733)</td>
<td>(.0212498)</td>
<td>(.0299861)</td>
</tr>
<tr>
<td>ContState</td>
<td>0.783***</td>
<td>0.578***</td>
<td>.5784461***</td>
<td>3.395438***</td>
<td>1.78522***</td>
</tr>
<tr>
<td></td>
<td>(0.193)</td>
<td>(0.183)</td>
<td>(.1831003)</td>
<td>(.444039)</td>
<td>(.5423122)</td>
</tr>
<tr>
<td>Dems</td>
<td>0.154</td>
<td>0.975</td>
<td>.975265</td>
<td>-2.739387</td>
<td>1.93987</td>
</tr>
<tr>
<td></td>
<td>(0.752)</td>
<td>(0.680)</td>
<td>(.6797918)</td>
<td>(1.942247)</td>
<td>(2.612373)</td>
</tr>
<tr>
<td>GovernmentIdeology</td>
<td>0.011**</td>
<td>0.010**</td>
<td>.0099123**</td>
<td>.0081829</td>
<td>.0069283</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(.0049331)</td>
<td>(.015725)</td>
<td>(.019354)</td>
</tr>
<tr>
<td>gsp</td>
<td>-0.00000</td>
<td>0.00001</td>
<td>.0000143</td>
<td>.0000499</td>
<td>-.0000178</td>
</tr>
<tr>
<td></td>
<td>(0.00002)</td>
<td>(0.00002)</td>
<td>(.0000166)</td>
<td>(.0000528)</td>
<td>(.0000689)</td>
</tr>
<tr>
<td>PopDen</td>
<td>0.077***</td>
<td>0.033*</td>
<td>.0325995**</td>
<td>.0914077**</td>
<td>-.078529</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.019)</td>
<td>(.0189781)</td>
<td>(.0438778)</td>
<td>(.0555816)</td>
</tr>
<tr>
<td>2010</td>
<td>.106281</td>
<td>.2467503</td>
<td>(.1377772)</td>
<td>(.6866298)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.1500172)</td>
<td>(.7416371)</td>
<td>(.7291792)</td>
<td>(.8756312)</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>.2237235</td>
<td>.5148803</td>
<td>(.1500172)</td>
<td>(.7416371)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.1549325)</td>
<td>(.7291792)</td>
<td>(.8756312)</td>
<td>(.8756312)</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>.3019154*</td>
<td>1.478203**</td>
<td>(.1549325)</td>
<td>(.7291792)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.1576862)</td>
<td>(.6975701)</td>
<td>(.8756312)</td>
<td>(.8756312)</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>.4244173***</td>
<td>2.20207***</td>
<td>(.1576862)</td>
<td>(.6975701)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.1749936)</td>
<td>(.7578312)</td>
<td>(.8756312)</td>
<td>(.8756312)</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>.5689655***</td>
<td>2.652703***</td>
<td>(.1749936)</td>
<td>(.7578312)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.1926029)</td>
<td>(.7989265)</td>
<td>(.8756312)</td>
<td>(.8756312)</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>.6918203***</td>
<td>3.044599***</td>
<td>(.1926029)</td>
<td>(.7989265)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.1998222)</td>
<td>(.8065279)</td>
<td>(.8756312)</td>
<td>(.8756312)</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>.7957171***</td>
<td>3.496471***</td>
<td>(.1998222)</td>
<td>(.8065279)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-------</td>
<td>-------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.002565***</td>
<td>3.949225***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.2147248)</td>
<td>(.8443919)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.15334***</td>
<td>4.156011***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.231531)</td>
<td>(.8934984)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>_cons</td>
<td>-5.344715***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.668267)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/cut1</td>
<td>4.14501</td>
<td>7.117275</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.474576)</td>
<td>(1.823887)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/cut2</td>
<td>4.750934</td>
<td>7.837074</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.47995)</td>
<td>(1.833461)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/cut3</td>
<td>6.511894</td>
<td>9.829036</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.509485)</td>
<td>(1.877855)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BetweenAvgPrice</td>
<td>-.3184706**</td>
<td>-.1586562</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.1266295)</td>
<td>(.1461689)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BetweenCitizenIdeology</td>
<td>.0172609</td>
<td>.0401052</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0395623)</td>
<td>(.0479741)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BetweenContState</td>
<td>-4.002369**</td>
<td>-2.243545</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.866221)</td>
<td>(2.120438)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BetweenDems</td>
<td>.6692177</td>
<td>-3.852324</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4.022494)</td>
<td>(4.809229)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BetweenGovernmentIdeology</td>
<td>.0139488</td>
<td>.01522</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0350484)</td>
<td>(.0406823)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BetweenGsp</td>
<td>-.000033</td>
<td>.0000343</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0000602)</td>
<td>(.0000745)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BetweenPopDen</td>
<td>-.0870602***</td>
<td>.0840112</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0440074)</td>
<td>(.0558958)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>StateFixedEffects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>StateRandomEffects</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>FixedTimeEffects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>392</td>
<td>490</td>
<td>490</td>
<td>490</td>
<td>490</td>
</tr>
<tr>
<td>R^2</td>
<td>0.142</td>
<td>0.088</td>
<td>0.4755</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loglikelihood</td>
<td>-293.88849</td>
<td>-270.32489</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FStatistic</td>
<td>7.793***</td>
<td>5.845***</td>
<td>24.08***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(7df,329)</td>
<td>(7df,425)</td>
<td>(16df,425)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ChiSquare</td>
<td>151.36***</td>
<td>144.95***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(14df)</td>
<td>(23df)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: *p<0.1; **p<0.05; ***p<0.01

The results of the linear fixed effects analysis excluding extrapolated values (Model 1) yielded multiple statistically significant and insignificant variables. Citizen and Government Ideology were both statistically significant at the 0.05 alpha level, while the contiguous states
and population density variables were statistically significant at the 0.01 alpha level. The average
electric price in states, share of Democrats elected in lower state houses, and gross state product
in dollars per person were not statistically significant. A change in Citizen Ideology from the
lowest quartile state to the highest quartile state would predict a 0.317 increase in the electric
microgrid policy strength. A 1-unit change in policy strength was the difference between a state
having no policy and a policy of market preparation etc. A change in Government Ideology from
the lowest quartile state to the highest quartile state would predict a 0.376 increase in the electric
microgrid policy strength. The largest effect on electric microgrid policy strength came from the
Population Density variable, where a change from the lowest quartile state to the highest quartile
state would predict a 5.566 increase in the electric microgrid policy strength. A change in the
Contiguous States variable from the lowest quartile state to the highest quartile state would
predict a 0.392 increase in the electric microgrid policy strength.

The R-squared value of 0.14 is low, which suggests this model only accounts for a small
amount of the observed variation, even though some of the independent variables were
statistically significant. This could be due to several reasons. The decision focus on state policies
and projects and exclude military and federal initiatives could make certain states have
artificially low dependent variable scores which could be higher if those were included. It is
possible that the partisan affiliation of state governors could play a role, which was not examined
here. The effect from population density could corroborate the aforementioned hypothesis
regarding increased energy demand placed upon more centralized energy infrastructure and need
for investment in these systems. The large effect from population density could be also causal.
There are urban and rural models for microgrid development, with urban microgrids serving as a
means of enhancing resilience of existing electric infrastructure, while rural microgrids generally
are the only source of electric generation and service provision for remote communities not tied to the macrogrid (K. B. Jones, James, and Mastor 2017). The positive and predictive effect of population density on policy level could suggest that the urban microgrid model was a focus of the policies adopted. Table 2.2 lists states and their policy level in 2018 in the order of their 2018 population density.

Table 2.2: Population Density and Policy Level

<table>
<thead>
<tr>
<th>State Name and Policy Level in 2018</th>
<th>2018 Population Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>District of Columbia (1)</td>
<td>4442.578269</td>
</tr>
<tr>
<td>New Jersey (3)</td>
<td>467.7041138</td>
</tr>
<tr>
<td>Rhode Island (3)</td>
<td>394.8807046</td>
</tr>
<tr>
<td>Massachusetts (3)</td>
<td>341.655672</td>
</tr>
<tr>
<td>Connecticut (3)</td>
<td>284.8639356</td>
</tr>
<tr>
<td>Maryland (3)</td>
<td>240.3470567</td>
</tr>
<tr>
<td>Delaware (0)</td>
<td>191.6444244</td>
</tr>
<tr>
<td>New York (3)</td>
<td>160.1074854</td>
</tr>
<tr>
<td>Florida (2)</td>
<td>153.3566902</td>
</tr>
<tr>
<td>Pennsylvania (2)</td>
<td>110.517106</td>
</tr>
<tr>
<td>Ohio (1)</td>
<td>110.4562595</td>
</tr>
<tr>
<td>California (3)</td>
<td>98.04299388</td>
</tr>
<tr>
<td>Illinois (3)</td>
<td>88.60687154</td>
</tr>
<tr>
<td>Hawaii (2)</td>
<td>85.39409317</td>
</tr>
<tr>
<td>Virginia (1)</td>
<td>83.27903798</td>
</tr>
<tr>
<td>North Carolina (2)</td>
<td>82.46216807</td>
</tr>
<tr>
<td>Indiana (0)</td>
<td>72.11915138</td>
</tr>
<tr>
<td>Georgia (2)</td>
<td>70.61981769</td>
</tr>
<tr>
<td>Michigan (0)</td>
<td>68.26175471</td>
</tr>
<tr>
<td>South Carolina (1)</td>
<td>65.30095749</td>
</tr>
<tr>
<td>Tennessee (2)</td>
<td>63.39085545</td>
</tr>
<tr>
<td>New Hampshire (1)</td>
<td>58.5001518</td>
</tr>
<tr>
<td>Washington (3)</td>
<td>43.78128522</td>
</tr>
<tr>
<td>Kentucky (1)</td>
<td>43.69257141</td>
</tr>
<tr>
<td>Texas (2)</td>
<td>42.42151453</td>
</tr>
<tr>
<td>Louisiana (1)</td>
<td>41.64502835</td>
</tr>
<tr>
<td>Wisconsin (1)</td>
<td>41.44613055</td>
</tr>
<tr>
<td>Alabama (2)</td>
<td>37.26340856</td>
</tr>
<tr>
<td>Missouri (2)</td>
<td>34.41059264</td>
</tr>
</tbody>
</table>
The results of the linear fixed effects analysis with extrapolated values (Model 2) also yielded multiple statistically significant and insignificant variables. Citizen and Government Ideology were both statistically significant at the 0.05 alpha level, while the contiguous states variable was statistically significant at the 0.01 alpha level, and the population density variable was statistically significant at the 0.1 alpha level. The average electric price in states, share of Democrats elected in lower state houses, and gross state product in dollars per person were not statistically significant. A change in Citizen Ideology from the lowest quartile state to the highest quartile state would predict a 0.303 increase in the electric microgrid policy strength. A change in Government Ideology from the lowest quartile state to the highest quartile state would predict
a 0.337 increase in the electric microgrid policy strength. A change in Population Density from the lowest quartile state to the highest quartile state would predict a 2.386 increase in the electric microgrid policy strength. For the Contiguous States variable, a change from the lowest quartile state to the highest quartile state would predict a 0.289 increase in the electric microgrid policy strength. The R-squared value of 0.09 is even lower, which suggests this fixed-effects model only accounts for a small amount of the observed variation as well, despite some of the independent variables being statistically significant.

The difference in R^2 value between the models in Model 2 and Model 3 is due to the inclusion of the time fixed effects dummy variable, which explains a large portion of the variance in policy outcomes. The coefficients on the time dummies trends upwards, suggesting there is a common national trend affecting policy across the states, but they do not reveal what the cause or causes were for this result. In model 3, 2012 was trending at the 0.1 level, while 2013-2014 were significant at the 0.01 level and 2015-2018 were significant at the 0.001 level. The within R-squared value was 0.476, which was the highest of the three linear fixed effects models.

