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Relationship of Solar Energy Installation Permits to Renewable Portfolio Standards and Insolation

Kirt Gordon Butler
Walden University

Walden University

College of Management and Technology

This is to certify that the doctoral dissertation by

Kirt Butler

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Review Committee
Dr. Jules Klagge, Committee Chairperson, Management Faculty
Dr. David Gould, Committee Member, Management Faculty
Dr. Mohammad Sharifzadeh, University Reviewer, Management Faculty

Chief Academic Officer
Eric Riedel, Ph.D.

Walden University
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Abstract

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by

Kirt Gordon Butler

MS, National Technological University, 2000

BS, Weber State University, 1991

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Legislated renewable portfolio standards (RPSs) may not be the key to ensure forecast energy demands are met. States without a legislated RPS and with efficient permitting procedures were found to have approved and issued 28.57% more permits on average than those with a legislated RPS. Assessment models to make informed decisions about the need and effect of legislated RPSs do not exist. Decision makers and policy creators need to use empirical data and a viable model to resolve the debate over a nationally legislated RPS. The purpose of this cross-sectional study was to determine if relationships between the independent variables of RPS and insolation levels and the dependent variable of the percentage of permits approved would prove to be a viable model. The research population was 68 cities in the United States, of which 55 were used in this study. The return on investment economic decision model provided the theoretical framework for this study and the model generated. The output of multiple regression analysis indicated a weak to medium positive relationship among the variables. None of these relationships were statistically significant at the 0.05 level. A model using site specific data might yield significant results and be useful for determining which solar energy projects to pursue and where to implement them without Federal or State mandated RPSs. A viable model would bring about efficiency gains in the permitting process and effectiveness gains in promoting installations of solar energy-based systems. Research leading to the development of a viable model would benefit society by encouraging the development of sustainable energy sources and helping to meet forecast energy demands.

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Dedication

To Dad (1934 – present) and Mom (1935 – 2014).

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Chapter 1: Introduction to the Study

The way of life led by typical individuals living in the United States exists because of the energy resources that are at their disposal and used by them every day (Hobbs & Meier, 2003). This way of life is threatened by global warming and an energy resource shortage (Rifkin, 2011). Global warming has been directly correlated to the use of fossil-based fuels as an energy resource (Global Carbon Project, 2011). Those who create policy and those who make decisions are faced with the task of addressing both of the societal concerns of global warming and the energy resource shortage if the current way of life is to be maintained and have forecast energy demands to be met. A nationally legislated renewable portfolio standard (RPS) is being considered by some policy creators and decision makers as a means of addressing these societal concerns (Bingaman, 2010). The problem is that policy creators and decision makers do not have a model they can use that considers the relationship that legislated RPSs and solar radiation levels may have with the percentage of approved permits for the installation of solar energy-based systems in the United States.

The remainder of Chapter 1 is comprised of several major sections that expand upon the need for this study. In the background section, I identify the gap that needs to be filled in current knowledge in order to address the problem. In the problem statement, I identify the variables and assessment approach used to conduct the study as well as the approach used in the research. In the section for the purpose of the study, I set present the specific focus and approach used in the research. The section titled theoretical framework for the study contains a discussion relevant to how the research question and hypotheses are related to theoretical considerations around the problem under study. In the sections for the definitions, limitations, and scope, I set forth the boundaries that are inherent in the research method and design. Finally in the summary, I briefly connect the preceding sections into a composite whole.

Background of the Problem

To legislate or not legislate a federal RPS is a question that has been debated over for the past decade. According to Senge (2006), positive social change cannot be achieved without the use of unbiased models in policy as well as decision-making efforts. This quantitative and cross-sectional survey-based research study was an effort to examine relevant data and develop a plausible model that policy creators and decision makers may use in their evaluation of the rationale for a nationally legislated RPS. The survey used for this study is contained in Appendix A.

To accomplish this examination, multiple linear regression analysis was used to examine the relationship between the independent variables of the existence of legislated RPSs and solar radiation levels with the dependent variable of the percentage of permits approved in the United States during the period from January 1, 2011 to December 31, 2011. If a legislated RPS was enacted any time during the 2011 calendar year, it was considered to be a legislated RPS. Historic longevity of an RPS was not the focus of this study. As the RPS level may either be legislated or not, this particular independent variable was considered to be a categorical (e.g., dummy) variable, it was given a coding of 1 when a legislated RPS existed and 0 when a legislated RPS did not exist. This approach for the use of a categorical variable in multiple linear regression was argued by Cohen, Cohen, West, and Aiken (2003). This approach is further explained in Chapter 3. Data used for this analysis were not used in a time-series context, nor were data obtained from a time-series context. This is further explained in Chapter 3. The solar radiation levels used for this study were the calculated median for the period from 1961 to 1990, as this was the period for which such data were published. The median was used as that statistic is robust and represents the fully trimmed center range of data (Ryan, 2011). This use of the median is explained further in Chapter 3. Only those permits that had applications submitted and the associated permit approved during the 2011 calendar year were the focus of this study. Results of this study may provide unbiased means that policy creators and decision makers may use for the evaluation of proposals for a nationally legislated RPS.

Legislated RPSs are one means by which elected officials of any given state in the United States may manage renewable energy resources, address global warming concerns, and institute means to support forecast energy demands (Graziani & Fornasiero, 2007). This study was conducted so that policy creators and decision makers may have a decision model that considers the relationship between legislated RPSs and solar radiation levels with the percentage of permits approved for the installation of solar-energy-based systems.

Some policy creators and decision makers in some jurisdictions have legislated RPSs in order to force renewable into the energy portfolio used to energize their community. Others refuse to legislate any RPS, and others refuse to include solar-based energy as a renewable form in any legislation. In 2011, 23 states in the United States had a legislated RPS (National Renewable Energy Laboratory [NREL], 2011. Yet, some states without a legislated RPS had more than twice the installed megawatt (MW) capacity of solar energy-based systems of those with a legislated RPS (Energy Information Association [EIA], 2011). In some states, legislators had energy resource related goals they had agreed on, yet not mandated through legislation (NREL, 2011). Though these goals are not legislated, they still comprise an RPS (NREL, 2011). Such cases were considered as a 0 for coding of this categorical variable for this research study. Again, this follows recommendations argued by Cohen, et al. (2003) regarding categorical variables and their use in multiple linear regression analysis.

Officials in the US Senate, Congress, and the Department of Energy are in debate over enacting a nationally legislated RPS (Schoofs, 2004). Senate Concurrent Resolution 3, as proposed during the 110th session of the Senate and Congress, is one example that demonstrates the extent of this 10-year debate (Tuerck, Bachman, & Head, 2011). According to Tiscareno-Sato (2012), President Clinton has been credited with saying; “If we’re not first or second in the world for power generated by renewables, shame on us” (p. 1). The US population may not need a nationally legislated RPS to keep it from shame, as evidenced by successes achieved by policy creators and decision makers in some states that do not have a legislated RPS.

Proponents for a nationally (e.g., federally) legislated RPS point to adverse trends in global warming, peak oil, and national security as reasons to enact a national RPS (Rocky Mountain Institute [RMI], 2012). In his 2011 State of the Union address, President Obama voiced the goal for 80% of the US energy supply to come from renewable sources by 2035, indicating that this would be a basis for a national RPS (Obama, 2011). Opponents of a nationally legislated RPS point to botched federal initiatives, poorly managed incentive programs, and results achieved in states without a legislated RPS as reasons to not enact a nationally legislated RPS (Ecological Society of America [ESC], 2012).

Legislating an RPS without understanding the plausible effects of such legislation can have adverse results from those intended. According to Tuerck, Bachman, and Head (2011), the cost of a nationally legislated RPS to the U.S. economy would exceed $4 trillion and job losses would exceed 1 million. These figures are based on a potential nationally legislated RPS of 30% (Tuerck, et al., 2011). If these figures are correct, the adverse societal effect of a nationally legislated RPS becomes more evident. Multiplying these figures by 2.67, which is the factor needed to reach the goal of 80%, as proposed by President Obama (2011), the societal effect is catastrophic (Tuerck, et al., 2011). Schoofs (2004) concluded that; "The large amount of questions that remain indicate that; passage of a federal RPS should only be done after more study is done" (p. 36).

Results of this study indicate that a federally legislated RPS is unnecessary. Results of this study indicate that reducing the impediments and number of steps to submit a solar-energy based system application and obtain a permit will produce a better return on investment. Thereby promoting this form of renewable energy while adding infrastructure to support forecast electrical energy demand, and reducing financial burdens on taxpayers.

There is a looming energy crisis in the US that must be addressed before essential services are adversely affected. According to information in the Future Renewable Electric Energy Delivery and Management Center (FREEDM, 2011) the United States is on the brink of an energy crisis. According to Woody (2007), this crisis cannot be avoided by incurring the cost of a nationally legislated RPS. This looming energy crisis is further exacerbated due to this nations ranking as the least user among developed nations of renewable energy resources (FREEDM, 2011). Rifkin (2011) warned that the looming energy crisis can only be mitigated through the institutionalization of nationally and internationally legislated RPSs. Results of this quantitative research study provide an approach that may be used by policy creators and decision makers for subsequent consideration of legislative necessity, energy resource management, and promotion of renewable energy resources and portfolio standards, particularly those involving solar energy.

The return on investment (ROI) economic decision model was the theoretical framework for this quantitative research study. The associated equation, calculation, and application for ROI in terms of this research study are explained further in Chapter 3. Multiple linear regression analysis provided the statistical basis for this quantitative research study. For this study I chose to focus on three specific areas. These are as follows:

- Level, represented by X1 in relevant formulae (e.g., legislated or not) of RPS for each city or state (e.g., jurisdiction) comprising the study population during the study period from January 1, 2011 to December 31, 2011. This constitutes a categorical (e.g., dummy) variable. Note that a coding of 1 was used to indicate a legislated RPS and a coding of 0 was used to indicate that there was not a legislated RPS. This is in accordance with the requirements for conducting such analyses based on argument by Cohen, et al. (2003). This is further explained in Chapter 3.
- Calculated median solar radiation (e.g., insolation) level for each state (or applicable city if available) during the period from 1961 to 1990, represented by X2, in relevant formulae. This is the period for which these data were published (Marion & Wilcox, 1994). Such data have not been published otherwise, making this publication by Marion and Wilcox the only available source of these data published in a format that is useful, yet still applicable for this study. These data were still useful and viable for this study because the data spans 30 years. Marion and Wilcox noted that there was little statistically significant and measurable change in the data

from one year to the next, in terms of standard deviation. Therefore, it was deduced that said data were viable to use for this study. The calculation for the median solar radiation levels was based on published data for southward facing flat-plate collectors with a fixed tilt (Marion & Wilcox, 1994).

- The percentage of permits approved, in terms of solar energy-based systems installations, for each city comprised the study population during the study period from January 1, 2011 to December 31, 2011. This dependent variable is represented by Y in relevant formulae.

As achievement of energy security through RPSs is dependent on the available energy resource, solar insolation data were used as a means to demonstrate why an RPS with any stipulated solar-based energy goal may or may not be plausible and of positive social benefit (e.g., a positive ROI). The relevant ROI, in terms of median insolation level and the percentage of approved permits for each applicable jurisdiction in the sample population, was calculated. The calculated ROI results were juxtaposed to regression analysis results as one means to check validity of the regression model. The means of calculating and applying this ROI is further explained in Chapter 3. Results of this demonstration may have bearing on the federal RPS debate and proposal. Results from this study may influence efforts by legislators, lobbyists, entitlement seekers, and special interest groups (policy and decision makers). Study results may shed new light on validity of such federal efforts as the SunShot Initiative enacted by the Department of

Energy (DOE, 2011), and the associated solar city awards (DOE, 2011). Results from this quantitative and cross-sectional survey-based research study were used to develop a model that policy creators and decision makers may use in their evaluation of the rationale for a nationally legislated RPS.

Published research and literature regarding the potential relationship between legislated RPSs, as noted in Appendix B, and solar radiation levels, as noted in Appendices B and C, with the percentage of approved permits for the installation of solar energy-based systems is sparse. Literature and published research studies concerning the examination of this relationship through the lens of economic theory with an ROI decision model (Sullivan, Wicks, & Koelling, 2011) focus is also sparse. Nonetheless, economic theory has been applied in various ways in efforts to manage aspects of energy based systems, including the promotion of energy resources and decisions relevant to their use (Hobbs & Meier, 2003). Some of these efforts have been supported and driven by way of federal and state government-sponsored initiatives.

One federal government effort to promote and ease decision-making based on ROI regarding solar energy use was the SunShot Initiative (DOE, 2011). This initiative was enacted in February 2011 in an effort to spur greater use of solar energy through a focus on reduction of system cost and streamlining of permitting processes (DOE, 2011). However, the mechanics and administration of this initiative did not include consideration of the relationship that existence of an RPS and solar radiation level may have with the percentage of approved permits for the installation of solar-based energy systems.

The city of Seattle, WA, which received a median level of solar radiation of 3.8 kWh/m^2/day (Marion & Wilcox, 1994), was a recipient of funding through the SunShot Initiative (DOE, 2011), even though the median annual insolation is less than other cities, such as Los Angeles, CA, which received median annual insolation of 5.45 kWh/m^2/day, and Santa Fe, NM, which received median annual insolation of 6.25 kWh/m^2/day (EIA, 2012). This is a difference of 43.42% and 64.47% respectively. Neither of these two cities (e.g., Los Angeles, CA and Santa Fe, NM) was selected as a solar city, even though their potential for electrical power production was greater than that of Seattle (Behrens, 2011). From the business and societal benefit perspectives, it makes sense to base legislation on facts such as insolation levels and ROI instead of emotion (Hofstede, Hofstede, & Minkov, 2010) and well written qualitative essays (Gordon, 2012).

According to data published by the DOE (2011), there are more than 18,000 permitting jurisdictions in the United States. This does not include the various electrical utilities, which often have to be included in permit review and approval processes as they often have jurisdiction over electrical power grids (DOE, 2011). Each of these jurisdictions has an energy resource management model and a jurisdictional boundary wherein they may pursue and practice energy resource management (Martin & Osherson, 1998). This is regardless of RPS status and the type of utility ownership. The American Tradition Institute (2011) argued that enactment of a national RPS would favor publically traded ownership type utilities and penalize the rest. This form of disparate energy resource policy (e.g., favoring one entity over another without scientific basis) could put downward pressure on the percentage of permit approvals and further worsen the energy crisis. It could also inflate the consumer cost of a nationally legislated RPS beyond the current estimate of more than $4 trillion (Tuerck, et al., 2011).

The proponent population for a nationally legislated RPS included more than 18 senators and congresspersons, President Obama, and a host of lobbyists from firms that manufacture systems for the production of energy from renewable sources (Tuerck, et al., 2011). Before its bankruptcy and collapse, Solyndra was one of these firms (Solyndra, 2011). Inclusion of this statement regarding Solyndra is critical due to the loan this company received from the DOE merely 2 years before Solyndra went out of business (Romano, 2011) as it is another example of how the federal government has engaged in energy resource management. Rule (2010), James (2011), and Shrimali and Kniefel (2011) considered this to be an example as to why the federal government should neither levy nor oversee a national RPS as it is a demonstration of poorly managing resources. None of the literature I researched that was published by entities of the national RPS proponent population touched on the relationship and analysis of the dependent and independent variables that were the focus of this study. I did not find any publications to refute the opposing arguments made by Schoofs (2004), Woody (2007), or Tuerck, et al. (2011).

Energy resource management models include mathematical and financial equations, organizational structure and hierarchy, and decision criteria and gates (Hobbs & Meier, 2003). Some of these models differ slightly from others, while some differ significantly in terms of their structure and means of prompting proactive action regarding management of energy resources (Rifkin, 2011). An example of a relevant model that includes elements from economics, organizational structure, and decision gates is the integrated resource planning model discussed by Logan, Neil, and Taylor (1994). The SunShot Initiative (DOE, 2011) is primarily based on the Breakeven Model from economic theory (DOE, 2011). The American Recovery and Reinvestment Act (ARRA, 2009) is primarily based on a stochastic model (Committee for a Responsible Federal Budget, 2009). Both the SunShot Initiative and the ARRA were based on economic principles of ROI, risk-benefit analysis, and supply and demand. One ROI model of consideration could be the energy returned versus the energy invested. For this model, a positive ROI would be demonstrated by having produced more energy than the work (e.g., energy) expended to produce it. This is a topic for future research. Another model is the mathematical equation for ROI, as provided in *Equation 1*.

Equation 1: ROI = [(Payback - Investment) / Investment)]*100, where

Payback = money earned or gained from the investment. This can also be the money saved from having made the investment.

The general phrase of energy resource management model(s) will be used from this point forward throughout this dissertation in place of each distinct type of management model (e.g., stochastic, integrated resource planning, breakeven, etc.). There are various approaches that decision makers and policy creators may pursue under the umbrella of a given model. For example, one approach could be focused on reducing an organization's carbon footprint to such an extent that carbon credits may be sold, creating a new revenue stream (American Solar Energy Society [ASES], 2011). Another approach could be focused on reducing energy related costs by means of energy conservation (EnerNoc, 2012). As a result, energy resource management models are quantitatively and qualitatively based (Barnes, Khandker & Samad, 2010).

The SunShot Initiative enacted by the DOE (2011) created 25 solar cities, a distinction given to cities that received DOE funds to promote the use of solar radiation for electrical power generation. A list of these solar cities is provided in Appendix C. Each of these cities received in excess of $500,000 to promote solar energy (DOE, 2011). The award decision was not based on the solar radiation received in the area that comprises the awardee jurisdiction. Rather, it was based on essays and proposals written by department personnel from these areas and submitted to the DOE for consideration as a potential awardee (DOE, 2012). The city of Seattle was a recipient of funding. The city of Los Angeles was not, even though city decision and policy makers submitted the requisite essay and proposal (Woody, 2012).

Intuitively, scientifically, and practically it is known that Los Angeles has a higher amount of insolation (e.g., solar radiation) than does Seattle. As a result, photovoltaic and concentrating solar energy-based systems can be used with greater success in Los Angeles than in Seattle (National Renewable Energy Laboratory, 2011). Successful use means that the system is generating the level of electrical energy that it was designed to accomplish, indicating a positive ROI and societal benefit. An applicable ROI equation, and the means of calculation performed with it, as well as the pertinent variables and its application, is further explained in Chapter 3. Yet, the distinction and associated funding went to a location with less energy production potential, even though both states had a legislated RPS, as noted in Appendix B. In fact, for 2010, the 1MW PV capacity built by the State of Washington failed to produce any measureable electricity (EIA, 2012). So, taxpayers (e.g., society) did not receive any return for their investment, in terms of energy production, from this 1MW facility (Seattle City Light [SCL], 2011). The award criteria were available to the general public even though the general public may not have known these criteria. Another source for this award and funding scenario includes the DOE (2011). This and other sources are used and cited in Chapter 2.

Awarding a less capable entity is a practice that is contrary to stable and sustainable economics, as argued by Smith (1994) and Sullivan et al. (2012). Regardless, the federal entity that oversaw this award scenario is the same one that would be in charge of implementing, overseeing, and enforcing a nationally legislated RPS (American Tradition Institute, 2011). This award scenario is another example of an energy resource management model, with the energy resource of concern being the funding, based on the perspective of the receiving jurisdiction (SCL, 2011). Award scenarios and practices such as this, drive up the overall cost of renewable solar energy-based systems (Woody, 2012). Such award oriented practices cause the taxpayer to incur a greater tax burden, often at significant loss (TulsaWorld, 2011). Taxpayer funds are often used to support government driven financial awards and efforts, such as the SunShot Initiative (Internal Revenue Service [IRS], 2012). So that taxpayers are afforded the best ROI possible for their funds, and so that national interests, in terms of electrical energy production, are effectively supported, it is necessary to ensure that decisions and policies concerned with permits and RPSs are instituted with a scientifically and economically, instead of emotionally biased, approach and rationale (Sullivan et al., 2012).

Problem Statement

Managers of permitting agencies, owners and operators of electricity consuming facilities, and elected government officials (all of which constitute policy creators and decision makers), need an energy resource management model regarding the relationship between legislated RPSs and solar radiation with the percentage of permits approved for solar energy-based systems installations in order to properly determine if a nationally legislated RPS is needed (Schoofs, 2004). There is a gap in published research, available literature, and energy resource management models concerning the relationships that may exist between legislated RPSs and solar radiation levels with the percentage of permits approved for the installation of solar energy-based systems. As with any construction effort, permits are required for such installations (King County, 2012). The higher the percentage of approved, legitimate permits, the more plausible it is that projected energy demands and compliance to a legislated RPS will be achieved.

It is unknown if having a legislated RPS makes any difference in the percentage of approved permits for installations of solar energy-based systems at any location, be it a residence or commercially oriented site. The lack of published research studies on this topic and the debate over a national RPS indicate that this is a problem that warrants study. The estimated cost, in terms of economic burden of enacting a nationally legislated RPS, as argued by Tuerck, et al. (2011), also indicated that this study is warranted. Results from this study may bridge this gap in knowledge and add to the body of knowledge relevant to energy resource management. The results may cause policy creators and decision makers to change their rationale and decision models with regard to energy resource management and RPSs.

Purpose of the Study

The purpose of this quantitative, cross-sectional study was to examine the relationship between (a) legislated RPS and the percentage of approved solar energy permits and (b) median annual solar radiation level by state and the percentage of approved solar energy permits for 68 separate jurisdictions within the United States. Through this examination, I tested the hypotheses and suggested recommendations that policy creators and decision makers may use in their evaluation of the rationale for a nationally legislated RPS. The variables for this examination were the following:

- RPS category (e.g., legislated or not, which is a dichotomous factor) for the RPS associated with each jurisdiction in the study population. This independent variable was represented as X1, and was either a 1 or 0, according to the RPS status (e.g., legislated or not) for the jurisdiction. This is a categorically oriented variable in that it is the evidence for one of two qualitative states for RPS status (e.g., legislated or not) as described by Cohen et al. (2003). This is explained in more depth later in this chapter and in Chapter 3.
- Median annual solar radiation level for each state (or applicable city if available) comprising the study population, which was the other independent (e.g., explanatory or predictor) variable, was represented as X2.
- The percentage of permits approved, specifically for solar energy-based systems installations, within the study population during the study period, which was the dependent variable, was represented by Y.

The regression equation, which is *Equation 2*, was

Equation 2: Y = Bo + B1X1 + B2X2 + E, where

Y represented the percentage of approved permits for a given jurisdiction from the calculated, randomly selected sample population from the study population, Bo represents the Y intercept for the combined dataset of all given jurisdictions from the calculated, randomly selected sample population from the study population, remaining Bs were constant yet unknown slopes (e.g., regression coefficients), X1 represents the RPS level, and was a 1 or 0 for each given jurisdiction from the calculated, randomly selected sample population from the study population, X2 represented the median level of solar radiation in kWh/m^2/day for each given jurisdiction from the calculated, randomly selected sample population from the study population, and E was the random error in prediction.

Once policy creators and decision makers have statistically based research regarding the relationship between these variables, perhaps they can come to an agreement regarding the need to enact or not enact a nationally legislated RPS. They may revise permitting processes in order to foster a higher percentage of approved permits for solar energy-based systems, resulting in increased energy production. This increased energy production may stem the energy crisis and ensure that a way of life can be sustained, thereby creating positive social change.

Research Question(s) and Hypotheses

Research questions and hypotheses, as well as the rational for each, are introduced in this section. According to Reynolds (2007), “Hypotheses are those statements without support from empirical research” (p. 80). Therefore, in order to reject or fail to reject a hypothesis, empirical data must be obtained from actual events. Ideas projected through hypotheses must be informed by asking questions focused on obtaining measureable data relevant to the variables being studied (Cohen, 2009). The research questions for this study were generated according to these criteria. These questions are annotated as the primary question and the secondary questions. There are four secondary questions. Though there may be a host of other potential primary and secondary questions that could be posited based on their relevance to such things as cultural influence, state population, and financial situation of citizenry, these were not the focus of this study. Only the following primary question encompassed the focus for this study:

Does a statistically significant relationship exist between legislated RPSs, solar radiation levels, and the percentage of permits approved in the study population during the study period?

The following secondary questions were used to inform this study:

1. What is the level (e.g., categorical scale) of RPS (e.g., legislated or not) for each state or jurisdiction? Answers to this question provided data relevant to the independent variable of a legislated RPS (e.g.,X1).
2. What is the calculated median solar radiation level (e.g., as measured in $kWh/m^2/day$) impinging on each jurisdiction comprising the sample population for this study during the study period? Answers to this question provided data relevant to the independent variable (e.g., X2) of annual median solar radiation levels. Appendices B and C contain this information relevant to capital and solar cities.

3. What is the percentage of permits approved (e.g., as a measured percentage of application submitted versus approved) for the installation of solar energy based electrical system infrastructure projects within the borders of each jurisdiction (e.g., each city) comprising the randomly selected sample population for the study period? Chapter 3 contains explanation relevant to this population and the selection method. Answers to this question provided data relevant to the dependent variable (e.g., Y) of the percentage of approved permits.

4. What was the resulting ROI for the calculated median insolation as a function of the permit application effort for each jurisdiction in the study population? Answers to this question aid in providing context to the relationship scenario noted in the primary research question, in terms of ROI. The formula used to calculate this and the rationale for it is expressed in Chapter 3. This is not to be confused with or construed as Y as defined for the multiple linear regression analysis. Rather, ROI*i* was used, as indicated in Appendices C and D.

Hypotheses must be tested in order to determine if the null hypothesis may be rejected by the researcher or if the researcher may fail to reject it (Ryan, 2011). There was one null and one alternate hypothesis relevant to the primary question for this study. The null hypothesis was annotated as H_0. The alternate hypothesis was annotated as H_a. Hypotheses are not stated for the secondary questions, as there were definitive answers to these questions. Meaning, there was nothing to reject or fail to reject. For example, the calculated median solar radiation level impinging on Little Rock, Arkansas during 2011 was 4.39 kWh/m^2/ day (DSIRE, 2012). This is lower than the calculation of 4.8 kWh/m^2/ day obtained by using data published by Marion and Wilcox (1994). Regardless, there was nothing in this answer that could be construed as assumption or concession, nor was any interpretation or test needed to understand or prove the calculated result in either case. Consequently, it did not make any sense to create hypotheses for the secondary questions.

H_0. There is not a statistically significant relationship between the dependent variable—the percentage of approved permits for the installation of solar energy-based systems, and any of the independent variables—the existence of a legislated RPS and the solar radiation level for the study area.

H_A. There is a statistically significant relationship between the dependent variable—the percentage of approved permits for the installation of solar energy-based systems, and any of the independent variables—the existence of a legislated RPS and the solar radiation level for the study area.

Theoretical Framework for the Study

ROI theory and analysis, as posited through economic theory, provided the theatrical framework for this study. This theory is based on empirical data (Smith, 1994).

