UNIVERSITY OF SHEFFIELD

THE CHANGING CONTEXT OF ENERGY GENERATION AND SUPPLY

The Case Study of Georgia

Thesis submitted for the degree of PhD

By

TIMINYO OWEI

Supervisors: Dr Aidan While, Dr Stephen Connelly and Dr Tim Vorley

Department of Urban Studies & Planning

University of Sheffield

August 25, 2017

ACKNOWLEDGEMENTS

"But he knows the way that I take; when he has tested me, I will come forth as gold ~ Job 23:10

I would like to thank all who lifted my up, cheered me on and pushed me through. I truly had the "dream team".

Thank you to my Supervisors, Dr. Aidan While and Dr. Stephen Connelly.

To Aidan, thanks for offering me the chance to study this topic. I am grateful for your consistent support, guidance and advice, throughout the PhD. This research has broadened my understanding of the world and for that I am thankful.

Thanks Dr Steve, for always leaving your door open. I am grateful that you had the time to talk with me, despite your busy schedule. I am grateful for your unique ability, to use engineering terms to explain social science issues. Thanks for telling me that I had the "dream team".

Thanks to my mother, who supported me through this PhD process. Thanks for all your love, prayers, lessons and advice, even when I didn't think I needed them. My respect for you grows every single day and after going through this process, I respect all you have achieved. Thank you for maintaining this magnificent balance between professor and mother. I hope that I have made you proud.

Thanks to my father who sponsored, encouraged, pushed and empathised with me. I am grateful for your sound advice and stories. I am constantly surprised by your ability to read a situation, so accurately and that you are always ready to jump on a 6-hour flight, just to make sure I am okay.

Thanks to my sister, this journey was as much yours as it was mine. I am grateful for the phone calls, which have become an essential part of my day. I am grateful for our adventures, road trips, conferences, TV marathons. Together we laughed, cried and were terrified throughout this journey. Thank you for driving me to interviews. I hope our adventures continue.

Thanks to my brother, who supported me by providing much needed entertainment value. I appreciated the chats about football, movies and games.

Thanks to the USP staff, Keely and Co., who provided consistent support throughout the PhD.

Thanks to Aisha, Uyi, Emma, Cissy, Aunty Lara and Rob who became my family in Sheffield. I will never forget the conversations, food, laughter and support. I am also grateful to friends and family, who despite being far away, always managed to check-in with me. Thanks to Lata, Dumbi, Amaka, Eloke, Ugonna, Douye and Isaac.

Thanks to those in Georgia who provided data for my research and broadened my knowledge of energy in the United States.

ABSTRACT

There is now extensive academic and policy literature on pressures to rethink prevailing logics of energy governance in response to a range of, challenges and opportunities from factors including, carbon reduction, concerns about the security of imported oil and gas, the exploitation of new fuel reserves, continued opposition to nuclear energy and new agendas of decentralised energy generation.

Decarbonisation is a key element of those debates about a new energy governance reflecting the influence of carbon policy in the present and the future. The new energy governance is affecting many countries. This thesis focuses on the changing context for energy governance, and especially electricity generation and supply in the USA. Electricity generation is selected as the primary focus in order to explore factors such as new models of decentralised energy generation.

The thesis presents an in-depth case study of the state of Georgia, and especially the changing strategies for the state energy provider, Georgia Power in response to changing economic and environmental imperatives in electricity generation and supply and lobbying from a range of key stakeholders. The case study is based on 25 interviews with key stakeholders, including Georgia Power officials, state energy regulators (public service commissioners), federal, regional and state agency representatives, industrial associations, clean energy businesses, environmental and consumer advocates and political organisations. The case study focuses on a range of key issues that mark tensions in the transition from the prevailing mode of energy governance, notably developing federal regulations, pressure for decentralisation and new nuclear development.

The thesis makes a number of key contributions to literature and debate on energy governance. By providing in-depth investigation of a context for energy transition/new energy governance that has not previously been researched, revealing new bottom up coalitions for decentralised supply and the importance of electricity pricing in influencing policy decisions.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

Across the world, energy systems are being rethought and reimagined in response to a range of challenges and opportunities. There is growing literature on energy transitions in response to present and future climate policy, concerns about the security of imported oil and gas, the exploitation of new fuel reserves, continued opposition to nuclear energy and new agendas of decentralised energy generation (Hodson & Marvin, 2009; Morris & Pehnt, 2012; Verbong & Geels, 2007; While, 2008, 2011, 2014). Literature has focused on experience around the world, with significant research in countries like the USA.

However, there is a need for further in-depth research on the response of key actors and interests to the changing context for energy generation and supply in different national and sub-national contexts. Indeed, although there has been significant research on changes in energy governance in the USA there have been relatively few detailed analyses of decision-making. The aim of this thesis is to take forward conceptual and empirical understanding of the changing context for energy governance focusing on the USA and particularly the state of Georgia. The introduction that follows provides a brief background to the context for the study and its intended focus.

1.1 The New Energy Governance: Understanding Energy Transitions

The new energy governance examined in this PhD reflects the coming together of a range of pressures, challenges and opportunities for existing modes of energy generation which are present and future climate policy, concerns about the security of imported oil and gas, the exploitation of new fuel reserves, continued opposition to nuclear energy and new agendas of decentralised energy generation (Hodson & Marvin, 2009; Morris & Pehnt, 2012; Verbong & Geels, 2007; While, 2008, 2011, 2014). It is a contingent matter whether these pressures and opportunities are present in all places and their implications for decision making. That will depend on the existing approach to energy generation and supply, the extent to which key actors are able to respond, different political, economic conditions (Hodson & Marvin, 2013; Unruh, 2000; While, 2011, 2014).

1.2 THE NEW ENERGY GOVERNANCE IN THE UNITED STATES

Arrangements for the generation and distribution of electricity vary across the USA, but in general by the early 2000s, the prevailing method was a highly-centralised model, dominated by monopoly provider with variation in markets (fully restructured, partially-restructured and traditional regulated markets), type of utilities, regulation, lock-in configurations of electricity networks and political and economic conditions. States are differentially impacted by the new energy governance because high electricity prices, outages/blackouts and new agendas of decentralisation, are also impacting electricity generation and supply, whereby states across the West, Northeast and Mid-Atlantic regions are adopting low carbon energy policies, like renewable energy portfolios, energy efficiency standards and introducing alternative energy providers to state electricity generation and supply (National Renewable Energy Laboratory, 2014; Rabe, 2006a).

The PhD focuses on the State of Georgia. The reasons for this are, having relied on coal for a large proportion of its electricity generation (Southern States Energy Board, 2012), since the early 2000s the state energy company has started having interesting discussions and debates about low-carbon energy restructuring. Georgia was selected because it has been under-researched but also because it is a context where electricity prices are low and low-carbon would not be expected to be a significant driver of change to the dominance of coal-fired power stations.

However initial research revealed evidence of pressures on the state electricity provider to reduce its dependence on fossil fuel and also pressures to open up the energy system to decentralised energy supply. The research provided an opportunity to explore what low carbon energy restructuring might mean in a context where political support for low carbon was traditionally weak and there is not an immediate crisis in the security of supply of relatively cheap electricity (compared with studies of areas that are typically seen at the forefront of low carbon energy policy such as California or Austin TX).

The PhD presents research based primarily on 25 interviews with key stakeholders which include, Georgia Power officials, state energy regulators (public service commissioners), federal, regional and state agency representatives, industrial associations, clean energy businesses, environmental and consumer advocates and political organisations.

The research focuses particularly on lobbying for supportive energy decentralisation, investment in solar generation and environmental regulations debates and discussions.

Interviews were used to explore how energy decisions are made, the context in which they are made and the factors driving or shaping those decisions. A key element of the research was to explore perceptions of the changing context for decision making, including some of the faultiness and tensions in organisational and activists' positions.

1.3 Aim, Objectives and Key Research Questions

The aim of the research is to examine the changing context for decisions about electricity generation and supply in the state of Georgia, USA.

The objectives of the research are as follows:

- To examine the impact of low carbon priorities on electricity generation and supply in the United States focusing on a case study of Georgia
- To investigate the relationship between low carbon priorities and other factors that might influence investment in electricity generation and supply
- To develop empirical and conceptual understanding of the restructuring of energy generation and supply systems in the current phase of low carbon restructuring.

The key research questions are:

1. What are the governance and management structures for electricity generation and supply in Georgia? How and why are they changing?
2. Who are the key actors and interests in energy restructuring and what is their impact?
3. What does the Georgia case study contribute to understanding of low carbon energy restructuring and the changing institutional context for energy generation and supply in the USA and internationally?

1.4 Structure of the Thesis

Following this introduction, chapter 2 describes how the context for making investments in electricity generation and supply in western countries with established infrastructure has changed since the 1990s. The chapter explains how important issues such as current and future climate policy, concerns about the security of imported oil and gas, the exploitation of new fuel reserves, continued opposition to nuclear energy and new agendas of decentralised energy generation, come together contingently, creating pressure on nations, cities and regions to restructure their energy systems.

Chapter 3, describes the changing context of the United States electricity generation and supply system. It reviews the history of development of energy system across the country and the events which impacted change on the system, from the origins to the current low carbon era. The chapter, also presents the current era of low carbon and fracking, explores the ongoing factors putting pressure on the system across the country. It argues that, the current energy governing system comprising of the electric utility business model and regulatory framework across the U.S. having remained largely unchanged for nearly 100 years is currently facing pressures and demands which are influencing the decisions about electricity generation and supply.

Chapter 4, presents the research design and methods used to carry out the research. It explains the choice of case study and the methods used for collecting data which include, semi-structured and observations. The chapter also explains the method of analysis and ethical framework.

Chapter 5, introduces the case study. It discusses energy context of the case study. It describes the prevailing method of energy generation and supply, the key actors involved in energy decision making. The chapter also explores, the conversations taking place amongst citizens around energy generation and supply.

Chapters 6, 7 and 8, provide an analysis of the case study undertaken. Chapter 6, discusses the drivers for low carbon in Georgia and explores the debate and decisions about low carbon investment shaped by different interests in Georgia.

Chapter 7, examines the resistance to energy restructuring in the state of Georgia. It explores a range of powerful technological, organizational, industrial, societal, institutional barriers to renewable energy investment which raise questions about ideas of energy infrastructure lock-in.

Chapter 8, describes the story of Georgia's solar growth and discusses the reasons and causes of conflicts between pro-and anti-solar groups and the outcomes of the solar debate.

Chapter 9, presents the conclusion to the research. It summarises the events which take place, after the conclusion of the fieldwork. It discusses the findings of the research and provides suggestions for future research.

2 THE CHANGING CONTEXT FOR DECISIONS ABOUT INVESTMENT IN ELECTRICITY GENERATION AND SUPPLY SINCE THE 1990S

Since the late 1990s the growing importance of concerns with climate change and the rising costs of imported energy have led to a new set of challenges and opportunities in energy governance at the national and sub-national scale in many countries around the world (Hodson & Marvin, 2009, 2010a; Lovell, Bulkeley, & Owens, 2009; While, 2014). The aim of the following chapter is to develop a conceptual framework for researching, understanding and explaining the changing context for investment and management of electricity generation and supply.

The argument of the chapter is presented in two sections. Section 2.1 explores the key factors which are leading to changes in the structure and management of electricity generation and supply. Section 2.2. explores how these key factors are impacting the subnational level. It considers the impact of climate change and energy insecurity on subnational approaches to energy. An important argument in this section is that prevailing modes and models of electricity generation are being challenged but there is uncertainty about the longer-term impact and importance of key elements driving change and different options for restructuring and reorienting energy systems.

Whilst many of the pressures may seem to be occurring across all nations with an established energy infrastructure, the context for energy restructuring differs from country to country, and in many cases between cities and regions within nation states, depending on factors such as the reliance on imported fuels, the costs of alternatives and political decisions about energy governance and climate policy, the strategies of private companies and varying lock-in configurations (Hodson & Marvin, 2013; Unruh, 2000; While, 2011, 2014) of existing electricity networks. Key actors are making decisions on the basis of current changes but also potential future shifts in policy and markets. Throughout the chapter attention will analyse general changes in context whilst being sensitive to the ways in which contexts and circumstances differ across national and regional modes of energy governance and regulation and how they put pressure on energy generation and supply systems.

2.1 THE CHANGING CONTEXT FOR ELECTRICITY GENERATION AND SUPPLY IN THE GLOBAL NORTH

In most countries, frameworks for electricity generation and supply have been periodically restructured in the twentieth century reflecting changing priorities for government regulation, technological change, changing business priorities and uncertainty/changing consumer preferences (Graham & Marvin, 2001; Joskow, 1998; Verbong & Geels, 2007). Since the late 1990s new pressures have emerged for existing systems of electricity generation and supply in terms of linked issues around climate change, concerns over energy security (and arguments over Peak Oil scenarios), the geopolitics of oil and shale gas, new technological innovations and the growing importance of cities in attempts to reduce greenhouse gases. This section will examine these pressures in detail.

2.1.1 Climate change and its impact on energy generation and supply models

The prevailing issue of climate change has, over the last two decades risen up international, national, regional and local agendas in the U.S. and elsewhere (Lovell et al., 2009; While, 2008). Concerns about climate change and its economic and social costs have ensured that:

> "the goal of radically reducing emissions of greenhouse gases, and particularly carbon dioxide, is rising up the political agenda" (While, 2008, p.1).

Additionally, varying carbon commitments to reduce greenhouse gas at multiple levels of government and in multiple sectors of the economy, especially electricity generation and supply, means that climate change and energy policy have increasingly converged so that energy policy is increasingly shaped by low carbon goals (Lovell et al., 2009). The problem of climate change, as described by the United Nations Framework Convention on Climate Change:

> "Refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods" (UNFCC, 1992, p. 7).

Human activities including electricity production, transportation, industry, some agriculture, land use and forestry (Environmental Protection Agency, 2013c), have resulted in an accumulation of greenhouse gases over time and have continued to increase, changing the composition of the global atmosphere (Watson, Albritton, Barker, et al., 2001). Greenhouse gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and the fluorinated gases (Environmental Protection Agency, 2013a).

Several forecasted changes due to climate change include: 'higher maximum temperatures', 'intensified droughts and floods in many regions', 'more intense precipitation events' (IPCC, 2001 p. 15) and the likely impacts of these will be increased risks to human health, life, infrastructure, and food (Stern, 2006; Watson, Albritton, Barker, et al., 2001).

The International Energy Agency (2013) argues that concentrations of CO_2 emissions continue to grow:

> "Global greenhouse-gas emissions continue to increase at a rapid pace. The 450 ppm threshold is drawing ever closer. Carbon-dioxide (CO2) levels in the atmosphere reached 400 ppm in May 2013, having jumped by 2.7 ppm in 2012- the second-highest rise since record keeping began" (IEA, 2013, p. 14- 15).

Since CO_2 emissions will predominantly originate from fossil fuel combustion during the 21st century (Watson, Albritton, Allen, et al., 2001) attention has turned towards attempts to decarbonise electricity generation and supply. Concerns about real or perceived effects of climate change have prompted some countries to act on low carbon regulation, with laws proceeding internationally, regionally and locally. Since 1997, 192 countries have ratified the Kyoto Protocol, committing states to reduce their greenhouse emissions (United Nations Framework Convention on Climate Change, 1997c).

However, some developing nations including China and India were made exempt from the treaty. The initial plan involved an initial 5% reduction target of emissions below 1990 levels. In December of 2012, the 1997 Kyoto Protocol was amended in Doha, Qatar, with a need for even more stringent emissions targets and extended to 2020 with the intention of reducing emissions by at least 18% below 1990 levels (United Nations Framework Convention on Climate Change, 2012). International agreements such as Kyoto offer flexibility on greenhouse gas emissions and policies to meet targets could vary between countries:

> "The logic of the 1997 Kyoto Protocol is that countries will achieve their emissions reduction through a framework of nationally distinctive carbon regulation via regulatory controls, green taxes, subsidies and grant support or the allocation of reduction targets to particular sectors or territories. Carbon regulation includes trading schemes where emissions allowance permits are distributed and exchanged so as to encourage investment in low-carbon alternatives" (While, 2014, p. 43).

Additionally, beginning in 2009, the European Union (EU) created a climate and energy framework for 2020 (further developed in 2014 to include 2030), setting out legally binding targets to collectively reduce greenhouse gas emissions initially by 20% of pre-1990 levels by 2020 and later by 40% by 2030 (European Commission, 2009a, 2016). Targets also include the development of renewable energy to comprise 20% of electricity generation in 2020 and 27% in 2030 and to improve energy efficiency by 20% by 2020 and 27% by 2030 (European Commission, 2009a, 2016). The member states of the EU have some flexibility in how to meet their greenhouse gas emissions reduction and renewable energy binding EU targets by creating national renewable energy action plans which can be tailored to each members' energy context (European Commission, 2009b).

Part of this package of legal binding agreements within the European Union, has been the creation of the Emissions Trading Systems (ETS) to aid participating countries in meeting their greenhouse gas emissions reductions targets. The EU ETS is a cap and trade system for electric power stations, industrial plants and inter-EU flights (European Commission, 2013). The ETS saw the addition of penalties for non-compliance with greenhouse gas emission targets, for example from 2005 to 2007, the penalty for not complying with rules was €40 per tonne of carbon dioxide and from 2008 to 2012, the penalty for non-compliance increased to €100 per tonne of carbon dioxide (European Commission, 2013). Since 2012, there have been more international negotiations towards even stricter climate change greenhouse gas emissions reductions commitments from the 19th, 20th, and 21st Conference of Parties in Warsaw, Lima and Paris respectively (Center for Climate and Energy Solutions, 2015b; United Nations Framework Convention on Climate Change, 2015).

Nevertheless, aside from international agreements there has been an 'acceleration' of carbon regulation throughout the world at national and subnational levels (While, 2014), with increasingly ambitious targets set requiring the restructuring of electricity generation and supply systems accordingly. While (2014) argues that this has led to:

> "Nation-states and sub-national governments taking the lead in setting ambitious carbon reduction targets, and introducing low-carbon regulations, taxes and carbon pricing mechanisms. Investment in low-carbon infrastructure and energy efficiency has increased significantly around the world" (While, 2014, p. 44).

The impacts of these carbon regulations in electricity generation and supply will vary across countries based on each country's political and economic conditions but also the context-specific forms of particular energy market and infrastructure configurations. For example, the EU-ETS, the EU 2020 and 2030 frameworks places European utilities in a different and perhaps stricter context, compared to U.S. utilities or those within other western nations, which may not have such a system in place. For European electric utilities:

> "In response to the energy and climate directives, the European power utilities ventured into renewable energy projects all over Europe. This triggered a wave of international investments by power utilities. Most often it has been domestic firms that have dominated the (large-scale) subsidised investment projects throughout the EU" (CIEP, 2013, p. 16).

And also:

> "In the deployment of RES capacity in the EU, we can observe some geographic trends. Large scale instalments of wind power generation capacity predominantly have taken place in the UK, Spain, Portugal, Germany and Denmark, while solar power generation capacity instalments have been highly concentrated in Spain, Italy and Germany. These investments were mainly driven by national policy, but also by the direct and indirect subsidies provided through different National Renewable Energy Action Plans. Although some of the major power utilities had specific strategies to develop renewable champions, without the subsidies many of these investments would not have been viable" (CIEP, 2013, p. 16).

The impacts of carbon regulation on electricity systems will also depend on what paths of decarbonisation are chosen at the national level and the extent to which they reflect other priorities across countries. For some western countries, it is possible other priorities for carbon regulation will include energy security (Lovell et al., 2009; While, 2011, 2014). While (2014) argues:

> "The *economic* imperative for national carbon regulation and decarbonisation is reinforced by the changing geopolitics of energy, notably the rising economic and political costs of imported energy and oil and predictions of declining global oil reserves. Issues of 'energy security' and climate policy are overlapping and converging in carbon regulation" (While, 2014, p. 45).

This will influence the investment decisions made in electricity generation and supply. For example, Germany has national targets of greenhouse gas reduction of 40% by 2020 and a reduction of 80 – 95% by 2050 (Federal Ministry for Economic Affairs and Energy, 2015). The country's low carbon electricity plan primarily involves rapid renewable energy deployment and increased energy efficiency (Morris & Pehnt, 2012), however, a core part of differentiation is the decision to phase out nuclear energy by 2022 (Morris & Pehnt, 2012). A crucial decision based on significant public perception of nuclear power:

> "The German public sees a significant difference between nuclear and renewables, however… the Energiewende movement started in the 1970s as a popular protest against nuclear power" (Energiewende, 2012, p. 7).

But also:

> "If we can gradually shift to a renewable energy supply, then it seems irresponsible to have nuclear plants today – and unethical to continue passing on these risks to future generations" (Energiewende, 2012, p. 7).

The UK in comparison considers a more diverse mix of options such as new nuclear plants, retrofitting fossil fuels plants with carbon capture and storage and continued growth in renewable energy as part of its energy transition:

> "The Government is happy for fossil fuels with CCS, nuclear or renewables to make up as much as possible of the 40–70 GW we think we may need. The Government would like to see the three low carbon technologies competing on cost in the 2020s to win their share of the market" (HM Government, 2011, p. 73)

These examples highlight various approaches to low carbon development across countries. One reason for these differences in approach to low carbon regulation are the different energy governing structures that exist. For example, in many western nations the electricity regime has gradually changed, most responsibilities have shifted to independent regulators and government influence has reduced or declined in energy generation and supply (Monstadt, 2007). For unbundled, liberalised and privatised integrated energy markets, there may exist tensions between market and government low carbon policy influencing the outcome of carbon regulation.

Nevertheless, there are some important ongoing uncertainties about future regulations or events which influence low carbon restructuring in electricity generation and supply. For example, many European renewable energy development projects have relied on national government support i.e. subsidies (Groot, 2013), some of which have been reduced or removed, such as a cut to including Spain's feed-in tariff in 2013 due to growing debt (Morales, 2013), which may have added to renewable energy investor uncertainty about the country meeting its EU binding targets.

Another example is in the United Kingdom, where in 2015 the government cancelled the £1 billion carbon capture and storage program after four years of ongoing planning and few projects (Carrington, 2015), leading to many investors/companies to stop projects (Energy and Climate Change Committee, 2016). In addition, in 2015 the UK government reduced subsidies in its solar Feed-In Tariff and Renewable Obligation programs (Department of Energy and Climate Change, 2015), adding to the possibility of missing the EU binding targets. Ultimately, according to While (2014):

> "The uncertain direction of future regulation and energy prices also make it difficult for political leaders to create longer-term investment vehicles around low-carbon pathways" (While, 2014, p. 53).

In summary, whilst climate change and subsequent international binding commitments to carbon regulation are putting pressure on some electricity generation and supply systems to restructure, there are other competing 'self-interest' or 'self-preservation' concerns (While, 2014), which will be reflected in the decisions taken to restructure electricity generation and supply. These other national political and economic incentives or priorities include energy security, future costs of fossil fuel (While, Jonas, & Gibbs, 2010) and potential gains from a low carbon economy. However, despite these broader concerns, decisions are being taken constantly due to current shifts in policy or markets as was the case in the European examples provided above but also potential future shifts in policy and markets.

2.1.2 A new era of energy (in)security and concerns over Peak Oil

There are arguments that since the early 2000s there has been a renewed concern with energy security in Western countries, brought about by concerns over the changing geopolitics of energy, uncertainty over global oil reserves (Peak Oil) and the high costs of imported fuels, all of which have economic and political impacts (While, 2014). Defined by the International Energy Agency as "the uninterrupted availability of energy sources at an affordable price" (International Energy Agency, 2014a), issues of energy security have varied over time. In response to the 1973 oil crisis, many countries initiated actions to reduce dependence on imported oil. In the USA for example, proposals by President Richard Nixon were geared towards energy independence such as an increasing drilling on federal lands, expediting permits and plants for nuclear and the encouragement of coal and renewable development (Grossman, 2013).

Another example is Denmark, which set a long term target to be independent of coal, oil and gas by the year 2050 whilst retaining economic competitiveness (The Danish Government, 2011). However, the immediate target was to reduce the dependence on imported energy. According to Sovacool (2013):

> "After the international oil crisis of 1973, it took Denmark only five years to switch from being 95% dependent on oil for electricity generation to 5 percent" (Sovacool 2013: p. 9).

The approach to gaining a high degree of energy independence was based on investing in fossil fuel resources but also extensive low carbon restructuring of electricity generation and supply (International Renewable Energy Agency, 2013; Sovacool, 2013) and imposing a series of high taxes on oil and petroleum products including diesel and petrol, natural gas, coal, carbon dioxide and sulphur (Sovacool, 2013), using the revenue to fund renewable energy and energy efficiency programs with wind energy as the preferred choice.

However, in most countries the experiments of the early 1970s were abandoned following the end of the oil crisis. The current era combines concerns about security of oil supply due to political instability in many oil producing countries and longer-term concerns about Peak Oil. Energy security concerns tend to vary across countries and are not solely concentrated on fossil fuels. In some countries energy security can relate to an energy supply gap that could occur with the phasing out of carbon-intensive energy resources and simultaneously investing in low carbon energy supplies. Additionally, there may also be a subnational dimension to energy security. In some cities, towns and regions, energy security may relate to the reorganising of energy infrastructure and resources in order to secure city reproduction (Hodson & Marvin, 2009) due to concerns about resource constraints and climate change. However, energy security and climate change are potentially competing agendas in some countries:

> "But for industrial societies with a high dependence on fossil fuels, climate change and the security of energy supplies present rather different sorts of challenges" (Bridge, 2010, p. 523).

Therefore, whilst energy security and climate change may overlap in carbon regulation (While, 2014), the added energy security concerns across countries may result in different restructuring pathways reflecting different priorities. As energy security and the theory of peak oil are related subjects, these issues will be examined together.

a. Energy security and Peak Oil concerns

The uncertainty about fossil fuel resources in part centres on *peak oil* theory. In summary, the peak oil theory originated from M. King Hubbert, who in 1956 predicted that the production of oil in the U.S. would peak in 1970 or 1971 (Hubbert, 1971). The theory has been expanded to include global oil production in subsequent years to be defined as:

> "When all the cheapest oil has been extracted and costs rise, with serious ramifications for our oil-dependent industrialised societies built upon low energy costs" (Chapman, 2013, p. 1)

Or

> "Peak oil refers to an impending, permanent decline in the production of so-called 'conventional' oil as geophysical limits on its availability begin to bite" (Bridge, 2010, p.1).

The theory is built on the assumption that the permanent declining production of conventional oil would not be fixed by new technological solutions related to oil discovery and extraction. Nevertheless, peak oil remains contentious (Bridge, 2010; Chapman, 2014; Fanchi & Fanchi, 2010; Helm, 2011; Maughan, 2015) due to differing opinions on when the peak will be reached in terms of time (Chapman, 2014) and the impact (or lack of) of technological shifts (Bridge, 2010; Helm, 2011; Maughan, 2015). This is summarised by Bridge (2010):

> "Although there is agreement that conventional oil production will peak at some point in the future, there are substantial differences of opinion over (a) the timing of the peak; (b) the significance of a peak in conventional oil for the availability of liquid fuels; and (c) the role of supply-side restrictions in driving peak production, given the possibilities for demand destruction via technological shifts (e.g. electric vehicles) and/or political action around climate change" (Bridge, 2010, p. 525).

Chapman (2013) categorises predictions about peak oil debates as early peak advocates and late peak advocates. Early peak advocates are mainly proponents of peak oil and have predicted peak production dates ranging from 2005 to 2017. Conversely, late peak advocates are mainly sceptics and opponents of the theory, who have predicted dates ranging from 2017 to no visible peak. Due to considerable variation in the models of geologists, industry experts, etc. the theory of peak oil has not been given closure and has led to considerable uncertainty about energy security.

Critics of peak oil often suggest that technological solutions/shifts have the ability to change issues of extraction, reserves and eventually price. For example, in completely dismissing the concept of peak oil, Maugeri (2012) adds that whilst some oil locations such as the North Sea are facing irreversible decline, others are growing and technology will allow for more growth:

> "In the aggregate, conventional oil production is also growing throughout the world, although some areas (the North Sea, face an apparently irreversible decline of the production capacity. In most traditional producing countries, old oilfields go through a production revival thanks to better techniques and knowledge, or advanced exploration and production technologies, so far used only in the U.S. and in the North Sea. Huge parts of the world are still relatively unexplored for conventional oil (for example, the Arctic Sea or most of sub-Saharan Africa)" (Maugeri, 2012, p. 66)

Additionally, he adds:

> "Oil is not in short supply. From a purely physical point of view, there are huge volumes of conventional and unconventional oils still to be developed, with no "peak-oil" in sight. The full deployment of the world's oil potential depends only on price, technology, and political factors" (Maugeri, 2012, p. 65)

And finally:

> "In other words, we are living in a transformational age where energy efficiency legislation, climate change policies, technological advance, and the dissemination of energy alternatives will reduce the impact of oil in global economies" (Maugeri, 2012, p. 35).

Helm (2011) highlights the uncertainty in making predictions about the future of oil resource:

> "There are, indeed, very good reasons for doubting the claims of the peak-oilers. The reserves may be much greater than currently assumed (especially in the Arctic), technology is likely to enhance both recovery rates and reduce the costs of currently marginal supplies, transport is increasingly likely to be electrified, and with the coming of unconventional gas, gas supplies look like joining coal in their abundance. The danger is now that we have far too much oil, gas, and coal, not too little, for the climate to tolerate. Any energy or climate change policy that rests on a bet on the future price of oil is inherently risky. Rather than assuming that the future and its technologies are known, policy should start from the assumption of uncertainty, and look for robust corrections of market failures (and to limit government failures)" (p. 89).

In contrast, the International Energy Agency's, World Energy Outlook (2013) argues for caution when predicting that the discovery of new unconventional oil and gas resources strengthen the arguments against peak oil:

> "It has become fashionable to state that the shale gas and LTO revolutions in the United States have made the peak oil theory obsolete. Our point of view is that the basic arguments have not changed significantly (IEA, 2013, p. 422)

Overall, the significant variation in dates, prices, supply or demand, etc. reveals, how uncertain energy futures can be. Despite these developments and uncertainties, Bridge (2010) explains that for countries with a high dependency on fossil fuels, the threat of oil resource depletion may result in pressure for low carbon restructuring or conversely, expand fossil fuel development:

> "Discourses of imminence and dependency associated with peak oil can, when conjoined, produce a compelling imperative for action. As part of a more general argument about increasing energy insecurity, for example, peak oil and the prospect of depletion can legitimate a wide range of projects, from heavy investment in fuel efficiency and renewables to opening up new areas for fossil fuel development" (p. 527)

The path of restructuring chosen may vary across countries and will depend on the economic and political contexts across countries.

b. Energy security and geopolitics of supply

There are arguments that since the industrial revolution Twentieth Century capitalist economies have been based on the supply of relatively cheap fossil fuels, especially oil and petroleum for North America and Europe in the twentieth century (While, 2014; Yergin, 2006). The energy crisis of the 1970s called into question the security of oil and petroleum from the Middle East, a recurring issue due to wars, conflicts and the exercise of power by oil producers. The 1990 Persian Gulf War, the 2003 Iraq War and the 2005 Russia-Ukraine natural gas dispute (Yergin, 2006) have revived concerns about oil and gas dependence and the security of the supply from areas with continuing and growing tensions in the Middle East and North Africa (MENA) region in both economic and political terms (Mitchell, Beck, & Grubb, 1996). For oil, the increased overreliance on a small number of oil producers in continuously unstable zones combined with the projected growth in energy demand have prompted concerns over energy security (International Energy Agency, 2014b).

It might be the case that new fossil fuel reservoirs are found but despite the knowledge of existing and potential reservoirs of fossil fuels, exploration conditions are difficult, especially in deep water and artic sites (Fanchi & Fanchi, 2010).

It might also be that fossil fuel reserves are found but are in tense or inhospitable regions such as the Middle East and North Africa (MENA) region. For electricity generation and supply, the concentration of natural gas reserves are concentrated amongst few producers since the early 2000s, has revived security of supply concerns in countries with high import dependency and given the economic and political impacts due to natural gas becoming the dominant fuel in many countries across Europe.

There remains pressure to ensure security of supply:

> "To some, this concentration of fixed oil (and gas) supplies in a few hands, faced with rising demand, spells disaster. Oil dependency on Middle East (and in Europe, gas dependency on Russia) is equated with threats to national security. Some advocate that this dependency should drive energy policy towards greater energy self-efficiency, diversifying sources of supply and reducing dependency on fossil fuels" (Helm, 2005, p.5).

Also:

> "While peak oil advocates have concentrated on conventional oil, there has in the background been a quiet but profound revolution going on in gas. The importance of gas has grown slowly. Up to 1990 it was regarded as a premium fuel, to be conserved for use primarily in the industrial sector, notably in petrochemicals. In Europe, it had been effectively illegal to burn gas in power stations. But with the coming of North Sea gas and the development of Russian natural gas supplies, gas stepped up to become the fuel of choice for new power stations." (Helm, 2011, p. 76).

More so, given the importance of natural gas in electricity generation and supply, Helm (2005), highlights that energy security policies across Europe and in the UK has been focused on natural gas:

> "All of these highlighted concerns about import dependency and tacking climate change, with the key difference being the US focus on oil and the EU/UK focus on gas" (p. 6).

These energy security concerns associated with dependence on imported natural gas and other political concerns have created pressures and demands for a restructuring of the electricity generation and supply system in countries such as Poland (Dittrick, 2011). In some cases, there may be pressure to develop a country's own fossil fuel resources in response or to diversify the resources or both. Outcomes will depend on the context of the country. For example, in the 2014 to 2015 period, Poland generated between 84% and 85% of its electricity from coal (Kureth, 2015). Additionally, the country has come to rely on Russia for nearly 60% of its natural gas and close to 90% for oil.

Combined with the European Union's 2020 targets to reduce its carbon emissions (European Commission, 2009a), and increasingly expensive coal (Kureth, 2015), this leaves Poland highly dependent on imported energy resources and exposed to the economic and/or political costs associated with supply contracts with Russia. An issue which the country sees as problematic for its energy security, putting Poland under pressure to diversify its electricity generation and supply. In a context of climate change targets, Poland has identified the development of unconventional gas, specifically shale gas, as a way to solve this problem (Natural Gas Europe, 2010). In the period of 2010 and 2011, the U.S. energy information administration estimated that Poland had up to 5.3 trillion cubic metres (Dittrick, 2011).

Another aspect of energy security is that energy insecurity is also about price as much as availability. There are some countries experiencing rising electric utility bills, which could reflect economic costs of imported energy:

> "There has been increased recognition of fossil-fuel import dependency among developed countries (and, indeed, some developing ones, too, such as India and China). For the USA, dependency on Saudi Oil will increase, and it has sought alternative supplies from Russia, Libya, and the opening up of its own Arctic reserves. Europe has similar oil dependency worries, and now over gas, too. In all of these areas, where politics had been on the backburner for the surplus years, it has now returned to centre stage" (Helm, 2005, p. 2).

For example, Lovell, Bulkeley & Owens (2009), describe that between 2003 and 2004, the UK has had concerns surrounding the security of natural gas supplies, especially when fossil fuel prices rose in 2004:

> "Despite the new position of climate change as a central issue on the energy agenda, the debate about the nature of the UK's energy policy remained wide open. In particular, concerns about energy security and the resulting impact on fuel prices continued to be voiced. Fossil fuel prices rose sharply in 2004 and the reliability of gas exports from Russia to Europe came under scrutiny. The Ukrainian gas pipeline conflict early in 2006 represented a policy 'focusing event', strengthening concerns about the UK's security of supply. Further, the UK's North Sea oil and gas reserves appeared to have peaked: the UK was a net importer of gas for the first time in 2004" (Lovell et al, 2009, p. 96)

The specific breakdown of utility costs is often complicated, but the literature suggests that a key factor to explain rising prices for energy is the unpredictable global energy market. A reason for this is, since 2004, the UK became a net importer natural gas, with gas occupying between 35-50% of the electricity mix in 2011 (Office of Gas and Electricity Markets, 2011).

By 2014, natural gas provided 30% of UK electricity (Électricité de France, 2016). EDF and National Grid also project that by 2020 the UK could be importing up to 66% of its natural gas (Électricité de France, 2016), further subjecting prices to global markets and or political uncertainty. In the UK, new nuclear energy development has emerged as a means of addressing both energy security issues and climate change (Lovell et al., 2009) but in 2013, the UK Government also stated its intention of fracking for shale (Cameron, 2013).

The context for energy security has been altered in some contexts by the opportunity for fracking for shale gas. Some countries may be under pressure to frack in an effort to ease energy costs. Others, which are net importers of energy, may be under pressure to frack to increase their own supplies of natural gas. For example, in 2013, the UK government stated its motivation with regards to the development of shale gas in the UK, believing fracking and shale gas to have the potential to reduce energy bills, create jobs, and boost local economies (Cameron, 2013). In 2016, the government released an official guide on fracking stating:

> "The government believes that shale gas has the potential to provide the UK with greater energy security, growth and jobs. We are encouraging safe and environmentally sound exploration to determine this potential." (Department for Business, Energy & Industrial Strategy, 2016)

This response highlights how technological developments in unconventional resources have influenced the investment choices being made about low carbon restructuring. Especially in the case of fracking and shale gas but also in carbon capture and storage. It shows that energy contexts are also shaped by technology which is in part driven by energy security concerns e.g. increased research, investment, and changing economics.

2.1.3 The uncertain landscape of technological futures

The previous section introduced the issue of unconventional fuels (specifically shale gas) and suggested how it might be influencing investment choices. However, there are many uncertainties in relation to the future of technologies such as future policies, binding targets, environmental constraints, replication, public and political support, etc. all of which affect the uptake of technology. What is certain, however, is the ability for technology development to influence or reframe issues of energy security, depletion, prices and climate change very quickly, with outcomes varying between countries.

The International Energy Agency's World Energy Outlook (2012) shows an increasing demand for natural gas to 2035 – it is the only fossil fuel, which has this prediction. Natural gas demand is predicted to grow at an estimated rate of 1.6% per year until 2035, with some variation between OECD and non-OECD countries (International Energy Agency, 2012).

The increased demand in natural gas is particularly significant in the power sector with a projection for a rise in global electricity demand might mean growth in the consumption of unconventional fuels such as tight gas, coalbed methane, shale gas and tight oil. Shale gas has shown to be the most popular, even with questions being raised about the environmental impacts of hydraulic fracturing (risk of earthquakes and water contamination). The availability of cheap and seemingly abundant gas supplies introduces a new challenge for decision makers, raising concerns over the role natural gas plays in the new fuel mix, including the potential for natural gas to be a bridge fuel (Helm, 2012) to a low carbon economy given its advantages over coal. Figure 2.1 shows the estimated unconventional gas resources across several countries.

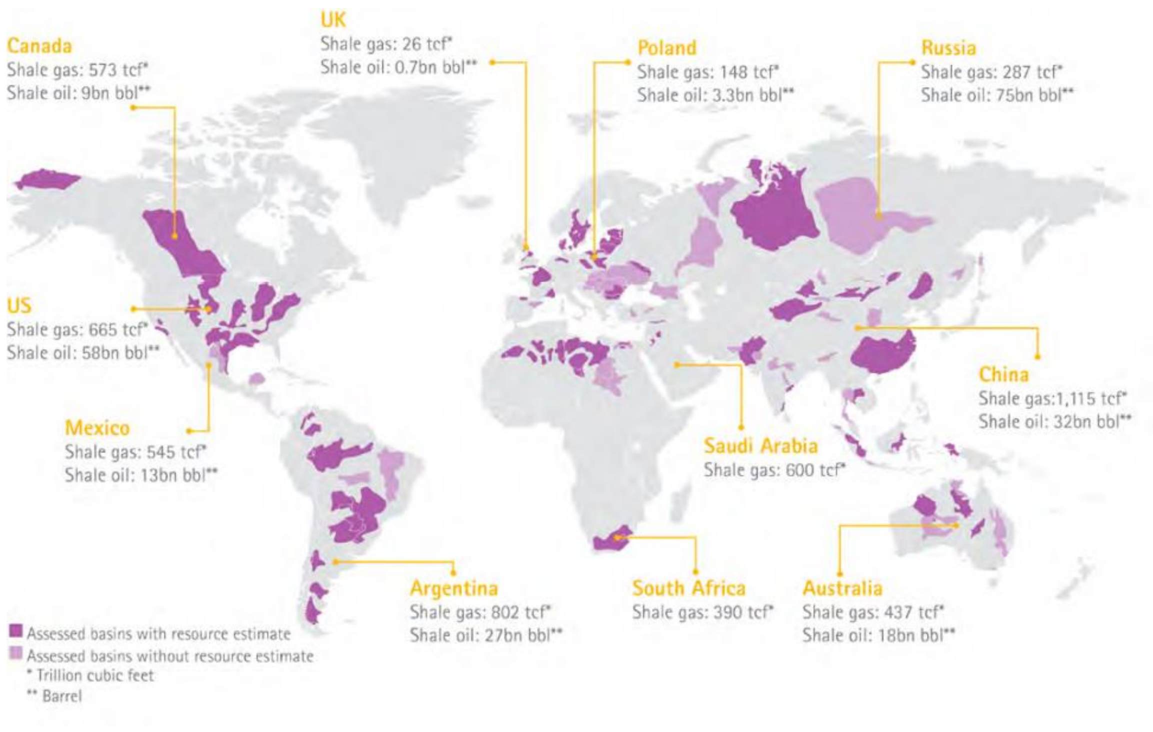


Figure 2-1: Estimates of shale gas and oil across developed and emerging economies
Source: Accenture 2015 International Development of Unconventional Resources: If, where and how fast?

In recent years, the United States has seen remarkable growth in shale gas, recently making it the world's largest producer of oil and gas (Dudley, 2015; U.S. Energy Information Administration, 2016c).

In terms of electricity the emergence of shale gas especially in the United States is seen in the changing the dynamics of energy provision in terms of supply (Haddadian & Shahidehpour, 2015; U.S. Energy Information Administration, 2012a), by making gas-fired electricity generation significantly cheaper to run than coal-fired plants in many states, allowing for the closure or retrofitting of coal-fired plants in others (U.S. Energy Information Administration, 2012a, 2014b) and to an extent reducing carbon emissions (U.S. Energy Information Administration, 2016a). Nevertheless, there remains uncertainty over whether shale gas development can be replicated in other parts of the world (Bassi et al., 2013; Helm, 2011; Natural Gas Europe, 2010; Stevens, 2010).

There also remains uncertainty over the technological breakthroughs involved in shale gas, addresses, the security of supply in countries outside the United States. For example, in Poland, Helm (2011) writes about the role technological breakthroughs (hydraulic fracturing and horizontal drilling) have played and could still play in developing unconventional fossil fuels thereby delaying peak oil. Helm, describes Poland as one of the European countries that has shown significant potential for shale gas, predicting:

> "Poland's current electricity industry is over 95% dependent on coal, and it is very exposed to climate change policy measures. The obvious strategy would be to switch to natural gas, but that requires reliance on Russia in a context within which the Nord Stream pipeline has been deliberately built outside its borders, between Russia and Germany. Given Poland's terrible historical experiences with its neighbours, energy independence has a much greater resonance than for most other EU members. Its potentially very large shale gas deposits therefore represent an alternative, which has attracted international oil and gas companies, and which is likely to be developed over the coming decade. Other European countries are likely to follow at a somewhat slower pace" (Helm, 2011, p.77).

This shale gas development was certainly probable, because in the period of 2010 and 2011, the U.S. energy information administration estimated that Poland had up to 5.3 trillion cubic metres of shale gas (Dittrick, 2011). This has been followed by a rush of licenses to drill exploratory shale gas wells in Poland. Five oil and gas companies (ExxonMobil, Shell, Chevron, ENI, Total) as well as ConocoPhillips and Marathon Oil, were licensed to drill exploratory shale gas wells in Poland. However, in 2012, the Polish government's downgraded estimates of its shale reserves to a range of billions of cubic meters (Kahn & Onoszko, 2012).

In 2012, ExxonMobil was the first to leave its shale gas projects, followed by Marathon Oil (2013), Eni (2014), Chevron (2015) and on the 5th of June, 2015, ConocoPhillips was the last international exploration and production company to cease shale gas exploration in Poland (Barteczko, 2015). Citing a combination of difficult geology, the necessity of regulatory reforms, local resistance and the downgrade of shale gas estimates, the global oil firms have abandoned the projects (Koper, 2015) and the status of shale gas in Poland is uncertain. In a similar vein, the UK government's choice to pursue shale gas, has been met with mixed responses. Whilst, there is agreement about the role of natural gas in a diversified energy mix, there is uncertainty whether fracking will reduce energy prices or significantly reduce energy imports in the long term (Bassi et al., 2013; Stevens, 2013):

> "As long as the UK remains a substantial net importer of gas, it is reasonable to assume that its wholesale gas prices will largely depend on prices charged by foreign suppliers. Although domestic shale gas production could benefit the economy by generating jobs and tax revenues while displacing imports, it is unlikely that gas consumers would see much, if any, benefit in terms of reduced gas and electricity bills. Of course, if proven reserves turn out to be significantly larger than current official estimates, or if UK shale gas production was part of a major increase in unconventional gas production around the world, there could be a significant effect, at least in moderating the increase in wholesale gas prices that would otherwise have taken place" (Grantham Research Institute, 2013, p. 18 -19).

2.2 The Sub-national dimension

So far, much of the discussion in the chapter has focused on issues requiring responses at the national scale. This section considers the impact of climate change and energy insecurity on sub-national approaches to energy. Some authors have argued that this is a new era of *urban* ecological securitisation in which the safeguarding of resource flows at the national level has been rescaled to the urban level (Hodson & Marvin, 2009, 2010a). Urban ecological security in an era of climate change and resource constraints describes the recognition that urban economic and social sustainability is linked to ensuring the supply of natural resources, low-carbon energy and climate proofing. It has resulted in cities starting to pursue or promote self-reliant strategies which would protect, continue or enhance their resources and economic growth (Hodson & Marvin, 2009, 2010a). Other authors have made a similar point with respect to energy and economic competitiveness, for example Troy (2012).

Hodson and Marvin explore how world cities such as San Francisco, London and New York are seeking to (re)gain control over energy infrastructure to ensure security of supply and prepare for future carbon legislation (Hodson & Marvin, 2010b):

> "The combination of reusing energy, energy efficiencies, behavioural change and new sources of energy production are being bundled together in relation to World cities under the auspices of building energy independence and security. This is being done as a preparatory response to resource availability and price volatility, to the challenges of the peaking of oil and fossil fuels and also to the vulnerabilities of energy systems to weaknesses" (Hodson and Marvin, 2010, p. 98).

The urban implications of low carbon restructuring have been explored in a range of literature (Hodson & Marvin, 2010a; Jonas, Gibbs, & While, 2011; While, 2008, 2011, 2014; While et al., 2010). The premise is that regulation will increase for cities that lag behind in low-carbon energy infrastructure (Center for Climate and Energy Solutions, 2015b; United Nations Framework Convention on Climate Change, 2015). The pressure potentially comes from a new regulatory era of carbon control (While, 2008), where international and national climate change agreements are passed down to governments, communities and organisations at the subnational level:

> "Once the global emissions reduction requirement is agreed, it is then translated into a series of territorially based targets organised at the scale of the nation-state" (While 2008, p. ix).

This includes, financial penalties for failing to meet the quotas or the existence of fiscal gains by meeting carbon quotas (Jonas et al., 2011; While et al., 2010).

Nevertheless, there are complications when attempting urban low carbon restructuring such as making decisions about the appropriate investments, inherited infrastructure lock-in (While, 2011, 2014), differing governing capacities involving legal authority, funds/resources, governing powers (Bulkeley & Kern, 2006), the specific economic, political contexts and other urban development priorities:

> "Cities will face differential challenges and opportunities in restructuring for a low carbon future, reflecting factors such as their position within inherited infrastructure networks, economic and political circumstances and the degree of political support for changes that might have a relatively long-term payback" (While, 2011, p. 96).

Given, these complications, low carbon restructuring will vary across cities as they respond to pressures of carbon control:

> “The mix of policy responses will vary between cities, but the processes and outcomes of low carbon restructuring will ultimately be determined by political choices about different pathways taken within the context of wider international and national carbon control regimes, and forged through compromise and negotiation between different interests at the urban scale” (While, 2010, p. 96).

As this quote suggests, a key issue will be the relationship between cities and ‘extra-local’ energy infrastructures in relation to the price of energy in the present and the future. Some cities will need to take control of energy infrastructure if the prevailing energy generation and supply network is not felt to deliver effectively for the city. However, often the urban approach is about selective energy restructuring (energy efficiency, decentralised energy generation or district heating networks) whilst retaining the benefits of prevailing energy generation and supply networks. At any spatial scale, a radical transformation of the prevailing energy generation and supply network will be costly in the short to medium term even if there are longer term cost savings and benefits for economic competitiveness. Cities will be sensitive to the price of energy for economic and social reasons.

This chapter has set out some of the drivers for change, however the response to these changes will not be easy and will have complications, not only due to the costs associated with energy restructuring and lock-ins from existing investments but also due to the fact that the effects of some of the changes are often uncertain, for example, with low-carbon there is considerable uncertainty about future legislation. The costs in undertaking low carbon energy restructuring may involve the capital costs of new generation capacity, retrofitting infrastructure, transmission and distribution upgrades, potential tax and regulation costs (While et al., 2010), stranded costs of existing capacity (Hawkey, Webb, & Winskel, 2013) and contracts, permits (M. A. Brown & Sovacool, 2011).

Additionally, electricity generation and supply infrastructure have long life spans, which after initial investment, may lock-in energy systems for a length of time and reduce the ability for networks to adapt to a changing environment (Unruh, 2000). Therefore, technological lock-in refers to a particular technology or product that is dominant, not because it is inherently superior because of its performance and cost, but that its continued use is supported by powerful economic, cultural and political factors, which reinforce each other to make the system more complex while restricting alternative technologies (Arthur, 1989; Foxon, 2013; Unruh, 2000). Throughout the twentieth century, energy providers, predominantly large companies, have invested in centralised power generation systems (U.S. Energy Information Administration, 2000) and over time built increasingly large energy systems. In the U.S. for example, utilities invested significantly in nuclear in the 1970s and coal in the 1980s (Joskow, 2001b; U.S. Energy Information Administration, 2000), while the UK investment in the 1990s, focused on combined cycle gas turbines (Simmonds, 2002).

Therefore, low carbon restructuring may encounter various forms of lock-in, reinforcing these existing investments including technological, organizational, industrial, societal, institutional and cultural lock-ins (Unruh, 2000, 2002). Finally, decisions about undertaking electricity generation and supply restructuring, are shaped by privatisation and liberalisation in some countries, which might ease low carbon restructuring, nevertheless, decisions about restructuring will usually reflect multiple decisions being taken by different interests at a range of spatial scales. In that context, the scene is set for a new energy politics to unfold. This thesis is interested in the United States and therefore, Chapter 3, will examine what the new energy politics might mean in the U.S. context.

2.3 CONCEPTUAL FRAMEWORK: FACTORS INFLUENCING LOW CARBON INVESTMENT DECISIONS

This chapter has set out potential challenges to prevailing modes of energy generation and supply. The rest of the chapter focuses on the factors which shape those decisions and highlights how these complicated explanatory factors may play out in different contexts. For example, decisions made by national government may be at odds with municipal authorities' due to the local economy; places with low fossil fuel dependence, for example, may perceive the national government as not being aggressive enough on shifts towards low carbon restructuring, while others with economies based on fossil fuels might consider the effects of carbon taxes to be unfavourable for their local businesses. Others, may perceive opportunities from low carbon restructuring for growth (Jonas et al., 2011; While, 2011). All of which are likely to shape the direction and decisions on low carbon restructuring.

The factors that might shape low carbon decision-making, and will be explored in this section, include:

- Ownership and control of existing infrastructure
- Vested interests
- Lock-ins (Technological, Organizational, Industrial, Societal, Institutional, Cultural)
- Politics and Ideology
- Capacity to act (Financial, Political support, Knowledge & Governing authority)

a. Ownership and control of existing infrastructure

In some countries decisions about how to proceed on energy investments are shaped by privatisation and liberalisation. During the twentieth century electricity generation and supply in many western nations tended to be through public control and integrated generation and supply at the regional scale. However, in most western nations, the electricity regime has gradually changed (Monstadt, 2007). In the 1980s to 90s the model was challenged by privatisation and liberalisation, which involved the sale of assets to private entrants and reforming the national governing structure to create competition in retail and wholesale markets (Pollitt, 2012), the creation of independent regulatory bodies and regulated access to monopoly networks i.e. transmission and distribution (Pollitt, 2012). For unbundled, liberalised and privatised integrated energy market, there may exist tensions between market and government on low carbon policy. Additionally, this shift in the electricity regime might present challenges in low carbon restructuring in some contexts that may complicate energy governance in cities and regions. As While (2014) argues:

> "The privatisation and unbundling of utility infrastructure has complicated investment decisions, and made it more difficult for cities to co-ordinate and cross-subsidise across different aspects of public policy" (While, 2014, p. 53).

Monstadt's (2007) study on urban governance and the transition of energy systems in Berlin, Germany, showed that the privatisation of national energy infrastructure has affected regional energy and climate policies. This resulted in the following number of issues;

- The management and decision makers for the utilities were located outside the area of operation, meaning that corporate decision making was separated from local regulatory processes. Furthermore, local and regional control over infrastructure or investments reduced, leaving energy provision to the private sector.

- Environmental political initiatives were not always successful because they didn't align with commercial interests of the utilities. This meant that to an extent, these policies were dependent on concessions from the utilities.
- The nature of supra-regional utilities meant that national and European decision makers overrode the influence of the Berlin senate on energy regulation.

In other national or urban contexts, liberalised energy markets might open up opportunities for low carbon restructuring by allowing new entrants into the electricity generation and supply markets. For example, in Germany:

> "While competition has been slow to evolve, it has been increasing over the past few years. In 2012, more than 20% of all end-user customers had a contract with a competitive retail supplier. Moreover, as more renewables have come on the system, the ownership profile of generation has been shifting. While the big four power companies own most conventional generation (hard coal, lignite, nuclear, and natural gas), they own only about 5% of renewable resources. Private citizens, including farmers own 46% of renewable generation in Germany, followed by project developers, industry, and banks" (Regulatory Assistance Project, 2015, p. 5).

Therefore, ownership of energy infrastructure is a crucial factor influencing investment decisions. It will vary across and within countries, as a barrier, opportunity or complication for low carbon restructuring. As the examples above showed, ownership of energy infrastructure may determine which groups will have the opportunities for investment in low carbon.

b. Vested Interests

The academic literature argues that any decisions made around energy restructuring are likely to involve struggles among different interests, because the choices made will impact individuals, businesses and Industries (Bulkeley & Kern, 2006; While et al., 2010). The interests between national authorities and city authorities in energy restructuring may differ substantially. For example, stricter carbon regulation will affect carbon intensive industries while any carbon taxes or prices that come as part of that legislation might disproportionately affect small or medium sized businesses. These means of low carbon energy intervention may put some local authorities at odds with national climate change targets. The explanation being that low carbon transitions require upfront investments which put small and medium at a disadvantage economically in comparison with large factories i.e. distributional politics of consequences and benefits (Meadowcroft, 2011; While et al., 2010).

Additionally, negotiating issues between all the necessary stakeholders is political by nature. There will be a variation in the power of actors in terms of resources and influence involved in the decision-making process. Actors involved range from large corporations in the financial and energy sectors, small and medium enterprises, non-profit organisations, municipal authorities, politicians, etc. (Bulkeley & Betsill, 2013) who may all have different motivations, depending on if they potentially gain or lose from low carbon restructuring (Lockwood, 2015; Newell, 2015).

In electricity generation and supply (currently comprising of energy providers, energy users and energy policy makers) investment decisions made in energy provision are generally a result of what energy policy makers set as incentives, regulations and the risks of the investment itself. The risks of the investment can be eased or heightened depending on the regulation or incentive given (Lockwood, 2015). These investment decisions then create vested interests that form or influence the actions of incumbents (mostly large energy companies) in the market. In order to influence policy, these incumbents may lobby governing officials or issue electricity reliability threats (Lockwood, 2015).

Additionally, energy intensive users (e.g. manufacturing) may seek assurances on low cost energy supplies, households may be concerned about electricity bills and energy decision makers will also need to maintain a relationship between all consumers i.e. residents, businesses, etc. Therefore, there are multiple stakes in energy restructuring and low carbon decisions will be shaped by all these interests.

c. Lock-in (Technological, Organizational, Industrial, Societal, Institutional, Cultural)

Unruh (2000) describes lock-in through the concept of a Techno-Institutional Complex. Unruh (2000) explains that large-scale technological systems made up of interconnected physical, social and informational components in a network or infrastructure are established “through a co-evolutionary process among technological infrastructures, organizations, society and governing institutions, forming a “Techno-Institutional Complex” (Unruh, 2002, p. 317). In this research, the large-scale technological system is the electricity generation and distribution network.

Unruh (2000), explains, that in the early stages of development and commercialisation, technologies may show increasing returns to scale, which help them expand rapidly, in comparison with competitors. Increasing returns to scale mechanisms include:

- Economies of scale: cost reductions per unit, as production is increased.
- Adaptive expectations: increased use of technology results in increased confidence from users and producers.
- Learning economies: cost reductions as knowledge and skills are improved.
- Network externalities: the value of the technology system increases as the network of interdependent industries and users grows.

These different increasing returns create technological lock-in. In addition, firm-level technological lock-in may be created, where incumbent producers of the technology, through repeated investments in infrastructure, reinforce the lock-in condition since the infrastructure is large, durable and cannot not be traded (Unruh, 2000). In addition, firm-level technological lock-in may be created as producers develop core competencies which initially allow the technological system to undergo rapid expansion and gain a competitive advantage over competitors, which may later become rigidities (Unruh, 2000). Essentially, core rigidities happen when, having established the technological system, firms become too dependent on their existing advantages and resistant to change. Both these firm-level technological lock-ins reinforce the technological lock-in, because when challenged by new market entrants introducing an alternative or superior technology, incumbents are unable to adapt and instead put more effort into making improvements in the current technology.

Institutions, both public and private, may reinforce the lock-in occurring in already existing systems. Private institutions (formal and informal) such as industry associations, unions and other professional organisations, develop as the technological system grows and may form an influential and invaluable lobby for the specific technological system (Unruh, 2000). Finally, public institutions can intervene in a way that favours the incumbent technological system, for example government policies, regulations which favour a dominant mode of electricity production, may also reinforce the lock-in. The Techno-Institutional Complex develops through *"a path-dependent, co-evolutionary process involving positive feedbacks (from increasing returns) among technological infrastructures and the organizations and institutions that create, diffuse and employ them" (Unruh, 2000, p. 818).*

Once established, the Techno-Institutional Complex creates continuous stability and reliability in the technological system, but this also means that the complex develops a resistance to change in the long run, locking-out alternative technological systems (Unruh, 2000). Therefore, *carbon lock-in* may be thought of as a fossil fuel based Techno-Institutional Complex. Unruh (2000) defines carbon lock-in as:

> "A condition that arises through a combination of systematic forces that perpetuate fossil fuel-based infrastructures in spite of their known environmental externalities and the apparent existence of cost-neutral, or even cost-elective, remedies" (Unruh, 2000, p. 817).

Since, the electricity generation and distribution network, composed of incumbent fossil fuel technologies and large centralised networks, exhibits increasing returns to adoption, through learning effects and efficiencies in the production and consumption of fossil fuels, it creates continuous, reliability, stability and predictability, despite the known environmental consequences. In other words, fossil fuel systems (technology and infrastructure) have undergone sustained periods of process innovation as opposed to product innovation, due to specialized knowledge and skills (Foxon, 2013) which complement infrastructure, consumer demands and expectations.

There are also institutional support systems i.e. government policy, legal and economic frameworks that stabilises electric power systems, not specifically fossil fuels, but this can have a long-term impact on the ability of alternative low carbon technologies to gain market share. Finally, the individual or existing societal perceptions about what the system should deliver are likely to become embedded in broader values in a way that hinders low carbon alternatives. For some organisations/individuals, this might be reliability of electricity, where people perceive renewable energy technologies as not being reliable in comparison with fossil fuels or nuclear energy, and therefore decisions favour those other systems (Foxon, 2013). To give clarity on the complex nature of carbon lock-in, Unruh (2002) attempts to summarize the different sources of lock-in (table 2.2)

Lock-in Source	Examples
Technological	Dominant design, standard technological architectures and components, compatibility
Organizational	Routines, training, departmentalization, customer-supplier relations

Industrial	Industry standards, technological inter-relatedness, co-specialized assets
Societal	System socialization, adaptation of preferences and expectations
Institutional	Government policy intervention, legal frameworks, departments/ministries

Table 2-1: Summarizing sources of Lock-in
Source: Unruh (2002) Escaping carbon lock-in

Table 2-1, provides a means to analyse a large scale and complex system, without ever losing sight of the broader picture. Carbon lock-in is likely to exhibit all of the categories but some might be more important than others in different contexts i.e. some forces can be specific or broad and some are easier than others to influence or remove (M. A. Brown, Chandler, Lapsa, & Sovacool, 2008). As table 2-1 shows, lock-in can occur at multiple scales. At an organisational level, firms/companies will have specific methods of operation. They may sort tasks per function, process or even products which lends to operational routines or decisions, hindering alternatives.

Industrial lock-in occurs over time, where members and firms of an industry, develop or improve practices or criteria for products and operation which often guarantee their continued use. This is often done because there is a degree of dependence between firms and members in the industry. An example could point to the relationship between turbine manufacturers and utilities, where increased improvement in the efficiency of turbines (GE Power & Water, 2014) leads to an increased use of gas in electricity production. Often, when there is an option for change, incumbent parties will generally seek to introduce the solution with the smallest impact in order to maintain the existing system.

This makes lock-in difficult to overcome but nevertheless, it can be challenged and broken. In the reduction of CO_2 emissions from power plants there are opportunities to allow alternative low carbon technologies or specifically renewables to gain market share, especially if constantly treating emissions and modifying specific components to make the system cleaner are no longer feasible (Unruh, 2002). Decision makers might conclude that the continued attempts at extending the life of the plants beyond the original design by retrofitting them with expensive upgrades are no longer worthwhile and it may be better to opt out of using specific fuels.

Examples include the increased use of wet electrostatic precipitators, wet and dry flue gas desulfurizers for SO_x, selective catalytic reduction systems (SCR) for NO_x and powdered activated carbon (PAC) Injection for Mercury (Environmental Protection Agency, 2014a). Some authors argue that extraordinary events must occur for the lock-in to be broken, which go beyond the alternatives being superior technologies. They argue that lock-ins can be challenged in different ways through processes such as consumer-led challenge, due to changes in taste, which shift the demand from the dominant technology, regulatory challenges, and technological cost breakthrough i.e. changing economics often realised after early adopters have achieved economies of scale (Cowan & Hultén, 1996; Unruh, 2002). The breaking or challenging of lock-in will be contingent on the nature of the lock-in, however there will always be vested interests interested in maintaining the status-quo who will resist change and the greater the system disruption, the increase in lock-in resistance. It is important to understand how in specific cases (i.e. a city or state in the USA) lock-in is reinforced by certain factors over time and given the pressure for low carbon energy development, what happens when those factors underpinning lock-in are being challenged.

d. Politics and Ideology

The political orientation of decision makers could be a factor in shaping low carbon energy intervention (Dunlap & Allen, 1976; Dunlap & Gale, 1974; Dunlap, Xiao, & McCright, 2001). In the U.S., Dunlap et al., (2001) found a correlation between a party's ideology and an individual's voting record on environmental issues. By looking at the legislator's personal and constituency characteristics (plus other variables) the study found out that there were significant partisan and ideological differences in concern for environmental quality, with Republicans and Conservatives consistently expressing less environmental concern than their counterparts. Similar studies in 1974 and 1976 conducted at the city and state level in the U.S. also noted similar conclusions. The reasons for this difference were that Republican Party decision makers were shaped by conservative ideology favouring business enterprise, limited government or limited intervention in a free market and a hesitancy towards changing incumbent institutions as a means of solving societal problems (Dunlap & Gale, 1974; Dunlap et al., 2001).

This may be significant because low carbon restructuring through carbon taxes or stricter emission controls may not align with the commercial interests of businesses (Monstadt, 2007) like electric utilities. Conversely, the Democratic Party was more favourable towards intervention measures, extending government activities, and pursuing an experimental approach to solving societal issues, which becomes evident in their support for environmental issues (Dunlap & Gale, 1974; Dunlap et al., 2001). The largest gap in ideology between the two focuses on the need for government intervention and its scope (Dunlap & Gale, 1974). Therefore, whilst, most U.S. decision makers would argue that environmental quality or protection was a non-partisan issue, their voting patterns would suggest significant variation in the outcome of environmental legislation (Dunlap & Allen, 1976; Dunlap & Gale, 1974; Dunlap et al., 2001). It should be noted that the extent by which the U.S. situation is representative of most political contexts is uncertain.

There will be variation across countries and within countries, for example between city and national authorities in some places. This is to be expected as, Meadowcroft (2011) explains, actors will naturally have and support competing viewpoints made up of alternative ideas about the intertwined roles of society, technology and the environment. This ends up producing conflicting and even contradictory, policy positions on each side within or between policies in various sectors. Nevertheless, it is possible to see how political identities and economic principles could shape decisions in low carbon intervention.

e. Capacity to act

Capacity to act refers to the capability to undertake urban low carbon energy restructuring. It is the combination of having the resources which allow for low carbon restructuring, such as financial means, regulatory authority, knowledge, organization and political support or persuasion (Bulkeley, 2010; Bulkeley & Kern, 2006; While, 2011). Given that the energy regulatory framework, financial resources and political support for low carbon energy restructuring varies according to context, so will the capacity to act.

Financial resources are important as they go some way to explaining the capacity of some cities and regions to undertake certain low carbon restructuring measures:

> "Although not as critical in life and death terms, similar findings concerning the lack of resources to implement measures that could address climate change have also been found in developed countries, where the ability to access external sources of funding has been a key factor in determining which municipalities have put some policies and measures into place" (Bulkeley, 2010, p. 243).

Depending on the relative wealth of the city or region, governing authorities may need access to financial support from external sources like private firms, non-profit company through joint ventures, government grants, public-private partnerships and co-operations (Hawkey et al., 2013). The involvement of private firms to assist with financing introduces issues around rate of return on investments and the management of risks on investment and contracts. The issue of acquiring adequate financial resources and subsequent low carbon restructuring is not always straightforward. There are examples of cities having the financial resources for investments but being unable to conduct low carbon restructuring, partly due to political support and persuasion. Political support for low carbon restructuring could be enabled or constrained by an electorate.

Decisions made on low carbon restructuring paths to an extent depend on the support of or persuading local businesses, residents, etc. (Bulkeley & Kern, 2006):

> “Moreover, where the capacity to intervene exists, there is a lack of willingness to act locally in the face of political, business or public opposition” (Bulkeley, 2006, p. 2248).

An issue in political support is the availability or lack of leadership to lead on low carbon energy restructuring intervention, with the influence to push forward options for low carbon development (Bulkeley & Kern, 2006):

> “The greater the support that exists for climate protection among a city’s political leadership, the more rapidly it becomes established as a key objective in all of the administration’s activities” (Bulkeley, 2006, p. 2253).

Another component of the capacity to act on urban low carbon restructuring could be the extent to which local authorities or stakeholders have the required knowledge of the nature of the problem and their awareness of the tools that may be available, such as through district heating schemes or community renewable energy projects.

One example is the case of a district heating scheme in the town of Woking in Surrey, UK, where the initial skepticism of district heating by local authorities and residents was overcome through the formation of a joint venture with a Danish commercial energy service company which could draw on technical expertise to establish legitimacy for the new project (Hawkey et al., 2013).

While (2011) introduces additional criteria, not previously considered, which may be significant in the capacity of cities in undertaking low carbon energy restructuring including, the economy, costs of low carbon restructuring and the competing costs of climate change:

> "The era of carbon control raises similar questions about the capacity of cities to make low carbon transitions, albeit on the basis of a slightly different set of criteria, including levels of carbon dependence (in the economy, infrastructure, land-use patterns, etc.), the costs of low carbon retrofitting and restructuring, the degree of political and public support for low carbon measures, and not least, the competing costs of climate change adaptation" (While, 2011, p. 121).

2.4 Conclusion

This chapter has explored the issues that place pressure on western countries, cities and regions to restructure their energy systems. The conceptual framework provides the tools which will be used to analyse the factors influencing investment decisions in the electricity generation and supply systems. The concepts introduced in the framework will be used to analyse the research findings in empirical chapters 6, 7 and 8. The next chapter describes the changing context of the United States electricity generation and supply system.

3 THE CHANGING CONTEXT FOR STATE-LEVEL ELECTRICITY GENERATION AND SUPPLY IN THE USA

The previous chapter was concerned with the changing context for decisions about electricity generation and supply, and especially the extent to which carbon reduction is influencing those decisions. The argument of this chapter is that the current energy governing system comprising of the electric utility business model and regulatory framework across the U.S. has remained largely unchanged for nearly 100 years and is currently facing pressures and demands which are influencing the decisions about electricity generation and supply, with particular attention paid to issues of carbon regulation. In this chapter, the changing context for management in electricity generation and supply industry in the USA is explored. This chapter is split into three sections.

The first section presents a history of the U.S. electricity generation and supply over the last century. It reviews the major eras in electricity development, the pressures and demands that have led to major changes, the significance and impact of these changes and the resulting current structure of electricity generation and supply. Throughout this section, emphasis will be placed on the variation in state responses to these pressures and demands over time and how they have led to current electricity governing and management frameworks. The second section outlines the current frameworks for U.S. state level electricity generation and supply and how they vary across the country.

This section draws out key themes that emerge from the history of electricity generation and supply including the relationship between the federal and state governments in electricity pricing, subsidies and regulation, the relationship between municipalities and state level intervention, the tensions and conflicts in those relationships, political will, business models, supply logics and energy mixes. Finally, the third section discusses the impact low carbon may be having on decisions made about U.S. state level electricity generation and supply. The understanding of factors shaping decisions about low carbon electricity requires an understanding of the institutional framework and inherited business models.

3.1 THE HISTORY OF U.S. STATE LEVEL ELECTRICITY GENERATION AND SUPPLY

This section examines how electricity generation and supply networks have developed across the United States over the last century, from 1882 to 2010. The history will be divided into six eras which began with the origins of the modern utility beginning in 1882 and ending in 1900, which comprised of small-scale electricity provision by multiple privately-owned companies to cities and regulated through municipal franchises and state laws (Hausman & Neufeld, 1990, 2011). This period ended due to technological advancement and realised economies of scale (Hirsh & Finn, 2002). This era also included the rise and peaking of municipally owned electric utilities in the late 1890s (Hirsh, 2003a; U.S. Census Bureau, 1905).

The municipal provision era is followed by the centralisation of electricity generation and supply (Hirsh, 2003a) and the consolidation of nearly 2805 private utilities to form a few holding companies between 1901 and 1932 (U.S. Energy Information Administration, 2000) who grew from municipal boundaries to cross state lines. This growth prompted the creation of state public service commissions from 1907 and the replacement of municipal regulation by state regulation through legislation and state public service commissions (Hausman & Neufeld, 2011). Furthermore, concerns about the consolidation of private utility ownership and financial misconduct (Hausman & Neufeld, 2004) prompted federal government oversight of electricity networks across state lines and breaking up holding companies (Hausman & Neufeld, 1999).
The period of consolidation was followed from 1933 to 1951 by increased federal government involvement in electricity generation and supply, the introduction of rural electrification, the increased electricity generation capacity of privately owned utilities and increasing efficiency in electricity networks (U.S. Energy Information Administration, 2000).

The next era from 1951 to 1970 can be summarised as one of successful growth of private utility companies in terms of predictable growth in electricity demand due to economic growth, drops in electricity prices, the introduction of nuclear energy in electricity provision, investment in excess coal and nuclear to match predicted demand and environmental awareness and environmental legislation in 1970 (Morgan, Apt, & Lave, 2005; U.S. Energy Information Administration, 2000).

This period of prosperity of private electric utilities was followed by the energy security era from 1970 to 1984 which was marked by the oil embargo of 1973 and the energy crisis of 1978, these crises, resulted in increasing costs of electricity generation from fossil fuel power plants, increased costs of electricity generation due to the environmental legislation passed in 1970 and cost overruns from excess plants from the growth era and finally reduced electricity demand due to conservation efforts. These events would raise concerns about U.S. energy security, prompting the intervention of U.S. federal government in the electricity sector. The interventions included a combination of laws, policies, and incentives which had the impact of introducing external producers into the electricity market in some states, increasing coal development generation capacity in others, increased renewable energy electricity in western states and aggressive natural gas development strategies across the country.

The effects of the cost overruns from excess capacity from private utilities, expensive nuclear plants and competition from non-utility power producers and expensive contracts signed in the previous era meant increasing costs of electricity in some states and marked the restructuring era from 1984 to 2002. The high rates of electricity in the late 1980s in mainly western states led to restructuring of investor-owned utilities by unbundling the generation of electricity from its transmission and distribution by the late 90s.

a. Private provision with municipal franchises: 1882 – 1900

On September 4th, 1882, the first electricity power station in New York City was opened by Thomas Edison's Pearl Street (Hausman & Neufeld, 1990). By the end of the year, nearly 150 small power stations modelled after Edison's Pearl Street had spread to other cities (Hausman & Neufeld, 1990). Private individuals and companies started acquiring franchises from municipal governments (Hirsh & Finn, 2002). By 1890, the changing demand from only street lighting to fully 24 hours electricity led to the creation of small electricity stations in U.S. cities which were located within a mile or a block to the city being supply (U.S. Energy Information Administration, 2000). The mile or block restriction was due to the *Direct Current* transmission power loss over long distances (Hirsh, 2003a). By 1896, the first centralised power plant was created that allowed for the transmission of electricity about 20 miles away (U.S. Energy Information Administration, 2000) due to improved technology, specifically, the switch to Alternating Current (AC) transmission which improved upon power losses over long distances (Hirsh, 2003a; Hirsh & Finn, 2002).

By the end of the era in 1902, there were 3620 electricity power stations in total across the United States (U.S. Census Bureau, 1905), with multiple companies, both private and public invested in electricity generation and transmission (U.S. Energy Information Administration, 2000). This total was made up of nearly 2805 private stations and 815 municipal stations (U.S. Energy Information Administration, 2000), meaning that private companies dominated the market, providing nearly 78% of electricity. For example, Alabama had 2 individual, 13 corporations and 1 municipal companies; California had 23 individual and 82 corporations; Georgia had 5 Individual and 19 corporations; Illinois had 137 individual and 127 corporations; New York had 63 individual, 164 corporations and 1 municipal and Nevada only had 1 individual and 4 corporations involved in electricity provision by 1902 (U.S. Census Bureau, 1905).

This era operated on the use of contracts or licenses also known as franchises obtained from the municipal governments and municipal authority over utilities was ingrained in varying forms of state laws. These franchises were required because of the placement of distribution systems within city streets, where ownership of the street i.e. the land belonged to the city governments and not private companies (Hausman & Neufeld, 1990). The U.S. Department of Commerce and Labour, Bureau of the Census in 1902 found that:

> "Electric lighting, street railway, and other analogous corporations derive their charters which give them the right to exist and which regulate them in a general way their internal government, from the state through the medium of either a general or special statute. Usually further authorization is necessary before wires may be run along a specific street or highway, and it is this authorization that is designated the term "franchise" in a more limited sense. By some state constitutions the legislatures are strictly prohibited from granting any use of streets or highways without the consent of the local authorities; and in nearly all the states where tis express provision is not found the practice of legislatures is to leave to the local governing body an effective control in this matter. This control ordinarily involves and implies the right of local authorities to impose such conditions as they may see fit at the time the franchise is granted, and these conditions are endless in their variations." (Chapter VII, p. 82)

Municipal regulation of the utilities was done by controlling the number of franchises and therefore the level of competition as opposed to rates (Knittel, 2006). Municipal authorities did not control the electricity prices directly, however they made sure that prices were not higher than the maximum of current prices (Knittel, 2006).

On the details of franchises, Hausman and Neufeld (2011) describe municipal franchises as follows:

> "These franchises were contracts specifying the rights and responsibilities of both the utilities and the municipalities in which they were located. Franchise terms were fixed but usually long – 20 to 50 years. The terms of the franchises varied considerably among municipalities and often included terms and availability of service, maximum prices, competitive conditions, discounts to the municipal governments, and many other requirements." (p. 725).

Since the *requirements* in franchises varied across cities, this would lead to variation in the distribution of small centralised power stations in the United States (U.S. Census Bureau, 1905). Finally, the era also was marked by intense and open competition especially in larger cities (Hausman & Neufeld, 2002) because franchises were non-exclusive and utilities did not receive monopoly protection (Hausman & Neufeld, 2011). A consequence of this structure was the duplication of transmission lines and an inefficient network (Knittel, 2006) as companies competed to serve the same cities. Another consequence was financing: electric utilities in the genesis era were not very profitable and as the demand for electricity continued to increase, so did the cost of the electricity networks. During this time, earnings from the electricity sold were far lower than the cost of investment made by utilities and utilities struggled to make further investments (Hausman & Neufeld, 2002).

There is literature which considers "bad practices", in the form of exploitation of utility contracts by municipal authorities leading to a push for state-wide utility regulation (Hausman & Neufeld, 2011; Knittel, 2006; Lyon & Wilson, 2012; Neufeld, 2008). Ultimately, this method of regulating through franchises and allowing open competition with the inability to properly recover costs, exploitation by municipal authorities, in combination with technological advancements as well as economies of scale (Hausman & Neufeld, 1990; Hirsh, 2003a; U.S. Energy Information Administration, 2000), would prove to be significant causes of transition in the era.

Towards the end of the century, state-led regulation and the growth of public service commissions were seen as the solution to these issues and by 1905, New York and Wisconsin had created *Public Utility Commissions* and adopted state wide utility regulation, with Georgia in 1907, and other states following each year after (Hausman & Neufeld, 2011).

Massachusetts was the outlier as it had created a Public Utility Commission in 1887. Municipal ownership was also proposed as a means to solve the issues of finance and exploitation because according to Hirsh (2003):

> "Because municipal governments paid no dividends to shareholders and could obtain low-cost loans by issuing tax-exempt bonds, they often could produce electricity at lower cost than private companies. Civic reformers, trust-busting politicians, and muckraking journalists supported the public power movement during an era when "big business" as typified by John D. Rockefeller's Standard Oil Company, acquired negative connotations. By 1902, 815 municipal systems had already formed in the United States and their combined capacity accounted for 9.3% of the nation's total. Supposedly insulated from business corruption, these public power systems constituted an alternative model for the utility industry." (p.22).

Nevertheless, the idea of municipal-owned utilities would remain contested over the next few decades, always recurring but never achieving enough popularity to grow. Hausman and Neufeld (2011) explicitly state about municipal ownership:

> "Disagreements over this issue were intensely ideological, emotional, partisan, and characterised by arguments that, at best, contained half-truths." (p. 726).

This resulted in the number of municipal utilities peaking and privately-owned utilities controlling the majority of electricity generation and supply and competing for city provision (U.S. Energy Information Administration, 2000). State-wide utility regulation became the dominant method across the United States of electric utility regulation.

b. Consolidation and centralisation of private provision: 1901 – 1932

The period of centralisation beyond city boundaries began in 1902 as part of a period of improved technology leading to falling residential electricity prices and the growth of electric power networks (U.S. Energy Information Administration, 2000). According to the U.S. Energy Information Administration's electricity power report:

> "Competition and technological improvements served to lower electricity prices steadily, with nominal residential prices falling to less than 17 cents per kilowatt-hour by the beginning of the 20th century." (U.S. Energy Information Administration, 2000, p. 111).

The growth of electric power networks during this era increasingly went beyond the city limits (Hirsh, 2003a) as companies placed transmission lines outside the single city of origin, with many growing the service territories to include multiple cities. For example, the U.S. Census Bureau reported in 1907 that the Boston Edison Company grew from operating in an area estimated to be an eighth of a square mile in the late 1880s, to operating within an estimated 509 square miles, covering 35 cities and some towns within Massachusetts. Furthermore, the customers served had grown to nearly a million by 1907 (U.S. Census Bureau, 1907). In 1912, Pacific Gas and Electric Company operating in central California supplied electricity across 30 counties and served 187 neighbourhoods (U.S. Census Bureau, 1912). The Central Illinois Public Service Company in 1912 served 87 communities (U.S. Census Bureau, 1912).