The two random effects ordered probit models run all used the extrapolated values mentioned previously. Both models yielded at least one, and in a number of cases a few statistically significant variables. The cutoff values calculated were also noteworthy. The models differed on whether time dummies were included and which (if any) variables were excluded. The random effects ordered probit model with no time dummies (Model 4) yielded statistically significant results at the 0.001 alpha level for Contiguous States and Average Price, and Population Density at the 0.05 alpha level. For both Models 4 and 5, effect sizes for the variables were calculated using average marginal effects coefficients, while both average
marginal and conditional marginal effects coefficients yielded qualitatively similar results. States in the highest quartile of Average Price were 17% less likely to have no policy and 7% more likely to have market expansion policies than states in the lowest quartile. States in the highest quartile of Contiguous States were 24% less likely to have no policy and 10% more likely to have market expansion policies than states in the lowest quartile. States in the highest quartile of Population Density were 9% less likely to have no policy and 38% more likely to have market expansion policies than states in the lowest quartile.

Model 5 included time dummies. In Model 5, Contiguous States was statistically significant at the 0.01 alpha level, and Average Price was trending at the 0.1 alpha level. The effect sizes were less than half of Model 4 and many of the time dummies were statistically significant as was the case in the linear fixed effects model that included them, which suggests the passage of time and other factors not captured by the model affected the calculated predictive power of Average Price and Contiguous States. Furthermore, this suggests that there is correlation between time and the independent variables, making it difficult to distinguish between effects on policy related to trends in the independent variables within states and effects on policy related to national trends that were common across states. States in the highest quartile of Average Price were 8% less likely to have no policy and 3% more likely to have market expansion policies than states in the lowest quartile. States in the highest quartile of Contiguous States were 11% less likely to have no policy and 5% more likely to have market expansion policies than states in the lowest quartile. The difference in thresholds between market preparation and market creation (.61 for Model 4 and .72 for Model 5) were much smaller than between market creation and market expansion (1.76 for Model 4 and 1.99 for Model 5). This
suggests that in going from no policy to market expansion, the market creation phase takes much more “effort” than the market preparation phase.

Conclusions and Policy Implications

The low amount of variation explained by the models suggests that it is difficult to pinpoint the exact factors contributing to microgrid policy adoption. However, future models could provide additional clarity as to which factors contribute to electric microgrid policy outcomes. The statistically significant factors-ideologies of citizens and governments, population density, average electricity prices, and contiguous states-suggest the hypotheses that these variables contributed to observed policy outcomes were corroborated by the analysis. The significance of population density suggests states with larger or more urban populations are more likely to adopt market expansion microgrid policies. The relationship between policy strength and population density also makes the urban microgrid model a focus of microgrid policy support. The significance of the ideology variables means that states that are more liberal in terms of their citizenry and the votes of their elected officials are more likely to have microgrid policies that are further along the policy sequence. States with higher average annual electricity prices are more likely to adopt policies further along the policy sequence, suggesting that the presence of high prices pressures states to explore and support technology and policy alternatives like microgrids that could rein in prices. The contiguous states variable’s significance means there is a relationship between the adoption of policies further along the policy sequence in a given state and that of its neighboring states. While spatial proximity of governments adopting policies has been used as an indicator of policy diffusion in the literature, there are many indicators used to measure policy diffusion, and further investigation is required to make a determination as to whether spatial proximity is a proxy for diffusion or not in the case of
electric microgrid policy. The results for partisan composition of state legislatures and state affluence as measured by gross state product per capita were all statistically insignificant. Thus, ideologies of legislators and citizens were more predictive than partisan affiliation of legislators. Gross state product per capita did not meaningfully predict which states adopted which policies along the policy sequence for microgrids. These findings are mostly consistent with previous research regarding other energy policies.

Compared to the discrete time multinomial logit model studying RPS policy stringency in Carley and Miller (2012), results for gross state product and Democrats in state legislatures variables were statistically insignificant in both studies. Citizen ideology, government ideology, and time variables were statistically significant in both studies as well. Contiguous states and average electricity price were statistically significant variables in my study of microgrids but were not in Carley and Miller’s (2012) analysis of RPS. The presence of statistically significant variables and increasing threshold values for the different dependent variable outcomes lends further credence to the hypothesis that policy stacking is applicable to the case of electric microgrid policy.

The greater R-squared values for models including time fixed effects suggests that national trends that affected states equally are important in understanding microgrid policy drivers. These trends could be technological advances in microgrids, federal policy changes and initiatives, and events that influenced the policy priorities of states. Hurricane Sandy struck the Northeast in the fall of 2012, which could have served as a focusing event for getting electric microgrid policy, as well as policies addressing resilience more generally, on the legislative agendas of states in the years that followed. The price of lithium ion batteries dropped by 85% between 2010 and 2018 (from $1,160 per kWh down to $176 per kWh in real 2018 dollars),
which is important since lithium ion batteries are a leading source of energy storage, and energy storage is increasingly viewed as an essential element of microgrids, especially for those utilizing renewable resources (Goldie-Scot 2019). The prices for renewable energy also declined, with a 77% cost reduction in utility-scale solar PV between 2010 and 2018, solar PV module prices dropped over 90% between 2009 and 2018, and a 35% drop in cost of onshore wind projects commissioned between 2010 and 2018 (IRENA 2019). These are several possibilities for national trends and events influencing state electric microgrid policy adoption. The complicated landscape created by state and national trends affecting microgrid policy makes it difficult to distill what is driving those policies to a few simple factors. Future research could explore variables beyond the scope of this study related to executive and gubernatorial policy, federal and military development of microgrids, and vulnerability of state infrastructure to various hazards including climate change.
CHAPTER 3: Energy Democracy and Electric Microgrid Policy

Abstract

Electric microgrids are a group of distributed energy sources and interconnected loads acting as one controllable entity that can connect and disconnect from the grid. Electric microgrids represent one set of technologies that can distribute and decentralize energy infrastructure assets and ownership, which can increase democratic participation in energy systems and transitions to renewable energy. This qualitative study compared the electric microgrid policies in Massachusetts, New York, and the largest city within each state to better understand whether they are consistent with the goals of energy democracy. Energy democracy is an aspirational and normative set of goals with the intent to increase public participation, ownership, and decentralization of energy systems as part of a transition to renewable energy sources. Analysis of interviews with representatives of state and city government, public benefit corporations, quasi-public agencies, and grassroots advocacy organizations revealed that elements of energy democracy were integrated into energy policy in both states and cities. Political factors with potential to inhibit energy democracy goals were also uncovered, including the influence and role of private developers in the decision-making process and limitations of community participation and feedback in some microgrid projects.

Keywords

Electric Microgrid Policy, Energy Democracy, Explanation Building Case Studies, Massachusetts, New York
Introduction

Extreme weather events, climate change, and other hazards threaten the stability of the electric grid; electric microgrids represent one technology that can enhance grid resilience and integrate more renewable energy sources (Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack 2008; EOP 2013; K. B. Jones, James, and Mastor 2017; National Research Council 2012; Panteli and Mancarella 2015; Quadrennial Energy Review Task Force 2015; Smith and Ton 2013; Vine, Attanasio, and Shittu 2017; H. Yin, Xiao, and Lv 2015; Zamuda et al. 2013). There are a number of definitions for what electric microgrids are; one is

a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island mode (K. B. Jones, James, and Mastor 2017; Smith and Ton 2013, 22).

The composition of microgrids as both an energy supply source and electric infrastructure to distribute the energy generated on-site allows them to operate independent from the macrogrid. The independence of both generation and distribution systems from the macrogrid can also be referred to as a power island, or “an energized section of circuits separate from the larger system” (K. B. Jones, James, and Mastor 2017; von Meier 2006, 152). The island, upon being disconnected from the macrogrid, transitions from being a redundant set of infrastructures to the main source of power for users connected to the islanded area (K. B. Jones, James, and Mastor 2017; von Meier 2006, 153). While many early microgrids were deployed at hospitals, universities, and military bases, electric microgrids have been deployed in every sector in both urban and rural settings (Cohn 2019; Roberts and Chang 2018). There is a dispute over which microgrid is the world’s largest, but the range is between 100MW to 135MW in capacity (Burger
As a proxy for average microgrid size, Hitachi claims the optimal range in microgrid size in terms of costs and benefits is between 1.5MW and 40MW (Wood 2016).

U.S. microgrid capacity has increased from 700 MW in 2010 to over 2 GW in 2017, with 545 MW in new capacity installed in 2018 alone (GTM Research 2018a; 2018b; Wood Mackenzie 2018; 2019b). Wood Mackenzie’s proprietary database of electric microgrids currently tracks 2,288 systems across the country, and they are forecasting that cumulative U.S. microgrid capacity will reach 8.8GW by 2024 (Wood Mackenzie 2019b; 2019a). Over half of all 2018 U.S. microgrid projects were third-party-owned, 80% were supported by third-party financing, and 39% of operational microgrids in 2018 were for commercial purposes (Wood Mackenzie 2018; 2019b). As a growing technology, microgrids serve as both a vehicle for renewable energy deployment and as a potential means of decentralizing and enhancing the resilience of electric infrastructure (Angel 2016a; Burke and Stephens 2017; 2018; Cook et al. 2018; GTM Research 2018a; 2018b; Speth 2015; Weinrub and Giancatarino 2015).

Furthermore, electric microgrids can decentralize the management structure and ownership of these systems relative to macrogrid systems, which are both intended outcomes of energy democracy. Microgrids can also be powered by fossil fuels like natural gas or diesel in a privatized, centralized ownership structure, so their contribution to energy system transformation is complex. In addition to the benefits for communities, microgrid projects can also serve the interests of large, centralized, legacy energy institutions that may not be interested in advancing renewable energy. Since microgrids can produce a range of process and equity outcomes, including everything between the two extremes presented here, comparing the design, process, and results of microgrid policy and development between states and at different scales can
provide insight into how microgrid policies can align with or stray from the goals of energy democracy.

This study provides a unique multi-scale comparative analysis of electric microgrid policy through the analytical lens of energy democracy. The case studies of New York and Massachusetts, through both state policy and municipal action in Boston and New York City, provide insights on the evolution of energy policy in two large urban contexts in the northeastern United States. Several prior studies highlight the value and need for further research in characterizing energy democracy in practice, including the efficacy and application of different combinations of approaches within and across communities (Angel 2017; Burke and Stephens 2017; Hess 2018; Szulecki 2018; Stephens et al. 2018). This study contributes to filling this gap by examining microgrids and related policies in two states with ambitious renewable energy goals and large cities within them. Building upon the applied research of energy democracy and electric microgrids is important in part because energy democracy is not a guaranteed outcome of their installation (Burke and Stephens 2018).

My research question is: how do policies and regulations related to microgrid development align with or run counter to the goals of energy democracy? Microgrids have historically been used by hospitals, universities and other large institutions that cannot be without power. More recently, cities have been encouraging more wide-scale adoption to enhance critical infrastructure resilience through energy redundancy, which would enable grocery stores, senior and affordable housing among other facilities to continuously function during and after extreme weather events (BRA 2016; City of Boston 2017b; City of New York 2014; 2015; Grimley and Farrell 2016; K. B. Jones, James, and Mastor 2017; Mayor’s Office of Recovery and Resiliency 2018). The energy democracy literature would suggest that where a city expands microgrids
may depend on private investment, which could exclude vulnerable populations from enjoying the benefits from the operation of these systems (Burke and Stephens 2017; 2018; Walton 2018). To examine that premise, this project examines what determines where microgrids will be located. Is it a function of the economic value of a particular part of the city? What determines whether or not low-income communities will be sites for microgrid development? Are the decision-making processes used consistent with energy democracy’s goals?

To examine my research question on how policies and regulations related to microgrid development align or counter the goals of energy democracy, I apply Burke and Stephens’ (2017) resist, reclaim, and restructure framework to comparatively assess two cases, each having two subunits of analysis. The cases are Massachusetts and New York. The state level actions represent the first subunit of analysis, while a municipality within each state (Boston and New York City respectively) are the second analytical subunit. Both states and municipalities are pioneering in microgrid policy. New York provides funding for all stages of microgrid projects, not just feasibility studies (EOEEA 2014; NYSEPB 2015; Rubenoff 2018). New York also changed its electricity market via the Reforming the Energy Vision (REV) proceeding to value Distributed Generation with a value stack (tariffs), whereas Massachusetts utilizes net metering (DSIRE 2016; NYSEPB 2015; Shrestha 2018). These differences, along with their similarities in regional proximity and governmental structure, make them ideal cases suited for comparative analysis.