Economics-based ROI theory has been used in the analysis of military decision systems (Davis, Kulick, & Egner, 2005) and environmentally focused energy related analyses (Hobbs & Meier, 2003). Jacob (2011) used economics-based ROI theory to lead and incorporate permitting process improvements in Portland, Oregon. Smith (1994) used economics based ROI theory to argue points about economic principles underpinning nations, concepts of national wealth, and the wellbeing of the citizenry of nations. Although in Smith's time, ROI theory was embedded with the concepts of profit and interest. Marx and Engels (2005) used economics based ROI theory to argue points regarding the relationship within and between working class (e.g., proletariat) and upper class (e.g., bourgeois) segments of society, in terms of economic benefit and societal wellbeing. Economics-based ROI theory was used in formulating the ARRA (ARRA, 2009) and the SunShot Initiative (DOE, 2011). Energy management guidelines, as specified in ISO50001, incorporate economics-based ROI theory (ISO, 50001).

Theoretical propositions and theory-based hunches can spark the imagination, leading to social change. Reynolds (2007) referred to theoretical propositions as hunches based on theory. Cohen (2009) discussed various theoretical propositions regarding the means of determining effect size (ES) for statistically based calculations. The major theoretical propositions of this research study were that

- A positive ROI is essential for societal benefit (Sullivan et al., 2012). The ROI calculation and concept are further discussed in Chapter 3.

- ROI analysis does not depend on financial units (e.g., bank notes). This proposition was based on economic theory as posited by Smith (1994), Jefferson (1977), and Marx and Engels (2005).
- Solar radiation levels, as measured in $kWh/m^2/day$, can serve as a financial unit in order to conduct ROI analysis (Content, 2009). This proposition was based on ROI theory.
- The permit application effort can serve as a financial unit in order to conduct ROI analysis. This proposition was based on ROI theory.
- Solar energy-based system installations cannot be accomplished unless permits to install them have been approved. This proposition was based on the code (University of California—Berkley [UCB], 2009).
- Multiple linear regression analysis has been used in a plethora of studies and is "highly general…flexible data analysis system" (Cohen et al., 2003, p. 1). Ryan (2011) argued that multiple linear regression analysis is an appropriate choice to use when a researcher wants to determine if a relationship exists between two or more independent variables and one or more dependent variables. As the research question for this study contains two independent variables and one dependent variable, multiple linear regression theory applied.

Notwithstanding these applications and theoretical propositions regarding ROI analysis, I did not find any use or application of the combination of multiple linear regression analysis and economic theory in the conduct of any research focused on understanding the relationship that may exist with the percentage of permits approved for solar energy-based systems installation, RPS levels, and solar radiation levels. Yet, given that the development, management, and use of energy resources do influence national economies, and vice versa, the application of economic theory, ROI analysis, and multiple linear regression analysis for this research study was appropriate. More detail concerning the theoretical framework used to guide this study is included in Chapter 2. The associated measures and means of analysis that informed economic theory, as relevant in this study, are detailed in Chapter 3.

Nature of the Study

The rationale for selection of the research design for this quantitative, cross-sectional survey-based study was based on the quantitative nature of energy resource management as argued by Graziani and Fornasiero (2007) and the plausible relationship between the existence of legislated RPSs and solar radiation levels with the percentage of approved permits for the installation of solar energy-based systems within the study population. Multiple linear regression analysis, using SPSS, was used for examination of the associated data. Descriptive and inferential statistics were used in the course of this examination.

This was a quantitative, cross-sectional survey design based research study. This research design was preferred given the variables being studied, the topic being researched, the population studied, and the nature of the associated data. Creswell (2009) argued that a quantitative research study is an acceptable approach when dealing with quantitatively based variables and survey data. A quantitative, cross-sectional survey design based research study was also the preferred design approach given the theoretical framework. Representative data for each of the variables were obtained through the use of a survey, as indicated in Appendix A, and by researching public records, as indicated in Appendices B**,** C, and D. The data associated with the RPS level of each jurisdiction required that the level (e.g., legislated or not) be coded in binary terms as either a 0 or a 1, with 0 indicating *no*, and 1 indicating *yes*, regarding the legislated level of RPS. This is further explained in Chapter 3.

Survey and public record data were analyzed using descriptive and inferential statics (Tanis, 1987) and (Ryan, 2011). Economic theory, specifically ROI analysis (Sullivan et al., 2012), served as the theoretical framework for this study. Comparison of public record data and the survey data was accomplished as a secondary test of data integrity. The data for this study were obtained and analyzed using manual and computer-based means. The numeric coding in SPSS for the jurisdiction-related RPS level is 0 or 1, as previously described. Empirical data for the annual median solar radiation level and the percentage of approved permits for each jurisdiction comprising the study population were used in ROI calculations and in multiple linear regression analyses. The ROI calculation associated with this research study and the relevant data from the percentage of approved permits and solar radiation levels is explained in Chapter 3. Results from this ROI calculation for each randomly selected sample of the population served as a means to evaluate any potential emergence of multicollinearity. Based on the definition for multicollinearity, the potential for its emergence is nearly zero given the data in Appendices B and C. Regardless, the data and analysis results were checked for this potential and for any emergence. In the event it was evident in either case, the juxtaposition against the calculated ROI served as a means to mediate interpretation of multiple linear regression model results. This juxtaposition approach agrees with recommendations from Cohen et al. (2003). Charts and graphs developed were accomplished using SPSS computer-based software. The techniques of data analysis are further discussed in Chapter 3.

Definitions

Definitions for the Variables

The independent variables were

- The level (e.g., X1) of RPS (e.g., legislated or not) for each jurisdiction comprising the study population during the study period of January 1, 2011 through December 31, 2011. The level was represented by X1 as previously described with a level of 1 indicating a legislated RPS and a level of 0 indicating the nonexistence of a legislated RPS (e.g., not legislated)
- Calculated median solar radiation levels for each jurisdiction (e.g., city or state, if / as available) that comprises the study population. This was represented by X2.

The dependent variable (e.g., Y) was

- The percentage of approved permits in each jurisdiction comprising the study population from January 1, 2011 through December 31, 2011 for the installation of solar energy based electrical systems at industrial, commercial, and residential locations. Though a specific range or segment in time was selected for this study, the associated data were neither in, nor presented, in a time-series based fashion. Therefore, this study was neither time-series data-oriented nor time-series data-based.

The resulting data table is in the form of Table 1. The data entered in Table 1 are relevant to Santa Fe, New Mexico, and are in part hypothetical. For example, given the calculated median annual insolation for Santa Fe, New Mexico was 6.25, a hypothetical RPS level of 1 for X1, and a hypothetical percentage of approved permits of 83%, the data table would be populated for each variable associated with this research study as shown with this example in Table 1.

Table 1

Data Collection and Variable Allocation

Percentage of permits, (Y)	Legislated or No Legislated RPS, (X1)	Insolation level, (X2)
0.83	1	6.25

There are various terms, acronyms, and phrases used in this dissertation that are specific to solar irradiation, solar energy resources, energy resource management models, and the associated infrastructure. In addition, there are other terms, acronyms, and phrases which have common use, yet specific meaning according to the context where they are employed within this dissertation. The significance and meaning of these is expressed at the time each is introduced in the body of this paper.

Specific operational terms and their definitions, various acronyms and their designation, and various phrases are used throughout this dissertation. The terms and their meaning are provided in the section titled *Operational Terms and Definitio*ns. These terms, acronyms, and phrases, and combinations of these, were used in the contextual setting and data analyses relevant to this research study.

Operational Terms and Definitions

Agency: The entity with authority to review and approve permits for the installation and / or integration of photovoltaic systems and their infrastructure on industrial facilities (Jacobs, 2007).

Applicant: The entity (e.g., person, group, organization) that is filing the permit application (American Planning Association [APA], 2002).

Array: A design configuration of solar panels (ASES, 2009).

Building integrated photovoltaics (BIPV): Systems for solar energy that have been incorporated into a building, such as in the roofing, windows, and/or siding (Rifkin, 2011).

Cap and trade (carbon offset). This is the act of placing limits on carbon emissions and allowing trade of unused emission credits (Center for American Progress [CAP], 2008).

Clusters of concern: Groups or sets of focused concern for any given energy resource (American Council for an Energy Efficient Economy [ACEEE], 2009).

Code: General reference to the uniform building code and associated regulations (UCB, 2009).

Community choice aggregator (CCA): The additive amount of benefit that a given community may obtain based on a given choice of energy resource and infrastructure (Pasqualetti, 2011).

Electric service provider (ESP): Any given provider, such as State Grid Corporation of China (SGCC) and Seattle City Light, specifically of and for electricity (Summit Blue Consulting, 2010).

Grid: A complete electrical power generation, transportation, and distribution system (Rifkin, 2011).

Impingement: The act of solar radiation striking a surface, such as the ground, a building, or array (ASES, 2009).

Industrial concern or industrial facility: Used to denote any industrial type of company or complex (Behrens, 2011).

Infrastructure: Exploration, development, transport, delivery, generation, storage, consumption, conservation, and recycling of energy resources and the resultant energy

([APA, 2012).

Insolation: Impingement of energy from solar radiation on the surface of an entity (e.g., person, industrial concern, array, etc.: Marion & Wilcox, 1994).

Investor-owned utility: A utility that is specifically owned by investors under the intent of making profit. For example, an investment group in Ireland may own a utility located in the United States (Line-Man.com, 2005; The Utility Connection, 2012). In contrast, some cooperatives in Wyoming own and operate the power generation equipment and infrastructure that produces the electricity they use. The primary intent is not focused on making profit (United States Securities and Exchange Commission [SEC], 2011).

Model: A mathematical, organizational, or infrastructural representation of the ways and means by which an operation or operations are carried out (Anderson, Sweeney, Williams, & Martin, 2008).

Permit: The document and authorization issued by an agency, that grants installation and / or integration of photovoltaic systems on industrial facilities, to an applicant (Arizona Department of Commerce, 2012).

Photovoltaic (PV): Cell or array of cells that convert insolation into electricity. Electricity derived from electromagnetic radiation (Graziani & Fornasiero, 2007).

Profit: Net gain after all expenses has been paid (Sullivan et al., 2012).

Renewable energy credits/renewable energy certificates (RECs): Specific credit given for production of energy from renewable sources. Also known or referred to as

Green Tags and Tradable Renewable Certificates (TRCs) (James, 2011).

Renewable energy mandate (REM): Government (federal, state) regulations that impose development and use of renewable forms of energy resources (Intergovernmental Panel on Climate Change [IPCC], 2012).

Renewable energy sources (RESs): Those energy resources that are renewable, such as wind, tidal, and solar (ACEEE, 2009). This is based on information in the associated web site.

Renewable portfolio standard (RPS): Government (Federal, State) regulations that specify production levels of energy from renewable sources. Typically designated as a percent of overall forecast energy production or utility plant capacity (United States Energy Information Association [EIA], 2012). This is based on information in the associated web site.

Return on investment (ROI): The ROI, be it financially, time, or resource based (Smith, 1994 / 1776). For example, the basic idea for the expense (e.g., investment) of energy in the form of currency, time, or material, is that the expected, calculated, or promised return on that expense is worth the sacrifice, with the least return necessary being equal to the expense. The return and the expense are equal, relieving the investor from any loss, yet also indicating zero gain. This term is being used in the research in the context of the percentage of approved permits as a function of insolation, as explained in Chapter 3 and in *Equation* 5.

Solar: Solar irradiation (ASES, 2009). The energy resource required for production of electricity and thermal energy via photovoltaic installations (Marion & Wilcox, 1994). See *Insolation*.

Solar America Communities: See *Solar city*.

Solar cell: Photovoltaic unit (ASES, 2009).

Solar city: One of 25 cities that received special federal funding through the SunShot Initiative sponsored by the DOE. In 2010 the solar city program was renamed the Solar America Communities SunShot Initiative (DOE, 2010 & 2011). Solar city is abbreviated as SC in tables and appendices contained in this dissertation.

Solar panel: Photovoltaic assembly containing various solar cells (Barefoot College, 2011).

Sustainable energy power system (SEPS): A power system that converts RESs into energy for use by any given entity (Cory & Swezey, 2007).

Utility: Used to express an energy delivery company, such as Puget Sound Energy (PSE), California Edison, and the Bonneville Power Administration (Utah State Office of Energy Development, 2012).

Assumptions

This quantitative research study rested on the following assumptions

- Permitting processes comprise a critical gate through which RPS compliance may be achieved and projected electrical energy production requirements may be met.

- The relevant public records, such as permit applications and approvals, contain the data associated with the variables studied.
- Setting β at 0.20, α at 0.05, power at 0.80, the confidence limit at 0.95, and ES at medium or 0.14, as argued by Cohen (2009) were appropriate for this study.
- The time frame chosen for this study was assumed to be one in which permit applications and approvals for the installation of solar energy-based systems actually occurred.
- The associated agency management personnel were willing and able to complete and return the survey in the time frame required.

The reasons why these assumptions were necessary in the context of the study are that

- Building projects cannot be accomplished unless the required permits are issued. For this reason project permitting processes comprise a critical gate through which RPS compliance may be achieved.
- Public records are supposed to contain the data relevant to permits for installation of solar energy-based systems. Data, which correspond to each variable being studied, from publicly available records and through the survey, were needed for analysis. Without these data, accomplishing the study and planned analyses proved to be difficult at best, and rather impossible at worst.

- Statistical assumptions must be made in order to establish some basis for calculation (Tanis, 1987).
- Research studies must have some finite time frame that sets the bounds for data collection (Cohen et al., 2003).
- Data from completed surveys were used in the multiple linear regression analyses.

Scope and Delimitations

The research problem studied was the relationship that RPSs and solar radiation levels may have with the percentage of approved permits for the installation of solar energy-based systems in capital cities and solar cities in the United States during 2011. This was approached through the lens of the plausible relationship that the existence of legislated state RPSs and the calculated annual median level of insolation received by a given area have with the percentage of approved permits for the installation of photovoltaic systems. The calculated annual median level of insolation is based on data corresponding to PV installations of southward facing flat panel collectors with fixed tilt. This panel collector type was used because it is the type most commonly used for typical residential- and business-oriented installations (Lawrence & Lauterbach, 2010). These insolation data were published by (Marion & Wilcox, 1994). Of these published data, 93% were based on modeling while 7% were based on actual measurement (1994). Modeling was accomplished by personnel at the National Solar Radiation Data Base

(NSRDB, 1994). Multiple linear regression analysis and ROI analysis was used in the examination of the data associated with each of the study variables.

The reason why this specific focus on permits was chosen is that the percentage of approved permits may indicate if a legislated RPS is required in each state, as well as if a nationally legislated RPS must be mandated, which in turn may influence energy resource management models. Management models are often used as decision models and to inform decision-making (Davis, Kulick, & Egner, 2005). Results of this study may demonstrate how well progress toward legislated, targeted—goal-oriented, and non existing RPS compliance is occurring, if a legislated RPS is necessary, and if RPS compliance is achievable given the energy resource management models being employed by the given state agencies. Glasnovic and Margeta (2010) argued that electrical grids may only be sustainable and supported when energy resource management models not only address current needs, but also establish compliance criteria that supports forecast future energy needs. Meaning, models used for managing energy resources need to ensure they are based on sustainability as well as ensuring the supply meets demand. In order to meet the demand, criteria and planning, as well as compliance to agreed upon planning and criteria is necessary. Of course, these must be achievable and realistic.

Documentation reviewed was limited to that used and dictated by agencies from the municipalities that comprised the population used for this study, which included the population of 50 state capitals and 25 solar cities. Seven of the solar cities are also state capitals, so these were subtracted in order to avoid counting them twice for inclusion in the total study population. The total study population was comprised of 68 separate cities. A randomly selected sample population of n = 52 was drawn from this total population to support this particular research study. The calculation for randomly selected population size is explained in Chapter 3. Additionally, documentation reviewed were limited to that used by and available to individuals within the confines of each noted municipality in Appendices B and C. The research period covered was January 1, 2011 through December 31, 2011. Permit percentage data and RPS category data from this year of time was used for the regression analysis. These data did not constitute time-series based data.

There are a plethora of government incentives and special programs involved with the control, promotion, and installation of solar based energy in the United States. From these, only the SunShot Initiative (DOE, 2011) and the ARRA (2009) were researched and used to inform this study. The SunShot Initiative (DOE, 2011) was influential in the selection of 25 of the cities for the study population. Socio economic and cultural elements for each city associated with this study were not among the variables being studied, nor were they relevant in the DOEs selection of solar cities. Socio economic and cultural elements were not a deciding factor in the selection of the study population.

This study approach, the survey, and the associated analysis methods are generalizable to other quantitative, cross-section, survey-based research studies wherein the researcher(s) is(are) seeking to understand the potential relationship between quantitative variables.

Theories and/or conceptual frameworks most related to the area of study relevant to this research, that were not investigated were

- Contingency theory,
- Utility theory, and
- Open systems theory.

I will not elaborate further on these theories because they were not used for this study.

Limitations

This study and the survey were limited to the data available and relevant to permitting agencies for each state capital and solar city (DOE, 2011) in the United States. The managers of authorized permitting agencies for each of these cities were those requested to participate in completing the survey. The research period was limited to January 1, 2011 through December 31, 2011. Only those applications and permits for the installation and/or integration of photovoltaic systems that were submitted and approved or disapproved during the study period were researched. Applications and permits for systems at residential and community type housing locations were included in this study, as were retail sales, medical, entertainment, educational, and other such public facilities. Distinction of these was not made, in terms of categorizing system capability, capacity, cost, or others.

Completion of the survey was considered to be self-guided and self-administered. The survey had specific verbiage regarding informed consent. Participants needed to read this verbiage and follow the directions, as noted in Appendix A, indicating they agreed with their participation and consent that I was allowed to use the data they included on the survey form.

Internal validity was protected through the format of the questions in the survey because they are empirically focused questions. Frankfort-Nachmias and Nachmias (2008) argued that empirically focused survey questions enhance internal validity. The anonymously provided answers to the survey questions were juxtaposed with publically available data, which further ensured internal and external validity. Creswell (2009) argued that comparison of similar type data from various sources adds grounding as well as internal and external validity to research studies. This juxtaposition was a comparison of survey answers to electronically published data for the same jurisdiction regarding the study variables.

There was no bias on my part regarding RPSs—legislated or otherwise. Nor did I have a bias regarding the percentage of approved permits. Data for these two elements may have included a bias due to the jurisdiction with which the data are associated. There may have been a bias on the part of survey participants. This was mitigated by comparing survey answers against publically available data relevant to the same questions as those posed in the survey. There are no other biases that I identified that could influence study outcomes.

Given these limitations and controls, the research questions and associated hypotheses, and the research design approach, threats to validity were considered to be minimal and acceptable. Notwithstanding these limitations and controls, there were factors beyond my control. These factors included the availability of the requisite data through public records, the quality of data contained in public records, and the return of properly and adequately completed surveys in the required time frame of 10 days.

Significance of the Study

Understanding the relationship of the independent variables with the percentage of approved permits for the installation of photovoltaic systems is critical to energy resource management. Schoofs (2004) indicated that this is one of the studies that ought to be accomplished in light of the debate regarding potential enactment of a nationally legislated RPS. The nonexistence of a RPS may impede the use of solar energy through the installation of photovoltaic systems by inhabitants of any given locale (Rifkin, 2011). Existing and currently used energy resource management models and decision criteria do not include measurements for, or consideration of, the potential relationship that a legislated RPS may or may not have with the issuance of said permits (American Tradition Institute, 2011). Identification, analysis, and juxtaposition of existing legislated RPSs and associated incentives, for benefits and risks, against the nonexistence of a RPS, may demonstrate

- How well current models and decision criteria perform
- How current models and decision criteria are used
- Where gaps exist that could hinder RPS compliance
- If a state or a national RPS, or both is necessary
- How achievement of projected energy production needs may be met

Additionally, by understanding the relationship between the study variables, personnel from the various agencies may be able to institute improved or new energy resource management models, processes, and decision criteria. These could possibly save the applicant, the taxpayer, and the permitting agency time and money, while achieving energy goals to meet current and projected demand. This could possibly spur a wider acceptance and use of photovoltaic systems and Self-Generation Incentive Programs (SGIPs), such as those offered by the California Public Utility Commission (CPUC, 2011), California Center for Sustainable Energy (CCSE, 2010), and the California Energy Commission (CEC, 2010). Managing solar energy use through new and improved energy resource management models and decision criteria may aid in the reduction of greenhouse gasses, thereby benefitting society (CAP, 2008).

Summary

The main points of this chapter included discussions regarding the background, scope, rationale, variables, and limitations of this quantitative, cross-sectional survey-based research study. This study was focused on the potential relationship between RPS level (e.g., category—legislated or not) and insolation levels with the percentage of permits approved for the installation of solar energy-based systems. These variables have importance as measureable metrics with a plausible relationship in achieving energy production goals and meeting utilization needs. Use of the survey in Appendix A, and implications of the hypotheses and research questions, was discussed. The theoretical framework of economic theory and ROI analysis was noted as the framework for this study. The statistical analysis method used, which was introduced and discussed in general terms, was multiple linear regression analysis. Both descriptive and inferential statistics were used in the course of data analysis. The potential for project permitting processes to serve as a gate leading to compliance with any given RPS was emphasized. Understanding the relationship between the study variables may keep users of electrical energy from shame, as proposed by President Clinton (Tiscareno-Sato, 2012), and electrical energy deficit while providing policy creators and decision makers with data and means to make decisions regarding permits, local RPSs, ROI, and a nationally legislated RPS.

Chapter 2 contains the results from the review and research of published literature which underpinned this study. The associated literature search was based on the research problem involving legislated RPSs, existing insolation levels, and the percentage of permits approved for photovoltaic systems installations. The literature review included works about the study variables and the processes associated with each. These processes involve a number of activities, including management methods, organizational infrastructure, and decision science as viewed through the lens of economic theory and ROI analysis.

Chapter 2: Literature Review

Managers of permitting agencies, owners and operators of electricity consuming facilities, and elected government officials (all of which constitute policy creators and decision makers) need a relationship-based energy resource management model. This model regards the relationship between legislated RPSs and solar radiation with the percentage of permits approved for solar energy-based systems installations. This model is needed in order to properly determine if a nationally legislated RPS is needed (Schoofs, 2004). There is a gap in published research, available literature, and energy resource management models concerning the relationships that may exist between legislated RPSs and solar radiation levels with the percentage of permits approved for the installation of solar energy-based systems. As with any construction effort, permits are required for such installations (King County, 2012). The higher the percentage of approved, legitimate permits, the more plausible it is that RPS compliance will be achieved, regardless of RPS status.

Chapter 2 is comprised of the following three major sections: Literature Search Strategy, Theoretical Foundation, and Literature Review Related to Key Variables. The section regarding the Literature Search Strategy contains descriptions for the key elements and fundamental perspectives, as well as research criteria used by me to conduct this literature review. The section concerning the Theoretical Foundation contains the discussion and rationale for selection of the theories that underpinned and guided this study. The relationship between the variables studied was explored and examined through the lenses of the hypotheses, research questions, the survey questions, and the theories underpinning this study. This exploration and examination is contained in the section regarding the *Literature Review Related to Key Variables.*

In this chapter, I elaborate on the published, and lack of published, research that gives merit to this topic of study and the research problem. I examine and discuss the roles, responsibilities, and authority that energy resource management models impart on RPSs and permitting processes according to the content of the literature reviewed for this study. I present some insolation data and relevant examples of these for comparison and contrast. I also discuss policies and concepts gleaned from this literature review in terms of the variables studied. These policies, concepts, and variables are juxtaposed with the research design and analysis methodology described in Chapter 3.

Literature Search Strategy

The literature search strategy for this quantitative research study included searching a variety of media. This research included researching library- and Internet-based sources for relevant literature published in print and in electronic form. The electronic forms involved library databases, Internet search engines, and critical websites internal and external to Walden University. These were the

- Thoreau Library database through Walden University
- Internet search engine Altavista; http://www.altavista.com
- Data base DSIRE; http://www.dsireusa.org/

- DOE web site for the SunShot Initiative; http://energy.gov/articles/sunshot-rooftop-challenge-awardees
- Internet search engine Google; http://www.google.com

Appendices B, C, and D each contain the Internet web sites relevant to solar energy approaches, as well as for applications and permits in each capital and solar city, respectively. A host of other websites was also researched for this study. These websites are noted in the References section of this paper. This list constitutes the complete listing of media forms researched for this literature review. Terms used in conducting this search are listed in Table 2. These media forms and terms were selected in an effort to ensure balanced and sufficient breadth and depth of data, context, and study population associated information. This literature search method ensured the valid and unbiased gathering of relevant documentation. Creswell (2009) argued that a research study approach based on balanced and sufficient breadth and depth of data, context, and study population-associated information was supportive of quantitative-based research studies. This search method also ensured that a reasonable sample population of the respective media forms was used to inform this study. Reynolds (2007) argued that evidence must come from reasonably based sample sizes representative of the available population in order to bolster theory development. Sample size selection for the study population associated with this research study is further detailed in Chapter 3.

Table 2

Search Terms Used

Solar energy systems	Permitting	Photovoltaic systems
Solar energy	Building permit	Environmental impact
Sustainable energy	Renewable energy	[*Specific City*] RPS
[*Specific State*] RPS	Solar cities awards	Industrial solar permits
US Industrial electricity demand	Industrial roof area in [*Specific City*]	Insolation data for [*Specific City* and / or *Specific State*]
National RPS	Solar system application in [*Specific State*]	Permit processes for industrial installations in [*Specific City*]
ROI analysis and renewable energy	Statistical analysis of solar energy based projects	ROI and multiple linear regression analysis

Description and Scope of Literature Review

The literature researched for this dissertation spanned the period of time from 1713 to the present (e.g., 2012). Sources and media forms researched included textbooks, white papers, peer-reviewed journals and journal-published works, legal documents, building codes, publically available government agency documents, and government initiatives. The portion of the search that involved white papers, peer-reviewed journals and journal-published works, and legal documents, was confined to a 5-year time frame commencing in 2007 and concluding in 2012. One exception to this is the work completed by Schoofs (2004), which I decided to use given its relevance to the research topic and problem. This comprised the non book, in-text based, published media researched for this study.

Additionally, electronic based media sources were researched. These sources included on-line publications, Internet websites for government agencies, corporations, and nongovernmental organizations (NGOs). Printed, in-text published numeric type data from these sources were augmented by data from the on-line Internet data bases administered by these agencies, corporations, and NGOs.

Handling for Scarcity of Published Research – Means, Methods, and Rationale

The scarcity of articles, peer-reviewed journals, and textbook publications was tempered by the use of public records, in terms of solar energy related energy resource management models and the plausible relationship these may have with the variables studied. Data for each of the variables studied were sought from these public records. Use of the survey, as included in Appendix A of this dissertation, and the associated answers to the survey questions aided in filling the gap of scarce publication. Each of these data sources added another form of validity control, and kept the study grounded. Creswell (2009) argued that valid data sources and control of data provide grounding and stability to research studies. The reason for this approach to the handling of scarcity was that there was little in terms of peer-reviewed journals and textbook publications for the topic and the problem associated with this research study. For example, there were edicts, regulatory requirements, and building codes, as well as municipal covenants that were not peer-reviewed for journal publications. Although not peer-reviewed, these sources influence the permitting and application processes associated with solar energy based system projects (Arizona Department of Commerce, 2012).