Nevertheless, the system of individual electric utilities performing all aspects of electric power supply (i.e. generation, transmission and distribution) remained unchanged. Furthermore, with this growth, many utilities took the view that state-level regulation could be to their advantage (Hirsh, 2003a). For example this was recognised by Samuel Insull, the President of the Edison company in Chicago, where the electricity network was the most advanced in the United States (Hausman & Neufeld, 2011). California was also another state where utility executives campaigned for state regulation in order to reduce or end competition and to boost financial valuation of their firms and reduce financial risks (Hausman & Neufeld, 2002). In many states, Public Service Commissions (PUCs) were introduced from 1905 with a duty to regulate the utilities. Overall, Public Service Commissions had a very specific purpose, which was to regulate the utility. According to Hirsh (1989), the general purpose of the Public Service Commissions was:

> "To assure the public that it would receive a socially and economically significant commodity electricity at reasonable rates and with reliable service; and to enable utility companies to earn a "reasonable" return on investments so they could produce electricity, construct new facilities, and, in general, maintain their financial integrity." (p. 22)

Hausman and Neufeld (2004), expand this purpose to include the following:

> "The primary job of the commissions was to ensure by setting the utility's rates that the profits earned by the regulated utilities were not excessive. The rates were supposed to be set at a level that just enabled the utility to cover its operating expenses and receive a "fair" return on the value of its capital facilities. What constituted a "fair" return depended on the utility's capital cost: what it had to pay bondholders and stockholders to obtain the funds

> needed for investment. This system reduced the apparent risk to utility bond and stock investors, and modestly reduced the interest rate regulated utilities paid for borrowed money." (p. 13).

Furthermore, the formal process of the PUCs electricity decision making as described by Hausman and Neufeld (2008) was as follows:

> "The commissions that regulate utility rates operate as quasi-judicial agencies. Each commission has several commissioners, and decisions are determined by vote. Before a rate can be established or changed, a formal hearing is held. Testimony is given under rules of evidence based on accounting data provided for a 'test year'. Commissioners also have power to decide whether a particular utility investment is 'prudent', and can therefore be included in the value of the total investment on which the fair return is calculated. The utilities participate in these hearings, of course, but they are also open to essentially anyone wishing to provide testimony. The decision of a commission can be appealed to the judiciary. Commissions generally have fulltime staffs reviewing the evidence presented and providing technical support, although their budgets are a small fraction of the administrative budgets of the utilities they regulate." (p. 724).

Regulation also included the introduction of indefinite terms and removing municipal franchises with fixed terms (Hausman & Neufeld, 2004), the assignment of existing utilities to specific service areas (Hausman & Neufeld, 2011) and rules which protected the investments of existing utilities. The process of regulating utilities via PUCs also became more sophisticated, as certain concepts were introduced which included: revenue requirements, rate of return, fair value, rate base (Preston & Vesey, 2008) and the controversial regulatory compact (Regulatory Assistance Project, 2011a). This is summarised by Phillips (1965) as follows:

> First, the "cost of capital" standard, under which the rate of return should enable a company to attract capital on terms that will (a) maintain its credit standing, (b) protect its financial soundness, and (c) maintain the integrity of its existing investments. Second, the "comparability of earnings" standard, under which the rate of return to equity owners "should be commensurate with return on investments in other enterprises having corresponding risks." (p. 268).

These were general utility accounting methods at the time with variations in detail across the country (Preston & Vesey, 2008).

c. Consolidation of private utilities: 1933 - 1951

Another mark of this era was the consolidation of privately owned utilities to form holding companies controlling stock of many utilities. By 1920s, due to the technological improvements in turbine technology (Balling, Termuehlen, & Baumgartner, 2002; U.S. Energy Information Administration, 2000) and continued demand growth, many of the smaller municipal-owned electric lighting and railway companies merged with or were acquired by the private owned utilities who were investing in larger and more efficient electricity systems (Hausman & Neufeld, 2002, 2004, 2011).

Additionally, many of the private owned utilities merged into a few number of holding companies, with those few holders in control of multiple subsidiary companies (Hausman & Neufeld, 2002, 2004). The main purpose of the holding companies was obtaining better funding, but other benefits included combining technical expertise in engineering, management expertise in business operations in an effort to assess larger networks and technological improvements (Hausman & Neufeld, 2002). By 1929, an estimated 16 public holding companies controlled nearly 75% of electricity provision (U.S. Energy Information Administration, 2000).

Examples of existing well known holding companies are Exelon Corporation with three subsidiaries including; BGE serving Maryland, ComEd serving north Illinois and PECO serving south Pennsylvania. Duke Energy with five subsidiaries including; Duke Energy Progress, Duke Energy Florida, Duke Energy Ohio, Duke Energy Carolinas and Duke Energy Indiana. Finally, Southern Company with four subsidiaries including; Georgia Power, Alabama Power, Mississippi Power, Gulf Power Company and Southern Power Company. However, alongside the formation of these holding companies also came the concerns about abuses in business practices like inflated electricity rates for consumers, hiding inflated rates in regulated rates, creating difficulties in application of regulation due to interstate electricity sales and debt problems from the crash in the stock market and depression (U.S. Energy Information Administration, 1993b).

These concerns and events forced the U.S. federal government to intervene in electricity governance to act in an effort to protect consumers (U.S. Energy Information Administration, 1993b). The U.S. federal government carried out extensive investigations of the holding companies' transactions, finding the need to curb holding company excesses.

In August 26th of 1935, the Public Utility Holding Company Act was introduced which would prevent regulated electricity consumers from subsidizing unrelated practices. The law also made clear that companies involved in interstate sales would additionally be monitored by the U.S. Securities and Exchange Commission Finally, the SEC, authorised by the law, forced the bigger holding companies to divest and be reduced to individual companies providing electricity to a specific geographic territory. Research into various state commissions would suggest that, following authorisation by state legislation, Public Service Commissions could then carve out territories and boundaries based on counties, cities, parishes and other factors including transmission and distribution infrastructure in existence (Floyd, 2009; U.S. Energy Information Administration, 2000). This process would be negotiated with all utilities involved and eventually, official territorial maps were drawn (Floyd, 2009).

This is the first major event in which the United States federal government intervened in electricity generation and supply. Still, its powers were limited. The legislation did not wholly change the structure of electricity generation with electricity regulation still essentially a function of the states. Specifically summarised by Baum (1942), as follows:

> "'Reasonable' rates and services is one of the primary aims of utility regulation. Direct control of these matters is now largely within the authority of the states, with Federal control now limited chiefly to interstate phases beyond the constitutional authority of the states." (p. 174).

The law would later be repealed in 2005. In summary, the most significant changes that came out of the events of the consolidation and centralisation era were the continued growth of electricity utilities, the strengthening of state regulation through legislation and state public service commissions, but most importantly the strengthened governing structure of the vertical integrated utility, with monopoly franchises and guaranteed rates of return (Morgan et al., 2005). The consolidation and centralisation era would be followed by unfettered and uninterrupted utility growth and prosperity from 1951 to 1970 (U.S. Energy Information Administration, 2000).

d. *The growth of private utilities: 1951-1970*

Overall, the period of 1951 to 1970 was one of rapid, unhindered growth for electric utilities in terms of an increase in supply and sales of electricity due to electric consumption for residents and technological advances for manufacturers after World War Two (Hirsh, 2003b, 2003c; U.S. Congressional Budget Office, 1986; U.S. Energy Information Administration, 2000). The U.S. Congressional office (1989) found:

> "From 1950 to 1970, electric utilities experienced a strong and stable period, marked by steadily increasing returns on equity, relatively high stock prices, and robust growth in electricity demand. With economies of scale and technological advances encouraging larger and larger plants, and with integration within and across firms improving efficiency, generating capacity more than quadrupled while real prices decreased by about 30 percent. Reserve margins the difference between total generating capacity and anticipated peak demand — were comfortably maintained at an average of 22 percent. These margins helped ensure a reliable supply of electricity even if demand increased faster than expected." (p. 6).

At the beginning of the growth era in 1950, there were a total of 4,007 electric supply systems, 1,495 utilities with generating plants and 3,867 generating plants (U.S. Census Bureau, 1952, 1972). By the end of the growth era in 1,970, there were a total of 1,092 utilities with generating plants and 3,519 generating plants (U.S. Census Bureau, 1952, 1972). The ownership of the plants, production, installed capacity and prime movers are summarised in tables

No. 827. Electric Utilities—Supply Systems and Generating Plants, by Class of Ownership: 1950 to 1970

As of December 31. Prior to 1965, excludes Alaska and Hawaii. Excludes duplications of establishments operating in two or more States and nonutility plants producing primarily for industrial use]

ITEM	Total, all classes	Privately owned	Cooperatively owned	PUBLICLY OWNED: Total	PUBLICLY OWNED: Municipal	PUBLICLY OWNED: Federal	PUBLICLY OWNED: Other [1]
1950: Total electric supply systems	4,007	821	963	2,223	2,077	55	91
Utilities with generating plants	1,495	393	92	1,010	955	13	42
Number of generating plants	3,867	2,334	166	1,367	1,136	83	148
1960: Total electric supply systems	3,637	496	965	2,176	2,026	43	107
Utilities with generating plants	1,198	270	68	860	802	6	52
Number of generating plants	3,435	2,000	132	1,303	1,017	142	144
1965: Total electric supply systems	3,614	472	986	2,156	[2] 2,114	42	(2)
Utilities with generating plants	1,139	243	75	821	764	8	49
Number of generating plants	3,290	1,827	165	1,298	1,006	160	132
1969: Utilities with generating plants	1,097	238	74	785	722	9	54
Number of generating plants	3,472	1,992	160	1,320	1,008	170	142
1970: Utilities with generating plants	1,092	238	74	780	717	9	54
Number of generating plants	3,519	2,033	160	1,326	1,009	174	143

[1] Public utility districts and State projects. [2] Municipal includes "Other publicly owned."

Table 3-1: Electric Utilities - Supply Systems and Generating Plants, By Class of Ownership: 1950 to 1970
Source: U.S. Census, Statistical Abstract 1972

[Production for calendar years; other data as of December 31. Prior to 1965, excludes Alaska and Hawaii. See also *Historical Statistics, Colonial Times to 1957*, series S 15–35 and S 44–69]

ITEM	1950	1955	1960	1965	1968	1969	1970	1971 (prel.)
Production (bil. kw.-hr.)	389	629	842	1,158	1,436	1,553	1,640	1,718
Industrial plants [1]	60	82	88	102	107	111	108	104
Electric utilities (for public use)	329	547	753	1,055	1,329	1,442	1,532	1,614
Privately owned [2]	267	421	579	809	1,019	1,102	1,183	1,250
Percent of utility production	81.1	76.9	76.8	76.7	76.7	76.4	77.3	77.5
Publicly owned [2]	62	126	175	246	310	340	348	364
Municipal	15	26	37	50	64	70	71	73
Federal	40	89	112	145	171	183	186	194
Cooperatives and other [3]	6	11	26	51	75	87	91	97
Source of energy (percent):								
Coal [4]	47.1	55.1	53.6	54.5	52.5	49.0	46.2	44.3
Nuclear						1.0	1.4	2.3
Oil	10.3	6.8	6.1	6.1	7.8	9.6	11.9	13.5
Gas	13.5	17.4	21.0	21.0	22.9	23.1	24.3	23.3
Hydro	29.2	20.7	19.3	18.4	16.7	17.3	16.2	16.5
Per kw. of capacity (kw.-hr.)	4,776	4 779	4,484	4,469	4,568	4,602	4,490	4,393
Installed capacity (mil. kw.)	83	131	186	255	310	333	360	387
Industrial plants [1]	14	16	18	18	19	19	19	19
Electric utilities (for public use)	69	114	168	236	291	313	341	367
Privately owned	55	87	128	178	221	240	263	287
Percent of utility capacity	80.1	75.9	76.5	75.2	75.8	76.6	77.0	78.1
Publicly owned [2]	14	28	40	59	70	73	78	81
Municipal	5	8	11	15	19	20	21	22
Federal	7	17	22	32	35	36	39	40
Cooperatives and other [3]	2	3	6	11	16	17	19	19
TYPE OF PRIME MOVER								
Electric utilities (for public use):								
Number of plants, total [5]	3,867	3,587	3,435	3,290	3,429	3,472	3,519	3,558
Hydro	1,458	1,381	1,331	1,231	1,207	1,188	1,183	1,176
Steam	1,051	1,045	1.060	1,068	1,206	1,003	1,009	1,017
Gas turbine						269	321	361
Internal combustion	1,358	1,161	1,044	991	1,016	1,012	1,006	1,004
Production (bil. kw.-hr.)	329	547	753	1,055	1,329	1,442	1,532	1,614
Hydro (bil. kw.-hr.)	96	113	146	194	222	250	247	266
Steam (bil. kw.-hr.)	230	430	603	856	1,102	1,178	1,262	1,319
Gas turbine						8	16	22
Internal combustion (bil. kw.-hr.)	4	4	4	5	5	6	6	6
Installed capacity (mil. kw.)	69	114	168	236	291	313	341	367
Hydro	18	25	32	44	51	53	55	56
Steam	49	87	133	189	230	246	266	285
Gas turbine					6	10	15	22
Internal combustion	2	2	3	3	4	4	4	4

[1] Plants of 100 kilowatts and over, including stationary powerplants of railroads.
[2] Noncentral stations included only in total prior to 1955; distributed to other publicly owned classes thereafter.
[3] Includes Power Districts and State Projects.
[4] Includes small percentage from wood and waste and geothermal sources.
[5] Each prime mover type in combination plants counted separately.

Table 3-2: Electric Energy Production and Installed Generating Capacity by Class of Ownership and Type of Prime Mover: 1950 to 1971
Source: U.S. Census, Statistical Abstract 1972

The 1950s was marked by strategies pushing for growth to utility sales and rapid expansion of the electricity network along with technological advances, all of which hit a peak in the 1960s. The successes of the 1960s included the highest efficiencies in electricity generation, the highest sales most utilities had ever seen, profits and capacity expansion for electric utilities across the United States and no controversy (Hirsh, 2003b; U.S. Energy Information Administration, 2000). Hirsh (1989) provides a summary of the early 1950s context:

> "The coming of World War II interrupted the concerted effort by most investor-owned utilities to increase electricity usage. Expanding defence industries and a reinvigorated economy rapidly drove up consumption without the need to promote it (after an increase of only 38% for the ten years after the depression began), and utilities did their best to provide adequate service. But even after the conflict, it took a few years before utilities regained the momentum of promoting electricity usage. For one thing, the industry experienced a shortage of capacity." (p. 48).

Therefore, to counteract the shortage in capacity and reduced sales, there began an aggressive push by electric utility managers to increase electricity consumption. The dominant post-war strategy was advertising, for example, the 'Medallion Home' program launched in March of 1956, where the home would get a gold medallion badge if all appliances within the home were completely electric (commonly known as 'all-electric homes') and where this medallion represented higher economic welfare and prestige (Southwest Museum of Engineering, 2007). Overall, the entire country experienced economic prosperity. According to Hirsh (1989):

> "As the country enjoyed post-war economic prosperity, consumers spent money on automobiles, televisions, and other "luxuries" as never before. Many of these, such as air conditioners and electrical space-heating systems, helped push electricity consumption up almost beyond belief. In 1955, managers marvelled at a 17% leap in electricity from the year before. This jump followed other big years making an annual growth rate of 10.8% for the immediate post-world war II decade. While annual sales growth moderated in the late 1950s and 1960s to a more "traditional" 7 to 8% range, the years still were punctuated by spurts of 10.1% in 1959, and 8+% figures in 1966, 1968, and 1969." (p. 56).

Overall, this strategy worked and created a cycle whereby residential growth increased, utilities increased the scale of generation plants, and manufacturers built bigger plants. According to Hirsh (1989):

> "Manufacturers adopted the approach because it yielded rapid advances in the capacities of components – exactly what utilities demanded. But vendors benefited too by developing increasingly powerful turbines and generators – equipment for which they could earn good profits." (p.63).

Furthermore, in order to keep up with the demand from utilities for new and larger plants, manufacturers changed some aspects of design philosophy:

> "Though the utilities' post-war grow and build strategy appeared similar to the traditional and successful approach used earlier in the century, the extra emphasis on large scale in the 1950s and 1960s put new pressures on manufacturers to develop a novel design philosophy. One element of it consisted of foregoing some of the conservatism in the design-by-experience approach by planning new and bigger machines before practical knowledge had accumulated from previous units. Called 'design by extrapolation' by some people in the industry, the new approach differed dramatically from its predecessor. Instead of waiting for experience – and learning – to accrue while observing how earlier machines operated in the field, manufacturers made abrupt jumps in design to the next stage." (Hirsh, 1989, p.63).

Generally, this period was marked by shared interests between customers (residential, commercial and industrial), utilities, manufacturers and regulators with limited conflict in the regulatory process. Utility companies generally worked to reduce their costs of producing electricity and increase the efficiency of the electric system (Hirsh, 2003b). Cost savings were passed on to consumers:

> "Few people complained about a service whose costs countered this general trend toward cost of living increases. As a result, regulatory actions tended to reinforce the *grow and build* strategy." (Hirsh, 1989. p. 85).

He also adds:

> "Yet as long as costs declined while utilities continued to supply electricity with ease, they received good treatment from state regulatory bodies. This happy situation by which utilities won monopoly status in return for providing cheap and abundant supplies of electricity has been called a 'social contract' by some utility managers. It was a contract that served the industry well for more than half a century." (p. 85 – 86).

The period was marked by increases in power plant efficiency and a rise in the growth of fossil fuel power plants (Hirsh, 2003d; U.S. Energy Information Administration, 2000). The growth in generation capacity was estimated to be 7.5% per annum, mainly attributed to oil and natural gas plants (U.S. Energy Information Administration, 2000). Unlike the other fossil fuels (natural gas and oil), which were growing at record capacity, coal stagnated and declined from the mid-1940s (Coal Age News, 2012a, 2012b; Gordon, 1975; Vietor, 1987). This stagnation and decline was caused by a combination of issues including an inability to compete with natural gas and oil, disagreements between coal workers and coal managers primarily over wages and increased costs from transportation which led to decreased output of coal. The signature coal industry magazine, *Coal Age* puts these issues with coal into context:

> "Fighting between union and management in turn curtailed output and raised prices and with America's economy modernizing rapidly, the railroads, the public and much of the nation's industry turned increasingly to the coal's more predictable competitors: natural gas and oil." (Coal Age Magazine, September 14th 2012)

The predominant issue however, was the persistent disagreements between coal unions and coal managers with regards to wages (Coal Age News, 2012b; Vietor, 1987), which spilled over to the 1950s.

Coal Age magazine reported:

> "Negotiations between coal operators and the union went well in early 1950 and the contract they collectively settled on created precisely the labour stability needed for coal to move ahead. Deemed "a sick industry" by President Truman, full government takeover or nationalization—at the time happening worldwide—was looming unless all parties could find some middle ground, roll up their sleeves and get back to it." (Coal Age Magazine, September 14th 2012)

However, this was not all, in the domestic electricity market, coal was also losing energy generation share to natural gas, oil and nuclear, heightened by the fact that coal was not profitable and competitive after transportation, preparation and combustion costs were factored in, in comparison to the other fossil fuels (Gordon, 1975; Vietor, 1987) but also coal producers did not have the political influence that oil producers had. Vietor (1987) explains:

> "By 1956, coal was a 'sick Industry' in more ways than one. Coal production had declined 39% from its peak in 1947; three thousand mines had closed, and the number of mines fell by nearly half. Coal's share of the energy market had fallen by 18%, with no end in sight. Although insufficient was not necessarily the coal industry's principal problem, it was amenable to political redress. The industry's real problems – inter-fuel competition, adverse energy policies and structural fragmentation, were less tractable politically." (p. 163)

Additionally, the coal industry's lack of profitability in comparison to natural gas and oil was an ongoing issue because there was no growth due to lack of integration at the time. Vietor (1984) summarises:

> "The absence of either horizontal or vertical integration in the coal industry was a basic cause of non-competitiveness and political ineffectiveness. Coal was among the least concentrated and least profitable of primary industries. There were an estimated 4,000 concerns, of which less than 1,000 reported any net income. The average net income for reporting firms was $82,000 in 1950 and $26,000 in 1953. After-tax profits averaged $22,000 during that period. The 20 largest companies, responsible for 39% of total coal production, averaged a return on net worth of only 5.8% from 1950 to 1955. This compared unfavourably with other fragmented industries, let alone the largest oil companies with an average return of 14.8%."

This decline continued until the late 1950s when a combination of strategies allowed coal to become the prime fuel of electric utilities and the coal industry to become the main partner with electric utilities.

The strategies included an agreement between coal management and the coal labour union on increased wages in 1951 (Coal Age News, 2012b), coal companies switched to using barges as opposed to rail to reduce freight rates and save costs, improving coal mining technology and improved electric transmission capacity. Some electric utilities acquired coal companies and some leased coal lands from the federal governments (U.S. Energy Information Administration, 1993a), which allowed the relocation of power plants to near the mines themselves to secure supplies of coal, cut transportation costs and finally to hedge their bets on a potential synthetic fuels boom triggered by federal government energy policy (Vietor, 1987). Ultimately, the significant investments made by electric utilities in coal reserves, coal mining and coal fired plants at the time, meant that by 1961 the electricity industry had become the only significant industry for coal (Coal Age News, 2012a; Gordon, 1975). The industry magazine Coal Age, covering the news and history at the time, summarises:

> "The saving grace of the industry was the development and build-out of America's new electrical power grid. Though in 1960, coking coal and industrial users were the largest consumers of coal, by the end of the decade, the electrical industry was by far coal's biggest client, receiving more than 310 million tons in 1969 as production increased to a high of 573 million tons that year—virtually all of it bituminous coal." (Coal Age Magazine, September 14, 2012)

The era was marked by the beginning of commercial nuclear operation in 1957 (U.S. Energy Information Administration, 2000). At the time, nuclear energy was seen as a promising technology and no significant problems were anticipated. As a result, in the 1960s nuclear power generation started to be used to address electricity demand with electric utilities placing large orders for nuclear power plants (U.S. Congressional Budget Office, 1986). The *Northeast Blackout* in 1965 prompted the first major concerns about system reliability and forced the creation of North American Electric Reliability Council or NERC (Warwick, 2002). NERC would be a completely voluntary organisation, managed by utilities overseeing ten regional reliability councils, covering all states in the U.S. (Warwick, 2002).

Finally, the period saw the rise of environmental concerns amongst the general public, as coal-fired plants came under increased scrutiny by the public and federal government (U.S. Energy Information Administration, 2000). However environmental concerns had limited impact because power plants started introducing few pollution controls.

e. *The era of energy security 1970 to 1984*

The 'energy security' era was marked by multiple unanticipated challenges to the electric power industry which would impact the decisions made about electricity generation and supply mix across states. Additionally, the energy security era was also marked by unprecedented federal Government intervention in the energy industry. Finally, this era was marked by energy policy tailored to energy independence in the United States (Grossman, 2013; Joskow, 2001b; Tomain, 1990).

The energy security era began with an inflation crisis attributed to increased federal government spending (Edison Electric Institute, 2012a; U.S. Energy Information Administration, 2000). The inflation caused significant cost increases in operations, maintenance, building and material costs and finally higher interest rates (Edison Electric Institute, 2012a; U.S. Energy Information Administration, 2000). These cost problems would be heightened by new environmental requirements but more seriously, by the Oil Crisis of 1973. Hirsh (1989) describes the impacts of inflation on electric utilities as follows:

> "Inflation struck the industry hard from several angles. Because building new plants formed an integral part of the utility business – one utility executive called his firm 'a construction company' – the inflated costs of building greatly affected its financial health. The Handy-Whitman index of the cost of labor and materials going into steam power plants rose 120% between 1970 and 1979, in contrast to a rise of 23% for the previous ten years. Meanwhile, as investors sought bond yields that exceeded the inflation rate, utilities watched their old bond prices plummet and new bonds carry soaring coupon rates – reaching an average of 11.85% in December 1979, up from an already stratospheric 10.28% in September 1974. For the most capital-intensive industry in the United States, the cost of borrowing became a major balance sheet concern, especially when plant construction took longer than expected." (p. 111).

— Oil Crisis of 1973

What has come to be known as the *Oil Crisis* began on the 17th of October 1973, when the Arab members of the Organisation of Petroleum Exporting Countries (OPEC) declared an embargo on crude oil relating to the United States' support of Israel in the Arab-Israeli Yom Kippur War of 1973 (Edison Electric Institute, 2012a; U.S. Congressional Budget Office, 1986; U.S. Energy Information Administration, 2000). The effects of the embargo were generally fuel shortages and price increases in petroleum related products including gasoline and residential heating fuels (U.S. Energy Information Administration, 2002a) triggering an energy crisis. In electricity generation and supply, the effect on electric utilities was marked by high fuel i.e. generating costs and retail costs. According to the Congressional Budget Office:

> "Higher oil and gas prices resulting from the 1973-1974 oil embargo and the 1979-1980 oil shortage caused even greater increases in utilities' operating costs. In 1973, for example, electric utility plants paid an average of 87.6 cents, 169.8 cents, and 73.1 cents (in 1984 dollars) per million Btu for coal, heavy oil, and natural gas, respectively. By 1981 the real prices of these fuels had risen twofold for coal, fourfold for oil, and fivefold for gas-to 181.6 cents, 627.6 cents, and 403.8 cents (in 1984 dollars) per million BTU, respectively." (p. 8).

For electric utilities, the energy crisis was so severe because oil-fired power plants had become increasingly important in electricity generation, since coal-fired plants had to comply with the 1970 Clean Air Act (U.S. Energy Information Administration, 2002a, 2011). To make up for some of the financial troubles, utilities sought to raise rates. In some states the changes in fuel prices were accounted for through an adjustment clause. This was preferable to constant rate cases to determine how to account for new fuel prices in electricity generation during the energy crisis. However, 15 states passed legislation which would ban this practice (U.S. Congressional Budget Office, 1986). Nevertheless, consumers struggled. Due to the rate increases, consumers increasingly complained to state regulators:

> "By the time of the crisis in 1973, consumers had already become accustomed to regular rate hikes, though they probably could not have anticipated the increases precipitated by radically higher fuel costs. The 94 companies that obtained more than $827 million in increased rates in 1972 preceded 235 that obtained $3.1 billion in 1975. To put these hikes in better perspective, consider the extreme case of the residential rate payer in New York City. Already paying the costliest electricity in the country in 1969 – these customers became indignant when Consolidated Edison raised rates soon after asking them to reduce consumption during summer capacity shortages. By January 1971, Customers paid $16.41 per month for 500 kilowatt-hours of energy – 11% more than two years earlier. But worse was in the offing. Retaining the position as the nation's most expensive provider of electricity. Con Ed continued to receive rate hikes that pushed the cost of 500 kilowatt-hours of energy up to $40.15 by January 1977 – 92% greater than the national average and up 171% since 1969." (Hirsh, 1989, p. 147).

The finances of electric utilities were further put under pressure due to the heightened environmental awareness about pollution, which led to new regulations in the form of the Clean Air Act of 1970, aimed at curbing emission pollution through the use of pollution controls (Environmental Protection Agency, 2013b; U.S. Energy Information Administration, 2000).

The Clean Air Act required the Environmental Protection Agency to establish standards which controlled common pollutants including sulphur dioxide, nitrogen dioxide, carbon monoxide, lead, particulate matter and ground level ozone (Environmental Protection Agency, 2010). This meant that electric utilities needed to install pollution controls on fossil fuelled power plants to curb emissions from flue-gas stacks (Environmental Protection Agency, 2013b; U.S. Congressional Budget Office, 1986).

Overall, the federal government's passage of the Clean Air Act of 1970 was a response to the American public's growing concern with environmental pollution and this influenced many regulators and politicians at the state and federal level (Hirsh & Finn, 2002; U.S. Energy Information Administration, 2000), leading to increased capital and operating costs on electric utilities (Hirsh, 2003e; U.S. Congressional Budget Office, 1986; U.S. Energy Information Administration, 2000). Although these pollution controls were expensive, environmental regulations in the late 1970s had bipartisan support and so were implemented without too much conflict because:

> "Newly emerging public values concerning the environment found ready expression by politicians who saw a good issue around which to rally. (Even President Nixon did not want to be perceived as opposing "clean air and water.") Perhaps as importantly, however Congressmen concerned with problems relating to the power industry also discovered a severe regulatory lacuna: except for local zoning limitations, no federal agency (including the Federal Power Commission and the Atomic Energy Commission) and few state bodies had jurisdiction over the siting and construction of power plants and transmission lines that would have an impact on the environment. (Hirsh, 1989, p. 149).

Additionally, there were also differing effects amongst states on environmental regulation. Hirsh (1989) explains:

> "Environmental regulations also forced utilities to shift from dirty coal to cleaner burning oil in the early 1970s, causing some companies – especially those in the heavily oil-burning north-eastern states – to watch their fuel costs sky-rocket." (p. 112).

Aside from the fossil-fuelled power plants, nuclear energy power plants were also subject to environmental concerns and new, additional safety requirements were introduced, including increasing the number of nuclear reactor simulations, improving the instrumentation in nuclear plant operations, technological upgrades to plant components, fire safety regulations, increased staff training, fitting every reactor with an Emergency Core Cooling System (ECCS) and reducing public exposure limits to radiation from nuclear power plants from 0.5 rem per year to 100 mrem per year (Komanoff, 1981; U.S. Congressional Budget Office, 1979; U.S. Nuclear Regulatory Commission, 2014a; Walker & Wellock, 2010). New regulatory standards for nuclear power plant safety and in equipment designs meant there were increased material costs associated with updating existing nuclear plants, increased capital costs for new plants and finally delays in the construction times of nuclear plant (U.S. Congressional Budget Office, 1986). Construction costs became significant for nuclear power plants as they increased rapidly in time of inflation. According to the Congressional Budget Office:

> "The cost (in 1984 dollars) of a typical nuclear plant entering commercial operation increased from about $715 per kilowatt (kw) in the 1971-1974 period, to about $1,389 per kw in the 1981-1984 period. The average cost of a plant expected to enter service in 1985 or 1986 has risen to about $2,600 per kW measured in 1984 dollars. For a nuclear plant begun in 1972, with debt financing at 12% and labour and materials inflation at 9%, the final cost of the plant would be 30% higher if the plant were completed in 1984 (12 years from start of construction) than if it were completed in 1980 (eight years from start of construction)." (Congressional Budget Office, 1986, p. 11).

The cost increases were such that multiple planned nuclear energy plants were cancelled. The Congressional Budget Office and Department of Energy, also calculated that the sunk costs associated with the cancelled construction of nuclear energy plants was $10 billion (U.S. Congressional Budget Office, 1986). During this era, the reputation of nuclear energy was further diminished by the *Three Mile Island* accident occurring in Pennsylvania in 1979 which led to more safety requirements, especially in eleven states including, California, Connecticut, Kentucky, Maine, Maryland, Massachusetts, Montana, Oregon, Vermont, Wisconsin and Washington who passed laws and regulations prohibiting new nuclear plants (Office of Technology Assessment, 1984; U.S. Congressional Budget Office, 1986). The environmental requirements were an ever present regulatory and cost concern for utilities and for their coal and nuclear plants throughout this era of energy security.

Therefore state regulators were under pressure to balance and seek ways to ensure that utilities could cope financially with the crisis but at the same time protect consumers from unfair practices and ensure consumers got fair prices (Hirsh & Finn, 2002). This meant that the regulatory process and relationship that had served the regulators, utilities and consumers well during the growth era came under scrutiny during this energy security era (Hirsh & Finn, 2002).

Therefore, in addition to the fuel adjustment clauses introduced by state regulators, other suggestions included:

> "State regulatory action took several forms. In many cases, for example Public service commissions simply disapproved the full extent of rate hikes requested by power companies, disappointing utility managers who felt that the commissions yielded to political forces and represented the public's immediate interests only. Perhaps more disturbing to utility managers, a few utility commissions tried to impose new innovative approaches to encourage conservation – the opposite of what utilities have been for so long – especially after the energy crisis had put greater pressure on rate increases. Some regulators even insisted that utilities re-evaluate their, grow and build strategy and give up their declining block rate structures that previously contributed to its success." (p. 151).

It is unclear how many of these new strategies were adopted or effective during the era and the literature demonstrates that in the end most states allowed electric utilities to increase their retail costs, passing the costs to customers (U.S. Congressional Budget Office, 1986). Ultimately, most of these actions at the state level would not be enough. These unanticipated changes regarding inflation, environmental regulations and the oil embargo (no utility could have foreseen) affected electricity demand, regulations and costs, therefore electric utilities struggled to recover financially. The response to the energy crisis were the wide ranging proposals from the United States federal government, and specifically President Richard Nixon to address electricity generation and supply concerns, including more nuclear, coal and renewable fuel use and development. In a special address to the U.S. Congress on energy policy, President Nixon highlighted a push for coal:

> "I urge that highest national priority be given to expanded development and utilization of our coal resources. Present and potential users who are able to choose among energy sources should consider the national interest as they make their choice. Each decision against coal increases petroleum or gas consumption, compromising our national self-sufficiency and raising the cost of meeting our energy needs."
>
> *President Richard Nixon, April 18, 1973, Oval Office, American Presidency Project*

These proposals became "Project Independence" and included more specific measures such as prohibiting coal-fired electric utilities from switching to oil, stopping ongoing construction of oil-fired electric power plants, expediting nuclear power plants and permits and plants and increasing drilling on federal lands (Grossman, 2013).

This was the first time the federal government set coordinated policies geared towards energy independence. The next president Gerald Ford continued the Nixon strategy. There was a slight shift in emphasis during the Jimmy Carter administration, who also promoted domestic oil and gas production, but was more focused on energy conservation and renewable energy. An excerpt of Jimmy Carter's National Energy Program Speech is provided, because it underlines his main principles:

> "We must reduce our vulnerability to potentially devastating embargoes. We can protect ourselves from uncertain supplies by reducing our demand for oil, making the most of our abundant resources such as coal, and developing a strategic petroleum reserve. We must be fair. Our solutions must ask equal sacrifices from every region, every class of people, every interest group. Industry will have to do its part to conserve, just as consumers will. The energy producers deserve fair treatment, but we will not let the energy companies profiteer. The cornerstone of our policy is to reduce demand through conservation. Our emphasis on conservation is a clear difference between this plan and others which merely encouraged crash production efforts. Conservation is the quickest, cheapest, most practical source of energy. Prices should generally reflect the true replacement cost of energy. We are only cheating ourselves if we make energy artificially cheap and use more than we can really afford."
>
> *President Jimmy Carter, April 20th, 1977, American Presidency Project*

Hence, the proposed National Energy Plan (NEP), promoted renewable energy. President Jimmy Carter went on to propose further energy efficiency and conservation measures, including the use of renewable energy resources which was seen as key to long term economic growth (UC Santa Barbara, 1999). In a visual bid to promote clean energy the White House installed solar panels on its roof.

Figure 3-1: President Jimmy Carter promoting domestic clean energy in 1977
Source: NBC News, 2010

As a result, electric utilities rapidly started switching generation plants, back to nuclear and coal electricity generation. Hence, coal, which had suffered a severe decline in the 1950s, became more important for electricity generation. The energy crisis also triggered more energy conservation amongst consumers and utilities due to cost concerns with electricity (Edison Electric Institute, 2012a).

The signature legislature to come out of Jimmy Carter administration during the energy security era and a significant intervention in electricity generation and supply by the Federal Government would be the passing of the Public Utility Regulatory Policies Act (PURPA) of 1978 and this is considered below. However, another significant policy intervention by the Federal Government included pursuing a natural gas strategy and repealing the Power Plant and Industrial Fuel Use Act (FUA) 1986, which also had a direct impact on electricity generation and supply decisions. These laws and strategies were significant because before 1973, federal energy policy had been largely uncoordinated but intended to support consumption (Joskow, 1997). Joskow suggests:

> "Prior to the first oil shock in 1973-74, federal energy policy consisted primarily of uncoordinated industry specific support policies: various tax subsidies for oil and natural gas production, the leasing of federal lands for oil and natural gas exploration and production, quotas on imported oil to protect domestic suppliers from cheap imports, substantial research and development expenditures devoted to promoting the production of electricity using nuclear power--- a legacy of the development of nuclear weapons during WW II---, the regulation of the prices charged for transportation by interstate natural gas pipelines and, beginning in the early 1960s, a complex system of price controls on natural gas sold in

> interstate commerce. The states were primarily responsible for regulating prices for electricity and the local distribution of natural gas since these services were provided by state-franchised monopolies. State agencies in Texas, Louisiana and a few other states also played an important role in regulating supplies of oil and natural gas" (p. 8).

This is arguably the first time which the US federal government made a concerted effort towards creating a comprehensive energy policy. Additionally, this is first time aside from PUHCA in 1935 that the federal government played a significant role in altering electricity generation and supply decisions made by state regulators and utilities. The full implications of this extended role for federal government would be felt in subsequent eras i.e. the restructuring era and low carbon and fracking era.

— Public Utility Regulatory Policy Act of 1978 (PURPA)

The promotion of energy independence continued into the Gerald Ford era and subsequent administrations (1974 - 1977). The U.S. federal government again intervened in the 1978 energy crisis, during the Jimmy Carter administration and influenced state electricity generation and supply by enacting five laws with the purpose of solving the energy crisis. Two laws especially influential on electricity generation and supply were the Public Utility Regulatory Policy Act (PURPA) (amended in 2005) and the Power Plant and Industrial Fuel Use Act (FUA) (repealed in 1987). The Federal Energy Regulatory Commission (FERC) was the federal agency created to implement PURPA with the state public service commissions.

In regulated markets, state public service commissions would govern the process of determining the avoided costs, Integrated Resource Planning (IRP) and requirements for Qualifying Facilities. PURPA was designed to open-up electricity generation to external power producers, in order to encourage the development of renewable energy, where before the passage of PURPA, electricity generation and supply was exclusively provided by the electric utilities. New decentralised power producers targeted by the legislation included cogeneration and renewable energy plants. Grossman (2013) explains:

> "Probably the most consequential act was PURPA, which gave independent power providers the ability to enter the market dominated by franchised monopoly electric power companies. Whereas previously independent generators could not sell power to the grid, PURPA *required* utilities to buy power from independent producers who could generate electricity for less than what it would have cost for the utility to generate the power itself, called the "avoided cost". (p. 342).

In a time of crisis, the U.S. federal government needed to encourage electric utilities to develop other sources of energy, as opposed to gas, oil and coal which had been the focus for a long time. As Joskow notes:

> "PURPA required states to determine whether they should and would introduce new pricing mechanisms to encourage energy conservation and obligated electric utilities to purchase power from cogeneration plants and small power production facilities using renewable and waste fuels." (p. 9).

The enactment of PURPA is credited for developing significant generation of renewable energy and changing many state profiles for electricity generation and supply (Union of Concerned Scientists, 2016). It was enacted in a time of crisis when oil prices were at a historic high and predicted to increase. Some state governments saw this as an economically viable option to reduce electricity generation prices. These same states would later restructure their electricity markets. Joskow (2001) describes PURPA's effect as follows:

> "Several states, including California, New York, all of the New England states, New Jersey and Pennsylvania embraced PURPA with great enthusiasm. In addition to requiring utilities to pay high prices for QF power under 20 to 30 year contracts, the implementation of PURPA was also accompanied by the creation of public "integrated resource planning" (IRP) or "least cost planning" (LCP) processes to determine "appropriate" electric utility investment and contracting strategies which were eventually implemented with competitive bidding programs." (p.12).

State Public Service Commissions that embraced PURPA set rates at the highest levels ensuring and encouraging that renewable energy and cogeneration would be developed (Thomas & Ayres, 2007). As Joskow (2001) notes:

> "The costs of these subsidies, in turn, were funded through higher regulated electricity prices. These states (California, New York, Massachusetts, Maine, Washington and a few others) led the development of an increasingly close linkage between energy policy and environmental policy. Many of these states were also the pioneers in electricity sector restructuring and competition in the mid-1990s, stimulated in part by the high costs and high electricity prices resulting from the PURPA initiatives of the 1980s." (p. 12).

In contrast to the states that embraced PURPA, some public service commissions were not receptive to PURPA and worked hard to weaken the law (Thomas & Ayres, 2007).

According to Sovacool and Brown (2007):

> "In other cases, commissions asked the regulated utilities to specify what plant they would build as the next electric generating unit, and then used the economics of that plant as a bogey for avoided costs. Some states did nothing. In the 28 years since PURPA enactment, we are unaware of any contract ever issued to a QF in Louisiana, South Carolina, South Dakota and Kentucky." (p. 154).

Aside from regulators trying to weaken the law, many utility executives were not overtly happy about PURPA, because they could lose out financially in a more competitive environment; additionally, they had genuine concerns about the role of independent power producers on the overall system. Richard Hirsh in the conclusion of his 1989 work writes about PURPA:

> "The resistance reflects some very reasonable concerns. For example, if too many industrial firms produce power for themselves, utilities would be left serving the remaining residential and commercial customers and that are more expensive to serve. In other words, the utilities would be losing some of the diversity that previously held down overall costs. Utility managers also feel that unregulated PURPA producers could decide to withdraw from the electricity producing business, thus leaving utilities "holding the bag" and jeopardizing system reliability. Finally, PURPA requires utilities to purchase electricity from independent producers even when regulated firms have sufficient capacity to meet demand or when they can provide electricity at lower costs. In both cases, consumers could suffer by paying more for electricity than if the utility provided it alone." (p. 169 – 170).

Additionally, Hirsh (1989), draws on some concerns with the way the electric utilities struggled to adapt due to PURPA and indeed the entire energy security era and as will be seen later in the restructuring and low carbon eras, this issue of changing the business model to adapt to changing circumstances will be brought up again and again:

> "These valid concerns notwithstanding, perhaps the greatest reason for resistance stems from utility managers' desire to retain control of an industry that they feel has served its stakeholders well. To be sure, the industry has faced some problems in recent years, but over the long run, haven't managers consistently provided a necessary commodity at reasonable prices? Most utility executives would answer "yes" and they generally do now want the industry structure to be altered. Rather they would prefer to see the industry retrogress – returning to the "good old days" when financing and construction of large base-load (preferable nuclear) power plants could be accomplished easily without outside interference. Unfortunately for many managers who think like this, public pressure and new laws such as PURPA make a return to 1965 impossible, with the result that utility managers are indeed losing control of their industry. Meanwhile, a long history of relative stability and

sameness has blinded many managers to the fact that in a changing world of technology and business, the structure of industries sometimes does change. This is exactly what is occurring in the electric utility industry, and like similar change that occurred in the deregulated long-distance telecommunications industry, managers must realise that they need to change as well" (p. 169 – 170).

Overall, PURPA succeeded in introducing independent power producers, increasing the development of renewable energy, and leading to development in natural gas due to the reduced cost in electricity generation and supply. The full effects of PURPA contracts were not experienced in the energy security era, but rather in the late 1980s to 1990s, during the restructuring era. In fact, expensive PURPA contracts would be a fundamental driver in the pressure to restructure the electric industry. Nevertheless, the enactment of PURPA has been useful for the federal government in influencing state electricity generation and supply and during a time of crisis.

— Repeal of the Power Plant and Industrial Fuel Use Act (FUA) 1986

Although the Power Plant and Industrial Fuel Use Act (FUA) was repealed in 1986, it was still a package of the energy security era interventions made by the Jimmy Carter administration and so has been included here. The repeal of the Power Plant and Industrial Fuel Use Act (FUA) in 1987 was influential because the act had limited the use of natural gas in electricity generation and supply, during the 1978 energy crisis. Grossman (2013) notes:

> "The Power plant and Industrial Fuel Use Act of 1978 had a very clear goal: to end the use of oil and natural gas in electric power generation. Over the next decade, most new power plants burned coal, and oil was largely phased out as a generating fuel. The bill was premised on the belief that natural gas would become increasingly scarce and expensive. When this premise was disproven – gas was far more plentiful than forecast – the bill was repealed. But the Power Plant Act has been the exception." (p. 556).

Joskow (2001) adds:

> The Fuel Use Act prohibited the use of natural gas and oil, whose prices were kept below market clearing levels by federal price controls, in new power plants and phased out natural gas use in existing power plants by 1990. These regulations reflected an effort to alleviate natural gas shortages and reduce the demand for oil burned "inefficiently" to generate electricity. These regulations pushed utilities to increase their use of coal to generate electricity (p. 9).

This repeal of FUA was brought by energy-state lawmakers, who felt that electric utilities should be able to use the fuels with least cost to serve their constituents. They had fought against the law in 1987 but lost. Coal-state lawmakers, on the contrary, wanted the law to stay in place (Journal of Commerce, 1987). Nevertheless, the repeal passed and new power plant designs did not have to include coal burning capability, increasing the usage of natural gas in electricity generation significantly. According to the U.S. Energy Information Administration, natural gas use in electricity generation increased by about 119% from 1988 to 2002 (U.S. Energy Information Administration, 2002b).

— Support for natural gas in the 1970s

One of the features of the energy security era was the increased pursuit of natural gas production in U.S. territories. Coordinated gas development in the U.S. began in the late 1970s, spurred by the energy crisis between 1973 and 1976 (Z. Wang & Krupnick, 2013a). From the late 1970s, the federal government focused on gas production by creating unconventional gas research programs in partnership with the private sector. The Department of Energy and the Gas Research Institute, in combination with private firms, organised demonstration projects, tests and information sharing in an effort to bring unconventional fuels to commercial quantities. The Federal government also created and designed a broad package of financial incentives to encourage domestic energy production. The Production Tax Credit (PTC) given by the federal government was an incentive needed by private companies from the 1980s to 2002 because, during the late 1970s to 1980s, most private U.S. gas firms did not have the capacity in size or finance to undertake the necessary research and development (Trembath, Jenkins, Nordhaus, & Shellenberger, 2012).

However, it was Mitchell Energy, a private company, in the late 1970s, which had the financial backing to explore the potential of shale gas extraction. Throughout the 1980s and 1990s the company persisted in shale exploration in Barnett in Northeast Texas. The company needed the gas supply because it had a long term contract to supply gas to the Natural Gas Pipeline Company of America (NGPL), so the firm also invested heavily in the natural gas shale formations in north Central Texas within the Fort Worth Basin (Oil & Gas Journal, 2016), commonly known as the *Barnett Play* from the 1980s to the mid-1990s (King, Nordhaus, & Shellenberger, 2015).

Throughout the 1980s and 1990s, there were technical innovations marked by successful horizontal drilling projects in 1986 in West Virginia and in Texas Shale in 1991. By 1995, Mitchell Energy had drilled 264 wells (Z. Wang & Krupnick, 2013b). By 1998, Mitchell Energy was viably able to extract commercial and profitable quantities of shale gas in Texas. Since 1998 improvements in the process of horizontal drilling and hydraulic fracturing (known as *fracking*) has opened up abundant reserves of gas. Figure 3-2 shows the current shale gas distribution in the United States compared to what was commercially available in 1998.

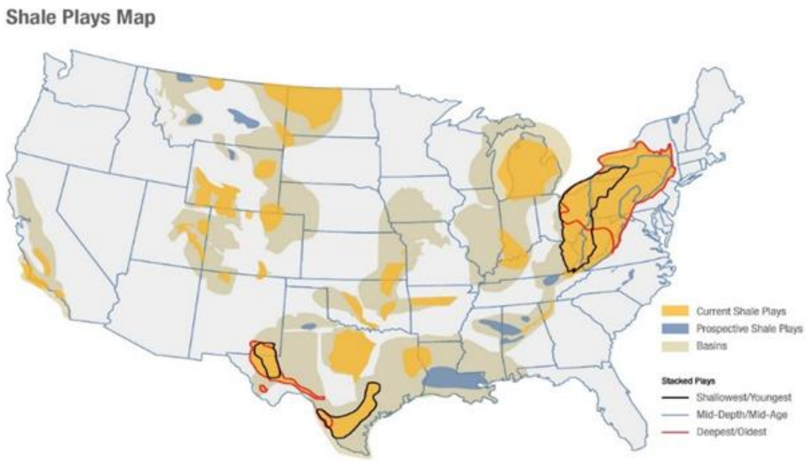


Figure 3-2: Shows the Current Shale Map within the United States
Source: American Petroleum Institute based on EIA Data

The U.S. Energy Information also predicts an increased production of alternative forms of Natural gas up to 2035, as shown in figure 3-3.

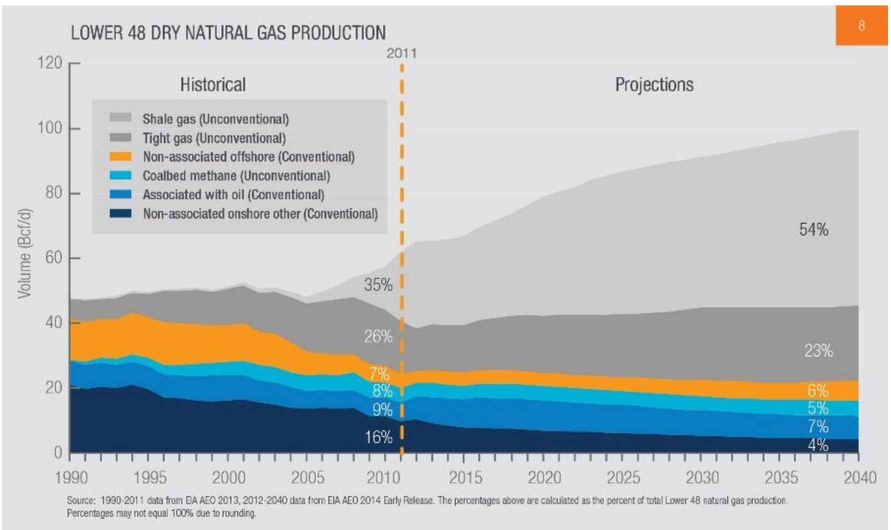


Figure 3-3: Shows the projected use of Natural Gas production in the United States
Source: American Petroleum Institute, based on EIA Data, September 2014

As will be seen in the subsequent restructuring and low carbon and fracking eras, the development of unconventional gas came to fruition in the late 1990s. Shale gas alone is calculated to have contributed to domestic gas supply from 1990 to 2010 to be about nearly 0% to 20% (Jacoby, O'Sullivan, & Paltsev, 2012). In electricity generation and supply, it gradually started replacing coal in the overall electricity generation mix from the late 1990s (*Figure 3-4*).

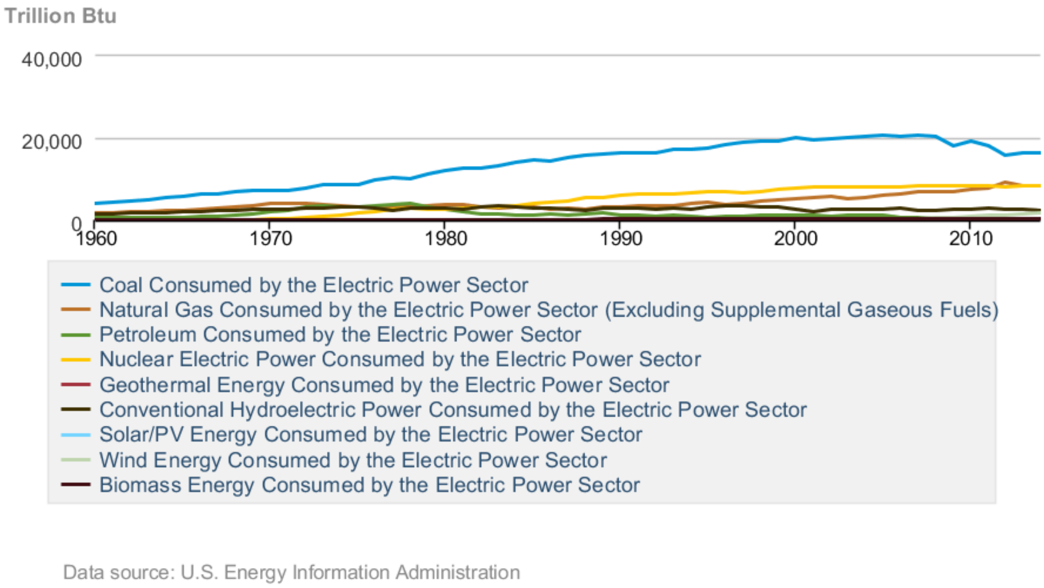


Figure 3-4: Electric Power Sector Energy Consumption
Source: U.S. Energy Information Administration

The energy security era ended with state legislators and regulatory commissions seeking ways to alleviate the costs of the energy crisis on their utilities and consumers. Despite the federal and state government' intervention, ongoing issues with high rates for consumers meant that by the late 1980s the federal government and certain state regulators, especially in states with the highest electricity costs, felt the need to restructure their electricity sectors, or at the very least look for ways to introduce competition and to allow customers to choose their electricity providers (M. Brown & Sedano, 2004; Joskow, 1997; Morgan et al., 2005; Warwick, 2002) and there was intense political pressure for restructuring. Additionally, the pressure for restructuring was in many of the states which had embraced PURPA during the energy crisis combined with the ongoing nuclear energy cost overruns or overcapacity at some point during or before the crisis, environmental (Northeast and California) had higher electricity retail rates compared to their counterparts across the country and these disparities strengthened the demand for restructuring.

f. The Restructuring era: 1984 – 2000

The restructuring era began with pressure from large industrial customers as well as independent power producers and energy marketers (Joskow, 1997; White, Joskow, & Hausman, 1996) for industry restructuring. The pressure for restructuring was based on decisions made by many state regulators and utilities during the energy crisis in the early 1970s, including the expensive PURPA contracts in the Northeast and California due to nuclear energy construction cost overruns and contracts, the rate increases needed to make up for the drop in demand and excess capacity that some utilities had incurred (M. Brown & Sedano, 2004; Regulatory Assistance Project, 2011a; Warwick, 2002). Underscoring the problem is Chao and Huntington (1998):

> "Once regulators approve the construction costs of a generating plant or the terms of an energy supply contract, these costs (amortized in the case of capital investments) continue to be included in regulated prices over the life of the investment or contract, independent of whether the market values of these commitments rise or fall over time as energy prices, technology, and supply and demand conditions change." (p. 17).

As shown by the quote above, the restructuring era highlights the issue that investment in electricity infrastructure involves long term decisions in a changing external context.

For example, PURPA was credited during the energy security era by environmental activists, independent power producers (IPP), and consumers for encouraging cogeneration, renewable energy and cost effective electricity production in California and the Northeast (Joskow, 2001b; Union of Concerned Scientists, 2016). Yet the duration and locked-in price of those contracts, became a problem in the restructuring era for California and the North-eastern states. Because the forecasts which underpinned the decisions of the regulators and utilities in those states did not occur, Borenstein & Bushnell (2000) summarise this as an impetus for restructuring:

> "The result was that many utilities signed long-term purchase contracts at very high prices. Those prices looked especially bad as the cost of natural gas fell in real terms through the 1980s and 1990s, making most other generation sources much less economic. Over about the same period of time, accidents, unforeseen construction costs, increased safety

regulation, and higher than-anticipated upkeep and waste disposal costs changed nuclear power from the cheap, clean power source advocates had promised to expensive white elephants. Under the regulatory agreement between states and the utilities, consumers still had to pay for the plants despite the fact that they turned out to be unwise choices. Uneconomic PURPA contracts and nuclear power investments were the primary reasons that some states found themselves in the 1990s with electricity prices that were well above the going-forward cost of building and operating new gas- or coal-fired power plants." (p. 2 – 3).

This was not just an issue for California:

> "Other states — those that had not pursued nuclear power and had been more cautious in signing long-term contracts under PURPA — retained relatively low prices. That contrast was probably the driving force behind the restructuring movement in the United States." (p. 3).

The result of this problem were wide disparities between electricity retail rates across the country by the early 90s to the late 90s (see Figure 3-5). Joskow (1997) explains:

> "In the Northeast and California, the average price of electricity is around 10 cents/kWh, while in Indiana it is about 5.5 cents/kWh and in Oregon less than 5.0 cents/Kwh. Some of this variation in prices can be explained by regional differences in fuel costs, the mix of customers, average utilization rates and load factors, and differences in population density and construction costs. However, a large fraction of the variation in prices reflects differences in the sunk costs of generation investments and long term purchase power contracts made during the 1970s and 1980s. As already noted, regulated retail prices reflect the amortization of the sunk costs associated with past regulator-approved investments in generating plants (for example, nuclear power plants) and prices paid for energy under long-term purchase contracts mandated by PURPA signed many years ago, when expectations about fossil fuel prices and demand growth were very different from what eventually transpired." (p. 8).

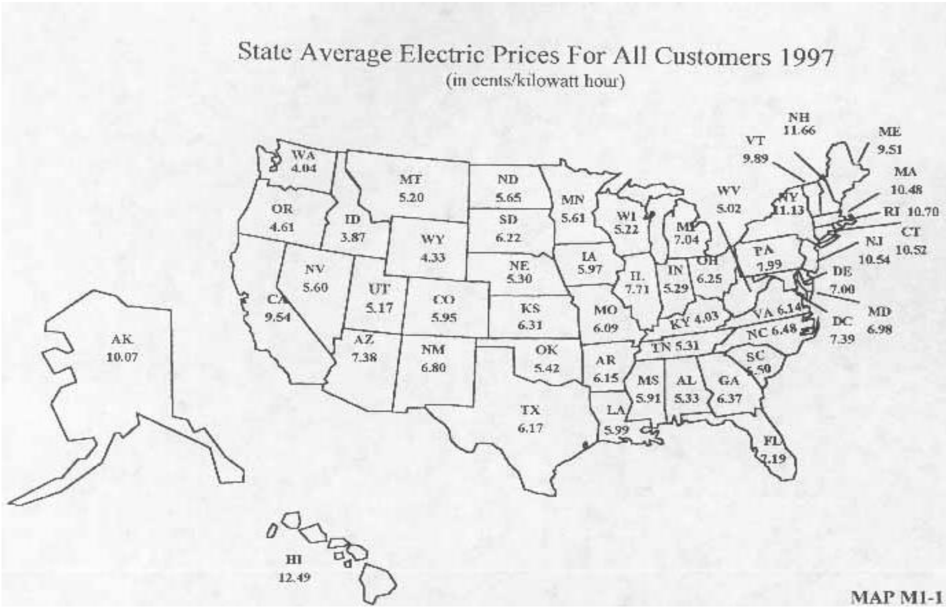


Figure 3-5: Shows the Average Retail Electricity Prices by State, 1997
Source: U.S. Energy Information Administration, 1997

The differences in generation were also significant, for example in electricity generation, Joskow (1997) explains:

> "Thus, in much of the northeast and California, the average cost of generation services reflected in regulated retail prices is in the 6–7 cent/kWh range, reflecting historical investments in nuclear power plants and high-priced PURPA contracts that regulators required utilities to sign. In Indiana and Oregon, the average cost of generation services reflected in retail prices is 2–3 cents/kWh, reflecting low-cost coal-fired and hydroelectric generation resources, limited commitments to nuclear power and state regulatory policies that did not require utilities to sign expensive long-term PURPA power supply contracts." (p. 126).

Another reason for popularity of electric restructuring according to Neufeld (2011) was that other industries including, airlines and telecommunications had already tried to restructure:

> "The idea that electricity could be produced competitively was encouraged by two other concurrent developments. First, all types of regulation, but especially the type of regulation used for electric utilities, in which regulators set prices and controlled entry, were under attack. Such regulation had recently been eliminated for both the airline and trucking industries, some regulations had been removed from the natural gas industry, and significant restructuring allowing competition was occurring in the telephone industry. Second, the disastrous experience with the huge waste of capital that had occurred in the electric power industry made competitive markets seem especially attractive: the risk associated with investment decisions would be borne by the companies making the decisions rather than passed along to consumers." (p. 737).

Therefore, by April 1998 many states aside from/other than California and the Northeast, had initiated studies to explore deregulation (shown in figure 3-6). This would involve studying the separation or unbundling of the generation of electricity from its transmission and distribution and the costs including stranded costs.

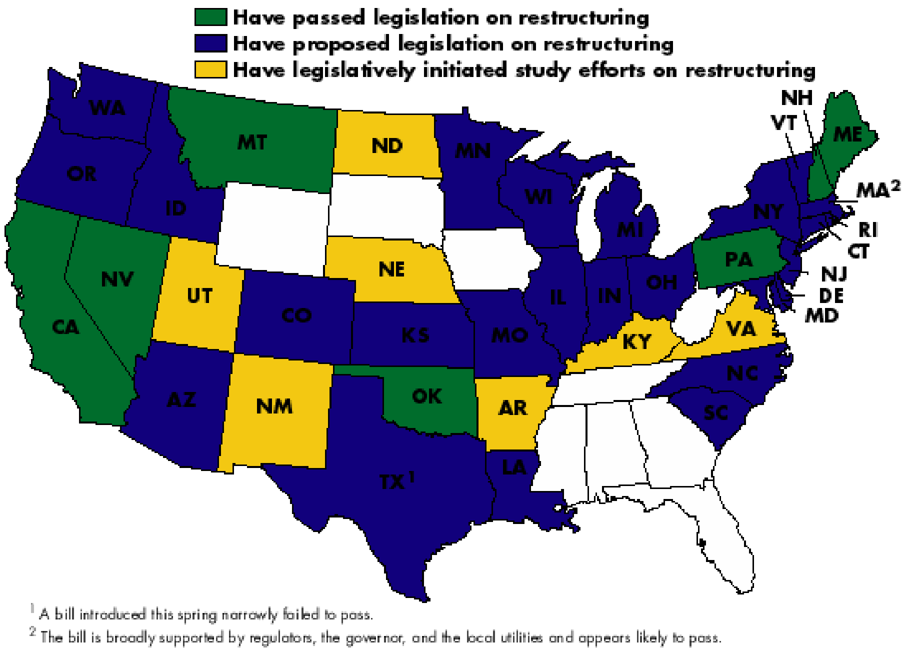


Figure 3-6: Shows the 1997 status on Utility Restructuring across States
Source: Energy Information Administration, 1997

The average retail price of electricity in 1998 is shown in figure 3-7.

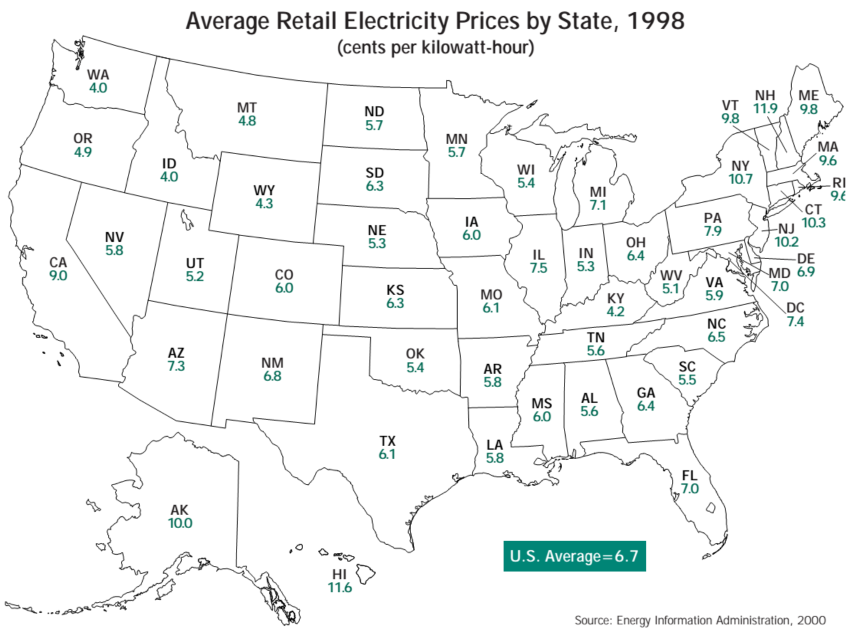


Figure 3-7: Shows the Average Retail Electricity Prices by State, 1998
Source: Energy Information Administration, 1998

As stated earlier, whilst most states proposed the opening up of electricity generation and supply and had initiated feasibility studies, the events from the 1970s and early 1980s meant that the prevailing business and regulatory model was exposed to rapid cost increases and reduced electricity demand (Joskow, Bohi, & Gollop, 1989).

Concerns about dealing with stranded costs of utilities and how best to restructure electricity in states with already low cost emerged as fundamental to the topic of restructuring during this period. On the issue of utility costs, Neufeld (2011) explains that the focus on stranded costs and who would bear the burden of increased prices nearly derailed the overall goal of restructuring electricity:

> "Switching generation providers seemed to offer huge savings to electricity users, but those savings exceeded the economic benefits of competitive generation because regulated utility rates had become much greater than marginal costs. The question was who would bear those costs in a regime where customers could abandon the utilities that had incurred them? Perhaps those costs would be borne by the utilities, their shareholders and bondholders. Perhaps they would be borne by those customers who would not or could not change their suppliers, a solution that would have required those electricity users to bear even larger rate increases." (Neufeld, 2011, p. 739).

Additionally:

> "The question of who would bear stranded costs absorbed significant time and resources in all considerations of industry restructuring to the possible detriment of the institution-creation activities that should have been the primary goal." (Neufeld, 2011, p. 739).

Nevertheless, the investor-owned utility industry representative group, the Edison Electric Institute, explains that for the states which decided to restructure, stranded costs were eventually addressed:

> "The design of the retail choice programs varied considerably across the states, but in virtually all of them the issue of stranded costs was addressed. Stranded costs generally referred to the portion of the original fixed generation costs incurred to meet the obligation to serve retail customers while there was still a retail monopoly that would be lost if the utility was immediately forced to sell at the market price. In addition, restructuring involved a so-called transition period to allow a gradual movement to retail competition. This was designed to serve two purposes. First, the incumbent utility would be given some time to undertake the necessary business transformation. Second, mass-market customers would continue to be served by the utility, providing stranded cost recovery for the utility and a safety net service for customers until retail markets had evolved sufficiently to serve the

> mass markets. In some cases, this period lasted as much as a decade and in others just a few years.” (Edison Electric Institute, 2012, p. 33).

States that benefited from low cost electricity were hesitant to implement any serious reform due to the fear of losing their competitive advantage in energy prices:

> “In low cost-states, the fear that low-cost generation might benefit other regions while increasing in-state average costs made regulators reluctant to support any changes. However, the availability of profitable export markets for power in some cases encouraged legislative and regulatory decisions to consider competition. Although “domestic” consumers might potentially stand to lose if their own rates rose if their utility sold power to neighbouring high-price states, excessive capacity reduced that potential impact relative to the gains in trade, which could be shared with home state consumers. This explains early consideration and decisions to adopt retail competition by state legislatures in low-cost states such as Montana and Oklahoma. On the other hand, some states acted to protect their monopoly utilities from competition. In Florida, the state supreme court interpreted a state power plant siting statute to limit plant siting to Florida utilities or suppliers who have contracts with Florida residents. The result was to close Florida’s wholesale power market to merchant power plants. Taking their cue from Florida’s success in blocking the development of wholesale power supply, other state and local governments, particularly in the South, imposed moratoria on merchant power plants.” (Isser, 2015, p. 203- 204).

Ultimately, debates about stranded costs, cost savings and low cost electricity would recede temporarily as most of the restructuring plans across the country were suspended or abandoned completely, due to the defining event of the era, the *California electricity crisis* from 2000 to 2001 (Borenstein & Bushnell, 2015; Joskow, 2001a; U.S. Energy Information Administration, 2000). The Californian energy crisis began in September 2000 and lasted for about a year (U.S. Congressional Budget Office, 2001). Electricity demand was greater than electricity generation capacity, leading to a shortage in electricity supply (U.S. Congressional Budget Office, 2001) which spiralled out of control and led to record level wholesale electricity prices (Joskow, 2001a). The record wholesale electricity prices were followed by severe financial losses by the states’ three investor-owned utilities since they could not cover losses. The inability to reduce wholesale electricity prices and cover these severe financial losses had been due to a combination of rigid policies related to the restructuring law (Bushnell, 2004; Joskow, 2001a; Sweeney, 2002). One of which was the freezing of electricity retail rates of the three IOUs (U.S. Energy Information Administration, 1998).

A casualty of the financial issue, was the largest investor-owned utility in the state, Pacific Gas & Electric (PG&E), filing for bankruptcy due to a $9 billion debt by April 2001 (Bushnell, 2004; Holson, 2001; Joskow, 2001a; Public Broadcasting Service, 2001). Another major utility Southern California Edison owed an estimated $596 million to its creditors and was unable to repay (Public Broadcasting Service, 2001). Ultimately, the combination of interdependent factors and decisions soon translated to the electricity grid in California experienced periodic blackouts.

> "Some observers began to question whether the old regime (power monopolies overseen by state regulators) did a better job of meeting the demand for electricity than the new ideal (many independent producers interacting with consumers in a deregulated market). Observers pointed out that the parts of the California market outside the restructuring plan (mainly in the Los Angeles and Sacramento areas) faced fewer problems than the rest of California, as did the other western states. By mid-2001—in the wake of one bankrupt utility, even higher wholesale prices, and rolling black-outs — skeptics blamed deregulation for putting California in a perilous position" (Congressional Budget Office, 2001, p. 12).

All of which culminated in intervention by the state and federal governments and eventually, at the end of the crisis, the California Public Utilities Commission took the decision on the September 20th, 2001 to suspend direct retail access to energy service providers (U.S. Energy Information Administration, 2001, 2010).

Accounts of the crisis also discuss the loss of excess generating capacity over time, the pending status of new investments, the underwhelming number of consumers who switched suppliers, the financial crisis the utilities came under and the refusal of independent wholesale generators to sell electricity to the IOUs until finances were in order which included federal and state emergency orders. All these issues can be used as evidence to show how the state's restructuring efforts and rigid and flawed market came to be blamed for the crisis (Bushnell, 2004; Joskow, 2001a; Sweeney, 2002, 2006; U.S. Congressional Budget Office, 2001; U.S. Energy Information Administration, 1998).

By 2010, the status of various state efforts at opening up electricity generation and retail to competition showed no new development, as shown in figure 3-8.

Figure 3-8: shows the status of United States Electricity by State in 2010
Source: Energy Information Administration

The full status of the United States energy regulation is shown in figure 3-9 and highlights a complicated energy generation and supply structure.

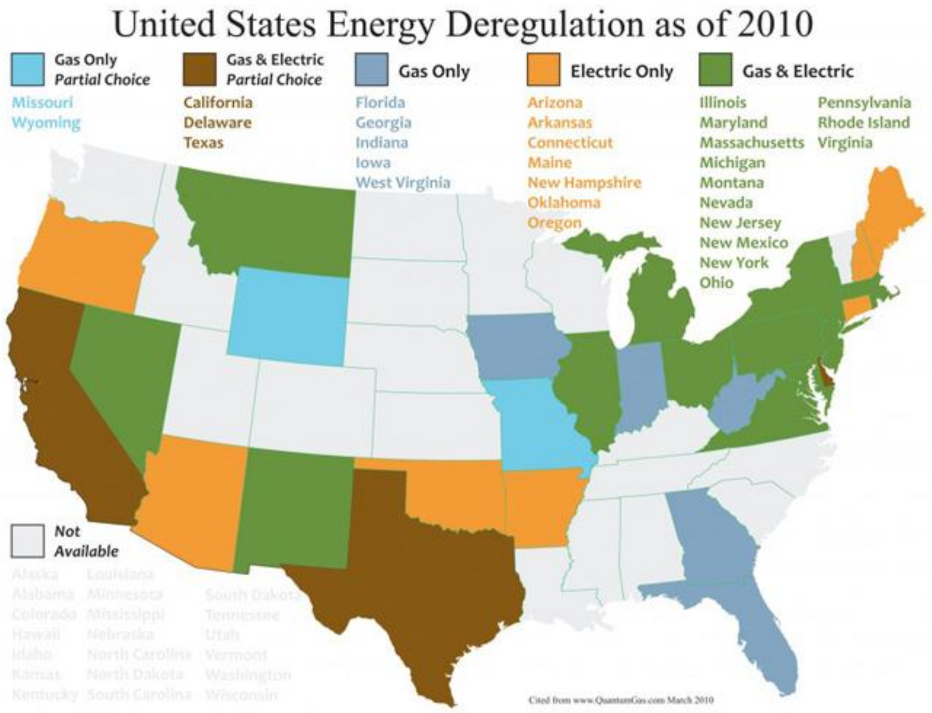


Figure 3-9: United States Energy Deregulation in 2010
Source: Energy Information Administration, 2010

The other significant events of the restructuring era were the introduction of the *Integrated Resource Planning* (IRP) process also known as *least cost planning* across the country in the 1990s and the passing of the Energy Policy Act of 1992 (EPACT). Originating from the states with the most expensive electricity, the *Integrated Resource Planning* (IRP) process spread rapidly across the country. Many state legislatures required their state regulators to take a more central role in the planning, investment and policy of their electricity infrastructure (M. Brown & Sedano, 2004; Joskow, 2001b; Regulatory Assistance Project, 2011a; Warwick, 2002), to strike a balance between utility and customer needs as opposed to a previous system of simply approving or dismissing plans submitted by utilities. Joskow (2001) and Warwick (2002) both argue that this process became very popular amongst state regulatory commissions.

Joskow (2001) states:

> "By 1990, least cost planning was the all the rage among state regulatory commissions and was spreading quickly from its origins in California, the Northeast and the Northwest. And it is these policies that are heavily reflected in the Energy Policy Act of 1992." (p. 35).

Warwick (2002) states:

> "IRP was successful in holding rate increases in check and stimulating consumer choice, but the process was highly adversarial, time consuming, and expensive. Regardless, rates were still high and significant differences among adjacent electric utilities and between gas and electric utilities caused political problems. Economic development efforts were stymied where electric rates were high, resulting in firms expanding in low-cost states. (p. 58).

The Energy Policy Act of 1992 (EPACT) established on October 24th, 1992 and signed by President George Bush, promoted restructuring and competition by creating another set of independent power producers, referred to as *Exempt Wholesale Generators* (EWGs), who would be independent non-utility power producers with open access to transmission (Federal Energy Regulatory Commission, 2010; U.S.C., 1992). The open access to transmission was enforced by the Federal Energy Regulatory Commission (FERC) Order 888, under the authorisation of the United States federal government. FERC Order 888 took effect on April 24th, 1996 and the order required all electric utilities involved in interstate electricity generation and transmission to provide transparent and non-discriminatory access to electric tariffs, to seek stranded costs recovery and unbundle wholesale electricity generation and supply (Federal Energy Regulatory Commission, 2010).

All of these measures combined were ways of assisting state efforts to restructure the electricity generation and supply system but the California electricity crisis derailed many states (Figure 3-10). This meant that since March 2010, after California suspended its efforts at restructuring (U.S. Energy Information Administration, 2010), the energy governing modes across the United States have remained unchanged. Some states fully restructured, others partially-restructured or none at all. Since restructuring, electricity rates, resources for electricity generation and laws have differed across the country. The series of maps below highlights the differences.

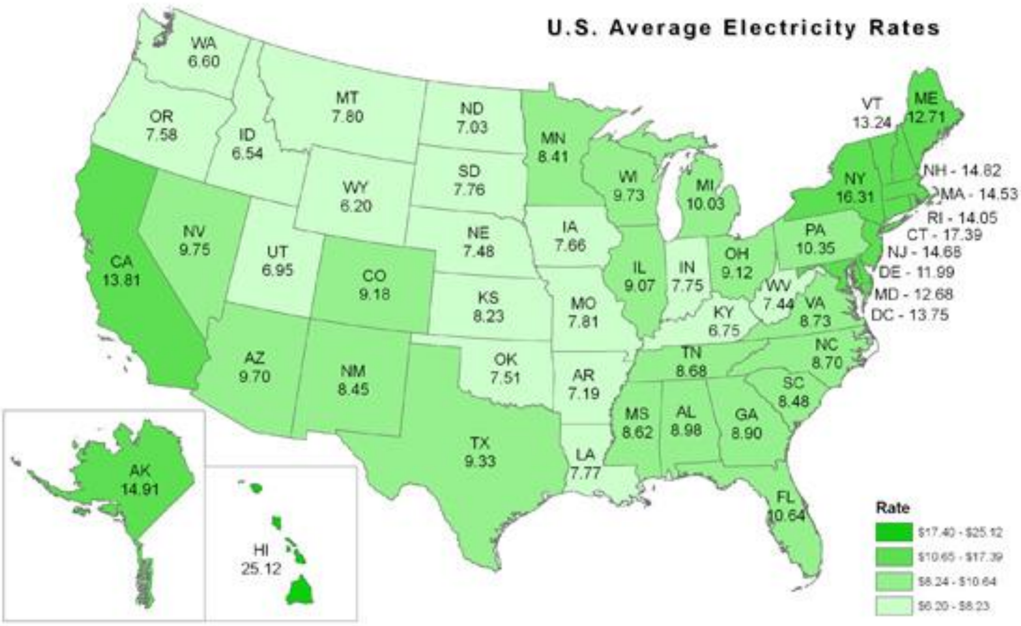


Figure 3-10: Average Residential Electricity Rates in 2010
Source: Energy Information Administration, 2010

By 2000, there was significant regional variation in the fuel mix of electricity generation across the United States due to a combination of natural resources, historical decisions, transportation costs, climate, regulation and structure of utilities. To summarise, historically the Pacific Northwest has been largely dependent on hydroelectric power because of the proximity to the Columbia River. The Southeast and Midwest have relied heavily on coal due to mining in the Appalachian region covering West Virginia, Kentucky, and up to Pennsylvania. Significant coal mining also exists in Wyoming and Montana (Edison Electric Institute, 2012b).

The Southeast and Midwest also rely heavily on nuclear energy, which could be significantly due to the existing large regulated electric utilities (Edison Electric Institute, 2012b; U.S. Nuclear Regulatory Commission, 2014b). The regulatory structures in these regions allow utilities to earn a guaranteed rate of return on the plant as well as to amortize the plants (World Nuclear Association, 2015). The south-central region has relied on significant natural gas reserves in Texas and Oklahoma. Finally, New England originally relied on coal and oil for electricity generation but now relies heavily on natural gas due to costs of transporting coal and the region's harsh winters. It is also increasingly importing electricity from neighbouring regions in Canada (U.S. Energy Information Administration, 2014b). The complete map of regional electricity variation is show in figure 3.11.

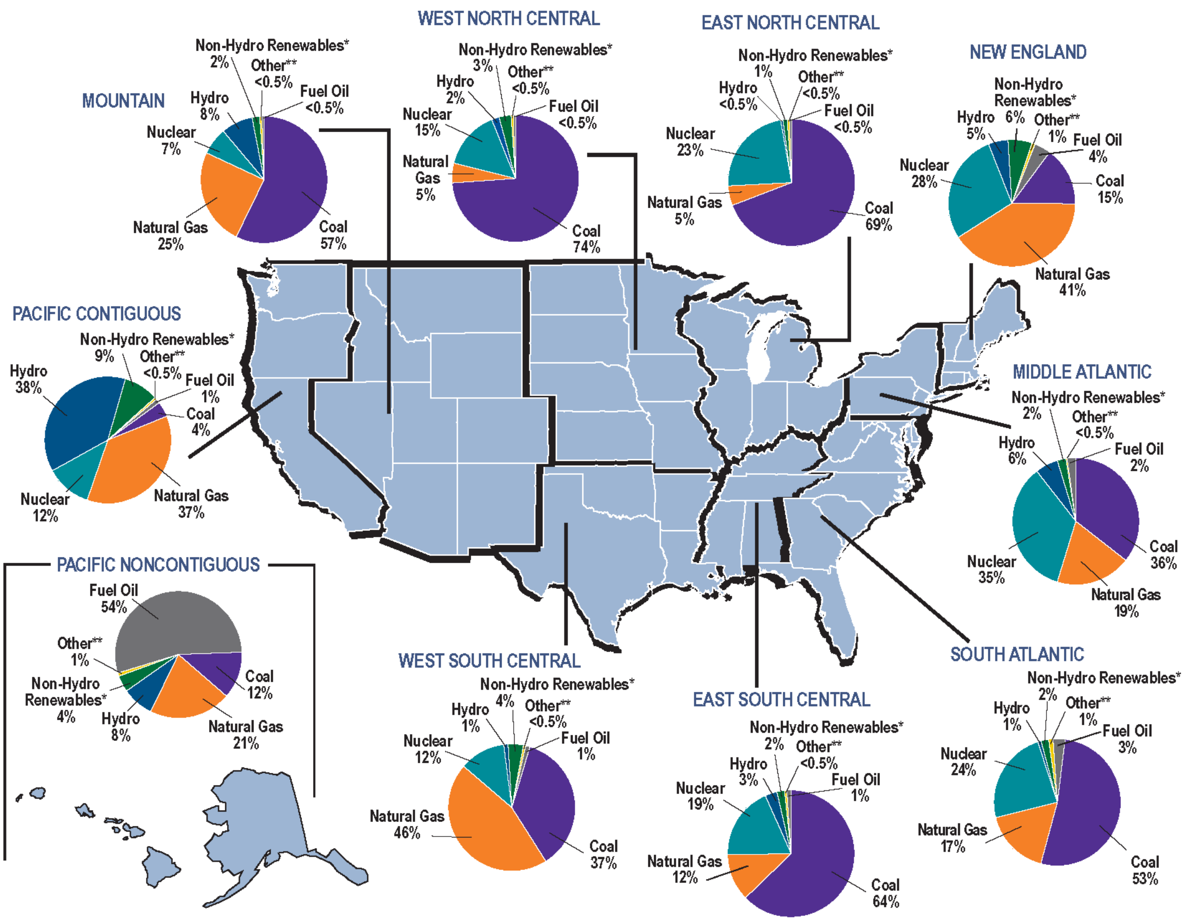


Figure 3-11: Regional Electricity Generation Variation
Source: Edison Electric Institute, 2014

g. The era of low carbon and fracking: 1994 to the present

The era of low carbon and hydraulic fracturing (fracking) began in the mid-1990s during the Kyoto negotiations, has spanned three presidential administrations including President Bill Clinton, President G.W. Bush, President Barack Obama, and is still emerging. From 1994, the era of low carbon and fracking has been marked by the following developments in electricity generation and supply:

- Contentious and politicised debates across the United States on climate change mitigation in electricity generation and supply by the federal government (Harris, 2009; Kraft, 2012).
- The use of hydraulic fracturing in increasing the supplies of natural gas and the opposition to hydraulic fracking from some cities and state governments (Baddour, 2015; Z. Wang & Krupnick, 2013a) combined with the onset of cheap natural gas displacing coal in electricity generation (Haddadian & Shahidehpour, 2015; Krupnick, Wang, & Wang, 2013).
- More states driven by climate change, energy security and competition are diversifying their electricity generation and supply, through renewable energy portfolios, natural gas and third party owned distributed energy providers (Byrne, Hughes, Rickerson, & Kurdgelashvili, 2007; Rabe, 2002, 2004b, 2006a, 2008; Rabe, Roman, & Dobelis, 2005).
- State undertaking low carbon energy, increased energy efficiency, renewable mandates and subsidies (Chandler, 2009; Rabe, 2006a).