Energy Democracy as an Analytical Lens and Frame

Energy democracy is an emerging social movement as well as a theoretical approach within the sociotechnical transition literature (Burke and Stephens 2017; Farrell 2014; Stephens 2019; Stephens et al. 2018; Van Veelen and Van Der Horst 2018). Energy democracy has three
overarching goals, with numerous intended outcomes associated with each goal (Angel 2016a; Burke and Stephens 2017; Speth 2015; Sweeney 2014; Weinrub and Giancatarino 2015). The first goal is to resist the agenda of the fossil fuel industry by eliminating its government subsidies and other public support, halting fossil fuel extraction and infrastructure expansion, and minimizing their public legitimacy and the sector’s privatization (Angel 2016a; 2016b; Burke and Stephens 2017; 2018; Chavez 2015; Farrell 2014; Grimley and Farrell 2016; Giancatarino 2012; Kunze 2014; Kunze and Becker 2014; Speth 2015; Sweeney 2014; 2015; Weinrub and Giancatarino 2015). Other strategies for resisting the dominant energy agenda are to stop land grabs for large-scale renewable energy, create new social alliances (municipalities, environmental groups, and unions etc.), cease intentional efforts to undermine climate action, and protect populations most dependent on fossil fuels with a particular focus on labor (Angel 2016a; Burke and Stephens 2017; Duda 2015; Farrell 2016; Jenkins et al. 2016; Weinrub and Giancatarino 2015). The second objective is to reclaim the energy sector, which directly shifts the ownership and paradigms guiding energy companies from private to public control (Angel 2016b; Burke and Stephens 2017; CSI 2013; Farrell 2014; 2016; Jenkins et al. 2016; Sweeney 2014; Thompson and Bazilian 2014; Weinrub and Giancatarino 2015). In the process of reclamation, existing energy corporations should become more local and democratic in their scope and guiding principles, while new energy companies, financial vehicles, and public and social ownership models develop (Angel 2016b; 2016a; Burke and Stephens 2017; 2018; Speth 2015; Sweeney 2014; Weinrub and Giancatarino 2015). The third aspect of energy democracy is to restructure the energy sector, which further entrenches the outcomes of the first two goals by treating control of, access to, and assets of the energy systems as decentralized and community-owned (Ahlborg et al. 2015; Angel 2016b; 2016a; Burke and Stephens 2017; 2018; Goldthau
Political and economic power become more distributed and decentralized. Community capacity and power to plan and control energy systems increases along with low-income communities, workers, and communities of color holding central positions in those systems (Angel 2016b; Burke and Stephens 2017; 2018; CSI 2010; LCEA n.d.; 2015; Speth 2015; Sweeney 2014; Weinrub and Giancatarino 2015). The geopolitics of energy focuses on global cooperation and peace rather than conflict and competition, with more democratic participation, inclusion, and solidarity. A new paradigm of viewing the energy sector as interdependent within the natural environment would predominate.

Within this concept and social movement, microgrids are recognized as one approach to advance energy democracy goals (Angel 2016a; Burke and Stephens 2017; Farrell 2014; Grimley and Farrell 2016). Advocates of energy democracy perceive centralized grid management that reinforces the power of large utility and fossil fuel companies as an obstacle to democratizing renewable energy (Burke 2018; Burke and Stephens 2017; Farrell 2014; Grimley and Farrell 2016; Stephens 2019; Szulecki 2018). Decentralizing and more equitably distributing ownership and management are both important to democratizing energy systems (Angel 2016b; Burke and Stephens 2017; CSI 2013; Duda, Hanna, and Burke 2016; Farrell 2011; 2014; 2016; Jenkins et al. 2016; Sweeney 2014; Szulecki 2018; Thompson and Bazilian 2014; Weinrub and Giancatarino 2015). Grid management that enables equitable access for all providers is the “structural center of a democratized energy system,” and electric microgrids can serve as a technological vehicle for the scale, distribution, and decentralization energy democracy advocates seek in energy systems (Angel 2016b; Burke and Stephens 2017; CSI 2013; Duda, Hanna, and Burke 2016; Farrell 2011; 2014; 2016; Jenkins et al. 2016; Sweeney
2014; Szulecki 2018; Thompson and Bazilian 2014; Weinrub and Giancatarino 2015). Burke and Stephens (2017) identify microgrids and democratized grid management as strongly related to the goal of reclamation of the energy sector and modestly related to the goal of restructuring it. While this literature suggests the potential is there, there has been little research on the extent to which electric microgrid policies in the U.S. are consistent with energy democracy objectives.

The resist, reclaim, and restructure framework is one of many energy democracy frameworks articulated in the literature. Table 3.1 lists energy democracy frameworks found in the literature, and delineates them by main, secondary, and ancillary dimensions. These studies were included because they represent a diverse sample of energy democracy dimensions and applications, ranging from discussions of state structures, policy outcomes, coalition structure or narratives driving energy democracy advocacy.

Table 3.1: Energy Democracy Frameworks and Dimensions

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Angel 2017</td>
<td>Energy Politics In-State, Energy Politics Against-State, Energy Politics Beyond-State</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burke 2018</td>
<td>Local and Regional Communities, Public Partnerships, Social Movements</td>
<td>Collective-Action Frames, Discourses, Sociotechnical Imaginaries, Stories</td>
<td></td>
</tr>
<tr>
<td>Burke and Stephens 2017</td>
<td>Resist, Reclaim, Restructure</td>
<td>Goals, Intended Outcomes</td>
<td></td>
</tr>
</tbody>
</table>
Stephens et al. (2018) applies the resist, reclaim, and restructure energy democracy framework to Vermont’s renewable energy transition policies and social movement networks (Burke and Stephens 2017; Stephens et al. 2018). While the authors concluded that the state’s renewable energy deployment targets were both strong and aligned with energy democracy goals, they observed a lack of focus on distributed ownership of renewable energy assets, a relative dearth of resistance to fossil fuels directly, and how organizations and initiatives struggled to simultaneously embrace working towards resisting, reclaiming, and restructuring the energy sector. These studies represent several applied approaches to study the actions and social fabric of the energy democracy movement.

Energy democracy, despite its relatively short history, has much to offer to energy transition and democratic governance advocates (Antal 2015; Becker and Naumann 2017; Burke and Stephens 2017; 2018; Hess 2018; Szulecki 2018). Some of the literature applies the concept to specific campaigns or coalitions with the intent of advancing multi-coalition energy transition efforts, while others focus on the relationships between civil and governmental actors in energy democracy (Angel 2017; Hess 2018). The fact that there are multiple definitions and typologies of energy democracy potentially further complicates the methodology of future analyses utilizing the framework (Becker and Naumann 2017; Burke and Stephens 2017; 2018; Szulecki 2018).
The advantage of the multiple typologies is that they help researchers and others distinguish the constituent elements and indicators of energy democracy, which enables applied analysis as demonstrated in the literature as well as for future studies. The distinctions between centralized and decentralized energy systems, public and cooperative vs. private ownership, and community scale vs. state management of systems as envisioned in energy sovereignty substantively distinguish elements of possible approaches to energy democracy. There is also a relative dearth of comparative in-practice energy democracy analyses vertically, horizontally, and internationally as Burke and Stephens (2017) explicitly highlight (Angel 2017; Burke and Stephens 2017; Hess 2018; Stephens et al. 2018). Stephens et al. (2018) concludes that the lack of focus on distributed ownership in Vermont’s energy democracy initiatives represents an opportunity for future innovation for both that state and beyond (Stephens et al. 2018). It is precisely this lack of applied analysis of energy democracy and focus on distributed ownership of energy assets in energy democracy initiatives in the literature that this chapter attempts to address through an inter-state comparative analysis of microgrid policy and stakeholders in practice (Burke and Stephens 2017).

This study of energy democracy and electric microgrid policies uses the resist, reclaim, and restructure framework articulated in Burke and Stephens (2017) and applied to Vermont in Stephens et al. (2018) (Burke and Stephens 2017; Stephens et al. 2018). The intent of the study is to analyze policy; frameworks that focus on the politics, models, coalitions, and narratives of energy democracy do not align well with the study’s purpose (Angel 2017; Becker and Naumann 2017; Burke 2018; Burke and Stephens 2018; Hess 2018). The framework articulated in Szulecki (2018) also focuses on analyzing and measuring energy democracy policies, but its indicators require the projects be completed to quantify properly, and many of the microgrids in
the cases studied here are unfinished (Szulecki 2018). The resist, reclaim, restructure framework provides a means of evaluating whether policies as designed are consistent with energy democracy’s goals without requiring the intended projects of those policies be completed already, which is why it was selected as the analytical framework (Burke and Stephens 2017; Szulecki 2018). Furthermore, the results of this study can serve to corroborate or refute Burke and Stephens’ (2017) finding that microgrids are most related to the goals of reclaiming and restructuring the energy sector and least with resisting the dominant energy agenda.

Methods

To address my research question and assess the explanatory proposition that the design and implementation of policies relevant to microgrid project support and development are inconsistent with energy democracy’s goals, a comparative case study approach has been adopted. The explanatory proposition is based upon the energy democracy framework guiding this study. Since energy democracy is considered by advocates as an aspirational and normative suite of goals, the explanatory proposition does not assume the goals have already been reached and is not structured as evaluating policies and projects retroactively. Instead, the explanatory proposition is designed to assess the alignment of ongoing projects and policies with the goals of energy democracy. Thus, the explanatory proposition is that the policies studied here are inconsistent with the concept’s objectives of resisting, reclaiming, and restructuring the energy sector. The intended outcomes of the three energy democracy goals serve as indicators and are contrasted with the observed outcomes. If one or more of the intended outcomes of at least one goal is observed as already having happened or is in progress, then the policies are deemed consistent with that energy democracy goal.
The contents of the policies were reviewed for consistency with the explanatory proposition and the energy democracy framework goals of resisting, reclaiming, restructuring the energy sector and their respective intended outcomes. The interview protocol template is included in Appendix A. The criteria for interpreting answers from respondents come from the three goals of energy democracy (resist, reclaim, and restructure) articulated by Burke and Stephens (2017) and their corresponding intended outcomes. For example, if an interviewee indicated through their answers to the interview protocol questions that new social alliances formed as part of an effort to develop microgrids, this would suggest the presence of energy democracy under the goal of resisting the dominant energy agenda’s intended outcome of cultivating new social alliances. If none of the intended outcomes of a particular goal were present based on the answers provided by the interviewee, then that goal was excluded from the results. If none of the intended outcomes were present according to the interviewee, energy democracy would not be considered present based on that interviewee. If interviewees for the same policy did not agree, then it was more challenging for me to interpret, and I would elaborate upon the conflict in my analysis.

Results

The policy context analyses of the two cases, and their analytical subunits, provide the backdrop for the data collected from interviews discussed below. Interviews for the first policy discussed below, MassCEC’s Community Microgrid Program, yielded evidence that the policy is consistent with resisting, reclaiming, and restructuring the energy sector. The data bolsters the case that the explanatory proposition that Massachusetts’ policies are inconsistent with the three goals of energy democracy is not supported.
Both administrators and recipients of MassCEC’s Community Microgrid Program cited high degrees of community engagement and open communication between them, and applicants had the authority to craft the projects to maximize community benefits, particularly for vulnerable populations. Furthermore, MassCEC had specific criteria that made carve outs for microgrids serving vulnerable populations as part of the application selection process. One administrator said:

It was frankly the right thing to do. Low-income and/or vulnerable populations don’t have as many options as middle and upper-income people do when it comes to escaping from natural disasters or bad storms, from long-term power outages…emergency management professionals would prefer that vulnerable populations be able to shelter in-place…Another reason was very practical in that, in many cases, low-income and/or vulnerable populations live in buildings with one owner so you have an opportunity to impact a lot of people positively by addressing energy resilience needs with one building owner.