Theoretical Foundation

Economic theory, as posited by Smith (1776, 1994); Marx and Engels (1848, 2005); Riggs, Bedworth, and Randhawa (1996); and Sullivan et al. (2011) with a focus on ROI analysis, served as the theoretical foundation for this quantitative cross-sectional survey-based research study. I chose to use economic theory so that the ROI concept could be used in data analysis. Economic theory and ROI analysis was also chosen because the focus of the SunShot Initiative was on reducing the kWh cost of solar energy based electricity (DOE, 2011). Descriptive and inferential statistical theory; as posited by Cohen (2009), Cohen et al. (2003), Frankfort-Nachmias and Nachmias (2008), Ryan (2011), and Tanis (1987); served as the theoretical foundation for data analysis via multiple linear regression analysis.

Major Theoretical Propositions and Hypotheses

From economic theory and ROI analysis the major theoretical proposition was that the elements involved with RPSs (legislated and otherwise), insolation levels, and permit approvals actually comprise an economic scenario that could be analyzed on an ROI basis. Woody (2012) used ROI to argue the point that the cost for photovoltaic systems made it impossible for the cost of electrical power generated from these systems to drop to levels matching those of traditional electrical energy generating means. As discussed in Chapter 1, Tuerck, Bachman, and Head (2011) used ROI analysis to estimate the cost that the consumers and the U.S. economy would incur in the event a nationally legislated RPS is mandated. Gordon (2012) looked to economic theory and ROI analysis to argue his point that incentive programs ought to have upper and lower capability and capacity PV system levels set to support an ROI based selection process. These levels would essentially comprise control limits, as presented by Ryan (2011). Personnel from Seattle City Light (SCL) produced documentation wherein the argument is made that conservation of energy (e.g., resources) and ROI are possibly phenomenological results from the functions of the application, permit process, and photovoltaic system selection (Seattle City Light (SCL), 2012). However, no information in this documentation indicated that any research study had been accomplished to support the claim.

Descriptive and inferential statistical theories were used in the DOE projections for future electrical energy needs (DOE, 2012). Much of the insolation data published by Marion and Wilcox (1994) was based on the application of descriptive and inferential statistical theories. These theories were the basis to analyze sampling data and create algorithms and computer-based modeling programs, as opposed to making actual observations for insolation levels across the United States (Marion & Wilcox, 1994). Bullis (2008) used descriptive and inferential statistics to accomplish linear regression analysis that indicated the cost for PV systems was in a downward trend. EnerNoc (2012) created algorithms and computer-based programs that used descriptive and inferential statistical and predictive analytical theories to control energy use at client facilities. These programs reduce and cutoff electrical power to those areas where it may not be needed (EnerNoc, 2012). These computer-based programs also limit the amount of electrical power that can be consumed during what may constitute peak usage times, essentially forcing energy conservation through applied statistics (EnerNoc, 2012).

Delineation of Assumptions

As previously noted in Chapter 1, there were various assumptions that were made and considered in order to conduct this study. This quantitative research study rested on the following assumptions that:

- Permitting processes comprised a critical gate through which RPS compliance may be achieved and projected electrical energy requirements may be met
- The relevant public records, such as permit applications and approvals, contained the data associated with the variables being studied
- Setting β at 0.20, α at 0.05, confidence limit at 0.95, power at 0.80, and effect size at medium or 0.14, as argued by Cohen (2009) are appropriate for this study
- The time frame chosen for this study was assumed to be one in which permit applications and approvals for the installation of solar energy-based systems actually occurred
- The associated agency management personnel were willing and able to complete and return the survey in the 10-day time frame required

The reasons why these assumptions were necessary in the context of the study are that

- Building projects cannot be accomplished unless the required permits are issued. For this reason project permitting processes comprise a critical gate through which RPS compliance may be achieved.
- Public records are, by law (United States Department of Energy, Loan Program Office [LPO], 2012), supposed to contain the data relevant to permits for installation of solar energy-based systems. Data that correspond to each variable being studied, from publicly available records and through the survey were needed for analysis. Without these data, accomplishing the planned analyses would be difficult at best and likely impossible at worst.
- Statistical assumptions must be made in order to establish some basis for calculation (Tanis, 1987).
- Research studies must have a finite time frame that sets the bounds for data collection (Cohen et al., 2003).
- Data from completed surveys was used in the multiple linear regression analyses.

Jacob (2011) argued that permitting processes for solar energy-based systems needed to be consolidated into one department and jurisdiction for Portland, Oregon. This consolidation was done with the hope of increasing the percentage of approved PV systems and the installation of PV systems, as well as achieving a positive ROI (Jacob, 2011). Fenn, Freehling, and Erickson, (2009) argued that the emphasis of permitting processes should be on conservation and point of use PV systems instead of megagrids and PV farms. These arguments supported the previously noted assumptions and reasons for the assumptions.

Previous and Similar Applications of the Theory

Previous or similar applications and approaches for economic theory, with a focus on ROI analysis were found in the feasibility study approach by EnerNoc (2012). ROI, project worth, and financial management, as argued by Sullivan et al. (2012) was used in applications presented by Fontevecchia (2011) and Fenn et al. (2009). Fontevecchia (2011) applied it in an analysis of the earnings reports from Exxon-Mobil. Herrick (2012) applied it in an analysis of PV systems for residential use. Tuerck et al. (2011) used it in an analysis of potential legislation for the mandate of a national RPS. In this analysis by Tuerck et al. (2011), economic theory was used to argue points relevant to societal benefit, in terms of ROI. The context for each of these uses being that ROI must be achieved for society (e.g. the investing entity, purported benefactor, etc.) to receive any benefit from the associated project, management decision, or other sorted investment.

The application of descriptive and inferential statistics is replete in the literature researched for this study. Shrimali and Kniefel (2011) used it in an analysis of government programs that have been instituted to promote the use of renewable energy resources. It was used by Mathur (2011) in an analysis of data associated with a survey regarding acceptance and intended use of mobile learning instruments. Kirk (2011) applied these in an analysis of geo-based systems, including geothermal energy, in Yellowstone National Park. More applications of economics based ROI analysis, and descriptive and inferential statics is included under specific headings for each of these theories. These theories were used in this quantitative, cross-sectional survey-based research study.

Economics

Management and employees of ExxonMobil applied economic theory, in terms of supply and demand as well as ROI analysis in business operations, for the 2011 tax year (ExxonMobil, 2011). This application of economic theory by management and employees of ExxonMobil is evident in the 2011 third quarter earnings report for ExxonMobil, wherein billions of dollars in profit were reported (ExxonMobil, 2011). Though such profits are seen as outstanding by management and employees of the receiving corporation, the financial impact to society as a whole is neglected in their analysis of the situation (Fontevecchia, 2011). Fontevecchia (2011) argued that excessive profits pose societal risks that are inversely proportional to the reported profits. The SunShot Initiative was enacted under the auspices of societal benefit (DOE, 2012).

The SunShot Initiative was enacted for the purpose of making solar energy more accessible and cost competitive (DOE, 2012). Essentially, the SunShot Initiative was an attempt to artificially affect the ROI of PV systems to such an extent that the ROI would be positive (Cory & Swezey, 2007). Personnel from the organization involved with the

Global Carbon Project (GCP) argued that economic theory might be used in the construct of organizational and governmental approaches geared towards the reduction of greenhouse gases and carbon effluent (GCP, 2011). One way that economic theory has been used in the effort to reduce greenhouse gases is through the use and allowance of carbon credits (Gillis, 2011). The ROI function comes into play with consideration for the fact that carbon credits can be bought and sold, making them a form of currency and an additional revenue stream for companies that sell their excess credits. A company accrues excess credits when it emits less carbon and greenhouse gases than it has been allowed (Gillis, 2011). The difference between these—emission and allowance, is the carbon credit. Star Energy Partners Solar (2015) observed that economic theory, ROI analysis, and renewable energy resource applications could actually prove beneficial for the operators and players of the Super Bowl XLVII, as well as attendees of events held at the stadium, in the aspect of electrical power for the venue. This qualified the venue and the operators of it to apply for carbon credits and RECs, both of which supported ROI efforts and created new revenue streams (Star Energy Partners Solar, 2015).

Descriptive and Inferential Statistics

Moritz et al. (2012) conducted analyses of global fire activity as a function of global warming, and demonstrated through these analyses that there is significant correlation between global warming and increases in the number and size of wild fires (Moritz et al., 2012). Personnel from the Energy Information Association (EIA) applied descriptive and inferential statics in their data analysis for renewable versus nonrenewable energy resources (Energy Information Association [EIA], 2011). Based on this analysis they reported that the use of solar energy-based systems could decrease the use of fossil based energy, thereby reducing carbon and greenhouse gas emissions (EIA, 2011). These reductions are means by which global warming may be mitigated and reversed (Intergovernmental Panel on Climate Change [IPCC], 2012). Sánchez et al. (2010) applied statistical theory in their study involving maintenance of Concentrating Photovoltaic electric power plants and the associated utilities which comprise such plants. Senge (2006) theorized that organizations that continually evolve and improve are learning organizations, and that said learning is statistically correlated to the wellbeing of the given practicing organization. These applications of descriptive and inferential statistics are examples that demonstrate that descriptive and inferential statistics would be useful to this particular research study.

Thiengkamol (2011) argued that the use of statistics can play an essential role in the security oriented management of energy resources in rural areas. In this case, statistics would be used to sample rural populations in terms of risks in the event of the loss of fuel and electrical power, and the statistically significant results that could transpire due to such losses (Thiengkamol, 2011). This application of statistics was focused on societal benefit, specifically where rural populations were involved, which are perhaps those most adversely affected and at risk where energy resource security is less robust (2011).

Summation of Theories

This quantitative, cross-sectional survey-based research study was accomplished through the use of ROI analysis as posited through economic theory. Multiple linear regression analysis, as supported by statistical theory, was used for data analysis. I focused my literature search on these theories given that they are the ones I chose as the theoretical framework for this study.

The DOE (2011) sponsored the SunShot Initiative for the purposes of promoting solar energy and reducing the associated kilowatt-hour (kWh) cost of electricity produced through PV systems. The SunShot Initiative was an attempt to inculcate the use of economic theory with energy resource management (Prometheus Institute for Sustainable Development [PISD], 2012). The intent of this initiative being to achieve a positive ROI and to promote solar energy while reducing greenhouse gases (DOE, 2011). Permitting processes, and the associated infrastructure, are part of the SunShot Initiative focus and are within the bounds of energy resource management (ENERGY.GOV, 2011). The DOE (2012) argued, via the SunShot Initiative, that beneficially economic applications of solar based energy are critical to the success of instituting a broader use of solar energy. According to Richardson (2008) policy creators and decision makers can institute an RPS as part of their economics based effort to encourage and broaden the use of solar-based energy through an increase in installations of PV systems.

Current economic theory has yet to include the potential relationship that insolation and an RPS—legislated and otherwise, may have with the percentage of approved permits for the installation of solar energy-based systems (CAP, 2008). Information in the state of Utah web site did not include solar-based energy in the set of available renewable energy resources, which eliminates the potential for any entity installing a PV system to take advantage of tax incentives offered by the state (Utah State Office of Energy Development, 2012). This failure to acknowledge solar-based energy as a renewable energy resource undermines opportunities to potentially achieve any required or planned ROI.

Multiple linear regression analysis had not been used to study the relationship between the noted variables of this study. Ryan (2011) argued that multiple linear regression analysis is one method that can be used to analyze data corresponding to the combination of quantitative and qualitative (e.g., categorical) independent variables. Cohen (2009) argued that multiple linear regression analysis is a reliable means to analyze potential relationships between such independent variable types and one dependent variable. The application of economic and statistical theories, via this study, may then likely be a new and unique approach, possibly building upon economic and statistical theories.

Literature Review Related to Key Variables

The key variables studied through this quantitative research study were of two types—independent and dependent. There were two independent variables and one dependent variable involved with this study. The RPS level (e.g., legislated or not) constituted one of the independent variables. The calculated median annual insolation level for each city comprising the study population constituted the second independent variable. Insolation was a key independent variable since it is the measure for the available solar energy, in terms of solar radiation impingement in $kWh/m^2/day$ at any given jurisdiction. The existence of a legislated RPS was a key independent variable since it may have indicated the level of commitment by legislators of any given locale to promote and use renewable resources to satisfy energy needs of their constituents.

The percentage of approved permits was the dependent variable. It was a key variable as this study was focused on determining if there was a relationship with this and either or both of the two independent variables. Data corresponding to the independent variables are contained in Appendices B and C. Data corresponding to the dependent variable are contained in Appendices A and E. Note that Appendix E was populated upon receipt of the survey from each jurisdiction comprising the randomly selected sample population for this study. This literature review was focused on the two independent and single dependent variables, as well as information, data, and evidence associated with them and the questions posed for this study. Brief descriptions of studies and constructs related to these variables are given in the next section.

According to information published in the Database of State Incentives for Renewables and Efficiency (DSIRE) in 2012, only 23 of the states in the United States had a legislated RPS. Tuerck et al. (2011) argued that 30 states have some form of RPS. The rest either do not have an RPS or have nonlegislated goals (DSIRE, 2012). Data published by the EIA (2012) indicated that 78% of the states have some form (e.g., goal, proposed, mandated, etc.) of RPS. For purposes of this research study, the existence of a legislated RPS was coded as a 1 and not legislated was coded as a 0. This coding constituted the categorization for this dummy variable. Coding into SPSS computing software for use in the multiple linear regression analysis was accomplished accordingly. Please refer to Appendices B and E for the complete listing of jurisdictions and associated RPS level or status. Regardless of RPS status, solar energy-based systems were considered to be energy production facilities, as argued by Rifkin (2011). Currently, each state, municipality, and often utility has specific jurisdictional bounds relevant to energy resources and permits for energy production facilities (Ecological Society of America [ESA], 2012). Though these bounds may overlap, this phenomenon of potential overlap was not a focus of the literature review accomplished for this study, nor was this potential overlap the focus of this research study. Regardless of any overlap, the end result was the percentage of approved permits within each total jurisdiction that constituted the population for this study, which was a focus of this research study and the associated literature review.

According to the DOE, there are more than 18,000 permitting jurisdictions in the United States, and many of these are inadequate in terms of promoting and encouraging the installation of solar energy-based systems (DOE), 2011). The inadequateness may be a result of ignorance or fear in the general population, which contains the general population of policy and decision makers. Perrow (1999) discussed a study accomplished by Clark University students, which indicated that the general population is of the belief that “solar electric energy” (p. 327) poses “unknown risks” (p. 326) to societal wellbeing. Perrow (1999) argued that the far greater risk to societal wellbeing is not from solar energy based electricity, but rather from greenhouse gas emissions resulting from burning fossil based fuels.

One substitute for fossil based fuel has been corn based ethanol (Brown, 2006). Turpen (2010) argued that the emphasized development and use of corn ethanol does not mitigate greenhouse gas emissions, rather it increases them. This emphasized use of corn-based ethanol would then fail the ROI analysis test as described in economic theory. It would also fail the test of benefit to society (Brown, 2006). The need to better understand the complete relationship within and between systems, in terms of positive economic value and societal benefit—a positive ROI, becomes more evident with examples such as this. So that society may be better informed regarding solar based energy and management of this resource (e.g., insolation), it is necessary to understand the relationship that may exist between legislated RPSs, insolation levels, and the percentage of approved permits for solar based energy systems. It is necessary to understand whether or not a legislated national RPS may be required in order to mitigate and decrease reliance on fossil fuels through the use of solar-based energy.

Description of Studies Related to the Constructs of Interest

The constructs (a.k.a. complex ideas formed from various elements (Zimbardo, 2008) of interest and relevant in the scope of this quantitative, cross-sectional survey-based research study were the

- RPS establishment and legislation
- Insolation, in terms of impingement angle and determination of available energy in units of $kWh/m^2/day$
- Building or project permits

Each of the noted constructs of interest comprised a segment of the scope for this study. Each of these constructs also provided the context within which the previously expressed hypotheses and questions were addressed. Descriptions of studies for each of these constructs follows, in the same order as the constructs are listed.

RPS Establishment and Legislation

Tuerck et al. (2011) analyzed senate bills wherein degrees and forms of nationally legislated RPSs were proposed. From their analysis they determined that the establishment of a nationally legislated RPS in any of the degrees and forms that had been proposed could have a devastating effect on the economy of the US and on the way of life lead by the average inhabitant of this nation (Tuerck et al., 2011). Through their study they postulated that an increase in renewables based energy projects would necessitate an increase on non-renewables projects to serve as redundant energy support systems (2011).

The hypotheses by Tuerck et al. (2011) posited that renewables based energy is unreliable—hydroelectric power is dependent on precipitation and control of water flow (State Grid Corporation of China [SGCC], 2011); wind power is dependent on wind speed, direction, and laminar flow of the airstream where horizontal wind turbines are the equipment employed (NREL, 1011), and solar power is dependent on insolation, system capability and type, and angles of impingement and receipt (Kramer et al., 2011). Tuerck et al. (2011) claimed that this need for redundant, nonrenewables based systems would actually increase carbon effluent and greenhouse gas emissions more than if renewables based energy resources were not used. They did not use any historical data nor data from existing uses of renewables based energy to support this claim. Neither did they compare and contrast any of the existing state RPSs with any of the degrees and forms of a proposed nationally legislated RPS.

Turpen (2010) argued that development of renewable-based energy resources should be based on the efficiency of that resource to perform work, and that said resources should be sustainable. For a renewable energy resource to provide positive societal benefit, these criteria of sustainability and efficiency must be met (Lawrence & Lauterbach, 2010). In the report from Turpen (2010), evidence was presented to demonstrate that corn-based ethanol does not meet either of these two criteria. The goal for renewable based energy that President Obama specified in his 2011 address, wherein he also proposed a nationally legislated RPS, included corn based ethanol (Obama, 2011). Based on these data, inclusion of corn-based ethanol in any RPS could make that RPS unachievable and damaging to society. I did not come across any statistically significant study regarding solar energy-based systems that remotely indicate this potential for societal damage nor inability to meet the criteria of efficiency and sustainability in regions of insolation exceeding a calculated annual median of 3.8kWh/m^2/day.

In the report published by the American Council for an Energy Efficient Economy (ACEEE) in 2009, the case is made that any degree and form of RPS must include provisions and requirements for increases in efficient use of energy. It was argued in this report that the US economy and societal wellbeing cannot continue to suffer losses of energy approaching an average of 32% per year, regardless of the energy resource (American Council for an Energy Efficient Economy (ACEEE), 2009). Thus indicating that the goal for 80% of our energy by 2035 to be supplied by renewable sources (Obama, 2011), efficiency and effectiveness of our overall energy related infrastructure must improve. Consideration for insolation, system type, and system position are related to efficiency and effectiveness of this infrastructure (Vorne Industries, Inc., 2012). Of course the more efficient and effective this infrastructure becomes, the more positive the ROI will be, and the more society will benefit, thus creating positive social change.

Economic considerations relevant to RPSs and permits involved with the installation of photovoltaic systems within the capital cities and solar cities of the United States of America fall under two primary foci (Sullivan et al., 2012). One is an internal focus and the other is an external focus. The internal focus, taken from the point of view of the system owner or operator, includes such characterizations as corporate responsibility, environmentally conscientious, sustainably centered, incentivized action, and fiscally forward thinking (Graziani & Fornasiero, 2007). The external focus, taken from the government agency point of view, includes such considerations as fee schedule and collection, zoning control and proliferation, and administration and bounds of jurisdiction (Hobbs & Meier, 2007). Both foci have some economically based concept involving ROI, near term and future sustainability and growth, and capital investment (Steitz & Rink, 2012).

Sullivan et al. (2012) argued that any given capital investment must meet some calculated threshold that supports meeting or exceeding break even points, tax advantage positioning, ROI, and non-profit or charitable organization positioning (e.g., IRS code *501(c)3* (Internal Revenue Service (IRS), 2012)). Marx and Engels (1848, 2005) argued that the proletariat (e.g., working class) should not be burdened to support the bourgeoisie (e.g., the wealthy, property owner class). Meaning, federal, state, agency, and utility incentives promoted for the installation of solar-based energy systems should not be funded by proletariat tax and fee dollars (Bingaman, 2010). Rather, this funding ought to come from the bourgeoisie (Bingaman, 2010), or entity installing said system. This approach could make the prospect of installing a solar system an impossible one for nearly 80% of the population in the United States of America (Rifkin, 2011), due to the project cost, which can be upwards of $15,000 for an average sized single family residence (Itek, 2012). However, since the typical asphalt shingle roof carries nearly the same price tag, upfront incorporation of either solar tiles (Solarwinds, 2012) or solar thin films (Solar Thin Films, 2012) could prove to be the better choice for the roof, in terms of function and investment (Lawrence & Lauterbach, 2010). Administration of a national

RPS would need to consider the burden that such a legislated RPS could place on the typical owners of any given single family residence, with or without incorporated solar energy-based systems (Barefoot College, 2011).

Fenn, Freeling, and Erickson (2009) proposed that any tax incentives associated with, and tax dollar funded, carbon cap and trade based projects ought to cease. They argued that the money spent on these projects would be better spent on efforts to reduce energy consumption (Fenn et al., 2009). Laird (2012) contended that energy savings efforts, and therefore economic improvement, should first focus on inculcating Lean Manufacturing principles rather than in pursuit of permits for costly, solar based energy systems. The ARRA of 2009 held billions of dollars to fund solar and other renewable based energy projects (ARRA, 2009). However, the time frame for this funding source was not infinite—it came with an eligibility deadline, forcing a rush of permit applications into agencies whose personnel had difficulty processing the permit applications in time to meet the deadline (James, 2011). This caused some applications to miss the deadline and therefore the funding for the applicant's project was not allocated (James, 2011). Additionally, the majority of this funding was earmarked for use on large, multimegawatt systems, not single family residences, which could negate the potential that typical home owners could install photovoltaic arrays on their homes in an effort to become more *green* (ARRA, 2009).

The Solar Energy Industries Association (SEIA) (2012) report for 2011 listed the 20 top companies in the US that have the most electrical power generation capacity from solar energy. Of these 20 companies, 45% are industrial companies that manufacture products. As argued by Smith (1994), manufacturing is one of the three activities that create wealth—economic benefit and positive ROI, for a nation. The remainders are commercial sites, such as malls and stadiums, and distribution oriented warehouses for companies such as Wal-Mart and Toys-R-Us. The economic activities at these remaining venues are not wealth producing from the standpoint argued by Smith (1994). With this consideration for wealth production added as a factor to the ROI model, further refinement of permit and insolation consideration may lead to a more beneficial energy resource management model. The annual electrical power generation capacity of this 45% totals 60,543-kilowatt hours (kWh) (SEIA, 2012). These data were relevant to this study since they provide some indication as to the extent of solar energy-based systems installed and the various types of facilities where they have been installed.

Insolation

Marion and Wilcox (1994) published a host of insolation data for various cities and regions throughout the US. These data are based on five types of PV systems, energy production expected, and incidence angles of those systems (Marion & Wilcox, 1994). More than 50% of these data are also derived from the use of a computer-based model as opposed to actual testing and measurement to collect the data at each site (1994). Analysis of these data determined that the difference in insolation and associated energy production values across the range of incidence angles for a given city were typically within a range of ± 10% over the course of a year, across the types of PV systems (1994).

To make this research study manageable, I calculated the associated annual median insolation value in terms of $kWh/m^2/day$, which is included in Appendices B and C. The rationale and use of this calculation is further discussed in Chapter 3. Insolation was not a consideration for selection of solar cities (DOE, 2011). Yet, Marion and Wilcox (1994) accomplished their work because insolation is critical to the function and energy production of PV systems.

Building and Project Permits

Outdated property rights edicts; acts, neighborhood covenants and restrictions, and laws are some of the impediments identified by the International Organization for Standards (ISO), (2011) within the body of ISO50001. ISO (2011) claimed that these are some of the areas that must be addressed and corrected in a positive manner as part of any energy resource management effort. Since ISO50001 was recently published and agreed upon in June 2011, literature regarding its incorporation and potential relationship with the variables associated with this research study was not found. This could be a gap in the literature, or it may seem to be a gap merely because of the rather newness of ISO50001, though ISO (2011) did indicate that these impediments could potentially have a negative influence on the ROI for renewables energy based projects.

Permit approval, based on relevant ROI criteria at the time of application and approval, can be viewed and analyzed in terms of financially associated energy resource management (Content, 2009). With more than 18,000 separate permitting jurisdictions throughout the U.S. (DOE, 2011), the complexity of permitting processes may be influenced by or may have a linear relationship with the existence or nonexistence of a locally legislated RPS and local insolation levels. This relationship can be seen as the relationship expressed in physics regarding action and reaction (Newton, 1995). Meaning, as the percentage of approved permits increases, the need for a legislated RPS may decrease (Perrow, 1999). However, there is no published study that provides data to defend or refute this, or to help us understand the potential relationship. Results from this quantitative research study may fill this gap. László (2012) argued that a holistic approach to system analysis, implementation, and improvement is needed in order to ensure that the system addresses and connects each facet leading to the requisite outcome. In this case involving a holistic, proactive approach, the outcome, in simple terms, is the approval of permits enabling the promotion of sustainable and renewable energy forms (Graziani & Fornasiero, 2007).

Separate and distinct permitting processes and permits for each of the building trades associated with installation of a typical PV systems (e.g., structural, electrical, plumbing, mechanical, aesthetics, zoning, property rights, and environmental) create difficulties in terms of logistics, cost overruns, and timely permit approval as well as project completion (Kramer et al., 2011). It was argued by Kramer et al. (2011) that some means of proactive permitting is needed if RPSs and incentive programs are to be successful. Yet, there is little in the literature, in terms of focused research studies concerning the relationship that may exist between proactive permitting, the existence of a legislated RPS, and insolation levels. An exception to this is the work accomplished by

Jacob (2011), which does show correlation between proactive permitting policy and the percentage of approved permits. Proactive permitting is one energy resource management approach that was used by municipal personnel working on inculcating solar energy initiatives in Portland, Oregon (Jacob, 2011). These personnel placed all solar energy based system permit reviews and approval authority into one agency and department (2011). Before this effort, the applicant had to deal with five separate agencies and departments (2011). Yet, the state of Oregon does not have a legislated RPS (DSIRE, 2012).

Another example of proactive permitting is the approach used by personnel in the permitting department for Ann Arbor, Michigan. This department functions on the mathematical rules of exponents (Cory & Swezey, 2007). These rules support the idea that an increase in the percentage of approved permits equates to a twofold or better increase in electrical power generation capability (DSIRE, 2012). According to data published in the web site for the city of Ann Arbor, Michigan, (City of Ann Arbor, 2012, *Solar Projects and Programs* tab); "If every residential building in Ann Arbor had a one kilowatt solar electric system on the roof, we could generate over 30 million kilowatt-hours of clean electricity each year or about 10% of the Ann Arbor's [year] 2000 residential electrical use." Meaning, to meet 100% of the year 2000 residential electrical use, total production would need to have been 300,000,000kWh, or at least a PV system per residence capable of producing 10kWh per day. This would be difficult to achieve without approved permits for the installation of the requisite solar energy-based systems.

