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# Nuclear New Build in the United States 1990-2010: A Three State Analysis

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**Abstract**

This research examines nuclear energy policy across three states in the United States (US) – Georgia, Pennsylvania, and Texas – from 1990-2010. The main research question seeks to ascertain what the pre-requisites are for successful nuclear new build to occur in the US. Interviews are at the core of the research methodology employed, as with other in-depth studies on nuclear new build. The aim of this research is to identify and clarify those aspects of the legal, economic, and political requirements of the US that effect prospects for nuclear new build but which, so far, have not been well understood by experts. The research provides these new insights through a unique comparison of US states which have deregulated, regulated and 'hybrid' electricity markets. From the research it is evident the central role that law can have in the nuclear energy sector, and that policy in the nuclear energy sector can become state driven. Further, the methodology identifies key assumptions within the nuclear sector in the US that are contested, and delivers lessons on how these contested issues may be resolved. The paper adds to the literature in public administration, legal development and nuclear energy policy, and in particular nuclear new build.

**Keywords** Nuclear energy policy; nuclear new build; lessons learned; Georgia; Pennsylvania; Texas

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# Nuclear New Build in the United States 1990-2010: A Three State Analysis

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## 1: Introduction

This paper seeks to identify and clarify those aspects of the legal, economic, and political requirements of the United States (US) that affect prospects for nuclear new build but which, so far, have not been well understood by experts. The main research question seeks to ascertain what the pre-requisites are for successful nuclear new build to occur in the US.

The nuclear energy incident at Fukushima in Japan March 2011 is beyond the scope of this research as its focus is on nuclear energy policy in the USA from 1990 to 2010. The fundamental conclusions of this research remain valid, as it remains to be seen what the impact of Fukushima will be and in addition the US has experienced an accident in Three Mile Island which has shaped its own nuclear industry to an extent already.

Research into new build nuclear energy is growing as a result of its increasing popularity as a secure low-carbon energy supplier and the importance placed on energy security (Cameron, 2007). Indeed, statistics from the International Atomic Energy Agency (IAEA) (2010), and the World Nuclear Association (2010) state that 65 countries have expressed interest in building nuclear power plants and 36 countries are actively pursuing nuclear power programs. Recent studies into nuclear energy policy have called for more research in the area; for example: the International Atomic Energy Agency (2008) has expressed the need for more studies to be completed in nuclear energy policy, highlighting the need for country-specific studies; and Pope (2008) stated that the nuclear sector is in need of more research, particularly on nuclear new build processes and policy.

The study of nuclear energy policy is interdisciplinary, and hence its research contributions are interdisciplinary. This is evident in that research articles on nuclear energy policy are not confined to a few select journals but are published in philosophy, sociology, psychology, law, economics, management, science, engineering, and physics journals. The research presented here draws

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on several disciplines in the social sciences and as such provides generalisable lessons beyond nuclear energy policy and in particular concerning technological change, public administration, and legal development in the USA.

Interviews are at the core of the research methodology employed, as with other in-depth studies on nuclear new build (see, Jasper 1990; Hecht, 1998, 2009; Pope, 2008). The research data gathered are comprised of 48 interviews across the three states: Georgia, Pennsylvania and Texas. Other studies on nuclear energy policy also use interviews (see Stoler, 1985; Morone and Woodhouse; 1989; Perin, 2005). Notable, however, is that these latter studies and others (Goodman and Andes, 1985; Campbell, 1988; Nohrstedt, 2008) draw *lessons* from their assessment of nuclear energy policy, a similar objective to this research.

## 2: Methodology

The research methodology used here is contrast explanation. At its core, contrast explanation involves dialectical learning that has a three step process whereby the researcher: (1) explores the research topic in depth; (2) enters the field and conducts the research; and finally (3) revises what was learnt at the first step (Lawson, 2009). Contrast explanation occurs at step 2, and involves the testing of each hypothesis established in step 1. Hypotheses are contested ideas that are termed as hypothesis to be elaborated upon. These research hypotheses are debated with the interviewees who state whether they are proponents or critics of the hypotheses. This research method is useful in particular to discover ideas that are beyond the obvious where an affirmative or negative policy action is the focus of the study – i.e. a nuclear power plant is to be built or it is not. The results are then presented visually on a graph demonstrating which hypotheses are contested and thus worthy of further analysis. Only hypotheses that are contested by interviewees to a sufficient degree (where there is no 75 *percent* majority of interviewees in favour or against) are further analysed; those that generate an immediate consensus view of greater than 75 *percent* are regarded as uncontroversial and not analysed further. Next, the stage three analysis begins, and this determines whether the hypothesis is proven or unproven. This decision is based on in-depth interview analyses (coded and managed using *Atlas.ti* qualitative data analysis software), analysis of policy actions and documents (including those suggested by interviewees), and a return to the literature review. Lessons from the analysis of each contested hypothesis emerge and are stated at the end.

Contrast methodology is used in a variety of forms across many disciplines in the social sciences and humanities: in philosophy (political – Carlson, 1990), psychology (in studying legal outcomes - Pepitone and DeNubile, 1976; Nagao and Davis, 1980; Ross and Simonson, 1991), increasingly in management (in examining consumer behaviour - Folkes, Martin and Gupta, 1993; Drolet, 2002; Aaker, Stayman and Hagerty, 1986; Sherif and Hovland, 1961) and economics (Pinkstone, 2002; Lawson, 1997; 2003; 2009). The method is similar to the US Environmental Protection Agency (EPA) methodology of

Expert Elicitation (see US EPA Expert Elicitation Task Force White Paper, 2011); however, it is noted in the White Paper (pg. 68) that Expert Elicitation is a financially expensive methodology, and hence contrast explanation is more suitable for a single researcher.

However, at its core is always dialectical learning which has existed as a method for learning since Socrates and Plato introduced it in its initial form (Lawson, 2009). It enables a researcher to focus and provide observations and lessons on long-term trends (Argyris and Schon, 1978; Seo and Creed, 2002). For instance, dialectical learning was employed by the Dutch stakeholder dialogue project *Climate OptiOns for the Long term* (COOL, 2001). This project had as its key aim the provision and assessment of stakeholder viewpoints on a wide range of long-term policy options for climate change. Dialectical learning was a key part of the process. This involved identifying and understanding the dominant issues, then exploring contrasting viewpoints or outcomes, and then the third step of deliberating, reflecting, and revising the original understanding (Van de Kerkhof, 2006). Further, at the core of the COOL project were stakeholder interviews similar to the interviews conducted for this research.

Contrast explanation has been employed in many other areas too: such as in corporate strategic planning (Mason, 1969; Mitroff 1971; Mason and Mitroff, 1981) for complex problems – where problems/issues are drawn from current understandings and then examined from previous or potential outcomes. This is similar to this study, as nuclear energy policy is noted as a complex subject matter (Breyer, 1978; MacKerron, 2004). Mitroff and Mason (1981) have argued that the policy and planning field is beyond the scope of traditional scientific experimentation. For example, Corbey (1995) used dialectal learning for analysis of EU policy where he assessed the various phases and process in the development and integration of the EU. Similarly this research examines the processes behind the development of nuclear new build. The central issue for contrast explanation is not really about what is possible within different perspectives but rather [as Bernstein (1976) noted]: "*it's about what's emphasized, illuminated, or made more likely; what's relegated to the background as unimportant or impractical; and what the impact of these prevailing emphases is on the actual practices of social scientists and the communities they study and serve*" (Moss, 1998:56).

Interviews form the essence of primary data for this research. Stakeholders in the nuclear energy sector were identified following that outlined in Table 1 below. This follows other efforts of researchers who identify stakeholders prior to conducting their analysis. For example, Jasper (1990) too conducted a similar study to this research with over 100 stakeholder interviews in examining nuclear energy policy. However, his focus was on three countries (the US, France, and Sweden) from the point of the 1970s oil crisis to *circa* 1990. He conducted 100 interviews with managers, policymakers and activists in the three countries. The focus of the work was exclusively on political and economic structures to account for public policy decision making for the nuclear energy sector.