They added that it was an open solicitation for projects that had a viable business model, had a strong community resilience project narrative, and had avid local supporters. The formation of RUN-GJC (Resilient Urban Neighborhoods-Green Justice Coalition) as a coalition of over 40 community organizations, environmental groups, and labor unions that advocated for and received grants from MassCEC for microgrid feasibility studies is an example of resisting the dominant energy agenda through the formation of a new social alliance. If built, the Chelsea microgrid would be the first to be a community-led and owned project (Wilcox 2018). The successful applications for the Chelsea and Chinatown microgrids provide evidence of both new ownership models and normalization of social control over energy production and consumption, which are two intended outcomes of reclaiming the energy sector. While these projects are still in the planning stages, they promise greater community autonomy over energy systems, indicate greater energy planning capacity, and would put low-income communities and communities of color in positions of authority over these energy systems. For the Chelsea microgrid, because the
low-income communities and customers are not all next to each other, a cloud-based system will be used to combine them (Wilcox 2018). According to David Dayton, engineer and founder of Clean Energy Solutions, a collaborator for the project,

We can sell solar panel output under the state’s new smart program to utilities. We can sell grid services to the independent system operator, ISO New England. We can lease clean energy products to neighboring businesses and folks who can afford to lease them and get a service contract (Wilcox 2018).

Chelsea’s town manager, Tom Ambrosino, commented on the project: “I see all positives attached to it and very little downsides to the city. We’re supportive if they get the state’s green light to go forward” (Wilcox 2018). While Reid Lamberty, a spokesperson for Eversource, mentioned that the project is still early on in its development, he said “we’re excited to be part of the process with the city, also with [Massachusetts Clean Energy Center], and the project teams that are developing these feasibility studies” (Wilcox 2018). Two representatives of a nonprofit that is part of RUN-GJC bolstered this point by mentioning that the microgrids are 100% based on the community’s feedback. According to them, the community has veto-power and that the project is for them, so they should have a say on all of this. A representative of a different nonprofit organization in RUN-GJC added that “…on our side we’ve been giving them [MassCEC] feedback about what we needed and hoping for…we wanted democratic community ownership and decision-making over the projects.” The representative of the second nonprofit desired “…a sustainable source of income and [to] empower communities to get control over this essential resource… getting at what this meant exactly was tricky because there was no model to go by, no template…we had to work with MassCEC on those questions.” The mutual agreement over empowering communities between MassCEC and RUN-GJC, as well as their collaboration to ensure these outcomes were achieved, serve as evidence of restructuring the energy sector.
Interviews with DOER about CCERI provided evidence for the energy democracy goals of reclaiming and restructuring the energy sector, and strengthens the case that the explanatory proposition is not accepted for the Massachusetts case. CCERI, according to one administrator, explicitly awarded additional points as part of the application selection process to microgrids that served dense and vulnerable population centers, with constituents wielding most of the authority in determining whether the projects served low-income neighborhoods. The administrator added that points were also awarded to applications that served different kinds of facilities, such as shelters, hospitals, wastewater treatment plants, and were geographically distributed throughout the state. All of the six winning microgrid projects after all three rounds of the competition support energy democracy goals because they would decentralize both political power in the energy sector and power generation. However, evaluating how much access community members have to these new energy assets can only be determined after installation. The interview data gathered suggests that CCERI aligned with two of the three goals of energy democracy. These were the data points collected from the Massachusetts and Boston subunits that led to the rejection of the explanatory proposition for the Massachusetts case.

While the Massachusetts and New York cases share similar policy requirements for serving vulnerable communities with microgrid incentives, levels of community engagement varied more in the NY case. The GOSR Microgrid Program had specific federal HUD and state requirements for projects to serve low-income communities. One administrator of the GOSR program, in response to the question about support and opposition to the program, mentioned that while there is not an organized resistance to the microgrid program and that no one is losing with this kind of project, in their view “…there’s not necessarily people cooperating or going out of their way to get things done. It’s not on their radar,” where the “thing” and “it” are microgrids.
This lack of coordination could hinder electric microgrid advocacy. Ensuring microgrids funded by NY Prize served low-income communities was a key criterion for the competition, and applicants have significant authority over their projects. One NYC government official, in reference to OneNYC and NY Prize, echoed enthusiasm that communities in the city have been pretty involved, the funding contained strings requiring that these projects serve particular populations, and that communication has been substantial. They elaborated that there was a community engagement process with regular public meetings, presentations of alternative project designs, and efforts made to understand community goals for these projects while increasing resilience. These developments are indicative of reclamation and restructuring of the energy sector.

In the New York case, the role of the private sector in microgrid policy was particularly divisive for interviewees regarding policy alignment with energy democracy goals. For RISE: NYC, serving LMI communities was part of the requirements of HUD block grant program RISE: NYC was funded by, but little community input was possible other than through the community complaints process, and most input came from small businesses that may or may not represent entire communities. Several NY government and nonprofit representatives noted that while the goals of NY state and NYC generally acknowledge equity as a desired outcome, microgrid development largely resides with the private sector. Both real estate companies and utilities have opposed such projects because the decentralization of authority and revenue generated from microgrid operation that can result from their development threatens the bottom line of these industries. The heavy involvement and opposition from the private sector, as well as the view of these representatives that communities have less than full authority over projects, are inconsistent with energy democracy’s goals. One interviewee, part of a statewide nonprofit
organization, labeled NY REV as being based on a neoliberal ideology, that microgrids are expensive and complex, and that for microgrids to scale, they will have to be part of publicly funded infrastructure projects rather than private sector initiatives. They went on to say that the high cost of microgrid projects affects the likelihood of them being developed in low-income communities and is in part why they are mostly built for large institutions. The representative of the NY nonprofit elaborated further that most microgrids use natural gas or are CHP facilities, and mentioned the Empire State Plaza microgrid project in an environmental justice community in Albany as a case of utilities and the State wanting to modernize the existing microgrid with CHP instead of geothermal that community advocates were pushing for.

The Empire State Plaza microgrid project was first proposed by New York Power Authority (NYPA) in May 2017 (Maloney 2019). NYPA announced in February 2018, in response to local advocacy from groups like the Sheridan Hollow Alliance for Renewable Energy, it would re-evaluate the microgrid plan in order explore whether it could use renewable energy resources. NYPA also reconsidered the microgrid in part because bids received for the project were 25% more expensive than anticipated. Since my interview with the nonprofit representative, the state has changed course with the project. The opposition to and expense of the project, as well as advocacy for renewable alternatives, ultimately led to NYPA and the Office of General Services (OGS) scrapping plans for the microgrid project altogether on September 19, 2019 in favor of building a solar PV project on state-owned land in Oneida County. The goal of the solar project is to provide half of the energy needs of the Empire State Plaza. NYPA spokesman Paul DeMichele commented that “we are moving in a different direction…we want more renewables, in keeping with the governor’s clean energy vision”
(Maloney 2019). Thus, the shift in renewable energy targets at the state level passed in July of 2019 influenced the trajectory of the project.

The data collected point towards continued dominance of the existing energy agenda of private corporations, a lack of democratization of energy production and political power, and no guarantee that low-income communities or communities of color would hold positions of authority over the energy system even though it might serve them. Thus, there is a lack of resisting, reclaiming, or restructuring of the energy sector. The conflict in data gathered for NY means there is evidence of elements of energy democracy in electric microgrid policy, but it is not the dominant paradigm.

Massachusetts state policies, and the political environments in which they operate, suggest they are consistent with energy democracy goals given the community engagement, criteria for project selection, and delegation of authority for project development. New York State policies all have goals that reflect principles of energy democracy, but opinions diverge on whether the political conditions are consistent with the concept. In particular, the roles of real estate and utility companies in driving electric microgrid development are sources of disagreement amongst stakeholders for whether the power dynamics and benefits accrued from projects go towards low-income and vulnerable populations. This divide in analysis largely split along sectoral lines; government and administrators of the projects in New York mostly thought the programs gave much authority over projects to applicants that were serving communities, while grassroots nonprofits were more inclined to believe it only further entrenched powerful private interests.

Boston’s microgrid development efforts are guided by the plans the city has published with input from over 10,000 residents for both Imagine Boston 2030 and Resilient Boston, the
regulations developed in consultation with city departments and external stakeholders, and the state and nonprofit policies that support their efforts (BPDA n.d.; City of Boston 2017a; 2017b; EOEEA 2014; MassCEC 2017b). In this regard, New York City is similar given the plans it has produced and the policies it has at the state level that support their vision articulated in their plans (City of New York 2015; 2018; NYCEDC 2015b; NYSERDA n.d.). Boston’s direct support for vulnerable populations, high community delegation of project authority, and open communication between recipients and administrators serve as evidence for the policies’ alignment with energy democracy’s goals. While New York City’s policies based on the policy context analysis, as well as the position of their administrators support a similar assessment as the Boston case, the interviews conducted provided a more conflicted result. One of the interviewees highlighted that a key difference between the two municipalities’ capacity to enact change is that NYC has the legal authority to change their building codes, while Boston does not. Despite this difference in legal capacity, the evidence gathered suggests greater grassroots advocacy for electric microgrids in Boston than in NYC.

Table 3.2 visually summarizes the results of applying the resist, reclaim, and restructure framework to both the policy context and interview data collected for both cases.

Table 3.2: Energy Democracy Analysis

<table>
<thead>
<tr>
<th>Case Study Policies</th>
<th>Evidence for resisting the dominant energy agenda</th>
<th>Evidence for reclaiming the energy sector</th>
<th>Evidence for restructuring the energy sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>GWSA (MA)</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>CCERI (MA)</td>
<td>N/A</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>MassCEC Electric Microgrid Feasibility Study Grant Program (MA)</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Greenovate Boston 2014 Climate Action Plan Update (Boston)</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>A Climate of Progress (Boston)</td>
<td>N/A</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Boston Community Energy Study (Boston)</td>
<td>N/A</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Resilient Boston (Boston)</td>
<td>N/A</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
Overall, of the 20 policies and plans studied across both states and cities, I calculated that 39 of the 60 (65%) goals were consistent with energy democracy without conflicted results. Broken down by goal, 30% of the policies and plans analyzed were consistent with the objective of resisting the dominant fossil fuel energy agenda, while 80% and 85% were aligned with reclaiming and restructuring the energy sector respectively. Both qualitative and quantitative analyses of these policies produced an answer that overall does not support the explanatory proposition, finding that generally the policies in these cases were aligned with energy democracy’s goals.

Conclusion

This comparative analysis of two cases of electric microgrid policy at different scales suggests that electric microgrid policy in these cases are aligned with energy democracy’s goals and do not support the explanatory proposition. Of the three energy democracy goals, electric microgrid policy was most related to restructuring the energy sector, followed by reclaiming it, and least with resisting the dominant fossil fuel agenda. Planners and policymakers in the two
cases, guided by plans that receive resident feedback, interdepartmental discussions, and even academic studies, created criteria that are used to evaluate potential microgrid projects. New York City’s regular meetings for citizen feedback on projects related to OneNYC and NY Prize resonate with concepts of popular sovereignty and participatory governance, while the projects related to the NY GOSR Microgrid Program did not appear to engage a similarly interested set of constituencies (Becker and Naumann 2017; Szulecki 2018). While the policymaking and public feedback processes observed in both cases advanced the goals of reclaiming and restructuring the energy sector, the program administrators had authority over which projects received funding. Civic ownership was a critical dimension of the RUN-GJC microgrid projects funded by MassCEC’s Community Microgrids Program. Projects like those spearheaded by RUN-GJC located in Boston and Chelsea, and funded a state-level organization (MassCEC), work directly towards the intended outcomes of resisting, reclaiming, and restructuring the energy sector because they empower communities instead of the private sector (Burke and Stephens 2017).

The formation of RUN-GJC better enabled and organized the Massachusetts communities they represent to advance their microgrid projects and apply for funding. A range of perspectives amongst interviewees existed, especially in the case of New York, regarding whether the policies aligned with energy democracy goals. Most of the policies examined, especially those directly addressing electric microgrids, contained provisions and legal requirements to serve low-income or vulnerable populations in project selection. Since all of the microgrid incentive programs studied were grant-based competitions, the burden was largely on applicants to make the case that their proposed plans would benefit vulnerable and low-income populations. Interviews with administrators of these programs reflected their interest in delivering benefits to the public through greater resilience and environmental outcomes. Some
government and quasi-public agency administrators acknowledged what most nonprofit representatives mentioned as hindering further microgrid development in their communities, which is that powerful private sector stakeholders like real-estate developers and utilities can greatly influence whether projects move forward and are consistent with community and energy democracy goals. The energy democracy movement is simultaneously concerned about the climate crisis and challenges people to understand the political underpinnings for rapid transitions: “Whose interests will be most served through new energy infrastructures? Will a rapid energy transition seek to extend concentrated power into new energy regimes, or conversely build new political power among communities, energy citizens, unions and so on?” (Burke and Stephens 2018).