Yet, inhabitants in the state of Michigan are accomplishing just that—approved permits and a supportive energy policy without a legislated RPS (DSIRE, 2012).

Rifkin (2011) proposed that many venues, including industrial facilities, may be outfitted with photovoltaic systems, turning them into small sized electrical power producing utilities. Rifkin (2011) did not discuss the concept of project permitting for approval to retrofit existing facilities, and for system integration of new facilities. Hobbs and Meier (2000) viewed renewable and nonrenewable energy resource management through the lens of multiple decision criteria that focused on environmental considerations, without regard for permits to install renewable and nonrenewable energy systems.

Dreveskracht (2012) examined the ways and means through which solar based energy projects may be instituted on Tribal Indian Lands within the United States. This examination focused on the influences that treaties, funding mechanisms, and cultural mores exude on the pursuit, installation, and control of solar energy projects within tribal lands (Dreveskracht, 2011). Dreveskracht (2012) did not delve into study of the relationship that such things as Energy Star (EPA, 2011) criteria or a legislated RPS may have with the permitting and installation of projects on tribal lands.

Energy Star criteria, as stipulated by the EPA (2011), provides some key factors used in determining the performance rating applied to specific electrical devices and buildings. These criteria are based on economic theory and statistical analyses of energy consumption of the device and the device life cycle (EPA, 2011). According to information published by the EPA (2011) regarding Energy Star rating criteria, energy consumption of some 200,000 buildings across the United States is measured and tracked in terms of efficiency of performance (2011). Some data for this performance measurement comes from the DOEs Commercial Building Energy Consumption Survey (CBECS) according to the United States Department of Energy, Loan Program Office (2012).

Some of these measures include building size, operational hours, and number of occupants. There is no consideration in the CBECS for the purpose of the building, the operational equipment contained therein, and the building code requirements relevant to the calculated full-load energy demand. Nor is there any consideration for potential carbon cap and trade benefit relevant to the potential reduction of greenhouse gas emission, which should be for Energy Star status (Fenn et al., 2009). The focus on Energy Star status and high marks on the CBECS are supposed to indicate that the recipient and respondent are examples for other firms to look toward for inspiration and potentially for guidance in green efforts (DOE, 2011).

Conversely, according to Gillis (2011), carbon emissions have actually increased over the past decade by nearly 200%, possibly putting the entire Energy Star rating system and the CBECS into question, in terms of their validity and influence relevant to RPS compliance (Gillis, 2011). In fact, merely 22% of existing commercial buildings classify as zero energy buildings (ZEB) (EIA, 2012). Meaning, the buildings supposedly use the same amount of energy as they contribute, which invokes the ZEB classification.

Neither the CBECS nor the ZEB classification and judgment criteria include consideration for the percentage of approved permits and insolation levels, though CBECS and ZEB do have some connection to RPSs—legislated and otherwise, according to Sánchez et al. (2010). Sustainability through efficient production, transport, use, and conservation of energy comprise the rationale behind ZEB (Clarke, 2012).

Rifkin (2011) argued that barely 68% of electrical power generated at large utilities, such as the Grand Coulee Hydroelectric dam, actually arrives for use at the intended user's facility. The remaining 32% is lost in transit. This transit loss may be more easily mitigated if the transit distance is reduced, essentially indicating that it may be more value added to have in-facility systems instead of large remote systems (Rifkin, 2011). This level of system inculcation would be considered as meeting the Point of Use principle from Lean Manufacturing (Laird, 2012). This support of system inculcation to existing facilities and homes is certainly within the arena of permitting and ROI analysis, albeit apparently not aligned with the ARRA (2009).

Locating electrical power generation nearer to the point of use may prove to be even more critical to energy resource management in light of any RPS scenario when one understands that any RPS—legislated or otherwise, may dictate some amount or goal of renewables based energy. In the event this amount or goal is reliant on production by large, remotely located systems, then system production and capability must actually be increased by 32% in order to cover this transit loss if compliance with the associated RPS is to be achieved (Chevron, 2011). With this increase in mind, under consideration for

ROI, the case for locally located PV systems is improved, making permitting increasingly critical.

Influences of permitting processes are evident in the rationales and considerations put forth in the SunShot Initiative (DOE, 2011). One of these influences is the statistic that there are over 18,000 separate permit jurisdictions within the United States (2011). In terms of the population for this study, there were 50 separate municipalities plus the 25 solar cities. Each of these jurisdictions has common as well as specific and unique permitting processes (Jacob, 2011). Some of these municipalities are also solar cities, as indicated in Appendix C. Appendix D contains a table with data relevant to each state capital and the means of obtaining a permit for the installation of a solar energy based system.

These data in Appendix D are provided to demonstrate the complexity that some jurisdictions have institutionalized in the permitting process they follow. In addition to these jurisdictions, the utility serving the specific area may also have jurisdiction over the electrical portion of photovoltaic systems, since these systems may be part of the general electrical grid, as opposed to stand alone systems (Rifkin, 2011). The general electrical grid can also be referred to as the common electrical grid. It may be essential that any RPS oriented legislation distinguish between general grid contribution and standalone oriented system contribution in order to adjust for capacity and goals influenced by these two contribution routes.

Examples of such utilities are SCL, Southern California Edison (SCE), Bonneville Power Administration (BPA), and Puget Sound Energy (PSE). These have jurisdiction over systems, which connect directly and indirectly to the common electrical grid. They do not have jurisdiction over standalone systems, nor do they have jurisdiction over autonomous systems that have no connection whatsoever to the common grid (Solar Washington, 2012). James (2011) examined the permitting process for solar projects that are directly connected to the grid and installed in remote desert locations. From this examination, it was determined that the permitting process for these project types was cumbersome, archaic, and time consuming (James, 2011).

Renewable portfolio goals and legislation are influenced by the various energy resource management models that have been developed and used for energy project consideration over the past 7 decades (EIA, 2011). Schoofs (2004) argued that additional research must be accomplished to determine the various relationships that may exist with renewable energy resources and their use before any value added debate could take place concerning the potential benefit of a nationally legislated RPS. This study regarding the relationship between approved permits, insolation, and legislated RPSs may add to this body of knowledge, and possibly bridge some gaps relevant to this national RPS debate. Self-directed improvement and sustainability initiatives relevant to renewable energy may be one means of bridging gaps relevant to RPSs and permitting. Some private and publically traded companies seem to have taken the lead in self-directed improvement and sustainability initiatives relevant to renewable energy (SEIA, 2012).

Description of Studies Related to the Chosen Methodology and Methods

Studies related to the chosen methodology and methods in the scope of this study stem from various disciplines. These included economics, energy resource development, and behavioral sciences (Cohen, 2009). Each used multiple linear regression analysis and ROI analysis in myriad ways. Economic theory applications have used multiple linear regression analysis for case review and earnings projections based on operational context and time value of currency (ExxonMobil, 2011). In their case study for the third quarter in 2011, personnel from ExxonMobil used multiple linear regression analysis of the variables associated with such elements as assets, depreciation, and liabilities was accomplished (ExxonMobil, 2011). Some case reviews have included carbon positive, neutral, and negative valuations in their economic based analyses (Fenn et al., 2009). These analyses were based on the principles of ROI (2009).

Economics, as used in analysis and observation, and applied through such routes as ROI, capital investment, carbon cap and trade, incentive protocol, taxation strategy, and cost—benefit analysis was evident throughout much of the literature. In the study accomplished by Schoofs (2004), the argument is made that more research must be accomplished and answers obtained before any statistical credence may be placed in the idea of legislating a national RPS. In their study regarding renewable energy, Graziani and Fornasiero (2007), made the argument that solar-based energy is the one renewable source that makes the future hydrogen based economy feasible. In other words, there was a direct correlation between solar based energy and the means of economically producing hydrogen in the amount needed for future hydrogen based energy infrastructure and applications. Woody (2012) argued that the complete cost for solar energy-based systems must be included in economics based analyses. This complete cost includes all costs offset through incentive programs, because someone has to foot the bill now or later (Woody, 2012). Woody used benefit-risk analysis in his study (Woody, 2012).

Venables (2008) contrasted the website for the Federal Energy Regulatory Commission (FERC) (2012) with the web site for the NREL through the lens of ROI criteria for ease of use (e.g., the easier something is to use the better the ROI). From this study Venables (2008) argued that that web site for the FERC does not have any direct or easily located path that leads the site user to information relevant to renewable energy resources, including solar. Multiple linear regression analysis of these data showed that as ease of use increases so does ROI, and as use becomes more arduous, ROI decreases (Venables, 2008). Additional research of this site by me determined that neither is there any direct or easily located path that leads the site user to information relevant to RPSs. Essentially, the content of this website cannot support any ROI oriented effort, including analyses. In contrast, I did find that personnel at the NREL working with the *Applied Materials* group compiled a report, listing, and map of the United States of America that showed which states had an RPS—legislated and otherwise. This report also contained contributing energy resources to the RPS, the level of the RPS, in terms of energy production, and the goal for energy production in terms of year and contribution amount.

Cory and Swezey (2007) argued that these data are essential in order to conduct economics and statistics oriented analyses.

One economics principle demonstrated through a study by Zimbardo (2008) is that typically the better the ROI is, the lower the use or expense of energy is. Essentially, Zimbardo (2008) demonstrated that these two variables are inversely correlated. Staff at the World Bank (2011) demonstrated through their report that higher poverty levels are correlated with increased economic drain on supporting economies and decreased economic activity in impoverished areas. Taking into account the affect from an 8% increase in drain and an 8% decrease in economic activity, the final affect is a 16% gap, which is difficult to bridge, regardless of incentives (World Bank, 2011).

Regardless of the variety of federal, private, and state agency publications, personnel from these venues (e.g., NREL and the Applied Materials group) have not used these data in any study concerning the relationship between a legislated RPS and calculated annual median insolation levels with the percentage of approved permits, even though this relationship may have a direct affect on national security (FERC, 2011). A brief risk-benefit analysis of the situation demonstrates the critical nature of energy resource management. A better-managed energy resource translates into improvements throughout the associated society, which increases the ROI for the management effort, which includes management of infrastructure (Sullivan et al., 2012).

Descriptive and inferential statistics were used in a study concerning the electrical grid for Pakistan (Kiani, 2012). This study was focused on the societal benefit of electricity and the electrical grid as viewed through the lens of national security (2012). Officials of the nation of Pakistan held legislative hearings in 2012 wherein statistically based testimony was given that firmly indicated the nation's general electrical grid would likely collapse within 4 years, regardless of the legislated amounts of electrical energy production they have published (Kiani, 2012). These evidences indicate the need for understanding of the statistically based relationship between legislated RPSs and calculated median annual insolation levels with the percentage of approved permits. This understanding may then be used to bolster or adjust RPS initiatives and permitting processes (Gordon, 2012), as well as the national security of the US.

James (2011) accomplished his research regarding regulation and environmental protection through the use of statistical data analysis (e.g., ANOVA) as applicable to data from desert settings in California. The results of James' research showed how eligibility deadlines for federal funding and ill prepared permitting agency processes combined to create an atmosphere capable of hampering job growth and achievement of RPS goals (James, 2011). Klass (2011) approached his statistically based research through a focus on law and easements relevant to renewable energy infrastructure requirements versus property rights and property valuations. Klass (2011) cautioned against the use of antiquated means and models of valuation review and consideration of renewable energy based project permit applications, and encouraged the need, development, and use of relevant means and models for project evaluation.

Rule (2010) used statistical theory via multiple linear regression analysis and examined the propagation of distributed, renewable energy systems through a focus on the conflict between legalities of land use, cultural perspectives of aesthetics, and social responsibility to embrace green technologies. Through the use of systems theory, Dreveskracht (2011) based his research on examination of potential solar-based energy projects that were possibly to be built on Indian lands. This examination included cultural, management, and financial perspectives, yet nothing directly by way of influences from the existence of an RPS—legislated or otherwise (Dreveskracht, 2011). Cohen (2009) argued that specific inferential elements and consideration must be used to plan a study and conduct the requisite data analysis.

Description of Strengths and Weaknesses in Researcher Approaches

Through this literature review it became evident that the associated research and researchers could be segregated into two fundamental groups. One group of researchers invoked the rule of law as the underpinning to their studies. From these studies, it can be derived as to how legalities and zoning processes associated with permitting supported or deterred the installation of photovoltaic systems. The aspect of national security falls into this grouping (Barrionuevo, 2009). From my research and literature review, the balance of researchers invoked the rule of economics and ROI as the underpinning to their studies. Through these studies, aspects of permitting that supported or deterred the installation of photovoltaic systems may be identified and subsequently researched (Herrick, 2012). This research was beyond the scope of this particular research study.

Few of the authors made any connection between, or attempt to study the aspect of insolation levels impinging the Continental United States (CONUS) with the existence of legislated RPSs and the relationship that may occur in terms of the percentage of approved permits. These plausible relationships are important elements for consideration since lower insolation levels equate to less energy production (Marion & Wilcox, 1994), a longer term to realize a positive ROI (Herrick, 2012), and failure to achieve the necessary level of energy production (Turpen, 2010).

Rifkin (2011) observed that it would make more sense, and statistically provide more energy to use existing facilities as the foundation for distributed renewable solar power systems. Jacob (2011) argued that it would make more sense statistically and economically to forego the expense and ramifications of environmental impact studies typically involved with remotely located projects and sites by using existing facilities as system platforms.

Both James (2011) and Jacob (2011) identified three prominent phenomena that pose difficulty in the permitting process. These phenomena are inter and intra-agency interference, lack of coordination within and between agencies and legislators in terms of laws involved with solar energy based projects, and lack of cohesion between involved building trades and understanding as well as enforcement of associated codes. Though James (2011) and Jacob (2011) identified these as problematic, I was unable to locate any in-depth research studies about the relationships that these phenomena may have had with the percentage of approved permits, RPSs, and insolation levels. As a result, there is an apparent gap in the literature regarding this potential relationship. None of the authors examined permit approval as a function of RPS compliance. Of the current CONUS RPSs listed by the EIA (2012), none included considerations or studies relevant to the requisite increases in the percentage of approved permits. Bridges (2010) focused entirely on RECs, not touching on the act of permitting whatsoever.

Justification from the Literature for Selection of the Variables

The independent variables for this proposed study were the level of RPS and the calculated annual median insolation level for each state and or city comprising the sample population. It is acknowledged that the metric for an RPS resulted in either a 1 or 0, as the level (e.g., category is legislated or not, respectively). Indication of a 0 was used for the null and a 1 for the positive, in binary terms. The median annual insolation level was in $kWh/m^2/day$, which is the measure used for this energy source. The dependent variable was the percentage of permits approved by the permitting agency of each city comprising the sample population during the study period. The resulting data was then used to determine the plausible influence of the RPS and insolation level, as well as any linear relationship that may exist with the percentage of approved permits for the installation of solar energy-based systems.

In the past half century there has been an exponential increase of interest in renewable and sustainable energy resources (NREL, 2011). One of the renewable energy resources is solar-based energy (Graziani & Fornasiero, 2007). Environmental concerns have prompted some of this increased interest (Graziani & Fornasiero, 2007). Fenn et al.

(2009) argued that the global community must reduce greenhouse gas emissions by as much as 80% from 1990 levels no later than 2050 if the effects of global warming are to be reversed. A multitude of researchers have studied such things as the effects of global warming, the various energy resources touted as being sustainable and renewable, and even the idea of establishing solar farms and wind farms that would take hundreds of acres of land to erect (IPCC, 2012). Each of these is influenced by economics and ROI.

According to Wang (2012), much of the interest involved with financial investment in solar-based energy systems and infrastructure may be fostered due to incentives from the federal government. These incentives are promoted and driven via grants, tax credits, and low interest rate loans (Shrimali & Kniefel, 2011). Two of these incentives (e.g., renewable electricity production tax credits [PTC] and U.S. Department of Treasury Renewable Energy Grants [REGs]) provided 30% of the funds to decrease the cost to install such systems and infrastructure. Recently, PTC and REG oriented funding came as part of the ARRA (ARRA, 2009) and the SunShot Initiative (DOE, 2011). However, this funding was earmarked for industrial and utility applications, not for residential applications (ARRA, 2009).

In the case of grants, 10% of all other property and building costs associated with the installation site would also be funded by the federal government, according to information in the ARRA (ARRA, 2009). This specific grant incentive also applies only to the commercial and industrial sectors (ARRA, 2009). Neither of these incentives—PTCs and REGs provided through the ARRA of 2009, applied to the residential sector

(DSIRE, 2012). Notwithstanding this practice for incentive based funding, all energy users and sites have the potential to contribute to greenhouse gas emissions (Graziani & Fornasiero, 2007).

The city of Seattle, WA, which receives median annual insolation of 3.8 $kWh/m^2/day$ (Marion & Wilcox, 1994) was a recipient of funding through the SunShot Initiative (DOE, 2011), even though the mean annual insolation is less than other cities, such as Los Angeles, CA, which receives median annual insolation of 5.45 $kWh/m^2/day$, and Santa Fe, NM, which receives median annual insolation of 6.25 $kWh/m^2/day$ (EIA, 2012). This is a difference of 43.42% and 64.47% respectively. These later two cities were not selected as solar cities, even though their potential for electrical power production is greater than that of Seattle (Behrens, 2011). From the business (e.g., ROI) and societal benefit perspectives, it makes sense to base legislation on facts such as insolation levels, instead of emotion (Hofstede, Hofstede, & Minkov, 2010).

Data from the website administered by the EIA (2012) indicate that in 2010, Washington State did not produce any measureable amount of electricity from its 1 Megawatt (MW) capacity for production of electrical power from solar energy. Considering that other regions of the US actually would have produced electricity at the full 1 MW capacity, it is then possible to demonstrate that societal benefit, as argued and presented by Anderson et al. (2008) was not achieved. Therefore, the ROI was negative, causing a greater cost to the taxpayer whose funds were used for construction of this capacity in Washington State.

From an investment and national security perspective, this lack of measurable production (e.g.,1kilowatt, or 0.001 of overall capacity) would be considered an abject failure, similar to the failure of Napoleon's dictatorship, in terms of societal benefit through economic means, as argued by Marx (2011). One must question how a nationally legislated RPS could ever benefit the taxpayer through any means of actualization, if said RPS were implemented in similar fashion as the SunShot Initiative was, especially since this initiative prompted this 1 MW capacity in Washington State. Maslow (1999) argued that actualization of an entity transforms that entity into something meaningful and of value, both for the entity and for those in observable distance. In other words, not only did this 1 MW capable facility fail to meet its intended purpose, those who sacrificed time and effort to make it capable were also likely left with some degree of disappointment and frustration, adding more to the negative side of the ROI balance. This information adds further validity to this proposed research study. Woody (2012) argued that lower insolation levels (e.g., < 3.8kWh/m^2/day) couples with system costs to bring the final kWh cost to exceed $10.00 per kWh, thereby demonstrating the importance in considering insolation level in the ROI analysis. This scenario also demonstrates why insolation must be considered for any RPS and initiative, and why insolation was one of the two independent variables for this study.

From this example, it can be deduced that any reasonable ROI is likely difficult to achieve in regions of low insolation (e.g., < 3.8kWh/m^2/day), even with federal incentives (Sullivan et al., 2012). Naturally, the existence of a legislated RPS and the relationship it may have with the percentage of approved permits has importance in investment towards specific energy resources (Dreveskracht, 2012). The multiyear saga that has taken place regarding the Keystone XL pipeline is one prime example of how permitting may influence energy resource management (TransCanada, 2011).

Review of Studies Related to the Independent Variables

The independent variables were the RPS level (e.g., legislated or not, coded as 1 and 0 respectively) and the calculated median annual insolation level for each city, or associated state comprising the study sample population. There were some interesting and complex dynamics that are involved with RPSs, insolation, and permitting. Because of these dynamic complexities, any intuitive perception regarding the relationship with the existence of a legislated RPS, insolation levels, and the percentage of approved permits for solar-based energy systems is likely moot. Senge (2006) argued, “real leverage in most management situations lies in understanding dynamic complexity” (p. 72). Given the breadth of legislative approaches involving RPSs, jurisdictional approaches of permitting for solar energy-based systems, and numerous energy resource management models that exist; dynamic complexity was arguably quite present in the topic and focus of this study.

Recall that achieving RPS energy production edicts or goals—regardless of RPS level (e.g., legislated or otherwise), and projected electrical power production levels cannot be reached without approved permits for the installation of renewable energy based systems such as photovoltaic arrays. Some RPSs have a legislated goal for the percentage of energy to be derived from solar-based systems, while some have the level of megawatts (MWs) to be derived from such systems (EIA, 2011. Some RPSs have a percentage of energy to be derived from renewable resources without distinction for the resource type, and some have a level of MWs to be derived from renewable sources without distinction for the resource type (2011). Some RPSs and permitting processes are coordinated, which may actively encourage installation of solar energy-based systems (Jacob, 2011). Some areas without an RPS seemed to issue more permits per capita than some of those with an RPS, regardless of socio economic status (DSIRE, 2012). So, just because an RPS existed, it did not mean that solar system permits are actively encouraged, nor did the lack of an RPS put a damper on the quantity of systems installed. This disparity fans the debate concerning the possibility and need of enacting a national RPS (Schoofs, 2004).

This disparity and the previously noted contradictory approaches involving ROI, insolation levels, and RPSs—legislated and otherwise, demonstrated the need to study and understand the relationship between RPSs and permits. In addition, studies accomplished by Schoofs (2004) and Bingaman (2010) indicated that a study of this nature is relevant. Results from these studies and from the study accomplished by Richardson (2008) indicated that a more proactive energy policy is critical to sustaining our way of life and meeting future energy demands. Currently, energy related policies may or may not be based on a legislated RPS (NREL, 2011).

The energy policy instituted by policy creators and decision makers for the state of Vermont is one example of a proactive energy policy that is not based on a legislated RPS. According to the Database of State Incentives for Renewables & Efficiency (DSIRE), elected officials in Vermont have established a target for 75% of utility-provided electricity to be generated via renewable sources by 2017eventhough no actual legislated RPS exists in Vermont (DSIRE, 2012). The calculated median annual insolation impingement on Montpellier, VT is 4.5kWh/m^2/ day (Marion & Wilcox, 1994). The state of Utah does not have a legislated RPS (DSIRE, 2012), yet the Salt Lake City area receives annual mean insolation of 5.45kWh/m^2/ day (Marion & Wilcox, 1994), which is 21% more than Montpellier. Regardless, Utah trails Vermont in terms of installed solar energy-based systems and power generation capacity from them (Rule, 2010). Thus, not having an RPS may or may not be an impediment to the percentage of permits being approved and systems being installed.

To make a solar energy based project economically viable, solar radiation levels, also known as insolation, must be considered. These levels dictate the amount of electrical energy that may be generated through the use of insolation collection devices, such as solar panels (Marion & Wilcox, 1994). Regardless of this viability requirement, insolation was not a criterion for federal funding awarded to solar cities selected via the SunShot Initiative (DOE, 2011). This act of funding without regard for insolation is counter to ROI protocol and sound economics, as well as stewardship of taxpayer monies

(Sullivan et al., 2012). Such evidence certainly positions the value, jurisdiction, and administration of legislating a national RPS into further scrutiny (Cory & Swezey, 2007).

A jurisdiction is the area, such as a city, county, or township that has an agency responsible for the review and approval of building permits. For example, King County in Washington State has the Department of Development and Environmental Services (DDES), which employs personnel responsible for the review and approval of permits involving electrical and plumbing oriented work accomplished within the county (King County Department of Development and Environmental Services [DDES] 2012). Initiatives can become pointless when myriad jurisdictions administer them through contrasting and inconsistent means (ACEEE, 2009).

The calculated median annual insolation for Trenton, New Jersey is 4.55kWh/m^2/day (NREL, 2012). In contrast, the calculated median annual insolation for Tallahassee, Florida, the S*unshine State*, as it has been nicknamed, is 4.90kWh/m^2/day. This difference of 0.45kWh/m^2/day is sufficient to add at least an additional 164.25kWh/m^2/year of energy to the grid. Regardless of this insolation difference, New Jersey had a legislated RPS and Florida did not. Yet Florida Power and Light (FPL) completed "three solar power plants that together can produce 110 megawatts of clean electrical energy" (FPL, 2012). The average annual production capacity for each FPL project is 36.67 megawatts. The production capacity in New Jersey is a difference of nearly 30 times more, which may be attributable to the existence of a legislated RPS and a supportive energy resource management model, as well as permit fee structure.

The size and encroachment of the federal government on states' rights has historically been a point of concern (Jefferson, 1977). The possibility of a federal RPS brings up a plethora of questions along this vein of potential encroachment. These questions were neither posed nor addressed in this study. Regardless, results of this study may add to the work accomplished by Schoofs (2004), Bingaman (2010), and Woody (2012) regarding the need for a national RPS. Results of this study may also be useful in protecting states' rights where energy resource management is concerned.

Review of Studies Related to the Dependent Variable

The dependent variable for this research study was the percentage of permits approved for the installation of solar energy-based systems from January 1, 2011 through December 31, 2011. According to data in the website for New Jersey's Clean Energy Program (2012), there have been more than 17,600 solar energy projects approved and completed since 2001. On average, each project has the capability to produce 49,755.79 watts annually for a total annual production capacity of 876.1 megawatts. New Jersey has a friendly permit application and approval process (New Jersey, 2012). As noted in Appendix D, it only takes a total of 18 steps to complete and submit a permit application. In contrast, it takes 52 steps to file an application for permit with Olympia, Washington, a designated solar city. Although the state of Washington has a legislated RPS, there is not any coordination between consideration for photovoltaic system permits and meeting the legislated RPS requirements (King County, 2012). This lack of coordination is an identified gap in the literature since research studies are nonexistent regarding the relationship that this lack may have on the percentage of approved permits with the existence of a legislated RPS and insolation level. Appendix D includes data relevant to each capital city to demonstrate how complex the mere act of seeking a permit can be.

The approval of permits for solar energy based projects is necessary if the goal of having the cost of solar-based energy being equal to the cost of electrical power from conventional sources by 2015 is to be achieved (Solar America Initiative [SAI], 2008). Results of this study may aid in determining if a nationally legislated RPS is necessary to reach that goal or if a national approach may be an impediment and encroachment on states' rights. Some studies related to the variables for this study included those by Jacob (2011), James (2011), Klass (2011), the Arizona Department of Commerce (2012), Alyseka (2011), Danescu and Danescu (2011), Gordon (2012), and Lai and Wang (2011). Each of these researchers approached study of permit approvals, insolation levels, and RPS endeavors from different perspectives.

Klass (2011) took his perspective from the legal point of view and focused on the legalities associated with permitting processes and the building codes by which approval determination was made. Jacob (2011) actually served on the municipal board that orchestrated and oversaw the overhaul of the permitting processes in Portland, Oregon. This overhaul moved the processes from five separate, disconnected departments into the realm of cohesive, coordinated function in one department. James (2011), as previously discussed, examined the permitting processes involved with the review and approval of large, megawatt solar energy based projects proposed for installation in environmentally sensitive desert locations.

Each researcher acknowledged the critical nature of permitting processes and approvals in terms of their influence on increased use of solar-based energy. Each also recommended that improvements of permitting processes needed to occur in order to prompt a higher percentage of approved permits. Improvements would undoubtedly increase the percentage of permits approved (Jacob, 2011). None studied the relationship between the percentages of approved permits with the independent variables involved in this study.