This section begins with the ongoing contentious debates about climate change policies at the federal level. Followed by, the natural gas expansion and transformation of the electricity sector across the United States. Then, the drivers for ongoing state restructuring of electricity generation and supply are explored and finally, the chapter analyses the ways in which states are undertaking low carbon energy restructuring.

— Federal contention over climate change

From 1994, international negotiations geared towards a global response on climate change strengthened (United Nations Framework Convention on Climate Change, 1997a) the presiding Clinton administration belief that climate change was real (Harris, 2009), that the United States was one of the highest contributors of global CO_2 emissions (European Commission Joint Research Centre, 2016) and that the federal government should take action towards reducing U.S. CO_2 emissions (Harris, 2009; Joskow, 2001b). Indeed, Bill Clinton's Vice President, Albert Arnold Gore, Jr. had been an environmental advocate during his time in senate and considered climate change a major issue (Harris, 2009; Joskow, 2001b).

However, the Clinton administration was constrained by the Republican Party majority in Congress in 1994. Commonly referred to as the Republican Revolution (Clymer, 1994; History.com Staff, 2010), the Republican party gained control over both the United States House of Representatives and the United States Senate on November 8th, 1997 (Clymer, 1994). The Republican-dominated Congress proceeded to weaken many environmental departments through budgets cuts in research programs and subsequently climate change reduction efforts (Harris, 2009; Kraft, 2012). Multiple debates took place in Congress around what constituted "valid scientific views" (G. J. Brown, 1997), especially as climate change came under intense scrutiny and scepticism. The late Representative George Brown Jr., a Californian Democrat, expressed at the time:

> "In their call for regulatory reform, members stated that "sound" science would be a basic element of the process. Apparently, sound science dictated the need for repeals, rollbacks, and research budget cuts. The majority justified proposed cuts in the budget of the global climate change research program, for example, by arguing that the program was merely politicized science, the product of "the Vice President of the United States' zeal for this particular issue," a zeal equivalent to "environmental fanaticism" (Brown, 1997, p. 1).

On the nature of the hearings He adds:

> "Supposedly a contest between equally valid scientific views, the hearings were in reality nothing less than a scientific court. The subcommittee played the role of judge and sought to determine scientific truth by soliciting testimony and asking questions. In reality, by substituting its own judgment for that of the scientific community, the subcommittee achieved exactly what it purported to condemn-the politicization of science. In the end, the hearings produced no credible substantiation of any of the claims of scientific misconduct. Instead, they made it quite clear that the science related to these issues was being

> conducted in an objective and apolitical manner, consistent with the traditional norms of scientific integrity. It was never demonstrated that the alleged incidents leading, to the charges had any influence on the interpretation of science for policy" (Brown, 1997, p. 14).

On the politics of Congressional members conducting these investigations Brown adds:

> "The witnesses and subcommittee members making these allegations seemed to fundamentally mistrust not only government-funded science but the process of peer review as a means of ensuring scientific quality and integrity. Scientific truth, they seemed to believe, was more likely to be found at the fringe than at the centre. This belief represents not only a repudiation of the validity of the scientific process and peer review but a serious misunderstanding of the history of science" (Brown, 1997, p. 14).

However, the most significant action was under the 105th Congress; on July 25th 1997 the United States Senate voted on a resolution known as the Byrd-Hagel Resolution (Library of Congress, 1997) to oppose any greenhouse gas reduction agreement made by the Clinton administration under the United Nations Framework Convention on Climate Change (Harris, 2009; Kraft, 2012; Library of Congress, 1997). This was because even though the Clinton administration had expressed concerns about the binding emissions reductions targets at the time, especially those related to developing nations (Kraft, 2012; Woolley & Peters, 1997), it did negotiate actively and reach an agreement of an emissions reduction target of 7% below 1990 levels (Kraft, 2012; United Nations Framework Convention on Climate Change, 1997b).

Nevertheless, it was the *binding targets* and their effects on the United States economy that the United States Senate was particularly wary of, and this was reflected in the vote. The Byrd-Hagel Resolution passed by a vote of 95 – 0 (Library of Congress, 1997). The main arguments made during the Congressional debates on the Byrd-Hagel Resolution included the effects on the economy and the need to include developing nations in the U.N treaty:

> "This resolution rejects the United Nations' current negotiating strategy of binding United States and other developed nations to legally binding reductions without requiring any new or binding commitments from 130 developing nations, such as China, Mexico, and South Korea. In addition, this resolution rejects any treaty or other agreement that would cause serious economic harm to the United States" (p. 3, Congressional Record, Proceedings and debates of the 105th Congress, First Session, Friday, July 25, 1997).

> "What this means to everyday Americans is very clear. The AFL–CIO has estimated the treaty would mean the loss of 1.25 to 1.5 million jobs. Energy prices will rise dramatically. Individual Americans will pay for this treaty either in their electric bills, at the gas pump, or

by losing their jobs." (p. 4, Congressional Record, Proceedings and debates of the 105th Congress, First Session, Friday, July 25, 1997).

Some of the sponsors of the resolution also exemplified the problem:

"Some – like Senator Robert Byrd, who represented West Virginia, a major coal-producing region whose source of income would be hurt by a reduction in demand for greenhouse-gas –intensive fuels like coal, almost certainly intended the resolution to prevent U.S. action on climate altogether, rather than simply signal the necessity of involving developing states in emissions reductions. (The same may be true for Senator Chuck Hagel, from Nebraska, where industrial agriculture is heavily dependent on fossil fuel use.)" (Kraft, 2012, p. 217 - 218).

Ultimately, the Senate resolution meant that the Clinton Administration would not be able to ratify the agreement:

"President Bill Clinton signed the agreement on behalf of the United States (something George W. Bush tried – unsuccessfully – to undo once he took office), but he knew that efforts at ratification would be fruitless" (Kraft, 2012, p. 218).

Since 1997, international climate change mitigation strategies have been ongoing within most industrialised nations including within the European Union (United Nations Framework Convention on Climate Change, 1997c).

Nevertheless, the United States legislative and executive branch of the government continue to be politically polarised and contentious because of significant political, ideological, economic, governing and regional disparities around electricity generation and supply. The conflict is political in the sense that environmental and energy policy has become increasingly partisan, with both political parties significantly at odds on the subject of climate change (Fuller, 2014). Ideological differences remain on the role of the U.S. federal government in intervening in state electricity generation and supply through CO_2 reduction measures. Regulatory and natural resource differences across the states and regions have resulted in highly varied electricity generation profiles. All these issues have resulted in gridlock, with multiple attempts to pass laws explicitly relating to CO_2 reduction but never being successful. The gridlock at the federal government has been an ongoing issue for the U.S. since 2001. For example, whilst the Clinton administration had reservations about international climate change binding targets, the administration did create pro-environmental policies specifically promoting low carbon technologies and energy efficiency:

"The Department of Energy's policies were heavily influenced by the Administration's environmental policy agenda, including concerns about global climate change. The DOE gradually reallocated R&D funding and policy initiatives away from coal and nuclear R&D programs toward programs focused on promoting energy efficiency and renewable energy supplies, and the development of more efficient vehicles that use fuels other than petroleum. Federal expenditures supporting energy efficiency, renewables, and alternative fuel vehicles increased significantly while funding for coal and nuclear technology declined. After 1994, these initiatives were impeded by a Republican Congress that was hostile to the DOE in general and the Clinton administration's favourite energy programs in particular" (Joskow, 2001, p. 17 – 18).

The G. W. Bush administration was however very different in its dealing with climate change as a concern:

"Perceptions of US disinterest in international climate change mitigation efforts have been fuelled by several key Bush Administration policy decisions: (1) the Administration's refusal to support adoption of the Kyoto Protocol; (2) its prioritization in US energy policy of next-generation fossil fuel and nuclear energy technologies over renewables such as wind and solar; and (3) its efforts to cast doubt about the phenomenon due to scientific ''uncertainties,'' while also denying a scientific consensus exists about the need to reduce GHG emissions (Byrne, Hughes, Rickerson & Kurdgelashvili, 2007, p. 4556).

Additionally:

"Despite the Environmental Protection Agency declaring the dangers of global warming, he actively sought to prevent domestic regulation of carbon dioxide. His policy proposals involved voluntary measures and research on new technologies. Meanwhile, Republicans of Congress in particular, using their party's control of Congress, pushed and advocated scepticism about climate change, building on similar efforts by fossil-fuel industries" (Harris, 2009, p. 969 – 970).

Despite the administration's efforts, the closest and bipartisan attempt at passing climate change legislation came during the 110th Congress (2007 – 2009), where the America's Climate Security Act of 2007 – 2008 was introduced. The bill was commonly known as the Lieberman-Warner Climate Security Act of 2007 – 2008, because it was the original work of an Independent Joseph Lieberman [ID-CT], Republican John Warner (R-VA) with 7 Democrats and 4 Republicans as the co-sponsors ("America's Climate Security Act of 2007," 2007).

The bill in essence proposed "*Cap and Trade*", a cross-sectoral bill which sought to establish a federal greenhouse gas registry, set up an allowable emissions quantity and made requirements for trading, transferring and offsetting emissions (Library of Congress, 2008). The bill's supporters were hopeful for its passage, as there was reluctant support from both environmentalists and businesses.

In terms of numbers, the sponsors were confident that they had enough Republicans to support the bill as well Democrats from politically difficult areas in the South and other coal burning regions. However, many concerns started to emerge as debates took place; concerns from those needed to be on board with its passage were not only partisan and ideological but regional as well, as the nature of the bill would inadvertently penalize the South and industrial Midwest more because of the greater proportion of coal use in those areas. There was also uncertainty because even though the sponsors had tried to gather support from environmentalists and businesses, there was still the issue that carbon reduction targets were seen as too aggressive by the business community, while environmentalists saw the targets as not strict enough, acerbated by the bill containing too many *give-aways;* even though the give-aways were needed to back it.

Permit auctions were a sticking point for environmentalists and critics of the bill. The bill sought to auction about 25% of the credits and have 75.5% of the carbon credits given for free to power plants, oil and gas refineries and processing plants, manufacturing companies and states in order to benefit consumers (Center for Climate and Energy Solutions, 2008) in 2012. The auctioned carbon credits would then be increased from approximated 59% by 2032 (Center for Climate and Energy Solutions, 2008). Critics argued that instead all the credits should be auctioned off and also argued that the biggest polluters historically would benefit the most whilst the cleaner and more environmentally-conscious companies would lose out. Furthermore the funds raised from the auctions should be rewarded straight to the consumers to offset the higher energy prices, anticipated in the short term (Los Angeles Times, 2007). Instead, as it stood the bill was estimated to raise $6.7 trillion for the duration of process (40 years) but the funds raised would be used to compensate polluters (Los Angeles Times, 2007; Pooley, 2008).

While both Democrats and Republicans agreed that climate change was real, points of disagreement included the solutions to the problems, the cost and how the bill would drive up energy prices and destroy the economy (Pooley, 2008). The bill needed 60 votes to pass the senate; the bill was defeated on the Senate floor on June 6th, 2008, in a vote of 48-36 ("America's Climate Security Act of 2008," 2008). Nevertheless, some of the bill's sponsors were positive about the process, because this was the closest the United States congress had come to reaching an agreement on climate change. In addition the bill's sponsors and the new President now knew the difficult areas, the areas of agreement and even who the *deal breakers* where (Pooley, 2008).

The Barack Obama administration continued to experience the same gridlock, consistently urging Congress to act on climate change. An example can be seen in an excerpt of the President's 2013 State of Union address, whereby, after acknowledging the role of increased domestic oil and natural gas production in the U.S. economy, still calls for congressional action on climate change and hinted at the use of executive action on climate change:

> "But for the sake of our children and our future, we must do more to combat climate change. Now, it's true that no single event makes a trend. But the fact is, the 12 hottest years on record have all come in the last 15. Heat waves, droughts, wildfires, floods—all are now more frequent and more intense. We can choose to believe that Superstorm Sandy and the most severe drought in decades and the worst wildfires some States have ever seen were all just a freak coincidence. Or we can choose to believe in the overwhelming judgment of science and act before it's too late. Now, the good news is we can make meaningful progress on this issue while driving strong economic growth. I urge this Congress to get together, pursue a bipartisan, market-based solution to climate change, like the one John McCain and Joe Lieberman worked on together a few years ago. But if Congress won't act soon to protect future generations, I will. I will direct my Cabinet to come up with executive actions we can take, now and in the future, to reduce pollution, prepare our communities for the consequences of climate change, and speed the transition to more sustainable sources of energy."
>
> *President Obama, February 12th, 2013, United States Capitol, American Presidency Project*

The U.S. Congress has not sent any bill and as the history of low carbon highlights, there is currently too much contention and not enough of political support in the U.S. House of Representatives and Senate to pass any stringent CO_2 emission reduction measures. Additionally, the development of the electricity network, which resulted in considerable variation in state generating profiles and governing structures means that there are significant details like cost which are proving difficult to overcome by the federal government.

— State low carbon actions since the Kyoto Protocol

A key development in the era of low carbon and fracking has been that whilst the U.S. Congress and subsequent administrations spar over the Kyoto Protocol and climate change in general, from the late 1990s certain state governments were more proactive than federal government for a range of reasons, including a stronger commitment to climate policy and an economic rationale for decarbonisation (Rabe, 2002, 2004b, 2006a, 2008; Rabe et al., 2005). A timeline of state actions on climate change would acknowledge that there was a period in the late 1980s of heightened climate change awareness during which 12 state legislatures, including Arizona, Connecticut, Iowa, Maine, Minnesota, New Jersey, New York, Oregon, Texas, Vermont, Washington, Wisconsin, introduced bills and laws detailing the reduction targets of greenhouse gas emissions (U.S. Office of Technology Assessment, 1991). The focus of these reduction targets were chlorofluorocarbons and increased energy efficiency.

Nevertheless, the rapid growth in state *Climate Action Plans* (CAP) to reduce greenhouse gas emissions across all sectors of the economy essentially began in the late 1990s. Rabe (2004) describes the contents of the Climate Actions Plans:

> "Dozens of states produced detailed "greenhouse gas inventories"; some used these to formulate "action plans" outlining various strategies for emission reduction. These analyses provided an empirical foundation for much subsequent state policy activity and also served, in many states, as an initial opportunity to bring together constituents from diverse state agencies, industries, universities, and advocacy groups to meet and consider climate change as a state policy issue" (p.19).

Other literature including Stephen Wheeler's 2008 account of first generation state and municipal climate change plans gives a detailed breakdown on particular action plans, from the early to the late 1990s. As shown in figure 3-13:

State	State planning actions	Emissions inventory?	Estimates GHG reductions from measures?	Estimates cost of measures?	Funding identified?	Follow-up reporting?	Comments
AL	1997 policy planning report	1990	No	No	No	None	Prepared by university w/ EPA grant; advisory
AZ	2006 climate change action plan	1990, 2001	Yes	Yes	No	None specified	Stakeholder process; 49 policy options
CA	2006 law; 2005 EO[a]; 1997 plan	1990, 2004	Yes; ARB[b]	Some	Some	Biannual reports	Very detailed process to implement law
CO	1998 plan, 2007 climate action plan	1990, 1995	No	No	No	Inv. every 5 years	Stakeholder process; 31 strategies identified
CT	2005 climate change action plan	1990, 2000, 2006	Yes	Yes	Proposed	Annual	Plan contains 55 detailed action items
DE	2000 climate action plan	1990	Yes	Yes	No	None	Prepared by university w/ EPA grant; advisory
HI	1998 action plan; 2007 legislative act	1990	No	No	No	Updates in progress	1998 plan developed under EPA grant; advisory
IA	1996 GHG action plan; 2008 report	2000	Yes	Some	No	To be annual	1996 plan prepared under EPA grant; advisory
IL	1994 climate action plan	1990, 1998	No	No	No	Updated in 1996	New advisory group appointed in 2006
KY	1998 mitigation strategies report	None	Yes	No	No	None	1998 report prepared under EPA grant; advisory
MA	2004 climate protection plan	2002; govt. only	No	No	No	None	Joint effort of 15 state agencies
MD	2004 report; 2008 interim plan	1990, 1995	Yes	Yes	No	To be annual	New plan due in 2008
ME	2000, 2004 climate action plans	1990	Yes	Yes	No	Biannual reports	Stakeholder process; 54 recommendations
MN	2003 climate change action plan	None	No	No	No	None	Framework only; new plan being developed
MO	1991 report; 2002 options report	1990, 1996	Yes	No	No	None	Produced with EPA grant; advisory
MT	1999 foundation, 2007 action plan	1990, 2005	Yes	Yes	No	None	Stakeholder process; 55 measures
NC	2000 report; 2007 draft action plan	1990, 2000, 2005	Yes	No	No	None	Stakeholder process; 56 recommendations
NH	2001 climate change challenge plan	1993	No	Some	No	None	By state Env. Dept.; new plan being developed
NJ	1999 Dept. of Env. action plan	1990, 1995	Some	No	No	Revised in 2002	Other reports by Princeton & New Jersey Future
NM	2002 GHG action plan; 2006 report	1990, 1996	Yes	Yes	Some	New inv. in 2008	2006 stakeholder process; 69 recommendations
NY	2003 recommendations plan	1990, 2001	Yes	Some	Some	Annual inv. planned	Stakeholder process; new plan being drafted
OR	2004 strategy for GHG reductions	1990, 2000	Yes	Yes	Some	Updated in 2006	Stakeholder process; 46 recommendations
PA	2007 climate change roadmap	1990, 2000	Yes	Some	No	Annual on gov. actions	Stakeholder process; produced by an NGO[c]
RI	2002 GHG action plan	1990, 1996	Yes	Yes	Some	2004 status report	Stakeholder process; 52 recommendations
TN	1999 emissions mitigation strategies	1990	Yes	Yes	No	None	Written by university with an EPA grant
UT	1990s report; 2007 blue ribbon commission	1990, 2000, 2005	Yes for report	Yes for report	No	None	Stakeholder process; 57 recommendations
VT	1998 action plan; 2007 report	1990, 2003, 2005	Yes	Yes	No	Biannual updates	2007 stakeholder process; 38 recommendations
WA	1996 action plan; 2008 interim report	1990, 2000	Yes	Yes	No	Inv. updates 2006, 2007	2007–08 stakeholder process; 43 recommended actions
WI	1998 action plan; 2008 interim report	1990, 2000	Some	Some	No	Inv. updated 2007	Stakeholder process; 9 initial areas for action

Notes:
a. Executive Order.
b. California Air Resources Board.
c. Nongovernmental organization.

Table 3-3: Shows Characteristics of State Climate Action Plans
Source: Wheeler (2008). State and Municipal Climate Change Plans: The First Generation

Furthermore, these initial greenhouse gas reduction activities from the 12 states also coincided with federal policy on air pollution in the early 1990s – the 1970 Clean Air Act, amended on November 15, 1990 (Rabe, 2004a). These amendments increased state commitments to greenhouse gas reductions. Additionally, this first group of states set a platform for more greenhouse gas policies in the late 1990s with discussions around the Kyoto Protocol and also passed some important laws specifically targeting CO_2 emissions. Rabe (2004), uses the examples of Minnesota in 1993 and Oregon in 1997:

> "Some significant state laws were approved during this period, ranging from Minnesota's 1993 legislation to include the environmental and economic impacts of carbon dioxide releases as a formal component of decisions on energy development to Oregon's 1997 law that established carbon dioxide emission standards for any electrical power plant opened in the state" (p. 20).

Concurrently, an estimated 16 states resisted making any changes with regards to greenhouse gas reductions, Kyoto and anything relating to climate change. These state legislatures showed resistance to the United States Senate by resolving to oppose any Kyoto related decision by the United States Senate, should it be considered. Some of these 16 states created and passed legislation to the same effect. These states were Kentucky, Michigan, North Dakota, Ohio, Pennsylvania, South Carolina, Virginia, West Virginia, Wyoming, Colorado, Illinois, Idaho, Alabama, Arizona, Indiana and Mississippi (Rabe, 2002). Rabe uses the example of West Virginia in 1998, which by means of legislation barred any state agencies from contracting with any federal agencies on greenhouse gas reduction. These states were a combination of heavy coal use states, coal producing states and heavy industrial states located across the Midwest and the Southeast of the United States. Since this period (1990s to 2004) of climate action and resistance, more states and cities across the country have created some form of action on greenhouse gases (Byrne et al., 2007; Rabe, 2004b; Wheeler, 2008).

Rabe (2004) states:

> "New legislation and executive orders intended to reduce greenhouse gases have been approved in more than one-third of the states since January 2000. Multiple programs have been enacted in some states, and many new legislative proposals are being advanced in a large number of states. These new programs include formal carbon dioxide caps on particular industries, state-wide goals for greenhouse gas reductions, formal agreements with utilities and industries to reduce carbon dioxide emissions, mandates to generate specified levels of electricity from sources that generate no greenhouse gases, mandatory reporting of carbon dioxide emissions, voluntary registries for industries seeking credit for reductions in any future regulatory regime, and de facto "carbon taxes" on utility bills that create pools of funds for energy efficiency, among others" (Rabe, 2004, p. 20).

Wheeler (2008) and Byrne (2007), also show that large and small cities across the United States have embraced climate change and initiated policies to that effect:

> "Since 2000, municipal efforts have been further advanced by the Sierra Club's Cool Cities campaign, launched in 2005, and the U.S. Conference of Mayors' Climate Protection Agreement, initiated by Seattle Mayor Greg Nickels, also in 2005. More than 500 mayors have signed this agreement, in which cities commit to meet Kyoto Protocol goals and to urge state and federal governments to take action" (Wheeler, 208, p. 482).

> “The US CCP participants represent some of the largest urban centres in the country and account for 19% of US population. American CCP commitments have been amplified by the US Mayors Climate Protection Agreement, launched in February 2005 and endorsed unanimously by the US Conference of Mayors in June 2005. Under the agreement, 435 cities have committed to meet or exceed the US Kyoto reduction target, and to lobby state, regional, and federal officials to take more aggressive action on climate change” (Byrne, 2007, p. 4559).

Detailed breakdown of the large cities and the characteristics of their climate action plans is shown in *Table 3-4*.

City	Planning actions	Emissions inventory status	Estimates GHG reductions from measures?	Estimates cost for measures?	Funding identified?	Follow-up reporting?	Comments
Austin, TX	2007 climate protection plan, utility green building program	Developing inventory	No	No	No	Not scheduled	Plan has strong goals but few details on implementation
Boston, MA	2007 climate action plan; 2007 EO[a] on climate change	Developing inventory	No	No	No	Updates every 3 years	Plan primarily reports on existing activities
Charlotte, NC	None; developing plan	Developing inventory	n/a	n/a	n/a	n/a	ICLEI member but has no plan to date
Chicago, IL	Part of 2005 environmental action agenda, updated 2006	Developing inventory	Yes	No	For some programs	Not scheduled	Reducing emissions is small part of city's environmental action agenda
Dallas, TX	None; developing plan	Developing inventory for 2005	n/a	n/a	n/a	n/a	3-year *Sustainable Skylines* project includes GHG strategies
Denver, CO	2007 *Greenprint Denver* plan	Inventories for 1990, 1995, and 2005	Yes for some	Yes for some	No	To issue annual report card	The integrating theme of *Greenprint Denver*
Houston, TX	None	n/a	n/a	n/a	n/a	n/a	Joined ICLEI's CCP in 2006
Indianapolis, IN	None; developing plan	Developing inventory	n/a	n/a	n/a	n/a	*Indy Greenprint* program underway
Las Vegas, NV	Mentioned within 2006 *Sustainable Las Vegas* plan	Developing inventory	No	No	No	Not scheduled	2006 plan is an outline of a future sustainability program
Los Angeles, CA	2001 energy climate action plan, 2007 *Green LA* plan	Developing inventory	No	No	No	To publish annual inventory	*Green LA* plan outlines climate change policies
Louisville, KY	None	Developing inventory	n/a	n/a	n/a	n/a	Signed the U.S. Conference of Mayors climate protection agreement
Milwaukee, WI	None	Developing inventory	n/a	n/a	n/a	n/a	Environmental sustainability plan does not include GHG emissions
New York, NY	2006 plan *NYC 2030* contains climate change section	Inventories for 1995, 2000, and 2005	Yes	No	For some programs	Not scheduled	$80 million in 2008 to reduce GHG emissions from city buildings
Phoenix, AZ	None	n/a	n/a	n/a	n/a	n/a	
Portland, OR	1993 Portland/Multnomah Co. action plan, updated 2001	Inventories for 1990, 1995, 1999, after	Yes	No	For some programs	2 follow-ups since 1993	First city in the U.S. to adopt a strategy to reduce CO_2 emissions
San Diego, CA	2005 climate protection action plan; 2002 sustainable community program	Inventory for 1990	Yes	No	No	Plans to review annually	Plan focuses mainly on city operations.
San Francisco, CA	2002 city council resolution; 2004 climate action plan	Inventories for 1990, 2000, and 2005	Yes	No	No	Not scheduled	Detailed plan with actions in 18 major areas
Seattle, WA	2006 climate action plan	Inventories for 1990, 2000, and 2005	No	No	For some programs	Inventory every 3 years	Plan implements 18 initiatives for transportation, energy, buildings

Table 3-4: Shows Characteristics of Large Cities Climate Action Plans
Source: Wheeler (2008). State and Municipal Climate Change Plans: The First Generation

— State-wide adoption of energy efficiency and renewable mandates

An ongoing development in the era of low carbon has been increased state-wide adoption of low carbon energy policies in the form of energy efficiency and renewable energy mandates. There is evidence of more state governments and public service commissions' mandating renewable energy development of some sort. Some of the more popular tools are Renewable Portfolio Standards (RPS), Energy Efficiency Standards (EEPS), and Net-Metering, all attempts to create a state market for renewable energy, potentially save on capital costs of new centralised power plants and increase energy efficiency measures and customer savings.

Since 2000, more state governments and regulators have created varying forms of renewable energy requirements and energy efficiency standards. Currently an estimated 29 states have increased their renewable energy generation and some have made their targets stricter. No longer predominantly motivated by climate change, there are increasing pressures on states to use renewable portfolio standards to enhance job creation, reduce wholesale electricity prices and possibly raise consumer savings (Rabe, 2006b, 2008; Ryan et al., 2016).

The state of Iowa was the only state to adopt an Alternative Energy law in 1983 (Iowa General Assembly, 1983). This was officially the country's first Renewable Energy Portfolio Standard (RPS) and was the only renewable energy mandate for nearly 10 years. The 1983 legislature's reasons were stated as the need for increased conservation and efficiency of finite energy resources (Iowa General Assembly, 1983). Other states officially began to adopt renewable energy portfolios in the late 1990, at the beginning of the low carbon era. The Renewable Energy Portfolio (RPS) is a regulatory measure requiring an increase in renewable energy in electricity, until a specific amount of electricity is generated from renewable energy resources by a specified date, For example, 15% by 2020 (National Renewable Energy Laboratory, 2014), hence specific targets and carve-outs vary across states. Figure 3-12, shows the timeline for state renewable energy portfolio adoptions from its inception to the present.

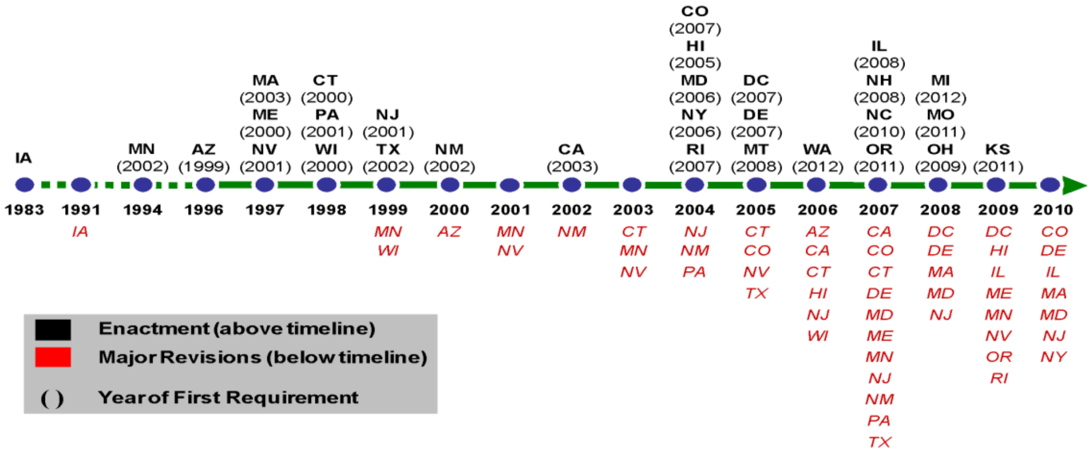


Figure 3-12: Shows the timeline for Renewable Energy Portfolio Standards
Source: Centre for Climate and Energy Solutions, 2011

Furthermore, the renewable energy portfolio, whilst not being the most cost-effective mechanism to reduce carbon emissions (Rabe, 2006a), is the most politically attractive. This is because it can be argued as a “cost-free” approach by decision makers, because it achieves numerous objectives including a reduction in carbon emissions (environmental benefits), investments, tax revenues (economic benefits) and comes with support from across the political spectrum. It is described as a political calculus with benefits (Rabe, 2008). The RPS also has the advantage of being perceived as not being a carbon tax by decision makers but rather a way to diversify the electricity generation mix. As can be seen in figure 3-13, the entire South-eastern region, with the exception of North Carolina, has very little renewable energy and has not adopted any renewable energy portfolios. This is supported by empirical studies on factors driving renewable energy portfolio adoption which show that the more heavily a state relies on coal or other fossil fuels, the less likely they are to introduce renewable energy (Chandler, 2009; Lyon & Yin, 2010; Rabe, 2004b, 2008).

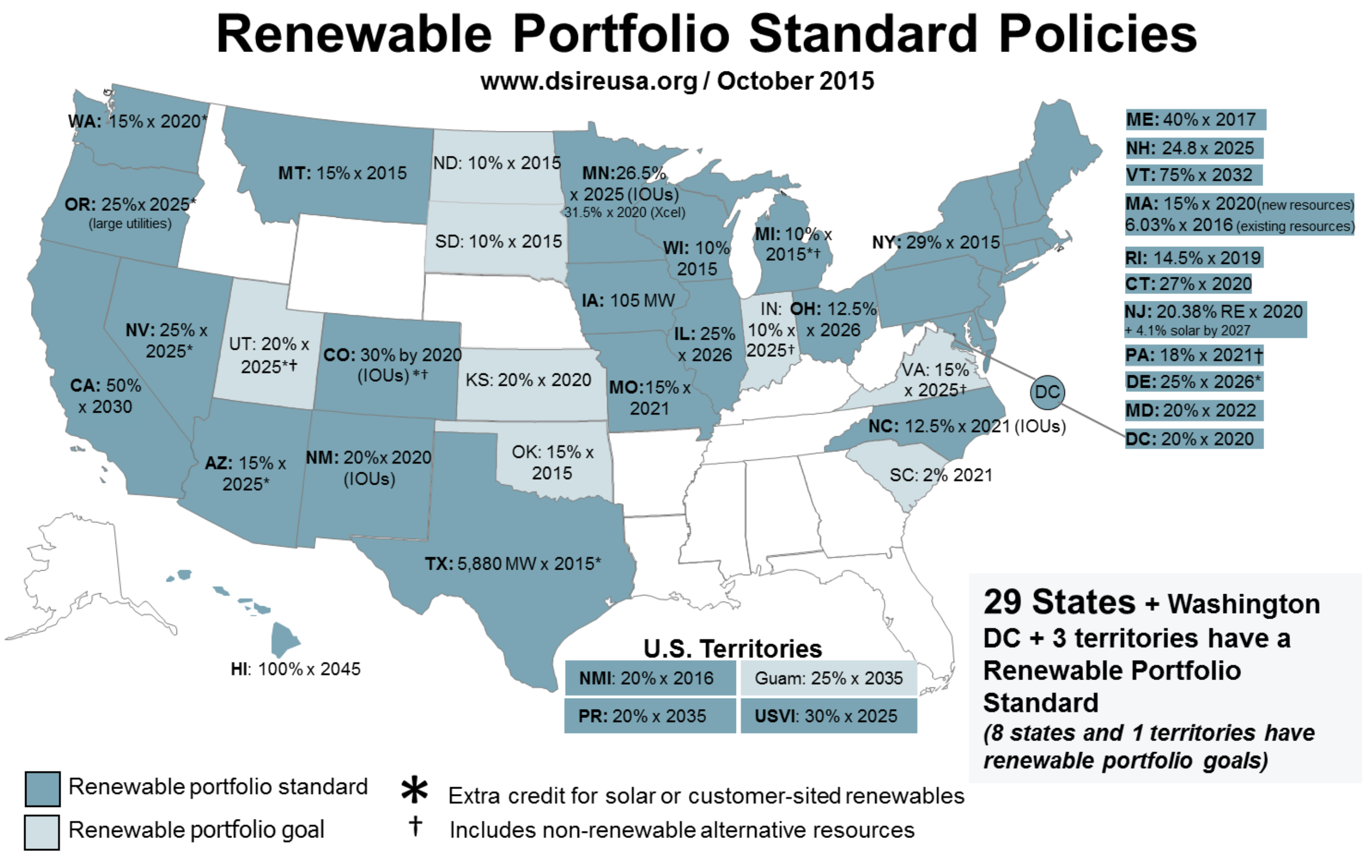


Figure 3-13: Shows Renewable Energy Portfolios in 2015
Source: DSIRE, 2015

Additionally, even states without renewable energy mandates at the time of writing were still increasing renewable energy production compared to where they were in late 1990s and 2000. A reason for this growth could be the federal incentives for renewable energy development becoming more consistent and substantial since the 1990s. Some states and municipalities have taken advantage of federal incentives such as the Production Tax Credits (PTC) and Investment Tax Credit (ITC) and combined them with in-state tax credits to develop low carbon energy technologies at a cheaper cost. The most prominent example being Texas, which used the Production Tax Credits (PTC) signed into law by President Bush, and has since developed an estimated 10,00MW of wind energy generation (Byrne et al., 2007).

Federal incentives such as the Production Tax Credit (PTC) have clearly been important to the growth of renewable energy since 2000. The tax credits have become a prominent feature of the low carbon era because, whilst not always consistent due to being a casualty of the federal level climate change politics, they have increased in value, therefore assisting in the overall costing and financing of the projects (Bolinger, Wiser, Cory, & James, 2009). An incentive like the Production Tax Credit (PTC) is an inflation adjusted tax credit for electricity generation from renewable energy resources (in kWh) by a company (North Carolina Clean Energy Technology Center, 2005; Union of Concerned Scientists, 2015). It has been significant for wind energy growth in the U.S. The wind energy incentive is listed at 2.3 ¢/kWh during the initial 10 years of operation. Some technologies like landfill gas, open-loop biomass and even municipal solid waste are listed at 1.1 ¢/kWh. The impact of the PTC on wind energy installed capacity is seen in Figure 3-14:

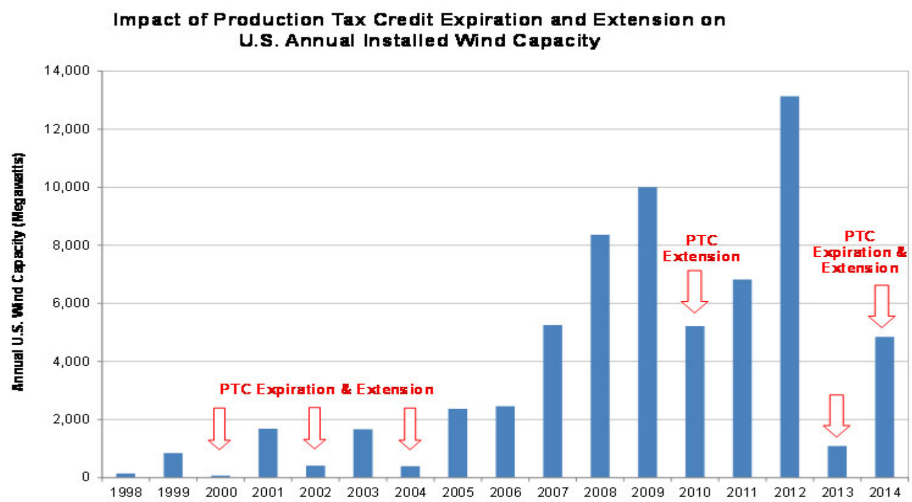


Figure 3-14: Shows the history of the PTC cycle
Source: Union of Concerned Scientists, 2015

The map in figure 3-15 captures this development, whilst noting the major growth is on the West coast.

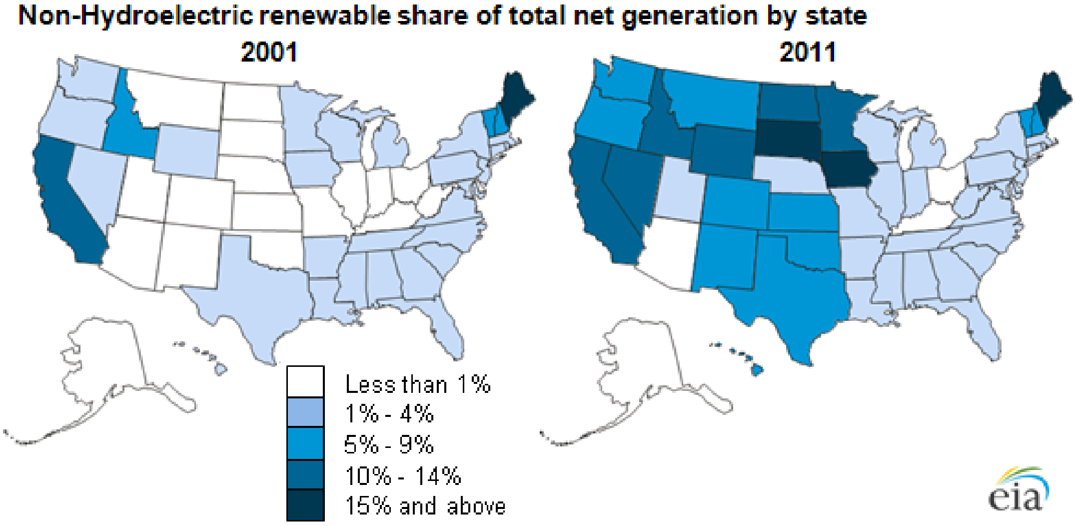


Figure 3-15: Compares the shares of renewable energy generation across states between 2001 and 2011
Source: U.S. Energy Information Administration, 2012

Finally, the Energy Efficiency Resource Standard (EERS), also began in the late 1990s in the state of Texas. It is a similar tool to the RPS but instead of renewable energy, it focuses on energy savings. Hence, the Energy Efficiency Resource Standard (EERS) is a target for energy savings established by state governments and regulators for utilities and non-utilities to achieve through efficiency measures on the customer side and on the electricity generation and supply network i.e. operational infrastructure efficiency (American Council for an Energy-Efficient Economy, 2015).

— The use and opposition to increasing hydraulic fracturing

The rapid development of shale gas and the increased use of fracking has come under increasing and sustained opposition (Baddour, 2015; Jopson, 2014); due to concerns about water (treatment, demand, waste disposal, spills), air (greenhouse gas emissions), seismicity (induced earthquakes) and health in some cities and states, opposition (Arent et al., 2015; Krupnick, Kopp, Hayes, & Roeshot, 2014; Logan, Medlock, & Boyd, 2015; Q. Wang, Chen, Jha, & Rogers, 2014). According to the U.S. National Renewable Energy Laboratory (2015):

> "Conflicts regarding environmental impacts have also emerged in certain areas of the country, leading to restrictions and moratoria on drilling by state, county, and municipal governments and raising questions about the industry's continued social license to operate in specific jurisdictions. Efforts by local governments to exert more control over shale gas

development have resulted in litigation in several states as well as new legislation and regulations intended to resolve some of these conflicts. Recent public opinion surveys reveal a general appreciation for the economic benefits of shale gas development but continued concerns about potential health and environmental impacts" (p. 4).

State and city governments that have introduced controls over fracking include, New Mexico County, Pittsburgh, Philadelphia, four cities in Ohio, Beverly Hills, New York State and Boulder, Colorado (Baddour, 2015; Jopson, 2014). These states, cities and local communities have banned or temporarily suspended fracking until environmental studies on the effects of fracking in their communities are complete. Assessments about environmental impacts are still ongoing and as of yet, it remains unclear how these bans will affect the associated electric utilities ability to buy cheaper natural gas for electricity generation.

Another development in the era of low carbon and fracking has been the now common practice of using hydraulic fracturing to increase the supplies of natural gas, resulting in cheap natural gas domestically. A result of the availability of cheap natural gas has been that, since 2007, natural gas has started competing with coal in electricity generation across the country, reducing the demand for coal-fired electricity and increasingly displacing coal in electricity dispatch across the entire country by natural gas (U.S. Energy Information Administration, 2016b). In short, natural gas has become favoured over coal by utility managers (Krupnick et al., 2013). Estimates of a 29% reduction in utilisation rates of coal-fired power plants from 2007 to 2015 have been recorded (U.S. Energy Information Administration, 2016b).

Electricity generation from coal is reported to have peaked in 2007 and started to decline in 2008 (Logan et al., 2015; U.S. Energy Information Administration, 2016b). What makes this recent development in the decline of coal electricity generation different, compared to its decline during the utility growth era has been the stable increase of coal's prices in relation to falling natural gas prices and environmental regulation. Before the shale boom (2007 – 2008), when natural gas capacity grew, coal also consistently grew (Logan et al., 2015), however, in the era of low carbon and fracking, low natural gas prices, the compatibility of natural gas with renewable energy systems, stricter environmental regulations for coal and coal transportation costs combine to effectively reduce the demand for coal. Figure 3-16 shows the drop in coal usage across all states:

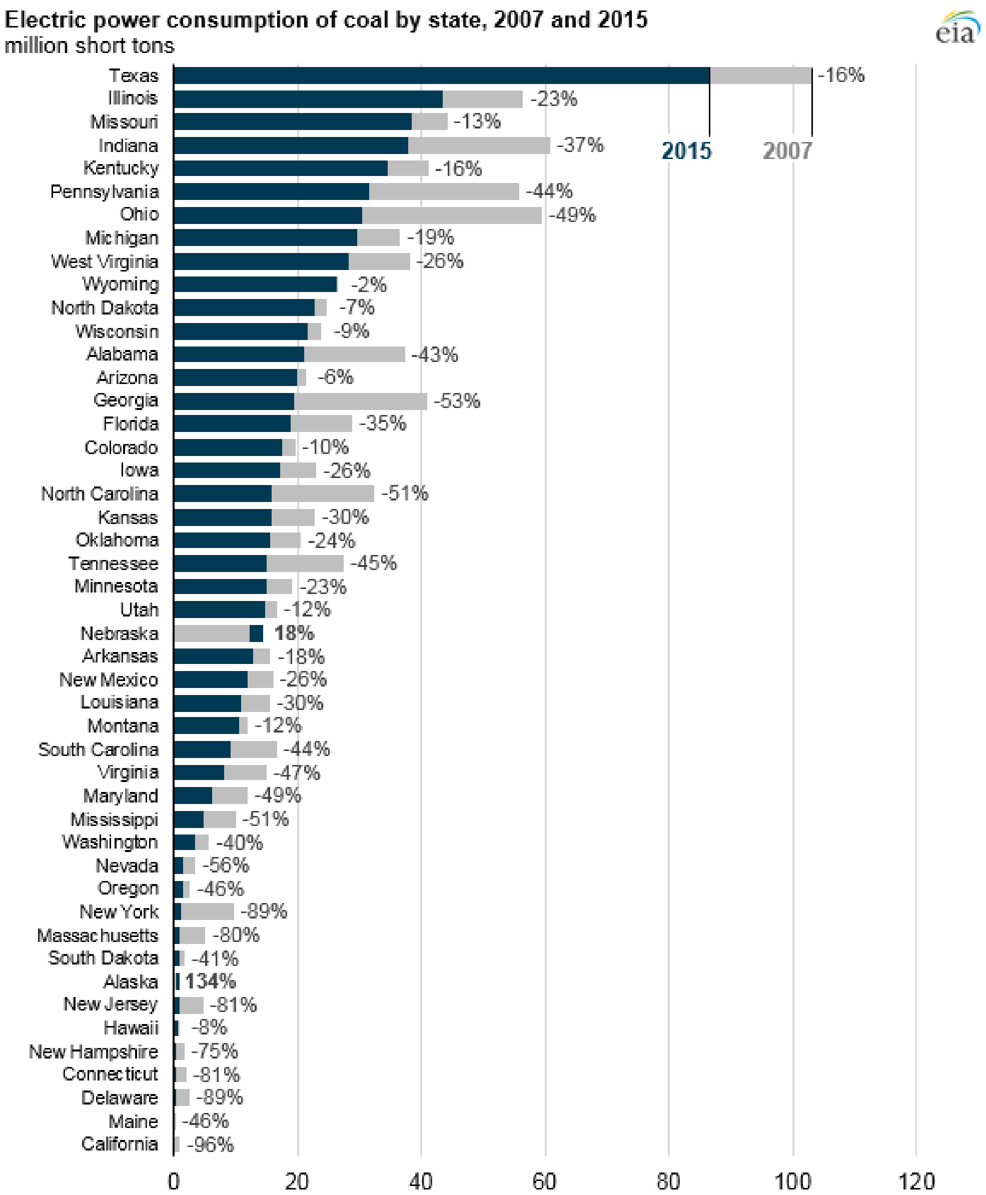


Figure 3-16: Shows the Electric Power Consumption of Coal by State from 2007 – 2015
Source: U.S. Energy Information Administration, Electric Power Annual, 2015

According to the U.S. Energy Information Administration's electricity annual power report (2011):

> "The increase in delivered coal prices and the decrease in delivered natural gas prices, combined with surplus capacity at highly-efficient gas-fired combined-cycle plants resulted in coal-to-gas fuel switching This occurred particularly in the Southeast (Alabama, Arkansas, Florida, Georgia, Mississippi, and South Carolina) and also Pennsylvania" (U.S. Energy Information Administration, 2009, p. 9).

The U.S. Energy Information Administration provides data to that effect and shows how gas plants are increasingly being run in a way they were not necessarily designed to be (peaking plants to baseload plants) even in the Southeast. The graphs can be seen in figures 3-17 to 3-19.

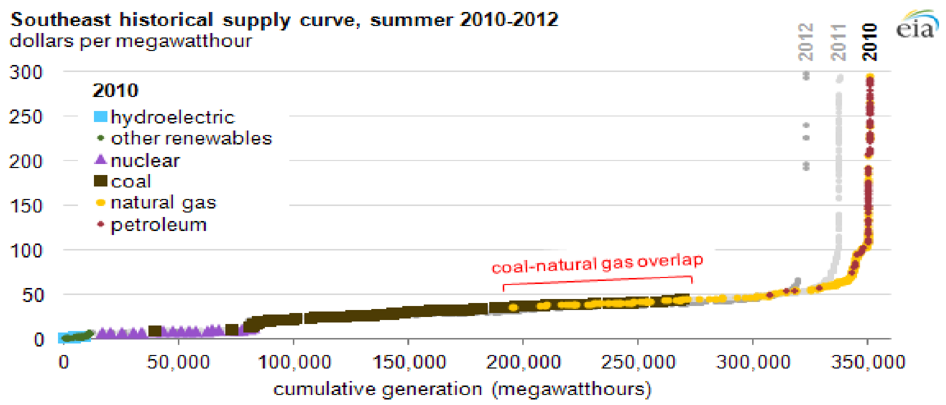


Figure 3-17: Shows the electricity dispatch curve of Power Plant Operations in the Southeast for 2010 Source: (U.S. Energy Information Administration, 2012a)

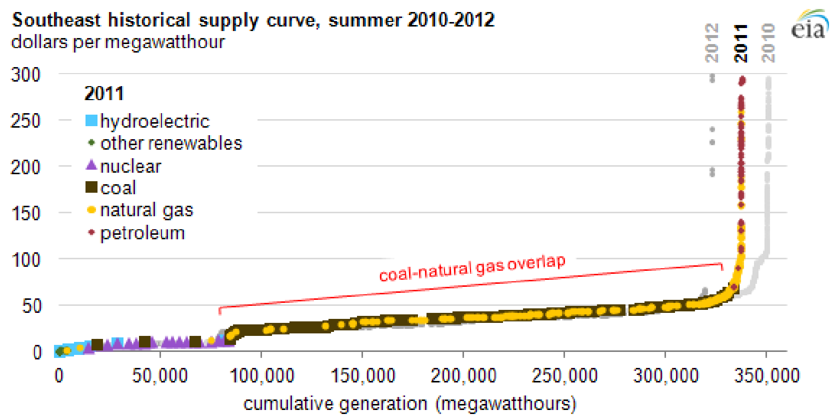


Figure 3-18: Shows the electricity dispatch curve of Power Plant Operations in the Southeast for 2011 Source: (U.S. Energy Information Administration, 2012a)

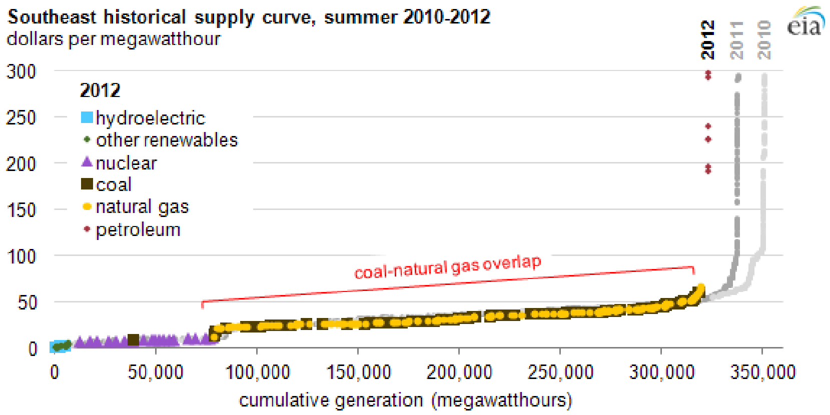


Figure 3-19: Shows the electricity dispatch curve of Power Plant Operations in the Southeast for 2012 Source: (U.S. Energy Information Administration, 2012a)

The significance to a region like the Southeast – and to a lesser degree the Midwest, cannot be overstated because of the historical dominance of coal in its electricity generation mix (U.S. Energy Information Administration, 2012a). Some states in the Midwest like Ohio which reduced coal consumption by 49% lie in close proximity to the Marcellus and Utica shale gas formations (U.S. Energy Information Administration, 2016b). Other states in the Midwest, (figure 3-14) including, Michigan – 19%, Iowa – 26%, Illinois – 23%, Missouri – 13%, Wisconsin – 9%, Minnesota – 23%, Indiana – 37%, had reduced coal consistently between the 2007 and 2015 period, but much more slowly than the other regions (Logan et al., 2015).

However, what these state reports indicate that the reduction in coal can not only be attributed to natural gas and that the entry of renewable energy into the generation mix of some of these states accounts for some coal reduction (U.S. Energy Information Administration, 2016b). In the Southeast and Northeast regions, some of these reductions in coal are not only happening by underutilising coal plants, but also by converting coal-fired plants under threat of closure to gas-fired power plants (figure 3-20).

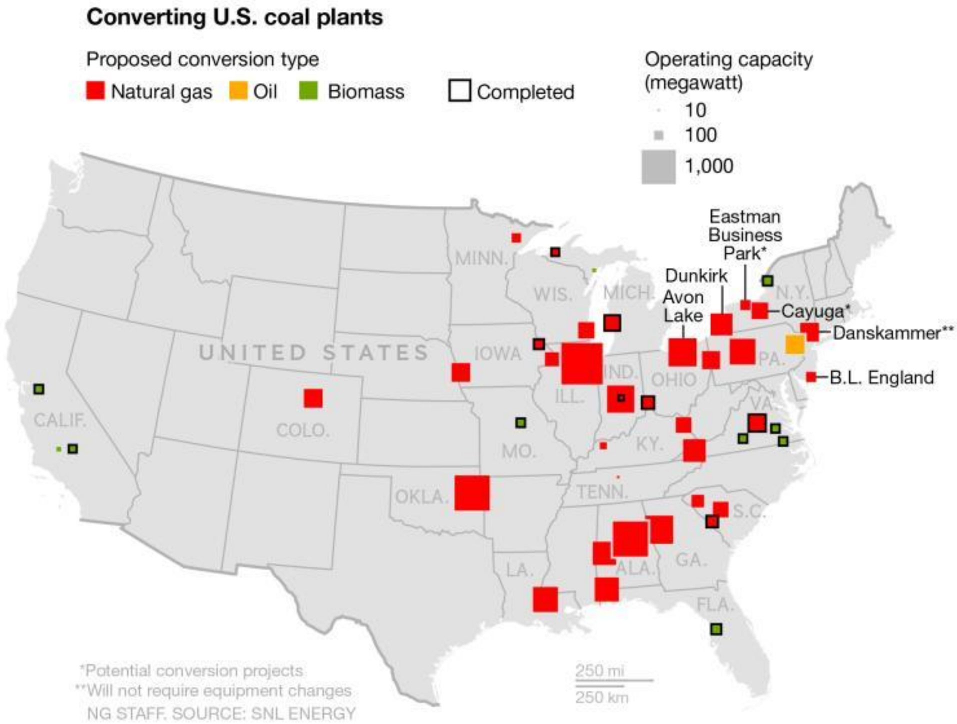


Figure 3-20: Shows the utilities converting coal plants to natural gas
Source: National Geographic, 2014

In summary, the impacts of cheap natural gas on electricity generation and supply in U.S. are ongoing, especially in terms of the impact on renewable energy contributions to electricity generation (Krupnick et al., 2014; Krupnick et al., 2013). This is especially the case where coal is the electric utility's fuel of choice. Nevertheless, it is clear that by 2012 in many states coal usage was in decline and was no longer competing on price with natural gas (U.S. Energy Information Administration, 2012b). Low natural gas prices encourage and give electric utilities the option to increase the use of gas-fired plants in electricity generation by increasing the utilisation factor of existing natural gas-fired turbines, which means running the gas-fired plants as a baseload option as opposed to being used solely as a peaking plant. It also gives utilities the option to convert coal fired turbines due to be closed due to environmental (emissions) reasons, costs and other regulatory concerns to natural gas turbines (Nunez, 2014).

3.2 Frameworks for U.S. State Level Electricity Generation and Supply by 2013

This section summarises the context for electricity generation in the USA by the time of research (2013), including, the different electricity management models within states and the existing mode of electricity generation. It also highlights potential tensions between federal and state governments on electricity CO_2 emission regulation, potential challenges to the business models of incumbent power companies and changing consumer preferences.

3.2.1 Current electricity management models within states

At the time of the research, there were roughly three models of electricity management in operation across the U.S. They are:

- The Restructured model, which involves a wholesale market for electricity generators controlled by Independent System Operators (ISO), and allowing competition for the customer at the retail level (picking their suppliers). This model can be seen in most of the Northeast states as well as Texas. Generators can also specialise in the type of electricity generation they wish to offer e.g. renewable energy as well as the customer segment e.g. industrial or residential (Regulatory Assistance Project, 2011a). This electricity model emerged from the energy security era mainly through the introduction of PURPA by the federal government and the restructuring era (3.1.c - 3.1.e). Reflecting back on the energy security era shows that most states which embraced PURPA, including California and the north-eastern states, were eventually stuck with uneconomic contracts and went on to attempt to restructure their electricity markets by unbundling electricity generation from transmission and distribution and providing retail choice. The process meant allowing independent power providers the ability to enter the market. Whilst the California energy crisis suspended many deregulation attempts across the country, the entire northeast with the exception of Vermont successfully deregulated their electricity markets.
- The traditional cost of service regulation model, is guided by an Integrated Resource Plan, a State Public Service Commission, a utility granted a monopoly franchise. It is negotiated through docketed proceedings where energy plans are debated, countered, and amended by all parties with an interest in state energy planning. Utility managers, regulators, technical experts, consumers and other advocates are all part of the electricity planning process. This model is predominantly found in the Southeast, the

Midwest and some states in the Pacific Northwest with strong regional and federal utilities (Boyd, 2014). Reflecting back to the energy security and restructuring era, these are the states which generally resisted PURPA and they have remained the same. These states, like Georgia, North Carolina and most of the Midwest except for Ohio, Illinois and Michigan, did not pursue deregulation and consumer retail choice. These states had some of the lowest electricity rates in the late 1990s and although they proposed restructuring studies, the regional powerful investor-owned utilities (Borenstein & Bushnell, 2015) and the California crisis combined to resist any further attempts. These regions have continued with the traditional model of electricity generation.

- Finally, the partially restructured or hybrid model, which involves a wholesale market for electricity generators controlled by Independent System Operators (ISO) but with a retail level controlled by utility monopolies and granted service areas (Boyd, 2014).

The models of electricity governing are distinctly geographical, specifically regional. There are five outlier states including, Oregon, Montana, Texas, Illinois and Vermont. The rest follow a regional pattern. The reasons why some regions ended up with either a restructured, traditional monopoly with cost of service regulation or partially restructured model of electricity management are due to the events and decisions taken from past eras, specifically the energy security and restructuring eras (3.1e) and (3.1f). Certainly, over the last two eras, crucial decisions taken by Public Service Commissions and state legislatures with regards to investments in nuclear generation, power plant construction cost overruns, high electricity prices, PURPA (embraced or opposed) and restructuring (embraced or opposed) have resulted in quite distinct modes of governing across the United States.

3.2.2 The relationship between the federal level and states on carbon regulation

The relationship between the federal level and states on CO_2 regulation is one defined by jurisdictional and legal boundaries. In electricity generation and supply the federal government's role is governed by the 10th Amendment to the United States Constitution, which helps define the relationship between federal and state governments generally. It states "the powers not delegated to the United States by the Constitution, nor prohibited by it to the states, are reserved to the states respectively, or to the people" (Cornell Legal Information Institute, 1992) Electricity generation and supply falls under state jurisdiction and is governed at the state level, through public service commissioners and state legislature. However the U.S. federal government is never fully separate from state level electricity generation because of its ability to intervene in an energy crisis and also through the Environmental Protection Agency's role (EPA) in air and water pollution control (Environmental Protection Agency, 2015a).

A current and ongoing source of legal and jurisdictional conflict between federal and state governments has been when some states pushed back on the federal level (such as through the Environmental Protection Agency) to act on CO_2 emission pollution, in the way that resulted in the landmark case *"MASSACHUSETTS et al. v. ENVIRONMENTAL PROTECTION AGENCY et al."* The states petitioning for CO_2 emission regulation included Massachusetts (main petitioner), California Connecticut, Illinois, Maine, New Jersey, New Mexico, New York, Oregon, Rhode Island, Vermont, and Washington, the District of Columbia. The cities included New York City and Baltimore. The states which sided with the Environmental Protection Agency included, Alaska, Idaho, Kansas, Michigan, Nebraska, North Dakota, Ohio, South Dakota, Texas, and Utah (Cornell Legal Information Institute, 2007).

Ultimately, the outcome was that the Supreme Court of the United States ruled that the EPA had a duty to regulate greenhouse gas emissions including CO_2 emission (Cornell Legal Information Institute, 2007). This duty to regulate CO_2 emissions led the Environmental Protection Agency to propose CO_2 emissions standards for emission control from new power plants on March 27th, 2012 (Center for Climate and Energy Solutions, 2015a, 2016). Furthermore, a consequence and significance of this ruling was that in the absence of federal government action on climate change, the Environmental Protection Agency has sought to regulate CO_2 emissions from new and existing power plants in electricity generation

(Environmental Protection Agency, 2013d), causing conflict between the federal agency and some state electricity regulators in a sector primarily governed by the states.

3.2.3 The relationship between the states and cities on carbon regulation

One feature of US energy-carbon restructuring is the growth action by cities and municipal authorities as they seek to reduce CO_2 emissions, promote renewable energy and ensure their competitive energy security (Byrne et al., 2007; Hodson & Marvin, 2009; Lutsey & Sperling, 2008; Rutland & Aylett, 2008). The municipal scale impetus for action might overlap with or create tensions with the state level approach. For example, overlaps include helping to meet state level targets for energy efficiency or helping to meet state level targets for renewable energy goals. Some examples are presented below to highlight geographical variations in cities undertaking renewable energy development (Byrne et al., 2007), the overlaps/conflicts with state leaders and motivations.

Two cities in the state of California – San Francisco and San Diego – have set 100% renewable energy electricity generation for 2030 and 2035 respectively (City of San Diego, 2016; San Francisco Department of Environment, 2012) as part of their climate change action plans. There is overlap between these renewable energy targets and the state of California's energy goals in the solar energy development for example. Both cities are set in a regional context of a state (California), which had an electricity crisis from 2000 to 2001 (Sweeney, 2002) resulting in high electricity costs and bankrupt utilities and which led to policies to drive renewable energy generation and decentralisation such as the California Solar Initiative (CSI). California since then has set some of the most ambitious clean energy goals in the United States (California Energy Commission, 2015). The state senate established an RPS in 2002, mandating 33% of renewable energy from utilities by 2020 (California Energy Commission, 2015). This target was amended to 50% by 2030 by Governor Jerry Brown on the 7th of October 2015.

This means that at the local level, rates of electricity are high in California. In keeping with the context, the average electricity costs in the San Francisco were 23¢/kWh in July of 2015 and 20¢/kWh by July 2016 (U.S. Bureau of Labor Statistics, 2016). The 100% renewable target for San Francisco was established in 2010 by then mayor Gavin Newsom (San Francisco Department of the Environment, 2012) and commitments included attempts to tackle climate change (San Francisco Department of the Environment, 2013), reduction in fossil fuel pollution, reducing high electricity costs and boosting the local economy (San Francisco Department of Environment, 2012). The city's plan to get to 100% renewable energy includes: energy efficiency programs, local renewable energy funding for technologies such as rooftop solar, net-metering advocacy, virtual net-metering, Pacific Gas & Electric's green power purchase and the CleanPowerSF (San Francisco Department of Environment, 2012).

The CleanPowerSF is the main method by which city authorities intend to reach their 100% renewable energy goal. CleanPowerSF is a Community Choice Aggregation (CCA) and means that the city of San Francisco, instead of creating a municipal electric utility, takes over the generation component of electricity, contracting with a supplier to provide the renewable energy required. However, the other electricity supply components remain functions of the investor-owned utility (San Francisco Public Utilities Commission, 2016). California is one of the few states that legally permit community choice aggregation (Stoner & Dalessi, 2009) but in spite of the legitimacy of the program there was still opposition, delay (Lagos & Baker, 2013) and legal challenges from external groups on behalf of PG&E (Baker, 2010), primarily because it undermined utility control. After a 10 year delay the CleanPowerSF began (Johnson, 2016) in May 2016. This example of San Francisco, represents one of the ways/strategies where a city is trying to take control over its energy generation and strengthen its energy security (Hodson & Marvin, 2010b).

Another example is of Georgetown, Texas, whose municipal utility switched to 100% renewable energy in 2012 (City Hall, 2015). The utility did so by changing its electricity providers to out of state renewable energy companies (City Hall, 2015). This was made easier by the partially restructured electricity market in Texas (Public Utility Commission of Texas, n.d.). This example, shows where the city of Georgetown goals differs from or are similar to the state of Texas. The state of Texas had a renewable energy portfolio (North Carolina Clean Energy Technology Center, 2016), but voted to end the program in April 2015, not wanting to give renewable energy any more advantages (Malewitz, 2015b).

On climate change however, Georgetown's leaders share the state of Texas climate change scepticism (Satija, 2014), with city authorities making clear that the efforts to develop renewable energy had no connection to climate change whatsoever (Dart, 2015) but was instead about locking-in competitive, cheaper electricity rates than had been previously obtained (Dart, 2015) as well as hedging against any future spikes in coal or natural gas price from changes regulations or market (Malewitz, 2015a).

Section 3.2.1, highlights the regional differences, when cities attempt control of electricity generation and supply across the USA. It is apparent that the traditional regulated mode of electricity governing which dominates the south is more rigid than the restructured electricity markets in electricity governing. Therefore, compared to the Georgetown, San Francisco, San Diego and even Portland (Rutland & Aylett, 2008) examples, municipal renewable energy generation and supply across the South-eastern region continue to be limited to demonstration projects:

> "Energy and climate mitigation projects are usually primary and include efficiency improvements to government and community buildings. Renewable energy demonstration projects are frequently proposed, though not to the extent that they will become dominant suppliers of local power" (Morsch, 2011, p. 9).

Renewable energy development in the South-eastern region is generally constrained by lack of local ownership of electricity infrastructure. Therefore, the lack of legal ownership of electricity infrastructure and subsequent development of renewable energy by municipal authorities or any other third parties at least in the Southeast indicates a more rigid and complicated system:

> "Stakeholders interested in efficiency improvements or renewables face a complex and highly regulated electricity system as well as a maze of legal parameters" (Morsch, 2011, p. 10).

3.2.4 The climate and energy goals of large firms in US

In July 2014, a group of initially 12 major companies which grew to 58 companies, created a "Corporate Renewable Energy Buyers' Principles" document which argued that in order to meet their pledged climate and energy goals, the marketplace should allow for increased access to renewable energy (Tawney, Baker, & Spitzer, 2014). All of these corporations were large Industrial and commercial users. They included big box stores like Walmart, Ikea, Staples, Target, hotel chains like, Starwood, Hilton and finally renowned corporations (blue-chip) including, Google, Microsoft, Bloomberg, Amazon, Hewlett-Packard, Facebook, 3M, GM.

These industrial and commercial customers called for electricity providers to create more flexible options to buy renewable energy, the ability to buy renewable energy directly and crucially, at rates competitive to traditional electricity rates (Tawney et al., 2014).

A crucial part of the principles list was the call for more access to third party renewable energy providers. Along with policies which encouraged clear and uncomplicated long term contracts for projects with third party renewable energy providers (Tawney et al., 2014). This meant making use of renewable energy power purchase agreements, leases and other types of contracts which reduced the cost of renewable energy projects and reduced price volatility:

> "A significant part of the value to us from renewable energy is the ability to lock in energy price certainty and avoid fuel price volatility. Many companies would like to have options for entering into contracts over various time periods" (Corporate Renewable Energy Buyers' Principles, 2015, p. 2).

This creates a potential tension between some electric utilities and commercial and industrial customers. Additionally, the combined commercial and industrial demand for electricity taken off the grid through self-generation or alternative forms of competitive electricity generation. The electric utility sector places high value on customer reliance, modelled load profiles and long established cost recovery methods (Edison Electric Institute, 2012a). However, according to the Edison Electric Institute:

> "A combination of technological innovation, public/regulatory policy, and changes in consumer objectives and preferences has resulted in distributed generation and other DER being on a path to becoming a viable alternative to the electric utility model" (Disruptive Challenges, 2013, p. 7).

As such, there are or could be financial (costs and revenues) and technical threats to traditional electric business models, if electric utilities are not able to address or accommodate these new preferences and entrants (Kind, 2013). Concurrently at the time of research, there was also evidence to show that increasing numbers of residential customers across the country were starting to engage with renewable energy in new ways, including net-metering programs for solar energy (U.S. Energy Information Administration, 2012c). Net-metering is a way to credit residential and commercial customers who generate electricity from solar photovoltaics for the excess electricity sold to the grid at the full retail rate (Solar Energy Industries Association, 2013).

Not without controversy, net-metering programs started in the late 1990s as a means of encouraging renewable energy generation and have since spread across the U.S. (North Carolina Clean Energy Technology Center, 2013). Encouraged by state government policies, by 2010 all states except Tennessee had net-metering customers, with California having the largest share (U.S. Energy Information Administration, 2012c). These new developments in consumers producing their own electricity and third party providers being able to enter the market, have opened up discussions about what the future of the electric grid will look like, how it will be paid for and what are the fair ways to charge for electricity services provided to customers (Aggarwal & Harvey, 2013). Additionally, some of the influences of these changing consumer preferences i.e. a willingness to pay more for cleaner energy (U.S. Department of Energy, 2014a), have resulted in existing electric utilities expanding their products to include green tariffs.

Green tariffs (or green pricing) is the buying of renewable (green) electricity from an electric power provider. Generally, providers sell the renewable electricity at a premium (Environmental Protection Agency, 2012b). Green tariffs are offered in both traditionally regulated electricity markets with assigned service territories and restructured electricity markets (U.S. Department of Energy, 2014b). Some of the reasons for offering green tariffs are to encourage renewable energy development and in other cases due to the decreasing costs of renewable energy. In 2002, across 32 states an estimated 300 IOUs and many publicly owned utilities offered green tariffs to approximately 26 million customers (Bird, Swezey, & Aabakken, 2004). By 2006 sales from green power were estimated to have developed 1GW of renewable energy capacity (Bird & Kaiser, 2007). By 2014 an estimated 850 utilities (IOUs and POUs) in the U.S. have green tariff options (U.S. Department of Energy, 2014a).

Therefore, what can be seen in competitive markets and also in traditional regulated markets in the U.S. is a changing system where low carbon development is being increasingly incorporated into electricity generation and supply. These programs are being mandated by energy governing bodies across the country and come with strong political support. In summary, at the time of research there was uncertainty about how utilities are able to adapt not only to industrial but residential customers demands and how they intend to serve these customers. Additionally, an area of tension is how states with powerful Investor-owned utilities would deal with third party providers and potential competitors, examples include the

Southeast and the Midwest electricity markets. This is an issue because these are markets, where the monopoly utilities have been protected historically from competition.

3.3 Conclusion

The low carbon and fracking era is introducing new challenges in the USA, and is forcing a major rethinking and restructuring of the entire system of electricity generation and supply systems. Additional pressures include the introduction of distributed electricity generation and supply in the form of third party electricity providers, self-generating customers who install rooftop solar, consumers demanding more renewable energy, shale gas and an uncertain regulatory and investment environment. There are significant disruptions to the current utility business model. The motivations for distributed generation and low carbon restructuring vary across the country. What is clear from the literature are the many ways in which low carbon energy restructuring is becoming a key strategy to solve multiple local issues including electricity prices, economic competitiveness and climate change mitigation.

Nevertheless, there is evidence of a regional divide in low carbon restructuring with the northeast, west coast, showing the most activity in terms of efforts aimed at renewable energy development and consumer integration. It would appear that restructured markets like the Western region, North-eastern, Mid-Atlantic states might be more exposed to low carbon restructuring whilst the traditional monopoly modes like the Southeast and the Midwest are more rigid.

It is unclear to what extent progressive ideals about climate change and environmental protection have driven the issue of low carbon energy restructuring in states within the Western region and Northeast, for example, California, New York, Pennsylvania and Hawaii, or whether the motivation for low carbon restructuring has been primarily rooted in energy prices. This is important because the most extensive changes are currently being experienced in states with the highest electricity costs e.g. Hawaii and California. Further research is required to understand how the various pressures and challenges mapped in this chapter are influencing infrastructures and management choices in relation to energy generation and supply across the US. The energy generation and supply system is different in each state and so is the impact of pressures for energy and low-carbon restructuring. It is in this context that the research now turns to the state of Georgia and the research objectives and questions are shown below.

4 RESEARCH METHODOLOGY

This chapter introduces the research objectives and questions that the thesis seeks to achieve and answer, the methods of data collection, the process of qualitative analysis that were followed and it addresses the ethical considerations that arose during the fieldwork and throughout the research.

The aim of the research is to examine the changing context for decisions about electricity generation and supply in the USA.

4.1.1 The Research Questions

The following research questions are intended to address the objectives of the research:

1. What are the governance and management structures for electricity generation and supply in Georgia? How and why are they changing?
2. Who are the key actors and interests in energy restructuring and what is their impact?
3. What does the Georgia case study contribute to understanding of low carbon energy restructuring and the changing institutional context for energy generation and supply in the USA and internationally?

4.1.2 The Research Objectives

The objectives of the research are as follows:

1. To examine the impact of low carbon priorities on electricity generation and supply in the United States focusing on a case study of Georgia
2. To investigate the relationship between low carbon priorities and other factors that might influence investment in electricity generation and supply
3. To develop empirical and conceptual understanding of the restructuring of energy generation and supply systems in the current phase of low carbon restructuring

4.2 THE CASE STUDY APPROACH

The thesis examines those questions through a single case study of the changing context for decisions about electricity generation and supply in the state of Georgia, focusing on state-level frameworks and decisions taken by local government, firms and citizens within Georgia. The following section explains the reasons for choosing that approach and case study and potential strengths and limitations of the single case study method.

4.2.1 The Case Study Approach

Yin (2003), presents five strategies to social science research which include experiment, survey, archival analysis, history and case study. Yin (2003) explains that a case study is appropriate when 'a "how" or "why" question is being asked about a contemporary set of events, over which the investigator has little or no control' (Yin, 2003, p.9). This means that the case study method is useful when the circumstances in that setting are relevant to the research. Since this research looks at how energy decisions are taken in the context of ongoing changes, uncertainties, challenges and opportunities and employs mainly how and why questions, the contextual conditions of this are critical to the research and the case study method is appropriate. Whilst experiments, history and sometimes surveys can answer "how" and "why" research questions, experiments require control of behavioural events/context in the study and historical method is used when studying the past and not contemporary events (Yin, 2003).

The case study approach allows for a detailed understanding of how energy decisions are made, the context in which they are made and the factors driving or shaping those decisions, with interview participants, over whom I have no control, in a context that is new and under researched. This thesis adopts an embedded single case study approach, where the state of Georgia is considered as a general problem for the factors shaping decisions about energy generation and supply, recognising the specific context for decisions in Georgia. The study is conducted by analysing the changing contexts for energy governance and management and potential challenges to existing modes of electricity generation and supply at state level and within the state. The number of case studies was limited to one.

The decision was taken at the outset of the thesis to examine electricity generation and supply in the United States because of the interesting changing context which include a highly-politicised debate on climate change, which has left the United States Congress at a gridlock over the passage of any low carbon law by the federal government. Second, technical breakthroughs in hydraulic fracturing have ushered in low cost natural gas, whilst simultaneously being opposed in more cities and states. Finally, citizens, firms, cities and states are increasingly and rapidly incorporating varied forms of low carbon restructuring, thereby changing and challenging the traditional relationships in electricity generation and supply between cities and states, firms/citizens and utilities.

As set out in previous chapter, the geography of the United States is important for electricity generation and supply, since it has a mixture of electricity markets, economic, political and cultural circumstances. The research therefore presented a choice about whether to compare similar or different state contexts. Whilst there is value in comparing different geographical contexts including their response and vulnerability to the changing U.S. context, low carbon reduction commitments, pressures on the existing energy system, pressure for energy restructuring and the relationship between state-levels and cities in governing electricity and determining the lock-ins that exist across energy systems, it nevertheless became clear that fully understanding decision making would be a significant research task and that two comparative studies would limit the depth of the research. Fully understanding decision making requires capturing sufficient knowledge of wide ranging discussions, debates and interests in electricity generation and supply, given different markets, attitudes, values, regulatory frameworks, economic, political circumstances, and so the decision was taken to do one case study and to look in depth at the different interests shaping decisions.

The researcher took the decision to do one case study and to look in depth at the different factors shaping decisions. The question was what to explore, why, the type of place and the spatial scale of analysis. These were based on an initial small piece of analysis of states which showed the following; regions and states in the U.S. which never restructured in the late 1970s and remain traditional vertically integrated include the Southeast and Midwest regions. These regions have also relied on one or two resources, predominantly coal for their electricity generation mix.

These states have an existing industrial sector or growing industries and have historically cheap electricity price. It was felt that this research could advance most by selecting a case study from these states.

The state of Georgia was chosen as the case study for this research because having relied on coal for a large proportion of its electricity generation (Southern States Energy Board, 2012) since the early 2000s, the state energy company has started having interesting discussions and debates about low-carbon energy restructuring. Georgia was selected because it has been under-researched but also because it is a context where electricity prices are low and low-carbon would not be expected to be a significant drive of change to the dominance of coal-fired power stations. However initial research revealed evidence of pressures on the state electricity provider to reduce its dependence on fossil fuel and also pressures to open up the energy system to decentralised energy supply.

Characteristics	Georgia	
Capital	Atlanta	
Region	Southeast	
Population	9,992,167	
Demographics	White 62.8%, Black or African American 31.2%, Hispanic or Latino 9.2%, Asian 3.5%, American Indian and Alaska Native alone 0.5%	
Governor	Nathan Deal (R)	
Legislature	State Senate Total - 56 38 - Republicans 18 - Democrats	House of Representatives Total - 180 118 - Republicans 60 - Democrats 1 - Independent
Electricity Market	Traditional Regulated (Cost of Service)	
Regulator	Georgia Public Service Commission	
Utility Companies	Georgia Power Company (IOU) 42 - Electric membership corporations (EMCs) 52 - Municipal electric power companies	
Average Electricity Retail Cost	9.63¢/KWh – 2013, 10.03 ¢/KWh - 2014	
Electricity Generation Mix	Coal 35%, Natural gas 39%, Nuclear 23%, Hydro 3%	

Table 4-1: Characteristics of the Case Study; Georgia
Source: Georgia General Assembly, October 2013, U.S. Census Bureau, 2012, Georgia Public Service Commission, 1997d, U.S. Energy Information Administration, State Electricity Profiles, 2013 & 2014

4.2.2 Research Methods

After the case study area was chosen, the next step was the choice of methods for data collection. A strength of the case study approach is its compatibility with a range of data collection types including documents, observations, interviews, artefacts, archives and audio-visual materials (Creswell, 2013; Yin, 2013). The researcher chose to conduct interviews and observations. Interviews are a popularly used method in qualitative research (Mason, 2002; Yin, 2013). The fieldwork was conducted over a 6-month period beginning in October 2013 and concluding in March 2014.

In choosing observations, the researcher gets the chance to observe individuals who currently or have been involved in projects, discussions, events, developments on electricity generation and supply. However, some limitations of observations are that it can be difficult to make notes whilst simultaneously observing and therefore some reliance on memory is needed. Additionally, the researcher can only be present in one place at a time and as such, important events may be taking place, elsewhere, that the researcher may miss (Yin, 2016, p. 434).

For interviews, Yin (2013), explains that interviews in case studies “resemble guided conversations rather than structured queries” (p. 288). Additionally, in a case study interviews would be “fluid rather than rigid” (p. 288). They can also be beneficial because interviewees can provide historical background information or when interviewees or events cannot be directly observed (Creswell, 2013, p. 190). Another strength of the interview is that participants can be interviewed multiple times if needed (Yin, 2016, p. 393). For some researchers, interviews may be the more pragmatic method, especially when data which helps answers the researchers’ questions may not be accessible (Mason, 2002).

The researcher chose semi-structured interviews. Limitations of interviews include the fact that some interviewees may not as articulate and perceptive as others, so documents may be needed to understand/ corroborate/contradict these ideas (Creswell, 2013). During the interviews, some interviewees may provide third-hand evidence about an issue and whilst this data is valuable, the researcher needs to consider that information is being filtered through the perception of the interviewees (Creswell, 2013) and this information may need to be checked.

Other methods which could have been used instead of semi-structured interviews include questionnaires or structured interviews, however in the case of the questionnaire, whilst this method has the advantage of "easy to process" answers (Bryman, 2012, p. 249) due to closed questions being simple for participants to complete and "availability of answers" provided (Bryman, 2012, p.250), questionnaires would not give the researcher the ability to probe or prompt participants on specific questions or for participants. Therefore, unusual or interesting answers may not be introduced, potentially missing out on important/interesting issues relevant to the research and only a few open-ended questions can be asked because questions with complicated formats would cause difficulty in a questionnaire format (Bryman, 2012, p. 234).