**Table 1: Stakeholders Identified and Interviewed for the Research**

| No./ Level | Function, Organisation | Interviewees Georgia | Interviewees Pennsylvania | Interviewees Texas |
|---|---|---|---|---|
| 1 | State Politicians on State Legislature Energy Committees | State Senators | State Senators, and State House of Representatives | State Senators, and State House of Representatives |
| 2 | State Electricity Regulator | Georgia Public Service Commission | Pennsylvania Public Utility Commission | Public Utility Commission |
| 3 | State Transmission Grid System | SERC Reliability Corporation | PJM Interconnection LLC. | ERCOT, Texas |
| 4 | State Agencies: Finance, Environment and Nuclear Safety | Center of Innovation for Energy. Georgia Environmental Finance Authority (GEFA); Georgia Department of Natural Resources – Environmental Protection Division, Environmental Radiation Program | Pennsylvania Department of Environmental Protection, Office of Attorney General - Pennsylvania | Texas Comptroller of Public Accounts; Office of Public Utility Counsel, Texas; Austin Energy; San Antonio Energy (CPS) |
| 5 | Nuclear Energy Companies | Southern Company | PPL - Susquehanna Energy PA; Exelon | NRG Texas LLC; Exelon; South Texas Project Nuclear Operating Company |
| 6 | Academic Researchers | Georgia Institute of Technology, & Oak Ridge National Laboratory; Emory Law School, Emory University, Atlanta | Carnegie Mellon Electricity Industry Center, Electricity Markets Initiative Pennsylvania State University – Electricity Centre | Centre for International Energy & Environmental Policy, LBJ School of Public Affairs; Cockrell School of Engineering; Institute for Fusion Studies (All at the University of Texas at Austin) |
| 7 | Non-Governmental Organisations | Southern Alliance for Clean Energy | Citizen Power (PA), Penn Future | Environmental Defense Fund; Clean Energy Technology Association |

The same interviews were completed at the 7 levels of stakeholders for all three states (for more complete list see Appendix A). 48 interviews were completed by the end of the process which lasted from June to August 2010. Interviews lasted between 25 and 150 minutes. Interviewees included state politicians, state regulators of electricity, state nuclear safety offices, electricity grid operators, electricity and nuclear energy company operators, academic experts, and members of various other state institutions, and environmental groups in all three states.

## 3: Research Hypothesis

The research question was: what are the pre-requisites for successful nuclear new build to occur in the US? Answering this question centres on establishing what are the key conditions for a company to invest in nuclear power. Hence, there is a need to focus on legal, economic and political structures in place in the US and assess how these influence nuclear new build conditions.

Three states in the USA were chosen for this research: Pennsylvania, Texas and Georgia. The reasons for choosing these three states were due to their characteristics which demonstrated their value as a representative sample of states within the US: Pennsylvania is a member of PJM (a liberalised electricity

market formed of 13 states and the District of Columbia, PJM represents the first three member states: Pennsylvania, New Jersey, and Maryland), and also the state where the 1979 Three Mile Island accident occurred; Texas is a 'hybrid' state in terms of having both regulated and deregulated electricity areas and, uniquely in the contiguous US, it has its own transmission system; and, finally, Georgia is a regulated state and also has the most advanced plans for nuclear new build in the US. Table 2 shows some basic features of the electricity and nuclear energy sectors within the three states. Knowledge of this information will be useful for the subsequent sections. The particular significance of Table 2 is that it shows that in late 2010 all three states had plans to build further nuclear power capacity.

**Table 2: Electricity and Nuclear Statistics in Georgia, Pennsylvania, and Texas in the US.**

| Feature/State | Georgia | Pennsylvania | Texas |
|---|---|---|---|
| Population | 9.68m | 12.6m | 24.8m |
| Electricity Sector Policy | Regulated | Deregulated (PJM) | Hybrid (ERCOT) |
| % Share of Nuclear Energy in the Electricity Sector | 23% | 34% | 10% |
| % Share of Coal, Gas, Renewables in the Electricity Sector | 63%<br>10%<br>2% | 54%<br>8%<br>3% | 36%<br>49%<br>5% |
| Nuclear Power plants | 4 | 9 | 4 |
| Planned Nuclear Power Plants | 2 | 1 | 6* |
| Companies | 1: Southern Nuclear | 4: First Energy, Entergy, PPL, Exelon | 2: Luminant Generation, STP Nuclear |
| Technology Provider | 2 types: General Electric, Westinghouse | 3: Westinghouse, General Electric, Babcock and Wilcox | Westinghouse |

Source: Compiled by the author as of December 2010 from the US Energy Information Administration (2010) and US Nuclear Regulatory Commission (2010).
*A more realistic number is two, however, plans were submitted by Exelon and Luminant Generation for two each but these plans have since been suspended.

The methodology of contrast explanation which is applied in this research has particular advantages for this type of research. It is emergent in the sense that it acknowledges that the researcher will acquire knowledge throughout each research phase and this can be incorporated into the research – in the form of the emergent hypotheses being examined. The research offers in-depth insight and policy development analysis of the contested hypotheses and advances a methodology to further knowledge on a complex policy issue. It is adversarial and incremental in its approach. The new knowledge is identified in the lessons learned from the further analysis of each hypothesis. After the literature review had been conducted, 12 research hypotheses were developed and tested in the interview process – for a full list of the interviewees, see Appendix A.

The research methodology used here is contrast explanation. Through this methodology the research hypotheses are established. At its core, contrast

explanation involves dialectical learning that has a three step process whereby the researcher: (1) explores the research topic in depth; (2) enters the field and conducts the research; and finally (3) revises what was learnt at the first step (Lawson, 2009). Contrast explanation occurs at step 2, and involves the testing of each hypothesis established in step 1. Hypotheses are contested ideas that are termed as hypothesis to be elaborated upon. Only hypotheses that are contested by interviewees to a sufficient degree (where there is no 75 *percent* majority of interviewees in favour or against) are further analysed; those that generate an immediate consensus view of greater than 75 *percent* are regarded as uncontroversial and not analysed further. Next, the stage three analysis begins, and this determines whether the hypothesis is proven or unproven. Only four of the twelve hypotheses qualified for further analysis under the research methodology and these are specified below in Table 3.

**Table 3: List of Research Hypotheses Developed**

| Number | Hypothesis (H) | Contested Hypothesis | Uncontested Hypothesis |
|---|---|---|---|
| **1** | There is too much competition by other energy sources to enable nuclear energy expansion in some states | | √ |
| **2** | State laws cannot encourage nuclear new build | √ - **H1** | |
| **3** | The Nuclear Regulatory Commission (NRC) is too slow in its approval of licensing for a new nuclear plant | | √ |
| **4** | The slow construction times of the previous nuclear new build still have a negative impact | | √ |
| **5** | Nuclear operating companies do not have the financial capacity to build a nuclear new build project | | √ |
| **6** | Deregulation of the electricity sector in US states has not succeeded | √ - **H2** | |
| **7** | Nuclear energy is an underfunded sector at state level | √ - **H3** | |
| **8** | Nuclear lobby groups are weak in comparison to environmental lobbying groups | | √ |
| **9** | Environmental lobbying groups no longer see nuclear energy as the primary opposition | | √ |
| **10** | There is no 'nuclear renaissance' in the US | √ - **H4** | |
| **11** | Information dissemination about nuclear energy is not sufficient | | √ |
| **12** | Education on nuclear energy issues and education of the next generation of staff for the sector are weaknesses in the sector | | √ |

The developed hypotheses that were uncontested are conclusions to the research themselves though as stated previously the researcher only explores in depth the uncontested hypotheses.

Nuclear energy in the US has significant competition as an electricity supply source, however, not just from coal and gas, but increasingly from renewable energy (wind in particular). Indeed, there is too much competition by other energy sources to enable nuclear energy expansion in many US states at present (H1). Further, the potential of shale gas (for example in Pennsylvania with the discovery of the Marcellus Shale gas reserves) is adding to the competition. Nevertheless, some interviewees expressed that nuclear energy is still needed, for example one interviewee (TI-6) from Texas states in this regard that:

> "When you look at long term growth numbers, if the nuclear plants are not built, you are going to have to do a lot of something else, and I do not know who is ready to step up to that one yet, so from that point of view regulators and ERCOT people are keeping their fingers crossed, along with political figures, that the (nuclear) power plants will go ahead as otherwise we will have to do a lot of something else..".

There are other factors which have played a role in nuclear energy development in the US, in particular, the regulator, the Nuclear Regulatory Commission (NRC). The NRC has struggled in the past in taking a long time to approve projects, and although it has undergone changes, there remains a need to improve (H3):

> "What impressed me about the NRC was their ability to make good technical decisions and that they made decisions. I was concerned before I went there. The fact that, you know, we had all heard that there had not been a new reactor license application since Three Mile Island. There were a lot of licenses in process but there had not been a new one. So I was concerned about the NRC's ability to make decisions but it turned out that that was an unfounded concern because they had done power upgrades, they had done license renewals so I was impressed with the agency. I thought they were a good focused organisation but like any organisation you can do much better" (GI-4).

Electricity policy suffers from fragmentation in the US with each state having significant control of their own electricity policy – except for those in regional electricity markets, for example PJM. This fragmentation led to individual technical designs and when coupled with the slow regulatory regime contributed to slow construction times in the past (H4). Further, the fragmentation resulted in the weakness in the financial capacity of energy companies in the US to build a new nuclear project (H5) with companies operating within states and not having without major public funds access to the financial resources needed to build a nuclear power project.

Nuclear energy lobby groups are weak in comparison to environmental lobbying groups (H8). For many years during the 1960s, nuclear had no need for lobbying because of the link between nuclear energy, the military and politics. As

a result lobby groups, lobby formations and networks do not as readily exist or are at a later stage of development than lobby groups, networks and associations for other energy sources. A positive issue related to this is that environmental lobbying groups no longer see nuclear energy as the primary opposition (H9). This because of the association of nuclear energy with clean energy sources in that it produces no carbon dioxide. Indeed, many environmental lobby groups are transferring their efforts to tackle carbon dioxide producing energy sources.