A democratic response to climate emergency requires immediate resistance to fossil fuels coupled with the deployment of renewable energy systems at a pace that sustains and can be sustained by democratic governance, lest projects of democratization collapse and renewable solutions rapidly transform into the next human catastrophe (Burke and Stephens 2018).

Energy democracy advocates warn that renewable energy systems, including microgrids, developed with the same systems of logic as used during the fossil fuel era risk exacerbating global social and environmental problems in the future (Burke and Stephens 2018; C. F. Jones 2013). In order to be more certain of climate benefits of projects, renewable energy systems need to substitute rather than be additive to existing fossil fuel systems, and from a biophysical perspective must not be deployed a pace exceeding global and local environmental capacity to accommodate their installation (Burke and Stephens 2018; Steffen et al. 2015; York 2012). The tension about the role of the private sector in the NY case reflects the concerns articulated in the energy democracy literature. While the evidence gathered here is insufficient to conclude that the economic value of city neighborhoods is the primary determinant of where publicly
supported systems are installed, the evidence suggests that privately funded electric microgrids are related to the affluence of the institutions they serve. Hudson Yards, the numerous universities in both cases, and national trends of third-party financing of electric microgrid investment exemplify the influence of capital in project location. Across sectoral lines, the higher cost of electric microgrids compared to on-grid only energy systems also posed an obstacle to further deployment in these cases.

While electric microgrids create the possibility for decentralized energy infrastructure, their installation does not guarantee the accompanying political power or dynamics associated with community-based project ownership and operation energy democracy strives for. This finding corroborates Burke and Stephens (2018), which concluded that a renewable energy transition does not guarantee energy democracy, and that a range of outcomes along a spectrum of more or less energy democratic are possible. Furthermore, this research also corroborates the findings of Burke and Stephens (2017) that electric microgrids, as a potential policy instrument, are least related to the energy democracy objective of resisting the dominant energy agenda, and more centered on reclaiming and restructuring the energy sector. This imbalance in emphasis of alignment of electric microgrid policies with energy democracy goals, especially with regards to a relative lack of resistance to the dominant fossil fuel agenda, is also similar to the minimal direct resistance to fossil fuels and failure to simultaneously operationalize all three energy democracy goals in the policies found in the case of Vermont in the literature (Burke and Stephens 2017; Stephens et al. 2018). While policymakers in both of these cases are striving to achieve high levels of support for vulnerable communities with these projects, operationalizing energy democracy in practice is an ongoing process and struggle between policymakers, constituents, and civil society stakeholders. Future studies could address the critique that most
energy democracy studies focus on European and American settings, thus under-examining how energy democracy may work in other countries with different economic conditions and governmental structures (Angel 2017; Hess 2018).

Abstract

Electric microgrids are a group of distributed energy sources and interconnected loads acting as one controllable entity that can connect and disconnect from the grid. Electric microgrids can integrate renewable energy sources, decentralize energy infrastructure, and increase macrogrid resilience. This qualitative case study compares the electric microgrid policies in Massachusetts, New York, and the two largest cities in these states (Boston and New York City) to better understand the development of their policies using the analytical lenses of policy diffusion and policy learning. Interviews of government administrators, quasi-public agencies, and grassroots advocacy organizations in both cities and states revealed policy diffusion through the mechanism of learning occurred in all cases but to varying extents. Energy planners from the cases studied frequently communicated about microgrid policy experimentation, shared lessons with each other, and these discussions influenced policy formulation that proceeded the earliest adopters.

Keywords

Electric Microgrid Policy, Policy Learning, Policy Diffusion, Explanation Building Case Studies, Massachusetts, New York

Introduction

Extreme weather events, climate change, and other hazards threaten the stability of the electric grid; electric microgrids represent one technology that can enhance grid resilience and integrate more renewable energy sources (Commission to Assess the Threat to the United States
from Electromagnetic Pulse (EMP) Attack 2008; EOP 2013; K. B. Jones, James, and Mastor 2017; National Research Council 2012; Panteli and Mancarella 2015; Quadrennial Energy Review Task Force 2015; Smith and Ton 2013; Vine, Attanasio, and Shittu 2017; H. Yin, Xiao, and Lv 2015; Zamuda et al. 2013). There are a number of definitions for what electric microgrids are; one is

a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island mode (Smith and Ton 2013, 22).

The composition of microgrids as both an energy supply source and electric infrastructure to distribute the energy generated on-site allows them to operate independent from the macrogrid. Hirsch et al. (2018) asserts that microgrids in industrialized countries must be contextualized as operating in parallel to a mature “macrogrid” featuring gigawatt-scale generation facilities and up to hundreds of thousands of miles of high voltage lines, little energy storage, and powered primarily by fossil fuels (Farzan et al. 2013; Hirsch, Parag, and Guerrero 2018; E. R. Morgan et al. 2016). The independence of both generation and distribution systems from the macrogrid can also be referred to as a power island, or “an energized section of circuits separate from the larger system” (K. B. Jones, James, and Mastor 2017; von Meier 2006, 152). The island, upon being disconnected from the macrogrid, transitions from being a redundant set of infrastructures to the main source of power for users connected to the islanded area (K. B. Jones, James, and Mastor 2017; von Meier 2006, 153). While many early microgrids were deployed at hospitals, universities, and military bases, electric microgrids have been deployed in every sector in both urban and rural settings (Cohn 2019; Roberts and Chang 2018). There is a dispute over which microgrid is the world’s largest, but the range is between 100MW to 135MW in capacity (Burger 2018). As a proxy for average microgrid size, Hitachi claims the optimal
range in microgrid size in terms of costs and benefits is between 1.5MW and 40MW (Wood 2016).

U.S. microgrid capacity has increased from 700 MW in 2010 to over 2 GW in 2017, with 545 MW in new capacity installed in 2018 alone (GTM Research 2018a; 2018b; Wood Mackenzie 2018; 2019b). Wood Mackenzie’s proprietary database of electric microgrids currently tracks 2,288 systems across the country, and they are forecasting that cumulative U.S. microgrid capacity will reach 8.8GW by 2024 (Wood Mackenzie 2019b; 2019a). Over half of all 2018 U.S. microgrid projects were third-party-owned, 80% were supported by third-party financing, and 39% of operational microgrids in 2018 were for commercial purposes (Wood Mackenzie 2018; 2019b). The Southeast, without state incentives supporting the region, led the country’s deployment of microgrids in 2018 and has most of the operational commercial microgrids with 75% of the region’s operational capacity serving commercial end users. Florida experienced the greatest year-over-year increase in microgrid projects, which could possibly be linked to recent hurricanes striking the state. State policy has been a significant source of electric microgrid financing; of the $275 million in microgrid-related state incentives announced between 2012 and 2017, 33% was in California, 27% was in New York, 19% was in Connecticut, and 15% was in Massachusetts (Wood Mackenzie 2018).

However, there is little analysis on the policies that have encouraged this growth in microgrids, whether policy learning has influenced policies implemented, and if policy learning has affected policy formulation how it changed these policies (Cook et al. 2018; GTM Research 2018a; 2018b). Policy learning refers to revising policies, strategies, and implementation based on observed or lived experiences, social interaction, or analysis (Checkel 2001; Dunlop and Radaelli 2013; Hall 1993; Heclo 1974; Meseguer 2006). Similarly, there is a gap in the literature
and lack of data regarding whether policy diffusion has played a role in the recent uptick in incentive programs and projects deployed, which this study addresses in part (Cook et al. 2018). Policy diffusion refers to the transfer of policy innovations from one government to another unit of government (Shipan and Volden 2008). A systematic analysis of policies in pioneering states could reveal the extent to which and the types of diffusion that led to policy implementation (Shipan and Volden 2008). While policy learning and diffusion theories have been used to understand renewable energy adoption, they have not been applied to microgrid development and policies to support it (Howlett, Mukherjee, and Koppenjan 2017; Motta 2015). Because microgrids are distinct, this chapter can provide new insights into a burgeoning field within the broader shifts occurring in the energy sector.

This chapter details a case study analysis of microgrid policies in Massachusetts, New York, the City of Boston, and New York City through the analytical lens of policy diffusion with policy learning as a mechanism of particular interest. These states and municipalities are early adopters of microgrid policies, and the New York case is a first mover, enabling examination of how governments learn when they create unprecedented policy. This analysis uniquely addresses how policy learning in and diffusion to and from governments implementing policies promoting microgrids takes place.

There are three research questions. Did policy diffusion occur in the case of electric microgrid adoption? If diffusion occurred, what was the mechanism of diffusion? How did policy innovation come from within the polity in cases where policy diffusion was not responsible for policy change? This chapter investigates the opportunities for and barriers to scaling up and accelerating microgrid policy implementation and project development, as well as
the extent to which the theories of policy learning and diffusion apply to the observed rate of microgrid deployment. This study attempts to identify the extent to which learning drives policy.

A Review of Policy Learning, Diffusion, and Measuring These Concepts

The updating process of policy learning can be intentional and conscious, more spontaneous and organic, or even unintended (Dunlop and Radaelli 2013; Hall 1993; Heclo 1974; Liberatore 1999). Superficial and limited analysis can be thought of as soft learning, whereas hard learning involves deep analytical processes (Dolowitz 2009; Dunlop and Radaelli 2013). Learning has also been conceptualized as being either single or double-loop, where single loop learning is simple and political actors adjust their strategies, whereas complex double-loop entails questioning and revising fundamental objectives, preferences, and even identities (Argyris and Schön 1978; Checkel 2001; Dunlop and Radaelli 2013; Levy 1994).

Policy innovation occurs when a government at any scale adopts a new policy, which can come either within or outside of the polity (Mintrom 1997; Shipan and Volden 2008; Walker 1969). Policy innovation from within the polity can be driven by interest group pressure, electoral politics, and the influence of other institutions (Shipan and Volden 2008). Policy innovation from outside of the polity, meaning the transfer of innovation from other governments, is called policy diffusion. The four major mechanisms for policy diffusion are learning, economic competition, imitation, and coercion. Policy diffusion via learning means the likelihood of a unit of government adopting a policy increases when the same policy is adopted by other places of the same scale. Policy diffusion via economic competition means that a unit of government is more or less likely to adopt a policy depending on whether there are positive or negative economic spillovers from spatially proximate governments. Policy diffusion via imitation, also known as emulation, is replicating the policy of another place in order to appear
similar to that other place, rather than focusing on the substance of the policy change seen in policy learning. Policy diffusion via coercion is when a government adopts a policy because it is either legally obligated to by a higher level of government pre-empting lower levels of government, a higher level of government making funding available or unavailable on the condition that a policy is adopted, or a higher level of government implementing a minimum set of regulations that applies to lower levels that can be built upon. The dichotomy and mechanisms of policy innovation coming from inside and outside of the polity are essential concepts for understanding the answers to my research questions. Policy learning represents one of the mechanisms for policy diffusion, connecting both the policy diffusion and policy learning concepts and literatures.

The policy learning literature includes different perspectives on the types of actors, knowledge, and policy processes that structure policy learning (Moyson, Scholten, and Weible 2017). The complexity of policy challenges that confront decisionmakers and inevitability of making mistakes in addressing them cements the value of learning in developing and implementing policy. Learning from the experiences of others, past and present, provides an opportunity to develop better policies in the future. Microgrid deployment is rapidly increasing, and yet there is little analysis on whether and how policy learning, and related policy processes, have defined and influenced practices in particular places. Understanding the role of learning in microgrid policy can contribute to the formulation, implementation, and ongoing refinement of efforts to develop microgrids.

Moyson et al. (2017) categorizes policy learning literature by the scales at which they operate: micro, meso, and macro-levels. Micro-level policy learning theories assert that learning
happens between and within individuals in social settings, also known as “social learning” (Moyson, Scholten, and Weible 2017).