These are similar reasons for not using the survey or structured interview format. In the structured interview, participants need to be asked the same questions and the process mainly uses a closed-question format. Probing in a structured interview is difficult, because of the closed question format and the need to standardize responses. Additionally, the researcher would not be able to vary the order/wording of questioning, which ruins reliability and validity (Bryman, 2012, p. 470). Overall, these interview types would be inflexible interviewing techniques, which may not produce the necessary depth the researcher seeks to achieve and may be more suited to survey research.

— Secondary data sources

During the research period documents were used as secondary data to build on the responses gained from the semi-structured interviews and to ensure valid interpretation of the data. Documents mainly related to Georgia while others on the wider Southeast region were collected. Documentation included government reports, state, city and federal maps, newspaper articles, official statistics, weblogs, press statements, webpages, reports, policy documents and dockets of organizations. Other sources included the blogs of interview participants. A number of interview participants permitted and directed me to their own opinion pieces in blogs and newspapers articles. Some interview participants also provided organisational documents. Some individuals had continuing Op-Ed pieces in state newspapers, other individuals had rebuttal pieces which followed energy developments within the state.

In this research dockets (case filings) of the energy regulatory body, the Georgia State Public Commission, were analyzed which showed the issues being addressed in Georgia's energy generation and supply context. These documents introduced some new actors that were not previously considered, and outlined their roles, arguments and opinions in energy decision making and specifically, low carbon restructuring. This allowed for further insight into the decision-making process and the differing perspectives of the actors involved. Data was triangulated between interviewees and also between interviews and secondary data to explore and assess differences in opinion and perception arising from interviews (Mason, 2002).

4.2.3 Semi-structured Interviews

It was decided to undertake interviews because the research is concerned with how decisions about energy investments are taken. It was important to gather data by speaking with key groups in electricity generation and supply, about their views, understanding, knowledge and interpretation (Mason, 2002, p. 63) of the decision-making context. The semi-structured interview method refers to, "a context in which the interviewer has a series of questions in the general form of an interview schedule but is able to vary the sequence of questions. The questions are frequently somewhat more general in their frame of reference from that typically found in a structured interview schedule. Also, the interviewer usually has some latitude to ask further questions in response to what are seen as significant replies" (Bryman, 2012, p. 212). Semi-structured interviews were used so participants would have the freedom to bring up and explain their perspectives on what they considered important details of energy generation and supply and climate change in Georgia whilst still allowing for specific, topic-centered questions (Mason, 2002).

The interview method provided the needed "depth, nuance, complexity and roundedness in data, rather than the kind of broad surveys of surface patterns which, for example, questionnaires might provide" (Mason, 2002, p. 65). Finally, this method also allowed flexibility to tailor questions to different interviews in order to ensure that the necessary, relevant context, depth and understanding issues from the interviewees perspective, in a way that a rigid, inflexible set of standardized questions would not allow for (Mason, 2002) and to adjust to unexpected issues as they come up (Bryman, 2012a).

a. Sampling and Recruitment

The sampling approach used by the researcher was purposive sampling. According to Bryman (2012), purpose sampling is the sampling approach which involves a non-random, strategic sampling of individuals that are relevant/pertinent to the research questions but whilst maintaining variety in the sample. Purposive sampling was used by the researcher to search, identify and compile an initial list of individuals involved in general electricity governing and supply, academics who had authored energy/climate change papers and actors speaking at or hosting energy or sustainability summits in the state of Georgia. The purposive sampling technique used by the researcher was snowball sampling (Bryman, 2012c).

In this research, some participants proposed new individuals who could be interviewed either because these new individuals had been part of similar projects or developments in the state of Georgia or because they had a different or more-in depth perspective on the questions being asked. Therefore, the sample expanded to include individuals involved in some of the most recent energy developments in the state of Georgia. After contacts/potential participants were identified they were contacted via email, which presented the researchers topic/credentials, having confirmed the researcher's credibility, formal interview invitations and interview schedules were made via email. Personal interactions during these meetings or events created opportunities to gain contacts, who would later become interview participants. The researcher presented and exchanged, business cards with contacts made during business events, following which, formal interview invitations and interview schedules were made via email.

b. Preparing for interviews

The researcher created an interview protocol. The researcher used the conceptual framework and documents to create broad, open-ended questions to be asked during the interview. Questions were placed into topic groups and probes written to accompany them. The question topic groups were focused on electricity managing, governance and decision making, ownership of electricity infrastructure, demand and pressures for or against low carbon restructuring. In addition to open-questions, specific, topic-centered questions were asked.

a. *Conducting Interviews*

Semi-structured, one-to-one individual interviews were conducted with key actors involved in Georgia's energy generation and supply including representatives from the electric utilities, state energy regulators, federal, regional and state agency representatives, state departments, state government i.e. members of legislature, industrial (trade) associations, and city hall representatives, as well as Fortune 500 companies, clean energy businesses, environmental advocates, consumer protection agency, political organisations. The total number of interview participants was 25 (see Table 4.2 for details).

Interviews were often conducted in the local offices of the participants but in the rare cases where a local office did not exist, as was the case for a few self-employed participants, interviews were conducted in a quiet cafe or restaurant. Interviews typically lasted between 45 minutes and 1 hour. All interviews followed the same conversational, open-ended format, with variation on the order of questions. The questions followed an open-ended format because this was the best ways to get interviewees to respond, flexibly and offered the potential for revealing unusual or new issues that may be useful data (Bryman, 2012d). The use of open-ended questions allowed for probing into some responses. If required interviewees were offered the chance to expand on their responses, giving greater clarity and information to the researcher.

Interviewees	Atlanta, Georgia
Public Officials	4
Advocates	2
Energy Providers	2
Federal and State Agencies	5
Business Associations	2
Business Community	5
Academics	2
Legal experts	1
Political Organisations	1

Table 4-2: Shows Interviews conducted with Key Groups in the Fieldwork

From the above table of interviews specific groups were of note; interviews with environmental advocates were important because the South-east region has a long history of coal dependence and an ongoing scepticism of environmental issues including pollution control and climate change. Opinions of environmental advocates on electricity generation and supply and low carbon restructuring in Georgia were an important component to this research. Interviewing businesses and trade groups was also important because of the growth coalition that exists between the government and business groups in Georgia - the interests of businesses in the state has been a key part of decision making in the state of Georgia. It was important to understand what this meant for low carbon restructuring in Georgia's electricity generation and supply.

Interviews with academics were useful because of the contextual knowledge of South-eastern energy, due to ongoing research in renewable energy, energy efficiency and decision making. Finally, interviews with public officials, including members of Georgia state legislature, state energy regulators and city hall representatives were useful as there was ongoing debate and discussion over investment changes to Georgia's electricity mix. It was important to gain insight from the decision makers involved.

These interviews with individuals from these key groups provided insight into the perspectives on the recent and ongoing developments in the state of Georgia and the drivers of these issues. These interviewees provided insight into the politics in decision making, priorities, visions, attitudes and values of key actors, the barriers, opportunities and lock-ins in Georgia's electricity generation and supply system.

— Challenges

Interviewing, legal-regulatory energy analyst and electric membership corporations (EMCs), presented a challenge. For this research, a legal-regulatory energy analyst would have been useful to explain and give depth to the understanding of ownership of electricity infrastructure, distributed generation and third-party entrants, traditional and competitive electricity markets in electricity generation and supply.

The electric membership corporations (EMCs), would have been useful in understanding their roles in electricity generation and supply in Georgia, how decision making for EMCs worked in Georgia, and how they differed from or agreed with the investor owned utilities with regards to energy-carbon restructuring. These individuals were not hostile to the researcher, but despite best efforts to schedule dates and times for interviews, they could not participate due to their own schedules.

These challenges were overcome by the researcher attending energy and climate change events based in Atlanta including the Sustainable Atlanta Roundtable, Green Chamber of Commerce, World Affairs Council of Atlanta and Southface conferences. These events helped broaden the energy context because many were legislative luncheons and roundtables, which offered an insight on the current issues in the city of Atlanta and State of Georgia. These challenges were also overcome by including questions about legal/regulatory and governing issues in my interview protocols.

4.2.4 Observation

Case studies take place in a real-world setting of the case which gives the researcher the opportunity for direct observations in real time (Yin, 2013). Observations can be conducted in formal or less formal settings including observing meetings, activities, and work places. (Yin, 2013). Observation when used together with other research methods including interviews and documents can provide additional contextual information to the issue being studied (Yin, 2013). In some cases, the researcher was invited to sit in on energy cases being discussed in the regulator’s office, to observe a formal session of the way the state energy regulators work. Finally, I read through, energy bills, rules and laws for the state of Georgia. In a few occasions, there were opportunities to view media broadcasts of certain key actors, discussing ongoing or past energy developments in the state of Georgia, to understand what their issues and opinions were.

Diary

A research diary was kept, for the duration of the fieldwork, where personal comments of observations, interviews and documents were made.

4.3 Data Analysis

For the analyses of the data, ongoing triangulation was conducted as the field work went on, assisted by the research diary. These following steps were undertaken for the analyses of the data, after the completion of the fieldwork:

First Stage: After all interviews were conducted the recordings and transcribed over a four-month period, during which each recording was played back two to three times and listened to. Recording was done with a Dictaphone and transcription was done verbatim. There were no paraphrases and missing or unclear words were indicated (Bryman, 2012d). The analysis began with coding transcripts. The researcher first coded concepts and phrases from responses frequently occurring across in the interviews (Bryman, 2012b). Then, codes were created for phrases and concepts occurring in the interviews, consistent with the secondary data.

Second Stage: Codes were created for concepts and phrases brought up during interviews and that were identified in the existing literature. Then codes were created for specific issues not identified from existing literature which were unexpected and mentioned by few interview participants. This meant that new issues, previously unidentified by the researcher, were not missed.

Third Step: Linkages between the codes were found and themes were created to properly organize groups of code (Bryman, 2012b), sub-themes were created to add complexity and structure to the major themes. As patterns appeared between the interviews, documents and theory, the themes and subthemes were refined and the story became clear. Finally, thematic groups which emerged from the data were analyzed in the empirical chapters.

4.4 Interview Data Analysis

This section explains the type of data derived/generated by the interviews, how the data was analysed and interpreted and how it was used in the empirical chapters. The interviews generated a range of data in terms of the positionality of the interviewee and their perspective on key events and issues and decisions (what those were and how they might be explained). The interview data reflected different accounts of these events. Interview transcripts were initially coded to allow for comparison and triangulation of different accounts. Key coding categories were: attitudes and values, utility planning factors, environmental/Climate change beliefs, key energy actors in Georgia, actions/plans of key actors, cities, legal barriers to renewable energy and decentralization, business models, carbon regulations, costs of energy resources and CO_2 price.

All transcribed interviews and documents were loaded onto single folder. In a computer database, a notebook of quotations was created, using the key categories as tabs. Interviews had been anonymised before the process, so the extracted quotes had identifiers, so the researcher recognised the interviewee. Coding and triangulation were undertaken. Extracted quotes were coded according to the key categories shown above. All interview transcripts were reread to ensure that the quotes were presented accurately or if the quote needed to be moved to another category or a new category needed to be created. The process was repeated for documents.

The research drew on documentary evidence which included, opinion editorials, rebuttal editorials, newspaper articles, organisations' web articles and newsletters, to cross check if the opinions/perspectives of interviewees were consistent with those given in the interviews. This was done for individuals involved in the ongoing public debates about solar energy/decentralisation, nuclear energy development and carbon regulations. Finally, docket documents of past and ongoing cases at the state energy regulatory (Georgia Public Service Commission), which included petitions, testimonies, rebuttal testimonies and planning documents were reviewed, to check if the official statements of organisations and individuals were consistent with the interviews. If opinions of interviewees were not consistent across all data sources, second interviews were requested, conducted or media broadcasts were used to gather more clarity on what had changed.

The initial coding formed the basis of chapter 5 in the thesis. Chapter 5, was written to provide the different perspectives on; the makeup of the local economy, the political context (political parties at state and city level), the prevailing energy strategy in the state and the main actors and institutions involved in energy decision making. The different perspectives of the interviewees needed to be understood to make sense of the different accounts given and the points of agreements, inconsistencies or points of disagreement across interviews. In general, the analysis which follows presents different opinions rather than seeking to resolve these, and that is a key part of the study. These formed the basis of the analysis of interpretations of key issues and decisions chapter 6, 7 and 8.

Chapter 6, introduces the three main issues ongoing in the case study including, the utility scale solar development/decentralisation, nuclear energy development and federal carbon regulations, the debates/discussions involving these issues and the different interests involved. The chapter was written to understand the politics of low carbon investment in the case study. Chapter 7, was written to take forward the idea of lock-in and introduce the idea of lock-out. The chapter was written to explore the components of lock-in/lock-out including technological, organizational, industrial, societal, and institutional barriers to renewable energy investment and energy restructuring. Chapter 8, was written to serve as an example of the way, the factors introduced in chapter 2, 6 and 7, came together during the main solar debate in the case study.

4.5 Linking Conceptualisation to Empirical Analysis

The key conceptual ideas set out in chapter 2 were:

- Ownership and control of existing infrastructure
- Vested interests
- Lock-ins (Technological, Organizational, Industrial, Societal, Institutional, Cultural)
- Politics and Ideology
- Capacity to act (Financial, Political support, Knowledge & Governing authority)

These underpin the approach to the empirical analysis in a number of ways.

a. Ownership and control of existing infrastructure

Interviews and documents were used to review the history of the energy system in Georgia (how it emerged the way it did, why and which groups were involved) and how the current energy system operates to understand the impact of ownership and control of existing infrastructure on energy investment decisions in the case study, past and ongoing projects/proposals of the different individuals, organisations and corporations actively involved in renewable energy, energy efficiency, fossil fuel and nuclear energy development in the state were reviewed. These included the activities of individual entrepreneurs, Georgia Watch, BLT Sustainable Energy, Georgia Institute of Technology, Sierra Club, Southface, Suniva, Environmental Protection Agency, Georgia Public Service Commission, GreenLaw, Georgia Power Company and Coca-Cola.

Interviewed with the above groups and official documents from the public service commission, were combined with analysis of documents from the Georgia General Assembly, opinion articles by commissioners, utilities and these groups to review laws in Georgia which established ownership and control of energy infrastructure including the Territorial Electric Service Act of 1973. The research explored how the Territorial Act by guarantees assigned territories to incumbent utilities, restricts retail choice to the assigned provider, encourages infrastructure investment by the monopoly and therefore ensures that infrastructure (generation to retail) is owned by the incumbent utility. The research examined how the law was interpreted across all groups involved in energy projects, especially the incumbent utility and renewable energy developers. The research used interviews to explore how transmission and distribution infrastructure, controlled investments by dictating what investments were made, who made the investments and costs of the investments.

These included advocating for laws which favoured centralised energy and restricted decentralised energy (Nuclear Financing Act of 2009 and Distributed Generation Act of 2001), restricting the capacity of distributed generation accepted on the grid, restricting the access of alternative energy providers through T&D costs and restricting the behaviour of consumers. The final step, was reviewing the decisions taken by customers, alternative energy providers, advocates, businesses in response to these restrictions.

b. Lock-ins (Technological, Organizational, Industrial, Societal, Institutional, Cultural)

The research reviewed the history of the energy system, exploring how decisions were taken and what decisions have been taken in the past and what decisions have not been taken and why. Interviews were important in examining the details of recent and ongoing events involving energy investments and examining the perceived barriers to renewable energy, energy efficiency and emissions reductions amongst different groups involved in these events. The research explored the projects of a range of individuals, groups and organisations including, Atlanta Tea Party, Ygrene, Georgia Watch, Georgia Institute of Technology, Sierra Club, Southface, Suniva, Environmental Protection Agency, Atlanta Office of Sustainability, Southeast Energy Efficiency Alliance and Coca-Cola. Using Unruh's sources for lock-in as a model (Section 2.3.c), the research used documents and interviews to explore sources which hindered the renewable energy, energy efficiency and emissions reductions projects of these groups.

The research used interviews to get the opinions of these groups on the barriers to projects and to renewable energy, energy efficiency and carbon regulation. For interviews which referred to technical and economic barriers including grid reliability and stability, business models, regulatory frameworks, costs of infrastructure, the research used academic journals, technical primers from system operators, independent NGOs, federal laboratories and institutes (California Independent System Operator, Regulatory Assistance Project, National Renewable Energy Laboratory and Edison Electric Institute) and books on integrating distributed generation resources. Next, the research reviewed additional documents and data from the *Database of State Incentives for Renewables & Efficiency* (DSIRE), to explore if these barriers were found in other states (California, Minnesota, Colorado and Hawaii) and how they were being dealt with, in contrast with Georgia. Interviews added an important dimension in terms of, exploring how the different groups perceived Georgia's barriers in comparison to other states.

For legal barriers, including the Territorial Electric Service Act of 1973, Distributed Generation Act of 2001, the research reviewed the language of the current laws, current proposed bills and past failed bills to counter these laws, using documents from the Georgia General Assembly, Georgia legal code and Georgia Public Service Commission. Finally, for institutional, cultural and political barriers including regulatory capture, environmental scepticism and a least cost approach to decision making, the research reviewed articles from New Georgia encyclopaedia, opinion editorials and rebuttal editorials and books on Georgia's special interests, politics and culture. The final step, was to compare the lock-in sources found in Georgia, to those used in Unruh's theory of lock-in. By comparing and contrasting these from the theory, the research introduced a new perspective to the theory of lock-in.

c. Vested interests

To study vested interests as a factor in investment decisions in Georgia, the research initially used newspaper articles, weblogs and interviews with clean energy businesses (Suniva, Ygrene), academics (Georgia Institute of Technology), state government agencies (Georgia Public Service Commission, Atlanta Office of Sustainability, Georgia Centre of Innovation), environmental advocates (GreenLaw and Sierra Club) institutes (Southface), federal agencies (EPA) and nongovernmental organisations (Georgia Watch, Southeast Energy Efficiency Alliance), business associations (Georgia Chamber of Commerce, Green Chamber of Commerce) and corporations (Coca-Cola), to explore what the projects of these groups were, how involved these organisations were in the ongoing cases involving nuclear energy, carbon regulations, solar energy investments and decentralisation, what were their demands and rationale for energy investments.

In addition to the interviews, docket testimonies, petitions and integrated resource plans from the Georgia Public Service Commission from past and ongoing cases involving rates, renewable energy, energy efficiency and integrated resource plans were reviewed. Books on Georgia's politics, special interests' groups and activities were reviewed. This was done to explore the history of interest groups involvement in energy, to explore their past and current proposals/demands.

This process introduced more interest groups including Atlanta Tea Party, Southern Alliance for Clean Energy, Georgia Solar Utilities and Americans for Prosperity. Interviews were conducted with members of the Atlanta Tea Party, Southern Alliance for Clean Energy and Green Tea Coalition.

Finally, interviews, events and documents, were used to establish the different activities of these groups involving energy decision makers, geared towards seeking favourable decisions including, case hearings, legislative luncheons, networking events, roundtables, energy summits and town hall meetings.

d. Politics and Ideology

To understand whether and how politics and ideology were a factor in energy investment decisions in Georgia, the research used articles from New Georgia encyclopaedia to review the history of the state government, local politics in the state and economy. In addition, the research reviewed the websites, newsletters and articles of the all groups, to explore the mission, belief and issue statements of these organisations. Especially, the environmental and consumer advocates and the political and trade associations, including Americans for Prosperity, Atlanta Tea Party Patriots, Conservatives for Solar, Georgia Tea Party, Georgia Chamber of Commerce and Sierra Clubs. This was done to understand what the motivation, beliefs and purpose of these groups were. Interviews were conducted to dig deeper into those beliefs and explore what they mean for energy investments in Georgia. Therefore, questions asked of these interviewees included, is decarbonising a priority for the grid, have carbon emissions or climate change been the reasons for any of the projects, how do you feel about Renewable energy portfolio standards, support of the EPA regulations or a cap and trade mechanism, what is meant by Georgia is a conservative and can you and how do you a conservative case for solar energy.

4.6 ETHICS

Interview participants were told the purpose of the research, what was expected of the research participant, including the amount of time likely to be required for participation, and the availability of transcriptions and audio of the interviews. Interviewees were also made aware that participation was voluntary. All information, including my name and contact details were provided, in the event that participants had questions or concerns with the research. Participants were made aware that their confidentiality would be protected. Participant confidentiality was protected by anonymizing the participant information. Participant information was stored, changed and assigned classifying labels, recognized only by the researcher. Finally, there was no familiarity with any of the contacts personally or professionally, nor could they be called acquaintances, these were contacts made during the research process. Due to the nature of the research, politics was important, however, the personal politics of the researcher was not made known to interviewees, to allow the researcher a degree of neutrality and not to give interview participants the impression of approval or disapproval.

4.7 CONCLUSION

This chapter has discussed the research strategy used in this research. It explains the researcher's data collection methods including the usage of semi-structured interviews, observation and documents. It also discussed the researcher's data analysis process and the ethical considerations of the research. The following chapters present findings from the empirical research. The structure for the remainder of the thesis is as follows:

Chapters, 6,7, and 8 explore how the state of Georgia increased the renewable energy in its electricity mix, from 21.4MW in 2011 to 800MW by 2014, by adding solar energy to the utility's Integrated Resource Plan and the debates to open the grid to new market entrants. These chapters discuss the factors which led to the development of solar, the interests involved in these decisions, the resistance to these decisions due to forms of lock-in and the politics of electricity-carbon restructuring in Georgia.

Chapter 6, discusses the factors which led to low carbon investments by Georgia Power in the electricity generation mix and the politics of energy investment decisions in conservative Georgia.

Chapter 7 explores the resistance to electricity-carbon restructuring in Georgia, through the different types of lock-ins found in electricity generation and supply.

Chapter 8 reflects on the utility-scale solar investments in Georgia, known as "The Advanced Solar Initiative" and the politics of electricity–carbon restructuring in Georgia.

5 THE CONTEXT FOR ELECTRICITY GENERATION AND SUPPLY IN GEORGIA

The following chapter sets out the context for decisions about the restructuring of electricity generation and supply in the state of Georgia. It describes the demographic, historical and economic context for governing in the state of Georgia. It also describes the context in which energy decisions are made, including the key actors who govern electricity generation and supply, the specific roles of these groups and the formal process of making decisions. The key arguments of the chapter are that Georgia is a politically and culturally conservative state and over time the relationship between the business and governing community is such that government decisions take into consideration the expectations of the business community. In addition, the state of Georgia, despite relying heavily on energy imports, has no formal energy policy created by state legislature which shapes the direction of electricity generation and supply decisions strategically away from imports. Instead, the Integrated Resource Plan developed by the investor owned utility Georgia Power, acts a de facto energy policy, subject to approval, disapproval and amendments by the state regulators and intervention by key groups.

5.1 THE POPULATION, HISTORY AND POLITICAL CONTEXT OF THE STATE OF GEORGIA

This section presents the history, the current population context and the political context of the state of Georgia. The state of Georgia was founded in 1733 by James Oglethorpe (New Georgia Encyclopedia Staff, n.d.), in the Southeast region of the United States and has 159 counties (New Georgia Encyclopedia Staff, n.d.). Georgia had a population of 9,994,759 in 2013 and 10,097,343 in 2014 (U.S. Census Bureau, 2014) and Atlanta, the state capital and most populous city, had an estimated population of 443,775 (U.S. Census Bureau, 2012).

Figure 5-1: Shows the location of Georgia in the United States with Capital, Atlanta.
Source: Google Maps, 2013.

5.1.1 The Political Context of Georgia

The 82nd and current governor is Nathan Deal and political affiliation is the Republican party. The Georgia state legislature is broken into the House of Representatives and a Senate, both of which make up the primary decision-makers within the state. The party affiliations of the senate and its committees are proportional to the party affiliations of the senate. The state has had a Republican majority in both houses. The legislative branch is as follows:

- House of Representatives: The State of Georgia has a total of 180 members. It comprises of: 60 Democrats, 118 Republicans & 1 Independent.
- The Senate: is much smaller and made up of the 56 members who represent districts from around the state. It comprises of: 18 Democrats and 38 Republicans.

Source: Georgia General Assembly, October 2013.

The state legislature has not always been dominated by the Republican Party, although it has always been conservative. Historically, Georgian leadership and its politics have also revolved around white farmers in rural areas, civil rights, segregation and economic issues (Fleischmann & Pierannunzi, 2007d). Georgia has largely been a one-party state and had been governed by the Democratic Party specifically from 1831 – 2003. Nevertheless, the 19th century Democrat controlled Georgia is not the same as the party after the American Civil War. The early Democratic party in Georgia aligned itself with rural white farmers but also segregationists (New Georgia Encyclopedia Staff, 2005b). It wasn't until 1963 under the leadership of Carl Sanders, that Georgia's politics turned moderately in the sense that, the then Governor was anti-segregationist and not focused on the rural vote (New Georgia Encyclopedia Staff, 2002) or a dominant agricultural economy.

Nevertheless in 2003 the state elected its first Republican Governor since its reconstruction era (New Georgia Encyclopedia Staff, 2005a). The state has elected Republicans ever since. The state's post war history suggests that a core principle in Georgian political leadership has been one focused on economic growth and development and most state's leadership has been elected on those principles (Stone, 1989). The reasons for this will be shown in the overview section of Georgia's and Atlanta's economy and history. However, it is important to briefly describe Atlanta as the capital of the state of Georgia as it plays an important role in the state politics and economy.

5.1.2 The Economic and Development Politics of Georgia

Pre-World War One, the Georgian economy was largely based on agriculture (New Georgia Encyclopedia Staff, 2004a), the main crops being cotton and tobacco. However, due to intensive cotton farming farmers were forced to diversify into poultry and livestock. The destruction of cotton farm land by pests, combined with low prices for the produce meant that cotton started to prove unprofitable but the chicken farms and livestock remained (New Georgia Encyclopedia Staff, 2004b, 2008).

Post-World War Two left Georgia without a large industrial sector since the original economic focus had been in rural Georgia because of the agriculture. State Government was more aligned to rural interests outside the capital city of Atlanta (New Georgia Encyclopedia Staff, 2005b). Calls to change the economic foundations of the economy from primarily agriculture to an industrial one had been made by Henry Grady in 1885 post the civil war and supported by business owners, landowners and the media (New Georgia Encyclopedia Staff, 2015), but whatever gains had been made where eradicated by World War Two.

Therefore post-World War Two saw a poor and struggling Government opposed to the Federal government's New Deal (New Georgia Encyclopedia Staff, 2004c) but needing to restructure in a way that promoted business growth and economic development. Therefore both the would-be mayor William Hartfield and Governor Eugene Talmadge allied themselves with city business leaders (New Georgia Encyclopedia Staff, 2008; Stone, 1989). The alliance between city hall and businesses collectively focused on transforming the economy into a service-based one with a strong and central business community (Stone, 1989). At the time the dominant businesses were the Coca-Cola company, the state utilities, the media and the banks (Stone, 1989). Since then, the partnership between City Hall and businesses has been long standing (Fleischmann & Pierannunzi, 2007d). The coalition focused on growth has since then left Georgia with major and renowned companies headquartered in parts of the state and contribute to the economy as well as the decision making, depending on the issue. Other companies involved in discussions include companies such as: The Coca-Cola company, UPS, Delta, CNN, Southern Company and Georgia Power (Metro Atlanta Chamber, 2014).

The strength of the business and government coalition continues to be critical to decision-making. Stone (1989), in a discussion on the extent of leadership, cooperation and influence that emanates from this relationship, explains that in an effort to have any sort of influence for business contacts, organizational support and even development projects and funds, it was important to be part of this network or coalition (Stone 1989, pp.192). The coalition was not defined by a single organization or group but rather overlapping organizations or groups amongst the business and governing community (Hunter, 1953).

Therefore Georgia continues to be a good state for business in part due to its regulatory environment and costs (Couret, 2012). A key reason and recurring theme in the state, especially outside of Atlanta, is the focus on business growth and development by limiting restrictions on investors. Therefore major selling points for the state have been its low tax rates, low cost of doing business and low-cost of energy (Georgia Department of Economic Development, 2012). This is not particularly surprising as Georgia is a home to a very strong business community in the sense that collectively, the community takes part in many civic activities, it has a broad network and it is staffed and organises for involvement in community activities, it controls funds and resources and dominant companies like Coca-Cola, UPS, Home Depot and Georgia Power which all have established foundations which are often put towards significant projects (Stone, 1988, 1989). The coalition has also invested heavily in the central district and growth of Georgia State.

5.1.3 State and Local Municipal Government

Georgia's cities are governed by the municipal charter which is a fundamental law that grants a municipality the authority to exist and function (Georgia Municipal Association, 2002). The charter establishes a municipal's structure and form of government, boundaries, powers and every municipality in Georgia has a charter (Georgia Municipal Association, 2012). General services provided by the municipalities include, but are not limited to, emergency services, budgets, public transportation, waste disposal and collection, environmental protection, police and fire protection, planning, zoning, taxes, codes, construction and maintenance (roads), water and sewage (Fleischmann & Pierannunzi, 2007a). The state of Georgia has four forms of municipal government including a strong mayor-council, a weak mayor-council, a council-manager and a commission. These structures separate the legislative branch from the executive branch (Georgia Municipal Association, 2012).

So, in the strong mayor-council form of municipal government, the city council is the legislative branch and the mayor is the executive. In a weak mayor-council form, policymaking is shared and the mayor has limited powers. Finally, the council-manager form, operates like a business corporation, where the city council hires a professional manager to run the city's everyday functions, whilst the mayor retains a somewhat ceremonial role (Georgia Municipal Association, 2012). Whilst municipalities have their policy making legislative branches, local policies are constrained by state laws, the Georgia constitution, the municipal governing structure and political support (Fleischmann & Pierannunzi, 2007a). For example, aspects of environmental protection are included in municipal powers but by 2006, only two of Georgia's largest cities (Atlanta and Savannah), had a local climate initiative (Morsch, 2010). Finally, municipalities have the power to contract with public utilities for the provision of services (Georgia Municipal Association, 2012).

5.1.4 Local Economy

Central to the Georgia State economy are private services-providing industries, private goods-producing industries, and civic government (U.S. Bureau of Economic Analysis, 2013). In 2012 the strongest growth to the local economy came from its private sector, business and professional services. Georgia has multiple tax exemptions which make it an attractive location, this has led to new companies starting up or relocating to metro Atlanta. By 2025 there is expected to be a further 1.8 million jobs in the state (Bureau of Labour Statistics, 2000) Atlanta is home to numerous fortune 500 companies and Georgia has important ports used for freight, one of which is the fastest growing in the country. Industries like freight and logistics are critical to the Georgia economy, as the cost of logistics and extensive combination of tax credits make Georgia a chosen destination for new businesses (Selig Centre for Economic Growth, 2013). Finally, Atlanta, is beginning to add a significant number of clean energy jobs to the state including conservation, water, and waste management, transportation, green architecture and green buildings and construction. The city of Atlanta has added an estimated 43,000 jobs in the clean sector from 2003–2010 but these jobs only make up for about 1.9% of the overall economy (Muro, Rothwell, & Saha, 2011).

5.2 THE ENERGY CONTEXT

The purpose of this section is to introduce the Georgia energy strategy and energy mix, to describe the main actors and institutions involved in energy decision making and to analyse the knowledge of the main actors involved in energy governance i.e. the actors who carry out electricity production, transmission, distribution and regulation in the region. It is hoped that this can lead to an understanding of how ownership and control of infrastructure influences decision making.

5.2.1 Georgia State Energy Strategy

The state of Georgia does not have its own crude oil or natural gas reserves and imports most of its energy resources (Governor's Energy Policy Council, 2006). Georgia relies heavily on imported coal resources from Kentucky and Wyoming delivered via railways, liquefied natural gas through pipelines from Elba Island LNG terminal, petroleum through pipelines from the Gulf Coast (Governor's Energy Policy Council, 2006) and local nuclear energy development (Governor's Energy Policy Council, 2006). Therefore, the state's energy strategy:

> "Strives to balance a number of significant issues including the affordability, reliability and environmental sustainability of our energy resources as well as to maximize the benefits derived from locally available energy resources, industries and expertise" (Georgia Environmental Finance Authority, 2006, p.3)

Despite these imports, the state energy strategy does not contain fixed net energy targets in terms of achieving, developing or reducing 'X' amount by 'Y' date. Nevertheless, it has key themes, which it organises around, involving renewable energy, energy efficiency, advanced nuclear and coal technologies and conservation:

> "State Energy Strategy recognizes the need for a combination of all resources with the assumption that no single resource can or will be sufficient. Relying on efficiency, conservation, and renewable energy first, supplemented with advanced clean technologies, including nuclear and advanced coal technology as needed, will ensure our ability to meet our future energy needs in an environmentally responsible and economic way" (Georgia Environmental Finance Authority, 2009, p. 12).

Objectives which emerged from the energy strategy included conducting analyses of the potential for renewable energy and energy efficiency in the state, estimating the risks of potential carbon regulations by the federal government, investing in feasible, clean, next generation technologies such as advanced coal and nuclear technologies like integrated gasification combined cycle, developing alternate fuel resources including biofuels, advocating for more renewable energy, with a focus on biomass resources and solar water heating and exploring potential for other technologies (Governor's Energy Policy Council, 2006). Subsequent energy strategies since 2006, including 2009, 2012 and 2014, have continued with those bases (Governor's Energy Policy Council, 2009, 2012).

5.2.2 Georgia's State Energy Mix

This sub-section will describe the energy portfolio of the sole investor-owned utility in Georgia which has Atlanta as its service territory. The energy portfolio of the utility should show what fuels dominate the mix, its total generation capacity and furthermore, where renewable energy and other low carbon resources rank in its portfolio. The fuel mix of Georgia Power's generation profile from 2010 to 2014 are shown below.

Georgia Power generation and purchased power	**2014**	**2013**	**2012**	**2011**	**2010**
Total generation (billions of KWHs)	69.9	66.8	59.8	65.5	75.3
Total purchased power (billions of KWHs)	23.1	21.4	28.7	26.8	21.7
Sources of generation (percent)					
Coal	41	35	39	62	67
Nuclear	22	23	27	23	21
Gas	35	39	33	13	10
Hydro	2	3	1	2	2
Costs of fuel, generated (cents per net KWH)					
Coal	4.52	4.92	4.63	4.70	4.53
Nuclear	0.90	0.91	0.87	0.78	0.66
Gas	3.67	3.33	3.02	4.92	5.75
Average cost of fuel, generated (cents per net KWH)	3.40	3.32	3.07	3.80	3.82
Average cost of purchased power (cents per net KWH)	5.20	4.83	4.24	5.38	5.68

Table 5-1: Georgia Power generation and purchased power
Source: Georgia Power Company Annual Report, 2012, 2013 & 2014

There are 6 existing nuclear reactors. Their capacities and ages are shown below:

Plant	Capacity (MWe)	Date of Operation	Reactor Design
HATCH-1	924	1975	Boiling water reactor
HATCH-2	924	1979	Boiling water reactor
VOGTLE-1	1215	1987	Boiling water reactor
VOGTLE-2	1215	1989	Boiling water reactor
VOGTLE-3	1117	2017	Pressurized water reactor
VOGTLE-4	1117	2018	Pressurized water reactor

Table 5-2: Shows Georgia Power Nuclear Reactors, Generation Capacity and dates of commercial operation
Source: (World Nuclear Association, 2013)

There are 11 coal fired plants in Georgia, the profile of coal plants in 2013, 2014 and 2015 is shown below:

Name	Date of Operation	2012 Capacity (MW)	2015 Capacity (MW)
Bowen	1975	3,160	3,160
Crisp	N/A	N/A	N/A
Hammond	1954	800	800
Harllee Branch	1961	N/A	N/A
Jack- McDonough		N/A	N/A
Kraft		N/A	N/A
McIntosh	1979	163.117	163.117
Mitchell	1964	125	125
Scherer	1982	750.924	750.924
Wansley	1976	925.550	925.550

Table 5-3: Shows Georgia Coal Reactors, Generation Capacity and dates of commercial operation
Source: Georgia Power, Facts and Financials, 2012, 2013, 2014 & 2015

The breakdown of these in real KW Capacity is shown below.

Total Georgia Power kW Capacity		
Hydro	1,087,536	1,087,536
Fossil	9,110,427	8,791,427
Nuclear	1,959,852	1,959,852
Solar		705
Other (Diesel, Combined Cycle and Combustion Turbine)	5,825,209	5,746,409
Total	17,983,024	17,585,929

Table 5-4: Shows Georgia Power's Total kW Capacity in the Year 2012 and 2013
Source: (Georgia Power Company, 2014b)

Data from the Energy Information Administration (EIA) in the United States shows a similar pattern of energy production and consumption within the state of Georgia.

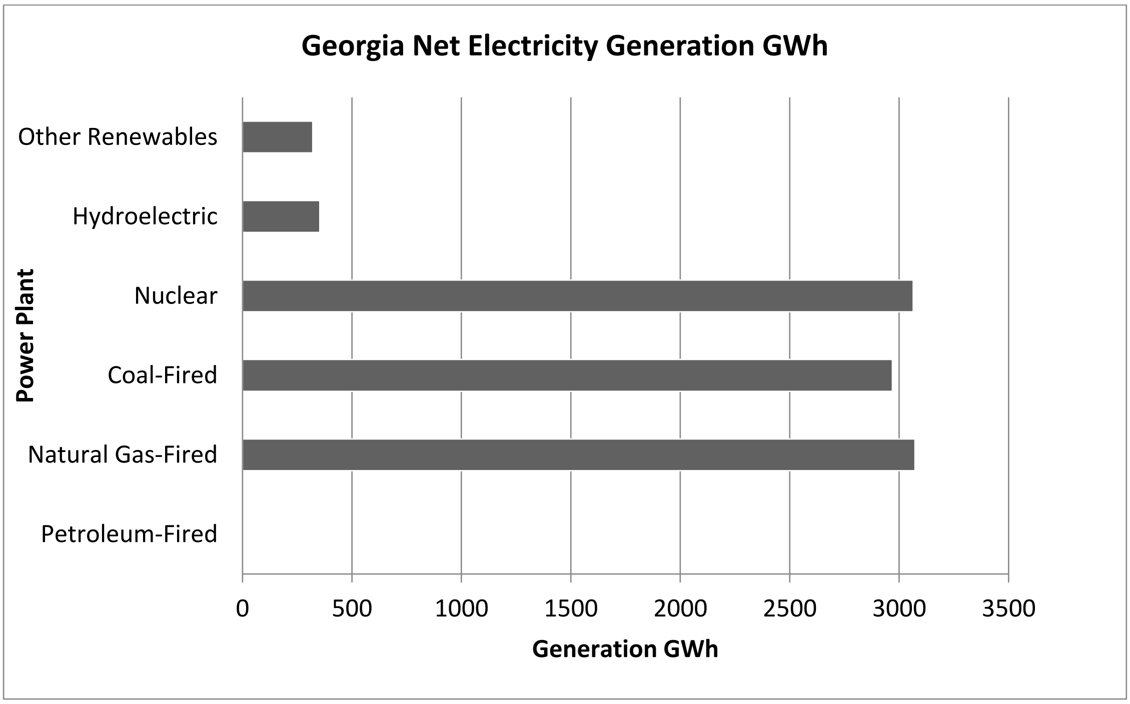


Figure 5-2: Georgia Net Electricity Generation GWh
Source: U.S. Energy Information Administration

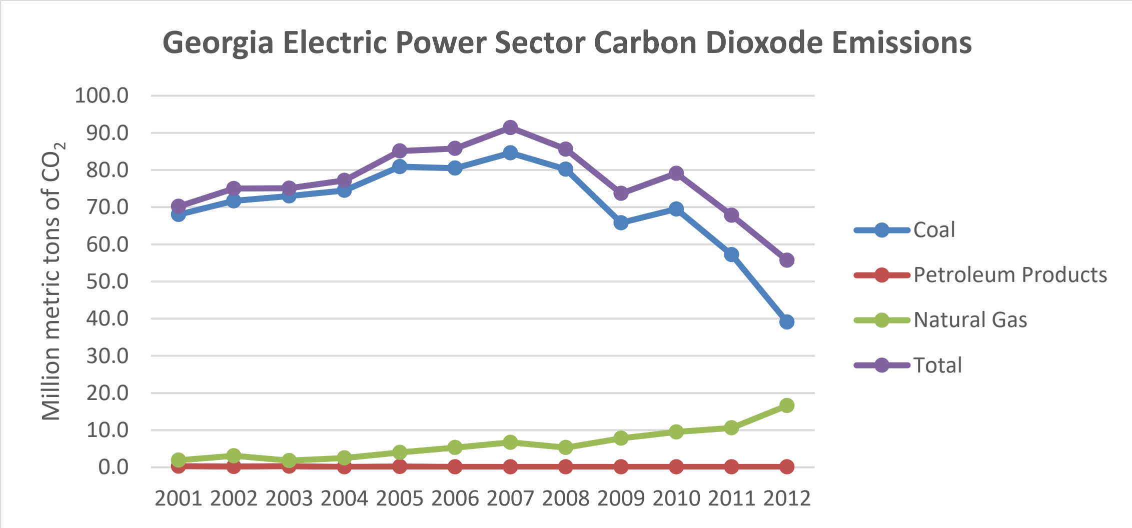
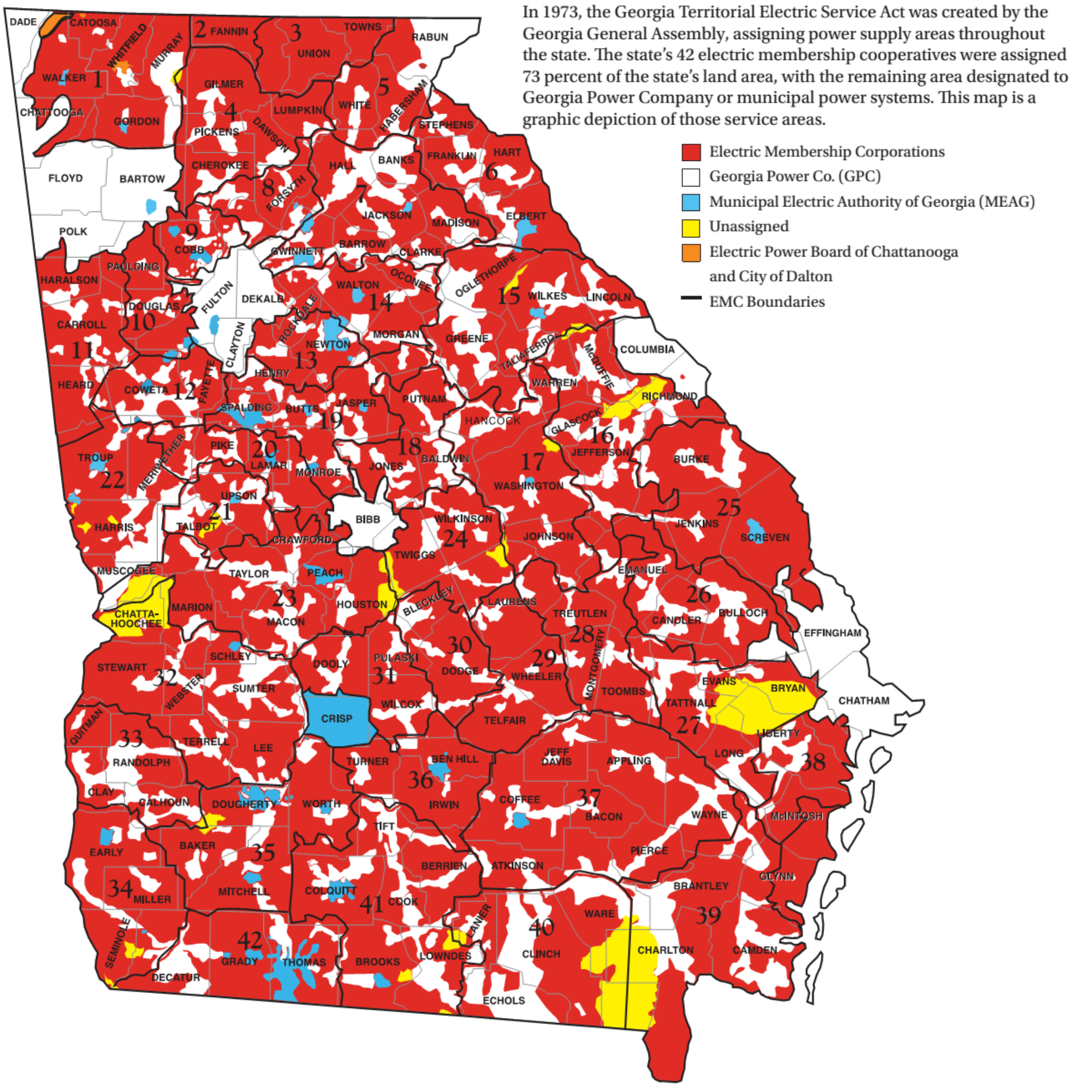


Figure 5-3: Shows Georgia Electric Power Sector Carbon Dioxide Emissions
Source: U.S. Energy Information Administration

It is clear, that from 2001 to around 2011, the dominant fuels for electricity generation have been coal and nuclear as the generation graphs show above. The emission graph also shows a steady emission reduction from coal and increased emissions from natural gas.

5.2.3 Mode of Energy Provision in 2014

Energy generation and distribution is governed through the Georgia Public Service Commission (GPSC), which is the state of Georgia's energy regulator. They operate on state laws and regulate the state's main investor-owned utility Georgia Power, a subsidiary of Southern Company. There are other power providers active in the state of Georgia including the 42 electric membership corporations (EMCs) and 52 municipal electric power companies. Nevertheless, the Georgia Public Service Commission does not regulate the EMCs or municipal power companies, but rather assists on issues of service territories and financing (Georgia Public Service Commission, 1997d). A map showing the service territories of utilities in Georgia and a summary of key organisations involved in generation and supply in Georgia is provided below. Following this is a description of how the energy governing process works in Georgia.



Key to Electric Membership Corporations

1. North Georgia
2. Tri-State
3. Blue Ridge Mtn.
4. Amicalola
5. Habersham
6. Hart
7. Jackson
8. Sawnee
9. Cobb
10. GreyStone
11. Carroll
12. Coweta-Fayette
13. Snapping Shoals
14. Walton
15. Rayle
16. Jefferson
17. Washington
18. Tri-County
19. Central Georgia
20. Southern Rivers
21. Upson
22. Diverse Power
23. Flint
24. Oconee
25. Planters
26. Excelsior
27. Canoochee
28. Altahama
29. Little Ocmulgee
30. Ocmulgee
31. Middle Georgia
32. Sumter
33. Pataula
34. Three Notch
35. Mitchell
36. Irwin
37. Satilla
38. Coastal
39. Okefenoke
40. Slash Pine
41. Colquitt
42. Grady

Figure 5-4: Shows the Electric Service Territories for Georgia's Utilities
Source: Planters Electric Membership Corporation

a. Governing energy in practice

The Georgian state law has provision for the Georgia Public Service Commission to supervise the utilities to ensure it is acting in the public interest (Georgia Public Service Commission, 1997c). Georgia state law requires that every electricity supplier in the state be subject to regulation by the public service commission. The regulated suppliers are then required by law to submit an integrated resource plan, which is critical to meeting energy demand in the state (O.C.G.A., 1981). Furthermore, the investor owned utility (IOU) works with the Georgian Public Service Commission to set the rates for electricity in a process commonly referred to as a rate case. Rate cases are negotiated and debated in a way that enables recovery of expenses by the utility e.g. capital, maintenance, operational costs, metering, billing, etc. (Georgia Public Service Commission, 1997a).

The entire process of rate cases and cost recovery is governed by a mechanism often referred to as rate of return regulation (Regulatory Assistance Project, 2011a). The rate of return regulation is a regulatory tool, which follows an agreement and is a guarantee by Georgian state law that for a service territory assigned to the utility by the state, the utility has a duty to provide reliable, affordable and safe electricity power in a way that is just, reasonable and not unduly discriminatory. In return, the utility gets to spend in a way that maintains and improves the electricity power network, recover its capital and earns a return on its investment (Regulatory Assistance Project, 2011a).

Integrated resource planning is not unique to Georgia. It emerged out of the energy security and restructuring era (See 3.1e and 3.1f), which required long term planning to avoid an energy crisis. It is, essentially, a long-term energy planning partnership in the states. One interviewee, who was also a Georgia Public Service Commissioner explains below:

> "The way that Georgia has set up its energy regulation is much like other states did with the trend that was sweeping the country called integrated resource planning and this integrated resource planning swept through the country, in the late 80s and the late 90s and integrated resource planning or IRP involves, more co-operation between utilities and states and regulators" (2Bi, Georgia Public Service commissioner, October 21, 2013).

Since the PSC operates as a semi legislative-judicial agency (Georgia Public Service Commission, 1997b), these IRP hearings and the subsequent proceedings take the form of judicial proceedings, held at the Commission in Atlanta, before the Commissioners.

Organisations/groups who file a petition to join in the hearings process are referred to as intervenors. During the IRP hearings rate cases and other issues, testimonies, rebuttal testimonies and exhibits are presented by the utilities, adversary staff, intervenors and public witnesses. Witnesses are cross-examined by the PSC, the utilities, adversary staff and intervenors (Georgia Public Service Commission, 1997b). The adversary staff and intervenors and public witnesses may also be cross-examined by the utilities. Finally, the staff of the Public Service Commissioners also conduct reviews which establish the position of the Commission and recommendations are made. In Georgia, the IRP process is perceived by the state energy regulators and electric utilities as democratic and transparent because state regulators are elected not selected by a governor, the process has hearings which are open to everyone:

> "Now you have to remember that only in 12 of the U.S. States are regulators elected. Most of the states they are appointed by a Governor or Senator and so their turnover is a lot more frequent than an elected regulator. An elected regulator can stay in office for a long time" (2Bi, Georgia Public Service commissioner, October 21, 2013).

People with a stake in the state's energy policies including advocates, residents, businesses, etc. and interested parties can intervene in the decision-making process and an energy policy and planning director at a utility in Georgia also echoed the same idea, as shown below:

> "To make a long story short, to get back to the IRP, it's a very open process, we file it every 3 years and then other stakeholder groups such environmental groups like the Sierra Club, they can come into the docket, they can questions us, there will be hearings and we are on the witness stand and we answer questions about the IRP, they can file their own testimony, they can put their witnesses up to testify what they like about the plan what they don't like about the plan, we have consumer groups that will be represented in it, groups that represent large industrial customers, so all different types of stakeholders can come forward during these proceedings and offer their views on what they like about the plan, what they don't like about the plan and then the commission certainly they have a staff that evaluates certain things for their opinions and typically what we do is we'll reach a settlement agreement with the different stakeholders to finally agree upon the plan and then the commission will vote on it and approve it and it generally takes about 6 months from the date that we file the plan to go through all the hearings process and then get a vote and like I said it basically establishes the roadmap that the company follows but again then we are right back again doing it again in 3 more years, so it's always in a fine tuning process" (13A, Director of energy policy and planning, April 1, 2014).

It is also a process, that reduces risk in the energy investments made by the utility, because state regulators can approve, deny and exert control over utility investment decisions with input from all stakeholders. This was stressed by a state energy regulator below:

> "So, but Integrated Resource Planning, allows power companies to consult and get pre-approval, pre-certification before building something, where before we had integrated resource planning, a power company would evaluate their energy needs, they would build it and then they would come to the commission and say "we need to get re-imbursement or recovery" after the fact and it was much riskier for them because what if the regulators didn't feel like they needed all that power. So now we approve in advance with gas plants, with coal plants and with nuclear power plants and that's what I was saying at the end today as part of my speech was that because the Power company already has this plan certified by the 5 commissioners they're going to get their money for the plant. So, it's a lot less risky for the power company to use the integrated resource planning because they are no longer building what's called "spec or speculation" (2Bi, Georgia Public Service commissioner, October 21, 2013).

Finally, outside opinions reflected the same idea as the utility and commissioner above showing that the process was well understood. Everyone knew who to talk to about energy decisions and how the process worked which reflected a consistency to energy decision making in Georgia. Two interviewee comments reflect that the process is well understood outside the utility and commission. The first comment is from an interviewee who was a member and director of a consumer advocacy group in Georgia and the second comment is from an interviewee who was a manager of a non-profit technical, research and advocacy, institute based in Atlanta. Their comments can be seen below:

> "So, in the state of Georgia, the Georgia Public Service Commission requires Georgia Power, every 3 years to put together an Integrated Resource Plan that looks 20 years into the future and forecasts what they think Georgia's energy needs will be and it's their job as the regulated utility monopoly to make sure, that people have their energy needs met. So, that they have enough base-load capacity so that when it's a hot day in the summer and everybody wants their air conditioner to work, there's enough power generation to meet that need. So they say we think that there will be this amount of needed capacity and then they propose how to meet that with the various ways they generate, so whether it's through their coal-fired plants or through their nuclear facilities and they are building two new nuclear facilities, its recently announced wind power purchase agreements, they've got some new biomass contracts and they've through this last IRP process were required to add another 525MW of solar to their capacity plan" (6E 14A, Director consumer advocacy group, January 9, 2014).

The second comment is shown below:

> "You have discussions with the public service commission. You have discussions with Georgia Power, the utilities. You have discussions with elected officials" (7E, Manager technical & research Institute, February 24, 2014).

Furthermore, the Georgia Public Service Commission based in Atlanta where energy decisions are made, is completely open to the public and the commissioners also engage with the public at town meetings or other avenues. This was confirmed by an interviewee who was a public service commissioner in the statement below:

> "Well I certainly participate in public hearings around the state. I was in Savannah last Thursday night for a public hearing about energy prices, so I'll go out in the public but you can't make the public come and listen to you, you can't make the public pay attention" (2Bi, Georgia Public Service commissioner, October 21, 2013)

Whilst the decision-making process was clear and open amongst all the groups involved and members of the GPSC made themselves available to the public, there was disagreement over, whether the public was involved in the energy decision making process or even knew about the GPSC. This was reflected in three comments. The first two comments shown below were made by an academic consultant for the Atlanta city government sustainability plan who explains public unawareness about their own importance and influence in energy decision making through the electoral process. The third comment was also a consultant for the Atlanta Office of Sustainability and director of an energy efficiency company:

> "They [the GPSC] are elected in a state-wide election. So, there would be a coin flip, as to whether you thought the city would exercise more influence or the city-citizens would exercise more influence across the state" (8Ai, Academic consultant, Georgia Tech, October 29, 2013).

Furthermore, public unawareness about the Public Service Commission elections:

> "Well the difficulty with that, so they run at the same time that you have all the other elections on-going. So, the emphasis tends to be on the governor's race or who's running for state senator or state representative and the commissioners are down ballot elections, so they are just a little down ballot, a bit further down. Of course, they don't read that, I mean, they vote, but no one knows who any of these people are, because they are not, they are not direct representatives for them that they may interact with on a daily basis. People are used to thinking of their state senator, their state representative or their governor as

> their elected officials who they need to interact with. Commissioner is kind of like a step below voting for a county judge for people. So, it is not really considered, it is not thought about most of the time. Which also makes it so that in terms of, so this is where the story thickens, the plot thickens" (8Ai, Academic consultant, Georgia Tech, October 29, 2013).

The second interviewee on public unawareness:

> "Here's my answer, are they involved, I don't think so. You know, if you and I went and starting knocking on doors and pitched around these neighbourhoods and said; are you involved, do you know who your public service commissioners, do you know what they do, do you know how to get in touch with them? I'd say 98% have no idea. Now this is me, this is my opinion. I'm not representing anyone else, but I don't think so. I don't really, I mean I've been in this industry too long, I don't think people know who they are, what they do, where they are, how to get in touch with them. So again, I think people at the end of the day when you look at the residential side [um] consumers pay electricity bills because they know they have to, they need light, they need power in their house. A bill is a bill, you know it's not, yeah there may be a spike in it and if there's a spike, your kind of try to figure out what's going on but for the most part, it's just you know, it's a month to month and they don't think about it" (4Bi, company president, October 31, 2013)

Nevertheless, groups representing other aspects of energy such as consumer advocacies like Georgia Watch, environmental groups like the Sierra Club and organisations representing business and industry like the chamber of commerce, are often part of the energy decision making process in the state because they can feed in information or intervene depending on the specific case at the hearings. Furthermore, these organisations also make use of experts from academia, industry or others to feed-in information in the decision-making process. An interviewee who was a representative of the chamber of commerce said:

> "You know, we've all got those education institutions that have high quality research facilities, they all, one way or another-, now, if they don't directly fit in, they might feed in because they do work with Georgia Power, Georgia Power feeds in or they might do work with a solar provider, and the solar person feeds in, so one way or another we get the benefit of what they do, because there's a lot of integration with those experts in the industries around Georgia so, you know, either way, their research capability influences the policy discussion, even to the point where they may give expert testimony and legislative hearing or to public service commission, so again, we're exposed to seek into their technology achievements, and we can, you know, see what the benefits might be or, you know, work with them to identify if there will be benefits of new technologies or what

> they’re thinking, so they’re very active in the development of the energy technology platform” (9A, Chamber Energy Consultant, October 30, 2013).

Finally, the last organisation involved in energy issues is the city government of Atlanta, represented by the Mayor’s Office of Sustainability, however they are generally not involved in the state’s energy decision making and instead focus on the city of Atlanta. Now that the process is understood, summaries of the profile of the principle organisations involved in energy decision making in Georgia are shown below.

Georgia Power Profile

Georgia Power provides electricity to around 2.36 million customers in 155 of the state of Georgia’s 159 counties (Georgia Power Company, 1945). It is a subsidiary of Southern Company who owns electric utilities in Alabama, Georgia, Mississippi and Florida and is a leading and dominant company in the South-eastern parts of the United States, it has an approximated generating capacity of 46,000MW. Georgia Power is the largest of these four. The headquarters of Southern Company is in Atlanta and Georgia Power has a total customer uptake of roughly 4.4 million customers (Southern Company, 1945). Other subsidiaries of Southern Company include brands such as *Southern Power* which is the operator of *Southern Nuclear, the owner of* three nuclear energy generating plants. The company also has *Southern Telecom and Wireless*. At the core of all these subsidiaries and brands are the low retail prices or more specifically prices below the national average.

Organisational Structure of Georgia Power

The organisational set up for Georgia Power is as follows: Georgia Power has a separate CEO and President from the president of Southern Company. A ten-member management council sits beneath the CEO, whose duties include, planning the company vision, offering community information and execution. Finally, a board of directors exists which consists of independent elected members from the community. Georgia Power has co-ownership of 17,000 miles of transmission lines and serves as the operator for the system. Other transmission line owners include: Municipal Electric Authority of Georgia (MEAG), Georgia Transmission Company (GTC) and the City of Dalton.

Georgia Power Electricity Programs and Rates

The company has low residential, commercial and industrial rates; with the average retail price of electricity in (cents/kWh) being 9.55¢/kWh, bringing it under the national average (U.S. Energy Information Administration, 2015). Furthermore, it offers variety of energy plans including green energy supply for its residential, commercial and business customers. Generally green energy programs are referred to as premium programs and come at an additional cost (Georgia Power Company, 2011a, 2011b). In terms of standard programs, the company has programs tailored to energy use, the varying seasons and low income usage. These include a standard service based on normal electricity rate based on usage, a flat bill with a fixed rate for a period of 12 months, a nights and weekends plan which shifts peak hours and finally a budget bill which can be effective for low income customers (Georgia Power Company, 2014e).

The green programs for residential, commercial and industrial customers usually require more commitment on the part of the customer. This involves purchasing green energy in 100 kWh blocks for 12 months at a time with an extra charge of $3.50 plus tax if the green energy source is biomass or $5.00 plus tax if 50% energy comes from solar power, the other 50% comes from biomass (Georgia Power Company, 2011b). The company also offers the option of a special event purchase which is essentially a one off purchase of renewable energy for special functions (Georgia Power Company, 2011a).

The concept of green energy as a premium is clearly shown within the state, as it is priced a higher cost. Nevertheless, the company's rates have managed to stay low and its low-cost energy is a key selling point for consumers. There is a however a side note according to Georgia Power: given the way electricity is produced, transmitted and distributed, the renewable energy option purchased by the customer may not be delivered to the customer specifically but rather it may be added to the grid and used as a substitute for traditional electricity power sources (coal, nuclear or natural gas). These add on charges tend to be written in parts into the state law (O.C.G.A. 46-3A-9 (2010).

The Georgia Public Service Commission Profile

The GPSC is the other state body which regulates the utilities by law. The commission's duty and responsibility is to make decisions which balance the service needs of Georgia's residents with the financial needs of the utility. Therefore the commission requires utilities to provide adequate service at fair and reasonable rates to all its customers (Georgia Public Service Commission, 1997c). This is in line with the U.S. Supreme Court which determined that utility rates approved by the commission must permit the utility to earn a return that does not place the utility at unnecessary risk, does not compromise its financial integrity and hinder its ability to attract investors. The process is governed by the Integrated Resource Planning Act (HB 280, 1990).

This act outlines the job of the commission and the process starts with the utility presenting a plan to the commission every three years. Generally, the commission deals with resource procurement plans, monitors reliability in electricity provision service i.e. plants as well as grid environmental cost and compliance, deals with service territories and rates, charges etc. and finally investigates and audits powers (Georgia Public Service Commission, 2005). Formerly known as the railroad commission, the Georgia Public Service Commission have an elected 5 members of staff, who serve six year staggered terms. The commissioners work with their own group or staff which tends to include experts on utility operations issues and these serve useful during proceedings as they may be called to give a testimony and or recommendations (Georgia Public Service Commission, 1997b).

Finally, the proceedings which take place at the Public Service Commission are open to the public. Since the PSC operates as a semi-legislative and judicial agency (Georgia Public Service Commission, 1997b), these hearings take the form of judicial proceedings, held at the Commission in Atlanta, before the Commissioners. Organisations who file a petition to join in the hearings process are referred to as intervenors. During the IRP/rate cases and other issue, testimonies, rebuttal testimonies and exhibits are presented by the utilities, adversary staff, intervenors and public witnesses. Witnesses are cross-examined by the PSC, the utilities, adversary staff and intervenors (Georgia Public Service Commission, 1997b). The adversary staff and intervenors and public witnesses may also be cross-examined by the utilities. Finally, the staff of the Public Service Commissioners also conduct reviews, which establish the position of the Commission and recommendations are made.

The chairman is elected by the Commission for a two year term with the opportunity to be re-elected for an additional two year term (Georgia Public Service Commission, 2014c).

Consumer Advocates Group

Georgia Watch is a state-wide consumer advocacy group founded in 2002. It acts on behalf of residents and small business owners in various sectors of the Georgian economy. One area is the Consumer Energy Program (CEP), which includes working for fair utility rates and diversifying energy options at the state level. Georgia Watch is involved in the decisions made by utility providers and public service commission. Georgia Watch says it stands for lowering utility rates and utilising cleaner and more efficient energy solutions (Georgia Watch, 2002):

> "Primarily residential, some small and small business customers but primarily we are speaking up for the average every day, you know homeowner or apartment renter or you know people who live in Georgia who have to pay their power bill whether its Georgia power or whether it's one of the gas marketers, natural gas marketers" (6E, 14A, Director consumer advocacy group, January 9, 2014).

b. Arrangements in Atlanta

Energy governance, is generally done at the state level. State law dictates that energy decision making must go through the legislative and regulatory process. This means that the city of Atlanta's office of sustainability is a customer of the dominant energy provider, governed by the state process, not independent of it. Furthermore, legislature on electricity means the mayor's office of sustainability focuses on a broad package of sustainability which includes water, buildings, greenhouse gas reduction, energy conservation within city limits (Mayor's Office of Sustainability, 2012a). Below is a profile of the office of sustainability and its targets and goals.

The Mayor's Office of Sustainability for the city of Atlanta

The role of the Atlanta office of sustainability is to drive environmental and economic sustainability for city government operations and throughout the city. The office creates programs and policies for the following sectors: water and energy conservation, solid waste reduction, emissions reductions and recycling rates. A major goal for the office of sustainability is to make the city a top tier sustainability city (Mayor's Office of Sustainability, 2012b). Part of this includes all the different city departments developing their own sustainability plans that target their major goals and to align those with greenhouse gas reduction goals. The office has broad collaborations with other urban leaders to encourage policy development and reform in select areas.

These urban leaders include representatives from academia, residential groups, faith groups, and non-profits. In terms of financing of the goals, the office of sustainability has secured significant funds for at least 25 new projects. The projects focus on increasing the municipal use of renewable energy to 5% by 2015, reducing city hall's greenhouse gas emissions by 25% by 2020, 40% by 2030 and 80% by 2050 and reducing energy consumption in existing municipal operations by 15% by 2020, 40% by 2030 and 80% by 2050 (Mayor's Office of Sustainability, 2012a). The city of Atlanta's office of sustainability has achieved many environmental and sustainability goals but in terms of electricity, it is limited in its ability due to the state's energy governance structure.

An interviewee, who was an academic consultant for the Atlanta city government sustainability plan summarises the limitations in the statement below:

> "This is part of where Atlanta's context is tricky. Um, so, climate change, you don't have any, there is not broad scepticism related to global warming or anything like that in City Hall. Everybody is pretty much on board with, this is the science and this is where we are. There is not [pause], most of the people that are involved with the city operations on the sustainability side either have kind of like an engineering or legalistic background so it's not as controversial for them, I feel. The difficulty is that Atlanta does not have control of its utilities. So, the utility that supplies power for Atlanta is Georgia Power, which is a state-wide enterprise, it's a state sanctioned monopoly" (8Ai, Academic consultant, Georgia Tech, October 29, 2013).

In terms of low carbon decision making the context of Atlanta differs in terms of the political dynamics within the state and city in a way that makes it different from other cities that could be considered progressive cities on low carbon energy development. The same interviewee, who was an academic consultant, goes on to explain this context in the statement below:

> "The other part is political dynamics within the state are interesting on this front where, so Atlanta is kind of viewed negatively by the rest of the state. So, there's Atlanta and there's the rest of Georgia and they, you see this very clearly if you look at the way the state house operates, that the state legislature operates. So Atlanta is the capital, so everything happens here, but you get a lot of people who are not from the city that are really pushing agendas that are anti-Atlanta. All that's to say that is complicates Atlanta's ability to make changes that impact its own electricity supply. Because the regulatory bodies. So, there's the two main regulatory bodies that are going to be the state legislature and the public utilities commission and those two bodies are state wide bodies they are not tied to Atlanta. So, if Atlanta wants to do things that change the carbon emissions profile of its electricity supply, it really has quite limited ability to do so. That's what I was saying it would be really different than say Austin or San Francisco" (8Ai, Academic consultant, Georgia Tech, October 29, 2013).

Another challenge for the city office is that it often has to work in a state setting where a climate change message is met with scepticism and thus reduction in carbon emissions becomes a hard sell. An interviewee who worked within the Mayor's Office of Sustainability summarises this point in the statement below:

> "It is definitely something that we, take into consideration but it is not a metric that is commonly used for us. We do have a greenhouse gas inventory which measures our carbon annually and then um and within certain groups we'll speak in terms of carbon. But, generally people don't want to hear that here. It is not, that's sort of; it's just not what people understand" (1C, Manager, Office of Sustainability, October 16, 2013).

Finally, given this context of environmental, specifically climate, scepticism, legal energy structures, and uncertain political dynamics, it is perhaps understood why the city does not or cannot play a more active role in energy decision making:

> "The main players would be, the city can agitate for a change in electricity composition and we are seeing that happen a lot lately, nationally. In Boulder, Colorado, just told Xcel get out, we're going to buy the power plants that you providing us, right, we are taking it back from you, you have not provided with the amount of carbon free power that we want. That's happening everywhere, that's been happening a lot this year. Minneapolis threatened to do the same thing which is where Xcel is actually based. That was the result when Minneapolis threatened to pull out, so they went okay, okay, we're going to buy 400MW more of wind. There are a couple of cities in Florida that have done the same thing, so Atlanta; the cities

have leverage if they have the willingness and the political backing to pursue it. I think Atlanta knows but I'm not sure if they know whether they've got the backing or not so I think they are kind of testing the water a little to see" (8Ai, Academic consultant, Georgia Tech, October 29, 2013).

Nevertheless, despite the challenge in any sort of environmental or climate change message, the city leadership continuously makes a conscious effort to look at emissions, efficiency and cost in a practical way. An interviewee who was a member and director of a consumer advocacy group in Georgia summarises these points in the comments below:

> "Like the Mayor's office, that was a decision by the mayor and he has his sustainability team working on that and city council I believe had to approve, might have just been an executive order but that's something that, that goes before the current mayor, mayor Franklin introduced that standard first but those are, again those are the kinds of things that we are encouraging homeowners to do. That's the decision the city is making, they are changing out their light bulbs, they are, stepping up their recycling, you know they are doing things that we, they are making personal choices to reduce energy consumption. So, the city said we want to have the standard of and there are specific things that municipals can do to reduce their carbon footprint and that's a choice thing, right, that's not a state policy, that's a city saying independently we are going to do some things to reduce our carbon footprint and that's an important platform of the mayor of Atlanta right now" (6E 14A, Director consumer advocacy group, January 9, 2014)

Overall, this shows the city of Atlanta being active within its jurisdiction on the issue of sustainability but also unable or unwilling to expand this into electricity generation and supply decisions.

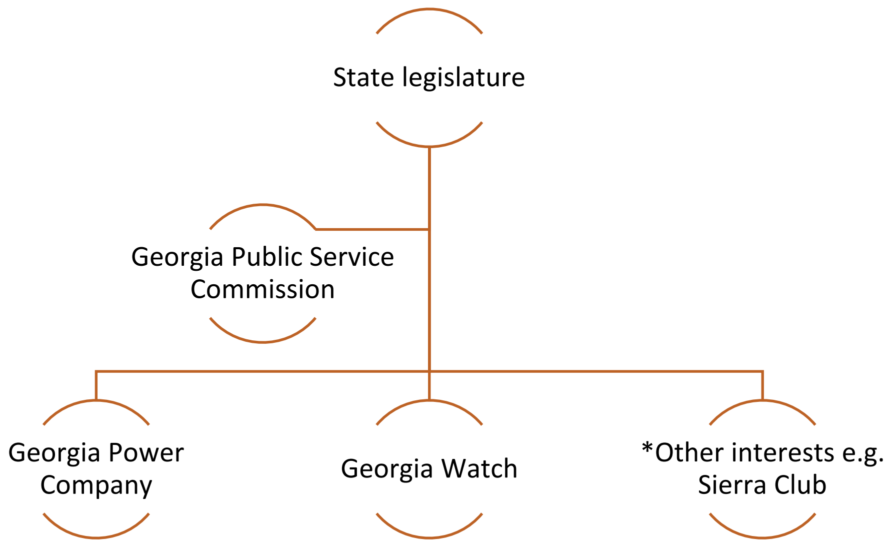
5.3 Key Actors in Energy Decision-making

The key actors involved in Georgia's electricity decision-making include:

- The Georgia state legislature, whose duty it is to create, amend and pass laws which govern electricity generation and supply.
- The Public Service Commission, who are bound by law and regulate the investor-owned utility, balancing the utility's and consumers' interests.
- Georgia Power, the only investor-owned electric utility in Georgia, after the merger with another Southern Company subsidiary Savannah Electric and Power Company
- Georgia Watch, the consumer advocacy group which monitors rates on behalf of utility customers.

Finally, the representatives of any other groups involved will be those with a specific interest in the case, for example, the Sierra Club for environmental reasons, the Georgia Industrial Group or the Georgia Association of Manufacturers. Evidenced by the statement by a Georgia Tech academic consultant:

> "I think you have to have some interest and so what is happening, the types of people that normally will show is the lawyers for everybody. You know, so the utility will always be there. When you have, when they are doing renewable types of stuff, you will have the renewables advocates appear and then there's another group of peoples who have traditionally been the ones there who are more focused on rates." (8Ai, Academic consultant, Georgia Tech, October 29, 2013).



5.4 Public Debates on Low Carbon Energy

In the state of Georgia, public debates and citizen concerns related to energy has focused mainly on rates, including rate increases and managing bills. Citizens care about rates and are sensitive to rate increases, primarily because cheap electricity has been an essential part of Georgia's electricity generation and supply. The consumer advocacy group, whose duty it is to know and advocate for what Georgia's utilities' consumers need, explain that managing bills was the most popular topic for customers of utilities in Georgia. This is evidenced by this statement from a member and director of a consumer advocacy group in Georgia:

> “They're very interested. This is one of our most requested topics. Carla's not here today, she can tell you about that. People are very interested in how they could save money on their power bills” (6E 14A, Director consumer advocacy group, January 9, 2014)

However, evidence from some consumers, technical, research and environmental advocates, suggest that Georgia is experiencing a shift whereby consumer choice and cost savings are perceived as being obtained through energy efficiency and renewable energy.

For an interviewee who was a manager of an Atlanta-based technical, research, advocacy institute, energy efficiency is no longer an outlier amongst the Georgian public anymore:

> “I’ll tell you one of the things that has happened recently two or three times is that people have asked me about LED light bulbs as I am shopping for them. Seriously, but that is, people actually stopped and joined in the conversation I’m having with someone because there’s a realisation that these energy-efficient light bulbs just aren’t outliers anymore. They see someone holding a $10 light bulb and looking at them and they have thought this as well, ‘Should I buy a $10 light bulb?’ They stop and we start engaging in a conversation and other people with stop and listen too” (7E, Manager technical & research Institute, February 24, 2014)

For an interviewee and director of a consumer advocacy group in Georgia, public engagement with energy now includes clean energy:

> “Yeah, people are not only interested in how they can lower their bills but also, they are certainly interested in making cleaner choices” (6E 14A, Director consumer advocacy group, January 9, 2014).

Nevertheless, there is more emphasis on energy efficiency for consumer cost savings, in comparison to renewable energy. This is evidenced by a manager of an Atlanta-based, technical, research, advocacy institute:

> “We are definitely, definitely, definitely advocates for increasing the renewable energy capacity of the state without a doubt, but we also will always remind people that the most cost effective source of energy is not using it in the first place” (7E, Manager technical & research Institute, February 24, 2014).

This conversation about energy efficiency has extended to include electric utilities as well, where some environmental advocates believe that with the preponderance of coal in the electricity mix, energy efficiency may need to be given some priority over renewable energy in the short term:

> "But when it comes to the energy efficiency phase which is obviously for, as it relates to carbon emissions in an area like ours or the Midwest where you've got such a high predominance of coal in the mix, the efficiency stuff can be as important or much more important than very quick or at least very short term, in the very short term it can be that much more important than doing renewable capacity expansion" (6E 7G, Sierra Club Chapter Organiser, February 26, 2014).

Therefore, the main groups for whom low carbon has become a political issue are the growing number of clean energy companies including solar and wind manufacturers, energy efficiency companies along with environmental and sustainability advocates who can benefit directly or indirectly from energy-carbon restructuring. In Georgia, there has been a growing push from the green business community whose businesses grow when forms of energy-carbon restructuring are undertaken in Georgia's electricity generation and supply. Illustrated by a comment from the manager for the Atlanta office of sustainability:

> "So, there's not a lot of push in the south. It has grown. It is a growing push." (1C, Manager, Office of Sustainability, October 16, 2013).

For example, solar manufacturers, many of whom are associated with the Georgia Institute of Technology, are coming together to grow solar in the state of Georgia, because despite being based in Georgia, renewable energy is estimated at 1% (See 5.2.2). This presents an opportunity to expand their businesses and impact upon Georgia's own electricity generation and supply. This is illustrated by comments from the manager for the Atlanta office of sustainability:

> "Solar is because of Georgia Tech, I know one of the bigger companies; Suniva. They are Georgia Tech alone. I mean, they just stay in Atlanta. That's where they base their company." (1C, Manager, Office of Sustainability, October 16, 2013).

> "Oh, but they are not a utility provider, just a bunch of manufacturers coming together." (1C, Manager, Office of Sustainability, October 16, 2013).

However, growing the solar energy market in Georgia, has become a political issue due to the regulatory and legislative nature of the traditional regulated market, dominated by single monopoly providers. This is illustrated by a director of one of the largest solar manufacturers in Georgia:

> "Yeah, I think, it's only been an active role since I joined Suniva start-up solar company here in Atlanta and I learned that Solar is part of the electricity markets which are very much

regulated, in Georgia and in the United States and its very political and at first, I wanted to be apolitical and just think about the technology but I realised that if we were going to have solar in our own backyard, Suniva is headquartered here in Atlanta Georgia, then we needed to affect policy." (4Bii 9B, Snr. Director International Sales & Market Development, February 20, 2014)

Similar reasons exist for energy efficiency or other companies who gain from energy-carbon restructuring. Examples include individuals involved with financing renewable energy and energy efficiency installations or retrofits in buildings and construction. These are illustrated by two comments below. The first from an interviewee, who was a director of an energy efficiency company looking to advance Property-Assessed Clean Energy (PACE) financing in Atlanta, describing the difficulties in getting the program approved:

> "So, I am actually working to get this program established here in Atlanta, so again step back, a PACE program requires a public partnership, the city of Atlanta is our partner, you need state enabling legislation as well, so you need some policy at the state level which we did in 2010, it just takes time. So, I like to say that there's three steps and there's not really three steps but it's easy to bucket them. State enabling legislation, city sponsor and then you have to validate the program legally and so in Atlanta we've done the first, we've done the second, we've got the state, we've got the city and we are in that final step of legally validating the program and you are just at the mercy of working in the court system because in essence you are taking a legal structure to validate the program and the bonds that get sold for the project through a legal discussion and it just takes time, it's just a timing thing. See, you know through-out the last year we've had city council votes, we've had resolutions passed, ordinances passed, resolutions that different agencies passed locally so all our work has been done, it's just getting us to the point of being able to launch where you need that final stage, that final step and that's where we are." (4Bi, company president, October 31, 2013)

The second was an individual from the construction industry, seeking to expand business opportunities:

> "I'm doing it because nothing's more fun than pissing off a monopoly, just great, but you also, for us in America, you have to have a business model because that's how I get Georgia Tech interested in what I'm doing. They're now hopefully going to help set me up so my business has a chance to succeed. Help introduce me to people who can get the things that I need and then possibly if the business is likely to be worth anything. They might invest and then everybody makes money so, I'm not doing any new technology as a matter of fact, what I'm doing is helping to get the technology more widely distributed. If my company works it will bring more solar to people than currently is being done. In other words, I'll

> greatly expand the market for solar and so that's what I'm trying to do." (4Ai, Business developer, February 19, 2014)

Finally, low carbon is a political issue for environmental and sustainability advocates, for whom getting cleaner energy into the Georgia's energy mix is a goal; such as the Sierra Club, which has a political campaign designed to end the use of coal in U.S. electricity generation. Sierra Club has a local chapter in the state of Georgia and one of the it's campaign manager confirms this position:

> "So, I primarily work on a campaign called the Beyond Coal campaign, and that's the Sierra club's largest national co-ordinated campaign, and the goals are to move, um, America's electricity sector, off, of coal, by 2030. We want to see the electricity sector move off, of all fossil fuels, natural gas, oil, coal, by 2050 and we want to see all of that capacity replaced by wind, solar, geo-thermal, hydro, energy efficiency." (6E 7G, Sierra Club, Georgia Chapter Organiser, February 26, 2014).

These are the groups, for whom, low carbon has become a political issue in the state of Georgia.

5.5 Conclusion

In summary, Georgia is a conservative state whose government is dominated by the Republican party in most branches of state government; from the executive branch, down to the state energy regulators. The state's economic policies are geared towards growth and as such, its energy strategy has been to use the least cost resources in electricity generation and supply; traditionally this has been coal. However, the city of Atlanta, due to its history, has emerged politically different to the rest of Georgia; It is the liberal city in a mainly conservative state, predominantly governed by the Democratic Party. Although Atlanta is a liberal city, one key point is that the city does not have its own electricity utility and hence is limited in its ability to enact to change.

Due to the traditional regulated structure of the electricity market in Georgia and the heavy use of coal and nuclear, electricity rates have been low in comparison to other states; so, the focus of residents in Georgia has been on rates or rates increases, not on low carbon energy. However, energy efficiency and renewable energy are starting to be perceived as means of cost savings. Finally, there is starting to be a small but growing push from the green business community for policies which grow renewable energy and energy efficiency in Georgia, to expand business opportunities and to benefit from energy-carbon restructuring. Recent developments in Georgia involving the federal energy regulations, new nuclear energy development, rate increases and distributed solar generation, (explored in the next chapter) describe the politics of low carbon advocacy in Georgia.

6 LOW CARBON ADVOCACY IN GEORGIA

So far, the PhD has examined the context in which energy decisions are made, including the key actors who govern electricity generation and supply, the specific roles of these groups and the formal process of making decisions. The following chapter discusses the debate and decisions surrounding low carbon investment shaped by different interests in Georgia. Of particular interest are the debates about EPA regulations, solar development and new nuclear development. Between 2011 and 2014, the state of Georgia was involved in three intertwined debates about energy-carbon restructuring and the direction of its energy generation and supply.