Information dissemination about nuclear energy is not sufficient in the US (H11). This is linked intrinsically to the problem of education on and surrounding nuclear energy issues. Nuclear energy is a complex subject and topic – there is an educational gap surrounding the subject area (H12). Indeed many of those interviewed expressed the view that employees across energy and nuclear energy institutions not to mention the public do not understand all the issues involved. They state that there is a shortage of current and prospective employees who can envisage the holistic picture of nuclear energy, and as a result decision-making from organisations in the nuclear energy decision-making sectors lack holistic decision-making ability; therefore decision-making on nuclear energy matters suffers from a piecemeal or fragmented approach, i.e. where a decision is made regarding a particular part of nuclear energy policy or regulation.

## 4: Research Analysis

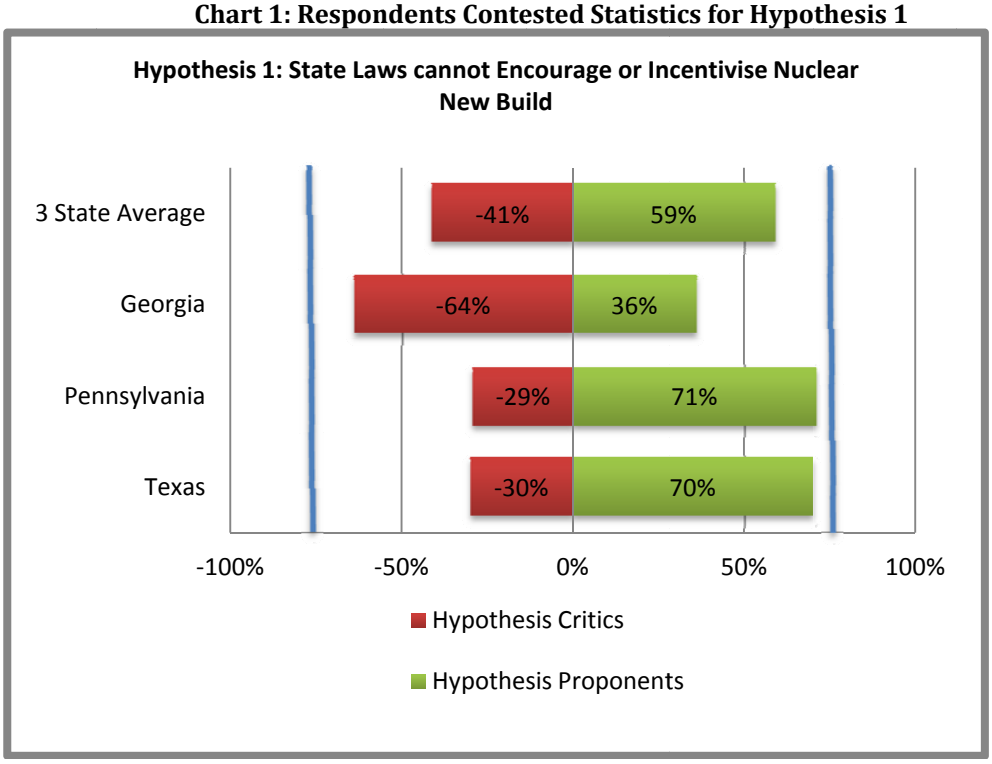
### 4.1: Hypothesis 1
### State Laws cannot effectively Encourage or Incentivise Nuclear New Build

The majority of research in the area states that nuclear policy is a national (Federal) issue in the US. This research builds on previous work by Parenteau (1976), Rabe (2004; 2006; 2007a; 2008), Matisoff (2008), Mullin and Daley (2009), and Carley (2011) which identified the value of state laws where the Federal system does not provide direction. This is identified as being the case in the nuclear energy industry generally, and particularly regarding nuclear new build. It is shown that the state can have a considerable role in developing growth in new nuclear build. Hence, this research demonstrates the significant role of the state in the nuclear industry, despite the majority of the literature viewing the nuclear energy industry as a national or international industry.

The judgement of interviewees is assessed in Chart 1 below. This chart analyses whether interviewees were proponents (positive) or critics (negative) of the researcher's hypothesis. For a hypothesis to be further analysed, the hypothesis must be a 'contested' hypothesis, which is where there is less than a majority of 75 *percent* of respondents either for or against. If it is more than 75 *percent* then it will not be considered contested and thus not further analysed, with this decision being based on the three state average. The blue line (see Chart 1) indicates the 75 *percent* threshold. The number 0 represents the hypothesis decision line – for or against. On the chart, the overall result - the three state average - is given first followed by the three states individually.

Interviewee responses (where total n=48) are recalculated to represent a value of 100 percent.

**Chart 1: Respondents Contested Statistics for Hypothesis 1**




n=48, nGeorgia=11, nPennsylvania=17, nTexas=20

As Chart 1 illustrates, the majority of the interviewees did not believe in the ability of state laws to affect or influence the nuclear new build policy. According to the criteria however, the hypothesis was not proven. This is demonstrated by the further analysis that follows (previously referred to as the stage three analysis), conducted on the interviewee data (through the use of *Atlas.ti* software), the analysis of legal and policy actions and documents within the three states, and updating the literature review through documents recommended and given by interviewees. In the text analysis that follows, GI refers to a Georgian interview, and GI-1 identifies the interviewee from the tables in appendix A – the same applies for PI and TI which refer to Pennsylvania and Texas interviews respectively. Further, some statements are supported by the critics or proponents of the hypothesis and in these cases the reference code is CVP which is the consensus view of proponents, and CVC consensus view of the critics.

In viewing the three states in Chart 1 it was in Georgia that the greatest proportion of the respondents were critics of the hypothesis. In Texas and Pennsylvania, as Chart 1 shows, there are more proponents than in Georgia of the hypothesis that state laws cannot encourage or incentivise nuclear new build. The view expressed by the majority was that it was at the Federal level that nuclear energy should be incentivised (CVP). There was the belief that it was not within a state's function, or remit, to be incentivising new energy infrastructure (CVP). Nevertheless, actions within both states demonstrate that there is the capability to incentivise or encourage new nuclear power plants.

In Texas, many of the views supporting the hypothesis suggest a bias against nuclear energy. It was argued by many that even if the state has the capacity to incentivise nuclear power it should not, and it should support more natural gas and renewable energy (CVP). This bias however, is demonstrated at an institutional level in Texas. For example, at state level Texas gives support to nuclear energy's competitors. Renewables, coal and natural gas all receive support (usually in the form of policy and subsequent financial subsidies through that policy) (TI-6). Renewable energy, in particular, receives heavy support in Texas due to being considered a clean electricity source (TI-1, TI-2, TI-6, TI-10, TI-11). Yet the benefits of nuclear energy are not viewed in a similar way, despite the acceptance that Texas needs energy supply diversity, there are benefits from keeping prices stable and the need to move towards the goal of energy independence (TI-1, TI-2).

Those who support this hypothesis have several objections to nuclear receiving incentivisation at state level in Texas (CVP). First, nuclear energy is supported at Federal level and should remain so and the state legislature should not be concerned with it (CVP). This view is particularly prevalent with the development of the deregulated electricity market in Texas, where prices and competition mean that nuclear energy is too expensive and not an attractive option. Second, it is argued that nuclear energy has received subsidy support in the past, and it needs to be a financially independent industry now (CVP). Third, there is not the ability within the state to support nuclear energy due to the financial position of the state of Texas, which has a budget deficit of circa $6 billion for 2010 (Texas Comptroller of Public Accounts 2010).

These latter arguments are heard in Pennsylvania too, yet there are problems with these arguments in many cases. For example, deregulated markets have had problems in Texas and Pennsylvania, and no guarantees can be made that the introduction of nuclear energy would increase the price above what it may rise to in any case (CVC). There is no reason for the nuclear industry to be an independently-financed industry, when its competitors are not (CVC) – more on subsidies will be discussed later. A state may have a budget deficit, but it can introduce other policies which could benefit nuclear energy but do not involve direct transfers of financial aid (CVC).

Critics of the hypothesis, who believe that state action can encourage nuclear, point to other policies that can occur without direct financial transfers. In Texas, these include encouraging regulated parts of the state to join together through incentives to develop a nuclear project, and applying some level of carbon tax (green tax), or giving nuclear energy the same benefits as renewables in the state (TI-1). Further, in both Texas and Pennsylvania attempts have been made to designate nuclear energy as a clean energy source and include it under their respective Renewable Portfolio Standards (RPS) (CVC). The latter is particularly emphasised by those in Texas who believe that the state is reaching its near maximum renewable capacity because of the massive investment in wind power (and which is expected to continue), which has occurred due to the RPS and Senate Bill 20. Hence, if Texas is to continue to reduce its greenhouse

gas (GHG) emissions, other clean energy projects will need to begin (CVC). Senate Bill 184 aims to initiate and support "*strategies for reducing greenhouse gas emissions that result in net savings for Texas consumers or businesses; can be achieved without financial cost to consumers or businesses; or help businesses in Texas maintain global competitiveness*"(p.1, Senate Bill 184). However, support for nuclear energy capable of reducing GHGs through the aims of Senate Bill 184 has yet to occur; nevertheless, it demonstrates that state level policy has the capacity to encourage nuclear energy.