...politics finds its sources not only in power but also in uncertainty—men collectively wondering what to do...Governments not only ‘power’... they also puzzle. Policy-making is a form of collective puzzlement on society’s behalf; it entails both deciding and knowing...Much political inter-action has constituted a process of social learning expressed through policy. (Heclo 1974)

Social learning approaches weave learning and power together (Moyson, Scholten, and Weible 2017; Parsons 1995). Policy knowledge comes from power relations between different groups of people and is embedded socially (Friedmann 1984; Moyson, Scholten, and Weible 2017). Haas’s epistemic communities, Hall’s social learning, and Sabatier and Jenkins-Smith’s advocacy coalition framework are examples of social learning approaches (Haas 1992; Hall 1993; Moyson, Scholten, and Weible 2017; Sabatier and Jenkins-Smith 1993).

The focus of meso-level approaches to policy learning is on organizations, which is a byproduct of two tendencies (Moyson, Scholten, and Weible 2017). The first, derived from political science, considers the role of learning as part of a body of research that takes a business viewpoint of government actions (Etheredge and Short 1983; Metcalfe 1993; Moyson, Scholten, and Weible 2017). Organizational science produced the second tendency, which is to take a learning perspective on how organizations, including public ones, behave (Common 2004; Gilson, Dunleavy, and Tinkler 2009; Moynihan and Landuyt 2009; Moyson, Scholten, and Weible 2017). Cyert and March (1963) assert that “through organizational learning processes...the firm adapts to its environment” (Cyert and March 1963; Moyson, Scholten, and Weible 2017). Organizational learning is strategic because it affects an organization’s capacity to identify, respond, and adapt to exogenous changes (Moyson, Scholten, and Weible 2017). Argyris and Schön (1996) note that learning includes the detection and correction of errors,
which enables organizations to implement their norms and objectives, which they define as
single-loop learning, while modifying them constitutes double-loop learning (Argyris and Schön
1996; Moyson, Scholten, and Weible 2017).

In contrast to micro and meso-level approaches, macro-level policy learning theory
examines how learning happens at the system level and often across units of government
(Moyson, Scholten, and Weible 2017). It analyzes how a policy decision could influence another
government over time; the process through which this can occur has been called policy transfer,
policy diffusion, lesson drawing, and policy convergence (Bennett 1991; Dolowitz and Marsh
These approaches, built on a foundation of sociological diffusion research, are “primarily
interested in the take-up of information and ideas, practices and technologies among networks of
peers” (Moyson, Scholten, and Weible 2017; Rogers 2003). The concept of policy transfer
exemplifies this as it has been defined as a process whereby decisionmakers in one institutional
environment “learn” from policy decisions made in another setting (Dolowitz and Marsh 2000;
Moyson, Scholten, and Weible 2017). The creation of a typology of rival mechanisms of
diffusion (competition, imitation, and coercion) is a byproduct of the indirect focus on learning
in the literature (Moyson, Scholten, and Weible 2017; Shipan and Volden 2008). However,
research into collective, system-scale learning facilitating idea transfer is relatively new (Gilardi
2010; Meseguer 2004; Moyson, Scholten, and Weible 2017; Volden, Ting, and Carpenter 2008).
Lesson drawing is an idealized type of learning that assumes a practical ability to take insights
from institutional setting to achieve goals in another institutional setting (Gilardi, Füglister, and
Luyet 2009; Moyson, Scholten, and Weible 2017; Rose 1991). In contrast to the ideal of lesson
drawing, and possible for the three scales of learning, policy learning can be biased, random, or
absent (Dussauge-Laguna 2012; Moyson, Scholten, and Weible 2017; Shipan and Volden 2012; Wolman and Page 2002).

There are three characteristics micro, meso, and macro-level policy learning share (Moyson, Scholten, and Weible 2017). The first is the focus on the relationship between the state and society; it is a dynamic exchange where political and policy-relevant ideas and power both circulate and exist in the state among stakeholders, scientists, experts, and citizens (Hall 1993; Moyson, Scholten, and Weible 2017; Sabatier and Jenkins-Smith 1993). Thus, policy learning literature applies to the development of ideas that revolve around collective action and people-government interactions, including epistemic communities, policy networks, and advocacy coalitions among others (Moyson, Scholten, and Weible 2017; Parsons 1995). The second trait, derived from psychological research, is that policy learning literature has largely adopted the “behavioral turn,” in which people have bounded rationality with incomplete knowledge, limited capacity to process information, and are constrained by their environment (Moyson, Scholten, and Weible 2017; Zito and Schout 2009). These factors affect policy learning because the relationship people have with their environment is dynamic and socially constructed, which influences the stimuli they observe and how they understand it. The third characteristic broadly shared by the different approaches to policy learning is that they view the policy process over time (Moyson, Scholten, and Weible 2017). One of the primary factors affecting policy at a given point in time is the policy that preceded it, which is important because ideas can have contradictory effects on politics (Hall 1993; Moyson, Scholten, and Weible 2017). The stability of ideas can grind decision making to a halt, but how ideas can be gathered, chosen, presented, communicated, advocated for, or abandoned can be quite dynamic. Public policy analysis must account for the potential influence of the stability or dynamism of ideas in the temporal
The micro, meso, and macro-level approaches to policy learning contextualize the scales and nature of policy innovation coming from outside of the polity.

Despite the interest in policy learning, it rarely explains policy change because it is one of many contributing factors to policy change. A unit of government could be influenced to adopt or not pursue a policy due to the amount of coercion they experience, the efforts of an entrepreneur, or a change in the governing coalition (Dolowitz and Marsh 2000; Moyson, Scholten, and Weible 2017). Individual policy learning also does not always result in collective learning and policy change (Heikkila and Gerlak 2013; Moyson, Scholten, and Weible 2017). Upscaling individual or micro-level knowledge obtained via learning to a collective in a system or organization is dependent on a variety of factors, including the network structure of individuals and governing rules of decision-making and information exchange (Heikkila and Gerlak 2013; Moyson, Scholten, and Weible 2017; Witting and Moyson 2015). The preferences of policy actors for particular policies can be rigid (Moyson 2018; Moyson, Scholten, and Weible 2017; Sabatier 1993). Due to psychological biases like the “certainty effect,” policy actors do not always exhibit perfect rationality by accepting information that could undermine those beliefs (Leach et al. 2014; Moyson, Scholten, and Weible 2017). Understanding how policy learning does not guarantee policy change contextualizes the interest of this paper in policy diffusion and learning within the plethora of reasons policy change does and does not happen.

While the link between policy learning and policy change motivates much of the published policy learning research, most of this research does not examine the mechanisms and extent of policy learning, as well as the conditions most conducive for it and its effects on policy
change (Moyson, Scholten, and Weible 2017). However, the studies that do analyze policy diffusion mechanisms, and their respective indicators, operationalize them inconsistently across the literature; Maggetti and Gilardi (2016) completed a fuzzy-set qualitative analysis of 114 articles published between 1990 and 2012 that focus on measuring diffusion mechanisms and the connection between concepts and indicators. They quantify the frequency the three mechanisms they study (learning, emulation, and competition) were measured by six different indicators (structural equivalence, geographic proximity, joint membership, success of policy, number of previous adopters, and trade flows) (Maggetti and Gilardi 2016). Structural equivalence measures units with structurally equivalent inside of a network that could be either competing with each other or exposed to analogous normative pressures and fit with the emulation mechanism. Geographic proximity refers to the geographic distance between units or whether they share an adjacent border and cannot exclusively be associated with a single mechanism. Joint membership measures co-participation in institutions, groups, or organizations where direct interaction or contact is assumed. Joint membership is unlikely to be linked to competition, and since the nature of interactions is not measured, it is difficult to connect to only one mechanism. Success of policy measures whether or not a policy was successful, which if effectively operationalized can be directly connected to the mechanism of learning. Number of previous adopters measures how many other units have previously adopted a policy either relative to potential adopters or in absolute terms. While number of previous adopters could be discussed in the context normative pressures and emulation as a mechanism, it does not directly identify norms. Trade flows measures pattern of trade and gives greater weight to countries with which one country exchanges large volumes of goods and services. Trade flows could be a good
indicator of competition if the competitive relationship is tightly connected to bilateral trade, but it could also indicate a link between countries more generally.

The results reveal significant inconsistencies. The same mechanisms are operationalized using different indicators, and different mechanisms are operationalized using the same indicators. What is more, no systematic patterns emerged about methodological choices, which are extremely varied, especially regarding the study of emulation. This state of affairs hinders the accumulation of knowledge and creates confusion and potential misunderstandings among scholars and vis-à-vis policymakers (Maggetti and Gilardi 2016).

Of the forty-seven operationalizations of the learning mechanism in the literature sampled, eighteen were operationalized through policy success as its indicator, ten by geographic proximity, seven by joint membership, six by structural equivalence, four by number of previous adopters, and two by trade flows (Maggetti and Gilardi 2016). To address the observed heterogeneity of policy diffusion methodology and application, Maggetti and Gilardi (2016) created a conceptually precise policy diffusion framework intended for applied analysis. They hold that policy diffusion has three levels: basic, secondary, and indicator.
The basic level corresponds to their theoretical definition of policy diffusion, which is that “policies in one unit are influenced by policies in other units” (Braun and Gilardi 2006; Maggetti and Gilardi 2016; Gilardi 2012; Goertz 2006; Graham, Shipan, and Volden 2013; Strang 1991). The secondary level consists of the three policy diffusion mechanisms: learning, emulation, and competition. If one of the three mechanisms are present, then policy diffusion occurs. The indicator level operationalizes the secondary level so a given case can be determined whether it is in fact policy diffusion with its associated mechanism. In other words, the indicator level denotes the types of evidence required to corroborate whether policy diffusion happened by which mechanism. Thus, three indicators of policy diffusion are successful policies for the learning mechanism, appropriate policies for emulation, or policies of competitors for competition. In Maggetti and Gilardi’s framework, learning is a result of being influenced by successful policies, emulation is copying appropriate policies, and competitions is following the
policies of competitors in the pursuit of attracting or retaining resources (Maggetti and Gilardi 2016). Policy success can take different forms: it can be related to the goals the policy is crafted to accomplish, the challenges of policy implementation, or receiving political support (Braun and Gilardi 2006; Gilardi 2010; Jensen and Lindstädt 2012; Maggetti and Gilardi 2016; Meseguer 2004; Volden 2006). Emulation prioritizes the symbolic and socially constructed aspects of policies rather than their objective consequences (Cao 2009; Fernández and Lutter 2013; Greenhill 2010; Krook and True 2012; Maggetti and Gilardi 2016).

Using the framework of Maggetti and Gilardi (2016), my research focuses on the following questions: is policy diffusion occurring in the rapid expansion of electric microgrids? If policy diffusion is happening, what is the mechanism? In cases where policy diffusion does not occur, how did policy innovation happen from within the polity? I chose this framework because it avoids the observed heterogeneity of the operationalization of the policy diffusion mechanisms in the literature by identifying and defining a single indicator for each mechanism of policy diffusion. To examine my research questions on whether policy diffusion is occurring, and which mechanism enabled the diffusion, I apply the different components of the policy diffusion framework identified in Figure 4.1 to comparatively assess two cases, each having two subunits of analysis. Shipan and Volden (2008) identify several sources of policy innovation from within the polity, which will be analyzed and discussed for my third question in cases when policy diffusion did not occur (Shipan and Volden 2008). The cases are Massachusetts and New York. The state level actions represent the first subunit of analysis in each case, while the largest municipality within each state (Boston and New York City respectively) are the second analytical subunit for each case. Both states and municipalities are pioneering in microgrid policy, but New York provides funding for all stages of microgrid projects, not just feasibility
studies (EOEEA 2014; NYSEPB 2015; Rubenoff 2018). New York also changed its electricity market via the Reforming the Energy Vision (REV) proceeding to value Distributed Generation with a value stack (tariffs), whereas Massachusetts utilizes net metering (DSIRE 2016; NYSEPB 2015; Shrestha 2018). These differences, along with their similarities in regional proximity and governmental structure, make them ideal cases for more detailed study. While policy innovation from within the policy is an important piece of the broader discussion of policy change, the focus of this paper is the study of policy diffusion and policy learning as a mechanism of it. Of the policy diffusion mechanisms considered, particular interest is paid to policy learning. If the lessons learned are beneficial for future policies adopted, then learning holds great potential value for other jurisdictions. Emulation of appropriate policies is less plausible because of the appeal of copying expensive incentive programs for the sake of imitation. Competition as a mechanism for policy diffusion is more plausible than emulation because marketing one’s state as the most resilient and cutting-edge could hold economic advantages in attracting investment and business opportunities. However, even if competition is the predominant mechanism, a certain amount of learning about competitor’s policies would be required in order to formulate and adopt a competitive policy. While the learning mechanism is the focus, both learning and competition would involve knowledge transfer from other governments.