This chapter investigates the decisions taken on low carbon investment by Georgia Power, the investor owned utility. This investment, it is argued, in part reflected persistent intervention and lobbying in the Integrated Resource Planning process and rate cases by a mix of renewable and energy efficiency business advocates, consumer advocates, conservative law makers, three Public Service Commissioners, a group of Atlanta Tea Party Patriots and environmental organisations. However, the decision for low carbon investment energy-carbon restructuring was also a response to federal climate protection policies, notably the recent Environmental Protection Agency proposal to reduce greenhouse gas emissions in April of 2012. The chapter brings out the complex politics of pro-low carbon lobby in the state of Georgia between 2011 and 2014, reflecting the overlap between environmental interests and conservative political support for reduced state intervention and energy freedom.

6.1 DRIVERS FOR LOW CARBON AND DISTRIBUTED GENERATION IN GEORGIA

This section of the case study explains the drivers for low carbon in Georgia, including the proposed energy regulations by the EPA making its way through the regulatory process, the pressures for solar distributed generation and decentralisation and the pressures to invest in new nuclear capacity.

6.1.1 Developing federal government regulations as a driver of low carbon in Georgia

In April 13, 2012, the national EPA proposed new standards of performance for greenhouse gas emissions from new fossil fuel power plants. The proposal received 2.5 million comments and based on these, issued an updated proposal on the 20th of September 2013 (Environmental Protection Agency, 2013d) aiming to curb emissions directly from power plant output from new fossil fuelled power plants. These actions signalled steps by the EPA and the current administration to form a federal climate change strategy for the United States in the absence of congress (Environmental Protection Agency, 2015b).

The 1970 Clean Air Act is an exhaustive law comprised of six parts, covering issues ranging from air pollution prevention to ozone protection (Environmental Protection Agency, 2013b), nevertheless, of importance in this proposal are rules governing *air quality and emission limitations* (U.S.C., 1970), relating to *standards of performance for new stationary sources* (United States Congress, 1970). In April 2012 the EPA proposed new standards of performance (NSPS) which essentially set limits on CO_2 emissions from *new* fossil power plants (Environmental Protection Agency, 2013d), notably (a) new coal fired plants would have a limit of 1,100 pounds of CO_2 per MWh; and (b) natural gas-fired plants would have a limit of 1,000 pounds of CO_2 per MWh.

After establishing new standards on new fossil fuel power plants, section 111(d) also requires the EPA to regulate CO_2 emissions on existing power plants (Environmental Protection Agency, 2013e; Tarr, Monast, & Profeta, 2013). This section of the law has rarely, if ever, been used in the past and utilities coped with environmental regulations by installing environmental pollution controls for reducing emissions such as scrubbers, low NO_x burners, and electrostatic precipitators. Furthermore, aspects of section 111 in the Clean Air Act have also in the past been designed in partnership with the states and utilities.

An interviewee, who was the Energy and Climate Change co-ordinator for EPA region four, which includes eight southern regions and Georgia, explains the implications of the proposed rule:

> “The President of the United States came out with his National Climate Plan of Action in June. So, he’s come out with his actual plan to address climate change both on mitigation, so now he’s proposing new power plant rules for carbon reduction, which has not been done in the United States before. Power plants have been allowed to produce as much carbon emissions as they’ve wanted. So, we’ve already submitted for new power plants, rules for new power plants and that’s currently under public review right now, public comment period. Then next year we’ll be releasing rules on existing power plants, which is going to be a more, tougher rule, at least in the aspect of it’s going to be harder to tell current power plants what to do than it would be their building new ones.” (10A, EPA regional co-ordinator, January 16, 2014)

The proposal also puts the spotlight on expensive, pollution controls often used by utilities, with cost estimates of installation for these technologies often ranging from hundreds of millions to a billion dollars (Regulatory Assistance Project, 2011b) , making it in the best interest for the power generation utilities to rethink the way they produce power and what fuel sources work in the long run (Environmental Protection Agency, 2013d). In Georgia, key decision makers including state energy regulators and utilities were aware the Environmental Protection Agency’s proposed carbon regulation was developing and gave similar responses to how they had adjusted their decision making in anticipation of it becoming a legal rule.

As Georgia relied predominantly on coal for energy generation, it became clear that the new regulation would have a significant effect on the state’s energy generation mix. An interviewee, a public service commissioner aware of the developments of the proposed regulation, explained that the regulation could potentially be very expensive, for Georgia, since the state had very low existing renewable energy capacity:

> "I think there is some value to getting ahead of potential federal regulation, so if the federal government in 20 years said that Georgia has to be at 25% renewable energy and right now, we are only at 1%, it’s going to be expensive to get to 25%, in a way, if we did have a standard it would ease us into this." (2Bi, Georgia Public Service commissioner, October 21, 2013)

In addition, the main utility, whilst acknowledging the pressure of federal regulation on coal plants, emphasised that potential regulations are incorporated into their planning process for electricity generation but signalled that coal would be replaced with mainly natural gas. One interviewee, a director of energy policy and planning at one the utilities in Georgia, acknowledged that carbon regulation was a key factor in their future electricity generation planning process:

> “Obviously and it’s probably true in the UK, the coal fired generation is the fuel type that’s under the most pressure with new environment regulations and so as part of our IRP filling, we conduct what we call unit retirement studies on the coal fleet and we look at, if we know we are going to get new environmental regulations coming down the pipeline in the future and we model what we think the cost of those regulations is going to be to comply with and we compare continuing to operate that coal unit on what these environmental regulations, we compare that to retiring the coal unit and replacing that it with a different type of technology which typically will be a natural gas combined cycle or a combustion turbine technology.” (13A, Director of energy policy and planning, April 1, 2014)

Nevertheless, there were suggestions by some interviewees, that the utility’s response to the EPA regulations has been and will be disputed due to the costs associated with compliance or noncompliance. This is illustrated in the comment made by a senior technical analyst for a southern interstate non-profit organisation:

> "Well, the rule for new plants is, the proposal has a year before it’s implemented there. So, people will complain, they still have a comment period, but the rule for existing plants is just, hasn’t been developed yet, so they’re collecting comment now for that one, so the utilities are screaming, I mean they are so, unhappy because it is going to increase the cost, screaming like babies. Cost, cost, cost, you’re not going to get out of it." (6E, Snr. technical analyst, October 31, 2013).

There were also environmental advocates, consumer advocates and green businesses interviewees, who were unconvinced about the EPA proposed rules as a main driver for low carbon in Georgia. One interviewee, a manager of a non-profit technical, research and advocacy organization based in Atlanta, believed that the main driver for low carbon in Georgia was extremely low natural gas prices:

> "There are incremental changes that are going to be put in place about emissions. Not all of it is carbon emissions. Some of it is other types of pollutants but what we have here is a confluence of tire regulation on the air quality or the air pollution and a dramatic drop in the price of natural gas because of fracking. So, those two things have combined to change

the fuel mix of Georgia Power's electricity which has reduced their coal use increased their natural gas use. That has impacted the carbon intensity of electricity at the smokestack because to me it's still unclear what the lifecycle carbon impact of fracked natural gas is. I've had that conversation with folks at Georgia Tech." (7E, Manager technical & research Institute, February 24, 2014)

However, a consultant and director of an energy efficiency company raised the issue that the drive to low carbon resources was also driven by the need to renew aging electricity infrastructure in Georgia:

> "So yes, the EPA is obviously putting into place restrictions on air emissions from coal plants but the majority here, the utility, the coal plants are in essence on their last legs. Most of them are getting shut down." (4Bi, company president, October 31, 2013)

6.1.2 Low cost natural gas as a driver for low carbon electricity in Georgia

In 2011, the state of Georgia had an energy generation mix of coal 48%, nuclear 26%, natural gas 21% and other resources including wood, hydro and petroleum making up the remaining share of 5% (Southern States Energy Board, 2012). By 2013 and 2014, Georgia's energy mix was coal 35%, natural gas 39%, nuclear 23%, hydro 3% (Georgia Power Company, 2014a). This reduction in Georgia's coal use (Figure 6-1), indicated a form of carbon reduction, but the degree indicated it was not driven by a low carbon strategy.

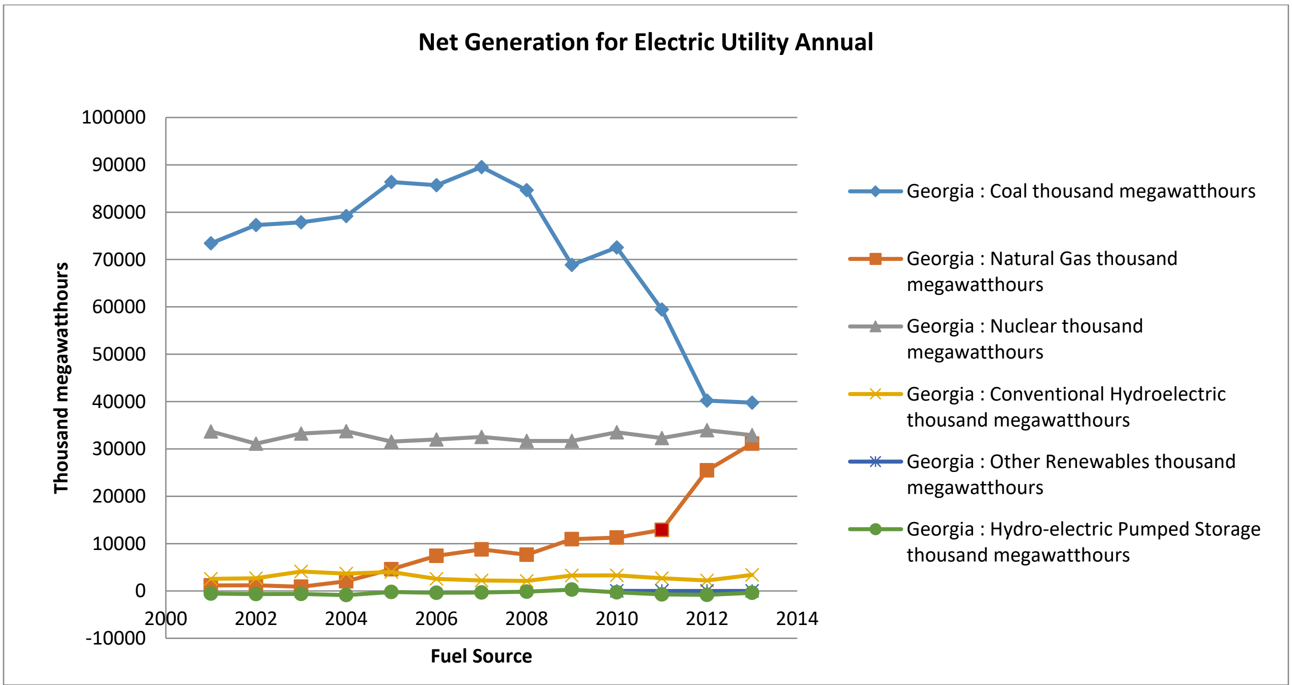


Figure 6-1: Net Generation for Electric Utility Annual from 2001 – 2014
Source: U.S. Energy Information Administration Electricity Data Browser

An interviewee from a Georgia consumer advocacy group explained that the coal reduction was an economic decision, due to the current era of cheap gas and the expense of environmental retrofits for coal plants:

> "The decision to close the coal plants was because it wasn't economic to open anymore because they are old and installing environmental controls is costly and the cost of natural gas has come so far down, right." (6E 14A, Director consumer advocacy group, January 9, 2014).

The perspective that it was not economic to run the coal plants was expanded by a senior technical analyst for a southern interstate non-profit organisation to include issues of profit maximisation:

> "They will run whatever is the cheapest thing to run because they're trying to maximize their profit and minimize cost" (6E, Snr. technical analyst, October 31, 2013).

Georgia Power tends to position itself as technology agnostic, being open to different approaches to solve problems, not relying on a specific strategy and considering all technologies. A director from a utility in Georgia said:

> "On the supply we take into account a myriad of things, certainly we look at our existing fleet of generation resources and how they are operating, how old they are, what new controls are going to be needed to ensure they stay in compliance with existing and new environmental rule making and then we also look from a expansion if we are going to need to have to add additional generation, we model what the expansion may look like, so if we are going to need to add generation in 2019, how much generation we think it would be and what would be the most economic technology to, that would be available then" (13A, Director of energy policy and planning, April 1, 2014).

But there were no indications of a low carbon plan or strategy in utility planning:

> "And what it does, it puts together what we call an indicative plan, it's not set in stone because you know obviously, conditions change, economic conditions change, environmental conditions change over a 20-year period. We look at fuel costs, so we see which way natural gas prices are going, coal prices, nuclear, we also look at renewables, what's happening with technology costs on renewables and are they becoming cost effective" (13A, Director of energy policy and planning, April 1, 2014).

Some business interests, like the Georgia Chamber of Commerce, embraced the advent of low cost natural gas, describing expanding its use, into other sectors of the Georgia economy:

> "We don't mine coal, and I don't believe we have any significant shale gas reserve, it might be little tiny pockets but, so as a state we're a net importer of both coal and various, you know, the natural gas supplies, irrespective of where they are sourced from, but Georgia is very supportive of the use of natural gas for energy generation, and there is a significant movement now to include natural gas for transportation" (9A, Chamber Energy Consultant, October 30, 2013).

Nevertheless, an environmental activist and campaign manager for the Sierra Club indicated that the utilities were responding more to natural gas than other technologies, because whilst they had shut down some coal plants, they had retrofitted others for natural gas generation to replace some of the free generation capacity. Additionally, the environmental activist also indicated that the Sierra Club wanted to shut a further five or six coal plants in the state of Georgia by 2020, with an eventual goal of closing even the retrofitted gas plants:

> "Yes, and we also want to see the retrofits that they did to natural gas, we want to see those turned off by 2050" (6E 7G, Sierra Club Chapter Organiser, February 26, 2014).

These comments demonstrate pressure for low carbon restructuring in the state of Georgia. Overall, by 2012, the oversupply of natural gas was making wholesale electricity prices for gas-fired power generation cheap in comparison to other fuels, to the degree that utilities in Georgia were retrofitting plants, evidenced by the comment below:

> "Yes, carbon emissions in the United States are lower than they have been in two decades, and that's partially because methane emissions, from natural gas are higher than they've been in a long time, ever been, excuse me" (6E 7G, Sierra Club, Georgia Chapter Organiser, February 26, 2014).

6.1.3 Attitudes on energy policy in Georgia

In Georgia, there were no formal goals or targets related to greenhouse gas emissions reductions or energy security measures. To some actors in the state legislature, this represents an absence of a formal energy policy and is often seen as regressive:

> "Why are we so dependent on foreign oil, we don't have a state energy policy and I think the last state energy policy I saw was back in 2012, I mean we've never had a state energy policy and it's just, I mean it's regressing, I have to say" (2A 3D, Georgia state representative, April 11, 2014)

Key actors in Georgia's electricity investment decisions (utilities, regulators, legislators and businesses), shared a similar attitude of having a reliable, affordable, energy supply, which governed, much of the decisions made about electricity generation and supply in the state. This attitude overlaps with a strong prevailing priority of keeping the energy price low to support economic development. For businesses like large manufacturing companies, these principles are long established in Georgia, evidenced by a representative of the Georgia Chamber of Commerce:

> "The way energy strategy or energy policy was initially developed was to ensure that everybody around the state had fair, equitable, reliable and affordable power, so there were policies and programmes set up to ensure that delivery" (9A, Chamber Energy Consultant, October 30, 2013).

Yet, whilst businesses may see, fair, equitable, reliable and affordable power as the main priority for of energy policy in Atlanta, representatives of the electric utilities stress that cleaner energy with each new investment also features as a core principle in Georgia:

> "I think the energy policy in the state is been focused on providing a reliable affordable energy supply to our customers to the citizens of the state to encourage growth, economic development you know quality of life, at the same time the policy is implemented by the commission is been focus too on how do we generate cleaner and cleaner energy, to every Kilowatt that we generate is cleaner than the last kilowatt" (13A, Director of energy policy and planning, April 1, 2014).

6.1.4 Other pressures and demands for and against low carbon restructuring in Georgia

In 2012, Georgia Power started seeking plans to close or convert around 15 units of its coal plants to natural gas or biomass (Reuters, 2014). The reasons included old or aging plants, possible federal regulations and cheap natural gas (Southern Company, 2013a). The 15 coal and oil units make up a substantial generating capacity and it was reported that the retired power units would free up over 2,000MW. This reduced capacity created a demand for newer resources, especially energy resources for baseload power, including new nuclear, natural gas and biomass. Some of the freed-up capacity was initially scheduled for biomass projects, but eventually did not come to fruition (Swartz, 2013a).

Other freed-up capacity was added to a new nuclear expansion project (Vogtle 3 & 4), to be developed by Georgia Power which became very expensive and incurred cost overruns (Swartz, 2012). The result of this nuclear expense created pressure on the utility and Georgia PUC from green businesses, environmental, technical, consumer advocates and a small sect of Tea Party members, for the development of decentralised energy, specifically solar energy.

a. Pressure for renewable energy and energy efficiency

In Georgia, the key actors lobbying for greater low carbon investment in the electricity mix were largely from the business and government sectors with some crossovers and advocates. Some of these groups saw renewable energy as an untapped resource, in a state which had sufficient resources. Some actors from the consumer advocacy groups were part of larger groups, exploring the technical potential of wind energy resources, confirmed by a member and director of a consumer advocacy group in Georgia:

> "I'm part of the Georgia Wind working group and we hope to see more wind generation here in Georgia, although Georgia Power did recently announce a power purchase agreement for wind from Oklahoma, well there's a working group that's looking at the real potential on the coastline and in some mountain areas but it's something that is still in the studying stage. Georgia power is going to be doing this, coming out of this IRP they are going to be studying, Georgia Power will be studying the potential for wind energy generation Georgia" (6E, 14A, Director consumer advocacy group, January 9, 2014).

Other groups including Southface, a non-profit technical, research and advocacy organization, were exploring energy efficiency as an untapped and underutilised resource:

> "Georgia has done a good job at adopting energy codes that bring our residential energy efficiency to the next level. The next task is for the individual governing municipalities, either at county level or the city level, to actually go out and enforce the code. Now the reason that's important for a low-carbon electricity standpoint is because the lowest carbon electricity is electricity that's not used. So, we begin with energy efficiency as an attempt to do what we can at the municipal level because the city-, so, the City of Atlanta cannot control necessarily the fuel mix at Georgia Power" (7E, Manager technical & research Institute, February 24, 2014)

An independent sustainability company was also looking to advance Property Assessed Clean Energy (PACE) financing and energy efficiency into the state of Georgia:

> "Well I mean there's a lot that can be done, we're just the tip of the market. I mean we're not even, if you look at the trajectory of efficiency programs just in the Atlanta market, we're still at the bottom of the curve. We've got a long way to go. There's much more market penetration or many more programs, efficiency programs that could be developed from the utility standpoint" (4Bi, company president, October 31, 2013).

Finally, there were groups who wanted to develop the solar energy market, and were eventually successful in pushing the utilities and PSC to develop 800MW of solar energy. They included consumer advocates like Georgia Watch, some members of the Tea Party, environmental advocates like Sierra Club, renewable energy businesses associations like the Georgia Solar Energy Industries Association, solar energy companies and state and regional groups like Southern Alliance for Clean Energy. The focus on solar energy was deliberate: in 2012, the National Renewable Energy Laboratory's resource map of technical potential for renewable energy in the United States (Figure 6-1), shows that there are not significant resources of wind, geothermal, tidal or wave energy resources in the state of Georgia. This fact is widely recognized by the advocates. An interviewee, who was a manager for the Office of Sustainability, said:

> "In Georgia, solar is an awesome resource, we get a lot of sun here. Wind, we don't get a lot of. There are a couple pockets, we have the Appalachian Mountains, on top of some mountains there are some good pockets and off-of the coast of Georgia there is a great opportunity for wind but that's outside of our cities" (1C, Manager, Office of Sustainability, October 16, 2013).

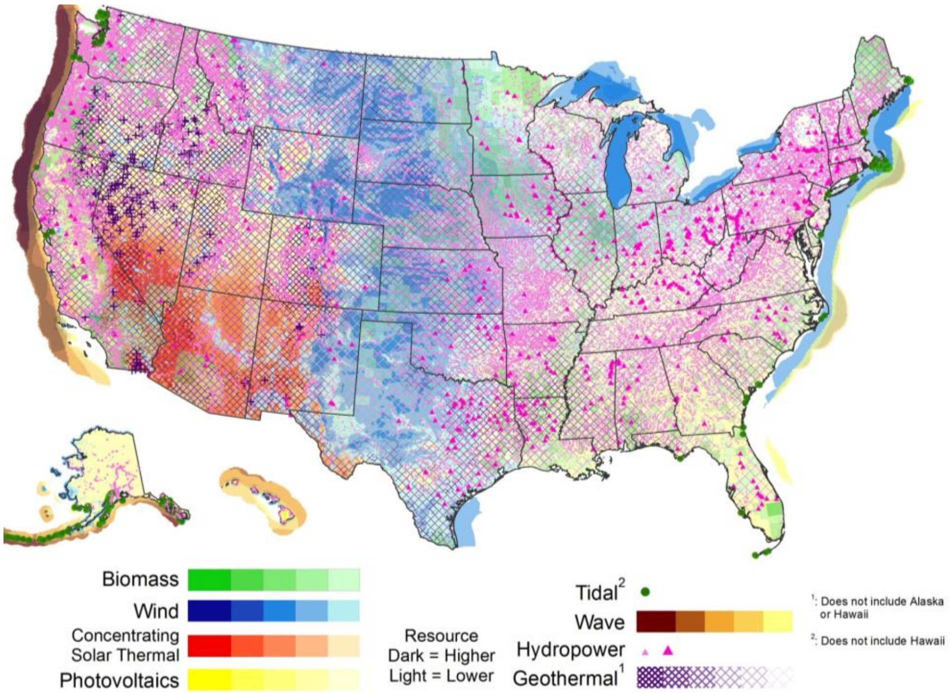


Figure 6-2: Shows Renewable Energy Technology Resource Maps and Technical Potential for the United States in 2012
Source: National Renewable Energy Laboratory, 2012

However, advocates from the construction industry and solar companies also pointed out that, unlike wind energy, a lack of state policy not resources, had been the issue for solar development. One interviewee from the construction industry and a solar advocate said:

> "You know what Georgia probably gets more sun in a week than Germany gets in a year, solar deployment follows policy, it doesn't have anything to do with the sun believe it or not, it has nothing to do with the sun, it depends on the policy. If your state has a good policy, solar will flourish, if it doesn't it won't, it doesn't matter where it is" (4Ai, Business developer, February 19, 2014).

This is backed up, by the National Renewable Energy Laboratory's solar resource map (*Figure 6-2*), showing that Georgia falls into tiers 2 and 3 as it has an above average solar insolation of 5.0 – 6.0 kWh/m^2/day. This represents a significant amount of solar energy given that the highest states are in tier 1-2. The states with high solar insolation and are as follows: California, Arizona, New Jersey, Nevada, and Colorado (National Renewable Energy Laboratory, 2013a). These states also have the highest solar installations in the country and the strongest solar incentives.

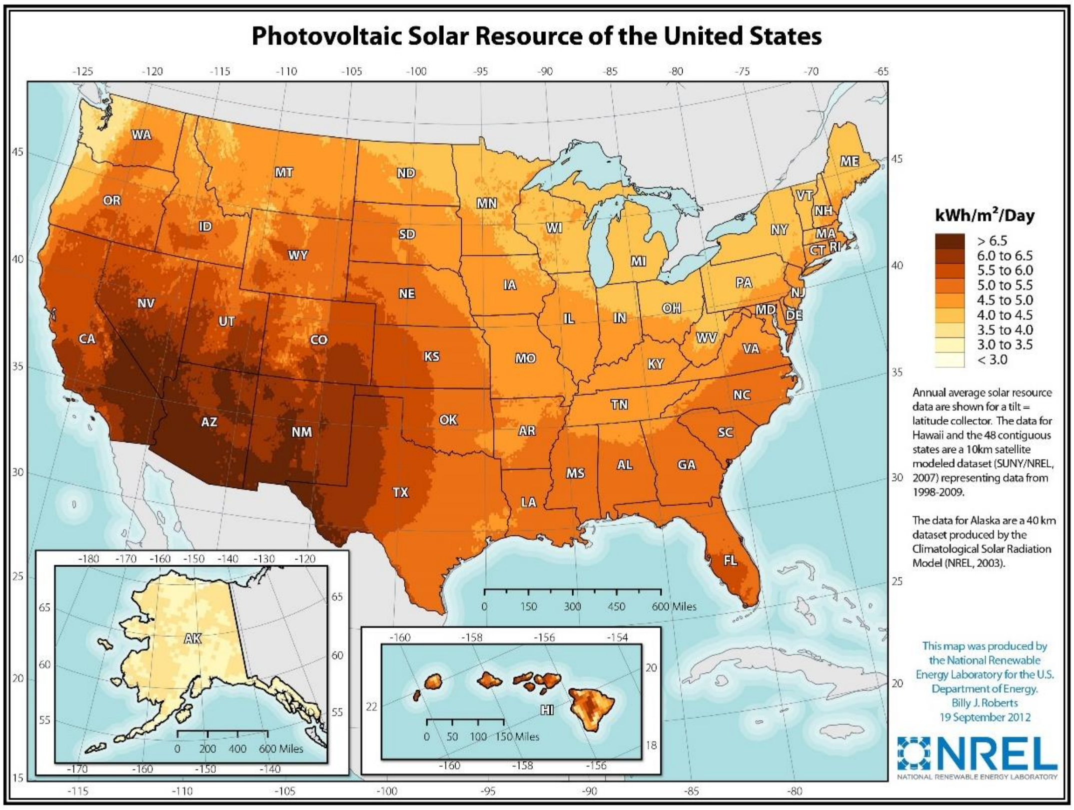


Figure 6-3: Shows Photovoltaic Solar Resource of the United States
National Renewable Energy Laboratory, 2012

The gap in solar deployment, despite its generation potential, created some of the pressures for low carbon restructuring in the state of Georgia.

b. Demand for baseload power

A key part of Georgia's low cost of electricity has been its reliance on baseload coal and nuclear plants (Figure 6-1) which are inexpensive to run, however the reduction in coal generation has led to new natural gas plants, along with demand for the first new nuclear plants in the United States in 30 years (Echols, 2015):

> "First, our state has no Columbia or Colorado River to produce big hydro power. We have no power plants on mine-mouths, natural gas fields, or Hoover Dams. A significant portion of Georgia's fuel for electricity production has to be transported over 1,000 miles. Yet, our energy prices are still low. Chalk that up to good planning and management by Georgia Power and constructive regulation from an all-Republican public utility commission-elected state-wide every six years. What we do have is nuclear power, and it enjoys widespread support" (Echols, November 13, 2015).

The support and demand for more baseload power is situated in the prevailing attitude of low cost, reliable, affordable energy supply (6.1.3), perceived as key to business success and economic growth in the area:

> "Only time will tell if Georgia and South Carolina can "jump-start" a nuclear renaissance. Let's hope we can, because low-cost base-load energy — the amount of electricity available 24 hours a day — is a key to economic growth" (Echols, July 25, 2013, Online Athens, Athens Banner-Herald)

To a great degree, this reliability and affordability in Georgia are distinctly perceived by the state energy regulators, the utilities and business associations like the Chamber of Commerce, as being achieved through building more nuclear baseload power, in a way that the other fuels are not:

> "In the case of nuclear, at the time that that was proposed, it was simply, you know, a response to the best alternative or base power. In the long term, what was the best economic opportunity to deliver affordable, reliable base-energy, and at the time, nuclear was the outstanding economic opportunity" (9A, Chamber Energy Consultant, October 30, 2013).

The outcome of the current demand for baseload power is low carbon restructuring in the form of new nuclear energy construction:

> "We use the IRP process to identify what we believe is going to be the lowest cost resources to meet our needs and so several years ago, we identify nuclear as being a cost-effective option for our customers and, and keep in mind we already have 4 nuclear unit on our grid today and they have been providing reliable load cost energy for several decades now" (13A, Director of energy policy and planning, April 1, 2014)

But this does not exclude future consideration of other baseload plants like advanced coal and newer combined cycle natural gas plants.

6.2 Outcomes of Pressures and Demands For and Against Low Carbon Restructuring

The outcome of the demand for baseload nuclear power and pressure for solar energy resulted in the commissioning by Georgia Public Service Commission of three solar initiatives; the Georgia Advanced Solar Initiative, the Large-Scale Solar Initiative, and the Integrated Resource Plan Expanded Solar Initiative (***Table 6-1***).

Georgia Power Solar Programs	MW
Final Order Integrated Resource Plan	525
GPASI Distributed Generation	100
Utility Scale Projects	110
Large Scale Solar	50
Existing Solar	22
Total	807

Table 6-1: Georgia Power Solar Programs Progress 2012 – 2015
Source: *Georgia Power Company*

These initiatives developed solar energy capacity in the state from 22MW in 2011 to a total of 800MW by 2016. In 2011 and 2012, renewable energy held a less than 1% share of generation capacity (Georgia Power Company, 2014a, 2014b), but by 2015/2016, after the solar addition, it would be a 2% share of generation capacity (Georgia Power Company, 2015).

In 2008, Georgia Power filed an original plan for two new nuclear reactors. The project was said to be a $14 billion capital investment in the state and the new nuclear reactors were originally funded by a United States Department of Energy loan guarantee. The loan was estimated at $6.5 billion (Mundy, 2014). The new nuclear expansion (Vogtle 3 & 4) is owned by all the major utilities in the state of Georgia; with each owning a percentage of the expansion plan, including; Georgia Power - 45.7%, Oglethorpe Power - 30%, Municipal Electric Authority of Georgia - 22.7% and Dalton Utilities - 1.6% (Southern Company, 2013b).

The demand for new nuclear by the utilities, became key in the debate to develop solar because the construction of the new reactors had incurred significant budget overruns and delayed schedules. The reasons for the significant delays and budget problems were a combination of various factors including a five-year project approval timeline by the United States Nuclear Regulatory Commission, an issue with the design of the reactors, causing the design to be altered 19 times (new design type in the United States) and legal issues between the nuclear contractors and the utilities involved (Swartz, 2012).

In 2013, Georgia Power filed a series of requests including a $1.46 billion request of increased rates which would fund pollution controls for existing coal plants and grid maintenance, a bill by state legislature to assist in the financing of the new nuclear project and a tax on owners of solar panels. This nuclear energy financing act in 2009 was passed by the state legislature and it allowed a recovery of financing costs during construction whereby utility customers were paying for the nuclear plant before the plant was finished and operational. Instead, customers paid whilst it was still under construction and before entering service (Georgia Power, 2014). The nuclear costs were incorporated into the customer's monthly power bill and stand currently at 9.3% (Georgia Public Service Commission, 2014b).

The requested new tax on owners of solar panels was rejected by the Public Service Commission and an $873 million rate increase was approved, as opposed to the initial $1.46 billion originally proposed. These series of actions added to the demand and pressure for renewable energy on the utilities and regulators, because the entire budget, delay and rate increase development was not well received by groups pushing for solar energy or energy efficiency in the state of Georgia. It is in this context, of the new nuclear delays and budget overruns, that the solar development story is analysed and told in chapter 8; where positions, attitudes, values, ideologies supporting or opposing solar energy development, could also be seen mirroring the nuclear energy development.

6.3 THE POLITICS OF ENERGY-CARBON ELECTRICITY RESTRUCTURING ADVOCACY

Georgia is a politically and culturally conservative state and its policies tend towards conservativism (Fleischmann & Pierannunzi, 2007c). Fleischmann & Pierannunzi (2007), *"Georgians have long been known for traditional values, conservative politics, and a general distrust of government"* (p. 85).

In Georgia's decision-making environment, conservative views are dominant, influential and sometimes may unfold in unexpected ways with regards to what aspects of low carbon energy policy are resisted and supported. In Georgia, the pressure from the EPA regulations to reduce carbon emissions plays out differently to the pressures to develop solar energy and nuclear energy.

EPA regulation is strongly resisted as a federal imposition and sometimes as an unnecessary liberal climate policy. Within that resistance there is a feeling that federal government is forcing Georgia to take decisions that are not in the best economic interests of the state; however, that resistance has limited impact on decisions. In this case, the power of the Georgia government is preferred over that of the federal government.

Conservative influence over solar development plays out rather differently because this low carbon initiative is supported on the grounds that it is about individual freedom versus regulatory control from the government. In this case, the power of the individual is preferred over the government.

Conservative influence over nuclear development also plays out differently. In this case, strict attitudes towards least-cost electricity generation and federal interventions are compromised to support nuclear energy development in a way that is not afforded to other technologies, especially renewable energy. The perceived benefits of baseload power to the utilities and businesses and state economy, supersede the subsidies, high capital costs, budget overruns and even rate increases associated with nuclear energy development.

This section explores each of these issues separately, beginning with EPA regulations, solar development and finally nuclear energy development.

6.3.1 Conservative influence over Federal Environmental Regulation

Environmental policies from the federal government have been and continue to be a source of conflict and resistance in Georgia, especially in relation to EPA regulations requiring power plants reduce carbon emissions. Much of the conflict arises from conservative ideology about state autonomy. This view of autonomy does not accept the EPA role in setting national regulation and is therefore resistant to the Environmental Protection Agency's plan to force existing power plants to reduce carbon emissions. Therefore, the EPA's proposed section 11-1(d) regulation on power plant carbon emissions reductions, is resisted based on two grounds: (a) an ideological opposition to federal power, and (b) an opposition to climate policy.

In Georgia, all five public service commissioners critiqued the EPA regulations. The concerns were that the EPA was exceeding its authority, it diminished state authority over governing electricity, it was an indirect mandate for renewable energy and the regulations were not grounded in science (Echols, 2014a). All these criticisms were rooted in opposition to federal power and climate policy. Illustrated by the comments from a Georgia Commissioner below:

> "'Climate talk' is en vogue right now and is receiving unprecedented media coverage. That doesn't give the EPA the right to exceed its authority. Historically, the EPA has focused on the power plant itself and little else. Until Congress expressly authorises it to do so, the EPA has no business impacting energy efficiency, solar and even the power plants we get to turn on." (Commissioner Echols, Athens-Banner Herald, June 14, 2014).

This opposition was characteristic of conservative Georgia, but it may be considered to be representative of southern Republicans:

> "You know again that's kind of the southern United States, Republican thinking is, less regulation, less government is better and I think you'll find that on renewables here, don't pass a government mandate to tell me how much renewables I need, let me go figure it out and make a business decision." (4Bii 9B, Snr. Director International Sales & Market Development, February 20, 2014)

Georgia's influential business organizations like the Georgia Chamber of Commerce also oppose the EPA on those two grounds. According to Chamber, the EPA regulations provide another means for the federal government to reduce CO_2 emissions, since climate change policy is at an impasse in Congress:

> "Okay, our response to that last one actually gave testimony at the EPA, on that it's to slow down-, there is an unhealthy pace that EPA is putting on, and it is political, we know that, you know, we know that president Obama cannot get his preferred legislation through the congress because he can't get it through the house of representatives, that's the political reality, that's what democracy has given, so actually he is trying to use whatever regulations EPA can provide to get the same or a similar, or a progressive outcome. Now, the point that we emphasised last week in the testimony was don't establish an artificial timeline to do this, because investments in power generation are not things that you turn on and off overnight, they are long term." (9A, Chamber Energy Consultant, October 30, 2013)

To the Chamber of Commerce, whilst the current issue is climate related policy, the opposition is to the federal government using its power to push through contested legislation whether it's a Republican or Democrat administration:

> "Except that, what you've got is, and I suspect it's the same with the Republicans, it's been some time since one or the other party has had sufficient control of the congress to be able

> to make sure that the EPA look like what they want it to look like, so they've all had a lack of numbers in some area where they've had to, the EPA had to go and finesse the rules and regulations they've got to fit a political ideology and some would argue that that's what's happening now." (9A, Chamber Energy Consultant, October 30,2013)

Furthermore, the Chamber of Commerce, perceives that despite having complied with the regulations, Georgia's utilities are still penalised in the long-term when a new policy is pushed through:

> "So if you are going to put in place a policy that says a certain power source, generation source, must do X and is going to cost billions of dollars, be mindful that that could have a 20 or 30 year life span, or, alternatively as one of the generators, well hang on a minute, we are coal because about 20 years ago when we wanted to build-, or when we built our new power plant, we wanted to use natural gas, but there was a specific federal law that prohibited the use of natural gas. Now, they're going to be taxed through a new EPA regulation. So, they'll spend billions of dollars on the coal power plant that they never wanted to build in the first place, but the law said that they couldn't build it with natural gas, so they're all these unintended consequences." (9A, Chamber Energy Consultant, October 30, 2013)

Ultimately, the perspective of the Chamber of Commerce, is that investments in low carbon should come about as a result of market signals and not regulations. The recent investments in natural gas plants are examples of responses to the market:

> "Well, people would very much support it if it was only the market, but it's not exclusively the market. Obviously, at the federal level, there hasn't been any consensus on climate change legislation, so there's no legislative driver, but EPA is doing its best at the president's direction to use existing regulations to put in place appropriate controls or directives. Now, the market is responding to those, and the market's responding to competitive pressures between natural gas supplies, which have increased rapidly over the last four or five years and coal, so that is why you're seeing a lot of coal supplied power plants being converted to natural gas." (9A, Chamber Energy Consultant, October 30, 2013)

Conservative political groups like the Tea Party also oppose government regulations because they believe in freedom, especially individual and economic freedom and in the case of the EPA regulation, the belief is that the utilities should be free to make their own business decisions. However, they also perceive these regulations to come at some cost to rate-payers. Therefore, the free market is preferred to deliver more economic, efficient and advanced solutions.

A Tea Party founder and solar advocate argues that removing regulatory barriers for clean energy from electricity markets whilst ensuring that polluting energy sources, pay for environmental or health damages, would be a more effective solution to reducing carbon emissions than EPA regulations:

> “Well, number one, I think the PSC is on top of that but you know, I oppose excessive regulation. I don’t support excessive regulation, whether it be from the EPA or anybody else. I think, we need to be deregulating, you know, I think we need to be removing some of the regulatory barriers. I think if, and I believe the free market is the way. I believe that, remove the barriers, allow clean energy to compete on a level playing field, in the free market and let the market decide what energy is best. I believe, energy that damages the environment, should be fully responsible for the repair and any health-related cost.” (15D, Tea Party activist, October 5, 2016)

Furthermore, given the traditional regulated electric market in Georgia, some of the investments costs (upgrades, pollution controls, etc.) will be incorporated into the rate structure and passed on to the utility customers. So, there is a cost to the consumer, in direct response to the federal regulation. These are illustrated in comments by solar and consumer advocates. The first comment was by a director for a solar firm:

> “So, Georgia Power makes the argument every time that I go to their corporate customer meetings and they'll their corporate customers, we are really trying to fight that EPA. They are adding cost to us and we have to pass that cost unto you and that environmental compliance cost is bad and we can make power cheaper for you if we did not have the EPA breathing down our necks. Well, so every home owner has to pay, environmental compliance and Georgia power puts that on there, to rub the nose of the EPA that if the president and the EPA are going to tell us we’ve got to clean up these dirty smoke stacks, we're going to tell the rate payer exactly how much that costs.” (4Bii 9B, Snr. Director International Sales & Market Development, February 20, 2014)

The second comment was from the director of a consumer advocacy group in Georgia:

> “Well no, we support the need for environmental controls but, that’s a good thing, but they are wanting to, Georgia Power is then saying, ‘so we are closing 15 units but we are going to keep these units open and we are going to collect this additional money from rate payers a hundred and something million dollars to install these controls.’ and we've said, ‘shut more units because you don’t need that excess capacity.’” (6E 14A, Director consumer advocacy group, January 9, 2014).

So, when the EPA regulations come through, they become an indirect cost to the consumer.

Finally, even some members of the state legislature, who were Democrats or considered themselves to be progressive on the issue of climate change, perceived the EPA regulations to have a cost to jobs in the region, specifically coal jobs. This meant that, due to the high economic dependency on coal within the region, a gradual phase out of coal would be less drastic. It also meant allowing coal to play a small part of the electricity generation in the south. This was illustrated in a comment by a state legislator who was a Democrat and an energy committee member, who supported the EPA regulations:

> "I think that it's you, being naïve, because, if you think about the region, the region where coal predominantly comes from is from the south, so, you are talking about a huge dependence economically on utilising coal and the southern states of course threw a fit when EPA followed these regulations, the cheer we hear today, you know, 'policy revolution that's against them', 'No new coal plants in the south', 'putting hundreds of thousands of people out of work.' So, I hear a lot of the conversation about new coal technology and I think that conversation, the one Obama started with originally was all-of the above, it has to be all-of-the-above strategy with an incremental change towards a low carbon platform and it can't be as noticeable or overnight especially in the south because you have such an over reliance on it and you are not really going to cost parity yet. You know, I'm from West Virginia so I'm a coal person and my undergraduate degree was in radiation physics so I'm a nuclear person and I'm a renewables person as well, so I believe it's an all of the above strategy that all of us should pursue but the portfolio has got to be more balance in a way that Georgia looks." (2A 3D, Georgia state representative, April 11, 2014).

Overall, these groups were focused on the types of costs that are incurred when the federal government, acting through the EPA, 'overreaches', and imposes regulations on coal states such as Georgia as opposed to letting the market dictate the change in technology. In addition, the fixation on opposition to federal power and climate change policy sometimes masked the more substantive critiques of the EPA regulations which included stranded assets, equity between states, pressure on rates, interstate issues, economic dispatch, penalties for non-compliance (Georgia Public Service Commission, 2014a). Whilst the leadership generally understood the point of the rules, they did have legitimate concerns about the impacts on Georgia:

> "I think there is some value to getting ahead of potential federal regulation, so if the federal government in 20 years said that Georgia has to be at 25% renewable energy and right now, we are only at 1%, it's going to be expensive to get to 25%, in a way, if we did have a standard

it would ease us into this however I probably wouldn't get re-elected if I did that." (2Bi, Georgia Public Service commissioner, October 21, 2013)

In summary, the values of the numerous groups that do not want federal environmental regulation align to make a powerful statement about the state's rights for energy provision. The main point being made consistently by all the interviewees was that the majority of conservatives wanted to be in charge of their energy policy in Georgia and did not want energy decisions to come from the federal government, especially at an additional cost. The federal government could not have a *one size fits all* approach to energy policy. These conservative organisations wanted these geographical and ideological differences to be respected and they also do not want to go above and beyond simple compliance with the clean air and clean water acts but it could be argued that this is what the Environmental Protection Agency is trying to get the states to do i.e. simple compliance is not enough. The research also shows, from statements by the chamber of commerce, the conservative Georgia Public Service commission and the multiple advocacy groups, that low carbon energy advocacy and decision making in Georgia must navigate complicated cultural, political and economic views of the role of government intervention and free markets; and in the case of the EPA regulation, these views hinder carbon restructuring. The outcome is that Georgia would attempt to resist the EPA regulations through the court system.

6.3.2 Conservative influence over solar development

In Georgia, the pressure to introduce solar energy development came from a variety of groups, including consumer advocates, some members of the Atlanta Tea Party Patriots, the Sierra Club, the Georgia Solar Energy Industries Association and regional groups such as the Southern Alliance for Clean Energy. Whilst all of these groups want more solar development, most are also pushing for distributed solar generation and consumer choice. In the case of solar development, conservative influence over solar development plays out rather differently: whilst there is resistance to renewable energy in general, low carbon energy may be supported on the grounds that it supports and values individual freedom over regulatory control from government. Here, the power of the Georgia government is preferred over the federal level but the power of the individual is preferred over any form of government. It is important to explore the views of these groups as they have influence over energy decisions making and may present opportunities or barriers to low carbon restructuring.

The views of the main decision makers, such as the utilities, regulators and the Georgia Chamber of Commerce, are presented first below. Then the views of the groups pushing for solar development are offered, with comments from the Tea Party, solar manufacturers and other businesses.

The utilities, public service commissioners and the Georgia Chamber of Commerce would resist solar energy development if it comes mandated by the federal government. These groups argued that renewable energy is only competitive with subsidies or mandates and without these subsidies/mandates cannot compete. While the Renewable Portfolio Standards (RPS), the Investment Tax Credit (ITC) and Production Tax Credit (PTC) have arguably been responsible for significant growth in utility-scale solar, distributed solar and wind energy across the United States, many of these groups, prefer to end subsidies for renewable energy, especially solar:

> “Now, you know, we think now that the market, especially when you look at solar, over the last 12 to 18 months, the installed price of a kilowatt of solar has become significantly more competitive to the point where it probably doesn’t need subsidies and it doesn’t need renewable energy targets and that is how we would prefer to see the market develop, because long term it’s going to be more sustainable, than being propped up by a tax payer subsidy somewhere along the line.” (9A, Chamber Energy Consultant, October 30, 2013)

In addition, groups such as the chamber of commerce, also oppose a mandate requiring specific amounts of renewable energy on the grid, especially when that technology is not considered to be cost-effective.

In theory, these groups maintain that there would be support for using as much of any technology as was technically possible, for so long as the technology is cost-competitive. This is illustrated in the comment by a consultant for the Georgia Chamber of Commerce:

> “I mean, as I said earlier, the chamber has found energy solutions, we have support for an all of the above policy, but we don’t support something that says there must be 30% solar irrespective of the cost. If solar is cost-competitive, we don’t have a problem with 100% of the energy being supplied by solar if that was technically and economically possible.” (9A, Chamber Energy Consultant, October 30, 2013)

This debate on ending renewable energy subsidies, extends beyond the state of Georgia, where at the federal level there have been persistent efforts to selectively portray solar companies as in need of substantial government backing and failing:

> “There was a big conservative push in 2010, against the Obama administration, that as one of its central talking points was the end of, this government picking winners and losers, particularly in the energy industry. There was a lot of hype about companies like Solyndra, that got a few hundred million dollars, to one or two hundred million dollars for their operations. Now, you know, conservative groups in the Obama administration, are giving billions of dollars to the nuclear industry, for one facility, and there’s not that same amount of outcry.” (6E 7G, Sierra Club Chapter Organiser, February 26, 2014)

This perception of solar companies may not be helped by the lack of solar representation amongst big business networks such as the Georgia Chamber of Commerce, which is often backed by many large industrial firms and heavy energy users and other organizations that may be skeptical of solar energy:

> “A standard chamber of commerce basically represents big business, it doesn’t represent small businesses, big businesses for you know Georgia Power or somebody and I don’t want to pick on them, they do a lot of great things, but when it comes to solar they, those big businesses represent huge interests that are entrenched interests, small business and start ups and things like me, we are bringing new ideas that threaten the existing business model. (4Ai, Business developer, February 19, 2014)

Contrary to the views of the Georgia Chamber of Commerce, the utilities and other conservative groups, the groups pushing for solar are not requesting a renewable energy portfolio. Instead most pro solar groups are pushing for *distributed solar*.

The pro-solar groups include representatives of the Atlanta Tea Party Patriots, solar developers and others from the business community. They want distributed solar on the grounds of individual freedom, economic freedom and general free market competition. Comments by a Republican director of a solar company, illustrate the point below:

> “All we need is, we want free access, free market and the obstacles removed and if we get that, we're going to be even closer to grid parity here and quicker.” (4Bii, 9B, Snr. Director International Sales & Market Development, February 20, 2014)

In fact, many solar manufacturers also wanted limited federal Government involvement in the development of solar, citing concerns of the freedom of businesses to operate without government interference:

> "That's the philosophy you'll find here. If it makes sense for me as a citizen or as a businessman, I'll do it. Don't get in my way, or if anything come clear out the obstacles." (4Bii, 9B, Snr. Director International Sales & Market Development, February 20, 2014)

Therefore, in the same way, that the government should not forcing private companies like utilities to develop solar, businesses and individuals should have the freedom to develop distributed solar energy as needed. The Tea Party reinforced this perspective and disagreed with the characterization of solar as being dependent upon subsidies:

> "If you remove the subsidies, number one, if you remove the subsidies and loan guarantees for nuclear, it would not exist! because nuclear cannot survive without the subsidies. During the first fifteen years of nuclear development, their federal subsidies accounted for 1% of the federal budget. At the highest level, the subsidies for solar, has not even been one-tenth of 1% of the federal budget. So, I say to them, you remove both the direct and indirect subsidies for coal and nuclear, they won't exist, they won't exist. Coal got its first subsidy in 1932." (15D, Tea Party activist, October 5, 2016)

And:

> "I think we need to remove all energy subsidies both direct and indirect and let the market decide. I just think, if we had a different approach, we would be much further ahead than what we are." (15D, Tea Party activist, October 5, 2016)

Overall, the Tea Party argued for distributed solar on the grounds of energy freedom and that individuals should have the freedom to choose any energy sources, energy providers and access the best financing options available on the market:

> "I think, it is time for, in a lot of states, to actually look at slowly unplugging monopolies and allow for true competition and true choice, because a monopoly is not free market, a monopoly is the government's way of picking winners and losers." (15D, Tea Party activist, October 5, 2016)

Overall, the debate between these groups reveals key issues such as the creation of unlikely alliances, while coalitions normally unified against federal intervention from the EPA are being split over solar development. There is ongoing development in conservative politics, where solar energy, especially distributed solar, is perceived to provide the kind of freedom that is a core part of conservative principles. These concepts of energy freedom, national security and free market competition are being selectively applied amongst the groups. Some of these groups, are likely to gain or lose by solar development and are using free market arguments to that effect.

Furthermore, whilst the debate is highly partisan, there is a level of pragmatism around solar development, whereby all groups acknowledge that solar is not yet at grid parity in the state of Georgia. It is in other states, such as California, for example. Conservatives pushing for solar realise that solar growth across the United States has not only been due to the falling PV module price but also due to the voluntary renewable energy portfolios made by state governments, the growth of third party financing as a way to develop solar and the 30% federal government solar investment tax credit (North Carolina Clean Energy Technology Center, 2014). In the same way, long-standing financial support for dominant energy sources such as coal and nuclear are being challenged by some conservative groups in Georgia. Finally, the adoption of solar energy in U.S. conservative politics may depend on this type of framing of distributed generation as a property rights and individual freedom issue.

6.3.3 Conservative influence over nuclear development

Conservative influence over decisions regarding nuclear energy development plays out in unexpected ways. Given that a key component to electricity decision making is the adherence to a least-cost approach and the dislike for subsidies, amongst Georgia's decision makers, subsidies, high capital costs and even rate increases are accommodated due to preference for baseload technologies and a desire for a nuclear "renaissance". Adequate baseload power is perceived to offer the stability needed for economic growth. The recent nuclear development is evidence of this peculiarity in Georgia's electricity decision making. In order to develop new nuclear generation capacity, Georgia Power had taken an estimated $6.5 billion loan guarantee provided by the United States Department of Energy (Mundy, 2014).

This was part of a $8billion loan guarantee package provided by the United States Department of Energy (Mundy, 2014). In addition, Georgia Power requested and succeeded in getting the state legislature to pass a nuclear energy financing act in 2009 (O.C.G.A., 2009). The law allowed a recovery of financing costs during construction whereby utility customers were paying for the nuclear plant before the plant was finished and operational. The nuclear costs, were incorporated into the ratepayers' power bills (Georgia Public Service Commission, 2014b).

A point of consideration was that the traditional utility regulation structure in Georgia allows for long-term planning and cost recovery and so permits this type of large investment. A manager at Georgia Power argues that undertaking nuclear investment in a restructured competitive market would pose too much of a risk to cost recovery:

> "One main reason is the regulatory structure we have here in the southeast, in other parts of the country, you have seen up in the Mid-Atlantic States, the Northeast, California and the Midwest a lot of restructuring of the wholesale markets, the electricity markets and people kind of look at the southeast and say 'you guys are kind of the sleepy southeast' and we still operate a very traditional regulated utility, what we call a vertically integrated market structure, so Georgia Power we are involved in every aspect of generation, transmission and distribution of electricity. The other markets, are competitive wholesale markets, power plants are bidding in their power plants on a day-ahead basis. They have an independent system operator that says 'I need this particular MWs on the grid at this particular time of the day' and people bid in and for the pure economic theorists, it sounds wonderful, you know this is the way America is supposed to work, but what's happened in a lot of those markets is that, it's a very short term transactional market and our view is that it doesn't generate the price signals that would promote the development of a big investment, nuclear plants are big investments, I mean Vogtle is a 14 billion dollar project." (Kyle Leach, "Forecasting Our Energy Future", World Affairs Council of Atlanta, February 27, 2014)

In addition, Georgia Power believed that the high capital costs were a compromise for long-term, low operating costs in nuclear energy development:

> "Nuclear is high upfront capital costs and very low operating and fuel cost and that's the trade-off. You can't have the cost recovery assurance in those types of markets and get the financing. We just recently submitted a DOE loan guarantee, actually it was just last week, so we are getting financing from the federal financing bank, it's going to lower our cost of

> borrowing, those benefits would flow through to our customers. The merchant nuclear plants in the northeast they can't get that because there's just too much risk in their ability to recover that type of investment in those very dynamic markets." (Kyle Leach, "Forecasting Our Energy Future", World Affairs Council of Atlanta, February 27, 2014)

It was not only the utility that pursued this deal; the development of new nuclear capacity was presented as having overwhelming political support from most decision makers in the state, whilst the financing of the nuclear development was described as a bargain:

> "Understand Georgia politics. The Georgia legislature passed a bill that allows Georgia Power to collect the financing cost of the Vogtle project during construction. The PSC, prior to my arrival, approved a similar measure. Why? Because it reduced the certified costs of the project by $300 million and reduced the company's borrowing cost by tens of millions of dollars. But let's be clear, it also vested the leadership of the legislature. So, with all the utilities investing in Vogtle, and many of the politicians vested in the project's success, the state was "all-in" on new nuclear. The addition of production tax credits, the federal loan guarantee, and the current low-interest cost environment further sweetened the deal." (Commissioner Echols, Power Engineering Magazine, November 13, 2015).

Despite the loan guarantees and financing method, the project still incurred cost overruns, some of which would be passed on to ratepayers. Furthermore, in accordance with the nuclear law, the Public Service Commission needs to decide if the spiralling costs were prudent or imprudent, because prudent costs may be paid by the ratepayers whereas the utilities pay for imprudent costs (Kempner, 2015). Despite these issues, key decision makers including the utilities and the Public Service Commission and specific influential organisations like the Chamber of Commerce, were not reconsidering the new nuclear project in Georgia.

The rationale for developing new nuclear capacity was consistent amongst these groups, arguing that nuclear energy presented the best economic, baseload power option and would bring economic growth:

> "In the case of nuclear, at the time that that was proposed, it was simply, you know, a response to the best alternative or base power. In the long term, what was the best economic opportunity to deliver affordable, reliable base-energy, and at the time, nuclear was the outstanding economic opportunity." (9A, Chamber Energy Consultant, October 30, 2013)

The perception of baseload nuclear which aids economic growth is widespread in Georgia. Regulators and some media personalities argued that having Plant Vogtle 1 and 2 has been fundamental to a low cost, stable and secure energy supply (Augusta Chronicle Editorial Staff, 2015; Echols, 2013b). Furthermore, it was clear that some state energy regulators, had clear visions about the broad benefits of nuclear energy to the state. Amongst decision makers, the connection between nuclear energy development as a creator of jobs in the state was a powerful motivator:

> "First, anything remotely related to nuclear means jobs — many of them good-paying jobs. There are 12,000 people working at SRS, there are 800 private-sector jobs at V.C. Summer and another 800 at Vogtle. The last two figures will double once the new units come online. Add to that the cumulative construction jobs, which should peak at more than 7,000, and the impact is enormous. Remember, jobs let you buy houses, cars, clothes and widgets — and cheap energy is a magnet for manufacturing these, as the Germans testified." (Commissioner Echols, Athens Banner-Herald, July 25, 2013)

In addition, the development of nuclear energy in order to reinforce national security like nuclear reprocessing and recycling (Echols, 2013b) and reduce Georgia's carbon emissions also justified the investment decision according electricity regulators:

> "I am thinking about the carbon which is one of the reasons I wanted to finish the nuclear power plant because I know that it is carbon free" (2Bi, Georgia Public Service commissioner, October 21, 2013).

The statement by the regulator on the decision to invest in new nuclear generation appears to be the pathway chosen by utilities and regulators to low carbon restructuring in the South-eastern region also:

> "I think that they are putting the nuclear investment into a low carbon kind of framework, I know we are at TVA, we've got a reactor which is going to be completed in the year 2015, December 2015. Well it's not a new AP1000, it's the old type, boiling water but still it's a reactor coming on board and everybody is talking about it as a very important climate change mitigation approach. Now again, keep in mind that they don't put the value of CO_2 into the calculations but they talked about it." (8Aii, Professor, Georgia Tech, March 24, 2014)

And

> “That’s right, there have been as in England lots of vocal backlash but they’ve been able to get it all approved through this Public Service Commission and we’ll see what happens, there are about five reactors being built in the South now and we’ll see how successful they and I think that’s going to lay the groundwork for whether or not another phase of these are to get built.” (8Aii, Professor, Georgia Tech, March 24, 2014)

Finally, a justification for the new nuclear development in Georgia, is that of cultural and utility familiarity with the technology. A Georgian-based academic explained that the South is comfortable with nuclear energy development, it has confidence in the workforce for such a development and has an affinity for baseload power:

> “I often put it in the context of, the South is very familiar with nuclear and comfortable with nuclear, and different states have different unique capabilities and I think in the South, has just been, it’s been a forte, we have the workforce, we have existing contracts and agreements with providers. So, it’s a familiar, easy way to go and of course utilities love baseload and nuclear, it’s the baseload.” (8Aii, Professor, Georgia Tech, March 24, 2014)

Granted, the consensus was that nuclear energy development had significant benefits in Georgia, there were signs that the consensus was being challenged. Some influential groups in Georgia’s electricity sector, having accommodated the nuclear energy decision initially, had since changed their minds due to some changed conditions in the advent of cheap natural gas and the spiralling costs. For example, the consumer advocates explain that the nuclear energy project was economic when it was first proposed in 2008, but since then the project’s capital costs had spiralled out of control, customers are facing rate increases and gas has become so cheap that the rationale for the project is no longer valid:

> “Well we have argued before the Public Service Commission that units 3 & 4 are not necessary and there were lower cost ways including combined cycle natural gas plants and even the company's witnesses on the witness stand when we asked them, acknowledged that, knowing today how far down the cost of natural gas has become and other things, that if you were to make that decision today you would not make that decision to build those 2 nuclear units. That it would not be in the best economic interest but at the time, they felt and they made the case and they still make the case because you've got to factor in the sub costs that they've already spent, so they will still say in the witness stand that they think it’s

> in the best economic interest but don't, we simply don't agree, if your building those units." (6E 14A, Director consumer advocacy group, January 9, 2014).

Georgia Watch were not against nuclear energy development per se, because of the potential benefits of baseload power for consumers, nor were they particularly environmentally driven because of the suggestion to switch to cheap natural gas. Instead they were against technologies that could increase rates or be passed onto consumers in any way. There were also individuals who whilst not supportive of nuclear energy development, understood why the decision was taken at the time by Georgia Power and the PSC, but saw the issue as one of uncertainty in making predictions about energy:

> "Nuclear plants when they are online, they are really cheap to operate and they operate really, really well. I mean they are expensive to build and it takes so long to build them so these plant Vogtle. I mean they started getting approvals 6 or 7 years ago, back when demand growth was a little higher than it is now and the forecast was higher demand." (6E, Snr. technical analyst, October 31, 2013).

Ultimately, the underlying factor in the investment in new nuclear capacity is the business model of the utility and the political support for the utility. A primary reason for why Georgia's utilities, typically very aware and opposed to any investment which would put upward pressure on rates, would continue with this project despite all current failings, is that new nuclear is associated with a long lifespan, is financed by the federal government and costs can be passed onto consumers, making the project a profitable venture. This perspective is held by solar advocates, evidenced in the comment by a representative of the construction and solar industry:

> "Well how does a utility in America get paid, it gets paid in cost plus, so in other words they get to earn a certain amount on their invested base amount. So, let's say they get 10% on everything they spend, that's a super simplified amount, roughly that, so the more they spend the more money they can make, and there is no more concentrated way to spend money than a nuclear plant. Nothing sucks up more cash per square inch than a nuclear plant, plus you can be guaranteed that whatever the budget was you set is going to be a lot higher-, and the other, it is so bad that and for what's interesting is conservatives which we call republicans, conservatives in this country always say, 'Well let the market decide, let the market decide.' Okay well let the market decide about nuclear plants, well you can't get

> insurance for them in the open market, the insurance companies won't touch them, you can't get financing to build them in the open market, the banks won't touch them. So, the only way you can build these things they need the government to guarantee you the loan, so for some reason the Obama administration let them build. So, the only way you can build these things, these two plants for Georgia Power couldn't have been built without the government coughing up $8 billion worth of guarantees, so I guess one could consider that as a subsidy so how about coughing up $8 billion for solar and see what happens." (4Ai, Business developer, February 19, 2014)

The comment also suggests that those conservative principles held amongst decision makers (utilities, regulators, state legislature) which include free market competition amongst energy technologies, the removal of subsidies and generally limiting federal support, were not consistently applied to nuclear energy development. Nevertheless, the utility business model remains the main issue in this investment. Investments in nuclear energy are consistent with the traditional, utility business model which supports a highly-centralised form of infrastructure, ownership and control by the utility.

This was and remains a view held by some solar manufacturers:

> "No, it means they want to control the asset. Utilities in the United States and probably around the world, used to be in the business of having big, centralised generating plants and that's what a nuclear plant is and so they know how to finance at a fixed capital cost, a plant that is going to run for 50 years, they know how to amortise that, how to run the numbers, the finances and the ROI and that's great and that's good for their business model and they're a publicly traded company that needs to make profit. They're not in for doing public good; they are in it to make corporate profit." (4Bii 9B, Snr. Director International Sales & Market Development, February 20, 2014)

In addition, the financial strategy using loan guarantees and those newly permitted method of pre-charging customers for the construction costs of the new nuclear facility, could also be applied to renewable energy investments, especially solar energy, but it was not. This suggests that the financial gains to be made from nuclear investments by the utility may outweigh those of solar investments:

> "I had that same argument with the CEO of Georgia Power when he came to visit our solar factory and he got very upset, he got very upset that I would challenge, when I said the ROI on solar would be better if you let people prepay it on their bills before it was even constructed and he said, that's not a fair thing to say, that we're saving the rate payers money by financing the construction costs in advance and I said I'm not arguing with that,

> I'm arguing with the fact that you do it for nuclear but not for solar (4Bii 9B, Snr. Director International Sales & Market Development, February 20, 2014)

Nevertheless, Georgia Power's representatives argue that the technologies should not be compared, that the two technologies provide value and can be used to meet different goals. Baseload generation technologies provide different benefits to intermittent renewable energy resources:

> "It's an intermittent resource so, we caution people not to try and compare, and you have heard the expression apples and oranges. Nuclear units, coal units, natural gas units, they are all dispatchable, they can be controlled even when the winds blowing and sun's not shining, we can operate those units and we can rely on the fact that they will be there and so trying to compare those types of units versus renewables that are intermittent in nature, are what we called apples and oranges. They all can provide value; it's just how do you properly assess that value and so I think we've done a pretty good job with that and we are starting to bring more and more renewables in and they are at a price that's not going to drive up customer rates, at least as they're currently structured. You know what we are finding though, is that the biggest competition for renewables is probably low natural gas prices." (13A, Director of energy policy and planning, April 1, 2014)

Finally, despite the rate increases and cost overruns, Georgia Power maintain that the nuclear project still represents the lowest cost option:

> "Remember too that, when I said earlier, that when we have a need and we go out to the market we do a request for proposals that all these different resources can submit proposals into that and then we will evaluate them on a total cost basis, so every resource that we've added and even when we've had to add increased rates to incorporate some of these resources, they have represented the lowest cost resources that have submitted and taken part in our request for proposals. So, you know, you can, that's when I say it's a market, you can have a reliance on the free market to determine what is the lowest cost resource to add to our fleet, so even when we add nuclear, natural gas combined cycles those kinds of units, they have represented the lowest cost option that have responded through our request for proposal process." (13A, Director of energy policy and planning, April 1, 2014)

6.4 Conclusion

The chapter has demonstrated that despite drivers for low carbon energy development, baseload generation and distributed generation in the state of Georgia, the politics of low carbon restructuring in the conservative state is complicated. The influence of conservative views on decisions over EPA regulations, solar energy and nuclear energy developments indicate that certain avenues for low carbon restructuring may encounter less resistance than others.

It is clear that, amongst Georgia's electricity decision makers including the PSC, Georgia Power and influential groups like the Georgia Chamber of Commerce, the value placed on nuclear energy superseded arguments about subsidies, federal involvement and upward pressure on rates or rate increases. The perceived value of nuclear generated baseload power, including job creation, economic growth and low cost of electricity by decision makers, mean that the need for a loan guarantee from the federal government to support the new nuclear development, the increases on customer's bills and near-term rate increases, could be rationalised. Furthermore, nuclear energy clearly suits the dominant mode of electricity generation in Georgia, which is a highly-centralised form of electricity generation and supply, delivering low cost electricity, adding to its perceived value. Nuclear could also help with CO_2 emissions reductions in the state.

Resistance to EPA regulations are widely shared by decision makers but also influential organisations like the Georgia Chamber of Commerce. Amongst decision makers, EPA regulations are unnecessarily costly, an unwanted liberal policy and a challenge to state authority. Instead, belief lies with the free market over federal intervention in energy policy. Nevertheless, resistance to the EPA is limited once a law has been passed or rule upheld. However, resistance to the EPA also reinforces the idea that environmental views do not gain traction in Georgia. Environmental bills, rules and regulations are contested in the political setting. Therefore, it may be necessary and more effective for advocates for low carbon to come from within the state of Georgia and for the issue to framed differently, in a way that reduces resistance from the largely conservative decision makers.

Finally, this chapter has shown that any mandates for renewable energy development, especially solar energy, would be resisted. Unlike nuclear energy, solar energy is not perceived to have the benefits of low cost electricity. Instead, it is perceived to be a technology which is highly subsidised and not cost effective without federal support. Conversely, distributed solar generation presents an opportunity for low carbon restructuring because individual freedoms are preferred over state government control.

The next chapter explores the sources of resistance which create lock-in or lock-out to energy-carbon restructuring in the state of Georgia.

7 RESISTANCE TO ENERGY-CARBON RESTRUCTURING AS LOCK-IN AND LOCK-OUT IN GEORGIA

The previous chapter explored the drivers for low carbon restructuring in Georgia and the complicated politics of low carbon advocacy. This chapter explores resistance to energy-carbon restructuring in the state of Georgia. A key aim of the chapter is to take forward the idea of lock-in as explored in chapter 2. In particular, the chapter introduces the idea of lock-out in addition to lock-in. The chapter especially highlights the need to think about the ways in which alternatives get locked out by a range of factors, including the ownership of infrastructure, the utility business model and the least cost approach, the legal and regulatory frameworks operating within the state of Georgia, regulatory capture, and the political and cultural resistance to environmental goals. The structure of the chapter is as follows. Section 7.1 reviews the theory of lock-in, section 7.2 explores the types of lock-ins identified in the Georgian electricity system and section 7.3 provides a summary of the chapter.

7.1 Exploring Lock-in In Georgia – The idea of energy infrastructure lock-in

7.1.1 Reviewing "lock-in" from the conceptual framework

Unruh (2000) describes lock-in through the concept of a Techno-Institutional Complex. Unruh (2000) argues that large-scale technological systems made up of interconnected physical, social and informational components in a network or infrastructure are established "through a co-evolutionary process among technological infrastructures, organizations, society and governing institutions, forming a "Techno-Institutional Complex" (Unruh, 2002, p. 317). In this research, the large-scale technological system is the electricity generation and distribution network. Unruh (2000) explains that in the early stages of development and commercialisation, technologies may show increasing returns to scale which help them expand rapidly in comparison with competitors. Increasing returns to scale mechanisms include;

- Economies of scale: cost reductions per unit, as production is increased.
- Adaptive expectations: increased use of technology results in increased confidence from users and producers.
- Learning economies: cost reductions as knowledge and skills are improved.
- Network externalities: the value of the technology system increases as the network of interdependent industries and users grows.

These different increasing returns create a technological lock-in. In addition, firm-level technological lock-in may be created, where incumbent producers of the technology, through repeated investments in infrastructure, reinforce the lock-in condition since the infrastructure is large, durable and cannot not be traded (Unruh, 2000). In addition, firm-level technological lock-in may be created as producers develop core competencies which initially allow the technological system rapid expansion and a competitive advantage over competitors but later become rigidities (Unruh, 2000).

Essentially, core rigidities happen when, having established the technological system, firms become too dependent on their existing advantages and become resistant to change. Both these firm-level technological lock-ins reinforce the technological lock-in, because when challenged by new market entrants introducing an alternative or superior technology, incumbents are unable to adapt and instead put more effort into making improvements in the current technology.

Both public and private Institutions may reinforce the lock-in already existing within a system. Private institutions (formal and informal), such as industry associations, unions and other professional organisations, develop as the technological system grows and therefore may form an influential and invaluable lobby for the specific technological system (Unruh, 2000). Finally, public institutions can intervene in a way that favours the incumbent technological system, for example government policies and regulations which favour a dominant mode of electricity production may also reinforce the lock-in.

The Techno-Institutional Complex develops through *"a path-dependent, co-evolutionary process involving positive feedbacks (from increasing returns) among technological infrastructures and the organizations and institutions that create, diffuse and employ them" (Unruh, 2000, p. 818)*.

Once established the Techno-Institutional Complex creates continuous stability and reliability in the technological system, but this also means that the complex develops a resistance to change in the long run, locking-out alternative technological systems (Unruh, 2000).

In the conceptual framework (see 2.3), the lock-in categories used were based on Unruh (2002) which included technological, organizational, industrial, societal, institutional:

- Institutional lock-in: Institutional support systems i.e. government policy, legal and economic frameworks that create stability of the electric power system not specifically fossil fuels but have a long-term impact on the ability of alternative low carbon technologies to gain market share.
- Societal/cultural lock-in, the individual or existing societal perceptions about what the system should deliver i.e. dominant technologies are likely to be embedded in broader values in a way that hinders low carbon alternatives.
- Organisational lock-in, can occur when firms/companies will have specific methods of operation. They may sort tasks, per function, process or even products which lends to operational routines or decisions, hindering alternatives.
- Industrial lock-in occurs over time, where members and firms of an industry develop or improve practices or criteria for products and operation which often guarantee their continued use. This is often done because there is a degree of dependence between firms and members in the industry.

In the state of Georgia, these lock-in categories have been refined to better suit the analysis of the state of Georgia’s complex electricity system.

7.2 Examining lock-in and lock-out in Georgia

As indicated in previous sections, there are powerful forces that maintain the dominance of a single supplier of electricity generation that favours the centralised electricity generation business model and the usage of fossil fuels. The following section will use the lock-in and lock-out framework to outline and explore the factors that contribute to the dominance of the monopoly provider which resists alternative energy in the electricity grid. Five key sources of lock-out are explored:

a. Infrastructure lock-out: Grid Infrastructure
b. The utility business model: lock-out of external providers
c. Institutional lock-out: regulatory and legal framework
d. Societal and cultural lock-out: shared resistance to low carbon

a. Grid Infrastructure

This section will discuss aspects of the power grid network, that could be argued cause stagnation in low carbon development.

— The issue of grid balancing and reliability

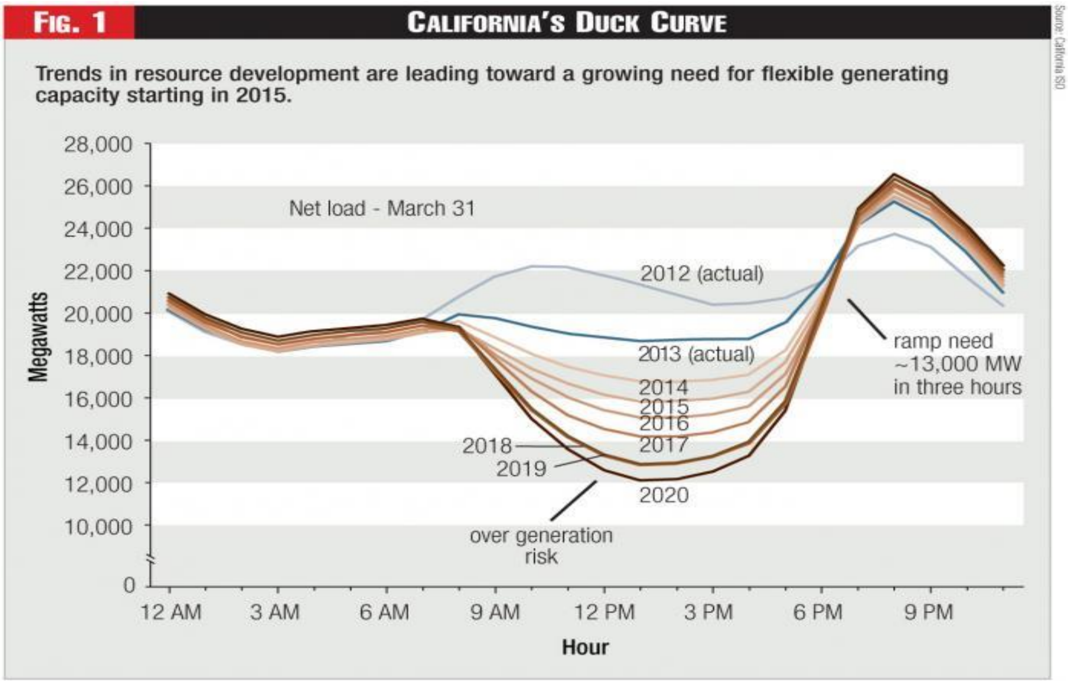
Electric utilities have been charged with the task of continuously balancing the grid at all times. In order to secure grid stability, the supply and demand must remain in balance in real time. The grid is especially responsive to load shape, voltage variations and variability in the output of energy sources. This is important because the introduction of supply-side distributed generation introduce challenges on the grid network design and operating procedures for system operators. It is not that grid operators do not know how to manage load profiles, voltage variations and output variability, but rather that variability in generation resources have been typically small compared to the load being served (Bird, Milligan, & Lew, 2013). An attractive quality of distributed renewable technologies is that they are often built and consumed at the point of need (Momoh, Meliopoulos, & Saint, 2012).

However, the interconnection of these technologies on the distribution grid introduces a set of challenges on that section of the system. Therefore, distributed generation systems need to be properly planned for in order to realise their full benefits. The distributed generation technology referred to in this case study is solar photovoltaic (PV). For customer owned photovoltaic rooftop solar installations which are still connected to the utility grid, there will be dominant technical issues at increased solar up-take rates. These are:

- Variability: the output of solar is varying with time but also with weather events like cloud-cover and storms, this comes with uncertainty over accurately managing or forecasting a load profile. This is not necessarily helped by the fact that solar is a non-dispatchable resource, meaning it is a *must take* resource i.e. regardless of prices or other conditions and utilities must plan around this resource to continuously meet demand. The increased percentage of customer-owned distributed generation means that the utility must manage the variability over the demand side as well as the supply side (Bird et al., 2013; Cochran et al., 2014; Denholm & Hand, 2011).

- Ramping issues: Utilities have historically needed to be able to respond to variability and uncertainty by fast ramping with the use of operating reserves which are essentially added capacity available to help in balancing power. It is a legal requirement in the United States for utilities, and every power system has these reserves planned for. Increased or uncontrolled renewable growth especially on the distribution side calls for increased and steep ramping on grid by spinning reserves which rely on mainly natural gas because of its flexibility, ease and rapidity of build but also ability of quick start-up times and faster ramp rate (Hummon et al., 2013). This will lead to more stress on generation components as well as cost to increased ramping requirements i.e. fuel, construction and overhead and maintenance (Cochran et al., 2014; Lazar, 2014).
- Voltage variations: The transmission network has been configured for bidirectional power flow, which has given utilities and system operators of the system more control over the design and process of power flow, however the distribution grid has been generally configured with radial, one way power flow from the substation to the customer (Bollen & Hassan, 2011a). One of the ways in which distributed solar impacts the grid is in the voltage variation and voltage variation is currently a significant concern for power network operators.
- The increased incorporation of customer owned generation leads to upstream power flow voltage rise, which can occur in a somewhat unpredictable manner because as clouds move over the solar panels, there is a time variation in output. Initially the distribution grid would manage voltages within predetermined standards using tools like voltage regulators and other electromechanical devices. However, since the changes cause a break from those standards, things like regulating voltage in the presence of high ranging sources of power and maintaining the supply and demand balance problem within distribution means managing the end-points instead of just reacting to the fluctuations. Ensuring that there is no over-voltage or under-voltage along the feeders but rather voltage maintained within the standard range, means that there is a new planning problem for grid operators to improve on the standard tools. There is a need for new devices along the distribution grid that can observe and react to changes in real time. Discussions taking place around how this could be done are ongoing (Bollen & Hassan, 2011b) with network operators, solar developers and utilities.

An example of a real, ongoing context of some of these issues can be seen in California and Hawaii's current experience with high solar penetration of the grid. The images below show the current and projected grid reliability problem of increased solar penetration.



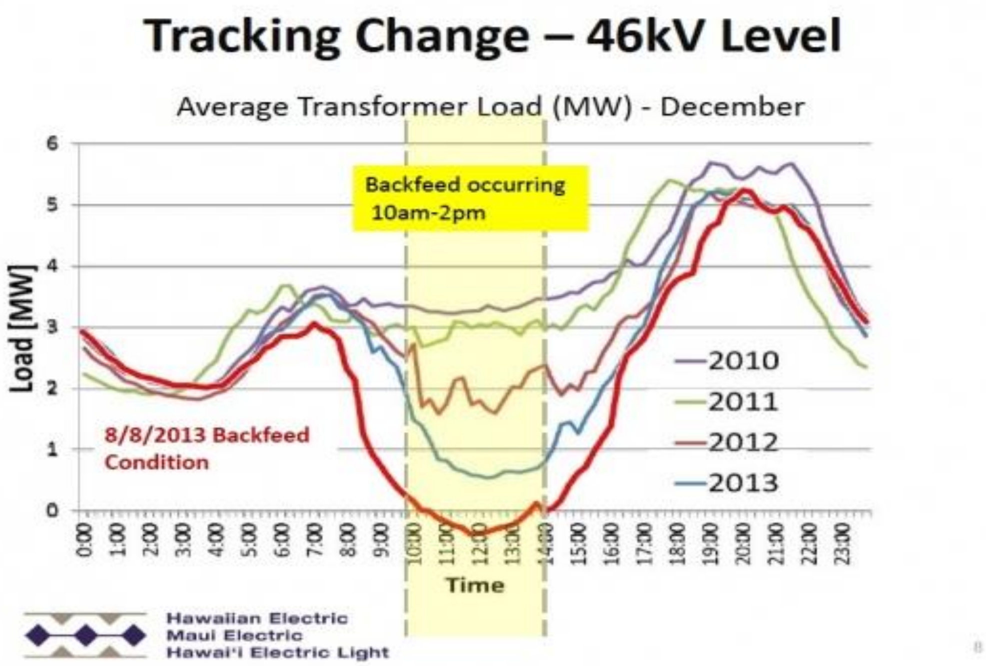


Figure 7-1: Shows California's and Hawaii's Load and Balance problem at high renewable penetrations
Source: California Independent System Operator, 2013

The California "duck chart" explains the load balance difficulty that grids operators expect to encounter and handle with increased levels of renewable energy specifically solar energy on the customer side of the meter. The current load profile is a *camel* i.e. two peaks, 1st Afternoon and 2nd early evening, but quickly an over-generation problem is seen in the afternoon i.e. the belly of the duck, followed by steep ramping in a short time i.e. the neck of the duck. As discussed above, the variability, voltage and ramping issues manifesting in the duck chart means that California and Hawaii are now seeking solutions for their grid (Bade, 2014). The incorporation of large amounts of distributed solar with some of the technical issues discussed, has made leading edge states in solar energy generation (California and Hawaii) to be referred to as *bleeding edge* in Georgia by energy decision makers.

It must be said though that these are quite high levels of renewable energy inclusion into the grid, arguably because there are quite high carbon emission targets in those areas. Furthermore, it is currently unknown what the hosting capacity of the electric grid in Georgia is i.e. the amount of distributed generation which causes the performance of the grid to deteriorate (Bollen & Hassan, 2011a), so direct comparison may be imprudent. This notwithstanding has meant that in Georgia these technical challenges are cited as a reason for a restrictive growth of renewables by utilities, consumer advocates and even renewable advocates. There is a consensus that nobody wants a California or Hawaii-style grid.