Understanding the relationship between the independent variables and the percentage of permits approved for the installation of solar energy-based systems is certainly one means through which such improvement may be accomplished. According to Richardson (2008), contradictory and confusing direction and dictates given to applicants, contractors, and agency personnel have a tendency to dampen enthusiasm for solar energy based projects, even in the face of government incentives. Since there is little literature regarding the potential relationship that contradictory and confusing direction and dictates regarding permits may have with the percentage of approved permits, this constitutes a gap in the literature.

Consideration regarding the potential influence of a legislated RPS on the percentage of permit applications and approvals is critical. Without approved permits, projected electrical power production levels cannot be achieved. Meaning, without a permit there is no project, regardless of the existence of an RPS—legislated or otherwise (Jacob, 2011). Failure to establish permit fee schedules bent on inculcating permit application, review, and approval processes can be a downward force on the percentage of approved permits (Shrimali & Kniefel, 2011). Since research studies regarding permit fee schedules and their relationship with the percentage of approved permits is sparse, this is a gap in the literature.

Review of What is Controversial in Studies

Itek Energy employees (2012) have published information in the company's website about the solar panel systems that they make and install specifically for Washington State residents. Itek Energy (2012) does not have any information on their website or in their brochure that is relevant to the permits required for installation of their systems. Contrary to the insolation data noted by Itek Energy in their website (2012), data published from Marion and Wilcox (1994), and the EIA (2012) indicated lower insolation levels for states such as those in the Northwest, than for those in the Southwest regions of the U.S. Such disinformation, as published by Itek (2012) or others, can skew perceptions and ill advise policy creators and decision makers who are in debate over a legislated national and even state RPS IPCC, 2012).

Notwithstanding this difference in insolation between Northwest and Southwest regions of the US, which can be as much as 4kWh/m^2/day less for the Northwest when compared to the Southwest (Marion & Wilcox, 1994), Seattle, Washington was one of the 25 cities awarded federal funding under the solar cities program (PSE, 2011), as previously discussed. This typical award scenario puts into question the rationale for the award, given that the ROI period is considerably longer than it would be if Santa Fe, New Mexico had received the award. The Santa Fe, New Mexico region receives nearly 65% more insolation than Seattle (Marion & Wilcox, 1994).

Much of these insolation data published by Marion and Wilcox (1994) are derived through the use of developed computer based models, such as Daymet. Much of this data used in these models is derived or calculated (Marion & Wilcox, 1994) instead of directly measured or read via the use of a variables gauge, as defined and controlled by the National Institute of Standards and Testing (NIST) (2012). A lack of real time, actually measured and recorded insolation data as compared to derived models creates a gap in the literature, as argued by Huff and Geis (1993), regarding statistical analyses of any data. This prompts questions as to the accuracy and validity of the data compared to actual, real time data collected at the intended installation site for any PV system.

For its business, EnerNOC (2012) focuses on demand—response systems programmed for forced control of energy consumption, under the guise of efficiency and potential cost savings. The cost of photovoltaic systems does vary, and the per kWh cost for electricity that these produce is often 15 times more than the cost for electricity produced by other means (DOE, 2011). This higher cost can have an effect of downward pressure on the pursuit of solar energy based system permits (Woody, 2012).

There are a plethora of government incentives that exist to recruit purchasers of solar-based energy systems, and offset this higher cost. One such incentive is the ARRA, which also contains an additional list of other incentives. Notably, the brunt of these government incentives was earmarked for industrial, not residential use (ARRA, 2009). These incentive programs can influence the manufacturing (Solyndra, 2011) and purchasing market (Smith, 2011), concealing inadequacies in permitting processes (NREL, 2008). These scenarios involving incentives and insolation indicated that there may be a complex relationship, in the spirit of the argument used by Senge (2006) with legislated RPSs, insolation levels, and the percentage of approved permits for the installation of photovoltaic systems.

Personnel from the EIA (2012) presented data in their on-line publications to demonstrate that the cost of electricity for consumers has risen 38% since 1990. From a general perspective, this metric may seem useful when considering this research study. However, under analysis, it becomes evident that such a measure, and the resulting increase, does not account for the influence of inflation in other areas, such as information technology and consumables (Hung & Chen, 2009). Nor does it account for the influence of government incentives (CME Group, 2012). Indeed, given the typical inflation rate of 3% per annum, the cost would have increased nearly 92% since 1990, instead of 38% (Sullivan et al., 2012).

Review of What Remains to be Studied in Recent Studies

The way agencies are populated, in terms of skills and experience of personnel may influence the relationship between the variables, and particularly influence the energy resource management models being instituted by a given agency (Turban, Aronson, & Liang, 2005). Municipal leadership and operating capital may have an effect on permitting approaches taken that have relevance to an existing goal oriented, planned, or legislated RPS. There may be variants in the percentage of permits approved due to perceptions and experience of the population comprising potential and actual owners and operators of solar energy oriented systems (Gordon, 2012).

Any upward pressure on the quantity of permit applications submitted due to policies and incentives, such as carbon cap and trade policy or RECs, may force reevaluation of the need for a legislated RPS—federal or state. This relationship is one example within energy resource management that may benefit from a research study based on a theoretical framework involving the laws of motion, as posited by Newton (1995). These are examples of areas that remain to be studied.

Review of Studies Related to the Research Questions

I did not come across any studies regarding the questions and hypotheses relevant to the existence of any relationship between the independent variables and the dependent variable associated with this study.

Summary and Conclusions

Summary of Major Themes in the Literature

There were three major themes in the literature researched for this study. These were environmental, financial, and social. Decisions to submit applications to install solar energy-based systems, establish or legislate RPS goals, and the quantity of permits a given agency may adequately approve in a specified time frame were influenced by these themes. The perspectives and basic decision criteria tended to differ between agencies, legislators, and would-be owners as well as operators of systems within the cities that comprised the study population, with each tending to focus on what will benefited them directly, in terms of one or more of these three themes.

The applicant may use environmental issues in an effort to receive support for issuance of a permit, whereas the agency management may use environmental considerations to levy fees or deny a permit. The applicant may use governmentally backed financial incentives, conservation, RECs, and net metering to support their rationale of submitting an application and pursuing a permit. The agency management may use governmentally backed financial incentives and permit demand to adjust application fees, revamp offices, engage in community partnership programs, and hire more staff. From the social perspective, each entity (e.g., applicant, legislator, and agency personnel) involved with the process and policy debates seems to be influenced by societal ideals regarding sustainability, carbon cap and trade, and global warming.

Summary of the Known and Unknown Issues

Insolation data were critical in determining one aspect of plausible influence on the percentage of approved permits. Much of these data are derived through the use of developed models, such as Daymet. Much of this data is derived or calculated instead of directly measured or read (Marion & Wilcox, 1994). This prompts questions as to the accuracy and validity of the data compared to actual, real time data collected at the intended installation site. It is known that there are over 18,000 permitting jurisdictions throughout the United States and that each has differing processes (DOE, 2011). It is unknown as to why these differing processes continue within multiple jurisdictions when some jurisdictions have demonstrated that inclusive, lean processes are superior (Jacob, 2011). It is unknown why some locales with reduced insolation and solar energy potential were given solar city awards while others with 200% greater solar energy potential were not considered for such awards.

From one source, it is known that 78% of the states had some form (e.g., goal, proposal, mandate, etc.) of RPS (EIA, 2012). From another source, it is known that only 46% of the states had some form of legislated RPS (DSIRE, 2012). It is unknown why all states don't have some form of RPS. It is known that some of the states with an RPS stipulated the level of energy to be derived from solar energy, and that this level is either a percentage of overall utility capacity, projected societal demand, or as watts (NREL, 2011). It is unknown why the rest merely had a level for renewable energy in general, instead of specific percentages, or actual capacity for each specific renewable energy resource. It is unknown why all don't use an actual measureable criterion, such as watts, for the level of electricity to be obtained through insolation. It is unknown why some jurisdictions have not coordinated their permitting processes to the RPS for their respective state while others have, in terms of energy resource management and support to achieve RPS compliance.

How this Study Fills Identified Gaps in the Literature and how it will Extend Knowledge in the Discipline

Gaps identified in this literature review included

- Disconnected, nonexistent RPS initiatives and permitting processes
- Foci on forced conservation without foci on value added use of energy through coordination of RPSs, insolation consideration, and permits
- Failure to include permit approval in sustainable and renewable energy programs
- Inadequate and difficult to navigate agency web sites,
- Outdated permit review practices
- Outdated property rights edicts, acts, neighborhood covenants and restrictions, and laws
- Separate and distinct permitting processes and permits for each of the trades (e.g., structural, electrical, plumbing, mechanical, aesthetics zoning, property rights, and environmental) involved in the installation of a typical photovoltaic system
- Inter- and intra-agency interference
- Lack of coordination within and between agencies and legislators
- Lack of cohesion between trades and enforcement of associated codes
- Lack of including the applicable RPS compliance requirement in the consideration for photovoltaic system permits

- Contradictory and confusing direction and dictates given to applicants, contractors, and agency personnel
- Failure to establish fee schedules bent on inculcating permit application, review, and approval processes
- A lack of real time, actual insolation data as compared to derived models

One of the underlying themes in these identified gaps involves the need for education regarding the ROI principle of economic theory. Within this theme is the consideration of processes, policies, fee schedules, and energy resource management models in concert with planning ahead in order to meet projected energy demands.

The primary research question, the secondary research questions, and those questions posed in the survey contained in Appendix A, acted as the guide posts by which data were sought, obtained, and analyzed in an effort to pair these questions with answers and the study variables. There is agreement within this literature by no less than 87 of the authors represented in this literature review that sustainable, renewable energy must be managed and inculcated with RPSs if we are to maintain our present way of life and meet our projected future energy needs. The use of fossil based fuels for our energy needs must change, given their unsustainable and rather nonrenewable nature (Tribal Energy and Environmental Information [TEEI], 2012).

Understanding the relationship between the variables for this study is critical to the management and implementation of improved and new energy resource management models, and in determining the need, as well as value, of legislated state RPSs and a potential nationally legislated RPS. Though there may be studies which have viewed RPSs (Bingaman, 2011), insolation levels (Wang, 2012) and Moritz et al. (2012), and the permitting process (James, 2011) through a qualitative lens, none have undertaken research involving the relationship of the variables stipulated for this proposed qualitative study. Using these variables and results from this study to possibly demonstrate new models, and improve existing models may extend knowledge in the discipline of energy resource management.

Transitional Discussion to Chapter 3

Each of the identified gaps and their associated data were analyzed using the ROI principle of economic theory, and descriptive and inferential statistics from statistical theory. The study population, in terms of municipalities and designated solar cities, served as the basis from which to select a reasonable sample population, representing cities from across the US. Multiple linear regression analysis was use in the analysis of the potential relationship between the independent and dependent variables. This analysis was accomplished in order to obtain a national representation, perspective, and generalizable research approach, as well as to reject or fail to reject the null hypothesis.

The expressed need to reduce greenhouse gases (National Oceanic and Atmospheric Administration [NOAA], 2012) and the act of providing financial incentives are evidence of sponsorship for survivability and attempts to meet basic physiological and safety needs of humans in the sense in which these needs were theorized by Maslow (1999). The evidence of study and research methods thus far infused to energy resource management and reduction of greenhouse gas emissions indicate that the primary research methods of choice have been based on economics (OneWorld, 2011) and psychology (Richardson, 2008). This quantitative research study took a different approach in terms of methods and instruments through and with which analyses were accomplished.

Multiple linear regression analysis of the data was accomplished using SPSS software. The F statistic was calculated in the course of statistically based data analyses. RPS level (e.g., legislated or not) was coded as 1 and 0, respectively. The median insolation level per annum was calculated from monthly data published by Marion and Wilcox (1994). The percentage of approved permits for each city comprising the study population was obtained through the use of the survey provided as Appendix A. Data from the survey were augmented by gleaning data from municipal, state, and federal government web sites by searching via the terms noted in Table 2. These three items—RPS level, insolation level, and percentage of approved permits were the variables of focus for this quantitative research study. Improved and new energy resource management models are needed if the trend of global warming is to be reversed (Moritz et al., 2012).

Chapter 3: Research Method

The purpose of this study was to examine the possible relationship between the

- Level (e.g., legislated or not, designated as 1 and 0, respectively for this categorical variable) of Renewable Portfolio Standards (RPSs), within the study population and
- Calculated median annual solar radiation level, as measured in kWh/m^2/day, for each state (or applicable city if available), within the study population
- Percentage of permits approved, in terms of solar energy-based systems installations, within the study population for the study period of January 1, 2011 through December 31, 2011.

Note that the calculated median annual solar radiation levels were based on data from 1961 through 1990 as published by Marion and Wilcox (1994). These data were the most current published insolation data available for this quantitative research study. These data were not time-series-based (Marion & Wilcox, 1994).

The independent variables, that are also the predictor variables for this study, were the

- RPS level (e.g., category—legislated or not)
- Annual median solar radiation as measured in kWh/m^2/day for each city or state, if / as available comprising the study population, as noted in Appendices B, C and D.

The dependent variable was the

- Percentage of approved permits during the study period from January 1, 2011 through December 31, 2011 for the installation of solar energy based electrical systems at industrial, commercial, and residential locations in the cities comprising the study population.

Preview for Major Sections of the Chapter

The two major sections that constitute this chapter are those annotated as Research Design and Rationale, and Methodology. The research design and rationale are explained and supported with applicable references to the specific theories and models that grounded this study and guided analysis of the data. These theories were economic theory (Sullivan et al., 2012) and statistical theory; (Cohen, 1988), (Ryan, 2011), and (Tanis, 1987). From statistical theory, multiple linear regression analysis was the method used for statistically based analysis of the associated data. This analysis method was applicable given the number of independent variables associated with this study (Frankfort-Nachmias & Nachmias, 2008). Hypothesis testing was accomplished using multiple linear regression analysis and the calculated *F*- statistic via SPSS, as demonstrated by (Cohen et al., 2003). Residuals were plotted. If the results were statistically significant, I conducted post-hoc *t-Tests*. Statistical analyses were accomplished using SPSS. I also calculated the ROI, as described later in this chapter.

As 23 of the states have a legislated RPS, the personnel from the associated permitting agencies within those states should have approved sufficient permits for projects so that the associated RPS for their state was fully supported. The opposite may then be expected for states without a legislated RPS. Meaning that few permits would have been applied for, few approved, and few projects resulting from the effort because no impetus, such as a RPS, existed to either bolster or animate any effort. I have previously discussed such expectations and demonstrated that the associated intuition with these expectations may be ill conceived. As Bullis (2008) implied, expectations must be tempered by appropriate analysis. The noted analysis methods provided that temper, as argued by Ryan (2011).

Research Design and Rationale

Research study methods employed by other researchers regarding energy resource management models have involved various elemental constructs. These elemental constructs include social (Hofstede et al., 2010), financial (Sullivan et al., 2012), and environmental (Hobbs & Meier, 2003) elements. Within each of these elemental constructs are various subordinate and contributing elements. The subordinate elements for the social construct are organizationally (Daft, 2010), culturally (Hofstede et al., 2010), and security-oriented (Marx & Engels, 1848). The subordinate elements for the financial construct are innovation (Brown, 2009) and profit (The Utility Connection, 2012) oriented. The subordinate elements for the environmental construct are sustainability (Hastie & Dawes, 2010), evolution (Darwin, 2004), and global warming oriented (Graziani & Fornasiero, 2007). Each of these has a quantitative aspect and methodology of research suited for this research study. I chose to use economic theory and conduct my research analysis within the financially oriented construct of energy resource management, in terms of ROI analysis, as pertaining to the variables associated with this study.

This research study was designed as a quantitative, cross-sectional survey-based study as described by Creswell (2009). I used the survey in Appendix A to add a cross sectional basis to the research. The quantitatively-oriented survey questions were derived from the research questions posed for this study, and I sought answers and associated data that may be useful in addressing the posed research questions. Answers to the survey questions were used to test the null hypothesis. The survey questions were strictly for the time period from January 1, 2011 to December 31, 2011. This study period was used because it spans a period for incentive provisions included in the SunShot Initiative and the ARRA (2009).

In terms of survey completion and submittal, time and resource constraints may have stemmed from management and personnel of the various jurisdictions that comprised the sample population for this study. These time and resource constraints could not be controlled by me, and were considered to be external time and resource constraints. It was only possible to ask that the survey be completed and returned within the specified 10-day time frame.

Survey and cross-sectional based research designs were used by; Davis et al. (2005), Dreveskracht (2011), and Hobbs and Meier (2000). These scholars advanced knowledge in the disciplines of energy project management, multiple criteria decision making, and decision science. Creswell (2009) argued that surveys provide "quantitative descriptions of trends" (p. 12). These trends then provide further insight of the research topic, thereby advancing the knowledge of the discipline. Multiple linear regression analysis is one means of calculating and depicting possible trends (Ryan, 2011; Tanis, 1987).

Theoretical concepts may be used to advance knowledge. Reynolds (2007) argued that survey-based research "can be used at any stage of the process" (p. 160) in order to formulate theoretical concepts, which fosters results supporting advances in knowledge of the topic and discipline being studied. Similarly, the survey- and cross-sectional-based research design used for this study was useful in collecting quantitative data and formulating theoretical concepts. The results of this research design may be used to advance knowledge in the discipline of energy resource management via RPS policy and project permitting processes.

This was not an intervention study. Therefore, any typical considerations for intervention-oriented studies are not addressed in this dissertation. A mixed methods research study approach was considered but not selected due to the scope being limited to quantitative data not obtained from sources such as a Likert scale. A qualitative research study approach was considered by not selected for the same reason. An experimental research study approach was not selected because experimentation was not relevant to the scope of the research problem. A quasi-experimental research study approach was not selected due to the fact that no level of experimentation was needed nor accomplished in order to address the research problem.

The quantitative research study approach was considered better than the mixed methods and the qualitative research study approaches due to the actual quantitatively based data available for answering the quantitatively oriented research question for this study. These data did not need to be derived from the use of qualitatively oriented instruments and scales. Data associated with the variables for the RPS level are categorically based and coded in binary terms as either a 1 or a 0. There is no fractional scale as a result. A nonexperimental or survey research study approach was considered to be a better fit to obtain the data needed to answer the secondary questions, address the primary question, and to accept or fail to reject the null hypothesis associated with this research study. Therefore the quantitative, survey-based research study approach was selected.

Methodology

The Target Population and Sample Size

The target population for this study was comprised of permitting jurisdictions (e.g., incorporated and unincorporated cities) located within the United States. This did not include Washington DC and the territories of the United States. The accessible population of jurisdictions exceeded 18,000 (DOE, 2011). One plausible target population was comprised of 23 cities, which were the capitals of the states with a legislated RPS, plus 18 cities, which constitute the number of solar cities that are not state capitals. This population, totaling 23+18 = 41, were represented in mathematical and statistical formulae by *N*. According to the U.S. Department of Health and Human Services—Health Resources and Services Administration (HRSA, 2013), the following equations, taken from the HRSA web site, which are *Equation 3* and *Equation 4*, respectively, are useful for calculating the sample size needed for quantitative research studies;

Equation 3: Sample Size = n / [1 + (n / population)]

Equation 4: n = Z * Z [P (1-P) / (D^2)], where

P = True proportion of factor in the population, or the expected frequency value

D = Expected Frequency Value minus (-) Worst Acceptable Value

Z = Area under normal curve corresponding to the desired confidence level

Confidence Level/ Value for Z = 95% / 1.96 (Ryan, 2011)

Setting P = 10%,

Worst acceptable value = 14%,

D = 4%,

The calculation for n is; 1.96 x 1.96[0.10(1-0.10) / (0.04^2) = 216.09.

The calculation for the sample size using *N* = 41 is 216.09 / [1+ (216.09 / 41)] = 34.46. Therefore, if only the noted population were used, the sample size for this study would have been 35. As the purpose of this study involved analyzing the effects of a legislated RPS on the percentage of approved permits, and it has been demonstrated that some areas without a legislated RPS have more solar based energy production facilities, it was necessary to include those areas in this study sample population as well.

Another plausible population consisted of the 50 state capitals, plus the 25 solar cities, minus the seven state capitals that were also solar cities, making $N = (50 + 25) - 7 = 68$. The calculation, using *Equations 3* and *4*, for the sample population from this plausible population yielded a sample size of 51.72, or $n = 52$. Coincidentally this exceeded the value for the sample size population recommended by Cohen (2009) for a study population of this size (e.g., 68) by a factor of 136.36%, given the confidence limit, power, α, β, and ES levels selected for this study. As an *n* of 52 barely covers the quantity of capital cities, I decided to round up to 55, which covers all of the capital cities plus 28% of the non capital solar cities. So, 55 cities were selected by way of random sampling from the plausible population of 68, leaving 13 cities unselected. This random sampling was accomplished by placing the names of each city comprising the plausible target population of 68 into a container and drawing names out until 52 had been drawn. As this random sample population included representation from the plausible population, as listed in Appendices B, C, and D, the relationship between the variables was appropriately accounted for in the context for consideration of potential relationships among variables, as argued by Reynolds (2007).

Context, Measures, and Means of Analysis

The study variables have been explained within the context of economics and ROI analysis and in terms of multiple linear regression analysis. Insolation level served as the rate of return on currency for ROI analysis, with the percentage of approved permits serving as the currency. Definitions were provided in Chapter 1 for terms used in this study that have multiple meanings (e.g., infrastructure, photovoltaic, applicant, etc.). These were necessary for increased ease in readers' and researchers' understanding the variables and measures involved with this study. The equation used for the regression analysis is *Equation 2*, which is

Equation 2: Y = E(Y| X1; X2) = B0 + B1X1 + B2X2 + E, where

Y represented the percentage of approved permits for a given jurisdiction from the calculated, randomly selected sample population from the study population,

B0 represented the *Y* intercept for a given jurisdiction from the calculated, randomly selected sample population from the study population,

remaining Bs were constant yet unknown slopes (e.g., regression coefficients),

X1 represented the legislated RPS level, and was either a 1 or 0 for each given jurisdiction from the calculated, randomly selected sample population from the study population,

X2 represented the median level of solar radiation in $kWh/m^2/day$ for each given jurisdiction from the calculated, randomly selected sample population from the study population, and

E was the random error in prediction.

Data obtained through researching answers to address the primary and secondary research questions was analyzed using multiple linear regression analysis. Analyses were accomplished for the study period previously noted, which was post ARRA and SunShot Initiative implementation years. Comparisons of data were accomplished in terms of RPS level and insolation level. Comparisons of graphs accomplished included slopes of regression lines and plotting of residuals.

The major theoretical propositions for this study were that RPSs cannot be supported and the stipulated level of renewables-based energy produced without the issuance of permits. Corey and Swezey (2007) argued that the issuance of permits depends on organizational preparedness, both of the permit applicant and the permitting agency, some predetermined ROI, and codes (e.g., regulations). Organizational preparedness, in the context described by Perrow (1999) may be a product of the energy resource management models used by the permit applicant and the personnel of the associated permitting agency. Also, organizational preparedness is comprised of, as well as influenced by, experience, education, culture, and legislation (Jacob, 2011). Similarly, legislation (e.g., rules) can be influenced by data and emotion (Zimbardo, 2008).

Sampling and Sampling Procedures

The strategy used to select the study population was based on criteria as previously described. First, it was hypothesized that if any municipality had permitting processes for renewable, solar energy based projects, those that serve as the seat of state government would have. The 50 jurisdictions chosen were those for each capital city in the United States. Second, the selection was based on ease of identifying one permitting jurisdiction per state. Using the capital city for each state made sense in this regard. Third, it made sense to include those jurisdictions of the 25 solar cities as the whole intent of the SunShot Initiative was to promote the use of solar-based energy (DOE, 2011). Given this intent, there may be evidence from each jurisdiction that indicates successful implementation of solar energy-oriented policy (Venables, 2008). The method regarding random selection of the sample for this study was previously described.

Procedures for Recruitment, Participation, and Data Collection

Data for this research study came from two sources. One source was the literature researched for this study. The other source was the survey included in Appendix A. The survey was sent to the management of the permitting department for each city comprising the randomly selected sample population. I included no names or other personally identifiable information to the survey. Participants were asked to provide their consent to complete the survey and for my use of the included responses to the survey questions. Surveys were tracked based on jurisdiction and date of dispatch as well as return. Hard copies of the survey were sent out to the attention of the management for each agency via the U.S. Postal Service. Participants had 10 working days in which to complete and return the survey in a provided self-addressed and postage-paid envelope. The record for tracking the submittal and receipt of the surveys is located in Appendix B for state capitals and Appendix C for solar cities.

Participants were strictly recruited and recognized for their position within each permitting department jurisdiction. Their selection was strictly based on their job role, such as being the primary manager for the given agency. No other criteria by this researcher were used for participant determination. Participant consent was based on the fact that a completed survey was returned, accompanied by express consent by each participant to use the data included in the survey. Participant names, as far as persons, were neither requested nor recorded in any publicly released form. The fact that a given, completed survey was submitted by a given representative from each respective agency, accompanied by their express consent, was considered as informed consent to use the associated data in this study, while maintaining an anonymous type of participant environment. Completed surveys will be kept in a locked file for 5-years from the date of approval for this dissertation. Data from partially completed surveys that were returned were not used and were destroyed by crosscut shredding. The randomly selected participating agencies were notified via the survey invitation that they may obtain a copy of the approved dissertation from the public domain if they so choose. No other follow-up type of procedures or effort with the participating agency personnel were made.

Beta Test - Pilot Study

A beta test of the survey was conducted, as previously described in Chapters 1. This beta test involved randomly selecting six municipalities from the sample population, sending surveys to the respective jurisdictional agencies for each municipality, and determining if the survey needed any revision as evidenced by the data in the completed and returned surveys. This beta test population constituted 10.91% of the sample population. All surveys sent to this beta test population were completed and returned. The completion and return of the survey by each of these participants indicated that the format of the survey, the questions in the survey, and the instructions for its completion were understood by the participants representing each of those agencies. This also provided the evidence needed to determine if any revision of the survey was needed, to what extent revision may have been needed, and if the correct agency for the municipality had been selected my me. In short, the beta test results demonstrated that the survey was an adequate and valid tool for the task it was designed to accomplish.

Considerations for Using Archival Data

Archival data, in terms of applications and permits for the installation of solar energy systems, located within the confines of each city comprising the randomly selected sample population of 52 cities, were also used. The intent was that these data would be provided via agency management completion and submittal of the survey contained in Appendix A. These data were also researched in an attempt to obtain them through agency documents and websites that are noted in Appendices B, C, and D. Access to data sets and databases was accomplished through any relevant Internet portals and means that are open to the general public. Permission to access these data is already granted through legislation, such as the Freedom of Information Act. Financial data, which involves published corporate earnings, was obtained directly from hard-copy publications, text-based electronic media publications, or from associated corporate web sites in electronic format. Some of these data were obtained during the course of research for the Literature Review accomplished for Chapter 2. The balance was obtained following approval of the proposal and receipt of IRB authorization to proceed with this research study.