In Georgia, state laws have encouraged and even incentivised nuclear to some degree. There is a very strong pro-nuclear lobby evident in Georgia, and that lobby has assisted in the creation of the law there (CVC). A reason to create favourable laws in Georgia for nuclear energy lies in the risks of nuclear construction (GI-2, GI-4). Georgia had in the past experienced such a situation where the cost escalated from $3.214 billion (at 2007 USD currency) at the Edwin I Hatch nuclear power plant for two reactors (876MW and 883MW) completed in 1974, to $19.071 billion (at 2007 USD currency) at the Plant Vogtle nuclear power plant for two reactors (1150MW and 1152MW), completed in 1989 (EIA, 2010).

It is recognised across public institutions in Georgia that the state needs to develop its energy mix and all forms of electricity will be supported should sufficient proposals be put forward (GI-1, GI-2). Nevertheless, legislation does support nuclear energy. One of the key pieces of legislation that favours nuclear energy at state level is Bill 31 which enacted the "Georgia Nuclear Energy Financing Act". This permits the state utility, Georgia Power, to recover costs of construction from the beginning of the construction phase - these are known as Construction Work In Progress (CWIP) payments. This legislation was only introduced in 2009. An earlier from of the legislation was in fact drafted and attempts made to introduce it in 1974/1975; however, this was rejected. Now the new law is not to favour nuclear as such, but to realise within the electricity sector *'...what's needed, what capacity has got to be out there, what the environmental impact is going to be, we have to make leadership decisions and make those decisions, (that) maybe (are) not political, but factually we think...better"* (GI-2).

The research, thus identifies through the policy actions in all three states the first lesson of the research, that:

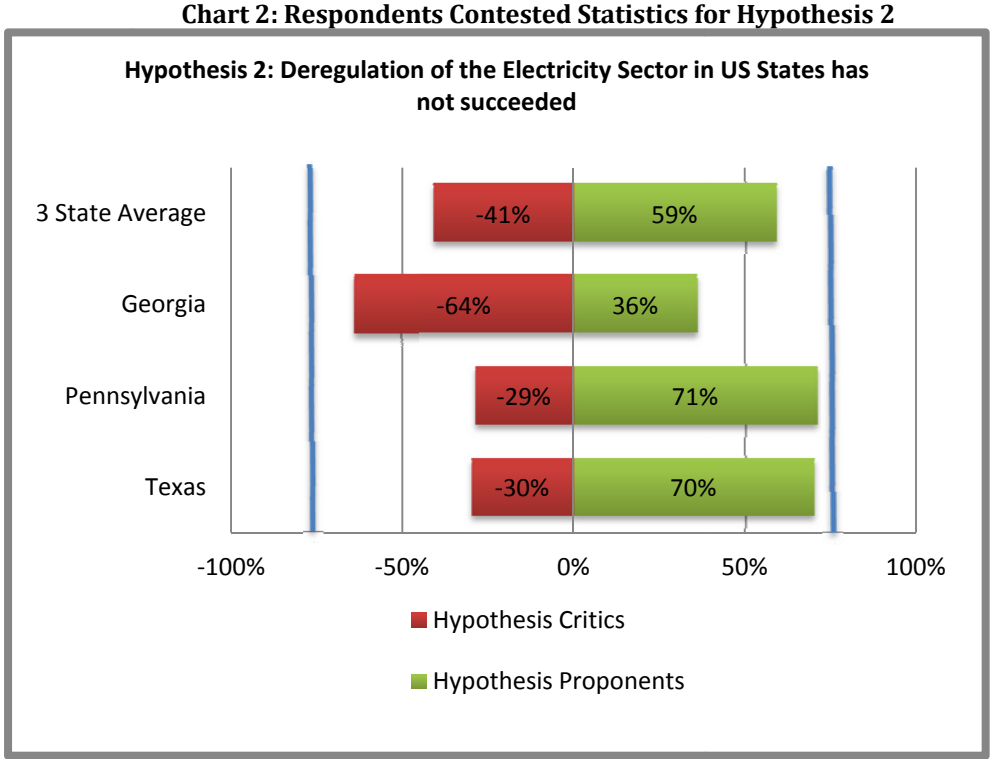
*Lesson 1: State Laws in the US do indeed have the capacity to encourage and incentivise nuclear new build.*

### 4.2: Hypothesis 2
### Deregulation of the Electricity Sector in US States has not succeeded

Deregulation of electricity markets has occurred across the European Union and the United States of America. The rate at and extent to which it has occurred are different. In the US, 25 states have not deregulated their electricity markets.

According to the academic literature (Joskow, 2005; Slocum, 2008; Blumsack, 2007), the success of deregulation in the US is mixed. This corresponds to the views of those interviewed, as shown in Chart 2 below; a percentage (*21 percent*) of those interviewed were giving their view through the lens of the nuclear industry. The hypothesis, while not a contested statement in Georgia, was contested on average across the three states, and hence was further analysed. The hypothesis was proven after the evidence from the research analysis demonstrated that deregulation in the two US states has not succeeded, and the resulting analysis that follows testifies to this.

**Chart 2: Respondents Contested Statistics for Hypothesis 2**




n=48, nGeorgia=11, nPennsylvania=17, nTexas=20

Opinion is evenly contested on average across the three US states concerning deregulation, as Chart 2 illustrates. However, in Georgia it does not present itself as an issue at state level due to it being a regulated state, and significantly there were no calls to deregulate the electricity market from the respondents. Texas and Pennsylvania provide interesting contrasts in examining electricity deregulation in the US. Texas has its own grid system, ERCOT, and within this system there are also regulated and unregulated areas; while Pennsylvania shares a grid, PJM, which now covers 13 states and the District of Columbia.

Deregulation was introduced through legislation in Texas in 1999 (Senate Bill 7) and began in 2002. Deregulation was brought into Texas with the promise of increasing economic efficiency in the electricity supply sector, reducing the cost, and therefore prices to consumers. However, as the state sought lower prices, deregulation and its long-term effects on the entire electricity industry were not considered (CVP). Deregulation has performed one main role in Texas, and that is to offer consumers more choice from whom they purchase electricity. However, there is a list of non-achievements (CVP). There is no evidence that it

has delivered new generation, new transmission or reduced electricity prices (CVP). The new electricity generation in Texas that has occurred, has only been because of very generous wind subsidies introduced by subsequent legislation which masks the cost of wind (CVP). Poor investment in new transmission structures still inhibit the addition of new generation as well as the performance of existing generation facilities (TI-1, TI-2, TI-6, TI-15). Further, prices have not decreased for consumers in the deregulated areas of Texas, which suffer in particular from natural gas price volatility and consequently, electricity prices as a result have become some of the most expensive in the US (CVP). Electricity prices are, however, lower in the regulated parts of the state than the deregulated parts (TI-6, TI-11). This explains the reluctance for the regulated parts of the state of Texas to deregulate. Incidentally, some of the municipalities that remain regulated are involved in both the nuclear projects in Texas: the South Texas Project and Commanche Peak. This represents a similarity in relation to Georgia, in identifying that new nuclear build can happen in regulated electricity markets.

In Pennsylvania a similar evolution of the electricity market has occurred following deregulation. Again, however, the introduction of the deregulation has been criticised by interviewees (PI-1, PI-2, PI-4, PI-5, PI-13). It is reported that legislation introduced to improve market prices and did not have new electricity generation or environmental concerns at the core (CVP). The actions by those in public administration institutions for the electricity industry were incomplete (CVP). A new policy (deregulation was enacted in 1998) was introduced in the electricity market without considering its long-term effects or the evolution of the industry (CVP). Renewable energy was also given heavy subsidies through the later introduction of a Renewable Portfolio Standard in Pennsylvania. Those who believe in market deregulation within the state believe that the new market system needs to be given more time, and PJM needs to develop as an institution (PI-8, PI-9, PI-10).

As Chart 2 illustrates, the majority of interviewees across the three states believe that deregulation has not succeeded. This (despite the influence of the Georgia results) highlights the need for a revision of the deregulation policy in these states. Blumsack (2007) examined the restructuring process in the US and stated that it is unclear whether electricity deregulation in the USA is a success or failure. Notably, he stated (2007: 183-184):

> "If electricity restructuring in the United States fails, it is not because of Enron or any other group of stakeholders, but rather because the markets and institutions emerged from a poor formulation of the problem that restructuring was supposed to solve. California's doomed market was designed without sufficient input from experienced engineers; by default this yielded an incomplete set of performance metrics and a verification process somewhere between terrible and nonexistent. The current controversy over regional integration in markets and electric grids stems from a lack of clarity regarding the policy goals underlying restructuring. Whether lower prices for consumers, open access to transmission, or the promotion of markets itself is the ultimate goal is far from clear. Just as problematic as the lack of well-defined policy goals is the lack of well-defined metrics for verifying whether the policy goals have been met. Good

> metrics are objective, thorough, consensual, and are reflected in policy decisions."