The focus on technical issues, whilst prudent, obscures the fact that more distributed solar can be incorporated onto the grid but the management of the grid, especially on the distribution side, must be proactive and not reactive by the utilities and system operators. Grid architecture needs to be properly designed if increased distributed solar is a target. The technical issues lead on to more economic and regulatory issues around clarity about grid access, ownership of the transmission and distribution, cost of distribution, regulations and resolution. The grid could be configured or managed to accommodate alternatives, but it is difficult because these technical solutions need to be combined with value judgements. These judgements revolve around who pays for these infrastructure upgrade, how upgrades are paid for, etc.

— Transmission and Distribution Costs and Ownership

The ownership of transmission and distribution lines in Georgia have locked out efficient distributed generation alternatives and the costs associated with partial use of the grid potentially enhances the lock-out of these alternatives and the lock-in of customers.

In Georgia, Georgia Power (See 5.2.3a) owns the entire infrastructure from the point of generation to the meter. The ownership of the lines mixed with the geographical assigned service territories given to the utilities by the state government and regulators (***Figure 5-4***), does dictate who is authorised to build what, the location of the build and ultimately who pays for the build. Power grid infrastructure by Southern Company, was constructed on decades of investment and expansion in fossil fuel energy generation and for Georgia Power, the earlier expansion by its holding company means there are significant embedded costs at the time of the study period.

The embedded costs are the cost of transmission and distribution infrastructure i.e. poles, wires, voltage corridors, transformers and other devices on the distribution feeder. Furthermore, this ownership of the transmission and distribution network also implies associated costs with operation, maintenance and distribution of those devices. Costs which will remain even with increased distributed generation (Bouffard & Kirschen, 2008; Zichella & Hladik, 2013).

Furthermore, the impending investment in low carbon sources if EPA regulation holds (See 6.1.1), means there are going to be significant investments made to that effect. Therefore, the use of the distribution grid in Atlanta suggests, dealing with the utility assigned the Atlanta region i.e. Georgia Power, which locks out external providers; unless agreements are made on. Agreements based on how the transmission and distribution grid is used, how it would be paid for between the solar installers, solar owners and Georgia Power.

These debates around agreements are very contentious in Georgia because firstly on the issue of transmission, solar advocates argue that transmission infrastructure has already been built out, in addition, there is too much expense involved in constructing new transmission infrastructure, therefore, they currently need access to the existing grid to support the costs of installation.

One interviewee, a consultant for the Atlanta Office of Sustainability and director of an energy efficiency company, reflected that since T&D infrastructure was expensive, solar developers could not simply construct their own transmission infrastructure and had to make use of existing grid infrastructure:

> "It's too expensive, they could not do their own, and you have to use transmission that's already there" (4Bi, company president, October 31, 2013).

Secondly, the utility ownership of grid infrastructure mean that policies regarding grid-tied distributed solar systems are considered by solar advocates to be too restrictive. An academic consultant for the Atlanta city government sustainability plan from Georgia Institute of technology said:

> "It had some pretty restrictive measures that said that you couldn't have distributed generation in total. So, like all renewables and combined heat and power and just like personally owned generators, whatever. They couldn't exceed 0.2% of summer peak demand. Summer peak demand is like 16GW in the state and so you couldn't have more than 320MW deployed, which is pretty, pretty restrictive" (8Ai, Academic consultant, Georgia Tech, October 29, 2013).

In addition, of the permitted solar under net-metering there are severe restrictions on system size. An interviewee who a consultant and director of an energy efficiency company explains the relationship between ownership of infrastructure and restrictions on net-metered solar:

> "So, we've talked about this, so the case is not strong because of the territorial issue related to who can produce and how they can produce. There's also a net-metering restriction. So, anything, well basically its anything under a 100kW is net-metered and anything over 100kW goes into another a whole other bucket and it's a whole other level of discussion and negotiations and it gets messy" (4Bi, company president, October 31, 2013).

However, critics of the restrictive policies argument make the case for system reliability and efficiency as paramount, which is that more concern should be placed on how distributed solar technology impacts the efficiency of the network, not just the growth of solar on others property. A statement by an interviewee who was a representative of the chamber of commerce provides evidence for this:

> "What you make sure is you differentiate between the technology and how it integrates with the market, and that's where part of the tensions rise now, because the solar people want to put in big facilities everywhere, but they want to do it on infrastructure that is

owned and operated by somebody else, it has an impact on the efficiency, or can have an impact on the efficiency of how those networks are operated, and they are arguing about whether or not they should be either restricted in their access to ensure supplier reliability or whether they should even pay for that access so, you know, those access charges and how it impacts on the reliability of things that we're very concerned about but we're also very concerned that, that becomes a tariff barrier" (9A, Chamber Energy Consultant, October 30, 2013).

Nevertheless, there is no evidence that the situation is settled and grid interconnection policies are being worked out:

> "So as far as solar, it's probably fair to say that it's not necessarily a free and open market for, you know-, I mean, you know, if you want to go and put up a solar now to run your business, you can do that no problem at all, if you want to put up 100 acres of solar and feed it into the system, so just to generate power, that is where the policies are still being-, the interconnection policies are still being refined. So, while it's not any impediment, well it is an impediment, there's not scope of access" (9A, Chamber Energy Consultant, October 30, 2013).

These debates reflect tensions between the utilities, advocates and solar developers. Tensions about the restrictive nature of the grid policies lead to a third issue, which is the appropriate costing of transmission and distribution in a way that is fair and allows all parties involved to benefit from the infrastructure owned by the utilities. Specifically, this means what can utilities charge and distributed solar customers pay for the partial use of the grid. The electric utilities in Georgia argue that supporting solar should be done in way that does not infringe on other customer's power quality and costs but also finding the method of making sure that the use of the grid is appropriately paid for.

The evidence is in the following statement from an interviewee, who was a director of energy policy and planning at one the utilities in Georgia, below:

> "I think the balance is and you're getting to the crux of the discussions going on right now, not only in Georgia but throughout the country. You want to ensure that customers, who choose to install solar, that they are paying for the fair value of the grid services that they still require. So the generation what we call the spinning reserves that's ready to go when the sun doesn't shine and we have to bring generation up to respond to the decline in solar production, to the transmission and distribution investments that are necessary to ensure that the consumer can continue to have reliable service if they should suffer a malfunction and their solar facility, you know an inverter goes out and now they are totally reliant on the company's grid" (13A, Director of energy policy and planning, April 1, 2014).

Some utilities and regulators across the country are contemplating new rate design methods; rate designs that accurately determine the value of distributed solar. New concepts such as the value of solar tariff (VOST), have been floated and the state of Minnesota and the city of Austin are currently testing out this method (National Renewable Energy Laboratory, 2015; Trabish, 2014). Since these new rate designs are undergoing tests, there is uncertainty about the outcome. Nevertheless, the reference to 'other states' shows Georgia's utilities are aware of these issues and anticipating problems, although Georgia has not yet experienced the levels of distributed solar that can start to cause significant problems. Evidence is provided in the following statement from the director of energy policy and planning at a utility in Georgia, below:

> "So, we need to make sure that our rates are designed to ensure that customers continue to pay for the fair value that they get from the grid. And at the same time, the company needs to make sure that we're paying, because many of these customers have the ability to sell back to us and so we need to ensure that our prices and what we are willing to pay for their solar energy is fair to the customer too. So I think it's all about fairness, in terms of the customer paying for the fair value of what they get from the grid, from the network because of they don't, other customers have to step up and pick up that responsibility and that's not fair to the customers who may not want to install solar or other types of distributed generation and likewise, from the customers perspective, if they choose to install solar and they have the ability to sell back to the company, that the company's prices are fair and they properly reflect the benefits that, that solar provides to the grid also" (13A, Director of energy policy and planning, April 1, 2014).

Overall, these statements point to a complex debate unfolding in a context of much uncertainty, which even solar advocates acknowledge is difficult. According to business associations such as the chamber of commerce, now that solar energy has disrupted a 100-year-old electric utility business model these 'legacy issues' will need to be resolved, whether they be about costs, price or policies. In the meantime, the situation is a work in progress and a lock-out of alternatives:

> "There are debates around what level of price should-, so Georgia Power pay for my surplus solar, couldn't pay for my surplus solar, or if I'm the solar provider, should I be the one who suffers a loss if I produce more than I can sell so, you know, that whole issue of the interconnection and the net energy metering and the charges etc., that is where the debate is very, very active right now as we speak. I suspect-, I won't say it'll be resolved in the next legislative session starting in January, but it will be a significant topic because there is

legislation on this very issue that will lead to the state legislature just a couple of days before it's adjourned in March this year, and that will be debated, or it'll be discussed this afternoon, and it will be debated come January, February, March next year, so it's just fair to say that is where there is a contentious issue, and it is still, kind of, open to all sorts of debate and discussion" (9A, Chamber Energy Consultant, October 30, 2013).

Georgia is not unique in this aspect of issue of transmission and distribution. 43 out of the 50 states have implemented net-metering policies (Solar Energy Industries Association, 2012a). Out of the 43 states, public service commissions and utilities in more than half have examined or are currently examining the imposition of fixed charges, also known as grid access charges, to distributed generation owners because it is argued that simple net-metering charges do not consider the full of the grid services. States which are currently involved in this process include: Wisconsin, Arizona, New Mexico, Florida, and Idaho (Inskeep, Kennerly, & Proudlove, 2015).

Wisconsin Utilities is currently seek to increase the customer connection fee of every customer from to \$16 - \$25 per month from the current connection fee which is \$9 - \$10 (Huebner & Klein, 2015). In Georgia, Georgia Power initially proposed a \$22 a month fee to distributed solar owners (Howland, 2013) but the Georgia Public Service Commission staff recommended against the solar fee (Henry, 2013) and they argued that at the time the utility had not proven that solar customers were dodging any costs.

Nevertheless, this debate continues and in Georgia there was no clarity as what the appropriate direction would be:

> "There are issues that are constantly being discussed, even as we talk, and I know there will be some more legislative action, and in fact I'm actually off to a committee meeting at the legislature this afternoon on this very issue. It is work in progress on how do you get the balance right, so that if I put up 100 acre solar field in one area, that it blends in with the management of the whole energy system, because solar is only good where at the moment while the sun's shining, but lots of people still need power, you know, when the sun goes down, so there is obviously a benefit for everybody using the existing infrastructure so, you know, balancing out those needs and charges and costs, that's where the debate is right now, and I think that's fair to say that it's probably a significant debate pretty much everywhere. I don't know too many people that have actually got it right; I mean everybody is dealing with what is the right answer to that?" (9A, Chamber Energy Consultant, October 30, 2013).

The monopoly Georgia Power exerts over generation and supply, the sunk costs of infrastructure, the revenue gained from continued investment in more power plants and infrastructure and the lack of an established method of compensation for grid access results in an unwillingness economically and politically to open-up that infrastructure to other energy generators and suppliers, thereby locking-out efficient distributed generation alternatives. The lock-out also remains because despite the complex rhetoric, there is a lack of established analysis demonstrating the value of distributed solar to the grid and a lack of will to conduct these analyses.

Finally, another explanation for the unwillingness to open-up the infrastructure and to clarify complex financial discussions as evidenced by the comments made by renewable energy advocates and the utilities, could be the financial business model for many utilities including Georgia Power that rely on volumetric sales of electricity which means that the shift to distributed solar would be a direct reduction of kwh's sold. Therefore, the utility business model as a form of organisational lock-in will be discussed in the next section.

b. The utility business model: lock-out of external providers

This section will argue that the utility method of rate-basing an asset as well as the volumetric charge of electricity does not allow for a decentralised model of electricity generation where the major beneficiary is the consumer. Rate basing an asset also does not allow external energy providers to bring in distributed generation technologies as this would cause a reduction in the revenue stream and create a cost recovery problem for utilities. In order to discuss the business model of the utility it is important to first rehash the regulatory atmosphere that governs utilities and creates this business model and incentivises sales.

— Regulatory Summation

Georgia state law has provision for the Georgia Public Service Commission to supervise utilities to ensure they are acting in the public interest (See 5.2.3a). In Georgia, the investor owned utility works with the Georgia Public Service Commission to set the rates for electricity in a process commonly referred to as a rate case.

Rate cases are negotiated and debated in a way that enables recovery of expenses by the utility e.g. capital, maintenance, operational costs, metering, and billing (Georgia Public Service Commission, 1997a). The process of rate cases and cost recovery is governed by a mechanism often referred to as rate of return regulation (Regulatory Assistance Project, 2011a). The rate of return regulation is a regulatory tool, which follows an agreement and is a guarantee under Georgian state law that for a service territory assigned to the utility by the state, the utility has a duty to provide reliable, affordable and safe electricity power in a way that is just, reasonable and not unduly discriminatory and in return, the utility gets to spend in a way that maintains and improves the electricity power network, recover its capital and earns a return on its investment (Regulatory Assistance Project, 2011a).

— The Revenue Model

For the utilities this is critical, because inherent in the rate design is a method of taking into account fixed and variable costs from all parts of electricity production to delivery (generation to retail) and is allocated to differing customer segments i.e. residential, commercial and industrial on a total cost to expected revenue basis (Massachusetts Institute of Technology, 2011). In other words, it makes an estimation of projected sales by the different customer segments, the total costs are then allocated to the different customer segments and finally, the segment costs are shared over the projected sales to get a rate (Edison Electric Institute, 2012a). The rate is a $/ kWh (rate) basis and a volumetric consumption pattern with a small fixed monthly charge (Massachusetts Institute of Technology, 2011). These rates are then fixed for a regulatory timeframe but can change if a rate case is petitioned.

The rates cases in Georgia happen when the utility files a petition requesting a rate increase and unless the GPSC suspends them, the rate takes effect within 30 days. If the increase is suspended, the GPSC orders a 5-month suspension, in an effort to study the petition and set up formal hearings to answer all the commissioners' questions and other details. However, within the first 30 days of filing the petition all interested parties intervene at the commission and all interveners are considered by the commission. Formal hearings usually last between 5 and 6 months, after which the GPSC makes its decisions (Georgia Public Service Commission, 1997a).

The relationship between the utility revenue and rate is: Actual revenue = Rate × number of sales (Edison Electric Institute, 2012a). In this relationship, however, if the utility sells more than the estimated sales the extra revenue is considered a profit. Simply put, within the window of an established rate, the more the utility sells above and beyond the projected sales, the more profit is made. Therefore, a reduction in number of sales clearly reduces the revenue stream. Nevertheless, this means that the incentive of the utility is to maximise sales. This is often called a throughput incentive (Regulatory Assistance Project, 2011c). This throughput incentive worked for utilities in the period of high demand growth i.e. 1940 – 1960s, because it allowed utilities to invest into the system, recover their costs and earn their return. On the customer part, it allowed as much consumption of electricity as possible with relatively low rates. At the time the volumetric revenue model for selling electricity and the consumer and utilities incentives were aligned.

— The lock-out of alternative providers

However, the current onset of distributed solar represents a period where the consumer and utility interests are misaligned, because the increase in customer energy efficiency measures and self-generation through distributed solar is at odds with a business model that needs to invest in an asset and rate-base and then charge on a volumetric basis for use of those assets. They are at odds specifically because the reduction in energy consumption through self-generation or energy efficiency by the consumer is a reduction of the volumetric Kwh sales by the utility.

This results in fewer customers left to bear the burden of the fixed and operating costs of the grid infrastructure as well a shift in asset ownership and control from the utility to the customer since currently distributed solar is customer-owned or at least owned by a third party that is not the main utility. In other words, the utility rate-base and rate design model which operates on selling of as many *"electrons"* as possible will struggle to be viable due to changing consumer patterns because it opens-up problems for utility cost recovery due to declining revenue streams and cross-subsidisation concerns:

> "The more penetration of solar under the current volumetric revenue model, the sources of revenue go down, now that's adjusted based on the capital cost that utilities must make to maintain a reliably distribution of power but fundamentally it gives rise to a kind of subsidy by those that do not adopt local generation of those that do. The impact of lost revenues is

> minimal at the current low penetration of PV but again if the predicted high level comes online by 2020, this issue of a potential cross-subsidy as well as revenue impact becomes significantly measurable." - Naimish Patel, CEO of Gridco Systems, March 4th 2014, The Expansion of Distributed PV in the Age of the Grid Edge, Clean Energy Connections Conference

This leaves the utilities with an economic problem with solutions currently being debated. In Georgia, the renewable energy advocates, consumer advocacy groups and even utilities recognise that there is a conflict between the utility throughput incentive and the incorporation of distributed solar by customers and other solar developers into the grid. An interviewee who was also a consultant and director of an energy efficiency company argued that the real reason Georgia Power resisted the increased distributed solar generation were not technical reasons as they had cited, but rather the economics of the business model they operated on and this is where the focus needed to be. This can be seen in the comment below:

> "In a city with the utility that's extremely conservative and has low cost of energy and wants to keep low cost of energy and their business model is predicated on selling, so the more they sell, the more they make and they've got to protect shareholder investments, energy efficiency is not cheap, right so at the end of the day, energy efficiency reduces revenues, it does yeah it cuts back revenues and therefore for a utility to grasp onto it, they need to be compensated for reduction and lost revenues and on and on and on" (4Bi, company president, October 31, 2013).

This opinion was a reoccurring theme especially amongst the renewable energy advocates, especially the obligations of the investor-owned utilities to earn a return on investment on behalf of their shareholders. However, one interviewee who was a director at a regional energy efficiency organisation, makes the point that utilities particularly focus on how best to generate those returns, in the comment below:

> "It is all a shareholder, they're only thinking about the shareholders. You know, it's like, 'And how am I going to generate that 10% return? Oh, most of the time it's going to be on the back of the consumer.' So, the utility-, granted, these are not bad people, but there is something, there is an obstacle in terms of how that system operates between the utilities and the regulators and the state government, and how that all works together" (7G, Director, regional energy efficiency agency February 25, 2014).

In general, most interviewees focused on the utility-shareholder relationship, perhaps because of the utility in question, Georgia Power Company or because investor-owned utilities in the U.S. controlled most electricity generation. Only two interviewees noted that the structure for costs and revenues in a monopoly, whether public or private, is designed in a way that is resistant to change. This is illustrated in the comment below:

> "It's resisted by all of the monopoly utilities that are in place, because you start taking away their revenue generation. You change their business model. You've actually taken money out of their revenue, because you're generating your own power and if you come in and your Solarcity and you say, with no money down homeowner, I will put, uh 10kw system on your roof and we'll pay your electric bill for you or we'll sell these electrons because we own the systems and your only leasing it, where we sell electrons to the utility or to you, suddenly a 3rd party is in the middle, selling electrons or buying electrons and that's what the utilities don't want" (4Bii 9B, Snr. Director International Sales & Market Development, February 20, 2014).

In Georgia, there was consensus that for distributed generation (specifically solar) to grow, the utility business model would need some form of change; yet the debate had become partisan with many vested interests, such that only few perceptions showed consideration for both utility and alternative providers interests, illustrated in the comments below. The first was a manager of an Atlanta based, technical, research, advocacy institute:

> "At the end of the day, I think it's too easy and it's too short-sighted to make the utilities out to be irrational, bad people. Well, specifically Georgia Power. I mean Georgia Power has been providing the state with extremely reliable electricity. Good rates, very reliable electricity, but here's the point. We have a social contract. This is just me talking now. This is me thinking about these things. When we have a social contract, that's when you have regulated monopolies, you have a social contract in my opinion. There has been a huge tremendous capital outlay on the part of utilities to make sure that we have safe, reliable, electricity. We don't have plants that explode. We don't have transformer lines that explode. Right, so when you get something that's very disruptive from a technology perspective, I can understand where utilities are coming from. On the flip side, I can then also understand where the market advocates are coming from whereby they're looking around saying, 'Hey guys. The time is now. Let's reach some compromise.' I personally believe that compromise is possible" (7E, Manager technical & research Institute, February 24, 2014).

The second was a director of a consumer advocacy group in Georgia:

> "Georgia Power wants to control the way that solar comes into the state because they want to benefit from it themselves, they want to have the greatest economic advantage, which is, they're a company, I don't, and you can't fault them for that but they use sometimes and in some ways, they've used the territorial act as a reason to we think, stymie the competition." (6E 14A, Director consumer advocacy group, January 9, 2014)

In addition, despite the multiple similar opinions about the business model of the monopolies being broken or being incompatible with this changing environment, there is no indication of a solution on how utilities could start expanding or altering the nature of their businesses in a way that provides the consumer with what they want and not lose out on economic benefits of distributed solar. This part of the debate is not unique to Georgia, in fact, the opinions in Georgia are representative of a broader debate taking place around the country at the time of writing about how utilities see distributed solar as a resource and an opportunity, instead of a threat to their business model, albeit in states with higher solar energy growth.

The debate between the utility revenue model is still the same even in California where there is 690.2MW of installed residential solar capacity (California Energy Commission & California Public Utilities Commission, 2015), 351.9MW of which has been installed by third party developers on residential sites. Nevertheless, this ongoing debate means that the utilities continue to resist distributed solar and developing it themselves in a way that they could benefit from the asset, which locks out alternative energy providers. Finally, alternative energy providers may continue to be locked out until economic measures which; open-up new revenue streams or change the roles of utility (minimum involvement, integrator, energy services provider) or find new cost recovery measures for fixed costs are found (Fox-Penner, 2014; Lehr, 2013).

Illustrated in a final comment:

> "I have got a question for you Mr Regulator, Mr Chairman, You want to encourage me to drive down my energy sales and all these things are going on to drive down my energy sales, so I'm guessing cause you want me to have a fair return on the investment to back up the guy that's got solar on the rooftop when clouds come in or it rains like hell, whatever and so I am betting you support a fixed variable rate so I get all my fixed costs back and they are allocated to all the customers or you're so enlightened that you will even adopt a maybe formula rate that effectively gets all my fixed costs back regardless of sales" - Jim Rogers, Former CEO Duke Energy, March 13th 2013, Technology a Game changer: Future trends in Electricity. IEE Conference: Powering the People, Innovations for a Better World.

The current lack of clarity regarding how to move forward, makes it unlikely that utilities will disrupt themselves given the benefits to the status quo. This means in Georgia utilities will continue with business as usual with little urgency and restricting the development of distributed solar.

c. Regulatory lock-out

This section argues that there is regulatory lock-out of alternative energy providers in Georgia at the state level that is restrictive or unfavourable to low carbon and therefore hinders development. It will focus on the specific constraints that lock-out alternative energy providers such as legal constraints and the existing regulatory framework that come together in a way that hinders development.

— Solar financing overview

Regulatory lock-out becomes especially relevant when discussing the ways in which distributed solar is financed. The premise is that although solar PV costs are reducing, in general solar projects still have high initial costs that can discourage many customers. Indeed, the typical upfront costs of a solar system are on average $29,000 (Speer, 2012) with slight variations depending on the geographic location of installation. The pay back times for most installations are estimated to be between 6 and 10 years (Kollins, Speer, & Cory, 2009). Nevertheless, solar financing allows for these potential customers to lower their energy costs.

Typically, methods of financing solar are as follows:

- Self-financing: Cash purchase upfront, home equity loans and cash-out refinancing from banks or credit unions, mostly on the condition of very good credit.
- Public financing: financing can come from state or local agencies and even utility companies.
- Property assessed clean energy (PACE) financing: a financing mechanism designed to encourage and assist the installation of renewable energy and energy efficiency systems in homes by reducing the initial capital costs of the different systems. The borrowed amount is then repaid over a property tax assessment over a certain time, typically 20 years. However, disagreements between the Federal Housing Finance Agency (FHFA) and mortgage lenders Fannie Mae and Freddie Mac over the increased risk posed by PACE loans in the event of a failure to pay (Gerdes, 2012; Speer, 2012) has resulted in a significant lack of uptake of PACE programs across the country. In other words, FHFA was concerned that PACE loans would have priority payment over Fannie Mae and Freddie Mac. The situation remains unclear at the time of writing.
- Third-party financing: solar leases or power purchase agreements. Third party financing is the most recent funding tool that is growing the solar market and in states that have favourable solar legislation is allowing for massive solar installations.
    a) Solar Power Purchase Agreements (PPA): The power purchase agreement is one where a solar developer (third party) owns, designs, and installs the solar panel but uses the roof space of a customer (residential or commercial) to operate and maintain the solar system with little or no upfront costs to the consumer. The power generated from the solar panel is sold back to the owner of the roof space at either a fixed or lower rate than the current utility rate, for a fixed period, typically 10 to 25 years (Solar Energy Industries Association, 2012). The customer does not have to deal with large capital costs, the task of maintenance and operation, but in return gets certainty in their electric bills. The developer (third party), also gains by taking advantage of electricity sales revenue as well as state and federal tax credits and incentives. The end of the contracts gives the customer three options: (a) extend the contract (b) remove the panels (c) Transfer to a new home.

b) Solar leases: a similar model as the power purchase agreement but the payment is made for the panels itself i.e. renting the panels and the benefits include the use of all the electricity produced by the system.

— Legal constraints

The foregoing discussion drew attention to a utility business model that was created because of a regulatory framework designed for rapid growth, sales maximisation and ultimately favoured incumbent utilities. These resulted in conversations of how a new regulatory model be designed to properly compensate utilities and enhance distributed solar in the grid. Nonetheless, there currently exists in Georgia, specific legislation about energy provision which indirectly prohibits adoption of solar distributed generation by restricting energy provision to utilities. It is known as the 'Georgia Territorial Electric Service Act of 1973'. Concurrent to the restructuring of the electricity provision to single providers in 1910 and 1970 and the assigning of geographic service territories to utilities, was the legal language barring the generation and sales of electricity by utilities or developers not authorised by the state regulators. For Georgia, this law was created in 1973 and it states that "in the interest of the public, for efficient, economic, safe and reliable supply of electricity, geographic areas within the state of Georgia will be assigned a specific electricity supplier or declared unassigned" (O.C.G.A., 1973a).

The assigned area has only one supplier with exclusive rights to electricity provision and the responsibility of assigning geographic areas is carried out by the public service commission (O.C.G.A., 1973b). Therefore the state of Georgia has a service territory allocated to the main investor owned utility which is the Georgia Power Company, as well the 42 electric membership cooperatives (Georgia Public Service Commission, 1997b). This law was established during the high growth of electricity in the United States. The regulated suppliers are then required by law to submit an integrated resource plan, forecasting how energy demand in the state will be met (See 5.2.3a). Crucial to Georgia's electricity regulation is the definition of a utility, which according to state law is "an electricity supplier whose rates are regulated by the commission" (O.C.G.A., 1981). In Georgia, the definition of a utility and Territorial Act (territories assigned to the utility) affect the ways in which distributed solar can be financed.

Since Georgia state law defined a utility as an electricity supplier whose rates are regulated by the commission, points of contention between solar installers, advocates and utilities were focused on which third party solar financing mechanism (PPAs or Leasing) was illegal and why, if the third-party providers were acting as utilities and how the Territorial Act should be interpreted.

— Solar financing and territorial Issues

In Georgia, there were differences in opinion about the extent to which the Territorial Act was being used by utilities to hinder solar energy financing and the subsequent development of renewable energy amongst clean energy advocates. First, there were clean energy advocates who perceive the Territorial act to have been engineered by Georgia's utilities, specifically to block solar energy from developing in the state. An interviewee from the construction industry and solar advocate had very strong views to that effect:

> "Well here, not in the state of Georgia because the main utility in the state Georgia Power which I say is who the state is named after because they have so much power has decided that they don't want solar power in the state,' and in the early 70s back when solar first raised its head, they got something through the legislation which is not hard on-, you'll find in America and especially in the Southern states of it, your legislatures are not expensive. They're fairly inexpensive and if you're a large company you can do whatever you want for not much money. They passed something called the Territories Act of 1973 which basically says only incumbent utilities, electricity suppliers as of 1973 are allowed to sell power." (4Ai, Business developer, February 19, 2014)

The extent that territories were assigned to circumvent new solar energy technologies or providers is difficult to assess, but the history of electricity development within the U.S. shows that most utility territories were assigned in the centralisation and consolidation era and growth era (3.1b and 3.1d), when multiple utility companies supplied the same geographical area and in order to ensure that transmission and distribution infrastructure was not duplicated, efficient, safe, balanced as well as reduce competition and protect existing investments, state regulation was introduced and monopoly franchises replaced municipal regulation.

The Territorial Act of 1973, towards the end of the growth period, 1910 to 1970 was acknowledged to be a growth period for the utilities. In Georgia, the state legislature and regulatory commission at the time believed this to be the most efficient and economical way for energy delivery for all parties involved (Georgia Public Service Commission Staff, 1997; O.C.G.A., 1973a), citing duplicates, safety, efficiency, etc. Since the state of Georgia never restructured or adopted PURPA, the outcome has been, no choice for consumers and no competitors for the monopolies.

The same interviewee goes on to explain the restrictive nature of the Territorial Act:

> The Territory Act restricts us from putting as much solar as the market would otherwise expect so unless-, if you listen to those conservatives, but we already know they're hypocrites and asymmetrical right, but if you actually listen to them, I won't recommend it but if you did and you let the market decide it becomes more solar here, the Territories Act removes the market from the decision and says, 'No this is a monopoly, this is not a market and we get to decide how much solar.' So, that's the situation in Georgia unfortunately, it's being chipped at, we're pushing Georgia Power to raise it a little. Eventually a brick or two is going to come out of that wall and it's going to fall." (4Ai, Business developer, February 19, 2014)

The view that the Territorial act, reinforces the monopoly status of the utilities was common amongst solar advocates, especially in the clean energy sector. A distinction made is that different forms of territorial acts exist across the country and their primary use is to prevent competition not block solar energy development per se. In other words, this was not unique to Georgia. This is illustrated by the comment made by an interviewee, an academic expert on clean energy policy in the South-eastern region:

> "I don't have a reference too it specifically, but I think almost every state has something like it that prevents competition. Oh! But it is. I think every state has it. Well it is a big deal for distribution generation; it's hard to grow competing providers with the Territorial Acts. So, it is a common problem; it has been passed by every state. It is a state kind of mandated regulation, you know, I'm sympathetic that it's a problem but it is everywhere." (8Aii, Professor, Georgia Tech, March 24, 2014)

Utilities themselves, were developing their own solar generation, albeit slowly. Therefore, the incumbent utilities engaged in legislative lobbying and hired lawyers in Georgia to preserve their monopolies. This is illustrated in a comment by a state legislator and energy committee member:

> "The territorial act of course originated in 1973 and that's really the holy grail of all the utilities in the state of Georgia. I tried to touch that certain topic and, well if you want to bring them out, you start going after the territorial act and distributed generation is the same idea because one of the bills that Mike Dudgeon and I introduced this year would actually allow people to actually finance the solar panels, the solar arrays like you would a car and let them basically to be as the Georgia Power people said a utility, you know once we allow people to finance solar arrays, what that was, it was a work around the Territorial act so we haven't been successful in being able to carve out for our school system, to let a school system to carve out 2MW a year, they won't let us do that, there is too much lobbying pressure if we start messing with that, Southern Company hires 70 lobbyists, exactly, normally we have 4 down at the capital but if you start gnawing in Territorial act stuff they hire all these contracts lobbyists, I mean they come out of the woodwork. I mean that's a lot! But see that tells you how important it is to them, its dollars to them" (2A 3D, Georgia state representative, April 11, 2014).

In addition, there were disagreements between solar advocates and the main utility, Georgia Power, about the scope of the Territorial Act on third party financing, from prohibitions on solar bank loans, lending or leasing the solar panels to power purchase agreements. These are illustrated in the comments below. The first comment came from a construction industry representative who was a solar advocate, who perceived all forms of financing solar to be prohibited by the utilities:

> "Yes, from then on, so it's a flat-out monopoly and so that's the way it's been and what that means is that you have the money, you can put solar panels on your own house, but right, you have to pay for it, you can't technically get a bank to lend you the money. You can't get a leasing company to lease you the panels because Georgia Power's attorneys got in the courts in one of the biggest legal stretches I've ever seen, to enforce that that is providing electricity to somebody. So, a bank can lend you money to drive a car or buy a gun, but if you hit somebody or shoot somebody they don't go back and sue the bank and say, 'You enabled that.' You can't lend or lease anybody solar panels because Georgia Power will go back and sue them and say, 'Oh well they're selling you electricity.' It's like, 'No, we lend them the money to buy anything they want, we don't care'" (4Ai, Business developer, February 19, 2014).

The second comment, from a member and director of a consumer advocacy group, perceives power purchase agreements to be prohibited:

> "Yeah, if you have $30 or $40,000, you can hire someone to install solar panels on your home and use those heat your home. In some states people are allowed to do what's called a third-party power purchase agreement so that they can basically lease the panels and then get the electricity from those, the organisation, the company that they lease them from. There are some issues raised by Georgia Power, there's something called the territorial act, that they claim would make that a violation of the territorial act but those are things that are coming up in this next legislative session but that's we believe that people should have, you know a right, property owners have a right to determine if they want to have solar panels on their homes and they should be able to get financing, if they can't afford to do it outright." (6E 14A, Director consumer advocacy group, January 9, 2014)

Finally, the third comment is from a director of an energy efficiency company:

> "You and I can go put solar on our house tomorrow and we can sell it to the utilities or we can use it directly for ourselves so but we can't have a 3rd party come in and put in our house and give us a power purchase agreement saying, you know you were paying 10 cents, I'm going to charge you 8 cents and here's the contract, you can't do it." (4Bi, company president, October 31, 2013)

The main utility's perspective however, has been to argue that solar advocates often mistake the ability to lease and use solar panels from a third party with the ability to sign a power purchase agreement with a third party, as is evidenced by the statement below. In other words solar energy can be financed whichever way possible, with the exception of the buying and selling of *kilowatt-hours* i.e. electricity from an unauthorised or external party (Environmental Protection Agency, 2014b):

> "The third-party financing, I think there is a misunderstanding on this issue. Customers have always been able to go out and buy solar panels and install them on their business or their home, take advantage of solar and customers have the ability to lease solar panels. So, when someone says: "even with all these tax credits that are available to me, I still can't afford the high upfront costs of putting in solar panels, is there another financing mechanism?" Well one financing mechanism is that you can go out and get a loan from a bank or you do a home equity loan and you can use the money from that to do solar or you can lease the solar arrangement from a supplier, a solar developer. Maybe you enter into a 20 year lease the equipment and then basically you get the output of that solar when the sun is shining you get the benefit of it, when it's not shining you don't obviously, you can do all of that

today in the state of Georgia. You can go out and you enjoy solar for whatever the length of that lease is." (13A, Director of energy policy and planning, April 1, 2014)

Georgia Power, makes the point that, the real intention of solar advocates is not simply to loan or lease the solar panels for electricity, but to sell electricity to their neighbours, which is prohibited under current legislative and regulatory structures, specifically the Territorial Act:

"The other kind of defining feature that you see that some advocates want, is that they want to go beyond leasing and say: "well, what I want to be able to do for the solar customers, is that I want to put a solar panel on their roof and I want to be able to put an electricity meter on it and then I want to be able to just charge them based on the meter, you know, just like an electric utility does." So when my solar starts producing and its finished generating, then the customer just pays me on a per kilowatt hour basis on what that solar power produces and that's where there's been a lot of discussion because the state law, the state of Georgia and other states say that only utilities, electric utilities like Georgia Power or Alabama Power or whatever can sell electricity on a per kilowatt hour basis to a customer because these utilities are regulated by the state, they have certain standards that they have to comply with, quality standards that they have to comply with, their rates have to under the jurisdiction of our state public service commission so that we can't charge whatever we want to for our electricity because those rates are regulated just like they are in the United Kingdom." (13A, Director of energy policy and planning, April 1, 2014)

Throughout this debate there is a point of agreement between the utility and solar third-party advocates; which is that solar advocates want to be able to sign power purchase agreements, hence, the presentation of power purchase agreements as the main/only way to finance solar. This is illustrated in a comment by a Tea Party founder and solar advocate:

"It was against the law, I disagree with, I mean customers where, you know, they could put solar panels on their rooftops, when, you know, if they paid for it outright, but until a bill passed the Georgia legislature a few years ago, it was against the law to actually, you know the way it works, is that whenever, you know, the way solar companies manage it is, they put solar panels on your rooftops with no upfront costs and you just agree to purchase the electricity produced from the solar panels, you know, for, at certain cost and a certain time period and that's the way that works because I mean, they can install solar panels and you have to enter into a contract. Well it was illegal to do that and I am a firm believer in private property rights, that the power you generate from solar panels on your private property, should belong to you to determine what to do with it." (15D, Tea Party activist, October 5, 2016)

Finally, the utility maintains, that if the third party solar developers wish to operate as a utility by signing PPAs, then there should be consideration given to applying regulation and compliance standards for these third party solar developers, because the legislative and regulatory structures have served the state extremely well and attempts to remove them need to be carefully considered. The statement can be seen below:

> "So, the question becomes well if you allow developers to put solar panels on peoples' roofs and put meters out there and charge them on a per kilowatt hour basis, are they becoming a utility? And should they be held to similar standards or requirements and so that's what the discussion is in the state of Georgia and in other parts of the country that if you allow this provision, are there any special rules that these developers need to comply with. Well that's the crux, the people who like I said, you can do third party leasing today. It is perfectly open. The question becomes can you move beyond that and actually sell on a per Kwh basis off those panels and there are some who argue that, yes we should be able to do that and not be called a utility or required to act like utility and there are others who say, by doing that you are starting to undermine the whole regulatory and legislative structure of the utility industry in the state of Georgia and we really need to understand what the long term implications are, if we are going to go down this road, let's make sure we understand what the long term implications are because the current model has worked very well in our state, the rates are below the national average and reliability is very very good, so let's make sure we don't mess that up." (13A, Director of energy policy and planning, April 1, 2014)

From the statements, it is easy to see that the Territorial Act is just one part of a complicated electricity governing structure. The solar financing debate just highlights this complication. Therefore, even though these opinions vary slightly in terms of the degree to which the Territorial Act is a barrier to clean energy financing and subsequent growth, all the stakeholders in the energy sector agreed that there were strong legislative and regulatory structures that needed to be either reviewed or left alone. In addition, the interviewees who were solar third-party advocates, agreed that the law tended to favour the incumbent utilities who take advantage of the law to maintain control over how energy is produced and delivered. There was precedent set by the case of the solar developer known as Georgia Solar Utilities, mounting a challenge in early 2012 to Georgia Power through the Public Service Commission to be made a solar utility, however the developer was not successful on the basis of the legal 1973 Territorial Act.

This led to further questions about recognising the Territorial Act as a barrier, to debates about having it repealed or removed, and to raising questions over the role of the regulatory bodies or legislative bodies in removing barriers to clean energy.
One interviewee, who described territorial assignments as a problem across most states and not specifically a Georgia problem, is accurate in that the responses to the problem have played out differently. Due to the way electricity grids, have evolved across the country, there have been and continues to be regulatory language for territorial assignments of some form in every state in a way that complicates third party solar models. These regulations around territorial assignments are not limited to the South-eastern region and their regulated markets but extend to hybrid states and some elements of deregulated markets.

Some responses in regulated markets like California and Colorado by state commission and legislature have been to exclude or not define third party PV companies offering power purchase agreements as a utility, even though they also sell electricity to customers. The legislative solution in California was as long as the electricity generated is used on site or used by up to two other consumers on the same site then it is in keeping with laws of the state. Colorado define developers of a residential system size (10kw or less) as not being a utility. In addition, the main utility Xcel energy waived monopoly rights for certain solar projects which opened the door to more solar growth.

It must be said that the states that have come up with solutions to their third party and solar language also have quite high renewable energy standards to reach and as such there may be more incentive or regulatory and legislative *will* to sort out these debates in order to reach those targets. The targets include:

- Oregon: 25% by 2025 (large utilities) and 5% - 10% by 2025 (smaller utilities)
- California: 33% by 2020
- Colorado: 30% by 2020 (IOUs) and 10% by 2020 (co-ops & large municipal utility)

Source: DSIRE, 2013
The solutions written in law required some creativity and trade-offs by all stakeholders involved. Therefore, the next issue of discussion will be the legislative and regulatory barriers in Georgia that seem to limit alternative energy growth.

— Regulatory capture and multiple interests influence

The previous discussion on the Territorial Act highlighted a monopoly on electricity provision as a legal constraint for solar energy developers, but it introduced more questions about why this legislative barrier could not be removed, especially given the examples of states (California, Colorado and Oregon), which had come up with varying solutions in response. It could be argued that the state of Georgia has simply not reached that point in the debate on solar and electricity provision where there is a consensus amongst state legislature and regulators that solar provision by alternative energy suppliers without assigned territories is a better value proposition to customers.

Still, there was evidence in Georgia of significant special interest influence on regulators and legislators. Unruh (2000) explains that over time there can be regulatory capture of governing bodies by the interests they were supposed to be regulating. Over time, they would develop their own language and methods of working together that may not often be challenged or questioned. In Georgia, the relationship between some members of the business community and state governing bodies is highlighted again when discussing the multiple interests influencing energy policy. In Georgia, interest groups are a major element of the state's politics (Fleischmann & Pierannunzi, 2007b). In the 1940s, 1950s and 1960s, these organisations included a few corporations and regulated firms like Georgia Power (Fleischmann & Pierannunzi, 2007b).

Since then, there has been growth in the number of interest groups in Georgia and the scope of lobbying by these groups is uncertain. More so, because laws governing interest group activity were not strict: until the 1990s Georgia was one of only two states which did not require lobbyists activities to be regulated (Fleischmann & Pierannunzi, 2007b). Activities range from, sponsoring events, testifying at proceedings, dissemination of information, etc. The research showed that in Georgia, there were clear activities geared towards seeking favourable decisions on energy policy on all sides. Interviewees focused on the fact that there are strong influences by special interests' groups but generally blame the opposing group as the cause.

The solar third party advocates argued that the main utility, Georgia Power, had influence in the regulatory and legislative process, through long standing accepted behaviour between the utilities, regulatory and legislative bodies, like lobbying and campaign contributions which many perceived as Georgia Power overtly influencing the electricity decision making process. Hence, an absence of free market financing for solar and consumer electric retail choice. Groups resisting third party solar like the utility perceived that renewable energy advocates were influencing the state legislature and regulators. Still, *all groups* lobby the state officials but perhaps not to the same degree.

The evidence is illustrated in five comments below which show variation amongst solar third party advocates about the extent of influence of the utilities on legislative and regulatory bodies. The initial three comments were from individuals who perceived Georgia Power's campaign lobbying and campaign contributions as excessive.

The first interviewee was from the construction industry and a solar advocate:

> "You try and change one letter in anything that affects Georgia Power, they will have 70 lobbyists down there, I guarantee you and I am not exaggerating, 70 to try and tell our legislature, 'No please don't do it.'." (4Ai, Business developer, February 19, 2014)

The second interviewee was a state legislator and energy committee member who explains how the Public Service Commission could support voluntary or incremental amounts of solar, stating, *"they're not because basically they are southern company supporters" (2A 3D, Georgia state representative, April 11, 2014).*

The third interviewee was an academic consultant for Atlanta's government:

> "So, we have five, there's five commissioners, four of them had more than 90% of their campaigns paid for by Georgia power the last time that they ran. The one that ran as not being owned by Georgia Power had, 70% of his campaign financed by Georgia Power. So, what most people who have been interested in change have been concerned with the apparent regulatory capture of the commission by the company that they are supposed to be regulating." (8Ai, Academic consultant, Georgia Tech, October 29, 2013).

Nevertheless, some interviewees make the point that solar advocates are starting to and should try to lobby legislators and regulators to be able compete with Georgia Power. An interviewee, a lawyer representing community and environmental groups, explains:

"Well I mean we engage in a small form of lobbying. We support and then we don't support laws that negatively or may positively affect the environment here in Georgia. So, if a solar bill is coming up this session that we are promoting and supporting, I'd have to find what the number is for that. So, we have a lobbyist, we know the lobbyist working on it, so we're helping to support it. You talk to the commissioners, you develop relationships with them so that you can lobby them and tell them your point of view and get them to understand your point of view. That would be one form of lobbying. Then you also lobby the senator and the representatives to get them to vote a certain way on a particular bill and tell them why they should vote in a respective way. We've just really gotten into lobbying this year." (5D, Lawyer, January 23, 2014)

An interviewee who was a director for Georgia's largest solar firm and Green business association explains how the firm engaged with state officials:

"The Public Service Commissioners have open doors and they are state-wide elected officials, there's 5 of them, so it's very small cadre of people, but you have to convince solar makes sense, so all of us started trying to talk to the ones trying to find people who were open minded there. We hosted at Suniva, I hosted plant tours, tours of the factory, see people working making solar panels, solar cells, look real jobs in Georgia, this is a real company. We are not just tree huggers wearing Birkenstocks, we're bringing in economic values-add to the state." (4Bii 9B, Snr. Director International Sales & Market Development, February 20, 2014)

These comments reveal disproportionate levels of influence in electricity decision making in Georgia, especially financially. For example, when comparing the '70' lobbyists being retained by Georgia Power, with no indication that this number is exaggerated, with a 'small form of lobbying' used by the Green firm. These comments also reveal that this form of political engagement may still be relatively new amongst solar and other clean energy firms in Georgia, which could be due in part to the sizes of the solar/renewable energy firms or ages of the firms. Therefore, whilst the solar developers' groups seem to be making a case for the legitimacy of their businesses to the regulators and legislators, there is already an established relationship between the utilities, the regulators and legislature that may be assured.

The size of some clean energy firms may be a factor in the regulatory lock-out, as many do not seem to be represented by more influential associations such as the chamber of commerce, who have a more prominent role in decision making. This is illustrated by a comment from an interviewee who worked in the construction industry and was a solar advocate:

> "Those big businesses represent huge interests that are entrenched interests, small business and start ups and things like me, we are bringing new ideas that threaten the existing business model. The chamber of commerce represents the big businesses; they don't want me coming in there cussing out everybody which I would do, basically you know and all of that. We don't want to listen to you, exactly, sit down, shut up and so we do things like form Green Chambers, the little business chambers of commerce's that focuses on minority businesses or green businesses or things like that, that's cool, but that's how it goes." (4Ai, Business developer, February 19, 2014)

Nevertheless, there were some solar third party advocates, from the solar and energy efficiency business community, who remained nonpartisan about interest groups involvement in the electricity decision making process and governing bodies. For example, one interviewee, a director and consultant of an energy efficiency company, explains that influence comes from all sides:

> "I mean you have a commission and its represented by five elected officials and yes they are elected and they are supposed to be acting upon political policy decisions that impact their constituents right, their people that voted them into office but there's influence, there's all kinds of external influences when you're in that role. You've got utility influences, you've got the consumer influences, and you've got business influences so you have lots of different aspects to consider before making a decision." (4Bi, company president, October 31, 2013)

Therefore, even some of the solar developers and other clean energy firms may find it necessary to be part of the process illustrated by this comment:

> "I would almost be willing, I would almost say to the solar community, 'Figure out a way to cough up half a million dollars and buy what you need from the legislature, get it done and be quick too.' Since we're all tiny companies here and none of us is making money in Georgia, it doesn't sound like much money and it's not, the lobbyists and the other people have that much money in their back pocket. Literally, I mean, that's not a lot. We need to get us some legislators just like Georgia Power." (4Ai, Business developer, February 19, 2014)

In addition, the PSC is bound by state law. State legislature would ultimately have to decide how to deal with third party solar. So, whilst there is focus on 5 elected officials with influence, the decision about third party solar rests in the hands of state legislature:

> "So, the Public Service Commission cannot write laws, they are not policy they are regulatory. They are given a mandate, to regulate, used to be telecommunications before it

was deregulated and now its utilities, limousines and taxis, just a few other things in the telecom area that are still, either regulated, we have probably regulated monopolies. So, they are only regulatory." (4Bii 9B, Snr. Director International Sales & Market Development, February 20, 2014)

Ultimately, Georgia law requires that lobbying expenses including meals, gifts, tickets, campaign contributions and the receiver of the expenses, be fully disclosed to the public (Fleischmann & Pierannunzi, 2007b). Since there are multiple groups of interest who lobby the decision makers, care must be taken not to attribute specific decisions directly to lobbying of the one group or the other. There is no direct evidence in this research that votes have been cast or changed because of specific activities. However, the perception is that the influential power of the interests' groups involved in the decision-making process is disproportionate. Since the state of Georgia never restructured its electricity market there is lock-out of many of the alternative energy providers which may need to be changed by law. This is illustrated in a final comment from a public service commissioner, who argues that the current model of electricity delivery has worked well in Georgia throughout its history:

"A lot of people ask can we deregulate our electricity market here and allow more choices and I am personally against that because I feel like that we've got some of the cheapest electricity in the United States, why would I want to take a system that's working and throw these unknowns into it. Now if we had, really, expensive electricity and we had a company that was running it, that was unreliable and with poor customer service, then I might be interested in doing it but I don't feel like things are broken here in Georgia, I feel like things are going very well, so I am not interested in changing in unless there's a problem." (2Bi, Georgia Public Service commissioner, October 21, 2013)

The absence of an updated state energy policy since the year 2005 means that significant special interests dictate the direction of energy policy. The cases of lobbying and campaign contributions to the regulators also show that pro-solar groups and groups resisting solar essentially carry out similar functions, the only difference being the political sway that each has on energy decision makers. Although, clean energy advocates perceive that there is not the same level of influence from clean energy circles compared to the utilities, the statements about special interests also ignore the fact that the regulators and legislators are not completely without sway in energy policy in the sense that they hold their own political and occupational views about electricity delivery, prices, renewable energy, nuclear energy and environmental regulations.

Furthermore, the hesitancy of regulators or legislators to acknowledge that aspects of current energy legislation like i.e. the Territorial Act legislation would need to change, like legislators and regulators have done in California, Colorado and the other above examples means that significant amount of distributed solar continues to be locked-out of the system. Given these, solar developers may have to provide solar energy by contracting with the main utilities in Georgia whilst customers will need to finance solar energy with all the available except power purchase agreements.

Finally, the hesitancy of regulators or legislators to open the electricity provision system could point to a problem of a political and cultural nature. The political and business nature of most of the energy decisions makers is generally conservative. The conservative attitude around electricity and the environment could explain the enforcing of old energy policies that do not favour low carbon energy.

d. Shared culture and political lock-out: resistance to low carbon

The previous section highlighted the regulatory lock-out of distributed generation and alternative energy providers. More importantly, the section described an energy governance system hesitant or resistant to restructure around low carbon goals. This hesitancy by regulators, legislators and businesses to open the electricity provision system could point to a problem of a political and cultural nature. Therefore, this section will discuss the shared culture across government organisations, businesses and individuals within Georgia which combine to resist low carbon development.

In Georgia, there is evidence which suggests that cultural attitudes, specifically shared resistance to environmental goals from the utilities, regulators, legislators and businesses, and a strict adherence to viewing the low cost of energy as pivotal to economic growth, may in part add to the switching costs of low carbon transitions. These cultural values reinforce each other to favour the current system of energy provision, i.e. the centralised energy and regulated monopoly system, which ultimately mean a change is resisted or limited (Woerdman, 2004). All of this strengthens the lock-in in energy governance in Georgia, but more so locks-out efficient distributed generation alternatives. The resistance to environmental goals and adherence to low cost of energy as pivotal to economic growth will be explored in this section.

— Shared resistance to environmental goals

The first shared attitude is one which resists environmental goals being pursued for its own sake. It is rare for the environment to be a dominant driver of any energy decisions that are made within Georgia. Focusing on a climate related argument for any kind of energy decision is not a popular position.

There is already widespread climate change skepticism amongst energy decision makers in the state of Georgia. Decision makers in Georgia tend to see environmental arguments as emotional, unworkable and not in the best interests of the bottom line for businesses and rate payers in the state of Georgia.

A Sierra Club chapter organiser argues that bills seen as leading with environmental goals will struggle:

> "It's taken a while to get us to a place where those types of bills aren't stigmatised in the conservative community as-, you know, conservatives have not necessarily adopted, or at least not in any widespread way, environmental ethic. So, bills that are seen as promoting clean energy have traditionally been stigmatised as being environmental bills, supported by environmental radicals. It's because the economics work now that, I think that they're not stigmatised, not as much." (6E 7G, Sierra Club Chapter Organiser, February 26, 2014)

Groups such as the Georgia chapter of the Sierra Club pushing to move *beyond coal, beyond natural gas* etc. are typically seen as activists by energy decision makers and not in possession of the economic details of the production of electricity. Two interviewees who were renewable energy advocates explained this point, but were quick to show a difference between environmentalists and other renewable energy advocates.

The first interviewee was a state legislator and energy committee member:

> "I think the issue really for renewable energy supporters is not to be against traditional means of generation, so that's why I have always stuck to all of the above and I've have been able to talk about cost and finance in a way that is credible to your argument. The fuzzy stuff, the warm and fuzzy stuff really has no bearing, you know. I mean that might be

your underlying goal is to protect the planet, or reduce CO_2, the likelihood of climate change getting worse but that doesn't sell, you don't gain any traction, when you start talking about the costs associated with it, how do you factor in all these costs in environmental fees that the companies have, how do you address the fact that the utilities pay for the grid, I mean you have to be prepared for logical arguments and instead you know, they come in, these feel good people and that has really set the industry back I think." (2A 3D, Georgia state representative, April 11, 2014).

This opinion was echoed by the director for Georgia's largest solar firm and green business association and it also showed a split or difference of opinion between the business-driven advocates of solar and the environmental advocates of renewable energy:

> "So, if the clean tech environmental renewable energy activist really could make the case that most Georgians want clean energy then they would be able to demonstrate it with facts. The fact is that Georgia Power would come back and say we offer an upcharge for clean energy, you can buy solar or you can buy renewable energy at an extra cost, only a few thousand people have signed up for it in the state. Not hundreds of thousands, not a million people." (4Bii 9B, Snr. Director International Sales & Market Development, February 20, 2014)

The last two comments indicate two opinions: first is a split in opinion about the best approaches for low carbon development between renewable energy advocates, solar developers and environmental advocates i.e. there was a recognition that within the energy decision making process in Georgia, the environment was something that did not hold much weight, was not critical to decisions made and did not drive energy policy. The approach therefore needed to be more focused on the economics of electricity production and consumption. The second is an appeal by many renewable energy and solar developers to environmental advocates about *being informed and open to all forms* of energy because of the economics of electricity production. Although, there was not a singular explanation of why the environment, carbon emissions or even climate change did not hold more weight in the decision-making process, it was shared by everybody interviewed. Even on the specific issue of climate change, the interviewees discussed the broad origins of why climate change and cutting CO_2 emissions was resisted and did not hold weight.

Some interviewees pointed to the conservative constituency as a resistive force of all things environmental and some interviewees pointed to a weak to non-existent carbon market as the reason for a lack of action. On the conservative constituency two comments exemplify this point; the first was the director of a consumer advocacy group, who describes how climate change has been politicised in Georgia:

> "Conservatives are perceived to think that climate change is not real they don't acknowledge climate change, so it doesn't really, if you're in a conservative state and you are trying to influence and you are talking about climate change it doesn't get very far." (6E 14A, Director consumer advocacy group, January 9, 2014)

The second was a senior technical analyst for a southern interstate non-profit organisation:

> "Currently it's very republican; every governor in the south is a republican except for Arkansas, Maryland is one of our states and Missouri is one of our states. Everyone else is republican, so they are very pro-business, pro-oil, pro-gas, pro-coal, so they are very supportive of coal and that sort of thing" (6E, Snr. technical analyst, October 31, 2013).

The main point being made by these interviewees was that there were incompatible ways of thinking with the climate and environmental issues. It was difficult to support fossil fuels and its competitors all at the same time but because of that, the conversation becomes difficult. Finally, an interviewee who was a manager of an Atlanta based, technical, research, advocacy institute, explains not only the contested nature of the climate debate but the reasons why the conversations shifts to economics of electricity in Georgia:

> "It removes the debate. We can have a gentleman's disagreement about the environmental merits but as long as we see eye-to-eye on the economic benefits, that's all that matters." (7E, Manager technical & research Institute, February 24, 2014).

The economic arguments which pointed to a resistive environmental ethic were also consistent. The first interviewee to show this consistency was a director and consultant of an energy efficiency company:

> "So, it depends on where you are and who the audience is here in Atlanta, carbon reduction it doesn't resonate, it's not the driver, it's really comes down, it's really the economic stand point of it, it's what's the return on investment, how much money are you going to save that's going reduce my electricity bill. Yeah, now other places, yes certainly carbon makes a difference but we are also in an unregulated carbon market, so there's no really set rules about how carbon is quantified, how it's marketed, how it's sold, how it's bought, you know,

we are not in a sophisticated carbon market in yet in the U.S." (4Bi, company president, October 31, 2013)

The second interviewee was one of the five public service commissioners in Georgia and he argues about valuing carbon in a way it makes an impact:

"No, I don't think so at this point, I think because, we haven't yet put a price on carbon in Georgia. You know, we don't have RECS that have value, so there's no trading of these carbon credits in Georgia. Like you have in other states where the RECS have a value, so because of that the price of carbon and is really not even a factor at this point." (2Bi, Georgia Public Service commissioner, October 21, 2013)

The third and fourth comments are from an academic expert on clean energy policy in the South-eastern region, who explains that evaluating CO_2 in traditional levelized cost of electricity model is difficult without a price on CO_2:

"It factors in, only to the extent we can quantity it in cost analysis using the levelized cost of electricity type concept, you know and since there is no price on CO_2 at the moment, it's only a kind of a sensitivity analysis. Certainly, because it's my life, my lifetime involvement has been on the, some of these other benefits of clean energy options, I'm constantly talking about it on the board but it comes right down to maybe that million-dollar investment, you know in some power investment Its difficult to get CO_2 valued and plugged into the formulas." (8Aii, Professor, Georgia Tech, March 24, 2014)

Also:

"Well in the financial analysis of different options, we take the position that unless regulation is already in place we do not speculate about what future regulations might be and so when we do our cost assessment of alternatives we only consider current environmental regulations in the U.S which do not cover CO_2 at the moment although we are always, I am certainly aware of the impending release of new rules and procedures impacting fossil, the Impacting the fossil fleet."(8Aii, Professor, Georgia Tech, March 24, 2014).

The last sentence of the final comment from the academic highlights why there could be an environmental resistance: because it *impacts the fossil fleet*. In Georgia, there is an idea amongst the regulatory officials and the utilities that their coal generation fleet is under attack by the current administration through its environmental goals.

Regulators in Georgia have also referred to climate change as being *in vogue* whilst arguing that more attention should be paid to the handling of nuclear waste (Echols, 2014a).

They have also referred to a federal carbon dioxide plan as one which will cost the country billions, warning of federal overreach and the erosion of state government regulatory powers (IRP process), not based in science but on philosophy, politics and legacy. In summary, combined with a perhaps weak environmental ethic, climate scepticism and difficulty with evaluating CO_2 into energy planning and the heavily contested nature of environmental regulations in the South, it is no wonder that the conversation shifts to economic benefits. Furthermore, the shared resistance to environmental issues have reinforcing constraints as can be seen above.

— Least-cost energy as a function of economic growth

The last subsection indicated that in Georgia we see a preference for economic benefits and growth above all else. Georgian decision-makers may dismiss the idea of environmental policies perhaps due to the fact that the region is rapidly growing and is becoming a carbon intensive industrial hub. The growth has been due to, in part, the low cost of energy achieved by the least-cost approach which prioritises using a combination of lowest cost fuels in the long term. The more environmental restrictions are put into place through various agencies especially federal affiliates, the more this threatens the lowest cost approach that has allowed the economy to grow and has historically been adopted. This value placed on business-led economic growth is extremely common in the South-eastern region.

The Director of the Georgia Centre of Innovation for Energy Technology, a state government department, explains the common directives given with regards to energy decision making and in this case with renewable energy:

> "I want to be clear on this, remember this, our agency here, we don't regulate, legislate or mandate, so we have to operate with what they give us. So, what do they give us, what is our mandate? They say bring investment, solve the job creation, increase the tax base that's it and we have to do. So, we are going after this, we cannot legislate or mandate, so we cannot say: "state what you got to do is 20% or your energy has to come from this, 30 from there, 10 from there or 5 from there, we don't like this stuff here! So, we said okay let's go and start changing the conversation. So, we started changing the conversation by bringing

> the players in, in the solar cell. So, our job was to identify, strategically identify the best players in the field." (1S, Director, State government department, February 19, 2014)

The idea of increasing the tax base by bringing in investment was a perspective echoed across all the interviewees. All participants acknowledged that state energy officials and locals wanted to see economic growth and commonly described Georgia as being "open for business" in an effort to continue to attract heavy industries and energy users (Echols, 2014b). Furthermore, the above interviewee introduced another attitude which was shared by most of the interviewees like the utilities, chamber of commerce and the majority of business owners, about a resistance to Government intervention in the form of mandates and subsidies especially in the case of solar energy.

In Georgia, a major factor that has helped with investment, job creation and an increased tax base has been the low cost of electricity provided by the utilities. Part of the problem here for the energy officials is the need to make the step up from the lowest cost energy mix dominated by fossil fuels to the cleanest which adds substantial costs to existing and future fleet. The costs involved in reducing or removing an extremely high proportion of baseload coal power for a lower carbon source when grid parity has not yet been reached makes for an expensive change which would put upward pressure on rates for residents and businesses in the state. This can be seen with basic tools, such as the levelized cost of energy approach.

A senior energy official also expressed the opinion of "cheap energy as the secret" to a wave of new economic growth and shared concern for countries who want to make wholescale changes to the way electricity is produced and in the process have put their utilities at risk and incurred serious upward pressure on rates (Echols, 2013a). The clean technology developers also agree that presenting a better value proposition of cleaner energy to individuals and businesses was extremely difficult due to cost not only in Georgia but in the rest of the South-eastern region. Three comments summarize this perspective perfectly. Again, the director for Georgia's largest solar firm and Green business association:

> "So, I think they, all of us, here in Georgia have learned and the legislators, politicians have learned that, you've got to be careful, you don't want to look like you're doing what California does but you can surely learn from it over time. And why California? Why is that the Pariah? Well because business costs are higher, energy costs are higher, electricity is three times the rate it is here. None of that is good for economic development here, no citizen here wants to pay more for their electricity here and it's just a little more laid back conservative approach, to living here and so, you know while the rest of the world may see California as a bastion of innovative, business and everything, there are folks in the United States that say, it's a nice place to visit but I wouldn't want to live there." (4Bii 9B, Snr. Director International Sales & Market Development, February 20, 2014).

The comments made by environmental advocates and clean energy developers grant some legitimacy to the view shared by the state utilities and regulators about opposition to any energy decisions that could potentially put upward pressure on rates. Generally, states leading on low carbon development (i.e. with a high percentage of renewable energy sources) were not seen as successful energy providers because of the high-energy prices in those areas. This prism of low cost is shared by residents of Georgia as well. This is a culture that expects and places value on a stable, reliable and low cost electric provision. Any change to operating and financial procedures is viewed as a deviation from the norm and is perceived as a threat by most stakeholders in Georgia especially the residents and any other heavily dependent low cost groups. The energy consultant for the Georgia Chamber of Commerce argues on behalf of businesses and residents:

> "Atlanta is a big part of Georgia, it's a driver of economic growth, but a lot of business and industry is located in areas beyond the metropolitan boundaries, so is it going to be equitable for agricultural industries, for food prep industries, for other industries that are located throughout Georgia. So, we look at all legislative proposals through that prism. Obviously one of the big take home issues for consumers is, 'Is it going to up my power bill?' So, you know, that's another one. They might not look at the intricacies of the policy, but they sure understand if it's going to drive up my power bill by 5%, they're actually not going to like it, so, you know, we've got to understand all of those issues." (9A, Chamber Energy Consultant, October 30, 2013)

It is interesting to note that even if the groups involved do not understand all the intricacies of energy policy, there is still a consensus that the low carbon approach could put upward pressure on rates.

The issue then becomes: if all the intricacies of the policy are not understood, how is a consensus reached. This notwithstanding, most renewable energy advocates in Georgia are starting to argue that, for individuals, the economic perspective is a better way to make energy decisions. These are illustrated in the comments below:

> "Seriously, but that is-, people actually stopped and joined in the conversation I'm having with someone because there's a realisation that these energy-efficient light bulbs just aren't outliers anymore. They see someone holding a $10 light bulb and looking at them and they have thought this as well, 'Should I buy a $10 light bulb?' They stop and we start engaging in a conversation and other people with stop and listen too. That doesn't mean that they're going to rush and buy a $10 light bulb. It's that it's entered the consciousness of people that there is an economic impact, not necessarily an environmental impact. People are looking at this from an economic perspective, and they should be looking at it from an economic perspective." (7E, Manager technical & research Institute, February 24, 2014)

Whilst there is this individual response to energy decision making amongst residents of Georgia, an economic perspective in Georgia is the often-uncompromising adherence to low cost electricity against all odds, which hinders low carbon development. Furthermore, in the absence of a strong environmental belief or ethic, low carbon developments become hard to justify because the benefits can be hard to quantify. Normally state regulators, legislature and utilities, need to work through and know how to measure the benefits of every energy investment, i.e. what is the benefit to the current system and how can these be quantified (Fox-Penner, 2014). In Georgia, however, this comes with the need to build upon the current mode of energy delivery, not to disrupt it, and to minimise risk and not put upward pressure on rates. This reluctance by everyone to incur any additional costs means that most energy stakeholders prefer governments, private residents and businesses to make their decisions themselves. The final statement by the solar manufacturers emphasises this point:

> "So most people don't want to pay the extra cost for clean energy and it's just like, you know everybody complains about Walmart but you find a lot of people shop for stuff at Walmart, not everything but they'll go get something in there, a commodity and if electricity is a commodity then why not pay a low cost price as you can, at the end of the day when you're running your electricity in the hot humid South and you need to be here in August to see how bad it gets and you'll realise why we treat electricity like we do. You'll see that people really do want to buy cheap." (4Bii 9B, Snr. Director International Sales & Market Development, February 20, 2014)

A recurring subject across the range of “attitudes” to energy decision making is the specifically conservative factor which emerges in the environmental resistance, economic growth and cost sections. Those conservative attitudes to electricity decision making have been explored in the previous chapter.

7.3 Conclusion

This chapter sought to explore the technological, organizational, industrial, societal, institutional barriers to renewable energy investment. The chapter however, illustrated a serious case of lock-out of distributed energy and alternative energy providers. In essence, the lock-out mainly prevented decentralisation, specifically distributed solar generation. It is a lock-out that holds low cost electricity and the least cost approach to energy decision making as paramount. The sources of technological lock-outs, like the technical issues related to grid stability, balancing transmission and distribution, which emerge when there is high penetration of distributed solar on the grid, are valid but are not the major cause of concern yet, as Georgia is not anywhere close to high penetrations of decentralised renewable energy.

However, the resistant attitude of Georgia’s decision makers to distributed solar and renewable energy in general, is much more difficult to overcome, given the technical issues in states like California and Hawaii with large sources of renewable energy. The reference to these other markets as ‘bleeding edge’ instead of ‘leading edge’, is an indication that Georgia Power considers distributed solar energy as high risk. The regulators and Georgia Power also consider large amounts of renewable energy to be risky.

This chapter also showed a powerful institutional lock-out of alternative energy providers exist. The combination of the monopoly laws, the restrictions on the distributed solar sizes, the IRP process, rate of return regulation and revenue model of incumbent utilities all serve that purpose. The close relationship between the regulators, state legislators and the incumbent utility, where the utility and regulators share the same values about energy, as well as a resistance to environmental goals reinforce the lock-out. It is the decentralisation that comes with alternative energy provider, not renewable energy that is explicitly locked-out.

A case can be made that as prices for solar and wind continue to drop, renewable energy will become part of the least-cost model, required by the Integrated Resource Plan and appreciated by decision makers. So, Georgia Power may be able to develop the renewable energy and rate-base the asset, similar to the way that it develops other energy resources.

In regard to solar, although it is evident that alternative energy providers are locked-out of the system, it is important to also acknowledge that the entire debate about specific forms of financing solar demonstrate that renewable energy is not currently or completely cost ready in Georgia. In order words, distributed solar providers may not be at grid parity in Georgia. Nevertheless, the fact that the state energy regulators are starting to have debates about incorporating renewable energy generation into Georgia's electricity mix, as well as allowing distributed solar energy into the grid and weighing the pros and cons of opening up the grid to alternative energy providers, shows that there is a rising challenge to Georgia's system of energy provision. The next chapter explores the story of energy-carbon restructuring challenges to Georgia's electricity generation and supply system.

8 THE ADVANCED SOLAR INITIATIVE: A REFLECTION OF ENERGY-CARBON RESTRUCTURING IN GEORGIA

So far, the PhD has explored the main debates and discussions in the case study by focusing on three topics including, the utility scale solar development, decentralisation, nuclear energy development and federal carbon regulations. The PhD has also explored the idea of lock-in and introduced the idea of lock-out. In the following chapter, the focus shifts to Georgia's advanced solar expanded initiative and how the target for solar electricity generation increased from 425MW to 525MW and how that maps onto a growth in solar generation of electricity in the state from 21.4MW in 2012 to 800MW by 2015. The chapter analyses the reasons why the increase in solar generation targets and outcomes occurred in the context of conflict between pro- and anti-solar groups. This chapter exemplifies the way the factors introduced in chapter 2, came together during the main solar debate in the case study.

The pro-solar advocacy interests were members of renewable and energy efficiency businesses and associations, consumer advocates, a southern regional organisation and a loose coalition of some Atlanta Tea Party Patriots and Sierra Club members. The pro-solar groups were driven by decentralisation concerns. These organisations were pushing to open-up Georgia's generation and allow customers a choice in using alternative providers. In formal proceedings, five organisations including Georgia Solar Energy Industries Association (GSEIA), Georgia Solar Utilities Inc. (GaSU), Georgia Watch, Southern Alliance for Clean Energy (SACE) and the Sierra Club were listed. However, many other organisations not on the docket still had influence in the process in the state.

The organisations mainly resisting solar were the Georgian utilities including Georgia Power and other utilities who owned percentages of energy generation plants, the Georgia Chamber of Commerce and initially the Georgia Public Service Commission and some members of the Georgia State Legislature. These organisations were not anti-solar per se or anti-renewables per se, but were attempting to preserve the existing electricity generation and supply structure which locked-out third party distributed energy.

8.1 State of the Solar Market in the United States and Georgia by 2013

At the end of 2011/2012, renewable energy generation in Georgia was mainly provided through hydropower, which made up 1% and 3% of electricity generation capacity in 2012 and 2013 respectively (Georgia Power Company, 2014a). In 2012, Georgia Power had approximately 21.4MW of solar PV capacity. One of the main reasons for the relatively small percentage of renewable energy generation was that, at the time, the costs for generation from renewable energy were higher than fossil fuel-based electricity generation. Georgia has the lowest costs or very near the lowest costs of electricity in the United States, (U.S. Energy Information Administration, 2014a).

By 2012, solar generation was gaining ground in the US especially in many pro-solar states with policies encouraging solar growth including Renewable Energy Portfolios (RPS), net-metering, third party financing and generous interconnection limits (Solar Energy Industries Association, 2012b). The growth was also arguably caused by the introduction of new methods of financing solar projects for across the United States. These especially helped the residential sector receive benefits in solar power installation because they allowed potential customers to reduce the upfront costs of solar installation. Furthermore, third party financing also attracted investors aiming to take advantage of federal and state tax benefits (Kollins et al., 2009). These pro-solar regulations and subsidies led to significant growth in solar generation (GTM Research & Solar Energy Industries Association, 2013) across all solar markets segments (residential, non-residential and utility). For example:

- The United States installed 3.3GW of Photovoltaics, an estimated 76% growth, from 2011 (GTM Research & Solar Energy Industries Association, 2013).
- Residential installations of photovoltaic solar were estimated to be 488MW in 2012 across the U.S., a growth of nearly 62% over 2011 (GTM Research & Solar Energy Industries Association, 2013).
- Non-residential and utility scale installations of photovoltaic solar were estimated to be 1.04GW and 1.78GW across the U.S., a growth of nearly 26% and 134% respectively, over 2011 (GTM Research & Solar Energy Industries Association, 2013).
- The price of solar in the United States reduced overall due to individual component prices reducing from global oversupply. Examples include polysilicon which has been the most expensive component in a photovoltaic module. In the U.S. the price for the

module at the start of 2012 was estimated at $31.62 and finished at $19.88 by the end of 2012 ((GTM Research & Solar Energy Industries Association, 2013) and the single PV module started from $0.94 at the beginning of the year but reduced to $0.68 by the end in U.S. (GTM Research & Solar Energy Industries Association, 2013).

- Finally, the five states with the highest photovoltaic installations include California, Arizona, New Jersey, Nevada and North Carolina, arguably due to the high number of finished utility-scale, ground-mounted projects and renewable portfolio standards (GTM Research & Solar Energy Industries Association, 2013).

In Georgia, an interviewee who is also a director of an energy efficiency company and acted as consultant for the Atlanta Office of Sustainability reflected that solar growth was at the early stage of market development in 2013:

> “So the solar market is, it’s a developing market here in Atlanta as well, it really doesn't compete, it’s a very, very small portion of generation in the mix and it’s not that it's, so cost effectively it's still has a little bit of differential so it’s a little more expensive. I think the bigger challenge on the solar side, renewable side for the Atlanta, Georgia market is archaic policies.” (4Bi, company president, October 31, 2013).

8.2 The Advanced Solar Initiative Process

In October of 2011, the Georgia Public Service Commissioner Lauren McDonald called for a study of renewable energy portfolio standards as means to promote solar development in the state (Georgia Public Service Commission, 2011). Lauren McDonald is one of five elected Republican Georgia Public Service Commissioners. Commissioner Lauren McDonald is a former Georgia state representative and three-time elected Public Service Commissioner. The significance is that he is a key actor in Georgia’s electricity decision making and has changed his long-standing opinion on renewable energy standards and made a proposal contrary to Georgia Power’s and other commissioners’ positions (Henry, 2011). This was influenced by evidence of solar generation in other U.S. states especially Arizona. Justifications for action in Georgia included attracting investment to the State of Georgia but also to assist Georgian ratepayers with environmental compliance fees currently incurred (Georgia Public Service Commission, 2011):

> "Finally, since March of this year, ratepayers have noticed an "environmental compliance" fee which can be as much as 6% of their bills. The Commission and the Georgia Power should evaluate what, if any, of these charges can be mitigated by increased solar production from additional third party Purchase Power Agreements (PPA). This review is in the best interest of ratepayers and important information for the Commission" (Lauren McDonald, Georgia Public Service Commission, 2011, p. 2).

And

> "Technology and the market have brought us a remarkable turn of events and one that the Commission should explore immediately. Solar prices today give Georgia an outstanding opportunity to supplement our fossil and nuclear power sources while creating good jobs and immediately assist in Georgia's recovery. Solar also brings significant property value and additional enterprise values to Georgia citizens and businesses that are currently not available to them through the purchase of electricity" (Lauren McDonald, Georgia Public Service Commission, 2011, p. 3).

However, although the case was made, action was not taken and the reason could be found in comments by another commissioner, suggesting that the idea was unpopular and would be 'dead on arrival' (Henry, 2011). The issue moved on in 2012 when a solar developer Georgia Solar Utilities Incorporated (GaSu) petitioned the Public Service Commission to be made a solar utility. GaSU is a start-up described as a group whose 'sole purpose is to generate electricity through the deployment of solar technologies' in a fashion that protects ratepayers' interests (Georgia Solar Utilities, 2012). The group's focus was on the underdeveloped solar market in Georgia. The significance is that this group was formed with the intent to operate as a 'utility' and designed as a copy of Georgia Power's and guaranteed territorial protection under the law (Georgia Public Service Commission, 2012c). They are of interest because this was a formal challenge to Georgia Power's monopoly, selling solely solar electricity directly to customers in Georgia. GaSU argued that the petition was a response to Commissioner Lauren McDonald's call for an exploration of renewable energy portfolios and solar development in Georgia (Georgia Public Service Commission, 2012d):

> "As part of the Georgia Solar Industry, the Principals of Georgia Solar Utilities (GaSU) undertook this investigation. It was found that the problem with solar development in Georgia came from the management of Georgia Power" (GPSC, Filing 144119, 2012, p.1).

The petition argued that although Georgia Power Company has controlled solar development, there was a positive aspect to the lack of solar development because, Georgia's ratepayers had so far been protected from the liability costs associated with early development of solar found in countries like Germany (Georgia Public Service Commission, 2012c) and GaSU, had learned from those examples:

> "We have not made any 'mistakes' in our solar development. Ratepayers do not hold any liability for the cost of the early solar development. Let us keep that record. GaSU has used the wisdom of recent solar history in Germany and other locations to guide our plan" (Georgia Public Service Commission, Docket 36286, 144119, p.2).

GaSU pointed to examples of utilities failing, when revenues streams were significantly and continually eroded from solar programs. Examples include, Germany's Feed-in Tariff and Power Purchase Agreements (Georgia Public Service Commission, 2012c). Finally, the petition argued that the due to the Territorial Act, these liabilities have been avoided in Georgia and therefore the request by GaSU was to be made a utility with all the legal protections of the Territorial Rights Agreement (Georgia Public Service Commission, 2012b). During the hearings, four organisations including Georgia EMC, Green Power EMC and Georgia Power filed to intervene in the hearings (Georgia Public Service Commission, 2012a).

The representatives for the EMCs and Georgia Power argued against the petition, citing laws and legal opinions relating to electricity generation and supply. They argued that, according to the Georgia Supreme Court, the GPSC only had powers granted to it by state legislature and law. Since there are no laws that grant the GPSC this authority, granting GaSU the right to develop solar energy exclusively or non-exclusively is beyond the jurisdiction of the GPSC. In addition, GaSU is currently free to produce solar energy, according to current laws and regulations, without the authorization of the GPSC in Georgia. Furthermore, the GPSC cannot pick winners and losers in solar energy production market, in this case, picking GaSU as a winner. Specifically, the GPSC cannot grant a billion-dollar monopoly on solar energy to GaSU and prevent the other utilities and independent power producers in the state the opportunities to develop solar energy (Georgia Public Service Commission, 2012a).

Finally, although GaSU is petitioning to be a solar utility, the company has no infrastructure nor plans for infrastructure including, transmission and distribution lines, back-up power, meters, staff, electricity dispatch and scheduling, for use in the provision of electricity, obligations that are key to utilities. Rather it expects these functions to be provided by the incumbent utilities, whilst profiting from solar (Georgia Public Service Commission, 2012a). After three months of hearings, the petition to be made a single provider solar utility was not successful. In the final decision, the Georgia Public Service Commission passed a motion, supporting the endeavours of solar companies in general, to take up the issue with the Georgia Legislature:

> “WHEREFORE IT IS ORDERED, that in recognition of the potential benefits of new solar technology to ratepayers, the Commission hereby supports the efforts of solar utilities to pursue appropriate legislation in the Georgia General Assembly” (Georgia Public Service Commission, Docket 36286, 145077, p.2).

In the 2011-2012 Georgia’s General Assembly legislative session, four Republicans and two Democrats of the Georgia State Senate introduced bill SB-401 which sought to amend the “The Georgia Cogeneration and Distributed Generation Act of 2001". Little is known about the senators, apart from the fact that, of the six sponsors of the bill, the main sponsor was on the Senate Regulated Industries and Utilities Committee, one was the Georgia Senate President Pro Tem, another was the Georgia Senate Majority leader and finally, one was a consumer rights advocate ("The Georgia Cogeneration and Distributed Generation Act of 2001," 2012).
However, the bill was drafted by a law firm on behalf of leaders in the renewable energy business industry (Lee Reece, 2012). The new bill sought to remove barriers to investments in alternative energy by proposing the following; removing the caps/limits on projects sizes for distributed generation, currently set at 10kW for residential systems and 100kW for commercial systems.

The removal of caps would allow for much larger residential and commercial distributed generation projects. It redefined the definition of a distributed generation facility as a facility ‘provided by or for a customer generator’ for the production of electrical energy ("The Georgia Cogeneration and Distributed Generation Act of 2001," 2012). It expanded the eligible resources in distributed projects to include biomass, municipal solid waste, landfill gas and hydropower. It clarified that net-metered customers earn a “commercially reasonable rate” on their distributed generation systems and finally, it prohibited unreasonable charges to distributed generation customers by the utility or other providers. These amendments, it was argued, would promote renewable energy investments, especially solar energy by permitting any financing and ownership mechanisms available by the market to reduce the upfront costs of these residential and commercial distributed energy systems. The proposed senate bill was assigned to the Georgia Natural Resources Committee, for a hearing in the General Assembly.

However, the bill eventually died in the committee when the chairman of the Georgia Natural Resources Committee argued that the impacts of the bill needed to be studied further and proposed a study committee to “to determine the scope of impact on Georgia families, jobs in our state, and economic development opportunities” (Sen. Ross Tolleson, Savannah Business Journal, March 5, 2012). Whilst, the proposed ‘SB 401’ bill had died in the Natural Resources Committee in late February of 2012, the main sponsor of ‘SB 401’ revived the distributed generation push by attaching the provisions of ‘SB 401’ to another bill ‘SB 459’ (a smart meter bill) and submitted it to the Regulated Industries and Utilities Committee (Landers, 2012) for consideration.