Historical and / or Legal Documents

Historical and/or legal documents were also used as sources of data for this study, as described in Chapter 2. The reputability of the sources for these data is supported by the fact that such data and documentation came from authorized sources and through accountable means. These sources were government agencies and NGOs. These represent the best sources for such data since they were both authorized and accountable to handle and disseminate such data. These data include insolation readings. Any supplemental data for RPS level and permits is noted as such in text format for data source explanation included with data analyses results located in Chapter 4. Data tables located in Appendices B through E also contain relevant citations for the data source(s).

Instrumentation and Operationalization of Constructs

Previously published instruments were not used. The survey in Appendix A was used to conduct research regarding actions relevant to the study period, and is considered to be an instrument in the context as argued by Creswell (2009). As this survey was specifically developed and used for this study, there are not yet any published reliability and validity values for any population associated with it. Although not actively used in this study, the CBECS (EIA, CBECS Survey Forms selection, 2012) was researched during the course of this study in order to determine its potential applicability in the examination of the potential relationship between the study variables. Permitting application processes, as published in the websites for each of the jurisdictions comprising the sample population, served as other instruments. These websites and the number of permit application steps it takes to submit a permit are noted in Appendix D. These websites and the number of steps were used to demonstrate ARRA 2009 and SunShot Initiative conditions during the study period, in terms of permit pursuance ease and ROI analysis. Equations from the field of statistics served as instruments for the analysis of data. SPSS was used in the course of accomplishing multiple linear regression analyses and in producing graphical representations of these analyses.

Of these instruments, the survey in Appendix A is the one instrument that had not been used previously. As it is fashioned in a similar manner to other quantitatively based surveys, such as those discussed by; Creswell (2009), Frankfort-Nachmias and Nachmias (2008), and Mathur (2011), I can estimate that it is a good instrument in the context argued by Creswell (2008). In order to add validity to my estimate, the survey was sent to 6 of the randomly selected sample jurisdictions as a beta-test. Beta test participants had 10 calendar days to complete and submit the survey. Responses were reviewed and the survey revised as needed to bolster ease of participant completion. Based on the responses received, I determined that no revision of the survey was needed and proceeded to send surveys out to the remaining randomly selected participant population of 46 jurisdictions. I can also state that the other noted instruments are good as they have been accepted and used in numerous ways, including quantitative research studies carried out by NOAA (2012).

The *operationalization* of the variables has previously been given and explained in Chapters 1 and 2. The RPS level (e.g., legislated or not) of the city or associated state comprising the randomly selected study population was coded in SPSS as a 1 or 0, respectively. The annual median insolation level for each city comprising the plausible target population was calculated from tabular data published by Marion and Wilcox (1994). These tabular data are from a 30-year period, beginning in 1964 and concluding in 1994. As previously noted in this dissertation, these are the most current insolation data available at the time of this specific quantitative research study. The results are provided in Appendices B and C. Data for the percentage of approved permits were expected to be provided as answers to the questions posited in the survey in Appendix A. SPSS was used to perform multiple linear regression analysis of the data. ROI analysis was accomplished using insolation levels and the percentage of approved permits as replacements for currency. Data cleaning and screening was not necessary. I have previously described how survey data were compared to data contained in public records.

Data Analysis Plan

Data analyses were accomplished through multiple linear regression analysis using SPSS. Insolation data for each city served as the currency for ROI calculation. Statistical power was set at 0.80, confidence at 0.95, Alpha (α) at 0.05, Beta (β) at 0.20, and Effect Size (ES) was set at 0.14, which were each comparable with similarly designed quantitative research studies (Frankfort-Nachmias & Nachmias, 2008). The required sample size, based on calculation using *Equations* 3 and 4, and tables published by Cohen (2009) was 35, as previously stated in the section titled *The Target Population and Sample Size*. I accomplished additional calculation, also based on *Equations* 3 and 4, resulting in a sample size of $n = 52$. As an added measure for validity, I increased this to 55 and used this population as the sample size used for this research study. This calculation was also explained in the section titled *The Target Population and Sample Size*. This is an increase of 48.57 % over the required sample size of 35, which did aid in mitigating bias and added validity to analysis results. The F statistic was calculated using SPSS. This was accomplished to test the null hypothesis and as part of conducting the regression analysis.

As previously described in Chapter 1 and in this chapter under the heading *Context, Measures, and Means of Analysis*, *Equation 2* was the basis for performing the regression analysis. Resulting slopes were juxtaposed as a group and as separate groups constituting each RPS category (e.g., legislated or not). This was accomplished to determine if any statistical significance existed in any of the relationships, as previously hypothesized. The significance of regression coefficients was tested by using linear regression *t-tests*, as argued by Ryan (2011). Residuals were plotted. As an example, if the sample population were one jurisdiction, anecdotally let us assume that the following were representative data of the noted variables for the city of Olympia, Washington;

$Y = 0.87$

X1= 1

X2 = 3.6, and

E = 0

Applying these data to *Equation 2*, we get;

0.87 = B0 + B1(1) + 3.6 + E

B0 = -2.73.

From this we can see that the slope of the line will be positive (e.g., rising from left to right). It is evident that the slope is not zero. The resulting calculated slope can then be juxtaposed with each calculated slope from the randomly selected sample population, as argued by Cohen et al. (2003). Following this rationale, I juxtaposed slopes for the entire sample population and for each category of RPS, as previously expressed. The results are in Chapter 4. Those which met the statistical parameters previously noted in Chapter 1 and in this chapter were identified, with the result being used to determine if the null hypothesis may be rejected or fail to be rejected. Of course the sample population for this study exceeded one. So, the associated data from each of the municipal jurisdictions for each of the cities in the randomly selected sample population of 55 were included in the regression analysis.

Both the calculated median insolation level and the total effort, in terms of application steps and mouse clicks to submit a permit application, were used as currency in calculating the resulting ROI as indicated in Appendices C and D. The median insolation level was represented by M and the effort by E, as noted in *Equation 5*. The resulting ROI calculations ranged from -0.07 to 0.97, the median was 0.25 and the standard deviation was 0.21. The numeric equivalents to each of these (e.g., M and E) were unitless for the purposes of this research study and in the use of *Equation 5*. The resulting ROI was used in conjunction, and juxtaposed with regression analysis results as a means to mediate potential multicollinearity. Given the basic equation, which is *Equation 5*, for ROI (e.g.,1 + ((M – E) / E) = ROI);

Equation 5: $1 + ((M - E) / E) = ROI$

For example, given the calculated median annual insolation for Santa Fe, New Mexico was M = 6.25, and a hypothetical effort of E = 83;

1 + (6.25 - 83) / 83 = ROI, yielding the end result of ROI = 0.08. Using the calculated median insolation for Seattle, Washington of M = 3.8 and the same hypothetical effort (i.e. E = 83), the resulting ROI was ROI = 0.05, demonstrating that the ROI decreases as the insolation value decreases, given the effort (i.e. investment) relevant to permit application. From this example it can be shown that in the event M / E approaches 1, the ROI approaches zero. Similarly, as M / E approaches zero, the ROI approaches 1, or 100%. Without inclusion of the constant 1 in *Equation* 5, the potential for a positive ROI is greatly reduced, as demonstrated with the former example. Also, once a solar energy based system is installed, it will generate electricity, even at miniscule amounts, as argued by administrators of the Barefoot College (2011), which translates into some return on the investment.

Restatement of the Research Questions and Hypotheses

As previously noted in chapter 1, the primary research question was

- What is the relationship between the existence of a legislated RPS and the solar radiation level for a given jurisdiction with the percentage of approved permits for the installation of solar energy-based systems ?

The following secondary questions were used to inform this study;

1. What was the RPS level (e.g., legislated or not) for each state? Answers to this question provided data relevant to the independent variable of RPS level, in a categorical context.
2. What was the annual median solar radiation level impinging on each jurisdiction comprising the sample population for this study during the study period? Answers to this question provided data relevant to the independent variable of annual median solar radiation levels.
3. What was the percentage of permits approved for the installation of solar energy based electrical system infrastructure projects within the borders of each jurisdiction (e.g., each city) comprising the randomly selected sample population for the study period? Answers to this question provided data relevant to the dependent variable of the percentage of approved permits.
4. What was the resulting ROI for the calculated median insolation as a function of the permit application effort for each jurisdiction in the study population? Answers to this question aid in providing context to the

relationship scenario noted in the primary research question, in terms of ROI.

Hypotheses must be tested in order to determine which may be rejected by the researcher or which the researcher may fail to reject (Ryan, 2011). There was one null hypothesis, annotated as H_0, and one alternate hypothesis, annotated as H_a, relevant to the primary questions. Hypotheses were neither posited nor stated for the secondary questions for reason previously stated.

H_0. There is not a statistically significant relationship between the dependent variable - the percentage of approved permits for the installation of solar energy-based systems , and any of the independent variables—specifically the existence of a legislated RPS and the solar radiation level for the study sample population.

H_a. There is a statistically significant relationship between the dependent variable - the percentage of approved permits for the installation of solar energy-based systems, and at least one of the independent variables—specifically the existence of a legislated RPS and the solar radiation level for the study area.

Results from the analyses were interpreted according to statistical criteria for multiple linear regression analysis, as accomplished via *Equation 2* by way of using SPSS. For example, the graphical plots in Figures 1 through 5 were plotted as a means of model criticism in accordance with argument made by Ryan (2011). If the existence of a legislated RPS had no correlation to the percentage of approved permits, then there should not be any discernible pattern in the residuals plot. Likewise with the median annual insolation level for each jurisdiction. I have previously explained the ROI calculation according to *Equation 5* and interpretation of the results. This was used in Chapters 4 and 5 to demonstrate a selection model and to demonstrate the critical nature that permit approval and insolation (e.g., ROI) impart to the consideration and debate for a nationally legislated RPS.

Threats to Validity

Some of the potential threats to validity included erroneous information on the returned surveys and in the literature reviewed. Survey answers were compared against publicly available information from each jurisdiction in an effort to mitigate this potential threat to validity. Survey questions were straight forward and easy to answer if functional policies of the given permitting jurisdiction were in place and the associated data recorded through fitting, applicable means and metrics.

There were potential threats to construct and statistical conclusion validity, as with any research study, as discussed by Reynolds (2007) regarding theory construction and as discussed by Cialdini (2009) regarding biased influence in statistical analyses. These were mitigated as much as possible via the survey, the literature review, through the use of accepted statistical analysis methods, and by random selection of a sample population for the study from those jurisdictions from each state capital and solar city. As the literature review included a cross section of data relevant to the variables being studied, construct and statistical conclusion validity were further supported. This approach fit the criteria for validity as argued by; Coffey (2010), Creswell (2009), and Tanis (1987).

Potential multicollinearity was remedied during data analysis through the juxtaposition of the calculated ROI against the RPS level and percentage of permits analysis. This juxtaposition served to gauge if evident multicollinearity was actually cause for concern. Also, as none of the variables used for this study were continuous, and one independent variable was binary, multicollinearity could not exist. In the event that the calculated ROI data from two or more jurisdictions happened to be the same, or within 1σ of the median ROI, then it also indicated that multicollinearity was not cause for concern but indicative of a sound model and correct demonstration of a relationship between the independent and dependent variables. Cohen et al. (2003) expressed that predictor variables need to be the same in order to achieve multicollinearity. As the data for the independent variables associated with each jurisdiction varied, as noted in Appendices B, C, and D, the potential for this to occur was less than 1.5%. In addition, the predictor variable, X2, and the dependent variable, Y, were not purposefully held constant from one jurisdiction in the randomly selected sample population to another, as the median annual solar radiation for each was different, essentially making the chance for existence of multicollinearity quite slim. This non-constancy of data for variables X2 and Y aided in reducing the opportunity for perfect multicollinearity, as described by Cohen et al. (2003).

Ethical Considerations

The procedures taken to ensure that an ethical approach was used for this study included the unbiased cross section review of literature, the means and explanation for calculating the sample size and selecting the random sample population, the way the survey was distributed and received, and the ensured anonymity of the individual(s) completing and submitting the survey. All applicable credit to theorists and sources, whose works have been reviewed for this research study, has been, and were given. Explanation was given for cases where surveys were not returned and for cases where data exhibited an apparent bias. In the event that notional or anecdotal data was used to demonstrate a model and provide an example, the data has specifically been, and was identified as such.

As the data for this study were publicly available, directly or upon request, it was unnecessary to obtain and file agreements to gain access to it or have the survey questions answered. These data were not considered to be confidential. This approach complied with ethical research approaches as discussed by Zimbardo (2008). Resulting survey data are only traceable by me to the permitting jurisdiction and applicable department, not to any one individual. This traceability was not published or disclosed in any form. Completed surveys that have been returned to me will be kept on file for a period of 5-years following approval of this dissertation. No other ethical concerns exist.

Summary

The research design for this study was survey- and cross-sectional-based. Anecdotal data were used to demonstrate the application of the various equations presented in this chapter. These equations were used in the data analyses and calculations contained in Chapter from the answered surveys and from the literature review. The results of these calculations are in Chapter 4.

The power presented for use in data analysis was 0.80. The randomly selected sample population used was $n = 55$. The randomly selected sample population of 55 was drawn from the target population of 68 permitting jurisdictions. As it turned out, there were 28 jurisdictions from this population that had a legislated RPS and 27 jurisdictions from this randomly selected population that did not have a legislated RPS in 2011. The time frame for this study corresponded to the approved permit data ranging from January 1, 2011 through December 31, 2011. Cognizant personnel for each agency/jurisdiction from the sample population were granted 10 days to complete and return the survey in the included self-addressed and postage-paid envelope. Answers to the survey questions aided in addressing the primary and secondary questions posed in this study, and in rejecting or failing to reject the null hypothesis. There were two independent variables and one dependent variable involved with this study.

Upon approval of the research proposal by my Committee and URR, IRB approval was sought. Following receipt of IRB approval, the survey was sent out to agency management from the randomly selected sample population of 55 municipalities for completion and return. The completed, returned surveys contained data, in terms of answers to the associated primary and secondary research questions.

Chapter 4: Results

This chapter contains dialogue and data regarding the beta test of the survey used in this research study. Based on the results of the beta test, it was evident that the survey was a valid instrument without any need for revision or amendment. Statistical and algebraic calculations were accomplished using the data from the answered surveys and from the literature review. The statistical calculations included multiple linear regression analysis using SPSS and ROI using basic algebra in accordance with the equations presented and demonstrated in Chapter 3. The *F* statistic was calculated, and the plotting of residuals from the regression analysis was accomplished. Correlation analysis and ANOVA was conducted as well. The sufficiency of the survey used in data acquisition for this study is discussed in this chapter. Relevance of data collection and the means by which data were collected is addressed as well as data analysis results.

Beta Test - Pilot Study

A beta test of the survey was conducted, as previously described in Chapters 1 and 3. This beta test involved randomly selecting six municipalities from the sample population, sending surveys to the respective jurisdictional agencies for each municipality, and determining if the survey needed any revision as evidenced by the data in the completed and returned surveys. This beta test population constituted 10.91% of the sample population. All surveys sent to this beta test population were completed and returned. The completion and return of the survey by each of these participants indicated that the format of the survey, the questions in the survey, and the instructions for its completion were understood. This also provided the evidence needed to determine if any revision of the survey was needed, to what extent revision may have been needed, and if the correct agency for the municipality had been selected. In short, according to the beta test results, the survey was an adequate and valid tool for the task it was designed to accomplish.

Sufficiency of Instrumentation

The survey proved to be easy to complete based on unsolicited brief comments received from agency personnel who completed and returned the respective survey for their jurisdiction. This ease of completion and the resulting data entries indicated that this instrument was sufficient for the intended purpose. As a result of the ease of completing the survey and returning it, from the beta test population, no revisions were made to the survey. The instructions related to survey were sufficient, as were the survey questions. Consequently, the survey was sent out to the remaining 49 randomly selected municipal agencies for completion and return.

Data Collection

Data relevant to the independent and dependent variables for this study were sought via the survey. I also accomplished research in a plethora of web sites and web links available to the general public. These are contained in the Bibliography. The primary site that served to provide the more extensive breadth and depth of data was http://www.dsireusa.org. Data from this source were used to supplement any incomplete and unreturned surveys, which accounted for 65% of the sample population.

Assumptions Relevant to Study Results and Analyses

The following assumptions relevant to regression analysis and this research study were kept and/or followed during the course of research, document review, data gathering, and data analysis that;

- There would be no outliers. Rather, data analysis results would follow a generally linear pattern. This assumption was met as evidenced by the data analysis results in the form of the scatter plots—Figures 1 through 5 and numerical results in the various tables—Tables 3 through 42. No outliers were removed as there were no data points considered to be outliers. No variables were removed from any of the analyses performed.
- Linearity would be evident and supported by the analysis results. This assumption was met as evidenced by the data analysis results in the form of the scatter plots—Figures 1 through 5 and numerical results in the various tables—Tables 3 through 42.
- Normality would be evident, not violated, and supported by the analysis results. This assumption was met as evidenced by the data analysis results in the form of the scatter plots—Figures 1 through 5 and numerical results in the various tables—Tables 3 through 42.
- Multicollinearity would not exist, as demonstrated by VIF being less than 10. This assumption was met as evidenced by the data analysis results

contained in Tables 8, 16, 24, 32, and 40, and shown in Figures 1 through 5.

- Homoscedasticity, not heteroscedasticity would exist. This assumption was met as evidenced by the data analysis results, and particularly as shown in Figures 1 through 5.

Pseudo correlation analyses were not performed as this was unnecessary. Autocorrelation was not a concern as the variables involved with this research study were not time-series-based.

Study Results

Results are based on analysis of data from two primary sources as previously discussed on prior chapters. One of these sources was the data from completed and returned surveys. This accounted for 35% of the sample population. The other source was the DSIRE (2012) database (e.g., http://www.dsireusa.org/). As previously explained, data from DSIRE were obtained in order to fill any voids from incomplete and unreturned surveys. These were the surveys that were sent out to a random selection of 55 jurisdictions from the sample population. The survey is contained in Appendix A. From these sources of data, 28 of the randomly selected jurisdictions had a legislated RPS and 27 did not. Data from the surveys and DSIRE were combined in one file in order to complete the multiple linear regression analysis using all available data relevant to the randomly selected study population, the primary research question, and the secondary research questions. Results of data analysis are presented in terms of the primary research question as well as the secondary research questions.

From the randomly selected study population, 35%, which equates to 19 jurisdictions, returned completed surveys. Of these, 42% came from solar city designated jurisdictions and 58% from non-designated solar city jurisdictions. For reference, the randomly selected study population percentages for non-designated versus designated solar cities was 66% and 34% respectively. From the randomly selected sample population, 28 had legislated RPSs during the study period and 27 did not. Statistical analyses associated with these data can be reasonably accepted given the standard deviation of these data, as argued by Ryan (2011) regarding the bases of and for statistical analyses. Five separate analyses of the data were performed using SPSS. These analyses are number as Analysis # 1 through Analysis # 5. For Analysis # 1 the standard deviation was 0.48512 for the percentage of approved permits, 0.505 for the RPS level of 1, and 0.57104 for the calculated median insolation. The resulting statistical data from performing Analysis # 1—the calculated median-insolation based model pertaining to the variables percentage of approved permits, RPS level, and calculated median insolation are contained in Tables 3 through 10. The associated probability chart for this analysis is shown in Figure 1. Remaining tables and charts for the other four analyses follow in numerical order corresponding to these analyses. The calculation for Cook's distance was not performed because it seemed unnecessary given the data analysis results from each of the five separate analyses performed.

Analysis # 1

Table 3

Analysis # 1 — Descriptive Statistics from the Calculated Median Insolation Based Model

Variable	Mean	Standard Deviation	Population (N)
Percentage approved	0.5635	0.48512	55
RPS dictated	0.51	0.505	55
Median Insolation	4.7582	0.57104	55

Table 4

Analysis # 1 — Correlation Results from the Median Insolation Based Model

Correlations		Percentage approved	RPS dictated	Median Insolation
Pearson Correlation	Percentage Approved	1.000	-.020	.033
	RPS Dictated	-.020	1.000	-.140
	Median Insolation	.033	-.140	1.000
Sig. (1-tailed)	Percentage approved	0.00	.442	.406
	RPS dictated	.442	0.00	.154
	Median Insolation	.406	.154	0.00
N	Percentage approved	55	55	55
	RPS dictated	55	55	55
	Median Insolation	55	55	55

Table 5

Analysis # 1 — Variables Entered/Removed[a] from the Median Insolation Based Model

Model	Variables Entered	Variables Removed	Method
1	Median Insolation, RPS dictated[b]	0.00	Enter

a. Dependent Variable: Percentage approved
b. All requested variables entered

Table 6

Analysis # 1 — Model Summary[b] for the Median Insolation Based Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.036[a]	.001	-.037	.49403

a. Predictors: (Constant), Median Insolation, RPS dictated
b. Dependent Variable: Percentage approved

Table 7

Analysis # 1 — ANOVA[a] Results for the Median Insolation Based Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.017	2	.008	.035	.966[b]
	Residual	12.692	52	.244		
	Total	12.708	54			

a. Dependent Variable: Percentage approved
b. Predictors: (Constant), Median Insolation, RPS dictated

Table 8

Analysis # 1 — Coefficients[a] Results for the Median Insolation Based Model

Model # 1	Unstandardized Coefficients		Standardized Coefficients	*T*	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
(Constant)	.447	.583		.767	.446					
RPS dictated	-.015	.135	-.016	-.114	.910	-.020	-.016	-.016	.980	1.020
Median Insolation	.026	.119	.031	.219	.828	.033	.030	.030	.980	1.020

Note: Dependent Variable = Percentage approved

Table 9

Analysis # 1 — Collinearity Diagnostics[a] Results for the Median Insolation Based Model

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	RPS dictated	Median Insolation
1	1	2.611	1.000	.00	.05	.00
	2	.383	2.612	.00	.91	.01
	3	.007	19.714	.99	.04	.99

a. Dependent Variable: Percentage approved

Table 10

Analysis # 1 — Residual Statistics Results for the Median Insolation Based Model

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.5258	.6061	.5635	.01767	55
Residual	-.59477	.47418	.00000	.48480	55
Std. Predicted Value	-2.130	2.416	.000	1.000	55
Std. Residual	-1.204	.960	.000	.981	55

a. Dependent Variable: Percentage approved

Figure 1. Scatter plot for Analysis # 1

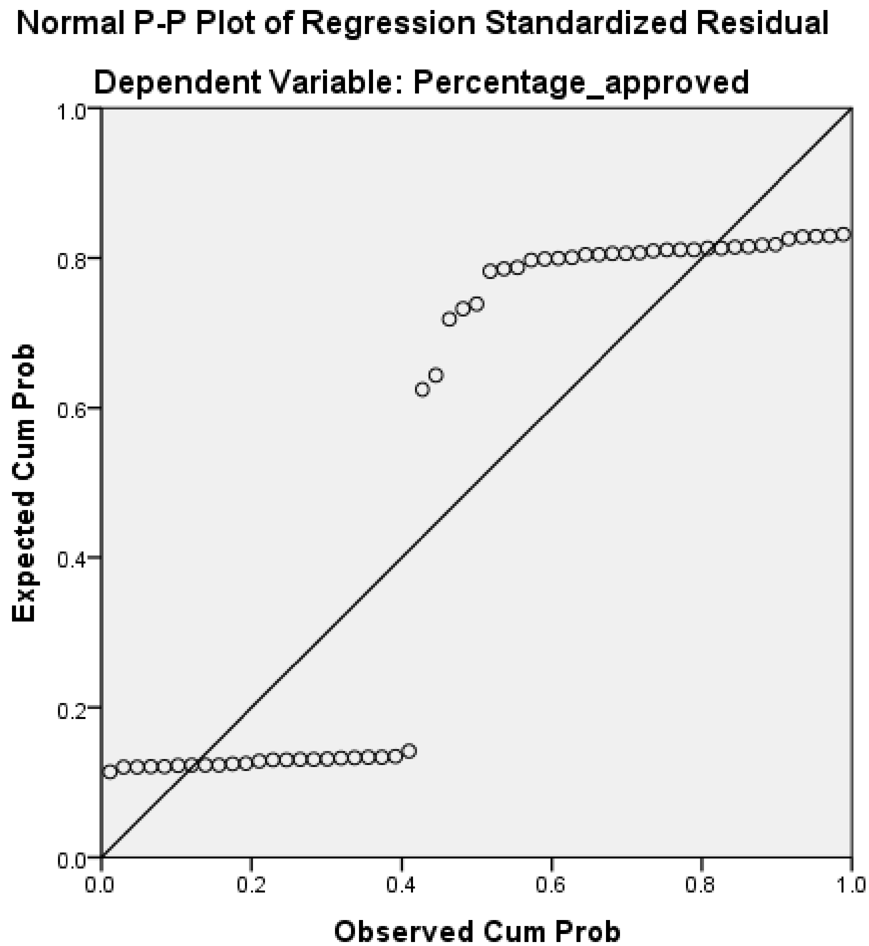

Figure 1. The Pearson correlation analysis results for the percentage of approved permits, RPS level, and calculated median insolation.

Analysis results relevant to Figure 1, in terms of the Pearson correlation analysis for the percentage of approved permits, RPS level, and calculated median insolation were not statistically significant. The results were; r = -0.020 and r = 0.033, respectively. The resulting f statistic for this model was 0.035, with p = 0.966. This lack of statistical significance is visible in Figure 1. Collinearity, in terms of the VIFs were 0.05 and 0.00, respectively, indicating that collinearity is not a phenomenon to be concerned with, as far as this calculated median insolation-based model and its use were concerned. Also as shown in, and can be deduced from, Figure 1, the assumptions for multiple regression were met.

Analysis # 2

Analysis # 2 was performed using the calculated ROI based model and the associated variables; percentage of approved permits, RPS level, and calculated ROI. Results for this analysis are contained in Tables 11 through 18. For Analysis # 2, the standard deviation was 0.48512 for the percentage of approved permits, 0.505 for the RPS level of 1, and 0.20875 for the calculated ROI. The resulting statistical data from performing Analysis # 2—the calculated ROI based model pertaining to the variables percentage of approved permits, RPS level, and calculated ROI are contained in Tables 11 through 18. The associated scatter plot for this analysis is shown in Figure 2.