A return to regulated electricity markets may not be the way forward, but some interviewees identified the need for electricity markets which had environmental policy and development of infrastructure as major considerations (PI-2, PI-4, PI-10, PI-11, PI-12, PI-13). States developed electricity policy in isolation from their other policies such as environmental policy, when electricity policy needs to be developed in unison (or at least in coordination) with other state policies (CVP). Focusing on short-term objectives (or electricity prices in the short term) was not the path forward – and the increase in electricity prices post-deregulation is evidence of the need for a new review of the deregulation process (CVP).

The evidence demonstrates three major policy issues: first, that the plans and strategies for the creation of these deregulated markets were ill-defined from the outset and this problem has not yet been resolved; second, that the electricity industry is an example where market liberalisation policies have not delivered; and, third, the push for deregulation shows a conflict with considerable tension between states' attempts to manage their economies, environments and financial resources. These latter three issues and the research analysis into the contested hypothesis identify two lessons learned from this hypothesis for the future:

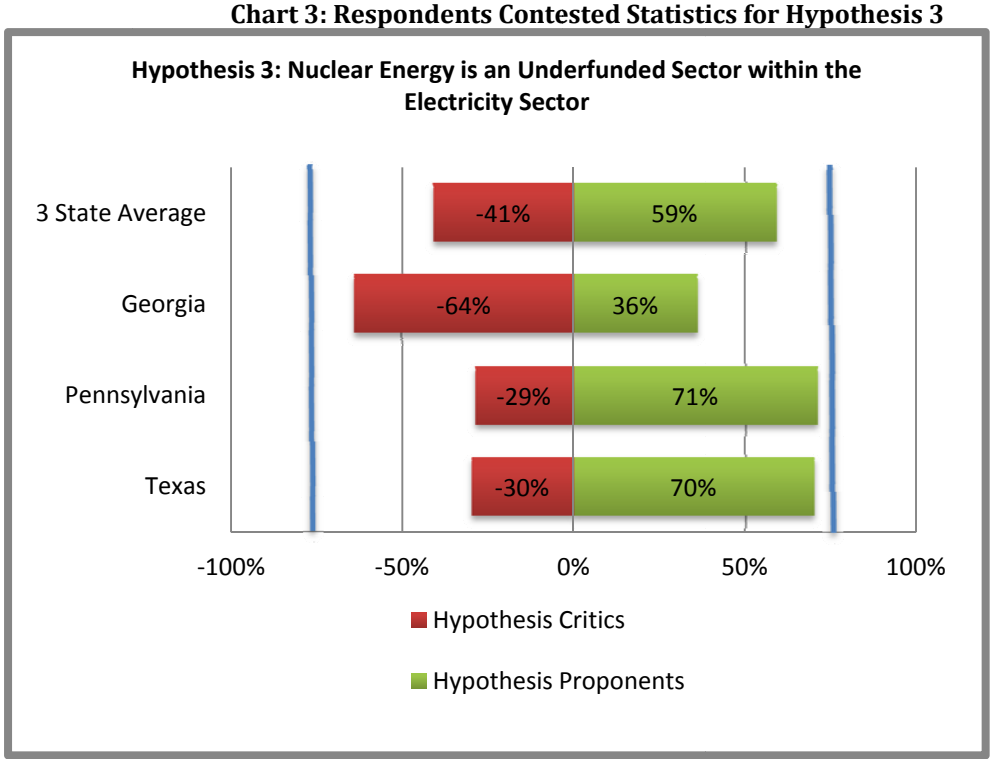
Lesson 2: *The public administration system in the electricity sector at state level in the US would benefit from realigning policy instruments with the policy goals of the sector.*

Lesson 3: *Deregulation as a policy in the electricity sector at state level merits a review.*

### 4.3: Hypothesis 3
### Nuclear Energy is an Underfunded Sector within the Electricity Sector

This was a contested hypothesis. The views of the respondents are near evenly divided across the three states on the issue and Chart 3 below exemplifies this even spread of the respondents on either side of the hypothesis decision line. 'Underfunded' in this hypothesis is taken to mean funding or finance from state or federal institutional sources. With opinion divided, it is evident that there is at some level a lack of information dissemination on the financial health of the nuclear energy sector. This represents a key concern for an industry such as nuclear energy where finance is an important issue because of high nuclear project costs and where safety issues are paramount.

**Chart 3: Respondents Contested Statistics for Hypothesis 3**




n=48, nGeorgia=11, nPennsylvania=17, nTexas=20

The majority of the literature on nuclear energy policy in relation to finance is dominated by nuclear economics and where construction costs are to the fore (Cantor & Hewlwtt, 1988; Mooz, 1979, 1979; Schriver, 1979; Komanoff, 1981; Zimmerman, 1982; Applied Decision Analysis 1983; Navarro, 1988; Proops, 2001; MIT, 2003, 2009). This research aims to focus more on the subsidies available to the industry and the financing of initiatives to encourage confidence in the industry (such as through safety and educational initiatives).

Some previous research has stated that the nuclear industry receives too many subsidies, such as through the Price-Anderson Act which provides a limited compensation fund of $10 billion should there be a nuclear accident (Dubin and Rothwell, 1990). The majority of interviewees were of the same belief and against the hypothesis. Nevertheless, the research into the hypothesis provides evidence contrary to that view: for example, underfunded safety initiatives in Georgia and subsidies in the electricity sector in Texas. Following the assessment of the research analysis and the interview evidence of the minority, hypothesis 3 was determined as proven, as the rest of this section will demonstrate.

*Pennsylvania*

Pennsylvania represents a different case from the other two states regarding this hypothesis, yet the hypothesis is similarly contested across all three states. Funding for state initiatives in the nuclear sector after the Three Mile Island (TMI) accident was of paramount importance to the state legislature in Pennsylvania (PI-7, PI-8, PI-10). State agencies received increased and sufficient levels of funding (PI-7, PI-8). Nuclear energy is seen as a vital part of the

economy in PA, and counteracts the environmental pollution from coal, and, despite TMI, people are accepting of nuclear energy in the state (PI-1, PI-4, PI-5, PI-7, PI-8, PI-10).

In Pennsylvania, despite the attention given to adequate funding for state agencies in the nuclear sector, too much is expected of the private sector in its ability to disseminate information to the public who need to be better informed (CVP). In particular, this function (formerly one of the public sector before privatisation) has not transferred itself to the private sector as of yet (PI-4, PI-13, PI-14, PI-15). Two issues are analysed here which demonstrate this same issue in the other two states. One concerns Texas, where people have a view that the nuclear energy sector is not underfunded. The other example is from Georgia, where the funding of a safety initiative identifies the lack of transparency in information provision in the sector.

*Texas*

The first issue regarding subsidy levels raises the problem of misinformation concerning subsidy levels in the electricity sector. In the case of the electricity sector, there is the need for a proper evaluation of subsidy levels and the merits of those levels. Competition in the electricity sector, particularly as the example that follows from Texas will demonstrate, is unfairly balanced (CVP). If deregulation of the electricity markets was an aim of the Texas state legislature, then this issue should have been resolved, as otherwise some incumbents and subsidised newcomers can emerge in stronger industry positions (CVP). There was a lack of research into how to level the 'playing field' for different electricity firms (CVP). This is not to mention which sources of electricity should have been preferred so as to benefit other state policies (i.e. so as to improve the state environmental policy or decrease carbon emissions). This demonstrates an example where best practice in the public administration process of deregulation could have been achieved.

Nuclear energy is considered by many of those interviewed (CVP) as an expensive option for electricity production for a variety of reasons. This centres on the industry having long construction times, being a highly complex technical project, and having extensive safety and environmental regulatory regimes. In addition, other interviewees (CVC) attach significant budget overruns and subsidies to nuclear projects. However, a few interviewees expressed the view that it is the uncertainty of what subsidies are available to nuclear energy that is adding to its expense (TI-12, TI-13). If there was the potential to cost nuclear to an accurate level, there would be more movement by individual firms to build new nuclear.

As stated, the lack of information dissemination is a feature of the nuclear energy industry, and across the energy industry itself in relation to subsidies. Nuclear energy as an industry is often challenged as an industry which is in receipt of too many subsidies (CVP). However, all across the energy industry subsidies are an everyday *modus operandi*. Indeed, while it is difficult to calculate subsidies (both direct and indirect) received by source when environmental

factors are taken into account Arias and van Beers (2010) demonstrate in a review of calculated subsidies that fossil fuels have been in receipt of major subsidies in industrialised nations. Further, a global assessment of subsidies in the energy sector as shown in Table 4 demonstrates that fossil fuels still receive significant subsides, and this figure is unquestionably higher according to an International Energy Institute (2010) which stated that globally it was €550 billion in 2008.