**Methods**

A comparative case study approach has been adopted to address my research questions and assess the explanatory proposition for these cases. The theory-based explanatory proposition is that policy diffusion did occur, and learning was the mechanism which enabled it. This technique uniquely addresses my questions about how and why electric microgrid policies developed in the selected cases in the manner that they did. The criteria for interpreting answers
from respondents comes from the framework articulated by Maggetti and Gilardi (2016) (see Figure 4.1) (Maggetti and Gilardi 2016). The basic level of the framework addresses whether policy diffusion occurred, the secondary level determines which mechanism resulted in the diffusion if diffusion did happen, and the indicator level is the evidence one would expect to find should the hypotheses about the basic and secondary levels be correct. Thus, if the basic level is that policy diffusion did occur, and the available evidence supports that learning was the mechanism, successful policies would have to exist prior to the case’s policy development and be cited as influential to the case’s policy design and adoption.

The interview protocol utilized in the interviews is included in Appendix B. The first question most directly related to policy diffusion was whether the microgrid policy or project was based on or inspired by a policy or project from somewhere else. This binary question had follow-up questions if the interviewee’s answer was “yes” to the first question. When, where, and how the learning occurred, what the interviewee thought of the other project or policy, the lessons taken from the other policy or project, and why their organization sought to learn more about the project or policy were the follow-up questions in the protocol. The protocol questions were designed to elicit details regarding the policy and political landscapes the cases operate in, whether policy diffusion was present, what mechanism was involved if policy diffusion was present, and what lessons were taken from other policies if policy diffusion had taken place. These details, if provided by the interviewee, would identify the successful policies that indicate policy learning as the mechanism for policy diffusion as outlined in Maggetti and Gilardi’s (2016) framework. The criteria for interpreting answers from respondents come from the basic level, mechanism, and indicators of policy diffusion (Maggetti and Gilardi 2016). For example, if an interviewee responded that a particular policy influenced the development of their own, this
data point would suggest the presence of policy diffusion via policy learning that was indicated by that policy. My interviews rely on the interviewee’s assessment of whether and how policy diffusion took place. If interviewees have conflicting assessments of whether and how policy diffusion took place for the same policy, I will contextualize and discuss their responses in my analysis.

The contents of the policies described in Chapter 1 were reviewed for consistency or lack thereof with the explanatory proposition and the policy diffusion framework (Maggetti and Gilardi 2016). If policy diffusion was present, a subsequent evaluation of what mechanism and its respective indicators that enabled the diffusion was carried out. The contextual background research and interview data for each case together comprise the case-level analyses detailed in the sections below.

Results

According to an NYSERDA representative, NYSERDA’s NY Prize was “… was based on the needs of NY, so most of it was built on our 2010 study…we have different generation resources, we have different state goals, we have different initiatives in REV etc., so it is meant to be NY-specific…” The policy review corroborates that NY Prize was a policy that pioneered competitive microgrid grant funding, so no single successful policy diffused from another state that served as a direct model for what became NY Prize. However, NYSERDA’s reports include analysis of the regulatory environments for electric microgrids in other states, which informed the development of NY Prize (NYSERDA 2010; NYSERDA, NYS DPS, and NYS DHSES 2014). The authors of the report cited California’s leadership in adopting a legal definition of what a microgrid is, financing research and development through their Public Interest Energy Research program. California’s implementation of virtual net metering for low-income multi-
family residential buildings and complexes allowed customers that may not otherwise be capable of receiving benefits of on-site generation to become a larger group that is served by a larger system (King 2006; M. G. Morgan and Zerriffi 2002; Navigant Consulting, Inc. 2006; NYSERDA 2010). California allows net metering for “multiple tariff facilities” to accommodate locations with more than one source of generation served through a single point of common coupling (NYSERDA 2010). “Under multiple facility net metering, billing credits are based on the proportional contribution of the energy production (in terms of kWh) of each net metering-eligible generator over the applicable billing period” (NYSERDA 2010). The report’s authors found that the latter policy is important for enabling microgrids because it clarifies billing protocols for facilities with multiple generation sources.

The two most frequently cited barriers to microgrid implementation NYSERDA found based on their interviews of other states were having public utility or electricity marketer status in order to sell electricity to others, and franchise violations arising from selling electricity to customers within an existing utility’s service territory or running wires across public rights-of-way (King 2006; M. G. Morgan and Zerriffi 2002; NYSERDA 2010). Microgrid interconnection to the distribution grid was not perceived by the study’s interviewees as technically or legally problematic, and most critically officials from multiple states suggested that the lack of economic incentives was a major obstacle to microgrid development (NYSERDA 2010). In the study, officials from Pennsylvania, Connecticut, Maryland, and Illinois “did not see the value-added for the development of such systems, and one stated that there should be no need for a microgrid if incumbent utilities were ‘doing their job’” (NYSERDA 2010).

Lessons were drawn from the experiences of these other states, as much of what had worked, as well as addressing what was lacking, translated into the recommendations made by
the 2010 report (NYSERDA 2010). The authors of the report recommended enacting a statutory
definition of microgrid, enabling via statutory authority the sharing of electric and thermal loads
among unaffiliated utility customers, measures that could encourage microgrid development like
net metering and virtual net metering, and that the NYS PSC should adopt policies that promote
microgrids in the state regardless of statutory authority. The report also recommended providing
incentives for development and demonstration of microgrids. Through the success of
California’s policies among others, as well as the challenges multiple other states faced, elements
of what became NY Prize diffused into the recommendations of NYSERDA’s 2010 report. The
2013 enabling legislation for NYSERDA’s 2014 report provided an operational definition of
microgrids, and continued the dialogue between the state and NYSERDA to advance microgrid
policy in the state (NYSERDA, NYS DPS, and NYS DHSES 2014). The findings and
conclusions of the 2014 report served as the final springboard between NYSERDA’s inter-state
research and NY Prize:

…NYSERDA in partnership with the Governor’s Office of Storm Recovery will
launch the NY Prize Community Grid Competition to support developing
community microgrids aimed at improving the local distribution system
performance and resiliency. Picking up where this study left off, NY Prize will
leverage the knowledge of incumbent utilities about their system conditions with
the creativity of community members to encourage broad customer participation,
protect vulnerable populations and provide tools for building an efficient, cleaner
and more reliable local-scale energy system. Several local community microgrids
grids are expected to be built through NY Prize where REV principles could be
tested.

The outcomes from this Critical Facility Resiliency Assessment, taken in the
proper context, coupled with ongoing NYSERDA and utility sponsored smart grid
research supported through a strategically administered Clean Energy Fund
(CEF), will fully reinforce a vibrant REV “ecosystem” across New York State
(NYSERDA, NYS DPS, and NYS DHSES 2014).

While policy diffusion of a competitive microgrid grant program to NY did not occur, the
legal and regulatory context in which NY Prize was created was heavily influenced by the
experiences of other states and diffusion of the best elements of other state policies contributed to NY Prize’s formulation. The case is particularly salient for the influence of California’s definition of a microgrid and its virtual and multiple tariff facility net metering policies. The successful policies of California and elsewhere serve as indicators of policy learning as a mechanism for policy diffusion the case of NY and NY Prize. The establishment of the mechanism of policy learning (secondary level) supports the explanatory proposition that the basic level of policy diffusion did occur, and the innovation in this case came in part from ideas originating from outside of the polity.

In an interview with DPS staff members, one individual said that while NY REV as a whole was not based on a single policy from outside of the state and was driven by existing clean energy policies within NY, they identified the NY’s community choice aggregation program was influenced by pre-existing programs in Massachusetts, Illinois, and Ohio. This evidence suggests policy diffusion of elements of NY REV happened as a result of learning about community choice aggregation policies from these three states.

In an effort to ensure federal procurement compliance, the NY GOSR Microgrid Program, according to a GOSR official, initially partnered with NYSERDA but eventually GOSR and NYSERDA decided to split off their programs.

The regulations didn’t line up, so we thought it would be easier to run the program separate and parallel than together because there were more stringent guidelines for procurement for federal dollars...we came in behind NYSERDA and we looked at projects they didn’t select. We did not do an RFP for our program because NYSERDA had already done the whole Phase 1 competition…it saved us dollars, it saved us time…from having to do the whole RFP process.

While there were differences between the sources of funding for NY Prize and the GOSR program, since the programs were initially collaborating together and the projects for both policies came from the NY Prize competition, NY Prize and the GOSR Microgrid Program seem
substantially connected to each other. Thus, the policy diffusion (basic level) through the mechanism (secondary level) of learning indicated (indicator level) by California’s successful policies (microgrid definition and virtual and multi tariff facility net metering) that contributed to the formation of NY Prize was both essential and the same learning that informed the GOSR Microgrid Program.

RISE: NYC was established as a response to damage and vulnerabilities identified in the electric grid from Hurricane Sandy. An advisory board member of RISE: NYC wrote that NYCEDC “dreamed up the RISE:NYC competition” (Crawford 2014). A representative of NYCEDC I interviewed, in reference to RISE: NYC “…couldn’t speak to any programmatic comparisons that we drew on” but thought that policies like it have been used more since then. The lack of influence from outside of the polity was echoed by David Gilford, Vice President of NYCEDC: “there hasn’t been something like this done before that we know of” (Gardett 2014).

The fact that people outside of NY and NYC viewed the program as innovative and a model to learn from is hinted at in a press release announcing the winners of the program (NYCEDC 2015a). The press release included laudatory quotes about RISE: NYC and the winners selected from a Yale University professor and a CEO and visiting scholar at the Harvard Wyss Institute. However, these individuals’ quotes were likely in the press release in part because they helped generate positive press coverage, which potentially biases their input. More evidence of outside interest in and learning from the program is required in order to determine whether it will become a source of diffusion. The explanatory proposition that policy diffusion (basic level) occurred via learning (secondary level) is not supported in the case of RISE: NYC because there are no successful policies (indicator level) that serve as the indicator of learning as the mechanism of policy diffusion. The policy innovation, originating from NYCEDC, was
spearheaded through a collaboration between it, Mayor de Blasio, and HUD according to New York City Council Speaker Melissa Mark-Viverito (NYCEDC 2014). NYCEDC and HUD represented other institutions that influenced NYC policy, which supports the rival explanation that policy innovation came from within the polity in the case of RISE: NYC.

A NYC official in the Mayor’s Office of Resiliency responded that he did not know if the city’s microgrid efforts were based on policies or projects from elsewhere. However, the same official affirmed they had learned about policies and projects related to solar and other technologies from other municipalities; they cited Boston as a good partner because their electricity sector is also deregulated and has a similar policy environment and suite of constraints. The basic level of policy diffusion occurred through the secondary level and mechanism of policy learning because of successful policies as the indicator (indicator level) regarding solar and other technologies they had taken lessons from. As first movers, neither NY nor NYC directly learned about (secondary level) and diffused policy about their respective electric microgrid policies from pre-existing successful electric microgrid policies as the indicator (indicator level), but lessons about the best practices and shortcomings of existing policies and regulatory environments in other states (indicator level) did diffuse (basic level) through learning (secondary level). Thus, the explanatory proposition in NY and NYC was supported.

The explanatory proposition for Massachusetts and Boston was supported by the evidence gathered. Massachusetts drew lessons directly from New York’s experience. A representative of MassCEC acknowledged that the MassCEC Community Microgrid Program was significantly influenced by the experience of NYSERDA’s NY Prize in NY. “We borrowed very heavily from NY, and… the staff there were very gracious in sharing lessons learned.”
They elaborated further that this information exchange is not new; “…it’s no secret that leading clean energy states like CA, NY, and MA are always looking at each other’s programming, and borrowed a lot of market development concepts from each other.” While this confirmed the influence of NY Prize on MassCEC’s program, MassCEC adapted the program to serve its needs:

We did change it a bit, we did learn some lessons from them…we were able to avoid some of the mistakes they acknowledged they made in their program design. And hopefully, collectively, as two states and ultimately as more are added to this list of states that are experimenting with microgrids, energy resilience program and policy makers and the industry will learn from these projects by providing injections of strategic investment capital and making tweaks to regulatory frameworks to enable and encourage private investment in clean and resilient microgrids…We were much more selective in picking the feasibility studies that we ultimately funded …I’m hoping we’ll have more of a 30-50% conversion rate, whereas NYSERDA had a pretty low conversion rate from feasibility study to project execution…NYSERDA also emphasized technical viability of these projects at the expense of the business or finance viability.