However, the bill’s sponsor decided to withdraw the amendment to ‘SB 459’ after a realisation that the necessary votes were not going to be obtained:

> “Finally, realizing that I don’t have the votes necessary for passage, I decide to withdraw my amendment to SB 459 so that the underlying bill dealing with smart meters can continue to move forward. The amendment, which was essentially SB 401 dealing with solar power purchase agreements, has garnered much attention over the weekend particularly among opponents of the bill who have convinced at least four more committee members to oppose this piece of legislation. This is a very disappointing setback, to say the least” (Sen. Buddy Carter, Effingham Herald, March 5, 2012)

In September 2012, Georgia Power announced that it had filed a new solar initiative called the Georgia Power Advanced Solar Initiative (Georgia Power Company, 2012b) which was approved by the Georgia Public Service Commission. The initiative is divided into two programs; a) the distributed generation program and (b) utility-scale Request for Proposal program. The distributed generation program gives existing residential and commercial Georgia Power customers (i.e. homeowners and solar developers) the option to generate electricity and sell it back to the grid through solar power purchase programs. The distributed generation program was further divided into small and medium scale programs which sought to generate a total of 45MW per year from 2013 through to 2014 and be in operation between 2015 and 2016 (Georgia Power Company, 2012a). The specific details of the distributed program are set out in (*Table 8-1*):

Program	Goal (MW)		Qualification Process	Project Size	Timeline
Distributed Generation	90 MW – 45 MW per year, for 2 Years	Small Scale (11MW)	Application	Residential and small commercial projects, sized up to 100kW	The projects begin commercial operation between 2015 and 2016.
		Medium Scale (34MW)	Application	System capacity 100kw and 1MW. Participants cannot exceed approximately 20% or 90MW of program capacity per year.	The projects begin commercial operation between 2015 and 2016.
Utility Scale	120MW	60MW per year for 2 Years	Request for Proposal	Projects range from 1 MW - 20MW	The projects begin commercial operation between 2015 and 2016.

Table 8-1: Advanced Solar Initiative Breakdown
Source: Georgia Power, 2012

The Georgia Power request for proposals, began in 2013 and continued through 2014. The RFP process, employed an independent evaluator (Accion Group). The chosen projects began commercial operations between 2015 and 2016. The reasons why the solar initiative was introduced are discussed in the next section. A manager of an Atlanta based, technical, research, advocacy institute, explained how the contracts work:

> "Okay. So, a lot of the MWs before 2012, most of the installations we're talking about were on top of homes, before 2012. Most of the capacity; however, were installations that were on top of commercial buildings which makes sense. Last year, going from 22MW to 100 MW, the vast majority of that was solar farms. We're talking about large scale 30MW,

> 20MW, 2, 3MW farms. That's where Georgia Power's voluntary solar initiatives kick in. Where they're voluntary buying these megawatts from solar farms with, you know, contractual periods I believe are 20 years." (7E, Manager technical & research Institute, February 24, 2014)

Furthermore, this interviewee also admits that Georgia Power had an existing large scale solar (LSS) project but it was developed differently and had different agreements to the new ASI program. The 'LSS' was based on solar farm installations and made use of power purchase agreements whilst the 'ASI' program was focused on rooftop and ground-mount residential and commercial solar installations:

> "They had what was called the Large-Scale Solar Project which originally was 50MW but now we understand that it's 60MW. Then, you've got the Georgia Power Advanced Solar Initiative, ASI. ASI is 'x' amount, of megawatts broken down over three years. Then there's another breakdown of what's considered distributed generation. So, it's 1MW or less, 1MW or more, then, there is utility scale. The Large-Scale Solar is a separate programme than Georgia Power Advanced Solar Initiative. So, LSS is different than ASI. LSS is essentially all solar farms whereas ASI is rooftop solar on homes, rooftop solar, or ground-mount solar that is-, let me rephrase that. It's, rooftop or ground-mount but it's homes. Then it's, rooftop or ground-mount but it's commercial. Then it's utility-scale solar farms." (7E, Manager technical & research Institute, February 24, 2014)

In addition, the large scale solar program was the outcome of a request by the GPSC from an administrative session in June 2011, that Georgia Power Company propose options that expand large scale solar projects (Georgia Power Company, 2014c). Georgia Power then proposed a 'large scale solar' plan whose goal was to add 50MW of solar generation capacity. Georgia Power would purchase 50MW by signing power purchase agreements with the solar project developers (Georgia Power Company, 2014c). In December 2011, Georgia Power signed two contracts of 30MW and 19MW of solar energy and in October 2012 Georgia Power signed a contract of 1MW (Georgia Power Company, 2014c). The ASI had a different rationale. In a formal document, Georgia Power stated:

> "We will continue to build on our record of maintaining one of the nation's safest, most reliable, and innovative electric systems at rates below the national average. To continue that tradition Georgia Power is pleased to propose the Georgia Power Advanced Solar Initiative ("GPASI"), a solar energy purchase program that will encourage new opportunities

> for solar development in our state. This program will dramatically spur the growth of solar generation in Georgia, and propel us to the forefront of this clean, safe energy technology" (Georgia Power Company's Advanced Solar Initiative, 2012, Docket No. 36325, p.1).

Nevertheless, solar advocates believe that the creation of the Advanced Solar Initiative (ASI) was a response to the growing pressure to facilitate distributed renewable generation. This was confirmed by an interviewee, who was an academic consultant for the Atlanta City government sustainability plan:

> "So, the official version is different from the real version. In the official version, Georgia Power recognised a demand and got together with the Georgia solar energy associations and some of the non-profits that lobby on this issue and came forward with this proposal, which was accepted by all parties and everyone smiled and had a nice photo op. The background was really that the State legislature was pushing forward some fairly new, aggressive legislation and it was going, because the last state law that was put in place was in 2001; it had some pretty restrictive measures that said that you couldn't have distributed generation in total, so, like all renewables and combined heat and power and just like personally owned generators, whatever. They couldn't exceed 0.2% of summer peak demand. So, if you wanted to, summer peak demand is like 16GW in the state and so you couldn't have more than 320MW deployed, which is pretty, pretty restrictive. So, they were a couple legislators that were bringing some new language to change those laws that Georgia power was opposed to and this was a, and the lobbyists and the non-profits kind of got together behind the scenes and accepted this as a temporary deal to go forward that if Georgia Power did the 210MW they would stop pushing this bill. So, that was issued and that's what's called the advanced solar initiative." (8Ai, Academic consultant, Georgia Tech, October 29, 2013).

The comment suggests that there had been pressure building from a few legislators, non-profits and representatives for the renewable energy industry and on occasion, a public service commissioner. It also shows a shift in the opinions of some state legislators on distributed energy, whereby the past severe restrictions on distributed energy were being challenged. The outcome was pressure that Georgia Power had to accept some form of energy-carbon restructuring. Finally, the comment highlights some of the internal politics involved in electricity decision making and energy-carbon restructuring like the negotiations and deals that had to be undertaken to get the Advanced Solar Initiative created.

Overall, Georgia Power has been extremely resistant and hesitant towards the idea of renewable energy, specifically solar and wind, as evidenced by the lack of and non- committal renewable plans in the integrated resource plans from 2007 to 2010. The only renewable energy Georgia Power had any vague plans for was biomass.

Nevertheless, the section shows past attempts at energy-carbon restructuring by the PSC; where moderate forms of restructuring including exploring renewable energy development projects have been suggested. Concurrently, there has been pressure on the PSC and state legislature from renewable energy businesses to introduce forms of decentralisation and to balance multiple interests in electricity generation and supply.

8.3 CORPORATE AND COMMERCIAL DEVELOPMENTS IN 2012

In 2012, before the IRP debate, three corporate and commercial organisations incorporated low carbon restructuring into their manufacturing and business process. They included, IKEA, Walmart and Coca-Cola. In July 2012, IKEA Atlanta installed a 1.03MW solar generation system consisting of 4,326 panels, and a distribution centre in Savannah Georgia installed a 1.46MW system (Cunningham, 2012). The organisation is thinking of expanding its solar projects to other parts of Georgia. The move is seen as part of the company's sustainability commitment to become energy and resource independent by 2020, with 16 similar solar projects coming online across the United States (IKEA Group, 2012).

Walmart and Sam's East (Walmart subsidiary), a commercial retailer, had corporate renewable energy targets as part of corporate social responsibility. By 2007 Walmart reported that it was involved with 335 renewable energy projects worldwide (Walmart, 2007). Walmart also testified in a docket on demand side management that it was scaling up its renewable energy electricity purchases and production and energy efficiency:

> "First, Walmart will scale renewable and drive the production or procurement of 7billion kWh of renewable energy globally by December 31, 2020 – an increase of over 600% versus 2010. Second, Walmart will accelerate energy efficiency. By December 31, 2020, our goal is to reduce the kWh/sq. ft. energy intensity required to power our buildings around the world by 20% versus 2010." (Testimony on behalf of Walmart, Docket 36499, 2013, p. 3).

A plan which the Georgia commissioners and the utilities were aware of (Solar Energy USA, 2013b).

Georgia Power is not the only utility to be made aware of this plan. In North Carolina, the investor-owned utility, Duke Energy has been challenged by Walmart's plan:

> "They're telling people like Duke Energy, 'We're going to put these panels on our roof and that's that.' I think for a few years ago, Duke Energy was telling big box stores like Walmart, 'Well yes you're going to put panels on your roof but we have to own them.' 'Are you out of your mind, if we put them on ours they're mine, you can forget that idea'." (4Ai, Business developer, February 19, 2014).

Finally, the Coca-Cola company installed a 6.5MW combined heat and power plant at one of its syrup plants in Georgia (Environmental Protection Agency, 2012a) and has reduced its electricity and manufacturing costs. For Coca-Cola, if an investment is good for the environment and improves the earnings, then it is undertaken:

> "We are concerned because we know we make an impact and we want to do the right thing. In some cases, we look for, as often as we can, we look for where green equals green; where improving the impact on the environment also improves our bottom line. So, there is business, there is bottom line business, you know triple bottom line kind of stuff reasons that we do that for and its risk mitigation, it builds trust in our brand." (4Aii, Program Manager, Coca-Cola, February 27, 2014)

In addition, the strategy by Coca-Cola is to circumvent any utility green power purchases, by investing directly in the technology and retiring the full benefits:

> "We don't buy green power right, any more than is embedded in the grid like if there's some standard green in the grid, then we would be purchasing it automatically but we don't go out there and specifically buy blocks of green power or buy wind power, we don't but RECS at least. We typically don't, especially North America, we would rather do the project on our own facility and retire the benefits. We do get our carbon footprint reduction compared to just getting it off the grid and it just so happens that our arrangement saves us money. So, we get it both, we get a win-win, that's what I meant, green equals green." (4Aii, Program Manager, Coca-Cola, February 27, 2014).

It is uncertain what the impacts of a growth in these projects which improve these companies' energy efficiency, carbon reduction, and economic competitiveness has on utilities. These corporate and commercial interests were not part of the solar IRP debates but these external developments may have played in role in the commission's approval of solar. Nevertheless, the comments above suggest that decision makers and the Georgia Power are aware and monitoring these recent low carbon developments made by corporate and commercial interests.

8.4 Integrated Resource Plan Expanded Solar Initiative

In January 2010, the Georgia Power Company filed its seventh Integrated Resource Plan as required under the Integrated Resource Planning Act (O.C.G.A., 1981). The plan referenced pursuing cost-effective renewable energy projects including solar projects and demonstration projects undertaken by independent power producers, not exceeding 2.5MW of capacity. The plan did not have any solar or wind projects incorporated into the 2010 Integrated plan. Nevertheless, there was a project to convert a unit of one of its coal-fired power plants (155MW, Plant Mitchell) to a 96MW biomass plant (Georgia Power Company, 2010). The project was suspended because it was dependent on Environmental Protection Agency policy. Georgia Power evaluated that it would not be cost effective based on a forthcoming EPA Mercury and Air Toxics Standards Rule (MATS rule) and changed market conditions like low natural gas prices (Georgia Power Company, 2014d). This meant that the project would not be cost effective when costs of complying with the regulation, low natural gas prices and other capital costs were considered.

In November 2012, the Georgia Power Company's eighth Integrated Resource Plans did not contain any new solar energy development aside from the 210MW that had been ordered under the Advanced Solar Initiative (ASI).

However, about five organisations filed separate petitions to intervene in the hearings at the Commission, immediately the Company filed its plans. The petitioners included Georgia Solar Energy Industries Association (GSEIA), Georgia Solar Utilities Inc. (GaSU), Georgia Watch, Southern Alliance for Clean Energy (SACE) and the Sierra Club. These were filed as separate interventions, not filed as coalitions. For example, the Southern Alliance for Clean Energy (SACE) filed the petition as, 'Application of SACE for Leave to Intervene', whilst a joint petition would be presented as, 'Application of Sierra Club and Coosa River Basin Initiative for Leave to

Intervene'. This began an eight-month long process of official testimonies, exhibits and data requests and rebuttal testimonies from all organisations that had filed to intervene including Georgia Power Company, before the commissioners at the Public Service Commission in Atlanta. As part of the process, the PSC staff requested 'data' from Georgia Power ("Georgia Power Company 2013 IRP Filing," 2013).

Over the eight months, a total of twenty data requests were made ("Georgia Power Company 2013 IRP Filing," 2013). Examples of the data requested included information on generation and supply performed modelling studies, environmental compliance analyses, operation and maintenance expenses for plants/units, load forecasts, fuel forecasts and programs/projects ("Georgia Power Company 2013 IRP Filing," 2013). Georgia Power presented the first testimony in March 2013 and over the following eight months, the intervening organisations presented their testimonies and exhibits ("Georgia Power Company 2013 IRP Filing," 2013). Georgia Power had no new solar energy planned in its IRP (Georgia Power Company, 2013). In testimony a representative confirmed that after the recent 'ASI', the company had no new plans till to develop new solar energy:

> "With the introduction of the GPASI, the total amount of solar energy under contract by Georgia Power is expected to be more than 270 MW by the end of 2014. In addition to procuring cost-effective renewable resources, Georgia Power also supports research and demonstration of renewable and emerging technologies. In all of these efforts, the Company seeks to responsibly expand the fuel diversity of our supply mix through our commitment to renewable generation. Notably, Georgia Power is one of the national leaders among utilities operating in states in which there is no mandate for solar procurement" (In re: Georgia Power Company's Application for Approval of Its 2013 Integrated Resource Plan, 2013, p. 28).

Consequently, the intervenors, GSEIA, GaSU and SACE, provided testimony at the Public Service Commission, each arguing that the IRP was inadequate due to its plans for no new solar capacity and that the commission should require Georgia Power to add additional solar energy into its IRP ("In Re: Georgia Power Company's 2013 Integrated Resource Plan," 2013). GaSU argued that, Georgia Power's IRP containing no solar, is due to its inflexible views regarding solar energy which do not allow the company to design solar projects to take advantage of the positive changes in solar energy, resulting in missed opportunities to reduce rates and hurt the ratepayer ("In Re: Georgia Power Company's 2013 Integrated Resource Plan," 2013):

> "Second, our state and Georgia Power's customers are paying a high price for the Company's lack of competence in adapting to solar energy. After so many years of telling everyone it's "too cloudy for solar in Georgia," Georgia Power has become functionally blind to the dramatic economic changes that are transforming the solar industry and energy generation forever. Huge price drops have made solar cheaper in many instances than Georgia Power's current resources, but the Company's inflexible view of the world prevents it from building solar into its economic modelling. That blindness has already resulted in missed opportunities for Georgia Power to bring downward pressure on rates by investing in solar projects that deliver low-cost energy for decades without fuel costs or regulatory compliance risks associated with other types of generation" (GaSU Testimony, 2013 In Re: IRP 2013, p.4).

Therefore, GaSU requested that the PSC approve 500MW of new solar capacity to be added to the IRP, to be developed by GaSU, because an additional 500MW of solar energy would still represent less than 1.5% of the company's total load ("In Re: Georgia Power Company's 2013 Integrated Resource Plan," 2013). SACE argued that Georgia Power lack of commitment to renewable energy had not allowed the company to produce an electricity forecast plan which lowered costs, lowered risks, increased flexibility, reliability and was cleaner ("In Re: Georgia Power Company's 2013 Integrated Resource Plan," 2013):

> "A stronger commitment to energy efficiency and renewable resources will result in a plan that is: Lower cost, resulting in $2.4 billion in potential system savings; lower risk, enhancing the use of zero-fuel resources; more flexible, increasing reliance on resources that can be developed incrementally and adjusted in response to market conditions and opportunities; cleaner, offering a lower-cost path to environmental performance; and more reliable, maintaining or extending the existing reserve margin" (Southern Alliance for Clean Energy, IRP Testimony, 2013, p. 6).

SACE emphasized that renewable energy including solar is not considered in GPC's models, therefore solar is not analysed in GPC's financial models:

> "Solar power costs are rapidly declining, and the Company's Advanced Solar Initiative is evidence that the Company now appreciates the value and potential of this rapidly-developing technology. Solar energy offers tremendous value to Georgia Power customers. At today's prices, and especially as the Georgia solar installation market matures over the next several years, Georgia Power should be able to acquire additional cost-effective solar resources for its customers. However, the Company did not analyze solar in its IRP financial

> models and did not adequately consider solar along with traditional resource options in the IRP" (Southern Alliance for Clean Energy, IRP Testimony, 2013, p. 9).

Therefore, SACE recommended that GPC add 2000MW of additional solar energy into its portfolio, given current solar energy costs ("In Re: Georgia Power Company's 2013 Integrated Resource Plan," 2013).

Finally, GSEIA's testimony focused on the distributed solar generation, arguing that GPC's plan was 'headed in the wrong direction, because the company delayed the development of distributed solar generation ("In Re: Georgia Power Company's 2013 Integrated Resource Plan," 2013) and that valuation techniques for distributed solar generation had improved significantly to the degree that electricity decision makers and utilities can make better decisions about the value of distributed generation to the utility and rate payers ("In Re: Georgia Power Company's 2013 Integrated Resource Plan," 2013) and distributed solar generation also reduced the risks to both the utility and the ratepayer whilst providing maximum value to the grid:

> "Distributed solar installation by the Company's customers and through third party contracts substantially reduces costs and risks to the utility and its ratepayers. The customer or third party assumes responsibility for financing, maintenance, and insurance requirements. With this kind of solar development, the utility obtains energy generation at or near the point of consumption, maximizing the value of solar to the system" (Georgia Solar Energy Industries Association, IRP Testimony, 2013, p. 23).

Therefore, GSEIA requested that the Commission, direct GPC to implement distributed solar initiatives to its IRP:

> "The market price and experience indicated that the cost of solar in Georgia to the Company is already below the value the Company received from solar deployment. Between the implementation of the Company's Advanced Solar Initiative ("ASI") and the expansion that I recommend, the Company can identify and benefit from the true resource potential for distributed solar by purchasing electricity from distributed solar resources at a price well below its solar value" (Georgia Solar Energy Industries Association, IRP Testimony, 2013, p. 6).

In Georgia Power's rebuttal, the company repeated its position on renewable energy, which was that the company would continue to pursue, develop and acquire, cost-effective renewable energy in a 'responsible manner' and maintained system reliability ("In Re: Georgia Power Company's 2013 Integrated Resource Plan," 2013):

> "The Company continues to pursue cost-effective renewable resources in collaboration with the Commission and remains open to future opportunities to add more renewable resources to the Company's portfolio, as has been demonstrated by numerous new ground-breaking programs and acquisitions since the 2010 IRP. The development of new renewable resources must continue to be done in a responsible manner that optimizes the benefits of such resources and provides customers with the lowest cost in procuring them. The Company's actions to date have provided for significant increases in the amount of biomass, wind and solar resources contracted to serve customers. The Company will continue to look for cost effective ways to continue the expansion of renewable resources in Georgia" (Rebuttal Testimony in Support of Georgia Power Company's 2013 Integrated Resource Plan, p. 4).

GPC used its recent wind purchase (250MW) from a developer in Oklahoma as an example of cost-effective renewable energy ("In Re: Georgia Power Company's 2013 Integrated Resource Plan," 2013). In response to GaSU's testimony, Georgia Power stressed that GaSU's main motivation is to be granted a monopoly to develop solar in Georgia and avoid competition:

> However, the "plan" put forward by Georgia Solar Utilities ("GaSU") should be rejected by the Commission. GaSU has provided no substantive details or analysis for this Commission to evaluate or consider. The only thing that is clear is that GaSU would prefer to bypass the competitive bidding process that is a staple of the Company's procurement practices and simply be granted an exclusive right to develop solar but has provided no legal, policy or economic justification for such an extraordinary step. In addition, GaSU's testimony makes clear that they do not desire to serve customers and that there is nothing novel regarding their ability or approach to solar development that should afford them any special consideration by the Commission" (Rebuttal Testimony in Support of Georgia Power Company's 2013 Integrated Resource Plan, p. 4).

In addition, Georgia Power perceived GaSU's proposals for solar development as unoriginal, non-viable and not in the best interests of the ratepayers:

> “GaSU’s proposal, to the extent it can be deciphered from Mr. Green’s testimony, is neither new nor innovative. Mr. Green seems to offer different things at different times. Sometimes it seems he is offering Georgia Power ownership of the asset, at other times Georgia Power is leasing the asset for nearly its entire life, and at still other times, a PPA for a collection of sources which he has aggregated together. None of those financial structures are new or innovative in general or in the energy and utility space. Nor is the idea of financing an asset with 100% debt or with public bonds innovative or new in any way” (Rebuttal Testimony in Support of Georgia Power Company’s 2013 Integrated Resource Plan, p. 36).

Finally given GaSU’s initial request to enter into contract to develop new solar resources, Georgia Power argued that the commission lacked authority to order the company to contract with another business entity in any form (*Georgia Power Company 2013 IRP Filing*, 2012). Similar responses were made by Georgia Power regarding the proposals forward by SACE. Georgia Power perceived the request for 2000MW of additional solar capacity as unnecessary, because the company had no need for the extra capacity and would raise rates:

> “As acknowledged by SACE witness John Wilson, the plan put forward by SACE is not “a plan that Georgia Power could begin executing” and was not designed around viable program concepts. There is simply no need or justification for the Company to commit to an arbitrary amount of additional MW of solar generation at this point in time, particularly because, as Mr. Wilson acknowledges, the Company currently has no capacity need and SACE’s proposed solar portfolio would put upward pressure on rates through 2023” (Rebuttal Testimony in Support of Georgia Power Company’s 2013 Integrated Resource Plan, p. 37).

According to one interviewee, an academic consultant, some of Georgia Power’s claims of the impacts of additional solar into the IRP were repudiated by the commissioners at the end of the hearing:

> “Very recently like this past summer, things were coming around again and there had been a proposal put forward to do 525 more MW of Solar. That one came from the solar advocates and was presented to the commission actually, so this was in the other body and Georgia Power was pushing back, their lawyers were pushing back at the commission. And so eventually one of the commissioners just stopped and asked a series of questions: "Will these increase rates? No!", "Okay, well you'd claimed that would happen before but it’s been, the lawyers had to say: "we were wrong before, this will not increase rates" And they went down a series of 4 or 5 claims that had been previously pushed by the utility that the commissioner just asked them bluntly: "Is this true?", "No". "Okay". Well then the commission voted to actually make the 525 come online.” (8Ai, Academic consultant, Georgia Tech, October 29, 2013).

Another interviewee who was a member and director of a consumer advocacy group in Georgia explains in the comment below that the "pressure on rates" argument was important for solar development in the state but more so for the competitive bidding process in solar development:

> "So there's likely to be another round of hearings we think in the second quarter of the year, that would begin to look at what is the true value of solar and you know as they've just announced the RFP for the 525, 425 of the utility scale of the 525MW plus the 70MW from the ASI from last year they're the RFP and that would help us find out if the cost of solar, they've said they can't, that these solar contracts can't put upward pressure on rates, so they have to be able to demonstrate they have to be able to get bids for solar that are per kwh at or below what is currently the cost of kwh for electricity in Georgia. Well, well you know, we will, it'll end up showing that it most certainly has, so that would be happening in the coming, in the months ahead." (6E 14A, Director consumer advocacy group, January 9, 2014)

In July 2013, the Georgia Public Service Commission voted 3-2 in favour of expanding the Advanced Solar Initiative (ASI) to include 525MW of further solar energy development (Georgia Public Service Commission, 2013b):

> "So, I think this is a, this is a much friendlier system for everyone involved, we just completed this and it was at the end of this process, that commissioner McDonald moved to add 525MW of solar, it wasn't in the original proposal, he moved, commissioner Everett seconded the motion and I was the third vote and just in a matter of seconds, we changed energy policy for the state of Georgia" (Commissioner Echols, Clean Energy Summit, Atlanta, October 17, 2013).

However, the expanded initiative was opened to a competitive bidding process rather than being allocated directly to Georgia Solar Utilities Inc. This program is felt to be the largest voluntary development for solar energy from an investor-owned utility in the U.S. The next two sections will describe in detail the groups that campaigned for and against solar energy within Georgia, including those that were not involved in the IRP docket.

8.5 LOW CARBON ADVOCATES AND SOLAR GENERATION IN GEORGIA

This section analyses the process of campaigning for solar generation within Georgia prior to the end of the field research. The research showed that solar advocates were a loosely grouped coalition of interests. However, each organisation filed a separate petition to intervene in the energy decision making process, which stipulated that members had to present their own interest and could not be adequately represented by other parties in the proceedings. The pro-solar advocacy interests were a broad grouping of interests. The key members are set out in Table 8-2 below. This is not an exhaustive list of participants but these groups were continuously referenced in the interviews and gave testimonies at the public service commission hearings for the IRP docket ("Georgia Power Company 2013 IRP Filing," 2013).

As the table suggests, the pro-solar interests were not just individuals but were fronted by wider advocacy, consumer and industry groups. These organisations represented numerous individuals whose concerns were of different aspects of energy decision making. In addition, these organisations collectively represented both clean energy and non-clean energy interests, making the overall reach of the low carbon advocates wide and with significant impact. An interviewee from a consumer advocacy group confirmed the range and diversity of interests in the groups pushing for solar at the hearings:

> “The southern alliance for clean energy and their legal team, the southern environmental law centre was also intervening, so were big industry groups, you know manufacturers, retailers, the solar power industry there were roughly a dozen different organisations intervening.” (6E 14A, Director consumer advocacy group, January 9, 2014).

Summary table of relevant advocacy groups

Organisation	SACE	SEIA	Georgia Solar Utilities	Georgia Watch	Sierra Club	Atlanta Tea Party Patriots
Category	Clean Energy Non-Profit / Government	non-profit trade association	Solar developer	Consumer advocacy and non-profit	Environmental Advocacy and non-profit organisation	Political Organisation and grassroots movement.
About	Founded in the 1985 and is a non-profit, non-partisan energy watch dog group.	Established in 1974 as a national association which represents solar companies.	Founded in 2012	Founded in 2002 as a state based organisation in Georgia.	Founded by 182 members on the 28th of May 1892.	The current tea party was formed in 2009
Role	Do not have a direct role in energy policy but focus on advocating for policy change in energy and environmental legislation across the federal, state and local governing sphere. Clean Energy and environmental policy is especially lacking in the south and the region is a major emitter of carbon.	Georgia chapter of SEIA represents between 142 and 146 solar companies	Atlanta based solar company currently trying to become a solar alternative to Georgia Power. Lobbying, Utilities Installation, Environmental Policy, Natural Resource Policy	Advocates for citizens on some of the following issues: energy and utility, healthcare, fraud, etc. In terms of energy the organisation also develops consumer friendly policies, educates residents and hosting consumer workshops.	Its mission includes preserving wild spaces, public education about natural environments and promoting environmental friendly behaviours. It is the largest and most influential environmental organisation in the United States and has since its inception founded many local chapters	They do not have a direct role in energy policy decision-making because they are not part of the groups involved in the current mode of energy provision.
Importance	Their approach to pertinent issues through the frame of energy independence, security and job growth, makes a stronger position when advocating for changing policies in the south.	The association backs solar energy at all two levels of government namely: Federal and state.	Solar Utilities innovative business structure focuses on both Georgia ratepayer interests and prevents state-wide solar opportunities from being extracted and sent out of state.		It lobbies for more environmental friendly legislation and it also lobbies to protect environmental legislation already in place like the clean air act.	The tea party platform focuses on issues around: Limited government, individual freedom, reduced taxes for individuals, businesses and reduced government spending.

Table 8-2: shows the groups that were listed as relevant to the solar debate
Source: Georgia Public service commission final order docket.

a. Advocate Groups and Relationships

Many of the advocacy groups in the pro-solar group like SACE, SEIA and Sierra club were national and regional organisations which had local chapters and brought wider resources such as knowledge and, an understanding of solar policies and wider lessons. The Georgia Solar Energy Association (GA Solar) and Georgia Solar Energy Industries Association (GSEIA) host events in Atlanta including solar summits, conferences, networking meetings and luncheons, to discuss relevant policy issues related to solar in Georgia like dockets or legislation to follow and how to increase renewable energy generation in Georgia. These are attended by industry professionals, lawmakers, activists, etc.

What united the business-led organisations like SEIA, Georgia Solar utilities, Walmart and the other industrial groups were the potential economic and reputational benefits of solar investment. Companies responsible for installation (i.e. manufacturers, developers, financers and potentially construction firms) had a direct interest in opening-up business around solar generation. GA Solar and GSEIA are the trade associations for the growth and expansion of the solar market within the United States, and conduct research and gather data to empower local governing bodies to develop more solar energy in states like Georgia. These associations focus more on the business aspect of growing solar, whilst the focus of the Sierra Club was primarily environmental aspect of growing solar.

b. The Atlanta Tea Party Patriots Involvement

One of the curious aspects of the loose coalition was the combination of organisations which might be expected to have different perspectives on the politics of renewable energy. For example, Sierra Club environment-led and business-led groups. Moreover, the group had strong involvement from Atlanta Tea Party Patriots. The Atlanta Tea Party Patriots were different from the other groups in many respects. The Tea Party is a conservative grassroots movement and the group operates on a core principle of individual freedom and economic freedom and limited government. The party believes in individual freedoms and rights as are guaranteed by the U.S. Constitution and Bill of Rights (Tea Party Patriots, 2015). It adheres strictly to conservative views on limited government, believing that individuals should retain the rights and freedom to pursue their dreams to the extent that they don't harm or infringe on others rights.

The Tea Party promotes individual freedom and limited government on multiple issues including healthcare, tax, immigration, federal regulation, etc. (Tea Party Patriots, 2015). The Tea Party Patriots is a collection of individual Tea Party Patriot grassroots activist groups, the Atlanta Tea Party Patriots, was the group involved in these solar debates. However, there were leaders from another Tea Party group, the *Georgia Tea Party Inc.* who opposed the expanded solar initiative (Rehm, 2013c). The spokesperson of the group was the co-founder of the Tea Party and the national coordinator of the Atlanta Tea Party Patriots. The national coordinator of the Atlanta Tea Party Patriots explained that the interest in energy policy started in 2009 when the Georgia Public Service Commission granted Georgia Power Company the ability to pre-charge consumers for the two new nuclear reactors being built:

> "I am actually, my background is, actually I've been politically active, I am a conservative, I am one of the national founders of the Tea Party movement, I, you know for me, it has always been policy over party and I began to, you know, I was very upset at Georgia Power, a utility in Georgia, over the fact, that they were pre-billing customers, for a nuclear plant, nuclear reactors, that may never be brought online. Yes, and the fact that they have all this power and clout and I was investigating them and I realised, okay, solar provides, can provide, competition and choice and I began to advocate for solar as a means of free market choice, individual freedom and energy freedom. So, I've been active, I'm active nationwide and I've been active ever since." (15D, Tea Party activist, October 5, 2016)

As shown in the statement above, this policy sparked an interest in the state's energy policy but also in the role of the state's investor-owned utility (Cottle, 2013; Greentech Media, 2015; Kormann, 2015). This interest prompted the Tea Party coordinator to undertake further research into energy sources that empowered consumers, resulting in decentralised energy as a goal, but more so solar energy and the ability to install solar panels on their roofs become attractive. Since the Tea Party is about individual freedoms and limited government intervention, distributed solar generation presents the opportunity to be free from the monopoly utilities, who might impede the freedoms to choose electricity providers, produce or even sell electricity. Since Georgia currently has restrictive laws around individuals and businesses buying solar panels and selling solar energy in a manner that resulted in a lack of competition for Georgia Power, the Tea Party Patriots involved in the solar energy push, perceived Georgia Power as a limiter in consumer energy choice and energy freedom.

An alliance in Georgia called the Green Tea Coalition was formed by the Atlanta Tea Party Patriots and Sierra Club. The Coalition was officially formed in August 2013 when some members of the Georgia chapter of the Sierra Club approached members of the Atlanta Tea Party Patriots who were disgruntled with Georgia's restrictive laws regarding buying, owning and operating distributed solar generation (Martin, 2013). The two groups have very little in common ideologically, especially with regards to their missions and values (*Table 8-2*) but in the solar energy debate found common ground in their support for solar energy:

> "It's not a formal coalition, as the name would suggest, it's we partner on issues as they suit our mutual interests. If it works for both of us, we'll partner together, but there's a lot of ground that we don't agree on" (6E 7G, Sierra Club, Georgia Chapter Organiser, February 26, 2014).

A key part in the lead-up to the Tea Party Patriots involvement with the Sierra Club, was that energy became tied up within the wider political ideology of the Tea Party Patriots. A Georgia Institute of Technology academic consultant describes this trigger for Tea Party involvement in the statement below:

> "Because they had a fairly influential conservative backer who was trying to do a big solar installation on a school and was ceased and desist by Georgia Power under their rights, under the territorial act and that's what really got the tea party incensed and then they realised they had these natural advocates, these allies over here that have already pushing some of this stuff and so they kind of made for interesting bed fellows that they would be able to work together on this, on this one thing so that's what really combined forces there between the far right and the environmental left." (8Ai, Academic consultant, Georgia Tech, October 29, 2013).

The research showed that the Atlanta Tea Party patriots were important to the solar debate in many ways, not least because they are important electorally in states like Georgia. The Atlanta Tea Party Patriots are an important electoral constituency because they are a conservative political group with influence in a state where the majority of the decision-makers are conservative from the judicial branch to the legislative branch (Georgia Secretary of State, 2014):

> "And then finally, let me say, just what's happened politically within the community that's been a game changer; I don't know, how you feel about the Tea Party or Debbie Dooley but let me tell you, her involvement in the last IRP with solar and this group support of solar,

> was very important because, we've got certain constituency represented here, but when you add her constituency to that, you are getting close to a majority and that has really been helpful and we'll see if Debbie and Sierra Club can continue to dance together, if they have a lot of things they disagree on, so we'll see how they do, but this is a really, a pretty amazing political dynamic that is happening in our state and I don't want to underestimate that." (Commissioner Echols, Clean Energy Summit, Atlanta, October 17, 2013).

All five of the Georgia public service commissioners are Republicans with known ties to the Tea Party (Georgia Public Service Commission, 2014c). The Atlanta Tea Party Patriot's commitment to individual liberty was expressed as follows by a Public Service Commissioner:

> "I don't think they are thinking of climate change, I think they are thinking in terms of energy independence, the Tea Party is all about Liberty and Independence and freedom from the Federal government and Freedom from institutions, so I really think the Tea Party sees Solar as a way to be Independent right! that if I want, I can put enough Solar and be completely off the grid." (2Bi, Georgia Public Service Commissioner, October 21, 2013).

The consolidation of these dissimilar groups to advocate for solar, highlight how different interests can find gains to be made by low carbon intervention and unite around a common goal. The Green Tea coalition is a stand out example of this. The involvement of the Tea Party Patriots by the Sierra Club to this solar debate opened a new opportunity politically to advocate for low carbon. Since Georgia does not have a strong environmental ethic and is resistant to environmental goals (7.2d) the involvement of the Tea Party Patriots allowed for a different point of view to be used in the argument for solar, one of individual and economic freedom and to be made by a politically important constituency.

c. Advocates Activities

This section discusses the activities of the organisations involved in the lobbying for solar including what actions they took and events held. Though the Atlanta Tea Party Patriots were not listed on the IRP docket, the Atlanta Tea Party coordinator testified as a public witness during the hearings at the Public Service Commission ("Georgia Power Company 2013 IRP Filing," 2013). A state legislator testified on behalf of his constituents, explaining that since the Public Service Commission had approved a specific coal plant for retirement, his county would suffer a loss of nearly $15 to 20 million of tax revenue and therefore urged the commission to work with Georgia Power to use that land for solar ("Georgia Power Company 2013 IRP Filing," 2013).

Solar town hall meetings were held across Georgia and they ranged in size. In some cases, these meetings were attended by most stakeholders including commissioners, politicians, representatives of solar manufacturers, solar associations, Sierra Club, Atlanta Tea Party Patriots and residents (Solar Energy USA, 2013a). Meetings were held amongst interested parties including SACE and the Sierra Club, who often invited the commissioners to these events:

> "We have coalition meetings I guess if you will at SACE and Sierra Club, Southeast Climate and Energy you know, various groups participate in. These are coalitions of, you know we have different, like we are a consumer advocacy organisation, they are an environmental organisation but when we have reasons to for example we worked with sierra club to hold town meetings about the rate case around the state. The commissioners came to that, people came to that so, yeah." (6E 14A, Director consumer advocacy group, January 9, 2014)

A pro-solar rally took place on the day of the PSC decision on the addition of solar which included Sierra Club, Georgia Solar Utilities, and Atlanta Tea Party Patriots (Southern Clean Energy Alliance, 2013). Phone calls to state officials in support of the motion (were made by parties with an interest (Tatum, 2013). The Sierra Club and the Public Service Commission also hosted town hall meetings attended by residents, a format which presented the opportunity for residents to engage with the commissioners on the subject of the IRP (Savannah Morning News, 2013).

> "So, we did a lot of work with the commissioners. We held town hall meetings across the state of Georgia, and we invited them to come, and many of the commissioners did attend, where we gave citizens, everyday folks in Georgia to tell commissioners what they wanted Georgia's energy future to look like, Georgia Power's energy future to look like. Over and over again, every single town hall, people said, 'Georgia Power needs to be adopting solar, they need to be adopting energy efficiency, and cheap Mid-West wind in to their energy portfolio,' and the commissioners heard it." (6E 7G, Sierra Club Chapter Organiser, February 26, 2014)

Finally, in Atlanta, a former director of Georgia Solar Energy Association gave a TedX talk advocating for solar in Georgia.

The talk covered the potential and barriers to solar in the state of Georgia and steps to remove those barriers. One of those steps included calling the Public Service Commissioners or meet with them and request solar to be added to the IRP portfolio (Moore, 2013). These meetings were influential, media recordings were made of some of these events and it gave residents all over the state, who may not otherwise be involved in energy decision making, the chance to know and meet their elected commissioners and give their perspectives on energy to the Public Service Commissions:

> "So as a result of those town hall meetings, the commission led by Commissioner Bubba McDonald, proposed 525 new megawatts of solar, and that was, sort of, on the back of a proposal that Georgia Power had made, which was 210MW. So together, they will have about 800MW of solar online by 2016." (6E 7G, Sierra Club Chapter Organiser, February 26, 2014)

These activities were also influential because there was more exposure from the media, newspapers, blogs, ensured by the diversity of the groups advocating. This was important because it put a spotlight on this debate for an otherwise routine process.

d. Atlanta City Government and the Solar Debate

There was also a city dimension to the solar debate. The research showed that many of the organisations involved in the solar and nuclear hearings, debates and campaigns, were state-based and not connected to the city government of Atlanta. There was no evidence that key city interests were active in the pro-solar coalition:

> "So, the people that have been pushing the Solar piece live in Atlanta but aren't connected to the city government at all." (8Ai, Academic consultant, Georgia Tech, October 29, 2013).

One suggestion for why the city government of Atlanta did not get involved directly in the hearings process is that the Office of Sustainability within the city government of Atlanta was considering pursuing its own sustainability plan which included the incorporation of renewable energy. The Atlanta system had not been made formal, but suggestions were that it may be a grid-tied residential scale solar system or a municipal building only service, that was likely to involve Georgia Power, due to Georgia Power's service territory:

> "We will see what the city government does here shortly because as they, a key component of the new sustainability plan will likely include more renewables providing power in Atlanta, how they make that happen, that could be in partnership with Georgia Power walking in the same direction or could be tooth and nail clawing at each other." (8Ai, Academic consultant, Georgia Tech, October 29, 2013)

And

> "This residential bulk by program has not started yet. We are still trying to figure it out, but it has to be done by the end of the month, so that we can partner up with Georgia Power and if we can get Georgia Power on our side and partner up with their Advanced Solar initiative program, then we have a little but more oomph to make it happen." (1C, Manager, Office of Sustainability, October 16, 2013).

The comments above suggest, a jurisdictional issue with created a tension between Atlanta's own plans for renewable energy and its ability to enact these plans under the current system. With the plan still in consideration it is unclear how this partnership was going to work, but the comments also show, a level of dependency by the City of Atlanta on Georgia Power to give this project the backing to come to fruition. Nevertheless, what was clear was that the City of Atlanta had its own plans for renewable energy, which may explain its non-involvement in the official solar debates. The next section will discuss mobilisation by groups that resisted solar throughout from 2011 to early 2014 during the Integrated Resource Planning process.

8.6 Opposition to solar generation in Georgia

In Georgia, there is a long history of powerful groups with vested interests in opposing solar energy. The opposition group had at its core the extant power generating and distribution interests, plus the Chamber of Commerce, the Georgia Chapter of Americans for Prosperity and Georgia Tea Party Inc. As will be seen their argument came to rest on issues of cost and especially cost to ratepayers. No organisation both on the pro-solar side and the resisting solar side wanted a technology that would raise rates. The research showed little opposition to the ASI 210MW program from these groups. Instead, the utilities and other supporting organisations like the Chamber of Commerce argued and campaigned against not only extending utility-scale development for solar but also opening the grid to third party, distributed solar generation. This coalition was not anti-solar or anti-renewables per se, but were reacting to attempts to extend third party distributed energy to alternative energy providers and consumers.

As stated in section 8.4, Georgia Power made the following arguments; it would continue to carry out demonstration projects, to see how it could cost effectively incorporate solar energy into the system without compromising on system reliability and raising costs (*Georgia Power Company 2013 IRP Filing*, 2012); it would continue to seek optimal locations to expand its solar projects in order to improve its knowledge about environmental conditions like sunlight, temperature and humidity on its solar energy projects thereby gaining valuable knowledge in owning and operating solar PV projects (*Georgia Power Company 2013 IRP Filing*, 2012); and since its 2010 Integrated Resource Plan, it has continued to implement diverse and innovative new programs which have increased renewable energy capacity. The positions set out in the paragraph have been explored above.

Groups like Chamber of Commerce and the utility companies were not anti-solar; they were more pragmatic in their approach. The Georgia Chamber of Commerce was very clear about supporting whatever technology would provide, reliable, affordable, supply:

> "Okay, as far as energy policy-, there is no question that it is focused on reliability of supply and affordability. Now, so irrespective of where that supply comes from, the chamber's policy is we want to encourage investment by the various generators and transmission agencies to ensure that all of Georgia continues to have access to high quality, reliable, affordable energy. So, that's what we have, we've been very fortunate to have that for a number of years, and we want to continue to have that, being the underlying theme to energy." (9A, Chamber Energy Consultant, October 30, 2013)

These opposing organisations sought to make a distinction between solar and other sources of energy. The Chamber of Commerce, much like Georgia Power, argued that solar could not be compared to other energy sources because of its intermittency and use as peaking power. It could not replace baseload sources of energy:

> "But we're also very concerned that, that becomes a tariff barrier so, you know, we've got to work through those issues so that you continue to stimulate investment in the new technologies, you don't disadvantage reliability of supply that everybody determines, because solar power is, at the moment, a peaking power, it is not a base load power, so you're always going to need a base load supply, and you've got to balance that out, you know, I'm not an expert on power, I did a visit to the distribution management centre, and the one thing I learnt there was for all of these competing supply sources, how they balanced the load, so that irrespective of where you are in the state, and what time in the

> day, you have got the quality of power that you want, and that's not an easy exercise, I mean, I didn't even realise it was part of an exercise, but it's an exercise that has to be managed." (9A, Chamber Energy Consultant, October 30, 2013)

a. Activities of Resistant Groups

In the build-up to the solar expansion (525MW) vote, scheduled for July 11th, 2013 at the Public Service Commission, the Georgia chapter of Americans for Prosperity a conservative non-profit organization founded in 2004 by David Koch, which advocates for conservative candidates at the local, state and federal government and economic freedom based on free markets (Americans for Prosperity, 2006), pressured the commissioners against the addition of more solar energy by sending mass emails, holding a rally on the day of the vote and holding a press conference at the Public Service Commission (Americans for Prosperity, 2013a). The mass email was sent to its 50,000 members of the Georgia chapter. Earlier on July 1, 2013, Americans for Prosperity had sent out a mass email to its 50,000-membership base in Georgia, warning members that a potential vote for solar energy would change their electricity bills in the state.

The main argument of the Americans for Prosperity email was that this vote would be a solar energy mandate in the state of Georgia and the mandate would raise their electricity bills by 40% based on experience in other states with similar programmes (Americans for Prosperity, 2013c; Jones, 2013):

> "According to the Institute for Energy Research, utility bills are 40% higher, on average, in states with a renewable energy standard than in states without one. It's a hidden tax because it drives up the cost of living for every Georgia family! And states like California have reported widespread brownouts and blackouts from an electricity grid that struggles to keep up with the new government-imposed solar mandates." (Americans For Prosperity Georgia, Virginia Galloway, July 1, 2013).

In the same month, Americans for Prosperity of Georgia launched a grassroots initiative titled "Keep the lights on in Georgia" urging AFP Georgia activists to oppose the proposed vote by the Georgia Public Service Commission on 525MW of solar additions. The initiative comprised of internet videos and a website dedicated to sending emails to the GPSC from AFP Georgia activists.

The number of activists emails was recorded at 3,118 (Americans for Prosperity, 2013d). In emails and articles some of the more prominent activists from Americans for Prosperity argued that Georgia was at the centre of fossil fuel hostility from the Obama administration and residents of the state had an opportunity to send a clear message to the Administration by urging the GPSC members to vote no on the solar expansion (Americans for Prosperity, 2013b).

Finally, Americans for Prosperity Georgia activists announced they would hold a press conference at the Georgia State Capitol at 11am on the July 11th, 2013, ahead of the vote. The press conference was held and featured prominent Americans for Prosperity affiliates including some Georgia Tea Party members, the Heartland Institute, the Georgia Tea Party Inc. and Partnership for Affordable Clean Energy (Americans for Prosperity, 2013a). The Georgia Tea Party Inc., also pressured the PSC against voting for the solar energy (Rehm, 2013b). This group also repeated the same argument about electricity bills increasing by 40% from mandated solar.

The result was that the commissioners received hundreds of emails and pushed back on those claims by writing editorials, conducting interviews with local newspapers (Galloway, 2013) and writing response emails to AFP-GA. Whilst not stating how he would vote, one commissioner made the point that the conditions given to vote for any solar bill was that it must not interfere with the existing Territorial Act, put upward pressure on rates and create a solar monopoly but more importantly the state of Georgia had reached a point where solar energy had become competitive (Rehm, 2013a).

In addition, the Atlanta Tea Party Patriots also pushed back on the claims by writing a letter to their members and other Tea Party members, arguing that the information put out by AFP-Ga was false, that the information was outdated with solar prices having dropped since (Jones, 2013):

> "I went to bat for solar, you know in my work nationwide and in the fight in Georgia, I am often fighting groups funded by Koch brothers and fossil fuels. So, Americans For Prosperity got involved, they put out information that was completely false and you know, completely false and I called them out on it. Now I said, 'look, this is wrong, you're putting out incorrect, false information.'" (15D, Tea Party activist, October 5, 2016).

8.7 THE GEORGIA PUBLIC SERVICE COMMISSIONERS SOLAR VOTE

This section will focus on three issues in the debate on solar addition. As stated earlier, on July 11th,2013, the Georgia Public Service Commission voted 3-2 in favour of expanding the Advanced Solar Initiative (ASI) to include 525MW of further solar energy development. All five commissioners gave various reasons for their votes of approval or disapproval. The three approving commissioners' reasons include, federal regulations, no upward pressure on rates and having a reliability electric supply (Georgia Public Service Commission, 2013b). One public service commissioner expressed his vote for solar based on probable stringent federal low carbon regulations coming through:

> "Adding 525 megawatts of solar to our 20-year energy plan is a hedge against more coal regulation and natural gas price volatility. When the President finishes his war on coal, he'll come after fracking, and gas prices will surely go up. We have to be ready." (2Bi, Georgia Public Service commissioner, October 21, 2013)

Another public service commissioner saw approving solar energy as a means to ensure more reliable electric service:

> "We are making decisions that affect millions of Georgians, ensuring that we have reliable electric service so we do not experience brownouts in extreme weather conditions and promoting economic growth and development" (Cmsr. Eaton, July 11, 2013).

The economic growth perspective showed that solar manufacturers had been successful in making the case that, post-recession the state of Georgia had not fully recovered economically (Selig Centre for Economic Growth, 2013) and the growth of the solar industry locally would bring economic value to the state:

> "So, we found two out of five commissioners that really wanted to hear the story a lot more of why renewable energy. One of them was a Tea Party activist and republican who wanted to hear about free market enterprise, job growth and economic development." (4Bii 9B, Snr. Director International Sales & Market Development, February 20, 2014).

A view that the Georgia Chamber of Commerce partially shared:

> "Yes, it could do, but it's not a driver of why people are coming to Georgia, you know, there's a whole conflict of reasons, you know, labour laws, access to, you know, Savannah port, which is terrific for export, competitive labour market, good transportation, good tax base, competitive energy water, so there's a whole mix of reasons why businesses are coming to Georgia or expanding within Georgia, you know, so yes green economy creates jobs, but

does it create more jobs than something else, it just depends on the field you're in I suppose, but having said that, the solar industry has developed quite well here in Georgia, there are a number of international solar operations that have established their facilities here, there's an facility producing jet fuel here that's come all the way from Australia, actually, so, you know, there's certainly green jobs being created here." (9A, Chamber Energy Consultant, October 30, 2013)

Finally, the commissioner who proposed the plan wanted to expand Georgia Power's solar portfolio (Georgia Public Service Commission, 2013b). Conversely, the main opposing commissioner wrote a dissent accompanying the final IRP order. The dissent stressed that the commissioner was not opposed to solar energy but rather opposed to the solar IRP plan, for reasons which were as follows: The ASI was a joint voluntary plan by the PSC and GPC, where insufficient capacity was filled by solar but on the other hand, this plan was a 'force-fed' mandate devised without consideration to GPC's excess capacity (Georgia Public Service Commission, 2013a):

"In contrast, this expansion of solar energy was not planned or proposed by Georgia Power Company in these dockets. Rather, it was conceived and advanced without regard to Georgia Power being long on power. While the ASI program was voluntarily brought before the Commission by Georgia Power, the solar program passed by the Commission in this docket results in a force-fed mandate. Though this solar program may not be characterized as a Renewable Portfolio Standard (RPS) where the utility chooses the renewable among various forms of renewable generation, in my opinion what the Commission has approved is worse than an RPS. The Commission's approved program is mandating a specific renewable and by doing so has predetermined the winner -- solar." (Cmsr. Wise, Final Order IRP, 2013, p. 1).

The PSC took the solar vote without a full understanding of the consequences to GPC and its ratepayers and GPC did not know the impact of the addition:

"The vote on this solar program was taken without full knowledge regarding the price of solar energy or even the trend, if there is one, of the price. While Georgia Power may already have received bids within the ASI program, the Commission does not yet know what those bids are, or what impact they will have on the Company's ratepayers." (Cmsr. Wise, Final Order IRP, 2013, p. 1).

Given that, GPC already had excess reserve capacity, so the addition would be forcing GPC to purchase unnecessary capacity for an unknown possibly uneconomic price (Georgia Public Service Commission, 2013a). Although few amendments have been passed to ensure that the addition did not result in upward pressure on rates, the reliance on the 'levelized cost of generation' as a determination for adding capacity was insufficient:

> "Common sense tells us that when you shut down a cheap natural gas plant so the Company can write a check to a solar developer for premium priced power, rates will go up. Even if the bids do come in within or below avoided cost, that should not be the only determining factor for whether this is good public policy. As I tried to articulate at hearing, just because wiregrass, biomass and wind may all come under levelized costs, does that mean we should add another 500 megawatts of each? At what point, does it move from being a policy decision of the Commission to just plain bad policy?" (Cmsr. Wise, Final Order IRP, 2013, p. 2).

In a final quote, the dissenting commissioner stated:

> "Smart energy purchases are better left to the experts with the long view in mind, not the social engineers. But that is the result of this vote by the Commission, social engineering. Rather, the Commission has engaged a Washington-style, feel good energy policy, not based on economics or any rational public policy argument." (Cmsr. Wise, Final Order IRP, 2013, p. 2).

The reasons given by the commissioners who voted for the addition of solar highlights why the activities undertaken by Georgia's Americans for Prosperity may not have worked. Essentially, the commissioners were positioning Georgia's energy system in a way that it would gain from new growth opportunities or not be damaged by external circumstances such as federal regulations. So, whilst the solar order was technically a mandate, there were broader issues to consider which affected the utility, rate payers and the state of Georgia. The dissent however, highlights some of the possible impacts of investing in solar in an uncertain context, which potentially could lock-in the utilities and ratepayers into higher priced solar energy whilst installation prices are still reducing, thereby putting upward pressure on rates. The sensitivity to upward pressure on rates is especially important for protecting the consumer, but may also unnecessarily deter low carbon restructuring.

Granted, the commission may not want to increase rates, but the traditional regulated structure allows Georgia Power to recover its costs through rates, so that the company is not especially damaged by solar development should the costs overrun:

> "I mean this starts to get, I can give you the short version of this. Part of the issue is that Georgia Power could build as much Solar as they wanted because they are a state-sanctioned monopoly, so they get to recover their stuff through rate cases. So, if they thought, solar was going to raise their prices by 10% they could raise that 10%, pass it through, recover it and be fine. The issue for them is really that they are owned by another company, they are owned by Southern company which owns a series of utilities in the south and Southern is also headquartered in Atlanta, but southern has got larger national interests that are and contracts that are as it's been told to me anyway, not interested in seeing a transition away from fossil fuels and so southern dictates to Georgia Power what Georgia Power will be allowed to do in the Georgia Territory so long as it's still complying with the state legal structures which slows down some of the transition itself." (8Ai, Academic consultant, Georgia Tech, October 29, 2013).

However, ways to balance consumer and company needs may be explored, if Georgia Power's Parent company intends to transition away from fossil fuels, although it seems it may not.

The solar debates also highlighted how in a short time, the state of Georgia had made significant changes to its electricity generation and supply profile, partly because this group of elected commissioners had been the most open to clean energy in years given what the renewable energy percentage has been in the state prior to this point and partly because these commissioners took a long view about Georgia's electricity generation and supply policies. Explained by a solar manufacturer as:

> "Bubba McDonald, said that he wanted to try and get 50MW which back 4 years ago seemed astronomical for Georgia said could we challenge Georgia Power and the regulated utilities that they control or regulate, could we get them to add 50MW not even one-hundredth, you know, one-tenth of a percent of the generation but wouldn't it be a way to show that everybody's thinking toward to future and can we do it without raising rates for the rate payer that was the key." (4Bii 9B, Snr. Director International Sales & Market Development, February 20, 2014).

8.8 Post 800MW

Immediately after the solar debates, multiple events occurred which allowed pro-solar and anti-solar advocates to continue to debate solar additions, specifically third party distributed solar options for consumers. Another solar bill (HB 657) was introduced by a state legislator, designed to remove Georgia Power's monopoly by creating a rural committee solar program, where any residential, business and commercial entities could sign up voluntarily (O.C.G.A., 2014a). The bill was introduced late in the legislative calendar, so was not put to a vote but got a hearing in the Georgia House Energy, Utilities and Telecommunications Committee where pro-solar advocates from the Sierra Club and a few public service commissioners commended the bill (Swartz, 2013b). In addition, when this bill was introduced, Georgia Power opposed the bill (Swartz, 2013b) but the Atlanta Tea Party Patriots' coordinator notes that the EMCs and the municipal-owned utilities also opposed this bill, because distributed solar generation was a threat to the monopoly utilities in general.

Since the focus of many pro-solar advocates had been on Georgia Power, as the sole investor-owned utility, with the largest operating area (Figure 5-4) opposition to solar from publicly owned utilities had not been explored. Nevertheless, the Atlanta Tea Party coordinator noted that the EMCs were equally resistant to distributed solar generation and given the structure for electricity regulation in Georgia, there was little regulatory oversight to provide a check on the behaviour of the public utilities:

> "Well, I mean, is more egregious with the EMCs and the Co-ops, because of the fact, I mean, they have a board that governs them but it's a kind of a board system and things like that, they are not regulated like Georgia Power is. So, you know, so it is, they can be more egregious with their attacks on competition and choice than Georgia Power. Georgia Power can't go out and do a lot, because of the fact that, hey! they know they have the Public Service Commission looking over their heads. And so, these, EMCs and Co-ops and municipal utilities, they feel more emboldened to attack solar. So, I think, but because of the fact, that you have Georgia Power and some of these monopolies are actually bigger by far and have a greater service area and attract more people and that's why a lot of attention is focused but I firmly believe that even though a lot of these EMCs are non-profit, I mean, they still, they hire employees, they can be paid big salaries, equipment and things like that, so these EMCs and Co-ops can be a bigger problem than the regulated investor owned utility" (15D, Tea Party activist, October 5, 2016).

In other words, all the monopolies were against opening-up the grid to alternative providers.

Georgia Power initiated a rate case based on recovering some of the cost overruns associated with the new nuclear plants (Vogtle 3 and 4). This rate case caused pro-solar groups including the Green Tea coalition, GSEIA, Georgia Watch, to continue the push for distributed solar, whilst arguing against the nuclear development and rate increase. During the rate case, the Green Tea coalition continued to hold rallies for distributed solar and limits on GPCs profits on the cost overruns on the nuclear expansion. The Green Tea coalition's advocacy continued despite the unusual ideologies involved, with all groups keeping a bigger perspective:

> "We often find common ground with one another. There are small issues where, based on the nature of the missions of our organisations we do diverge a little bit, but the vested interest in this state, the utility companies have so much political and capital power that it is not in our interests to concentrate on those little things. You know, we have to find where we find common ground together and work on those things. (6E 7G, Sierra Club, Georgia Chapter Organiser, February 26, 2014).

In addition to the Green Tea coalition, larger loose coalitions of low carbon interests, seem to be forming in Georgia:

> "We have a loose-knit coalition of environmental groups, consumer advocates, some of the people involved in the Green-Tea Coalition, that have internally committed to getting us to 20% energy efficiency and renewable energy by 2020." (6E 7G, Sierra Club Chapter Organiser, February 26, 2014)

And unofficial targets for low carbon are being set within these groups:

> "It's nothing that we've ever been public about, but when we sit down together as coalition partners and think about what positions are we going to take on this piece of legislation, or this proposal by Georgia Power, we make that decision through the framework of, 'Is it going to get us to 20% by 2020?' So, Georgia Power's proposed 250-, the thing that we are immediately working on, are HB874, this solar legislation and then Georgia Power's proposed wind power purchase agreements. They've proposed 250MW, we think that they should do about 1,000MW." (6E 7G, Sierra Club Chapter Organiser, February 26, 2014)

With regards to the decision makers, including the utilities, the process of adding 525MW of new solar generation to the Integrated Resource Plan, began and GPC starting taking requests for proposals by qualifying facilities including Southern Company's subsidiaries.

The process was opened to all bidders and the company used an independent monitor approved by the commission to manage the process.

Some public service commissioners, also left open the possibility for more solar additions at the next IRP and in the future:

> "So, we've got the solar majority going, you've got me on the end there, then Commissioner Everett, I won't mention the next gentleman and then in the foreground there, Commissioner McDonald. So, in another three years, we'll do another IRP and we'll see what happens with solar there. This part is really important, with this 525MW, that we are about to contract for, that it be done well. We need quality workmanship, we don't need stuff in the paper about problems and issues, it just needs to be done right. And we are probably not going to have enough time to even have problems, it's in year 20 or year 25 and how we see these panels are performing that's going to be, I think, important but of course 25 years is a long time from now but we want to do it right." (Commissioner Echols, Clean Energy Summit, Atlanta, October 17, 2013).

Yet another bill was introduced in the Georgia House of Representatives designed to expand distributed solar energy (O.C.G.A., 2014b). The HB 874: Solar Power Free-Market Financing and Property Rights Act of 2014 seeks to open up the currently restricted access for individual and business property owners with regards to buying solar by allowing them to finance or contract with solar energy installers. The Georgia House Energy, Utilities & Telecommunications committee is made up of 20 elected officials from different districts. The Bill was sponsored by six individuals from the Georgia House of representatives. There were five Republicans and one Democrat (O.C.G.A., 2014b). It is said to have support from not only the solar industry in Georgia i.e. GSEIA but also the real estate community, the Georgia Property Rights Council and the Georgia Association of Realtors. The bill was introduced at the end of the field work; it is currently in the second reader stage at the time of writing.

Finally, the persistency of the pro-distributed solar groups has shifted the focus of the argument in groups opposed to distributed solar, to one of cross-subsidies and the fair value of the grid. Georgia Power currently argues that opening the grid to distributed solar generators leaves customers who do not install distributed solar subsidising those who do, leaving the same total infrastructure costs to be shared by fewer customers.
This was a concern expressed by the director of energy policy and planning of Georgia Power:

> "Well, I think the balance is ensuring and I mean you're getting to the cracks of the discussions going on right now is not only in Georgia but throughout the country, is that we

> want to ensure that customers who choose to install to solar, they are paying for the fair value of the grid services that they still require. so you know the generation what we call *spinning reserves* is ready to go when the sun doesn't shine and we have to bring you know generation up to respond to the declining solar production to the transmission and distribution investments sort of necessarily to ensure you know that you know, that the customer can continue to have reliable service if they should something malfunction in their solar facility, you know the inverter goes out and now they are totally relying on the company's grid." (13A, director of resource policy and planning, April 1, 2014)

In addition, ensuring an appropriate tariff, for the distributed generation customers that is fair to both the utility and ratepayer:

> "So we'll need to make sure that our experts design to ensure that customers continue to pay for the fair value that they get from the grid and at the same time the company needs to be, make sure that were paying because many of these customers have the ability to sell back to us and so we need you know to ensure our prices, what we willing to pay for their solar energy is fair to the customer too. So, I think is all about fairness in terms of the customers paying for the fair value of what they get from the grid and from network because when they don't other customers have to step up and pick up that, that responsibility and that's fair to customers who may not want to install solar or other type of distributed generation and likewise." (13A, director of resource policy and planning, April 1, 2014)

This remained the status of the conversation, going forward for distributed generation in Georgia.

8.9 Summary: the politics of the 'solar push'

In Georgia, a loose coalition of interests was able to promote and debate a possible change in legislation in relation to the opening up of monopoly state energy systems to third party solar generation. The 'solar push' was stimulated primarily by solar businesses and then attracted other organisations into a loose coalition. The push drew on wider changes underway across the U.S. and dissatisfaction with aspects of existing provision and management. In Georgia, the noticeable cause was not carbon and climate change: these were rarely mentioned unless talking about federal regulations. Instead, arguments were made on different foundations: free market competition, individual freedom and property rights with no interest in pursuing renewable energy that had the potential to increase costs of energy.

The pro-solar group included an intriguing range of interests, solar manufacturers, consumer advocates, environmentalists and Atlanta Tea Party Patriot members. Faced with this challenge, established interests representing existing powerful bodies or those concerned about the cost implications of solar, were able to mobilise in their own loose coalition. The anti-solar group had an intriguing collection of organisations, including the utilities, the Georgia Chamber of Commerce, political groups like Americans for Prosperity, Georgia Tea Party Inc. and members of state legislature. The prime argument was about offering ratepayers the choice to install distributed solar systems, to be able to sign power purchase agreements with alternative energy providers and sell electricity back to the wider grid. Georgia Power sought to head off the challenge by introducing its own initiative, the Advanced Solar Initiative, designed for Georgia Power to increase its solar capacity by signing power purchase agreements with solar energy generators.

Both sides sought to influence the debate in various ways, including launching significant public engagement methods through letters, emails, press conferences and talks. This made some difference as the public service commissioners started to actively engage with these groups and consider these new arguments. Nevertheless, the real push for distributed solar was unsuccessful. Instead, a small accomplishment was made by adding 525MW of solar, bringing Georgia's total solar to 800MW from 22MW. In the end, decision making remained strongly in favour of vested interests because decision makers were supporters of the current electricity system and utilities, which delivered low costs and were not convinced about the need or the value in opening up the system in a way that may compromise the low costs of energy.

9 CONCLUSION

The main aim of this research was to examine the factors which shape decisions about electricity generation and supply in the state of Georgia, USA. More specifically, the research sought to examine how factors associated with 'the new energy governance' were impacting on decisions about the future of electricity generation and supply in a context of ongoing change and uncertainty in the regulatory, fiscal and political context for management and investment. To answer the research questions, this research focused on one state as its case study; the state of Georgia in the United States. As chapter 3 demonstrated, the institutional, infrastructural and political context for electricity generation and supply varies considerably across the USA.

The state of Georgia can provide general insights into the wider national politics of energy governance but also allows for the exploration of the particularly regional and local circumstances that shape processes of low-carbon energy restructuring within that broader multi-level context. Georgia was selected because it has been under-researched but also because it is a context where electricity prices are low and low-carbon would not be expected to be a significant drive of change to the dominance of coal-fired power stations. However initial research revealed evidence of pressures on the state electricity provider to reduce its dependence on fuel and also pressures to open up the energy system to decentralised energy supply.

This is a contrast to many of the case studies of energy governance and sub-national low-carbon governance in the USA that have tended to focus on places with proactive low carbon policy or more explicit crises in the mode of electricity generation and supply such as California. The research provided an opportunity to explore what low carbon energy restructuring might mean in a context where political support for low carbon was more equivocal.

The research employed qualitative research approach, using 25 interviews with key decision makers and influential political, business, environmental, consumer groups.

9.1 RESEARCH FINDINGS AND CONTRIBUTION

First and foremost, the thesis makes a contribution by providing in-depth investigation of a context for energy transition/new energy governance that has not previously been researched. The issues covered included, the prevailing mode of governing energy generation and supply in Georgia, the key groups which were influential in energy decisions, their views, values and priorities in energy generation and supply. More issues covered included, the types of lock-ins found in Georgia's energy system and the effects of lock-in on energy decisions. Finally, the events and discussions which were occurring at the time concerning decentralisation, nuclear energy development and carbon regulations and plans.

Second, the in-depth research revealed aspects not previously brought out or covered in research on energy governance in the United States, notably the impact of the bottom up pressure for decentralised supply and, especially, the coalition of different and diverse interests that came together around that agenda. The research showed that, bottom up pressure to decentralise electricity generation and supply, from a range of interests including, citizens, firms, alternative energy providers and other political organisations, was an effective way of making changes to energy systems in conservative political settings.

The decentralization coalition which included, solar manufacturers, consumer advocates, environmentalists and Atlanta Tea Party Patriot members, focused on decentralisation, using distributed solar generation. It shifted the conversation away from climate change, carbon emissions and environmentalism and towards consumer choice, property rights and free market competition.

The involvement of political groups like the Atlanta Tea Party Patriots, strengthened the coalition, because they represented an important constituency in conservative politics, which could mobilise residents around a cause and provide a counter to other political groups. However, the failure of the coalition to change the policy of Georgia Power reflects the entrenched power of the energy company and the limited wider pressure from the public, municipal authorities or firms for a supportive decentralised system. In turn that also reflects the absence of a sense of crisis in the existing mode of energy generation and the ability of Georgia Power to deliver low price electricity without interruption.

Other significant contributions from the research included:

The extent to which decarbonisation is important for energy governance in the US, even in contexts where climate policy is weakly supported: the research showed that decarbonisation may be important to the extent that there are groups, especially large firms for whom, decarbonisation is strategic to long term goals. The research showed that a number of large firms including IKEA, Walmart and Coca-Cola, had developed distributed low carbon energy, for use in their firms, with the intent of more distributed energy. By 2012, almost 60% of the largest companies in the U.S. have set out renewable energy goals (Tawney et al., 2014). These are firms with estate that can be used for electricity generation, but also pressure on electricity generators for low carbon.

Importance of understanding the importance of electricity pricing: The research showed that understanding electricity prices and how it influences policy are a key part of understanding energy investment decisions in the United States. In Georgia, investment decisions are designed to keep prices low. Regulators, were very conscious of any investments which would risk putting upward pressure on rates, or lock-in high prices. Since, Georgia's energy system was keeping prices low, regulators and legislators, were not inclined to make any changes to existing policies on electricity generation and supply.

In contrast, the state of California, provides an example whereby, high electricity prices and cost overruns were crucial to the decision to restructure (U.S. Congressional Budget Office, 2001). The expectation was that competition would give customers choice, prevent utilities from making risky investments and deliver cost reductions to consumers. Since California's electricity prices have remained high, decision makers have created policies to encourage and support new market entrants to provide alternatives for consumers and competition for the utilities. Another outcome of California's high electricity prices has been that residential solar is an attractive option for customers. and this is evident as the state has the largest residential solar market in the United States (GTM Research & Solar Energy Industries Association, 2014). These elements are absent in Georgia. However, both states show how important electricity prices are in influencing policy decisions.

The relative absence of an urban dimension to pressures for state-wide energy restructuring: there is a growing volume of research on urban energy restructuring which can put cities in conflict with prevailing systems of energy generation and distribution (Bulkeley & Kern, 2006; Hodson & Marvin, 2009, 2010b; While, 2011). This reflects the growing importance for cities in controlling the urban energy metabolism as part of carbon policy and to secure energy supplies for economic development. It is argued that there is a new imperative for cities to take control of urban energy policy underpinned by a logic of capturing and retaining the benefits of investment in decentralised energy generation.
However, it was noticeable that pressure for energy decentralisation from Georgia's cities such as Atlanta was fairly muted.

This might be surprising given the economic development context in cities like Atlanta and the fact that Georgia's cities operated in a context where there was, lack of control over energy production. The city of Atlanta was considering a city renewable energy plan, but lacked governing capacities over existing energy infrastructure, which meant that the ability to enact these plans, were limited under the current system. In addition, the low costs of electricity, provided by the existing energy system meant there was no desire, urgency or political support for a distinctive urban energy strategy.

In Georgia, pressures for low carbon have been rather moderate, compared with some of the pressures for low carbon restructuring in other states, for example, the North-east, states.
In Northeast, pressures to address; lack of capacity from retiring coal and nuclear plants, excessive dependence on energy imports especially natural gas, high electricity prices and increasing citizen demand for renewable energy, have resulted in intense political pressure to undertake low carbon restructuring. Whilst the dominant mode of electricity generation and supply, remained during the research period, these pressures for decentralisation, potentially represent the start of the emergence of a new context for governing energy.

The scope and implications of any new business model for electricity generation will likely depend upon on the degree to which various challenges to the control of Georgia Power are successful, but the search for a new business model in Georgia, will likely first involve, legal, regulatory, planning and operational changes which allow incumbent utilities and alternative energy providers to share the electricity infrastructure.

Nevertheless, for Georgia Power, a new business model might involve charging fees to distributed energy customers for the limited use of transmission and distribution infrastructure. It may involve Georgia Power, developing and selling distributed generation resources to consumers, alongside alternative providers. It may also involve, a reduced rate of return, due to competition from distributed energy providers, which has implications for investment.

9.2 Summary of Events Post Research

The research was undertaken at a particular moment of time and could be seen as the opening stages of a broader politics of restructuring and transition around energy generation and supply. In February of 2014, the Environmental Protection Agency, extended the comment period for the proposed standards to limit carbon emissions from new power plants. In June 2014, the Environmental Protection Agency also announced a proposed plan to limit CO_2 emissions from existing fossil power plants, which is formally known as the *Clean Power Plan* (Environmental Protection Agency, 2015b). The proposed plan aims to reduce emissions by 32% below 2005, by the year 2030 (Environmental Protection Agency, 2015b). Each state has a calculated target for emissions reductions based on the existing baseline (The state of Georgia has between a 46% and 48% emission reduction target by 2030. In response, by the end of 2015 twenty-four states including Georgia had filed lawsuits against the EPA's Clean Power Plan (Environmental Protection Agency, 2016).

In January 2015, a final solar financing bill titled the "Solar Power Free-Market Financing Act" was introduced into the Georgia general assembly, by five Republican state legislators and one Democrat (O.C.G.A., 2015). The bill passed in May 2015. The law allows solar energy procurement agreements (SEPAs), which include solar Power Purchase Agreements, leases and other financing mechanisms available, as a means to fund solar energy installation for residents, businesses, schools and other institutions (O.C.G.A., 2015). The law does not negate the Territorial Act, because it does not permit third party retail sales of electricity with PPAs. The law places limits on the size of the installed solar systems. Overall, the law resolves some of the issues, regarding property rights and free market financing and it makes Georgia was the first state in the Southeast to allow third party financing of solar.

The Green Tea Coalition in collaboration with some local groups in Florida, are pushing for distributed solar and consumer choice in Florida and new conservative organisations like 'Conservatives for Energy Freedom' have emerged (Dooley & Perfetti, 2015). In June 2015, Southern Company, announced that Georgia Power, would start selling rooftop solar systems to residential customers in Georgia, beginning in July 2015 (Polson & Chediak, 2015) and also announced a deal with Tesla Energy to provide, electric batteries to residents and homes. Southern Company also announced its plans to purchase, a natural gas distributor in August 2015 (Polson, 2015). Finally, in August 2015, as a response to solar advocates, a docket was opened by the Public Service Commission to examine the value of renewable and distributed energy resources to the grid, in preparation for the 2016 IRP (Georgia Public Service Commission, 2015). This means that the low carbon story is still unfolding.

9.3 Implications for Energy Governance Outside of the U.S.

As with any case study the Georgia example reflects a range of factors specific to its regional and national context. For example, the state of Georgia like much of the Southeastern region relies on a highly centralized, low cost model of electricity generation and supply, provided by powerful investor-owned monopolies with a high dependence on coal. Like much of the region, Georgia has little environmental ethic and significant climate change skepticism amongst its decision makers. Nevertheless, like states across the country, Georgia is rapidly switching from coal to natural gas due to the low cost of natural gas. Finally, Georgia also reflects the national context, whereby the 30% renewable energy investment tax credit, has reduced the upfront costs of renewable energy, providing opportunities for a decentralization challenge.

As outlined earlier in the thesis, Georgia might reflect and provide insights into the wider U.S. context in a number of ways such as the importance of decarbonisation in the absence of climate change policy, pressure for utility-scale development of renewable energy and pressure for decentralization from residents, businesses and large firms. However, there is wide variation in the context for electricity generation and supply and Georgia might be said to contrast with some states in the U.S., like California where pressure for low carbon restructuring is significant due to high electricity prices and in the Northeastern states, where there is a lack of generation capacity and high electricity prices. Looking beyond the U.S. there are potentially parallels as well as differences to be drawn to what is happening in other countries, for example Germany and the UK.

For example, on the surface it might appear that that the context in Georgia is very different from Germany or the UK. In Germany and the UK, decision makers and utilities are under pressure to decarbonize due to EU and national emission reductions, energy efficiency and renewable energy targets. Germany's Renewables Energy Act and the Federal Energy Concept have goals to reduce greenhouse gas emissions by 80% by 2050, increase the share of renewables to 60% by 2050 and phase out nuclear energy by 2022. The UK's target is to reduce emissions by 80% by 2050. These stringent requirements are in contrast with the United States, where the clean power plan has stalled.

Additionally, Germany and the UK have liberalized energy markets, whereby alternative energy providers can enter the market and consumers have retail choice, allowing them to switch providers. Therefore, some of the sources of lock-in/lock-out found in Georgia, including the legal constraints, regulatory framework and the ownership of transmission and distribution infrastructure are not apparent. Finally, Germany and the UK, have stronger attitudes to the environment amongst decision makers and residents, therefore some of the cultural resistance to environmental causes are not apparent. However, looking beyond issues of climate change policy, infrastructure and cultural lock-out, Georgia tells a story that has some connections in terms of low carbon restructuring, especially the costs of low carbon restructuring in the current centralized model of electricity generation and supply.

The utilities invest in the lowest cost energy resources, which used to be coal but now is natural gas, hence the switching. The upfront costs of renewable energy, whilst continuously reducing like those of solar energy are still high and require subsidies. In the same way that nuclear energy needs subsidies due to its high capital costs but very low operating costs. For renewable energy, despite the 30% ITC, Georgia's utilities are hesitant to develop utility scale renewable energy due to its high costs and effects on rates, preferring instead to buy renewables from other generators. Ultimately, the subsidies have been more successful for distributed generation companies, reducing the upfront cost of developing solar energy, but still struggling to be competitive against Georgia's low cost of electricity.

Germany's energy transition (Energiewende), also highlights these costs of renewable energy, requiring significant subsidies to help meet its greenhouse gas emissions targets and renewable energy targets. Whilst these have allowed rapid development of renewable energy, residents have experienced increased electricity bills in the form of the renewable energy surcharge on their bills. Finally, the UK to meet its targets or rapid renewable energy developments, also introduced multiple subsidies to reduce the costs of renewable energy and incentivize investment, including the Renewables Obligation and the Feed-in Tariff. However, consumers have also experienced increases in their electricity bills as costs are passed through to consumers. Across these countries and in Georgia, the upfront costs of incorporating renewable energy mean that utilities hesitate to invest in renewable energy without significant subsidies.

REFERENCES

Aggarwal, S., & Harvey, H. (2013). Rethinking Policy to Deliver a Clean Energy Future. *The Electricity Journal, 26*(8), 7-22. doi:http://dx.doi.org/10.1016/j.tej.2013.08.009

America's Climate Security Act of 2007, 2191, 110th Congress (2007).

America's Climate Security Act of 2008, 3036, 110th Congress (2008).

Americans for Prosperity. (2006). About. Retrieved from https://americansforprosperity.org/about/

Americans for Prosperity. (2013a). AFP-GA Activists to Hold Press Conference against Green Energy Mandates In Georgia [Press release]. Retrieved from http://americansforprosperity.org/georgia/article/immediate-release-afp-ga-activists-to-rally-against-green-energy-mandates-in-georgia/

Americans for Prosperity. (2013b). AFP GA Activists fire first major shot against Obama's 'War On Consumer Energy' Agenda. Retrieved from http://americansforprosperity.org/georgia/article

Americans for Prosperity. (2013c, July 11, 2013). AFP Releases Solar Energy Mandates Opposition Points & Supporting Facts. Retrieved from http://www.southeastgreen.com/index.php/news/georgia/9111-afp-releases-solar-energy-mandates-opposition-points-supporting-facts

Americans for Prosperity. (2013d). The Truth about Your Electric Bill. Retrieved from http://americansforprosperity.org/georgia

Arent, D., Logan, J., Macknick, J., Boyd, W., Medlock, K. I., O'Sullivan, F., . . . Bazilian, M. (2015). A Review of Water and Greenhouse gas impacts of Unconventional natural gas development in the United States. *MRS Energy & Sustainability, 2*, E4 (21 pages). doi:doi:10.1557/mre.2015.5

Arthur, W. B. (1989). Competing Technologies, Increasing Returns, and Lock-In by Historical Events. *The Economic Journal, 99*(394), 116-131. doi:10.2307/2234208

Augusta Chronicle Editorial Staff. (2015, March 1, 2015). Towers of power, Editorial. *The Augusta Chronicle*. Retrieved from http://chronicle.augusta.com/opinion/editorials/2015-03-01/towers-power

Baddour, D. (2015, February 2, 2015). List of places than ban fracking keeps growing, News. *Houston Chronicle*. Retrieved from http://www.chron.com/business/article/List-of-places-than-ban-fracking-keeps-growing-6057266.php

Bade, G. (2014). SolarCity partners with HECO to study solutions to solar problems. Retrieved from http://www.utilitydive.com/news/solarcity-partners-with-heco-to-study-solutions-to-solar-problems/335221/

Baker, D. R. (2010, June 10, 2010). PG&E's Prop. 16 lost big in its service area, News. *San Fancisco Chronicle*. Retrieved from http://www.sfgate.com/business/article/PG-E-s-Prop-16-lost-big-in-its-service-area-3185513.php

Balling, L., Termuehlen, H., & Baumgartner, R. (2002). *40 Years of Combined Cycle Power Plants*. Paper presented at the 2002 International Joint Power Conference, Scottsdale, Arizona, USA.