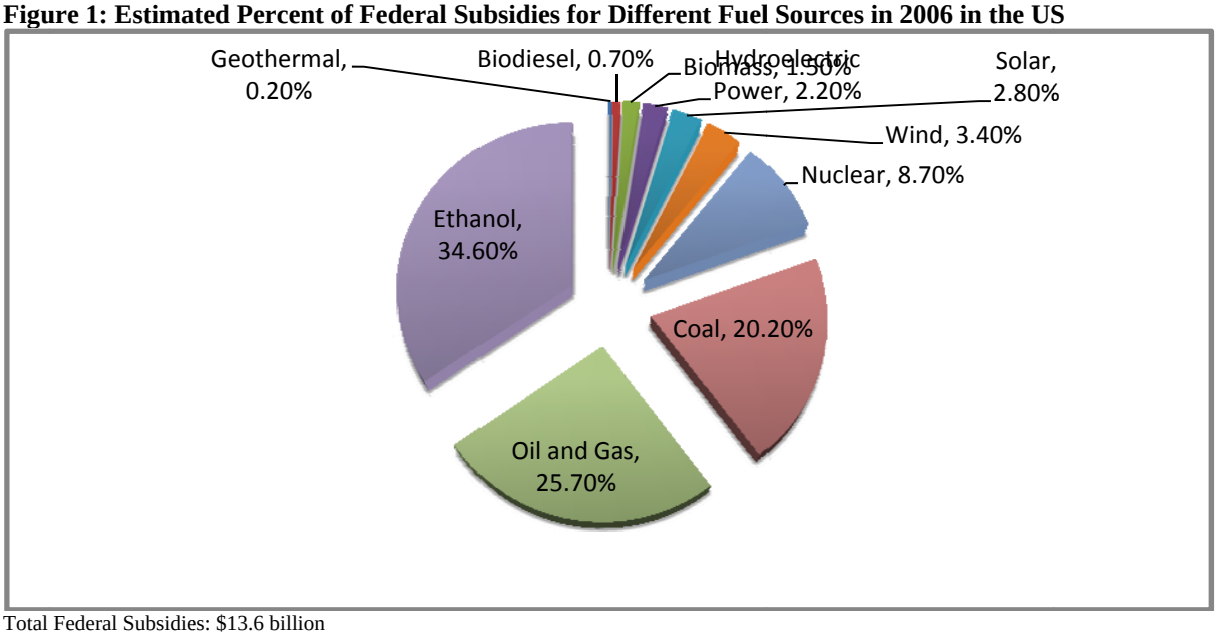
**Table 4: Subsidies to Different Energy Sources**

| Energy Type | Subsidy Estimate (US$ billion/year) | Subsidies per energy unit (US cents/kWh) |
|---|---|---|
| Nuclear Energy | 45 | 1.7 |
| Renewable Energy (excluding hydroelectricity) | 27 | 5.0 |
| Biofuels | 20 | 5.1 |
| Fossil fuels | 400 | 0.8 |

Source: Relative Subsidies to Energy Sources. Global Subsidies Initiative, 2010.

Figure 1 details at a Federal level the estimated amount each fuel source receives as a share in the total amount of subsidies ($13.6 billion) coming from the Federal government. The data demonstrates that nuclear energy receives only 8.7%, while coal (20.2%), oil and gas (25.7%) receive a significant share of the subsidies. Yet it is nuclear energy which has the major reputation for receiving subsidies (CVP).

**Figure 1: Estimated Percent of Federal Subsidies for Different Fuel Sources in 2006 in the US**




Total Federal Subsidies: $13.6 billion
Source: Adapted by author from Texas Comptroller of Public Accounts 'Energy Report 2008', pg. 371.

In examining the subsidies at state level for the electricity sector, Table 5 demonstrates that nuclear receives no subsidies while oil and gas receives $1.4 billion. Yet the majority of interviewees are unaware of such subsidies to nuclear's competitors in the electricity sector in Texas. These levels of subsidies in Figure 1 and Table 5 demonstrate that while nuclear energy does receive subsidies (at the Federal level), it receives less than its major competitors in

Texas, such as gas and coal, and distinctly less at state level. Indeed, gas receives near $1.1 billion in severance tax incentives in particular for high cost oil wells.

**Table 5: Estimated Texas State and Local Taxpayer Subsidies in 2006**

| Energy Source | Texas State and Local Subsidies | Energy Source | Texas State and Local Subsidies |
|---|---|---|---|
| Oil and Gas | $1,417,434,337 | Ethanol | n/a |
| Coal | n/a | Biodiesel | $2,107,420 |
| Nuclear | n/a | Wind | $1,508,800 |
| Total $1,417,434,337 | | Solar | $2,574,101 |
| | | Hydroelectric | n/a |
| | | Biomass | n/a |
| | | Geothermal | $45,400 |
| | | Total | $6,235,721 |

n/a= not applicable; *$2,074,101 of this total comes from Austin Energy utility company
Source: Compiled by the Author from Texas Comptroller of Public Accounts 'Energy Report 2008', pg. 372.

*Georgia*

The second issue concerns the financing of safety and education initiatives in industry. It is discussed how, in a time of planned industry expansion, costs were being reduced in safety and education initiatives. Elements of the nuclear power program are underfunded in Georgia (GI-9). Chart 3 illustrates the point that this is not just the view of the Southern Alliance for Clean Energy environmental group. This latter organisation, however, is taking Southern Nuclear to court in order to have more transparency in the operations of Southern Nuclear on their nuclear activities (GI-9).

Despite the ambition of Southern Nuclear to develop more nuclear power, it cannot ignore some of the financial concerns faced by other institutions in the state which affect those institutions' performance of their duties to high standards of safety. For example, the Environmental Protection Division (EPD) which operates the Environmental Radiation Program (ERP) has suffered financial cuts at a time when the nuclear industry is proposing expansion in Georgia (GI-5). Upon closer examination, it is Southern Nuclear that has contributed funding to this agency. It also made the funding cutbacks to this agency over the period 2007-2010, despite this period also representing the time when it was actively promoting its nuclear new build expansion plans (GI-5). However, the latter company did not act in isolation and the state legislator had a role to play too, and according to an employee in the Environmental Radiation Program:

> "We've had some instances in the past just with our programme where there were proposals that would have threatened the existence of this programme. And the way I've heard it …Southern Company legislators or lobbyists came to our aid and made sure that the legislature knew that if they carried through the proposals that they were talking about, that it would…in doing harm to our programme would in effect harm them as well" (GI-5).

It is clear that there is a realisation by Southern Nuclear, lobbyists and the legislature (the state of Georgia) that funding is needed for environmental

programs. However, despite this Southern Nuclear still persisted in reducing their funding. With work having already started at the site in Georgia by Southern Nuclear 2009 under a Limited Work Authorization permit, this action was inconsistent with the aim of nuclear expansion. It demonstrates poor public management in the state of Georgia that they have not prioritised safety in the electricity sector in new electricity generation projects.

In Georgia, those interviewees who are proponents of the hypothesis (CVP) state that there is a lack of understanding of the nuclear energy sector in the context of there not being the realisation that the composite parts of the nuclear energy sector make up the whole. For example, prioritising funding - which in the case of the EPD-EPR agency is a fraction of an overall nuclear budget - for such small but vital agencies that can increase public confidence in the nuclear sector represents good public management practice. It would demonstrate that those in nuclear sector have safety at the forefront of their operations and policy. In Georgia, this should be of particular relevance due to the presence on the River Keowee of reactors in South Carolina which have had bad reports concerning leaks of radioactive waste into the water (GI-5). This is in contrast to the performance of the Vogtle reactors on the same river where - not accounting for batch releases which are a normal process in the nuclear energy process - monitoring on the Vogtle plant has revealed no accidental or major releases, and that "*...you'd have a hard time proving from our environmental monitoring results that there were nuclear plants there*" (GI-5). This latter view, and the scientific analysis that supports it, need to be disseminated to the public in Georgia: i.e. the environmental monitoring results of this agency need to be publicised to demonstrate part of the environmental record of the operation of Plant Vogtle (GI-5). This can encourage public support for nuclear activities. Instead, this agency has insufficient funds to do so, nor are the value of its activities realised by other organisations in the Georgia nuclear sector (GI-4, GI-5, GI-9).