Multiple interviewees from nonprofits in Massachusetts corroborated that MassCEC communicated with NYSERDA and formulated their Community Microgrid Program based on NY Prize. A representative of one such grassroots group that received a grant from this program added that MassCEC learned from the experience of Connecticut and their microgrid incentive program; Massachusetts decided to more specifically require “clean” energy generate the power used in the microgrids funded. An official at DOER mentioned that DOER’s CCERI also informed the development of MassCEC’s Community Microgrid Program. The link between MassCEC’s program and previously implemented successful policies in MA and other states (indicator level) provide sufficient evidence to conclude that policy diffusion (basic level) occurred with learning as the mechanism (secondary level). Thus, the explanatory proposition for MassCEC’s Community Microgrid Program was supported.
An official at Massachusetts’ DOER recounted that their CCERI policy was developed under the Deval Patrick administration as a response to Hurricane Sandy and had continued support under the Baker administration. Two DOER officials asserted there were no specific policies that DOER learned from to create CCERI, but one of them noted that DOER coordinated with MassCEC in developing the funding and programmatic elements for CCERI out of a mutual interest to support this policy approach. The same official elaborated that while DOER had implemented other grant-funded demonstration projects, it “was a first-of-its-kind program in the country” to focus specifically on infrastructure resilience projects to mitigate the impacts of extreme weather events exacerbated by climate change. While this program was a first mover, it did not exclusively focus on microgrids, which is part of what distinguished NYSERDA’s NY Prize. A different DOER official said CCERI “was based on best practices established nationally, particularly the focus on energy security for critical infrastructure and local services, which informed the various rounds we went through.” However, the second official went further to suggest that CCERI informed policy in the Commonwealth since its implementation, with the SMART solar incentive program pairing solar and energy storage for energy resilience as an example. While there is insufficient evidence to suggest that policy diffusion (basic level) through learning (secondary level) occurred due to a specific pre-existing and successful policy (indicator level), CCERI (indicator level) served as a source of learning (secondary level) for policy diffusion (basic level) to SMART and MassCEC’s Community Microgrid Program. Thus, the explanatory proposition for CCERI is supported.

At the municipal level, at least one microgrid project in the cases studied was influenced by the experience of another project. According to a Boston government official, the plans for the Raymond L. Flynn marine park microgrid, funded in part by MassCEC’s Community
Microgrid Program, were inspired by a master’s thesis from a former City of Boston official about DER, including the Hudson Yard microgrid in New York City (Sheehan 2012; 2016; Wood 2018). Navigating the complexities of owning and operating multi-user microgrids, as well as ensuring appropriate incentives existed to support their functioning via offset tariffs, were among some of the ideas Boston gleaned from New York’s experience that influenced its design and development (Walton 2018). In particular, the Boston official elaborated that “the hybrid ownership solution of ConEd and Hudson Yards…really unstuck the stuck” with regards to resolving the standby tariff issues experienced in the case of Hudson Yards. These specific lessons support the explanatory proposition because policy diffusion (basic level) was enabled through learning (mechanism and secondary level) about the substance of New York City’s successful Hudson Yards hybrid ownership model and offset tariffs (indicators and indicator level).

Policy diffusion through the mechanism of learning was indicated by successful policies in both cases at both analytical subunits. NY Prize, Hudson Yards’ hybrid ownership model and offset tariffs, and CCERI were some of the successful policies that were indicators of policy diffusion through the policy learning mechanism. The policies of California and elsewhere served as indicators of policy diffusion through policy learning for first mover policies and projects at both analytical subunits in NY. The relatively consistent finding that policy learning was enabling policy diffusion is bolstered by the accounts of multiple interviewees from the two cases and their analytical subunits that policymakers in this field in these jurisdictions are frequently discussing their experiences with each other, as well as observing what does and does not work with electric microgrid policy experimentation in other states. Only in the case of RISE: NYC did policy innovation come from within the polity as part of a collaboration between
NYCEDC, NYC government, and HUD. Collectively, the evidence of successful policies as an indicator for policy learning facilitating policy diffusion is strong for both cases and supports the explanatory proposition.

Conclusion

Understanding the details of how policies are developed and implemented provides a policy foundation to build upon going forward. Massachusetts learned from the New York cases, New York learned about the successes and challenges of other states in formulating their policies, and other states may look to the examples set by them for their own programs. The interview data suggests that these policies generally benefitted, either directly or indirectly, from the diffusion of ideas and experiences through learning about the experiences of other cities and states. The discussions with the representative of MassCEC and NYC official in particular highlighted that energy planners from leading states and cities are frequently communicating with and learning from each other about microgrid policy. Even in the case of RISE: NYC where policy innovation came from within the polity, these entities collaborated to implement policy change that advanced electric microgrids. While NY was a first mover for many of its policies and the explanatory proposition was not supported in every case studied here, the level of communication present suggests it is unlikely that most of these policies were created in a vacuum. Much of the learning that happened did not shift fundamental governmental objectives, but was single loop learning where policymakers and planners tweaked policies to optimize outcomes for existing goals (Argyris and Schön 1978; Checkel 2001; Dunlop and Radaelli 2013; Levy 1994). This study serves as the first to document how different jurisdictions at different scales learn about electric microgrid policies and projects, and what kinds of lessons are drawn and influence future policymaking. Furthermore, it examines how policy pioneering jurisdictions
learn, inform, and develop policy, as well as how it affects the places that follow them. Despite the numerous policy changes studied in this analysis, the presence of policy learning and diffusion did not guarantee policy change, corroborating findings in the literature (Dolowitz and Marsh 2000; Metcalfe 1993; Moyson 2014; Moyson, Scholten, and Weible 2017). The case of the Raymond L. Flynn microgrid in Boston is one where lessons were learned from Hudson Yards in NYC, but since the legislative petition to grant Boston authority to pursue an ESPC has yet to be signed, factors other than learning could be impeding progress on the project.

While grants and financial incentives were the dominant policies that diffused in these cases, there are calls for other forms of governmental support rather than increasing funding, such as regulatory reform for permitting multi-user non-utility owned microgrids (Cohn 2018). Thus, while the literature on policy diffusion is correct to warn that “it would be wrong to declare inter-related policy decisions across governments are always beneficial,” learning led to positive outcomes in the cases examined here (Shipan and Volden 2012). The number and sectoral demographics of people who were interviewed represents a limitation of this research. The decision not to interview representatives of private companies, particularly real estate and microgrid developers kept the focus of the research on how policy innovation occurred rather than whether these stakeholders found the changes in policy helpful. Similarly, the inability to schedule representatives from utility companies also yielded similar constraints on the study. Future studies could examine the consequences of the policy changes and decisions from private sector perspectives that were unrepresented here. Future research on these cases and the field of policy learning more generally could focus on improving knowledge of the effects learning has on policy processes for specific groups or for particular kinds of knowledge claims (Moyson, Scholten, and Weible 2017).
CHAPTER 5: Concluding Analysis

The story arc of this dissertation started with what is driving the divergent outcomes in observed in policy outcomes for U.S. states regarding electric microgrid policy, whether such policies were consistent with the goals of energy democracy, and whether governments at state and local scales were learning from each other as they formulate and implement policies supporting their development. The findings from both Chapters 2 and 4 support the hypothesis that policy diffusion has occurred, and Chapter 4 expands upon this in the cases of NY and MA and concludes that policy learning was the mechanism responsible for the diffusion observed. Furthermore, policy learning is occurring in these cases through a context of frequent interstate communication between policymakers and close observation of policy outcomes from policies outside their own boundaries, even when a jurisdiction is a first mover. However, even with the generally favorable outcomes for learning observed in these cases, it did not guarantee policy change as in the case of developing the Raymond L. Flynn microgrid in Boston. The city is still waiting for the state legislature to grant the city the authority to execute an ESPC for private buildings in addition to public buildings which the city already possesses the authority to do. The random effect ordered probit analyses in Chapter 2 quantifies and corroborates policy stacking theory does apply in the case of electric microgrids. The threshold values between different categories of policy increased from market preparation to market creation and market creation to market expansion. This is consistent with what policy sequencing theory would predict despite the low proportion of variation explained by the independent variables in the models. Elements of energy democracy’s aspirational goals were found in the electric microgrid policies in the NY and MA cases, especially consistent with those of reclaiming and restructuring the energy sector. However, it was revealed through the interviews conducted that
private sector stakeholders, namely utility companies and real estate developers, influence the policy landscape in ways incongruent with the goals of energy democracy advocates. All three chapters confirm that numerous factors contribute to the policy development and outcomes observed; no single policy concept or theory, be it policy stacking, energy democracy, or policy diffusion can fully explain the policy outcomes observed. Another takeaway from these chapters is that policy is a dynamic field of study where shifts can occur even quickly. Less than a year after I conducted my interviews, NY passed CLCPA and changed course regarding the Empire State Plaza microgrid project.

The inquiries conducted here focused on public state and local level electric microgrid policies coming primarily from legislative efforts and quasi-public agencies. Future studies examining the U.S. can build upon the cases here or others by contextualizing these findings with federal, military, gubernatorial, and private sector efforts to develop microgrids. The policy sequence scores of states created in Chapter 2 could be compared with the partisan affiliation of state governors or number or capacity of private sector microgrids. The latter could reveal whether public policy was related to private investment in microgrids in states. Qualitative studies could examine whether lessons from military and federally funded microgrids diffused to public microgrid development efforts. States that have regulated energy sectors, operate under Dillon’s rule and not home rule, and U.S. territories represent several opportunities to explore the same questions but with cases with different characteristics. As more microgrid projects are completed, an analysis of these projects using Szulecki’s (2018) framework could also be conducted to quantitatively measure energy democracy in and across states. Exploring efforts to reform regulations defining microgrids, and under what circumstances they are permitted to be developed and owned, could further advance the literature on electric microgrid policy. All of
these opportunities for future study could also be pursued outside of American and European contexts because few studies exploring these topics exist in their respective literatures.
Bibliography


Appendix A: Chapter 3 Interview Protocol Template

- Would you say that your state/city is on a pathway to continue to build microgrids? Why or why not?
- In your experience, how has developing microgrids changed the relationship between the city and the utility company that serves it?
- Who was involved (participants) in the development of the microgrid project/policy of (organization)?
  - Biggest supporters/opponents of development of the microgrid project/policy, and why?
  - How did your organization notify the public of the project/policy development efforts?
  - How did your organization engage participants?
  - What degree of decision-making authority did participants have on aspects of the project/policy?
- How did your organization decide to site/fund the projects you selected?
  - If a project, who owns and operates it?
- What determines whether or not low-income communities (or facilities that serve them) will be sites for microgrid development?
- Briefly, please describe how the microgrid project/policy is connected to other policies and projects being pursued by your organization?
- What is the most important thing you think I should know that I have not asked about yet?
Appendix B: Chapter 4 Interview Protocol Template

• Would you say that your state/city is on a pathway to continue to build microgrids? Why or why not?

• Who was involved (participants) in the development of the microgrid project/policy of (organization)?
  o Biggest supporters/opponents of development of the microgrid project/policy, and why?
  o How did your organization notify the public of the project/policy development efforts?
  o How did your organization engage participants?
  o What degree of decision-making authority did participants have on aspects of the project/policy?

• Was the microgrid project/policy inspired by or based on a project/policy from elsewhere?
  o If yes, when, where, and how did you learn about the other project/policy?
  o What did you think of the other project/policy?
  o What lessons did you take away from the other project/policy?
  o Why did your organization pursue the project/policy and relevant learning?

• How did your organization decide to site/fund the projects you selected?
  o If a project, who owns and operates it?

• Briefly, please describe how the microgrid project/policy is connected to other policies and projects being pursued by your organization?
• What is the most important thing you think I should know that I have not asked about yet?