Table 11

Analysis # 2 — Descriptive Statistics from the Calculated ROI Based Model

Variable	Mean	Standard Deviation	Population (N)
Percentage approved	.5635	.48512	55
RPS dictated	.51	.505	55
Calculated ROI	.2951	.20875	55

Table 12

Analysis # 2 — Correlation Results from the Calculated ROI Based Model

Correlations		Percentage approved	RPS dictated	Calculated ROI
Pearson Correlation	Percentage Approved	1.000	-.020	.179
	RPS Dictated	-.020	1.000	-.009
	Calculated ROI	.179	-.009	1.000
Sig. (1-tailed)	Percentage approved	.	.442	.096
	RPS dictated	.442	.	.473
	Calculated ROI	.096	.473	.
N	Percentage approved	55	55	55
	RPS dictated	55	55	55
	Calculated ROI	55	55	55

Table 13

Analysis # 2 — Variables Entered/Removed[a] from the Calculated ROI Based Model

Model	Variables Entered	Variables Removed	Method
1	Calculated ROI, RPS dictated[b]	0.00	Enter

a. Dependent Variable: Percentage approved
b. All requested variables entered

Table 14

Analysis # 2 — Model Summary[b] for the Calculated ROI Based Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.180[a]	.032	-.005	.48632

a. Predictors: (Constant), Calculated ROI, RPS dictated
b. Dependent Variable: Percentage approved

Table 15

Analysis # 2 — ANOVA Results for the Calculated ROI Based Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.410	2	.205	.866	.426[b]
	Residual	12.299	52	.237		
	Total	12.708	54			

a. Dependent Variable: Percentage approved
b. Predictors: (Constant), Calculated ROI, RPS dictated

Table 16

Analysis # 2 — Coefficients Results for the Calculated ROI Based Model

Model # 1	Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
(Constant)	.450	.133		3.390	.001					
RPS dictated	-.018	.131	-.019	-.136	.892	-.020	-.019	-.019	1.000	1.000
Calculated ROI	.415	.317	.178	1.308	.197	.179	.178	.178	1.000	1.000

Note: Dependent Variable = Percentage approved

Table 17

Analysis # 2 — Collinearity Diagnostics[a] Results for the Calculated ROI Based Model

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	RPS dictated	Calculated ROI
1	1	2.413	1.000	.04	.06	.05
	2	.432	2.364	.01	.72	.26
	3	.155	3.942	.95	.22	.70

a. Dependent Variable: Percentage approved

Table 18

Analysis # 2 — Residual Statistics[a] Results for the Calculated ROI Based Model

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.4614	.8346	.5635	.08712	55
Residual	-.75581	.53864	.00000	.47723	55
Std. Predicted Value	-1.172	3.112	.000	1.000	55
Std. Residual	-1.554	1.108	.000	.981	55

a. Dependent Variable: Percentage approved

Figure 2. Scatter plot for Analysis # 2

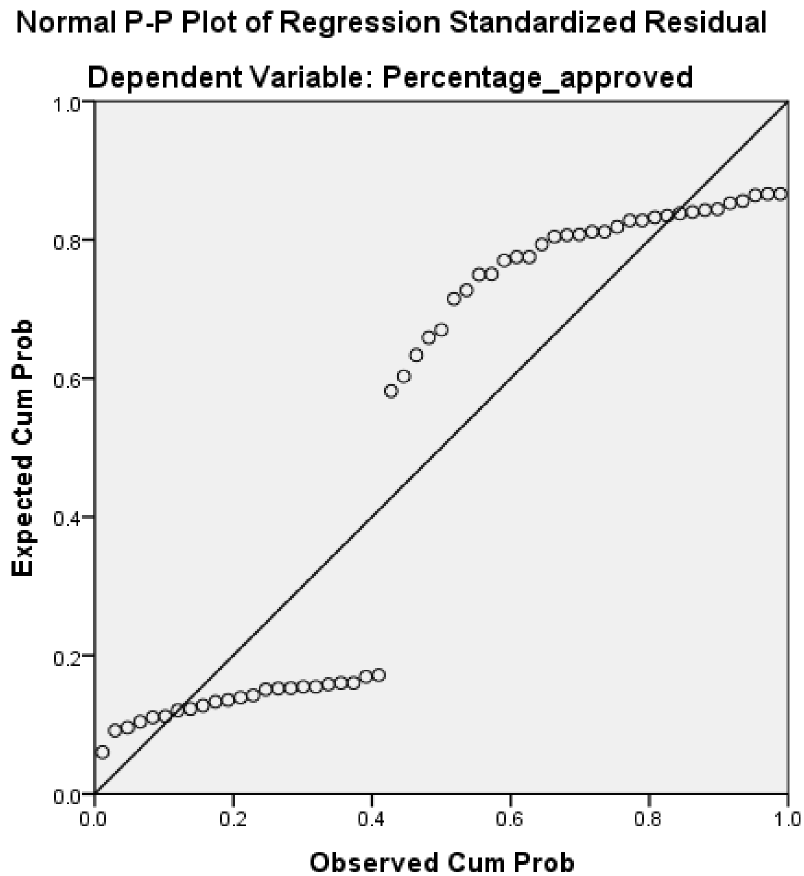

Figure 2. Plot of the Pearson correlation analysis results for Analysis # 2 — the calculated ROI based model consisting of the variables; the percentage of approved permits, RPS level, and calculated ROI.

Analysis results relevant to Figure 2, in terms of the Pearson correlation analysis results for the percentage of approved permits, RPS level, and calculated ROI were more significant than those for Analysis # 1. Regardless, these results were not statistically significant, as they were: r = -0.020 and r = 0.179, respectively. Although the analysis results are slightly more statistically significant than those for Analysis # 1, there is a lack of statistical significance, in visible terms, in Figure 2. The resulting *f* statistic for this calculated ROI-based model was f = 0.866, with p = 0.426. It is of interest to note that use of the calculated ROI in the analysis does slightly improve the statistical outcome, as also visible in Figure 2, when comparing this result against that in Figure 1.

Analysis # 3

Analysis # 3 was performed using the calculated ROI based model and the associated variables percentage of approved permits, RPS level, and calculated ROI. For Analysis # 3, the standard deviation was: 0.48512 for the percentage of approved permits, 0.505 for the RPS level of 1, 0.57104 for the calculated median insolation, and 0.20875 for the calculated ROI. The resulting statistical data from performing Analysis # 3—the combined calculated median insolation and calculated ROI-based model, pertaining to the variables percentage of approved permits, RPS level, calculated median insolation and calculated ROI are contained in Tables 19 through 26. The associated probability chart for this analysis is shown in Figure 3.

Table 19

Analysis # 3 — Descriptive Statistics from the Combined Median Insolation and Calculated ROI Based Model

Variable	Mean	Standard Deviation	Population (N)
Percentage approved	.5635	.48512	55
RPS dictated	.51	.505	55
Median Insolation	4.7582	.57104	55
Calculated ROI	.2951	.20875	55

Table 20

Analysis # 3 — Correlation Results from the Combined Median Insolation and Calculated ROI Based Model

Correlations		Percentage approved	RPS dictated	Median Insolation	Calculated ROI
Pearson Correlation	Percentage approved	1.000	-.020	.033	.179
	RPS dictated	-.020	1.000	-.140	-.009
	Median Insolation	.033	-.140	1.000	.108
	Calculated ROI	.179	-.009	.108	1.000
Sig. (1-tailed)	Percentage approved	.	.442	.406	.096
	RPS dictated	.442	.	.154	.473
	Median Insolation	.406	.154	.	.215
	Calculated ROI	.096	.473	.215	.
N	Percentage approved	55	55	55	55
	RPS dictated	55	55	55	55
	Median Insolation	55	55	55	55
	Calculated ROI	55	55	55	55

Table 21

Analysis # 3 — Variables Entered/Removed[a] from the Combined Median Insolation and Calculated ROI Based Model

Model	Variables Entered	Variables Removed	Method
1	Calculated ROI, RPS dictated, Median Insolation[b]	0.00	Enter

a. Dependent Variable: Percentage approved
b. All requested variables entered

Table 22

Analysis # 3 — Model Summary[b] for the Combined Median Insolation and Calculated ROI Based Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.180[a]	.032	-.025	.49104

a. Predictors: (Constant), Calculated ROI, RPS dictated, Median Insolation
b. Dependent Variable: Percentage approved

Table 23

Analysis # 3 — ANOVA Results[a] for the Combined Median Insolation and Calculated ROI Based Model

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.411	3	.137	.569	.638[b]
	Residual	12.297	51	.241		
	Total	12.708	54			

a. Dependent Variable: Percentage approved
b. Predictors: (Constant), Calculated ROI, RPS dictated, Median Insolation

Table 24

Analysis # 3 — Coefficients Results for the Combined Median Insolation and Calculated ROI Based Model

Model # 1	Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
(Constant)	.405	.581		.697	.489					
RPS dictated	-.016	.134	-.017	-.122	.903	-.020	-.017	-.017	.980	1.020
Median Insolation	.010	.119	.011	.080	.936	.033	.011	.011	.969	1.032
Calculated ROI	.412	.322	.177	1.279	.207	.179	.176	.176	.988	1.012

Note: Dependent Variable = Percentage approved

Table 25

Analysis # 3 — Collinearity Diagnostics[a] Results for the Combined Median Insolation and Calculated ROI Based Model

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	RPS dictated	Median Insolation	Calculated ROI
1	1	3.328	1.000	.00	.03	.00	.02
	2	.446	2.732	.00	.80	.00	.15
	3	.219	3.895	.01	.13	.01	.82
	4	.007	22.265	.99	.04	.99	.00

a. Dependent Variable: Percentage approved

Table 26

Analysis # 3 — Residual Statistics[a] Results for the Combined Median Insolation and Calculated ROI Based Model

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.4516	.8343	.5635	.08729	55
Residual	-.75415	.54835	.00000	.47720	55
Std. Predicted Value	-1.281	3.103	.000	1.000	55
Std. Residual	-1.536	1.117	.000	.972	55

a. Dependent Variable: Percentage approved

Figure 3. Scatter plot for Analysis # 3

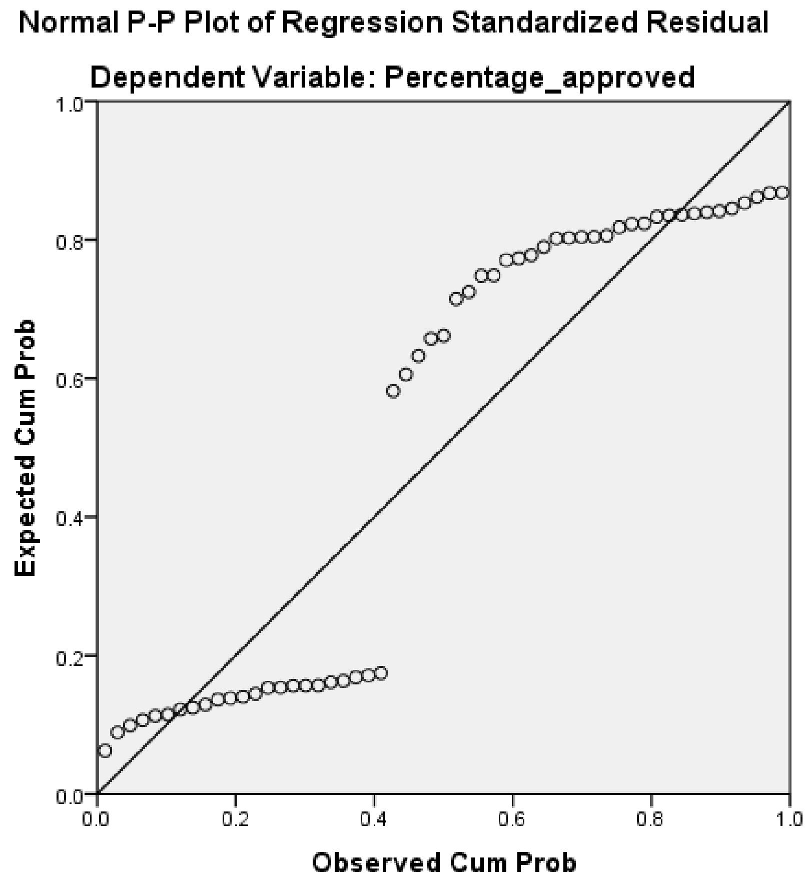

Figure 3. Plot of the Pearson correlation analysis results for Analysis # 3 — the combined calculated median insolation and calculated ROI-based model consisting of the variables; the percentage of approved permits, RPS level, calculated median insolation, and calculated ROI.

Analysis # 4

Analysis # 4 was performed using the RPS dictated based model and the associated variables: percentage of approved permits and RPS level. Results for this analysis are contained in Tables 27 through 34. For Analysis # 4, the standard deviation was 0.48512 for the percentage of approved permits and 0.505 for the RPS level of 1.

Table 27

Analysis # 4 — Descriptive Statistics from the RPS Based Model

Variable	Mean	Standard Deviation	Population (N)
Percentage approved	.5635	.48512	55
RPS dictated	.51	.505	55

Table 28

Analysis # 4 — Correlation Results from the RPS Based Model

Correlations		Percentage approved	RPS dictated
Pearson Correlation	Percentage approved	1.000	-.020
	RPS dictated	-.020	1.000
Sig. (1-tailed)	Percentage approved	.	.442
	RPS dictated	.442	.
N	Percentage approved	55	55
	RPS dictated	55	55

Table 29

Analysis # 4 — Variables Entered/Removed[a] from the RPS Based Model

Model	Variables Entered	Variables Removed	Method
1	RPS dictated[b]	0.00	Enter

a. Dependent Variable: Percentage approved

b. All requested variables entered

Table 30

Analysis # 4 — Model Summary[b] for the RPS Based Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.020[a]	.000	-.018	.48958

a. Predictors: (Constant), RPS dictated
b. Dependent Variable: Percentage approved

Table 31

Analysis # 4 — ANOVA Results[a] for the RPS Based Model

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.005	1	.005	.022	.884[b]
	Residual	12.703	53	.240		
	Total	12.708	54			

a. Dependent Variable: Percentage approved
b. Predictors: (Constant), RPS dictated

Table 32

Analysis # 4 — Coefficients Results for the RPS Based Model

Model # 1	Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
(Constant)	.573	.094		6.085	.000					
RPS dictated	-.019	.132	-.020	-.147	.884	-.020	-.020	-.020	1.000	1.000

Note: Dependent Variable = Percentage approved

Table 33

Analysis # 4 — Collinearity Diagnostics[a] Results for the RPS Based Model

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions	
1				(Constant)	RPS dictated
	1	1.714	1.000	.14	.14
	2	.286	2.446	.86	.86

a. Dependent Variable: Percentage approved

Table 34

Analysis # 4 — Residual Statistics[a] Results for the RPS Based Model

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.5539	.5733	.5635	.00979	55
Residual	-.57333	.44607	.00000	.48502	55
Std. Predicted Value	-.973	1.009	.000	1.000	55
Std. Residual	-1.171	.911	.000	.991	55

a. Dependent Variable: Percentage approved

Figure 4. Scatter plot for Analysis # 4

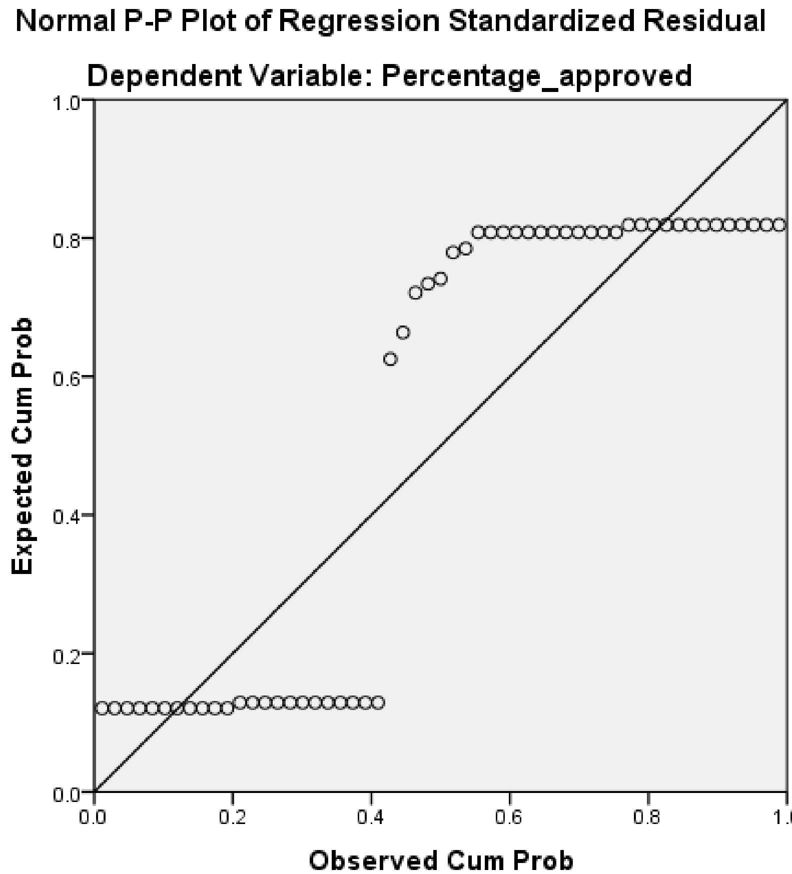

Figure 4. Plot of the Pearson correlation analysis results for Analysis # 4 — the RPS dictated-based model consisting of the variables; the percentage of approved permits and the RPS level. Noticeably, there is weak correlation between the two variables, as visibly demonstrated in this probability plot.

Analysis # 5

Analysis # 5 was performed using the combined RPS dictated level, median insolation, and calculated ROI-based model, and the associated variables: percentage of approved permits, RPS level, calculated median insolation, and calculated ROI. For Analysis # 5, the standard deviation was 0.48512 for the percentage of approved permits, 0.505 for the RPS level of 1, 0.57104 for the calculated median insolation, and 0.20875 for the calculated ROI. The resulting statistical data from performing Analysis # 5—the combined calculated median insolation, RPS dictated level, and calculated ROI based model, pertaining to the variables: percentage of approved permits, RPS level, calculated median insolation and calculated ROI are contained in Tables 35 through 42. The associated probability chart for this analysis is shown in Figure 5. These have similarities to the results from Analysis # 3. The Casewise Diagnostics table for this analysis—Analysis # 5 is included with this dissertation as Appendix F.

Table 35

Analysis # 5 — Descriptive Statistics from the Combined RPS, Median Insolation, and Calculated ROI Based Model

Variable	Mean	Standard Deviation	Population (N)
Percentage approved	.5635	.48512	55
RPS dictated	.51	.505	55
Median Insolation	4.7582	.57104	55
Calculated ROI	.2951	.20875	55

Table 36

Analysis # 5 — Correlation Results from the Combined RPS, Median Insolation, and Calculated ROI Based Model

Correlations		Percentage approved	RPS dictated	Median Insolation	Calculated ROI
Pearson Correlation	Percentage approved	1.000	-.020	.033	.179
	RPS dictated	-.020	1.000	-.140	-.009
	Median Insolation	.033	-.140	1.000	.108
	Calculated ROI	.179	-.009	.108	1.000
Sig. (1-tailed)	Percentage approved	.	.442	.406	.096
	RPS dictated	.442	.	.154	.473
	Median Insolation	.406	.154	.	.215
	Calculated ROI	.096	.473	.215	.
N	Percentage approved	55	55	55	55
	RPS dictated	55	55	55	55
	Median Insolation	55	55	55	55
	Calculated ROI	55	55	55	55

Table 37

Analysis # 5 — Variables Entered/Removed[a] from the Combined RPS, Median Insolation, and Calculated ROI Based Model

Model	Variables Entered	Variables Removed	Method
1	Calculated ROI, RPS dictated, Median Insolation[b]	0.00	Enter

a. Dependent Variable: Percentage approved
b. All requested variables entered

Table 38

Analysis # 5 — Model Summary[b] for the Combined RPS, Median Insolation, and Calculated ROI Based Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.180[a]	.032	-.025	.49104

a. Predictors: (Constant), Calculated ROI, RPS dictated, Median Insolation
b. Dependent Variable: Percentage approved

Table 39

Analysis # 5 — ANOVA Results[a] for the Combined RPS, Median Insolation, and Calculated ROI Based Model

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.411	3	.137	.569	.638[b]
	Residual	12.297	51	.241		
	Total	12.708	54			

a. Dependent Variable: Percentage approved
b. Predictors: (Constant), Calculated ROI, RPS dictated, Median Insolation

Table 40

Analysis # 5 — Coefficients Results for the Combined RPS, Median Insolation, and Calculated ROI Based Model

Model # 1	Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
(Constant)	.405	.581		.697	.489					
RPS dictated	-.016	.134	-.017	-.122	.903	-.020	-.017	-.017	.980	1.020
Median Insolation	.010	.119	.011	.080	.936	.033	.011	.011	.969	1.032
Calculated ROI	.412	.322	.177	1.279	.207	.179	.176	.176	.988	1.012

Note: Dependent Variable = Percentage approved

Table 41

Analysis # 5 — Collinearity Diagnostics[a] Results for the Combined RPS, Median Insolation, and Calculated ROI Based Model

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
1				(Constant)	RPS dictated	Median Insolation	Calculated ROI
	1	3.328	1.000	.00	.03	.00	.02
	2	.446	2.732	.00	.80	.00	.15
	3	.219	3.895	.01	.13	.01	.82
	4	.007	22.265	.99	.04	.99	.00

a. Dependent Variable: Percentage approved

Table 42

Analysis # 5 — Residual Statistics[a] Results for the Combined RPS, Median Insolation, and Calculated ROI Based Model

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.4516	.8343	.5635	.08729	55
Residual	-.75415	.54835	.00000	.47720	55
Std. Predicted Value	-1.281	3.103	.000	1.000	55
Std. Residual	-1.536	1.117	.000	.972	55

a. Dependent Variable: Percentage approved

Figure 5. Scatter plot for Analysis # 5

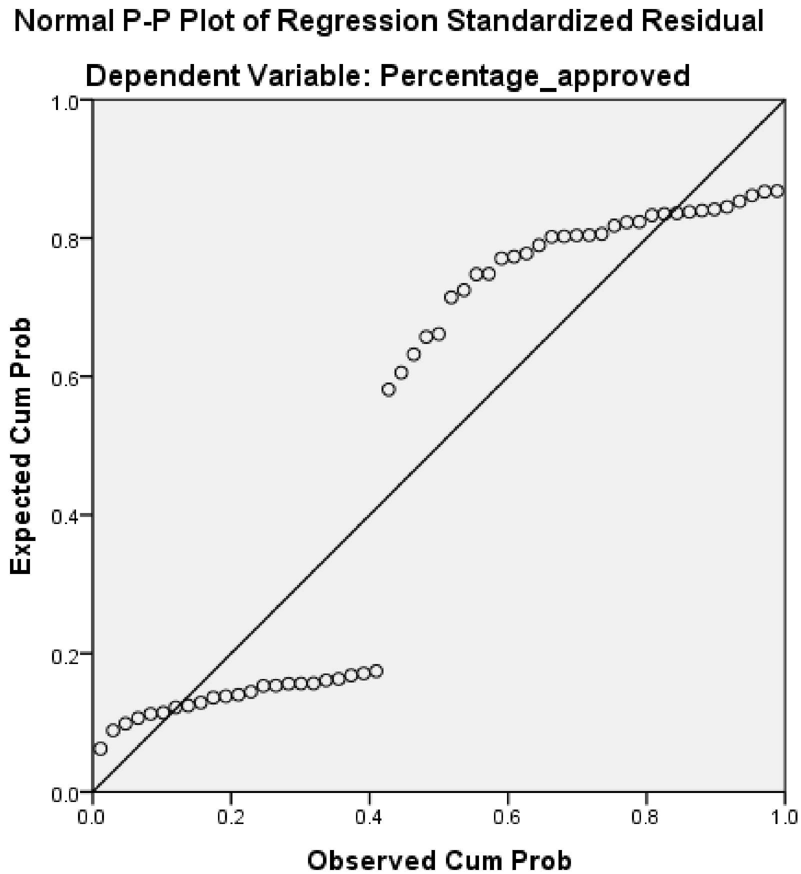

Figure 5. Plot of the Pearson correlation analysis results for Analysis # 5—the combined calculated median insolation, RPS dictated level- and calculated ROI-based model consisting of the variables; the percentage of approved permits calculated median insolation, RPS dictated level, and calculated ROI. Noticeably, there was stronger correlation between these variables, with the ROI portion being the more influential, as visibly demonstrated in this probability plot.

Linear Regression Analysis

Linear regression analysis was accomplished using SPSS as the analysis software with the Enter method from this software, and the independent and dependent variables previously stated. Figures 1 through 5 contain the graphical results of the data analysis, in the form of scatter plots for probability. From these results the existence of a legislated RPS did not have any statistically significant effect on the percentage of permits that get approved. Therefore, I failed to reject the null hypothesis. At the same time, the alternate hypothesis may be rejected.

The method for the ROI calculation was explained in Chapter 3 and demonstrated with an anecdotal application of *Equation 5*.

Pearson Correlations

The Pearson correlation results for these data analyses were; -0.020 for the correlation of the percentage of approved permits and legislated RPS, 0.033 for the correlation of the percentage of approved permits and the median insolation, -0.140 for the correlation of the legislated RPS and the median insolation, 0.179 for the correlation of the percentage of approved permits and the calculated ROI, and -0.009 for the correlation of the legislated RPS and calculated ROI. From these results, the best correlation, albeit still considered to be statistically negligible, is between the RPS level and the calculated ROI. The worst is the correlation between the legislated RPS and the median insolation. The poor correlation between the percentage of approved permits and legislated RPS cannot be discounted as this relationship has relevance in answering the primary research question for this study. With this result, there is little statistical evidence to indicate that having a legislated RPS makes any improvement or difference to the percentage of approved permits.

ANOVA

From ANOVA, results using the percentage of approved permits, RPS level, and median insolation, indicated that $\rho = 0.966$, with F being 0.035. For ANOVA of the percentage of approved permits, RPS level, and ROI, results were $\rho = 0.426$, with F being 0.866. This later result, based on the inclusion of ROI and exclusion of median insolation, indicates that using a model based on ROI is a better choice than using a model based on median insolation. Inclusion of other coefficients from future research may be useful in determining greater validity of this ROI-based model and these associated analysis results. Scatter plots, as provided in Figures 1 and 2, demonstrate that there is a slightly positive correlation and slight statistical significance in the relationship of the various independent and dependent variables. As previously discussed, the ROI model is better in terms of statistical significance than the median insolation model is.

Research Question 1

The primary research question was

- What is the relationship between the existence of a legislated RPS and the solar radiation level for a given jurisdiction with the percentage of approved permits for the installation of solar energy-based systems ?

Results obtained via regression analysis based on the data in returned surveys and from DSIRE (2012) indicate that there is a slight or weak statistically significant relationship between the RPS level, median insolation, and the percentage of approved permits. Results obtained via regression analysis based on the data in returned surveys and from DSIRE (2012) indicate that there is a slightly stronger statistically significant relationship between the RPS level, ROI, and the percentage of approved permits. Both of these analyses were accomplished using data obtained based on relevance to the secondary research questions.

The secondary questions were used to inform this study were

1. What was the RPS level (e.g., legislated or not) for each state? Answers to this question provided data relevant to the independent variable of RPS level, in a categorical context.
2. What was the annual median solar radiation level impinging on each jurisdiction comprising the sample population for this study during the study period? Answers to this question provided data relevant to the independent variable of annual median solar radiation levels.
3. What was the percentage of permits approved for the installation of solar-energy-based electrical system infrastructure projects within the borders of each jurisdiction (e.g., each city) comprising the randomly selected sample population for the study period? Answers to this question provided data relevant to the dependent variable of the percentage of approved permits.

4. What was the resulting calculated ROI for the percentage of permits approved as a function of the median annual insolation for each jurisdiction in the study population?