The analysis on the hypothesis revealed two major concerns over information dissemination in the nuclear industry - concerning subsidy levels, and the level of financing of safety and educational initiatives. This highlights the lessons learned in the nuclear energy sector for the future from the analysis of this hypothesis:

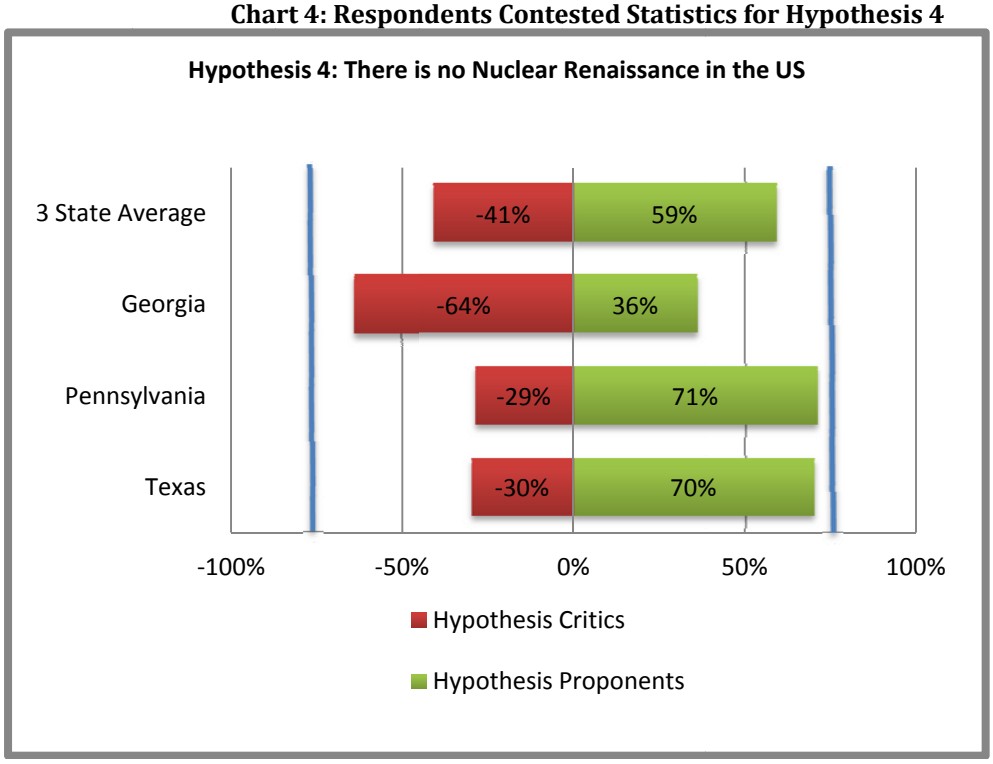
Lesson 4: *Policies for further information dissemination should be facilitated in the electricity sector at US state level.*

Lesson 5: *Consideration should be given to the establishment of new state-level agencies which can disseminate information on the electricity industry and in particular on the financial health of safety and educational initiatives.*

### 4.4: Hypothesis 4
### There is no Nuclear Renaissance in the US

This hypothesis was contested on average across the states. However, on the individual state level analysis both Texas and Pennsylvania were just within the threshold for a contested hypothesis, as shown in Chart 4. The majority of those interviewed believed that there is no nuclear renaissance in the US. However, despite this, and a low level of critics, after the research analysis into the hypothesis was not proven.

**Chart 4: Respondents Contested Statistics for Hypothesis 4**




n=48, nGeorgia=11, nPennsylvania=17, nTexas=20

The hypothesis was not proven for a number of reasons. The analysis demonstrates that there is a misconception of the nuclear renaissance, and what it was to be. Further, there has been a failure to take into account the evolution of the nuclear industry. Indeed, academic literature has recognised these issues (Joskow and Baughman, 1976; Rossin and Reick, 1978; Kasperson et al., 1980: Lestor, 1986). The nuclear industry is still growing in the US, albeit at a much slower pace than in the 1960s and 1970s. Indeed, its market penetration for a new technology was significant – circa 20% of the electricity market. This same level of market penetration should not have been expected to occur again, for the academic literature (see above, and Lund, 2006) suggests that market penetration levels will decrease as market share rises. The expectation therefore for the nuclear sector would therefore be slow incremental growth rather than a significant increase in the growth rate. This research aims to build upon this previous literature.

The nuclear industry has entered a new phase of evolution. This consists of plant upgrades (uprates) and licence renewals for existing nuclear reactors,

which have resulted in the slow regeneration of the industry. Indeed, one of the major developments in the nuclear industry over the 1990-2010 period has been the upgrades to nuclear reactors. The EIA (2010) has stated that year-on-year nuclear capacity increases each year from about 0.2 percent to 0.4 percent due to uprates in existing plants. There are however two other developments that may affected the evolution of the sector. A number of the interviewees who were proponents of the hypothesis stated that the nuclear renaissance was not going to happen and, if it were to have happened, it would be at a more advanced stage by now. However, to propound that view is to ignore two fundamental characteristics of the nuclear energy industry which will be discussed in the following paragraphs: (1) the technologically-determined attributes of the nuclear industry; and (2) the fact that the pace of change in the industry is defined by lengthy regulation and legal hearing processes - and these characteristics are not unique to the US.

1) Technologically-determined attributes of the nuclear industry

The change in technology in the nuclear industry concerns two effects: (1) the ability to prolong in operation the existing technology; and (2) the next generation reactor technology to be employed at new nuclear power plants in the US.

The majority of existing nuclear power plants can be expected to receive 20-year licence renewals in addition to their initial 40-year licenses (based on the fact that 70 out of the 104 reactors in the US already have been granted renewals – NRC, 2010). Maintaining this assumption will mean that a third of the existing US nuclear energy capacity will close between 2029 and 2035.[2] However, applying for a licence to operate a nuclear power plant beyond 60 years is not out of the question (CVC). It should be recalled that that Atomic Energy Act of 1954 authorised the US NRC to issue operating licenses for commercial nuclear power plants for a period of 40 years.[3] This 40-year time frame was not based upon technical limitations, but accounting and antitrust concerns (NRC, 2007). The law permits the NRC to issue operating licence renewals in 20-year increments, provided that the reactor owners demonstrate that continued operations can be conducted safely. As of 2009, the NRC has granted licence renewals to 50 of the 104 US reactors. 15 applications are under review and another 21 operators have indicated their intention to apply.[4] So far, no applications have been refused. In December 2009, the Oyster Creek Generating Station in New Jersey became the first nuclear reactor to begin its 40th year of operation, so it will be another 5 or 10 years before there is an indication of whether to continue beyond 60 years, provided that extending the life of a reactor remains an economically viable route.

[2] EIA, 2010. Annual Energy Outlook 2010 with Projections to 2035. US Nuclear Power Plants: Continued life or replacement after 60.
[3] Ibid, 69.
[4] See NRC website for this information and where updates to these statistics will be: Last Accessed August 2011: http://www.nrc.gov/reactors/operating/licensing/renewal.html.

Technological development has also occurred in the provision of new reactors. Nuclear new build projects in the US will all use Generation III technology – similar to current projects in France and Finland. In essence, the industry is rejuvenating itself, as it is undergoing an evolutionary phase to the next technological stage, and this is a slow process rather than a rapid one (CVC). This argument is further augmented by the changes which the regulator (NRC) has introduced into the industry in applying for design approval. New incentives for nuclear power (but not limited to nuclear power) were also introduced with the Federal Energy Policy Act of 2005; however, they have been slow to be introduced into the industry. For example, it was fully six years later, in 2011, that the first loan guarantees were awarded – in this case to Georgia (Southern Nuclear). Nevertheless, since 2005 firms in the nuclear energy sector have been developing their plans (CVC); Plant Vogtle in Georgia will be the first to go through the new regulation process, which consists of a Combined Operating and Licensing system (COL). The nuclear plant was also issued a Limited Work Authorization permit in 2009, and was also successful in securing an ESP (Early Site Permit) in 2009. It is currently applying for the COL, and this is expected to be awarded in early 2012.

2) The pace of change in the industry is defined by lengthy regulatory hearing processes

Little has changed since the last period when nuclear new build projects began construction (CVP). Public administration has not improved in terms of delivering a coherent long-term energy policy (CVP). Nuclear energy is cited as being one of the solutions in the battle against climate change, and also for US energy security and US energy independence (CVP). However, to date this has not been supported at an administrative level. The Energy Policy Act of 2005 (2005 Act) which incentivised nuclear new build, and was responsible for 18 applications for nuclear new build projects, has been slow in its implementation – "*...it (the 2005 Act) has taken years to implement*" (FNI-7). It was only in 2011 that the first company was awarded loan guarantees under the 2005 Act, and the amount stated to be available under the loan guarantee system has been demonstrated to have been significantly too low. This is evidenced by 2005 Act which allowed for $18.5 billion for loan guarantees, however, the Georgia project has claimed near half of these ($8.33 billion). Further, the Obama administration has debated and sought unsuccessfully an increase to the amount available under the loan guarantee system of up to $36 Billion in 2010 (Chu, 2010) and $54.5 billion in 2011 (Holt, 2011).

Mechanisms to deliver on policy in the form of outcomes remain a weakness of the US public administration system. Nor are there examples of project management for large infrastructure projects having improved in the US (TI-15). The NRC, viewed as a contributor to the time delays and cost overruns in the last nuclear new build projects, has aimed to standardise the design process for new projects, and implemented the new COL licensing process in order to decrease the length of time of the licensing process and provide more certainty in the process to potential operators (CVP). However, it is a new process, and Southern Nuclear in Georgia is the first company to go through this new

regulatory regime and consequently, as the test case, the process is expected to be slower (CVP).

The lessons learned from this hypothesis were:

Lesson 6: *Uncertainty in the legal structure of the nuclear industry continues to be a factor that hinders new investment. A legal system that establishes more confidence should be encouraged.*

Lesson 7: *The nuclear energy project in Georgia is a test case of the current legal regime and the lessons learned from this test case need to be implemented quickly to encourage future nuclear new build.*

Lesson 8: *The impact of electricity laws, such as the Energy Policy Act of 2005, would benefit from re-examination in light of the slow implementation process of these Acts.*

## 5: Conclusion

This research identifies key lessons over the period 1990-2010 from the nuclear energy sector which can enhance the conditions needed for new nuclear build. The research demonstrates the evolution of the nuclear industry in the US, which has taken the form of incremental change. The methodology identifies key assumptions within the nuclear sector in the US that are contested, and delivers lessons on how these contested issues may be resolved. The paper adds to the literature in public administration, legal development and nuclear energy policy, and in particular nuclear new build.