Barteczko, A. (2015, June 5, 2015). Conoco the last global oil firm to quit Polish shale gas. *Reuters*. Retrieved from http://www.reuters.com/article/conoco-poland-shalegas-idUSL5N0YR2R320150605

Bassi, S., Rydge, J., Khor, C. S., Fankhauser, S., Hirst, N., & Ward, B. (2013). *A UK 'dash' for smart gas*. Retrieved from London, UK: http://www.lse.ac.uk/GranthamInstitute/publication/a-uk-dash-for-smart-gas/

Bird, L., & Kaiser, M. (2007). *Trends in Utility Green Pricing Programs (2006)* (NREL/TP--670-42287; Other: 5273 United States10.2172/1219301Other: 5273Tue Oct 20 05:31:18 EDT 2015EE-LIBRARYEnglish). Retrieved from http://www.osti.gov/scitech//servlets/purl/1219301/

Bird, L., Milligan, M., & Lew, D. (2013). *Integrating Variable Renewable Energy: Challenges and Solutions* (NREL/TP-6A20-60451 United States10.2172/1097911Thu Nov 07 12:02:41 EST 2013NRELEnglish). Retrieved from http://www.osti.gov/scitech//servlets/purl/1097911/

Bird, L., Swezey, B., & Aabakken, J. (2004). *Utility Green Pricing Programs: Design, Implementation, and Consumer Response* (NREL/TP-620-35618). Retrieved from http://www.osti.gov/scitech//servlets/purl/15006910-sstklG/native/
Bolinger, M., Wiser, R., Cory, K., & James, T. (2009). *PTC, ITC, or Cash Grant? An Analysis of the Choice Facing Renewable Power Projects in the United States* (DE-AC02-05CH11231). Retrieved from http://www.osti.gov/scitech//servlets/purl/950222-YXBsWb/
Bollen, M., & Hassan, F. (2011a). Power System Performance *Integration of Distributed Generation in the Power System* (pp. 84-101): John Wiley & Sons, Inc.
Bollen, M., & Hassan, F. (2011b). Voltage Magnitude Variations *Integration of Distributed Generation in the Power System* (pp. 141-222): John Wiley & Sons, Inc.
Borenstein, S., & Bushnell, J. (2015). *The U.S. Electricity Industry after 20 years of Restructuring*. Retrieved from Cambridge, MA: https://ei.haas.berkeley.edu/research/papers/WP252.pdf
Bouffard, F., & Kirschen, D. S. (2008). Centralised and distributed electricity systems. *Energy Policy, 36*(12), 4504-4508. doi:http://dx.doi.org/10.1016/j.enpol.2008.09.060
Boyd, W. (2014). Public Utility and the Low-Carbon Future *University of Colorado Law Review, 61*(14-5).
Bridge, G. (2010). Geographies of peak oil: The other carbon problem. *Geoforum, 41*(4), 523-530. doi:http://dx.doi.org/10.1016/j.geoforum.2010.06.002
Brown, G. J. (1997). Environmental Science Under Siege in the U.S. Congress. *Environment: Science and Policy for Sustainable Development, 39*(2), 12-31. doi:10.1080/00139159709604359
Brown, M., & Sedano, R. (2004). *Electricity Transmission: A Primer*. Washington D.C.: National Council on Electricity Policy.
Brown, M. A., Chandler, J., Lapsa, M. V., & Sovacool, B. K. (2008). *Carbon Lock-In: Barriers to Deploying Climate Change Mitigation Technologies*: U.S. Dept. of Energy. Engineering Science

Technology Division

Oak Ridge National Laboratory.
Brown, M. A., & Sovacool, B. K. (2011). Barriers to the diffusion of climate-friendly technologies. *International Journal of Technology Transfer and Commercialisation, 10*(1), 43-62. doi:doi:10.1504/IJTTC.2011.038453
Bryman, A. (2012a). Interviewing in qualitative research *Social Research Methods* (4th ed., pp. 469 – 499). Oxford, UK

New York, NY: Oxford University Press.
Bryman, A. (2012b). Qualitative data analysis *Social Research Methods* (4th ed., pp. 565 - 589). Oxford, UK

New York, NY: Oxford University Press.
Bryman, A. (2012c). Sampling in qualitative research *Social Research Methods* (4th ed., pp. 416 - 429). Oxford, UK

New York, NY: Oxford University Press.
Bryman, A. (2012d). *Social Research Methods* (4th ed.). Oxford: England: Oxford University Press.
Bulkeley, H. (2010). Cities and the Governing of Climate Change. *Annual Review of Environment and Resources, 35*(1), 229-253. doi:doi:10.1146/annurev-environ-072809-101747
Bulkeley, H., & Betsill, M. M. (2013). Revisiting the Urban Politics of Climate Change. *Environmental Politics, 22*(1), 136-154. doi:10.1080/09644016.2013.755797
Bulkeley, H., & Kern, K. (2006). Local Government and the Governing of Climate Change in Germany and the UK. *Urban Studies, 43*(12), 2237-2259. doi:10.1080/00420980600936491
Bushnell, J. (2004). California's electricity crisis: a market apart? *Energy Policy, 32*(9), 1045-1052. doi:http://dx.doi.org/10.1016/j.enpol.2003.11.003

Byrne, J., Hughes, K., Rickerson, W., & Kurdgelashvili, L. (2007). American policy conflict in the greenhouse: Divergent trends in federal, regional, state, and local green energy and climate change policy. *Energy Policy, 35*(9), 4555-4573. doi:http://dx.doi.org/10.1016/j.enpol.2007.02.028

California Energy Commission. (2015). *Renewable Energy – Overview*. Retrieved from Sacramento, CA:

California Energy Commission, & California Public Utilities Commission. (2015). California Solar Statistics: Program Totals by Administrator (Statistics Report). Retrieved April 16, 2015, from California Energy Commission

California Public Utilities Commission https://www.californiasolarstatistics.ca.gov/reports/agency_stats/

Cameron, D. (2013, August 11, 2013). We cannot afford to miss out on shale gas. *The Telegraph*. Retrieved from http://www.telegraph.co.uk/news/politics/10236664/We-cannot-afford-to-miss-out-on-shale-gas.html

Carrington, D. (2015, November 25, 2015). UK cancels pioneering £1bn carbon capture and storage competition, Opinion Editorial. *The Guardian*. Retrieved from https://www.theguardian.com/environment/2015/nov/25/uk-cancels-pioneering-1bn-carbon-capture-and-storage-competition

Center for Climate and Energy Solutions. (2008, June 12, 2008). Analysis of the Lieberman-Warner Climate Security of 2008. Retrieved from http://www.c2es.org/federal/analysis/congress/110/analysis-lieberman-warner-climate-security-act-2008

Center for Climate and Energy Solutions. (2015a). EPA regulation of Greenhouse Gas Emissions from New Power Plants. Retrieved from http://www.c2es.org/federal/executive/epa/ghg-standards-for-new-power-plants

Center for Climate and Energy Solutions. (2015b). Outcomes of the U.N. Climate Change Conference in Paris. Retrieved from http://www.c2es.org/international/negotiations/cop21-paris/summary

Center for Climate and Energy Solutions. (2016). Clean Air Act Cases. Retrieved from http://www.c2es.org/federal/courts/clean-air-act-cases

Chandler, J. (2009). Trendy solutions: Why do states adopt Sustainable Energy Portfolio Standards? *Energy Policy, 37*(8), 3274-3281. doi:http://dx.doi.org/10.1016/j.enpol.2009.04.032

Chapman, I. (2014). The end of Peak Oil? Why this topic is still relevant despite recent denials. *Energy Policy, 64*, 93-101. doi:http://dx.doi.org/10.1016/j.enpol.2013.05.010

City Hall. (2015). Georgetown Utility to be Powered by Solar and Wind Energy by 2017 [Press release]. Retrieved from https://georgetown.org/2015/03/18/georgetown-utility-to-be-powered-by-solar-and-wind-energy-by-2017/

City of San Diego. (2016). *Climate Action Plan*. Retrieved from San Diego, CA: https://www.sandiego.gov/planning/genplan/cap/

Clymer, A. (1994, November 10, 1994). The 1994 Elections: Congress the Overview, Opinion Editorial. *The New York Times*. Retrieved from http://www.nytimes.com/1994/11/10/us/1994-elections-congress-overview-gop-celebrates-its-sweep-power-clinton-vows.html?pagewanted=all

Coal Age News. (2012a, September 14, 2012). 1960s: Coal Fuels America's Critical Electrical Backbone - 1960-1969.

Coal Age News. (2012b, September 14, 2012). Labor Peace, Continued Mechanization and a Changing Focus on the Environment - 1950-1959.

Cochran, J., Miller, M., Zinaman, O., Milligan, M., Arent, D., Palmintier, B., . . . Soonee, S. K. (2014). *Flexibility in 21st Century Power Systems* (NREL/TP-6A20-61721 United States10.2172/1130630Tue May 13 05:18:40 EDT 2014NRELEnglish). Retrieved from http://www.osti.gov/scitech//servlets/purl/1130630/

Cornell Legal Information Institute. (1992). CRS Annotated Constitution: Tenth Amendment. Retrieved January 25, 2016, from Cornell Legal Information Institute https://www.law.cornell.edu/anncon/html/amdt10_user.html#amdt10_hd4

Cornell Legal Information Institute. (2007). Massachusetts v. EPA. Retrieved January 25, 2016, from Cornell Legal Information Institute https://www.law.cornell.edu/supct/html/05-1120.ZS.html

Cottle, M. (2013, September 16, 2013). The Green Tea Party: Debbie Dooley Battles Big Energy, Opinion. *The Daily Breast*. Retrieved from http://www.thedailybeast.com

Couret, J. (2012, December 12, 2012). Georgia ranks in Forbes' Top 10 states for business, Economic. *Atlanta Business Chronicle*. Retrieved from http://www.bizjournals.com/atlanta/news/2012/12/12/georgia-ranks-in-forbes-top-10-states.html

Cowan, R., & Hultén, S. (1996). Escaping lock-in: The case of the electric vehicle. *Technological Forecasting and Social Change, 53*(1), 61-79. doi:http://dx.doi.org/10.1016/0040-1625(96)00059-5

Creswell, J. W. (2013). Qualitative MethodsResearch Design: Qualitative, Quantitative and Mixed Methods Approaches (4 ed.). Thousand Oaks, CA

London, UK: SAGE Publications. Retrieved from https://us.sagepub.com/en-us/nam/research-design/book237357.

Cunningham, D. (2012). Ikea Powers-Up Solar Energy System's Panels on Atlanta Store [Press release]

Dart, T. (2015, March 28, 2015). Texas city opts for 100% renewable energy – to save cash, not the planet, Opinion Editorial. *The Guardian*. Retrieved from https://www.theguardian.com/environment/2015/mar/28/georgetown-texas-renewable-green-energy

Denholm, P., & Hand, M. (2011). Grid flexibility and storage required to achieve very high penetration of variable renewable electricity. *Energy Policy, 39*(3), 1817-1830. doi:http://dx.doi.org/10.1016/j.enpol.2011.01.019

Department of Energy and Climate Change. (2015). Changes to renewables subsidies [Press release]. Retrieved from https://www.gov.uk/government/news/changes-to-renewables-subsidies

Dittrick, P. (2011, 11/07/2011). Unconventional Oil & Gas Focus: Poland shale gas could change European supply mix. *Oil & Gas Journal*.

Dooley, D., & Perfetti, T. (2015). About Conservatives for Energy Freedom. Retrieved from http://energyfreedomusa.org/

Dudley, B. (2015). *BP Statistical Review of World Energy*. Retrieved from London, UK: http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html

Dunlap, R. E., & Allen, M. P. (1976). Partisan Differences on Environmental Issues: A Congressional Roll-Call Analysis. *The Western Political Quarterly, 29*(3), 384-397. doi:10.2307/447511

Dunlap, R. E., & Gale, R. P. (1974). Party Membership and Environmental Politics: A legislative Roll-Call Analysis. *Social Science Quarterly, 55*(3), 670-690.

Dunlap, R. E., Xiao, C., & McCright, A. M. (2001). Politics and Environment in America: Partisan and Ideological Cleavages in Public Support for Environmentalism. *Environmental Politics, 10*(4), 23-48. doi:10.1080/714000580

Echols, T. (2013a, July 5, 2013). Germans have interesting model for energy transition, Opinion Editorial. *Athens Banner-Herald*. Retrieved from http://onlineathens.com/opinion/2013-07-05/echols-germans-have-interesting-model-energy-transition

Echols, T. (2013b, July 25, 2013). Nuclear power can be economic boon to Southeast, Opinion Editorial. *Athens Banner-Herald*. Retrieved from http://onlineathens.com/opinion/2013-07-25/echols-nuclear-power-can-be-economic-boon-southeast

Echols, T. (2014a, June 14, 2014). New carbon rule is administrative overreach, Opinion Editorial. *Athens Banner-Herald* Retrieved from http://onlineathens.com/opinion/2014-06-14/echols-new-carbon-rule-administrative-overreach

Echols, T. (2014b, December 8, 2014). Viewpoint: Our expensive energy diet, Opinion Editorial. *Atlanta Business Chronicle*. Retrieved from http://www.bizjournals.com/atlanta/news/2014/12/08/viewpoint-our-expensive-energy-diet.html
Echols, T. (2015, November 13, 2015). Why Georgia Marches on Towards More Nuclear. *Power Engineering*.
Edison Electric Institute. (2012a). *Cost of Service Regulation In the Investor-Owned Electric Utility Industry: A History of Adaptation*. Retrieved from Washington, D.C.: www.eei.org
Edison Electric Institute. (2012b). *Fuel Diversity*. Retrieved from Washington, D.C.:
Électricité de France. (2016, 2016). The challenge in detail: What it means for the UK. *Energy in the UK: Energy Security.* Retrieved from https://www.edfenergy.com/future-energy/challenges/security
Energy and Climate Change Committee. (2016). *Future of carbon capture and storage in the UK*. Retrieved from London, UK: www.publications.parliament.uk
Environmental Protection Agency. (2010, March 30, 2016). Criteria Air Pollutants. Retrieved from http://epa.gov/
Environmental Protection Agency. (2012a, February, 19). Green Power Partnership: Partner Profile - Coca-Cola. Retrieved from https://www.epa.gov/greenpower/green-power-partner-list
Environmental Protection Agency. (2012b, March 29, 2016). Green Power Supply Options. Retrieved from https://www.epa.gov/greenpower/green-power-supply-options
Environmental Protection Agency. (2013a, September 3, 2015). Causes of Climate Change. Retrieved from http://epa.gov/
Environmental Protection Agency. (2013b). *The Clean Air Act in a Nutshell: How it Works*. Washington, D.C.: Environmental Protection Agency Retrieved from http://epa.gov/air/caa/pdfs/CAA_Nutshell.pdf.
Environmental Protection Agency. (2013c, September 3, 2015). Climate Change. Retrieved from http://epa.gov/
Environmental Protection Agency. (2013d). *"Standards of Performance for Greenhouse Gas Emissions from New Stationary Sources: Electric Utility Generating Units; Proposed Rule"*. (2013-28668). Office of the Federal Register U.S. Federal Register Retrieved from https://federalregister.gov/a/2013-28668.
Environmental Protection Agency. (2013e, July 17, 2015). What EPA is Doing. Retrieved from http://www2.epa.gov/cleanpowerplan/what-epa-doing
Environmental Protection Agency. (2014a, February 11, 2014). Cleaner Power Plants Retrieved from http://www.epa.gov/mats/powerplants.html
Environmental Protection Agency. (2014b, April 15, 2014). Solar Power Purchase Agreements. Retrieved from http://www.epa.gov/greenpower/buygp/solarpower.htm
Environmental Protection Agency. (2015a, September 29, 2015). Our Mission and What We Do. Retrieved from https://www.epa.gov/aboutepa/our-mission-and-what-we-do
Environmental Protection Agency. (2015b). *Overview of the Clean Power Plan: Cutting Carbon Pollution from Power Plants*. Washington, D.C.: Environmental Protection Agency Retrieved from http://www2.epa.gov/cleanpowerplan/fact-sheet-clean-power-plan-numbers.
Environmental Protection Agency. (2016). *Clean Power Plan for Existing Power Plants*. Washington, D.C.: Environmental Protection Agency Retrieved from https://www.epa.gov/cleanpowerplan/clean-power-plan-existing-power-plants.
European Commission. (2009a, July 11, 2016). 2020 Climate & Energy Package. Retrieved from http://ec.europa.eu/clima/policies/strategies/2020/index_en.htm
European Commission. (2009b, October 16, 2015). National action plans. Retrieved from https://ec.europa.eu/energy/node/71
European Commission. (2013). *The EU Emissions Trading System (EU ETS)*. Retrieved from http://ec.europa.eu: http://ec.europa.eu/clima/policies/ets/index_en.htm

European Commission. (2016, July 11, 2016). 2030 Climate & Energy Framework. Retrieved from http://ec.europa.eu/clima/policies/strategies/2030/index_en.htm

European Commission Joint Research Centre. (2016). CO2 time series 1990-2013 per region/country. Available from European Commission Joint Research Centre Emission Database for Global Atmospheric Research Retrieved May 11, 2016, from European Commission Joint Research Centre http://www.eia.gov/electricity/data/browser/

Fanchi, J., & Fanchi, C. (2010). Peak Oil *Energy in the 21st Century* (2nd ed.). Singapore: World Scientific Publishing Company.

Federal Energy Regulatory Commission. (2010, June 28, 2010). Order No. 888 - Promoting Wholesale Competition Through Open Access Non-discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities Retrieved from http://www.ferc.gov/legal/maj-ord-reg/land-docs/order888.asp

Federal Ministry for Economic Affairs and Energy. (2015). *Making a success of the energy transition*. Berlin, Germany: Federal Ministry for Economic Affairs and Energy Retrieved from www.bmwi.de.

Fleischmann, A., & Pierannunzi, C. (2007a). Local Government and Politics *Politics in Georgia* (2 ed., pp. 243 - 277). Athens, GA: University of Georgia Press.

Fleischmann, A., & Pierannunzi, C. (2007b). Political Parties and Interest Groups *Politics in Georgia* (2 ed., pp. 130 - 163). Athens, GA: University of Georgia Press.

Fleischmann, A., & Pierannunzi, C. (2007c). Public Opinion *Politics in Georgia* (2 ed., pp. 84 - 104). Athens, GA: University of Georgia Press.

Fleischmann, A., & Pierannunzi, C. (2007d). The Setting for Contemporary Georgia Politics *Politics in Georgia* (2 ed., pp. 20 - 44). Athens, GA: University of Georgia Press.

Floyd, P. E. (2009). Georgia Territorial Electric Service Act 101. Atlanta, GA: Alston & Bird LLP.

Fox-Penner, P. (2014). *Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities* (Vol. Anniversary edition edition). Washington, D.C.: Island Press.

Foxon, T. J. (2013). Technological Lock-In. In J. F. Shogren (Ed.), *Encyclopedia of Energy, Natural Resource, and Environmental Economics* (pp. 123-127). Waltham: Elsevier.

Fuller, J. (2014, June 2, 2014). Environmental policy is partisan. It wasn't always. *The Washington Post*. Retrieved from https://www.washingtonpost.com/news/the-fix/wp/2014/06/02/support-for-the-clean-air-act-has-changed-a-lot-since-1970/

Galloway, J. (2013, July 6, 2013). In Georgia, solar power finds a respected place in the GOP vocabulary, Georgia-Politics. *Atlanta Journal-Constitution*. Retrieved from http://www.ajc.com/

GE Power & Water. (2014). Explore Gas Turbines. Retrieved from https://powergen.gepower.com/plan-build/products/gas-turbines/explore-gas-turbines.html

The Georgia Cogeneration and Distributed Generation Act of 2001; change provisions; provide declaration of policy, SB 401, Georgia General Assembly 1 - 2 § 3-51, 3-52, 3-54 (2012).

Georgia Department of Economic Development. (2012). Business Incentives. In Georgia Department of Economic Development (Ed.). Atlanta, GA: Georgia Department of Economic Development.

Georgia Municipal Association. (2002). Georgia's City Governments *New Georgia Encyclopedia*. Atlanta, GA: New Georgia Encyclopedia.

Georgia Municipal Association. (2012). *Handbook for Georgia Mayors and Councilmembers*. Retrieved from Atlanta, GA: http://www.gmanet.com/Home.aspx

Georgia Power Company 2013 IRP Filing, Georgia Public Service Commission, (2012).

Georgia Power Company. (1945). Our Leadership. Retrieved from http://www.georgiapower.com/about-us/our-leadership/

Georgia Power Company. (2010). *2010 Integrated Resource Plan*. Retrieved from Atlanta, GA:

Georgia Power Company. (2011a). EarthCents Commercial Green Energy. Retrieved from http://www.georgiapower.com/business/programs-and-services/green-energy/

Georgia Power Company. (2011b). Electric Service Tariff: Green Energy Schedule: "GE-4". Retrieved from http://www.georgiapower.com/business/programs-and-services/green-energy/
Georgia Power Company. (2012a). Advanced Solar Initiative. Retrieved from http://www.georgiapower.com/about-energy/energy-sources/solar/asi/advanced-solar-initiative.cshtml
Georgia Power Company. (2012b). Georgia Power files largest solar initiative in state history [Press release]. Retrieved from http://www.georgiapower.com/about-us/media-resources/newsroom.cshtml
Georgia Power Company. (2013). *2013 Integrated Resource Plan*. Retrieved from Atlanta, GA:
Georgia Power Company. (2014a). Energy Sources - Diversity for Reliability. Retrieved from http://www.georgiapower.com/about-energy/energy-sources/home.cshtml
Georgia Power Company. (2014b). Facts & Figures. Retrieved from http://www.georgiapower.com/about-us/facts-and-financials/facts-and-figures.cshtml
Georgia Power Company. (2014c). Georgia Power Company's Renewable Resource Action Plan and Timetable Update. Atlanta, GA: Georgia Power Company

Georgia Public Service Commission.
Georgia Power Company. (2014d). Georgia Power to file decertification request for Plant Mitchell Unit 3 [Press release]. Retrieved from https://www.georgiapower.com/about-us/media-resources/newsroom.cshtml
Georgia Power Company. (2014e). Pricing & Rates - Residential Pricing. Retrieved from http://www.georgiapower.com/pricing/residential/rates.cshtml
Georgia Power Company. (2015). Energy Sources - Diversity for Reliability. Retrieved from http://www.georgiapower.com/about-energy/energy-sources/
Georgia Power Company's 2013 Integrated Resource Plan and Application for Decertification of Plant Branch Units 3 and 4, Plant McManus Units 1 and 2, Plant Kraft Units 1-4, Plant Yates Units 1-5, Plant Boulevard Units 2 and 3 and Plant Bowen Unit 6, No. 36498 (Georgia Public Service Commission 2013).
Georgia Public Service Commission. (1997a). Deciding a rate case. Retrieved from http://www.psc.state.ga.us/cases/deciding_a_rate_case.asp
Georgia Public Service Commission. (1997b). Frequently Asked Questions. Retrieved from http://www.psc.state.ga.us/pscinfo/faq.asp
Georgia Public Service Commission. (1997c). An Introduction to Your Georgia Public Service Commission. Retrieved from http://www.psc.state.ga.us/pscinfo/pscintro.asp
Georgia Public Service Commission. (1997d). What Is Regulated by the PSC? Retrieved from http://www.psc.state.ga.us/pscinfo/pscintro.asp#regulated
Georgia Public Service Commission. (2005). Georgia PSC Regulation of Electric Utilities *Overview of How Georgia's Electric Utilities Are Regulated by the GA PSC*. Atlanta, GA: Georgia Public Service Commission.
Georgia Public Service Commission. (2011). McDonald Calls for Study of Renewable Portfolio Standards to Promote Development of Solar Energy [Press release]. Retrieved from http://www.psc.state.ga.us/pscinfo/bios/myviewson/mcdonald/20111018.pdf
Georgia Public Service Commission. (2012a, December 4, 2012). Georgia Solar Utilities Incorporated. Retrieved from http://www.psc.state.ga.us/factsv2/Docket.aspx?docketNumber=36286
Georgia Public Service Commission. (2012b). Notice of Georgia Solar Utilities Inc., Request to be Authorized as a Solar Utility. Atlanta, GA: Georgia Public Service Commission,.
Georgia Public Service Commission. (2012c). Notice of Georgia Solar Utilities, Inc.: Request to be Authorized as a Solar Utility. Atlanta, GA: Georgia Public Service Commission.
Georgia Public Service Commission. (2012d). Statement from the Office of Georgia PSC Commissioner Lauren "Bubba" McDonald on Georgia Solar Utilities, Inc. Announcement [Press release]. Retrieved from http://www.psc.state.ga.us/GetNewsRecordAttachment.aspx?ID=226

Georgia Public Service Commission. (2013a). *Final Order: Georgia Power Company's 2013 Integrated Resource Plan and Application for Decertification of Plant Branch Units 3 and 4, Plant McManus Units 1 and 2, Plant Kraft Units 1-4, Plant Yates Units 1-5, Plant Boulevard Units 2 and 3 and Plant Bowen Unit 6*. Retrieved from Atlanta, GA: http://www.psc.state.ga.us/factsv2/Docket.aspx?docketNumber=36498

Georgia Public Service Commission. (2013b). PSC Approves Agreement to Resolve Georgia Power 2013 Integrated Resource Plan and Expands Use of Solar Energy [Press release]. Retrieved from http://www.psc.state.ga.us/

Georgia Public Service Commission. (2014a). *Comments of the Georgia Public Service Commission Regarding Docket No. EPA-HQ-OAR-2013-0602*. Retrieved from Atlanta, GA: http://www.psc.state.ga.us/

Georgia Public Service Commission. (2014b). Georgia Power Bill Calculator - Effective July 2014. Retrieved from http://www.psc.state.ga.us/calc/electric/gpcalc.asp

Georgia Public Service Commission. (2014c). Meet the Commission. Retrieved from http://www.psc.state.ga.us/content.aspx?c=/commissioners/

Georgia Public Service Commission. (2015). Notice of Inquiry and Workshop to Examine Issues related to the Value of Renewable and Distributed Energy Resources in preparation for the 2016 Georgia Power Company Integrated Resource Plan (IRP): Consideration of Motion. Atlanta, GA: Georgia Public Service Commission.

Georgia Public Service Commission Staff. (1997). *Georgia Public Service Commission Staff Report on Electric Industry Restructuring* (Docket Number 7313-U). Retrieved from Atlanta, GA: http://www.psc.state.ga.us/electric/crstructure.asp

Georgia Secretary of State. (2014). Current and past elections results. Retrieved from http://sos.ga.gov/index.php/Elections/current_and_past_elections_results

Georgia Solar Utilities. (2012). About Us - Corporate Profile. Retrieved from http://www.gasolarutilities.com/

Georgia Watch. (2002). Energy and Utilities. Retrieved from http://www.georgiawatch.org/protect-yourself/energy-and-utilities/

Gerdes, J. (2012, January 1, 2012). Powerful Solar Financing Program For Homeowners Gets Reprieve. *Forbes.* Retrieved from http://www.forbes.com/sites/justingerdes/2012/01/27/rumors-of-the-death-of-pace-financing-greatly-exaggerated/

Gordon, R. L. (1975). *U.S. Coal and the Electric Power Industry*. Baltimore, MD: Johns Hopkins University Press.

Governor's Energy Policy Council. (2006). *State Energy Strategy For Georgia*. Atlanta, GA: Georgia Environmental Facilities Authority Retrieved from http://gefa.georgia.gov/.

Governor's Energy Policy Council. (2009). *State Energy Strategy For Georgia*. Atlanta, GA: Georgia Environmental Facilities Authority Retrieved from http://gefa.georgia.gov/.

Governor's Energy Policy Council. (2012). *State Energy Strategy For Georgia*. Atlanta, GA: Georgia Environmental Facilities Authority Retrieved from http://gefa.georgia.gov/.

Graham, S., & Marvin, S. (2001). The Collapse of the Integrated Ideal *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition* (pp. 91 - 136). London, UK

New York, NY: Routledge.

Greentechmedia.com (Producer). (2015, February 5, 2015). *The Energy Gang* [Retrieved from https://soundcloud.com/the-energy-gang/why-the-tea-party-is-getting-behind-solar

Groot, K. (2013). *European Power Utilities Under Pressure? How the electricity majors are dealing with the changing investment in the EU power sector*. Retrieved from The Hague, NL: http://www.clingendaelenergy.com/

Grossman, P. (2013). CrisisU.S. Energy policy and the Pursuit of Failure (pp. 21 - 91). Cambridge, UK: Cambridge University Press.

GTM Research, & Solar Energy Industries Association. (2013). *U.S. Solar Market Insight Report, 2012 Year in Review, Executive Summary*. Retrieved from Washington, D.C.

Boston, MA:
GTM Research, & Solar Energy Industries Association. (2014). *U.S. Solar Market Insight Report, 2013 Year in Review, Executive Summary*. Retrieved from Washington, D.C.

Boston, MA:
Haddadian, G., & Shahidehpour, M. (2015). Ripple Effects of the Shale Gas Boom in the U.S.: Shift in the Balance of Energy Resources, Technology Deployment, Climate Policies, Energy Markets, Geopolitics and Policy Development. *The Electricity Journal, 28*(2), 17-38. doi:http://dx.doi.org/10.1016/j.tej.2015.02.004
Harris, P. G. (2009). Beyond Bush: Environmental politics and prospects for US climate policy. *Energy Policy, 37*(3), 966-971. doi:http://dx.doi.org/10.1016/j.enpol.2008.10.042
Hausman, W., & Neufeld, J. (1990). The Structure and Profitability of the US Electric Utility Industry at the Turn of the Century. *Business History, 32*(2), 225-243. doi:10.1080/00076799000000047
Hausman, W., & Neufeld, J. (1999). Falling Water: The Origins of Direct Federal Participation in the US Electric Utility Industry, 1902–1933. *Annals of Public and Cooperative Economics, 70*(1), 49-74. doi:10.1111/1467-8292.00099
Hausman, W., & Neufeld, J. (2002). The Market for Capital and the Origins of State Regulation of Electric Utilities in the United States. *The Journal of Economic History, 62*(04), 1050-1073.
Hausman, W., & Neufeld, J. (2004). The Economics of Electricity Networks and the Evolution of the U.S. Electric Utility Industry, 1882-1935. *2*.
Hausman, W., & Neufeld, J. (2011). How politics, economics, and institutions shaped electric utility regulation in the United States: 1879-2009. *Business History, 53*(5), 723-746. doi:10.1080/00076791.2011.599589
Hawkey, D., Webb, J., & Winskel, M. (2013). Organisation and governance of urban energy systems: district heating and cooling in the UK. *Journal of Cleaner Production, 50*(0), 22-31. doi:http://dx.doi.org/10.1016/j.jclepro.2012.11.018
Helm, D. (2011). Peak oil and energy policy — a critique. *Oxford Review of Economic Policy, 27*(1), 68-91. doi:10.1093/oxrep/grr003
Helm, D. (2012). *The Carbon Crunch: How we're getting climate change wrong and how to fix it* (1st ed.). New Haven, CT

London, UK: Yale University Press.
Henry, R. (2011, October 19, 2011). Ga. utility regulator backs solar power subsidy, Local News. *Athens Banner-Herald* Retrieved from http://onlineathens.com/node/129430
Henry, R. (2013, October 18, 2013). PSC staff recommends against Georgia Power solar fee, Local News. *Athens Banner-Herald* Retrieved from http://onlineathens.com/local-news/2013-10-18/psc-staff-recommends-against-georgia-power-solar-fee
Hirsh, R. (2003a). Managerial and technological foundations *Technology and Transformation in the American Electric Utility Industry* (pp. 22). New York, NY

London, UK: Cambridge University Press. (Reprinted from: November 20, 2003).
Hirsh, R. (2003b). The Mid-1960s: At the Pinnacle of Success *Technology and Transformation in the American Electric Utility Industry* (pp. 82 - 86). New York, NY

London, UK: Cambridge University Press. (Reprinted from: November 20, 2003).
Hirsh, R. (2003c). Postwar Strategies of Utilities and Manufacturers *Technology and Transformation in the American Electric Utility Industry* (pp. 47 - 70). New York, NY

London, UK: Cambridge University Press. (Reprinted from: November 20, 2003).
Hirsh, R. (2003d). Technical Limits to Progress in the 1960s and 1970s *Technology and Transformation in the American Electric Utility Industry* (pp. 89 - 94). New York, NY

London, UK: Cambridge University Press. (Reprinted from: November 20, 2003).

Hirsh, R. (2003e). Understanding values: The basis for a new consensus *Technology and Transformation in the American Electric Utility Industry* (pp. 145 - 158). New York, NY

London, UK: Cambridge University Press. (Reprinted from: November 20, 2003).

Hirsh, R., & Finn, B. (2002, June, 2002). Powering The Past: A Look Back. Retrieved from http://americanhistory.si.edu/powering/backpast.htm

History.com Staff. (2010). The Republican Revolution. Retrieved from http://www.history.com/this-day-in-history/the-republican-revolution

Hodson, M., & Marvin, S. (2009). 'Urban Ecological Security': A New Urban Paradigm? *International Journal of Urban and Regional Research, 33*(1), 193-215. doi:10.1111/j.1468-2427.2009.00832.x

Hodson, M., & Marvin, S. (2010a). *Producing Urban Ecological Security*. England: Open University Press.

Hodson, M., & Marvin, S. (2010b). Rebundled Urban Network Ecologies *World Cities and Climate Change: Producing Urban Ecological Security*. Berkshire, UK: Open University Press.

Hodson, M., & Marvin, S. (2013). *Low carbon nation?* London, UK: Routledge.

Holson, L. (2001, April 7, 2001). California's Largest Utility Files for Bankruptcy, Opinion Editorial. *The New York Times*. Retrieved from http://www.nytimes.com/2001/04/07/us/california-s-largest-utility-files-for-bankruptcy.html

Howland, E. (2013). Georgia Power drops proposed solar fee. Retrieved from http://www.utilitydive.com/news/georgia-power-drops-proposed-solar-fee/196169/

Hubbert, K. (1971, September 1, 1971). The Energy Resources of the Earth: They are solar energy, tides, the earth's heat, fssion fuel and perhaps fusion fuel. *Scientific American, 224*.

Huebner, T., & Klein, B. (2015). Opinion: A view from Wisconsin on fixed charges and utility-solar troubles. Retrieved from http://www.utilitydive.com/news/opinion-a-view-from-wisconsin-on-fixed-charges-and-utility-solar-troubles/376729/

Hummon, M. R., Denholm, P., Jorgenson, J., Palchak, D., Kirby, B., & Ma, O. (2013). *Fundamental Drivers of the Cost and Price of Operating Reserves* (NREL/TP-6A20-58491 United States10.2172/1089587Thu Aug 15 07:24:29 EDT 2013NRELEnglish). Retrieved from http://www.osti.gov/scitech//servlets/purl/1089587/

Hunter, F. (1953). *Community Power Structure: A Study of Decision Makers*. Chapel Hill, NC: The University of North Carolina Press.

IKEA Group. (2012). *People & Planet Positive IKEA Group Sustainability Strategy for 2020*. Retrieved from Conshohocken, PA:

In Re: Georgia Power Company's 2013 Integrated Resource Plan and Application for Decertification of Plant Branch Units 3 and 4, Plant McManus Units 1 and 2, Plant Kraft Units 1-4, Plant Yates Units 1-5, Plant Boulevard Units 2 and 3 and Plant Bowen Unit 6. (2013). Atlanta, GA: Georgia Public Service Commission.

Inskeep, B., Kennerly, J., & Proudlove, A. (2015). *A Quaterly Look at America's Fast-Evolving Distributed Solar Policy & Regulatory Conversation*. Retrieved from Raleigh, NC https://nccleantech.ncsu.edu/10793/

International Energy Agency. (2012). *World Energy Outlook 2012*. Retrieved from Paris, FR:

International Energy Agency. (2014a, June 24, 2014). What is energy security? *Energy Security.* Retrieved from http://www.iea.org/topics/energysecurity/subtopics/whatisenergysecurity/

International Energy Agency. (2014b). *World Energy Outlook 2014: Executive Summary*. Retrieved from Paris, FR: http://www.worldenergyoutlook.org/publications/weo-2014/

International Renewable Energy Agency. (2013). *30 Years of Policies for Wind Energy: Lessons from 12 Wind Energy Markets*. Retrieved from Abu Dhabi, UAE:

Alternative Energy Producing Facilities and Research, 476 § 41 - 43, 182 Stat. (1983 June 6, 1983).

Jacoby, H. D., O'Sullivan, F. M., & Paltsev, S. (2012). The Influence of Shale Gas on U.S. Energy and Environmental Policy. *Economics of Energy & Environmental Policy, 1*(1), 37 - 51.

Johnson, L. (2016, May 1, 2016). Greener generation begins with CleanPowerSF, News. *San Fancisco Chronicle*. Retrieved from http://www.sfchronicle.com/bayarea/article/Greener-generation-begins-with-CleanPowerSF-7386921.php

Jonas, A. E. G., Gibbs, D., & While, A. (2011). The New Urban Politics as a Politics of Carbon Control. *Urban Studies, 48*(12), 2537-2554. doi:10.1177/0042098011411951

Jones, W. C. (2013, July 8, 2013). Tea party groups on opposite sides of solar debate. *Athens Banner-Herald*. Retrieved from http://onlineathens.com/

Jopson, B. (2014, October 28, 2014). Fracking: In the path of the 'shale gale', Business. *Financial Times*. Retrieved from http://www.ft.com/cms/s/0/6d93d494-5dc5-11e4-b7a2-00144feabdc0.html#axzz3zBuuaHTN

Joskow, P. L. (1997). Restructuring, Competition and Regulatory Reform in the U.S. Electricity Sector. *Journal of Economic Perspectives, 11*(3), 119-138. doi:doi: 10.1257/jep.11.3.119

Joskow, P. L. (1998). Electricity Sectors in Transition. *The Energy Journal, 19*(2), 25-52.

Joskow, P. L. (2001a). California's Electricity Crisis. *Oxford Review of Economic Policy, 17*(3), 365-388. doi:10.1093/oxrep/17.3.365

Joskow, P. L. (2001b). *U.S. Energy Policy during the 1990s* (w. 8454). Retrieved from Cambridge, MA: http://www.nber.org/papers/w8454

Joskow, P. L., Bohi, D. R., & Gollop, F. M. (1989). Regulatory Failure, Regulatory Reform, and Structural Change in the Electrical Power Industry. *Brookings Papers on Economic Activity. Microeconomics, 1989*, 125-208. doi:10.2307/2534721

Journal of Commerce. (1987, AprIL 2, 1987). Energy States Hope to Repeal Fuel Use Act. *Journal of Commerce*.

Kahn, M., & Onoszko, M. (2012, November 28, 2012). Results 'humble' so far for Polish shale gas, minister says. *Reuters*. Retrieved from http://www.reuters.com/article/poland-shale-idUSL5E8MS5YZ20121128

Kempner, M. (2015, March 5, 2015). Overruns invite questions about Vogtle approval. *Atlanta Journal-Constitution*. Retrieved from http://www.myajc.com/

Kind, P. (2013). *Disruptive Challenges: Financial Implications and Strategic Responses to a Changing Retail Electric Business*. Retrieved from Washington, D.C.: www.eei.org

King, L., Nordhaus, T., & Shellenberger, M. (2015). *Lessons from the Shale Revolution*. Retrieved from Oakland, CA: http://thebreakthrough.org/images/pdfs/Lessons_from_the_Shale_Revolution.pdf

Knittel, C. (2006). The Adoption of State Electricity Regulation: The Role of Interest Groups. *The Journal of Industrial Economics, 54*(2), 201-222. doi:10.1111/j.1467-6451.2006.00280.x

Kollins, K., Speer, B., & Cory, K. (2009). *Solar PV Project Financing: Regulatory and Legislative Challenges for Third-Party PPA System Owners* (NREL/TP-6A2-46723; TRN: US201001%%593 United States10.2172/969152TRN: US201001%%593Mon Mar 15 07:13:12 EDT 2010NRELEnglish). Retrieved from http://www.osti.gov/scitech//servlets/purl/969152-BkgkJN/

Komanoff, C. (1981). *Power Plant Cost Escalation: Nuclear and Coal Capital Cost, Regulation, and Economics*: Van Nostrand Reinhold.

Koper, A. (2015, July 31, 2014). Poland cuts estimate for shale gas exploration wells, Regulatory News. *Reuters*. Retrieved from http://uk.reuters.com/article/poland-shalegas-minister-idUKL6N0Q438P20140731

Kormann, C. (2015, February 17, 2015). Greening the Tea Party. *The New Yorker*

Kraft, M. (2012). Congress and Environmental Policy. In M. Kraft & S. Kamieniecki (Eds.), *The Oxford Handbook of U.S. Environmental Policy* (pp. 280 - 305). New York, NY: Oxford University Press.

Krupnick, A., Kopp, R., Hayes, K., & Roeshot, S. (2014). *The Natural Gas Revolution: Critical Questions for a Sustainable Energy Future*. Retrieved from http://www.rff.org/research/publications/natural-gas-revolution-critical-questions-sustainable-energy-future

Krupnick, A., Wang, Z., & Wang, Y. (2013). *Sector Effects of the Shale Gas Revolution in the United States*. Retrieved from Washington, D.C.: www.rff.org
Kureth, A. (2015, October 17, 2015). Why Poland still clings to coal. *Politico*. Retrieved from http://www.politico.eu/article/why-poland-still-clings-to-coal-energy-union-security-eu-commission/
Lagos, M., & Baker, D. R. (2013, November 12, 2013). CleanPowerSF remains mired in politics, News. *San Fancisco Chronicle*. Retrieved from http://www.sfgate.com/science/article/CleanPowerSF-remains-mired-in-politics-4975691.php#photo-5049074
Landers, M. (2012, February 24, 2012). Solar bill jolted back to life, Opinion. *Savannah Morning News*. Retrieved from http://savannahnow.com
Lazar, J. (2014). *Teaching the Duck to Fly*. Retrieved from http://www.raponline.org/: http://www.raponline.org/document/download/id/6977
Lee Reece, J. (2012, February 7, 2012). GA State Senate Bill 401 seeks to promote property rights and renewable energy. Retrieved from http://www.sgrlaw.com/
Lehr, R. L. (2013). New Utility Business Models: Utility and Regulatory Models for the Modern Era. *The Electricity Journal, 26*(8), 35-53. doi:http://dx.doi.org/10.1016/j.tej.2013.09.004
Library of Congress. (1997). S. Res 98. Available from Library of Congress Thomas Retrieved October 12, 2015, from Library of Congress https://www.congress.gov/bill/105th-congress/senate-resolution/98
Library of Congress. (2008). S. 2191. Available from Library of Congress Thomas Retrieved October 12, 2015, from Library of Congress http://thomas.loc.gov/cgi-bin/bdquery/D?d110:268:./temp/~bdTwsm::|/home/LegislativeData.php?n=BSS;c=110|
Lockwood, M. (2015). The Political Dynamics of Green Transformations: Feedback effects and institutional context. In I. Scoones, M. Leach, & P. Newell (Eds.), *The Political Dynamics of Green Transformations*. Oxfordshire, UK

New York, NY: Routledge.
Logan, J., Medlock, K. B., & Boyd, W. C. (2015). *Review of Sector and Regional Trends in U.S. Electricity Markets. Focus on Natural Gas.* (NREL/SR-6A50-64652 United States10.2172/1226162Wed Mar 02 05:20:55 EST 2016NRELEnglish). Retrieved from http://www.osti.gov/scitech//servlets/purl/1226162/
Los Angeles Times. (2007, October 25, 2007). Not so hot, Opinion Editorial. *Los Angeles Times*. Retrieved from http://articles.latimes.com/2007/oct/25/opinion/ed-captrade25
Lovell, H., Bulkeley, H., & Owens, S. (2009). Converging Agendas? Energy and Climate Change Policies in the UK. *Environment and Planning C: Government and Policy, 27*(1), 90-109. doi:10.1068/c0797j
Lutsey, N., & Sperling, D. (2008). America's bottom-up climate change mitigation policy. *Energy Policy, 36*(2), 673-685. doi:http://dx.doi.org/10.1016/j.enpol.2007.10.018
Lyon, T. P., & Wilson, N. (2012). Capture or contract? The early years of electric utility regulation. *Journal of Regulatory Economics, 42*(3), 225-241. doi:10.1007/s11149-012-9200-9
Lyon, T. P., & Yin, H. (2010). Why do states adopt renewable portfolio standards?: An empirical investigation. *The Energy Journal, 31*(3).
Malewitz, J. (2015a, March 18, 2015). Georgetown Goes All In on Renewable Energy, Opinion Editorial. *The Texas Tribune*. Retrieved from https://www.texastribune.org/2015/03/18/georgetown-goes-all-renewable-energy/
Malewitz, J. (2015b, April 14, 2015). Senate Votes to End Renewable Energy Programs, Opinion Editorial. *The Texas Tribune*. Retrieved from https://www.texastribune.org/2015/04/14/senate-votes-end-renewable-energy-programs/
Martin, C. (2013, November 27, 2013). Tea Party, Sierra Club Unite to Support Solar Energy in Georgia, Opinion. *Bloomberg Business*. Retrieved from http://www.bloomberg.com/bw/articles/2013-11-27/tea-party-sierra-club-unite-to-support-solar-energy-in-georgia

Mason, J. (2002). Qualitative interviewing *Qualitative Researching* (2 ed., pp. 62 - 83). Thousand Oaks, CA

London, UK: SAGE Publications.

Massachusetts Institute of Technology. (2011). *The Future of the Electric Grid: An Interdisciplinary MIT Study* (6). Retrieved from Cambridge, MA: http://mitei.mit.edu/publications/reports-studies/future-electric-grid

Maughan, J. R. (2015, September 2, 2015). A Brief History of Peak Oil. Retrieved from http://www.geglobalresearch.com/blog/brief-history-peak-oil

Mayor's Office of Sustainability. (2012a). About the Office of Sustainability. Retrieved from http://www.atlantaga.gov/index.aspx?page=153#

Mayor's Office of Sustainability. (2012b). *Atlanta Rising to the Challenge, 2012 Annual Report*. Retrieved from Atlanta, GA: http://www.atlantaga.gov/modules/showdocument.aspx?documentid=7445

Meadowcroft, J. (2011). Engaging with the politics of sustainability transitions. *Environmental Innovation and Societal Transitions, 1*(1), 70-75. doi:http://dx.doi.org/10.1016/j.eist.2011.02.003

Metro Atlanta Chamber. (2014). Metro Atlanta Fortune 500 & Fortune 1000 Headquarters. Retrieved from http://www.metroatlantachamber.com/business/data/fortune-500-1000-hq

Mitchell, J. V., Beck, P., & Grubb, M. (1996). *The new geopolitics of energy*: Royal institute of international affairs London.

Momoh, J., Meliopoulos, S., & Saint, R. (2012). *Centralized and Distributed Generated Power Systems - A Comparison Approach* (12-08). Retrieved from Tempe, Arizona:

Monstadt, J. (2007). Urban Governance and the Transition of Energy Systems: Institutional Change and Shifting Energy and Climate Policies in Berlin. *International Journal of Urban and Regional Research, 31*(2), 326-343. doi:10.1111/j.1468-2427.2007.00725.x

Moore, J. (Writer). (2013). The Power of Solar in Georgia [Video file], *TEDx Talks*. Atlanta, GA.

Morales, A. (2013, July 17, 2013). Spain Clean Energy Subsidy Cuts Raise Bankruptcy Risk, Opinion. *Bloomberg Business*. Retrieved from http://www.bloomberg.com/news/articles/2013-07-17/spain-clean-energy-subsidy-cuts-raise-bankruptcy-risk

Morgan, G., Apt, J., & Lave, L. (2005). *The U.S. Electric Power Sector and Climate Change Mitigation*. Retrieved from Pittsburgh, PA:

Morris, C., & Pehnt, M. (2012). *Energy Transition: The German Energiewende*. Retrieved from Berlin, DE: www.energytransition.de

Morsch, A. (2010). *State of the Southeast: How Cities Are Addressing Climate Change*. Retrieved from Durham, NC: https://nicholasinstitute.duke.edu/climate/seclimate/state-of-the-southeast-how-cities-are-addressing-climate-change

Mundy, A. (2014, February 18, 2014). DOE to Approve Loan Guarantees for Georgia Nuke Plant, News. *Wall Street Journal*. Retrieved from http://www.wsj.com/articles/SB10001424052702303945704579391601080866752

Muro, M., Rothwell, J., & Saha, D. (2011). *Sizing the Clean economy: A National and Regional Green Jobs Assessment*. Retrieved from Washington, D.C.:

National Renewable Energy Laboratory. (2014, September 8, 2014). Renewable Portfolio Standards. Retrieved from http://www.nrel.gov/tech_deployment/state_local_governments/basics_portfolio_standards.html

National Renewable Energy Laboratory. (2015, October 07, 2015). Value-of-Solar Tariffs. *Technology Deployment: State and Local Governments.* Retrieved from http://www.nrel.gov/tech_deployment/state_local_governments/basics_value-of-solar_tariffs.html

Natural Gas Europe. (2010, November 17, 2010). The European Kuwait. Retrieved from http://www.naturalgaseurope.com/

Neufeld, J. L. (2008). Corruption, Quasi-Rents, and the Regulation of Electric Utilities. *The Journal of Economic History, 68*(04), 1059-1097. doi:doi:10.1017/S0022050708000818

New Georgia Encyclopedia Staff. (2002). Governors of Georgia: Carl Sanders (1925-2014) *New Georgia Encyclopedia*. Atlanta, GA: New Georgia Encyclopedia.

New Georgia Encyclopedia Staff. (2004a, July 30, 2014). Agriculture in Georgia: Overview. Retrieved from http://www.georgiaencyclopedia.org/

New Georgia Encyclopedia Staff. (2004b). Boll Weevil *New Georgia Encyclopedia*. Atlanta, GA.

New Georgia Encyclopedia Staff. (2004c). Eugene Talmadge (1884-1946) *New Georgia Encyclopedia*. Atlanta, Georgia: New Georgia Encyclopedia.

New Georgia Encyclopedia Staff. (2005a). Civil War & Reconstruction, 1861-1877: Reconstruction in Georgia *New Georgia Encyclopedia*. Atlanta, GA: New Georgia Encyclopedia.

New Georgia Encyclopedia Staff. (2005b). County Unit System *New Georgia Encyclopedia*. Atlanta, GA: New Georgia Encyclopedia.

New Georgia Encyclopedia Staff. (2008). Progressive Era to WWII, 1900-1945: New Deal *New Georgia Encyclopedia*. Atlanta, GA: New Georgia Encyclopedia.

New Georgia Encyclopedia Staff. (2015). Atlanta *New Georgia Encyclopedia*. Atlanta, GA: University of Georgia Press.

New Georgia Encyclopedia Staff. (n.d.). Quick Facts *New Georgia Encyclopedia*. Atlanta, GA: New Georgia Encyclopedia.

Newell, P. (2015). The Politics of Green Transformations in Capitalism. In I. Scoones, M. Leach, & P. Newell (Eds.), *The Politics of Green Transformations*. Oxfordshire, UK

New York, NY: Routledge.

North Carolina Clean Energy Technology Center. (2005). Renewable Electricity Production Tax Credit (PTC). Available from North Carolina Clean Energy Technology Center

Interstate Renewable Energy Council, Inc.

U.S. Department of Energy DSIRE Retrieved November 9, 2015, from Database of State Incentives for Renewables & Efficiency http://programs.dsireusa.org/system/program/detail/734

North Carolina Clean Energy Technology Center. (2013). Net Metering. Available from North Carolina Clean Energy Technology Center

Interstate Renewable Energy Council, Inc.

U.S. Department of Energy DSIRE Retrieved March 3, 2014, from Database of State Incentives for Renewables & Efficiency http://www.dsireusa.org/resources/detailed-summary-maps/

North Carolina Clean Energy Technology Center. (2014). Solar Investment Tax Credit (ITC). Available from North Carolina Clean Energy Technology Center

Interstate Renewable Energy Council, Inc.

U.S. Department of Energy DSIRE Retrieved December 20, 2014, from Database of State Incentives for Renewables & Efficiency http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US02F

http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US37F&re=1&ee=1

North Carolina Clean Energy Technology Center. (2016). Texas: Renewable Generation Requirement. Available from North Carolina Clean Energy Technology Center

Interstate Renewable Energy Council, Inc.

U.S. Department of Energy DSIRE Retrieved August 8, 2016, from Database of State Incentives for Renewables & Efficiency http://programs.dsireusa.org/system/program/detail/182

Nunez, C. (2014, November 20, 2014). A Slew of Coal Plants Get New Lease on Life — With Gas. *National Geographic*.
Georgia Territorial Electric Service Act, LexisNexis § 3, 46 Stat. (1973a March 29, 1973).
Public Utilities And Public Transportation, § 3A - 3 (1973b).
Public Utilities And Public Transportation, § 3A (1981), Code 1981, § 46-3A-9, enacted by Ga. L. 1991, p. 1696, § 1.
Georgia Nuclear Energy Financing Act, LexisNexis § 2 - 25, 46 Stat. (2009 April 21, 2009).
Rural Georgia Economic Recovery and Solar Resource Act of 2014, HB 657, Georgia General Assembly § 1 (2014a).
Solar Power Free-Market Financing and Property Rights Act of 2014, HB 874, Georgia General Assembly 1 - 4 § 1 (2014b).
Solar Power Free-Market Financing Act of 2015, HB 57, Georgia General Assembly § 1 (2015).
Office of Gas and Electricity Markets. (2011). Why are energy prices rising? In O. o. G. a. E. Markets (Ed.), (Vol. 108). London, UK: Office of Gas and Electricity Markets.
Office of Technology Assessment. (1984). Public Attitudes Toward Nuclear Power *Nuclear Power in an Age of Uncertainty*. Washington, D.C.: Office of Technology Assessment

Library of Congress

U.S. Government Printing Office.
Oil & Gas Journal. (2016, 2016). Barnett Shale. Retrieved from http://www.ogj.com/unconventional-resources/barnett-shale.html
Pollitt, M. G. (2012). The role of policy in energy transitions: Lessons from the energy liberalisation era. *Energy Policy, 50*, 128-137. doi:http://dx.doi.org/10.1016/j.enpol.2012.03.004
Polson, J. (2015, August 24, 2015). Southern Co. to Buy AGL Resources for $8 Billion in Cash. *Bloomberg Business*. Retrieved from https://www.bloomberg.com/news/articles/2015-08-24/southern-co-to-buy-gas-distributor-agl-resources-for-8-billion
Polson, J., & Chediak, M. (2015, June 9, 2015). Southern Furthers Move Into Solar With Georgia Rooftop Sales. *Bloomberg Business*. Retrieved from https://www.bloomberg.com/news/articles/2015-06-09/southern-will-sell-rooftop-solar-in-georgia-mulls-batteries
Pooley, E. (2008, June 9, 2008). Why the Climate Bill Failed. *TIME*.
Preston, A. M., & Vesey, A. M. (2008). The Construction of U.S. Utility Accounting: 1882–1944. *Accounting, Organizations and Society, 33*(4–5), 415-435. doi:http://dx.doi.org/10.1016/j.aos.2007.03.003
Public Broadcasting Service. (2001). The California Crisis: California Timeline. Retrieved from http://www.pbs.org/wgbh/pages/frontline/shows/blackout/california/timeline.html
Public Utility Commission of Texas. (n.d.). Municipally-Owned Electric Utilities and Electric Cooperatives FAQs. Retrieved from https://www.puc.texas.gov/consumer/facts/faq/Muni.aspx
Rabe, B. (2002). *Greenhouse and Statehouse: The Evolving State Government Role in Climate Change*. Retrieved from Arlington, VA: www.pewclimate.org
Rabe, B. (2004a). The Politics of Climate Change State Style *Statehouse and greenhouse: The emerging politics of American climate change policy*. Washington, D.C.: Brookings Institution Press.
Rabe, B. (2004b). *Statehouse and Greenhouse: The Emerging Politics of American Climate Change Policy*. Washington, D.C.: Brookings Institution Press.
Rabe, B. (2006a). *Race to the Top: The Expanding Role of U.S. State Renewable Portfolio Standards*. Retrieved from Arlington, VA: www.pewclimate.org
Rabe, B. (2006b). Race to the top: The expanding role of US state renewable portfolio standards. *Sustainable Dev. L. & Pol'y, 7*, 10.
Rabe, B. (2008). States on Steroids: The Intergovernmental Odyssey of American Climate Policy. *Review of Policy Research, 25*(2), 105-128. doi:10.1111/j.1541-1338.2007.00314.x

Rabe, B., Roman, M., & Dobelis, A. N. (2005). State Competition as a Source Driving Climate Change Mitigation. *New York University Environmental Law Journal, 14*, 53.
Regulatory Assistance Project. (2011a). *Electricity Regulation In the US: A Guide*. Retrieved from Montpelier, VT: www.raponline.org
Regulatory Assistance Project. (2011b). *Incorporating Environmental Costs in Electric Rates: Working to ensure affordable compliance with public health and environmental regulations*. Retrieved from Montpelier, VT: www.raponline.org
Regulatory Assistance Project. (2011c). *Revenue Regulation and Decoupling: A Guide to Theory and Application*. Retrieved from Montpelier, VT:
Rehm, T. (2013a, July 2, 2013). Doug Everett responds to Americans for Prosperity Georgia on solar. Retrieved from http://gapundit.com/2013/07/02/doug-everett-responds-to-americans-for-prosperity-georgia-on-solar/
Rehm, T. (2013b, July 9, 2013). Georgia Tea Party opposes Solar Mandate. Retrieved from https://gapundit.com/2013/07/09/georgia-tea-party-opposes-solar-mandate/
Rehm, T. (2013c, July 11, 2013). Solar Vote today at Public Service Commission [Georgia Politics, Campaigns & Elections for July 11, 2013]. Retrieved from http://gapundit.com/category/gapundit-daily/page/38/
Reuters. (2014, Jan 7, 2013). Georgia Power seeks to retire 15 coal, oil power units. Retrieved from http://www.reuters.com/article/2013/01/07/utilities-southern-georgia-idUSL4N0AC5UA20130107
Rutland, T., & Aylett, A. (2008). The Work of Policy: Actor Networks, Governmentality, and Local Action on Climate Change in Portland, Oregon. *Environment and Planning D: Society and Space, 26*(4), 627-646. doi:10.1068/d6907
Ryan, H. W., Galen, L. B., Jenny, H., Trieu, M., Lori, B., Mark, B., . . . Dev, M. (2016). *A Retrospective Analysis of the Benefits and Impacts of U.S. Renewable Portfolio Standards*. Retrieved from
San Francisco Department of Environment. (2012). *San Francisco Mayor's Renewable Energy Task Force Recommendations Report*. Retrieved from San Francisco, CA: http://www.sfenvironment.org/
San Francisco Department of the Environment. (2012). Renewable Energy. Retrieved from http://sfenvironment.org/energy/renewable-energy
San Francisco Department of the Environment. (2013). *San Francisco Climate Action Strategy Update*. Retrieved from San Francisco, CA: http://sfenvironment.org/cas
San Francisco Public Utilities Commission. (2016, July 12, 2016). About CleanPowerSF. Retrieved from http://sfwater.org/index.aspx?page=959
Satija, N. (2014, July 13, 2014). Climate Scientists: Texas is Missing an Opportunity, Opinion Editorial. *The Texas Tribune*. Retrieved from https://www.texastribune.org/2014/07/13/growth-adds-denial-and-vulnerability-climate-chang/
Savannah Morning News. (2013, June 12, 2013). Community Calendar, Announcement. *Savannah Morning News*. Retrieved from http://savannahnow.com
Selig Centre for Economic Growth, Terry College of Business. (2013). *2014 Georgia Outlook*. Retrieved from Athens, GA:
Simmonds, G. (2002). *Regulation of the UK Electricity Industry*. Retrieved from Bath, UK: http://www.bath.ac.uk/management/cri/pubpdf/Industry_Briefs/
Solar Energy Industries Association. (2012a). Net Metering by State. Retrieved from http://www.seia.org/research-resources/net-metering-state
Solar Energy Industries Association. (2012b). State Solar Policy. Retrieved from http://www.seia.org/policy/state-solar-policy
Solar Energy Industries Association. (2013). Net Metering. Retrieved from http://www.seia.org/policy/distributed-solar/net-metering

Solar Energy USA. (2013a). Georgia Solar Industry Town Hall Meeting Recap. Retrieved from http://news-archives.solarenergy-usa.com/2013/06/georgia-solar-industry-town-hall-meeting-recap/

Solar Energy USA. (2013b). Solar Q & A With Georgia Public Service Commissioner Tim Echols. Retrieved from http://news-archives.solarenergy-usa.com/2013/06/solar-q-a-with-georgia-public-service-commissioner-tim-echols/

Southern Clean Energy Alliance. (2013, July 15, 2013). More solar and what else? A breakdown of the approved Georgia Power IRP. Retrieved from http://blog.cleanenergy.org/2013/07/15/more-solar-and-what-else-a-breakdown-of-the-approved-georgia-power-irp/

Southern Company. (1945). Our Business Overview. Retrieved from http://www.southerncompany.com/about-us/our-business/home.cshtml

Southern Company. (2013a). Georgia Power seeks approval to retire generating units at four plants [Press release]. Retrieved from http://southerncompany.mediaroom.com/index.php?s=43&item=2734

Southern Company. (2013b). Nuclear Energy: Plant Vogtle. Retrieved from http://www.georgiapower.com/about-energy/energy-sources/nuclear/vogtle.cshtml

Southern States Energy Board. (2012). *Southern States Regional Energy Profiles*. Retrieved from Norcross, GA: http://www.sseb.org/

Southwest Museum of Engineering, C. a. C., ,. (2007, 2007). Live Better Electrically Medallion Home. Retrieved from http://www.smecc.org/live_better_electrically_medallion_home.htm

Sovacool, B. K. (2013). Energy policymaking in Denmark: Implications for global energy security and sustainability. *Energy Policy, 61*, 829-839. doi:http://dx.doi.org/10.1016/j.enpol.2013.06.106

Speer, B. (2012). *Residential Solar Photovoltaics: Comparison of Financing Benefits, Innovations, and Options* (NREL/TP-6A20-51644 United States10.2172/1055369Thu Nov 29 07:14:29 EST 2012NRELEnglish). Retrieved from http://www.osti.gov/scitech//servlets/purl/1055369/

Stern, N. (2006). *PART II: The Impacts of Climate Change on Growth and Development - Costs Of Climate Change In Developed Countries*. Retrieved from London, UK

Cambridge, UK:

Stevens, P. (2010). *The Shale Gas Revolution: Hype and Reality*. Retrieved from London, UK: https://www.chathamhouse.org/publications/

Stevens, P. (2013). *Shale Gas in the United Kingdom*. Retrieved from London, UK: https://www.chathamhouse.org/publications/

Stone, C. N. (1988). Preemptive Power: Floyd Hunter's "Community Power Structure" Reconsidered. *American Journal of Political Science, 32*(1), 82-104. doi:10.2307/2111311

Stone, C. N. (1989). *Regime politics : governing Atlanta, 1946-1988*. Lawrence, KS: University Press of Kansas.

Stoner, P. G., & Dalessi, J. (2009). *Community Choice Aggregation Guide* (Docket Number 7313-U). Retrieved from Sacramento, CA: http://www.energy.ca.gov/2009publications/

Swartz, K. E. (2012, November 2, 2012). New $900 million Vogtle lawsuit filed, News. *Atlanta Journal Constitution*. Retrieved from http://www.ajc.com/

Swartz, K. E. (2013a, January 7, 2013). Georgia Power to close 15 coal, oil units, Business. *Atlanta Journal-Constitution*. Retrieved from http://www.ajc.com

Swartz, K. E. (2013b, October 26, 2013). Georgia's solar potential faces new test, Business. *Atlanta Journal-Constitution*. Retrieved from http://www.ajc.com

Sweeney, J. L. (2002). *The California Electricity Crisis*. Stanford, CA: Hoover Institution Press.

Sweeney, J. L. (2006). Chapter 10 - California Electricity Restructuring, The Crisis, and Its Aftermath. In W. Pfaffenberger & F. P. Sioshansi (Eds.), *Electricity Market Reform* (pp. 319-381). Oxford: Elsevier.

Tarr, M. J., Monast, J., & Profeta, T. (2013). *Regulating Carbon Dioxide under Section 111(d) of the Clean Air Act: Options, Limits, and Impact*. Retrieved from Durham, NC: https://nicholasinstitute.duke.edu/sites/default/files/publications

Tatum, G. (2013, July 17, 2013). Environmentalists, Tea Party Patriots Win Solar Expansion at PSC, News. *Atlanta Progressive News*. Retrieved from http://atlantaprogressivenews.com/2013/07/17/environmentalists-tea-party-patriots-win-solar-expansion-at-psc/

Tawney, L., Baker, B., & Spitzer, M. (2014). *Corporate Renewable Energy Buyers' Principles: Increasing Access to Renewable Energy*. Retrieved from http://buyersprinciples.org/: http://buyersprinciples.org/join-us/

Tea Party Patriots, I. (2015). Our Vision | Core Issues. Retrieved from https://www.teapartypatriots.org

The Danish Government. (2011). *Energy Strategy 2050: from coal, oil and gas to green energy*. Retrieved from Copenhagen, Denmark: http://www.ens.dk/en/info/publications/energy-strategy-2050-coal-oil-gas-green-energy

Thomas, C. R., & Ayres, R. (2007). Energy Myth Eight – Worldwide Power Systems are Environmentally and Economically Optimal. In B. K. Sovacool & M. A. Brown (Eds.), *Energy and American Society – Thirteen Myths* (pp. 224 - 225). New York, NY: Springer.

Tomain, J. (1990). The Dominant Model of United States Energy Policy. *University of Colorado Law Review, 61*(2), 355-392.

Trabish, H. (2014, April 11, 2014). Can Minnesota's Value of Solar end the net metering debate? The answer could come within 30 days or not any time soon at all. . Retrieved from http://www.utilitydive.com/news/can-minnesotas-value-of-solar-end-the-net-metering-debate/250451/

Trembath, A., Jenkins, J., Nordhaus, T., & Shellenberger, M. (2012). *Where the Shale Gas Revolution came from: Government's role in the development of Hydraulic fracturing in Shale*. Retrieved from http://thebreakthrough.org/blog/Where_the_Shale_Gas_Revolution_Came_From.pdf

U.S. Bureau of Economic Analysis. (2013). "Gross Domestic Product by State (millions of current dollars)", New estimates for 2012 and revised estimates for 2009 - 2011 (Interactive Data). Available from U.S. Bureau of Economic Analysis Retrieved April 17, 2014, from U.S. Bureau of Economic Analysis http://www.bea.gov/iTable/index_regional.cfm

U.S. Bureau of Labor Statistics. (2016). Average Energy Prices, San Francisco-Oakland-San Jose – July 2016 [Press release]. Retrieved from http://www.bls.gov/regions/west/news-release/averageenergyprices_sanfrancisco.htm

U.S. Census Bureau. (1905). *Central Electric Light and Power Stations 1905*. Retrieved from Washington D.C.: http://onlinebooks.library.upenn.edu/webbin/book/lookupname?key=Steuart%2C%20William%20M.%20(William%20Mott)%2C%201861-1956

U.S. Census Bureau. (1907). *Central Electric Light and Power Stations 1907*. Retrieved from Washington, D.C.:

U.S. Census Bureau. (1912). *Central Electric Light and Power Stations and Street and Electric Railways: With Summary of the Electrical Industries 1912*. Retrieved from Washington, D.C.:

U.S. Census Bureau. (1952). *Statistical Abstract of the United States: 1952*. Retrieved from Washington, D.C.: https://www.census.gov/library/publications/time-series/statistical_abstracts.html

U.S. Census Bureau. (1972). *Statistical Abstract of the United States: 1972*. Retrieved from Washington, D.C.: https://www.census.gov/library/publications/time-series/statistical_abstracts.html

U.S. Census Bureau. (2012). Population, 2012 estimate. Available from U.S. Census Bureau State & County QuickFacts Retrieved September 18, 2013, from U.S. Census Bureau http://www.census.gov/quickfacts/table/PST045214/1304000

U.S. Census Bureau. (2014). Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014. Available from U.S. Census Bureau State & County QuickFacts Retrieved September 20, 2015,

from U.S. Census Bureau http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk
U.S. Congressional Budget Office. (1979). *Delays in Nuclear Reactor Licensing and Construction: The Possibilities for Reform*. Retrieved from Washington, D.C.: https://www.cbo.gov/publication/21115
U.S. Congressional Budget Office. (1986). *Financial Condition of the U.S. Electric Utility Industry*. Retrieved from Washington, D.C.: https://www.cbo.gov/sites/default/files/99th-congress-1985-1986/reports/doc10b-entire_1.pdf
U.S. Congressional Budget Office. (2001). *Causes and Lessons of the California Electricity Crisis*. Retrieved from Washington, D.C.: https://www.cbo.gov/sites/default/files/107th-congress-2001-2002/reports/californiaenergy.pdf
U.S. Department of Energy. (2014a, January 13, 2015). Green Power Markets. Retrieved from http://apps3.eere.energy.gov/greenpower/markets/index.shtml
U.S. Department of Energy. (2014b, January 13, 2015). Green Pricing. Retrieved from http://apps3.eere.energy.gov/greenpower/markets/pricing.shtml?page=0
U.S. Energy Information Administration. (1993a). *The Changing Structure of the U.S. Coal Industry: An Update* (DOE/EIA-0513(93)). Retrieved from Washington, D.C.:
U.S. Energy Information Administration. (1993b). *Public Utility Holding Company Act of 1935: 1935-1992* (DOE/EIA- 0563). Retrieved from Washington, D.C.:
U.S. Energy Information Administration. (1998). Provisions of AB 1890. Retrieved from http://www.eia.gov/electricity/policies/legislation/california/assemblybill.html
U.S. Energy Information Administration. (2000). *The Changing Structure of the Electric Power Industry 2000: An Update* (DOE/EIA-0562(00)). Retrieved from Washington, D.C.:
U.S. Energy Information Administration. (2001). Subsequent Events California's Energy Crisis. Retrieved from http://www.eia.gov/electricity/policies/legislation/california/subsequentevents.html
U.S. Energy Information Administration. (2002a, April 16, 2015). Petroleum Chronology of Events 1970 - 2000 Retrieved from http://www.eia.gov/pub/oil_gas/petroleum/analysis_publications/chronology/petroleumchronology2000.htm
U.S. Energy Information Administration. (2002b, April 16, 2015). Repeal of the Powerplant and Industrial Fuel Use Act (1987). Retrieved from http://www.eia.gov/oil_gas/natural_gas/analysis_publications/ngmajorleg/repeal.html
U.S. Energy Information Administration. (2010, May 2010). California Restructuring Suspended. Retrieved from http://www.eia.gov/electricity/policies/restructuring/california.html
U.S. Energy Information Administration. (2011). History of energy consumption in the United States, 1775–2009. Retrieved from https://www.eia.gov/todayinenergy/detail.cfm?id=10
U.S. Energy Information Administration. (2012a). Cheaper natural gas alters generation dispatch in Southeast. Retrieved from http://www.eia.gov/todayinenergy/detail.cfm?id=9090
U.S. Energy Information Administration. (2012b). Competition among fuels for power generation driven by changes in fuel prices. Retrieved from http://www.eia.gov/todayinenergy/detail.cfm?id=7090
U.S. Energy Information Administration. (2012c, May 15, 2012). Participation in electric net-metering programs increased sharply in recent years. Retrieved from http://www.eia.gov/todayinenergy/detail.cfm?id=6270
U.S. Energy Information Administration. (2014a). Average retail price of electricity Average retail price of electricity : residential. Available from U.S. Energy Information Administration Interactive Electricity Data Retrieved September 1, 2014, from U.S. Energy Information Administration http://www.eia.gov/electricity/data/browser/

U.S. Energy Information Administration. (2014b, August 22, 2014). New England relying more on natural gas along with hydroelectric imports from Canada. Retrieved from http://www.eia.gov/todayinenergy/detail.cfm?id=17671

U.S. Energy Information Administration. (2015, April 16, 2015). Georgia State Profile and Energy Estimates Data. Retrieved from http://www.eia.gov/state/data.cfm?sid=GA#Prices

U.S. Energy Information Administration. (2016a). Carbon dioxide emissions from electricity generation in 2015 were lowest since 1993. Retrieved from http://www.eia.gov/todayinenergy/detail.cfm?id=26232

U.S. Energy Information Administration. (2016b). Power sector coal demand has fallen in nearly every state since 2007. Retrieved from https://www.eia.gov/todayinenergy/detail.cfm?id=26012

U.S. Energy Information Administration. (2016c). United States remains largest producer of petroleum and natural gas hydrocarbons. Retrieved from http://www.eia.gov/todayinenergy/detail.php?id=26352

U.S. Nuclear Regulatory Commission. (2014a, December 12, 2014). Backgrounder on the Three Mile Island Accident. Retrieved from http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html#impact

U.S. Nuclear Regulatory Commission. (2014b, November 09, 2015). Operating Nuclear Power Reactors (by Location or Name). Retrieved from http://www.nrc.gov/info-finder/reactors/

U.S. Office of Technology Assessment. (1991). *Changing by Degrees: Steps to Reduce Greenhouse Gases.* Retrieved from Washington, D.C.:

Clean Air Act, 42, U.S. Government Publishing Office, Pub. L. No. 91-604 § 7401-7431 (1970 December 31, 1970).

Energy Policy Act of 1992, Library of Congress, Pub. L. No. 102-486, 2776 Stat. (1992 October 24, 1992).

UC Santa Barbara. (1999, 2016). National Energy Program Fact Sheet on the President's Program,. Retrieved from http://www.presidency.ucsb.edu/index.php

Union of Concerned Scientists. (2015). Production Tax Credit for Renewable Energy. Retrieved from ucsusa.org

Union of Concerned Scientists. (2016, 2016). Public Utility Regulatory Policy Act (PURPA). Retrieved from http://www.ucsusa.org/clean_energy/smart-energy-solutions/strengthen-policy/public-utility-regulatory.html#.Vqt7iPmLShc

United Nations Framework Convention on Climate Change. (1997a). Kyoto Protocol. Retrieved from http://unfccc.int/kyoto_protocol/items/2830.php

United Nations Framework Convention on Climate Change. (1997b). Kyoto Protocol: Countries included in Annex B to the Kyoto Protocol for the first commitment period and their emissions targets. Retrieved from http://unfccc.int/kyoto_protocol/items/3145.php

United Nations Framework Convention on Climate Change. (1997c). Kyoto Protocol: Status of Ratification of the Kyoto Protocol. Retrieved from http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php

United Nations Framework Convention on Climate Change. (2012, August 17, 2015). Status of the Doha Amendment Retrieved from http://unfccc.int/kyoto_protocol/doha_amendment/items/7362.php

United Nations Framework Convention on Climate Change. (2015). Conference of Parties 21. Retrieved from http://www.cop21.gouv.fr/en

United States Congress. (1970). Clean Air Act *Standards of performance for new stationary sources*. Washington, D.C.: Cornell Legal Information Institute.

Unruh, G. C. (2000). Understanding carbon lock-in. *Energy Policy, 28*(12), 817-830. doi:http://dx.doi.org/10.1016/S0301-4215(00)00070-7

Unruh, G. C. (2002). Escaping carbon lock-in. *Energy Policy, 30*(4), 317-325. doi:http://dx.doi.org/10.1016/S0301-4215(01)00098-2

Verbong, G., & Geels, F. (2007). The ongoing energy transition: Lessons from a socio-technical, multi-level analysis of the Dutch electricity system (1960–2004). *Energy Policy, 35*(2), 1025-1037. doi:http://dx.doi.org/10.1016/j.enpol.2006.02.010

Vietor, R. (1987). Synfuels revisited: Nostrum for the coal industry *Energy Policy in America Since 1945: A Study of Business-Government Relations* (pp. 163 - 177). New York, NY: Cambridge University Press.

Walker, S. J., & Wellock, T. R. (2010). *A Short History of Nuclear Regulation, 1946–2009*. Retrieved from Washington, D.C.:

Wang, Q., Chen, X., Jha, A., & Rogers, H. (2014). Natural gas from shale formation – The evolution, evidences and challenges of shale gas revolution in United States. *Renewable and Sustainable Energy Reviews, 30*, 1-28. doi:http://dx.doi.org/10.1016/j.rser.2013.08.065

Wang, Z., & Krupnick, A. (2013a). *A Retrospective Review of Shale Gas Development in the United States: What Led to the Boom?* Retrieved from Washington, D.C.: www.rff.org

Wang, Z., & Krupnick, A. (2013b). *US Shale Gas Development: What Led to the Boom?* Retrieved from www.rff.org

Warwick, W. M. (2002). *A Primer on Electric Utilities, Deregulation, and Restructuring of U.S. Electricity Markets* (PNNL-13906). Retrieved from Richland, WA: http://www.osti.gov/scitech//servlets/purl/15001013-6NFa4G/native/

Watson, R. T., Albritton, D. L., Allen, M. R., Baede, A. P. M., Church, J. A., Cubasch, U., . . . Gregory, J. M. (2001). Summary for Policymakers: A Report of Working Group I of the Intergovernmental Panel on Climate Change. In D. J. Dokken, M. Noguer, P. v. d. Linden, C. Johnson, J. Pan, & G.-A. D. Studio (Eds.), *Climate Change 2001: Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of theIntegovernmental Panel on Climate Change* (Vol. 4). Cambridge, UK

New York, NY: Cambridge University Press.

Watson, R. T., Albritton, D. L., Barker, T., Bashmakov, I. A., Canziani, O., Christ, R., . . . House, J. (2001). Summary for Policymakers. In D. J. Dokken, M. Noguer, P. v. d. Linden, C. Johnson, J. Pan, & G.-A. D. Studio (Eds.), *Climate Change 2001: Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of theIntegovernmental Panel on Climate Change* (Vol. 4). Cambridge, UK

New York, NY: Cambridge University Press.

Wheeler, S. M. (2008). State and Municipal Climate Change Plans: The First Generation. *Journal of the American Planning Association, 74*(4), 481-496. doi:10.1080/01944360802377973

While, A. (2008). Climate change and planning: carbon control and spatial regulation. *Town Planning Review, 79*(1), vii-xiii. doi:doi:10.3828/tpr.79.1.2

While, A. (2011). The Carbon Calculus and Transitions in Urban Politics and Political Theory. In H. Bulkeley, V. Castán Broto, M. Hodson, & S. Marvin (Eds.), Cities and Low Carbon Transitions (pp. 439). Oxfordshire, England

New York, NY: Routledge. Retrieved from https://www.routledge.com/products/9780415586979.

While, A. (2014). Carbon Regulation and Low-Carbon Urban Restructuring. In M. Hodson & S. Marvin (Eds.), *After Sustainable Cities?* (pp. 41 - 75). London, UK: Routledge.

While, A., Jonas, A. E. G., & Gibbs, D. (2010). From sustainable development to carbon control: eco-state restructuring and the politics of urban and regional development. *Transactions of the Institute of British Geographers, 35*(1), 76-93. doi:10.1111/j.1475-5661.2009.00362.x

White, M. W., Joskow, P. L., & Hausman, J. (1996). Power Struggles: Explaining Deregulatory Reforms in Electricity Markets. *Brookings Papers on Economic Activity. Microeconomics, 1996*, 201-267. doi:10.2307/2534749

Woerdman, E. (2004). Chapter 3 - Path Dependence and Lock-In of Market-Based Climate Policy. In W. Edwin (Ed.), *Developments in Environmental Economics* (Vol. Volume 7, pp. 55-82): Elsevier.
Woolley, J., & Peters, G. (1997). President Clinton: Opening Remarks at the White House Conference on Climate Change, October 6, 1997. (Archives). Available from University of California, Santa Barbara The American Presidency Project Retrieved January 5, 2016, from University of California, Santa Barbara americanpresidency.org
World Nuclear Association. (2013, January, 2015). US Operating Nuclear Reactors Nuclear Power in the USA Appendix 1. Retrieved from http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/Appendices/Nuclear-Power-in-the-USA-Appendix-1--US-Operating-Nuclear-Reactors/
World Nuclear Association. (2015, November, 2015). Background to nuclear power. *Nuclear Power in the USA.* Retrieved from http://www.world-nuclear.org/info/country-profiles/countries-t-z/usa--nuclear-power/
Yergin, D. (2006). Ensuring Energy Security. *Foreign Affairs, 85*(2), 69-82. doi:10.2307/20031912
Yin, R. K. (2003). Introduction: Comparing Case Studies with Other Research Strategies in the Social Sciences *Case Study Research: Design and Methods* (3 ed., pp. 3 - 11). Thousand Oaks, CA

London, UK: SAGE Publications.
Yin, R. K. (2013). Collecting Case Study EvidenceCase Study Research: Design and MethodsApplied Social Research Methods (5 ed.). Thousand Oaks, CA

London, UK: SAGE Publications. Retrieved from https://us.sagepub.com/en-us/nam/case-study-research/book237921.
Zichella, C., & Hladik, J. (2013). Siting: Finding a Home for Renewable Energy and Transmission. *The Electricity Journal, 26*(8), 125-138. doi:http://dx.doi.org/10.1016/j.tej.2013.09.001