The paper advances research in nuclear energy policy in adding to the limited research that focuses in particular on nuclear new build. It contributes a three state study. While no nuclear new build has occurred in the US over the period 1990-2010, the industry has nevertheless been active. Capacity has been increased at existing nuclear plants, licences to extend reactor lifetimes have been applied for and plans are firmly developed in Georgia for two units at an existing facility (Plant Vogtle). However, as the industry is on the verge of a nuclear new build project for the first time in this period, the research identifies a number of policy areas that would facilitate growth of the sector should they be reviewed. The research provides these new insights through a unique comparison of US states which have deregulated, regulated and 'hybrid' electricity markets.

The research also advances knowledge in the public administration of the electricity sector, and in particular contributes to the literature on state led policy action within the US. The research identifies that any overall review of state energy policies would (or at least could) be beneficial to nuclear energy, due to it also being a source of clean energy. Primarily, this concerns electricity deregulation policy and information provision on the sector. Deregulation as a

policy in the electricity sector is in need of reform in some states. It has failed to provide for investment in the transmission system or new generation, and prices have not decreased. The lack of information dissemination in the nuclear energy sector is expressed as a major concern that is yet to be resolved. Consideration should be given to the establishment of a new state-level agency which can disseminate information on the electricity industry and in particular on the financial health of safety and education initiatives in the nuclear energy sector.

Numerous legal conditions have changed in the nuclear energy sector which increase the likelihood of future nuclear new build. In this context the research builds upon and advances the literature that focuses on the legal development of the energy sector. From the research it is evident the central role that law can have in the nuclear energy sector. States legislatures have become more active in the electricity sector and there is potential for them to incentivise nuclear projects at a local level. The Nuclear Regulatory Commission has re-designed the construction and operating licence system, which was previously a cause of delay. Nevertheless, the nuclear energy project in Georgia is a test case of the current legal regime and the lessons learned from this test case need to be implemented quickly to encourage future nuclear new build. Uncertainty in the legal structure of the nuclear industry continues to be one of the factors that hinders new investment and needs to be reviewed. In this regard, the impact and the evolution of electricity law such as the Energy Policy Act of 2005 should be re-examined in light of its slow implementation process.

The nuclear project in Georgia will serve the industry as the test-case. In all likelihood the onus or burden of proof will fall on the nuclear industry, ever more so, to prove its credentials in terms of meeting its operating safety requirements and having the capability to build a project to the highest safety standards as well as on time and on budget.

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# Appendices

## Appendix A: List of Interviewees

Interviews were completed with the individuals listed below. Other interviews completed which provided no new insight have been excluded. All those interviewed are thanked. All interviews were recorded with the permission of the interviewee. Interviews were conducted in the United States during June to August 2010.

48 interviews had been completed by the end of the process. Interviewees lasted between 25 - 150 minutes. Interviewees included state politicians, state regulators of electricity, state nuclear safety offices, electricity grid operators, electricity and nuclear energy company operators, academic experts, and members of various other state institutions, and environmental groups in all three states. All state senators and state house members were member of the state energy committees responsible for nuclear energy.

In interview, interviewees were asked to focus on the period 1990-2010. This was achieved by asking them what were the major developments in the nuclear sector over that period of time. The interviewer asked in question form the twelve hypotheses or elicited the answer by making a statement and asking the interviewee their opinion. In other cases the interviewee stated their view on the issues without the need for intervention. The interviews followed a semi-structured approach based around the 12 hypothesis.

The empirical data was analysed using *Atlas.ti qualitative data analysis v.6*. Coding categories were developed from the literature review that reflected the key issues in nuclear new build, for example, as legal development, regulation, technology, political change. The data was sorted, with further sub-categories developed. The advantage of such a qualitative data analysis is that it allows for statements and claims of various interviewees to be corroborated against other interviewees. This is also a validity process which is of central importance to qualitative research (Miles and Huberman, 1994). Validity in this regard is the process of checking, questioning, and theorising, and not a strategy for establishing rule based correspondence between findings and the real world (Miles and Huberman, 1994).

**Table A: Georgia Interviewee List**

| Interview Code | Interviewee Position | Organisation |
|---|---|---|
| GI-1 | State Senator | Georgia State Senate |
| GI-2 | Commissioner | Georgia Public Service Commission |
| GI-3 | Public Relations Officer | Southern Company |
| GI-4 | Board of Directors | Southern Company |
| GI-5 | Manager | Georgia Department of Natural Resources – Environmental Protection Division, |

| | | |
|---|---|---|
| | | Environmental Radiation Program |
| GI-6 | President and CEO | SERC Reliability Corporation |
| GI-7 | Engineer | Georgia Public Service Commission |
| GI-8 | Director | Center of Innovation for Energy.<br>Georgia Environmental Finance Authority (GEFA) |
| GI-9 | High Risk Energy Director | Southern Alliance for Clean Energy |
| GI-10 | Professor, School of Public Policy | Georgia Institute of Technology, & Oak Ridge National Laboratory |
| GI-11 | Professor of Law | Emory Law School, Emory University, Atlanta |

**Table B: Pennsylvania Interviewee List**

| Interview Code | Interviewee Position | Organisation |
|---|---|---|
| PI-1 | State Senator | Pennsylvania State Senate |
| PI-2 | State Senator | Pennsylvania State Senate |
| PI-3 | State House Member | Pennsylvania State House of Representatives |
| PI-4 | State House Member | Pennsylvania State House of Representatives |
| PI-5 | State House Member | Pennsylvania State House of Representatives |
| PI-6 | Chief, Division of Nuclear Safety | Pennsylvania Department of Environmental Protection |
| PI-7 | Nuclear Safety Specialist | Pennsylvania Department of Environmental Protection |
| PI-8 | Utility Energy Analyst | Pennsylvania Public Utility Commission |
| PI-9 | Client Manager, Market Services Division | PJM Interconnection, LLC |
| PI-10 | Head of Office of Consumer Advocate | Office of Attorney General - Pennsylvania |
| PI-11 | Professor of Technology,<br>Executive Director of Carnegie Mellon Electricity Industry Center | Tepper School of Business, and Engineering and Public Policy, Carnegie Mellon University, PA |
| PI-12 | Professor of Economics and Co-Director of Carnegie Mellon Electricity Industry Center | Tepper School of Business, and Engineering and Public Policy, Carnegie Mellon University, PA |
| PI-13 | Assistant Professor of Energy Policy and Economics | Department of Energy and Mineral Engineering, and Electricity Markets Initiative Pennsylvania State University – Electricity Centre |
| PI-14 | Director | Center for Energy, Enterprise and the Environment, Penn Future |
| PI-15 | Director | Citizen Power (PA) |
| PI-16 | Supervisor – PPL Susquehanna Energy Information Center | PPL - Susquehanna Energy PA |
| PI-17 | Principal Market Planning Analyst | Exelon |

**Table C: Texas Interviewee List**

| Interview Code | Interviewee Position | Organisation |
|---|---|---|
| TI-1 | State Senator | Texas State Senate |
| TI-2 | State House Member | Texas State House of Representatives |
| TI-3 | State House Member | Texas State House of Representatives |
| TI-4 | Director of Competitive Markets Division | Public Utility Commission |
| TI-5 | Director of Communications | Public Utility Commission |
| TI-6 | Senior Research Analyst | Texas Comptroller of Public Accounts |
| TI-7 | Assistant Director of Regulatory Analysis | Office of Attorney General |
| TI-8 | Assistant Director of Regulatory Affairs | Office of Public Utility Counsel, Texas. |
| TI-9 | Director Of Media Affairs | ERCOT, Texas |
| TI-10 | Corporate Communications | Austin Energy |
| TI-11 | Director, Market Policy at CPS Energy | San Antonio Energy (CPS) |
| TI-12 | Director of Communications | NRG Texas LLC. |
| TI-13 | Vice President of Nuclear Project Development | Exelon |
| TI-14 | Vice President of Regulatory Affairs | South Texas Project Nuclear Operating Company |
| TI-15 | CEO | Former Luminant/Energy Start-Up (TX) – Clean Energy Technology Association |
| TI-16 | Energy Specialist | Environmental Defense Fund |
| TI-17 | Research Associate | Centre for International Energy & Environmental Policy, LBJ School of Public Affairs, The University of Texas at Austin. |

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|---|---|---|
| TI-18 | Research Assistant and PhD Candidate | Centre for International Energy & Environmental Policy, LBJ School of Public Affairs, The University of Texas at Austin. |
| TI-19 | Assistant Professor | Cockrell School of Engineering, The University of Texas at Austin. |
| TI-20 | Senior Research Scientist | Institute for Fusion Studies, The University of Texas at Austin. |

*All State senators and State House members interviewed were on their states' respective energy or environmental committees.

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