Summary

The RPS level was recorded as a 0 when not legislated and as a 1 when legislated during the study period. The RPS level for each jurisdiction is contained in Appendices B and C. The median solar radiation level was calculated for each jurisdiction comprising the study population. Data used for this calculation came from the study accomplished by Marion and Wilcox (1994) for flat-plate, non-tracking photovoltaic arrays. The results of calculating the median insolation for each jurisdiction are contained in Appendices B and C. The data for the percentage of permits approved came from returned surveys and from the DSIRE (2012) web site. The percentage for each randomly selected jurisdiction in the sample is contained in the SPSS file that was created for this research study. These data are also contained in Appendix E. The resulting calculated ROI for each randomly selected jurisdiction in the sample is contained in an Excel spreadsheet, Appendix E, and in the SPSS file that was created for this research study. The ROI for each was determined by completing the calculation in accordance with *Equation 5*.

Results obtained via regression analysis based on the data in returned surveys and from DSIRE (2012) indicate that there was a slight or weak statistically significant relationship between the RPS level, median insolation, and the percentage of approved permits. Results obtained via regression analysis based on the data in returned surveys and from DSIRE (2012) indicate that there was a slightly stronger statistically significant relationship between the RPS level, ROI, and the percentage of approved permits. Both of these analyses were accomplished be using data obtained based on relevance to the secondary research questions. From these analyses, the ROI-based model is the better choice to use when conducting this type of research study for this topic. Therefore, use of this model could provide management, law makers, and others (e.g., policy creators and decision makers) with unbiased results for the purpose of deciding whether or not a legislated RPS may be necessary and/or of value.

Chapter 5 contains discussions, conclusions, and recommendations relevant to the data analysis results discussed in Chapter 4. These discussions, conclusions, and recommendations are written in terms of their plausible applicability towards decisions and policies made and/or created by decision makers and policy creators. The perspective from which these discussions, conclusions, and recommendations is where RPSs, energy related legislation, and energy related decision-making is concerned with a focus on solar-based energy. Of course, this perspective is bound by the results from data analyses performed relevant to this specific research study.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this quantitative, cross-sectional study was to examine the relationship between (a) legislated RPS and the percentage of approved solar energy permits, and (b) median annual solar radiation level by state and the percentage of approved solar energy permits for a population of 68 separate jurisdictions within the United States. The calculated sample size was 52. The randomly selected sample size used was 55.

Regarding the nature of this study; the rationale for the selection of the research design for this quantitative, cross-sectional, survey-based study was based on the quantitative nature of energy resource management as argued by Graziani and Fornasiero (2007), and the plausible relationship between the existence of legislated RPSs and solar radiation levels with the percentage of approved permits for the installation of solar energy-based systems within the study population. Multiple linear regression analysis, using SPSS, was used for examination of the associated data. Descriptive and inferential statistics were used in the course of this examination.

This was a quantitative, cross-sectional, survey design-based research study. This research design was preferred given the variables being studied, the topic being researched, the population studied, and the nature of the associated data. Creswell (2009) argued that a quantitative research study fits well with quantitatively-based variables and survey data. A quantitative, cross-sectional, survey design-based research study was also the preferred design approach given the theoretical framework. Representative data for each of the variables were obtained through the use of a survey, as indicated in Appendix A, and by researching public records, as indicated in Appendices B**,** C, and D. The data associated with the RPS level of each jurisdiction required that the level (e.g., legislated or not) be coded in binary terms as either a 0 or a 1, with 0 indicating *no*, and 1 indicating *yes*, regarding the legislated level of RPS. This distinction and use of categorical variables was further explained in Chapters 1 and 3.

Survey and public record data were analyzed using descriptive and inferential statics (Ryan, 2011; Tanis, 1987). Economic theory—specifically ROI analysis (Sullivan et al., 2012) served as the theoretical framework for this study. Comparisons of public record data and the survey data were accomplished as secondary tests of data integrity. The data for this study were obtained and analyzed using manual and computer based means. The numeric coding in SPSS for the jurisdiction related RPS level was 0 or 1, as previously described. Empirical data for the annual median solar radiation level and the percentage of approved permits for each jurisdiction comprising the study population were used in ROI calculations and in multiple linear regression analyses. The ROI calculation associated with this research study and the relevant data from the percentage of approved permits and solar radiation levels was explained in Chapter 3. Results from this ROI calculation for each randomly selected sample of the population served as a means to evaluate any potential emergence of multicollinearity. Based on the definition for multicollinearity, the potential for its emergence was nearly zero given the data in Appendices B and C. Regardless, the data and analysis results were checked for this potential and for any emergence. It was not evident in either case, based on the juxtaposition against the calculated ROI as a means to mediate interpretation of multiple linear regression model results. This juxtaposition approach agreed with recommendations from Cohen et al. (2003) regarding comparisons of data. The creation of charts and graphs developed was accomplished using SPSS computer-based software. The techniques of data analysis were discussed in Chapters 3 and 4.

This study was conducted to see if there was any statistically significant relationship between the variables and to potentially posit an unbiased decision model relevant to legislating RPSs. It was found that there is a weak, yet positive statistical relationship between the variables of the percentage of approved permits, the RPS level, and the median insolation. It was found that there is a stronger, albeit still weak, positive statistical relationship between the variables of the percentage of approved permits, the RPS level, and the calculated ROI. These were each key findings, singularly and when juxtaposed. There is little significance in legislating any RPS when the permitting process is arduous and/or when the calculated ROI is poor or negligible. These findings also indicated that policy creators, decision makers, and legislators may now have a less biased model with which to make energy management decisions, as opposed to making them based on emotionally charged models.

In this chapter, I discuss my interpretation of the findings based on the associated statistical analysis via regression analysis and ROI analysis of the data as performed and explained in Chapter 4. The equations and software used for these analyses were described in Chapter 3. In this chapter, I also discuss limitations of the study from the standpoint of relevant data availability as well as potential societal and mechanical variables that may be of value to include in any future study of this particular research topic. I provide recommendations for future research, the methodology and process used to accomplish this research, and the literature researched during the course of the proposal and dissertation effort for this study. This is followed by dialogue regarding implications of the study results, my research experience in terms of this study, and conclusion.

Interpretation of the Findings

There is little to gain by legislating any for of RPS if permitting processes are not efficient. The ROI-based model can be used by policy creators and decision makers in efforts to add/or improve efficiency to permitting processes. This model may also be used to improve overall energy management practices. As with other resource-based sectors of life, energy resources (i.e., time, work, effort, financial securities, equipment, property, etc.) can and ought to be considered in the overall calculation for ROI. The ROI-based model was demonstrated in Chapter 4 and the equation for it was introduced in Chapter 3.

Effect of Findings on Extension of Knowledge

The findings in this research study extend the application of knowledge in terms of legislated RPS considerations and ROI based analysis as well as the use of value based on effort (i.e., exertion, work, etc.) and energy (i.e., insolation). Prior to this study, ROI analysis was steeped in value based on monetary units and commodities, whereas this model uses work in terms of insolation and the steps involved in submitting a permit application. For example, Smith (1776), and Sullivan et al. (2012) reflected this focus based on monetary units and commodities. Other texts and articles within the researched and reviewed references for this research study also have content that reflects this focus on monetary and commodity-based units.

Theories for energy related management and decision sciences, and practices of these theories, may benefit from the approach of using dummy or categorical variables, in terms of 1 and zero, for quantitative research studies. Results of this study can be used to demonstrate the viable nature of categorical (i.e., dummy) variables when performing quantitatively based research studies. This supports the various arguments by Cohen et al. (2003), Content (2009), and Sage Publications regarding the use of dummy (i.e., categorical) variables in multiple linear regression analysis.

Findings are in agreement with Jacob (2011) regarding the need to simplify permitting processes and institute efficient permitting processes in agencies, municipalities, and jurisdictions. In terms of efficiency consideration of the permit application, submission, and approval process, findings are in agreement with the theories of motion as posited by Newton (1713), and with the theories of efficiency as argued by Baxter (2008). Schoofs (2011) argued that more study is needed to determine if legislated RPSs would be needed to promote the installation of renewables-based energy systems, such as photovoltaic arrays for electricity production. Results from data analysis for this study extend this argument by Schoofs (2011) and add knowledge to the discipline of RPS legislation determination. Behrens (2011) found that solar systems installed on roof tops would be of benefit in Los Angeles. The city of Æro on the island of Æroskobing in Denmark uses solar energy output tracking as a means of determining the ROI for the roof top mounted system of 149 arrays, as shown in Figure 6. I found that the ROI for such systems would be positive and that a legislated RPS would not necessarily increase the quantity of installed systems. Rather, this quantity could simply be increased by instituting more efficient and user friendly permitting processes.

Figure 6. Photograph of solar energy output tracker

Figure 6. Solar energy production tracking is one visual means by which decision makers and policy creators can actively monitor the function of photovoltaic systems. Such trackers may also be useful in collecting data with which ROI analysis may be refined and performed.

The photograph in Figure 6 was taken by me on 27 April 2015 of the solar energy output tracking display at the Æro Community Center. The total production of 159.19MWh since the date of installation on 15 February 2013, the electricity generated daily on 27 April in terms of 35.9 kilowatts, and the energy delivered on 27 April in terms of 35.9 kilowatt hours are each displayed in this output. Although this photovoltaic system did not exist in 2011, it is a viable example of how energy output tracking may be used to determine the societal benefit of any given system.

Limitations of the Study

This study was limited by the data available in completed and returned surveys, and by data made available in the DSIRE (2011) data-base as well as data made available via websites operated by the various jurisdictions that comprised the sample population for this study. For ease of readability by those who may read this dissertation, the citations for this database (i.e., DSIRE) and the various jurisdictionally operated websites for the study population are provided in Appendices B, C, D, and E.

Only those data relevant to the questions in the survey, the primary and secondary research questions, and the study variables were sought. Socio, economic, and cultural mores were not included in this study. Consideration for such variables as the number of inhabitants and their educational background, as well as proficiency in English was neither included neither in the data research nor in the research and survey questions. Inclusion of these mores and variables in a future research study may be of benefit in order to determine if these may have any bearing on the statistically based benefit of legislating any RPS and its potential affect on the number of approved permits to install a photovoltaic system at a residence, business, community center, etc.

Recommendations

Recommendations for Future Research

Literature regarding ISO50001, in terms of its incorporation and potential relationship with the variables associated with this research study, was not found. This could be a gap in the literature, or it may seem to be a gap merely because of the rather newness of ISO50001, though ISO (2011) did indicate that these impediments could potentially have a negative influence on the ROI for infrastructure oriented projects relevant to renewable forms of energy.

The way agencies municipalities, jurisdictions, and other decision-making bodies as well as policy creation bodies are populated, in terms of skills and experience of personnel may influence the relationship between the variables. The energy resource management models being instituted and/or employed by personnel of any associated agency involved with policy enforcement, interpretation, etc. may influence the relationship between the variables. This idea of a management model affecting external (i.e., customer) and internal (i.e., employee) actions and perceptions was argued by Turban, Aronson, and Liang (2005). Municipal leadership and operating capital may have an effect on permitting approaches taken that have relevance to an existing goal-oriented, planned, or legislated RPS. There may be variants in the percentage of permits approved due to perceptions and experience of the population comprising potential and actual owners and operators of solar energy-oriented systems. This idea was partially argued by Gordon (2012).

Based on the scatter plots in Figures 1 through 5, given the slight curve which the data seems to follow as opposed to a linear pattern, it may be more beneficial to use a curve-based instead of a linear-based equation and model for data analysis. A curve-based model could incorporate a parabolic or hyperbolic equation. Signal processing and wave analysis may be other relevant curve based means through which these data could be analyzed. The use of histograms for chart output may provide a different view and/or contrast of analysis results. In these cases or approaches, linear regression analysis would not be applicable (Ryan, 2011).

Any upward pressure on the quantity of permit applications submitted due to policies and incentives, such as carbon cap and trade policy or RECs, may force a re-evaluation of the need for a legislated RPS—federal or state, as well as the actual versus perceived benefit of such a RPS. This relationship is one example within energy resource management that may benefit from a research study based on a theoretical framework involving the laws of motion, as posited by Newton (1995).

Recommendations Regarding the Methodology and the Research Process

The research and data analysis methodologies chosen for this research study have been used in the past for other quantitative and economically oriented studies. Gathering of data via the survey was not permitted until institutional review board (IRB) approval was received. Had IRB approval been granted earlier, it would have been more possible to conduct an extensive research of jurisdictional records during the research study proposal phase. Results of such research may have fostered a different line of research and survey questions. It is doubtful that these results may have promoted any other research and data analysis methodologies than those selected and described. Conducting research of the various forms of publication—in text physically (e.g., text books, journals, professional publications, etc.) and electronically published (e.g., web based) did provide breadth and depth to the research and the associated results.

Recommendations Regarding the Literature

Throughout the research it was obvious that there is misunderstanding and confusion regarding what is a renewable versus nonrenewable energy source. Examples of energy resources purported as renewable although they are not due to their dependence on global conditions (Moritz et al., 2012) include hydroelectric and geothermal. This confusion permeates the various approaches of jurisdictional management regarding such things as RPSs, permits, applications, web site content and layout, staffing, government incentive programs, and more. Confusion is further propagated by the lack of consistency within and between jurisdiction web sites, vocabulary, fees, forms, and approval or denial of covenants and restrictions (Shrimali & Kniefel, 2011). This was the case for those in the same county and often state, as well as between states.

Implications

The implications noted in this chapter are addressed via the lens of positive social change from the perspective of ROI and linear regression analyses. Individuals may use the data and means of analysis contained herein, as well as the developed model to determine if it makes economic sense for them to install, or have installed on their home a solar based energy system. Individuals may also use these to influence RPS and energy-oriented decisions and policies of elected officials for their given jurisdiction. The findings from this study may be used to support the argument of Tuerck et al. (2011), potentially aiding in the reduction of any adverse energy management decisions where the legislation of any RPS may be in consideration. Such reductions of adverse decisions and policies, as well as any increase of non-adverse decisions and policies would of course be of benefit to society, as argued by Thiengkamol (2011). Organizations involved with energy management, the review and/or approval of permits, the development and maintenance of relevant web sites, and the installation of solar based energy systems may use the results from this study during examination of these actions and items for the sake of improvement in terms of ease of use and efficiency.

Conclusion

Local governments have the ability to move energy markets and related construction of energy collection points through innovative permitting processes. The City of Chicago, for instance, created the Green Permits Program in which projects can receive permits within 15-30 days and also qualify for partial waiver of review fees (DSIRE, 2012). With support from the SunShot Initiative Rooftop Solar Challenge, Broward County in Florida launched the streamlined Go SOLAR website, which can be accessed to request and obtain a solar energy system permit and a preapproved set of design plans in just 30 minutes. This certainly is indicative of an efficient permitting process, and supports the results and findings as well as the interpretation of results regarding the ROI-based model.

Ultimately, decision makers and policy creators from the various states and local governments can posit and implement systems for energy resource management. Given the forecast demand for electrical energy, and the results of this study, such systems are needed to accomplish solar energy market support goals and expected consumption of electricity. Regardless of overlapping or even contrary jurisdictional policies currently in place, the demand for energy and management of the resources from which energy may be drawn will every increase. In order to meet this increase, models such as the two, which resulted from this study, may be of benefit in the energy resource management arena. A high level of coordination and communication between state and local government authorities seems to create the greatest opportunity for success in solar energy systems development, use, and market advancement, regardless of RPS status.

Consistency of regulation content, scope, and requirements makes for a more efficient system, resulting in higher quantities of permit applications and approvals. Higher quantities of permit applications and approvals will result in higher kW and MW energy collection and production. The higher permit approval to permit application ratio (e.g., percentage of approved permits) does foster a higher ROI, which creates higher societal benefit and more environmentally friendly energy.

Decision makers and policy creators can take a number of actions as they employ the two models derived from this study. These actions include mitigation, reduction, and elimination. Mitigate, reduce, and eliminate splintering of regulations within and between jurisdictions. This will tend to create an environment, which encourages a variety of solar energy capturing methods, and applications that presently exist, as well as future such methods and applications.

Permitting fee structure and the ease with which a permit may be obtained would be straight forward if the ROI formula presented in Chapter 3 and demonstrated in Chapter 4 were used for evaluation and combined with the kWh market price for electricity. It would also be of benefit to have one controlling agency per jurisdiction for would-be solar energy system owners, installers, and users to work with, as opposed to two or more. Instituting a national RPS will not cure the ills of poor permitting practices and poor energy management practices nor will it encourage upward pressure on the percentage of approved permits for the installation of solar energy-based systems. The mere existence of a legislated RPS did not show statistical significance in the increase in the quantity of permit applications and approvals. The existence of a legislated RPS did not have any downward pressure on the number of steps and fees associated with submission of a permit application. Based on the results of this research study, legislating a national RPS will do nothing in terms of increasing the quantity of permits and percentage of permits approved for the installation and use of solar energy-based systems.

The data analysis based on the ROI calculation indicates that having a legislated RPS does not correlate to a positive ROI. Rather, the higher the percentage of approved permits, the better the ROI. The tipping point for more rapid ROI is the median insolation level of 3.08kWh/m^2. Below this level the ROI period tends to follow a parabolic curve, making it more difficult to achieve any reasonable ROI as the median insolation level decreases. This is the case regardless of the percentage and quantity of approved permits.

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Appendix A: Letter of Introduction, Participant Invitation, Participant Consent Form, and Participant Survey

The following letter and accompanying survey will be sent to managers in the permitting sections and agencies for each of the randomly selected municipalities:

Letter of Introduction

From: Kirt Butler

To: Dear Madam / Sir,

I am a Ph.D. candidate attending Walden University. I have written my research proposal. It has been approved by my dissertation committee. For my research I am studying the relationship between legislated Renewable Portfolio Standards, median annual insolation for each state and city comprising a randomly selected population of 52 cities, and the percentage of permits approved to construct / install solar energy based / focused projects within these cities located in the United States. I have randomly selected this study sample population of cities, and the respective management of the associated permitting departments / agencies for these cities, to complete this brief survey. In order to accomplish my planned analysis of the relationship between the variables, there are various questions that I hope you can help answer from the perspective of the permitting authority.

Letter of Invitation

You are invited to take part in a research study regarding legislated renewable portfolio standards and solar energy system permits. Given your position within an agency or department that is likely to deal with permits (e.g.,review applications, grant permits, etc.) for such systems, and also likely to have knowledge regarding the renewable portfolio standard for your jurisdiction / municipality, I am requesting your participation in this research study. Your participation will involve completing the Informed Consent process by reading the balance of this letter, completing the survey, and returning the completed survey to me. Please keep a copy of the completed survey and this letter for your records. Reading about the informed consent process should take approximately 5 minutes. This is provided to allow you to understand this study and informed consent process before deciding whether or not to take part and be a participant. The survey consists of seven questions related to this study. The time needed to complete the survey is in part dependent on how readily available data are and how well organized it is to support answering these survey questions. A reasonable estimate for survey completion is approximately one hour. Placing it in the return envelope and mailing it may take a few minutes. Please note that the return of the completed survey will indicate your consent to participate in the study. Return of the completed survey will also constitute your informed consent for me to use the information you provided as answers to the survey questions.

As previously noted, this study is being conducted by me – Kirt Butler in the course of completing my doctoral program in Applied Management and Decision Sciences at Walden University.

Background Information

The purpose of this quantitative, cross-sectional study is to examine the relationship between (a) legislated RPS and the percentage of approved solar energy permits, and (b) median annual solar radiation level by State and the percentage of approved solar energy permits for 68 separate jurisdictions within the United States.

Procedures

If you agree to be a participant in this study, you will be asked to;

- consent to my use of the data requested via the survey questions,
- complete the seven questions contained in the survey, and
- return the completed survey to me – Kirt Butler. Please note that a self-addressed, stamped envelope will be included for you to use to return the completed survey.

Voluntary Nature of the Study

Your participation in this study is voluntary. I will respect your decision and that of the agency you represent of whether or not you choose to participate in this study. Neither you nor the agency you represent will be treated any differently by me should you decline to participate in this study as described.

Risks and Benefits of Being in the Study

There are few foreseen risks for you to participate in this study, as participation involves completing the survey followed by making and keeping a copy for the agency and municipality you represent, and by returning the original to me by using the self-addressed, stamped envelope. Potential risks depend on the reasonable safety of your work place and the ease of obtaining data to support completion of the survey. Potential risks identified in accomplishing this effort include paper cuts, closing a filing cabinet on ones fingers, and back strain from bending over to retrieve a file. I encourage you to follow all safety protocols presently constituted for your work place by your employer.

It is speculated that by understanding the relationship between the study variables, personnel from the various agencies may be able to institute improved or new energy resource management models, processes, and decision criteria. These could possibly save the applicant, the tax payer, and the permitting agency time and money, while achieving energy goals to meet current and projected demand.

Payment of Participants

No participant or the agency they represent will receive any form of payment or reward of any type for having participated in this research study.

Participant Privacy

All information you provide will be kept confidential. Published data to be included in my PhD dissertation will be contained in the final two chapters of it. These data will be published in such a manner that readers will not be able to identify from which agency said data was provided. Only I will have a key for this, and that key will be locked in a personal filing cabinet for the span of 5 years following publication of my dissertation, as required by Walden University. At the end of this 5 year term, the key and the completed survey will be destroyed. Under no circumstance will any personally identifiable information be requested, published, or will it be used for any purpose.

Contacts and Questions

You may ask any questions you have now, or if you have questions later, you may contact the researcher via the contact information I have provided at the beginning and end of this letter. Questions can also be directed to my chair, Dr. Robert Kilmer at (717) 241-6250 or robert.kilmer@waldenu.edu. If you have questions about your rights as a participant, you can contact the Walden representative who can discuss this with you at 612-312-1210 or irb@waldenu.edu.

Walden University's approval number for this study is **IRB will enter approval number here** and it expires on **IRB will enter expiration date**. Please keep a copy of this letter and the completed survey for your records.

In order to protect your rights and your identity as a participant in completing and returning the survey, I am seeking your informed consent. The parameters that I will use to protect your identity and rights as a participant so that I may use the survey data in my research are explained under the Informed Consent of the Participant heading.

Informed Consent of the Participant

Statement of Consent

I have read the above information and I feel I understand this survey-based quantitative research study well enough to make a decision about my involvement and participation. By completion and return of the survey I understand that I am agreeing to the terms described above.

Participant Survey

By completing and returning this survey within 10 days from its receipt, you consent to my use of the answers you provide to the survey questions in the course of my research and the associated data analysis. You understand that the completed survey will be kept in a locked file by me for 5 years, and that a key will be used to tie the completed survey data to the published data in the dissertation.   This will ensure the confidentiality of the participant and the agency that is represented by the participant. The questions are as follows:

1. How many permit applications for the installation of photovoltaic systems, solar panels, etc. on facilities (structures and grounds) located within your city, were submitted to your office during from the period of January 1, 2011 through December 31, 2011?
2. How many applications were approved within the time frame of January 1, 2011 through December 31, 2011?

Questions 3 and 4 are specific to the city (   ) served by your department.

3. Did a legislated renewable portfolio standard exist for your city from January 1, 2011 through December 31, 2011? Please circle the applicable response;

   Yes   No
4. What form of Renewable Portfolio Standard did your city have from January 1, 2011 through December 31, 2011? Please circle the applicable response;

A. legislated B. proposed goals – non legislated C. none

Questions 5 and 6 are specific to the state ( ) wherein your department is located.

5. Did a legislated renewable portfolio standard exist for your state from January 1, 2011 through December 31, 2011? Please circle the applicable response;

   Yes No

6. What form of Renewable Portfolio Standard did your state have from January 1, 2011 through December 31, 2011? Please circle the applicable response;

A. legislated B. proposed goals – non legislated C. none

7. If the state has a legislated Renewable Portfolio Standard (RPS), does this legislation dictate that the city wherein your department is located must also have a legislated RPS? Please circle the applicable response; Yes No

Thank you in advance for your assistance and participation,

Kirt Butler

Appendix B: Capital Cities Comprising Part of the Study Population

Table B1

Study Population with solar city, RPS, and Insolation Data included for Appendix B

Row #	City & State	Website	Legislated State RPS *, ¥, and solar goal	Annual Median Insolation, in terms of kWh/m^2/day, based on Ж
1	Montgomery, Alabama	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=AL&&re=0&ee=0.	No (¥)	5.10
2	Juneau, Alaska	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=AK&&re=0&ee=0.	No (¥)	3.15
3	Phoenix, Arizona	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=AZ&&re=0&ee=0.	Yes (¥)	6.35
4	Little Rock, Arkansas	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=AR&&re=0&ee=0.	No (¥)	4.8
5 SC	Sacramento, California	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=CA&&re=0&ee=0.	Yes (¥)	5.85

6 SC	Denver, Colorado	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=CO&&re=0&ee=0.	Yes (¥**)**	5.3
7	Hartford, Connecticut	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=CT&&re=0&ee=0.	Yes (¥**)**	4.6
8	Dover, Delaware	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=DE&&re=0&ee=0.	Yes (¥**)**	4.45
9	Tallahassee, Florida	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=FL&&re=0&ee=0.	Yes (¥**)**	4.9
10	Savannah, Georgia	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=GA&&re=0&ee=0.	No (¥**)**	4.9
11	Honolulu, Hawaii	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=HI&&re=0&ee=0.	Yes (¥**)**	5.65
12	Boise, Idaho	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=ID&&re=0&ee=0.	No (¥**)**	5.35
13	Springfield, Illinois	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=IL&&re=0&ee=0.	Yes (¥**)**	4.85

14	Indianapolis, Indiana	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=IN&&re=0&ee=0.	No (¥**)**	4.6
15	Des Moines, Iowa	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=IA&&re=0&ee=0.	Yes (¥**)**	4.75
16	Topeka, Kansas	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=KS&&re=0&ee=0.	No (¥**)**	4.9
17	Frankfort, Kentucky	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=KY&&re=0&ee=0.	No (¥**)**	4.65
18	Baton Rouge, Louisiana	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=LA&&re=0&ee=0.	No (¥**)**	4.8
19	Augusta, Maine	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=ME&&re=0&ee=0.	Yes (¥**)**	4.45
20	Annapolis, Maryland	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=MD&&re=0&ee=0.	Yes (¥**)**	4.7
21SC	Boston, Massachusetts	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=MA&&re=0&ee=0.	Yes (¥**)**	4.65

22	Lansing, Michigan	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=MI&&re=0&ee=0.	No (¥)	4.35
23SC	St. Paul, Minnesota	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=MN&&re=0&ee=0.	Yes (¥)	4.75
24	Jackson, Mississippi	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=MS&&re=0&ee=0.	No (¥)	5.05
25	Jefferson City, Missouri	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=MO&&re=0&ee=0.	No (¥)	4.95
26	Helena, Montana	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=MT&&re=0&ee=0.	Yes (¥)	4.8
27	Lincoln, Nebraska	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=NE&&re=0&ee=0.	No (¥)	5.05
28	Carson City, Nevada	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=NV&&re=0&ee=0.	No (¥)	5.8
29	Concord, New Hampshire	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=NH&&re=0&ee=0.	No (¥)	4.7

30	Trenton, New Jersey	Retrieved 2012 from http://www.njcleanenergy.com/renewable-energy/programs/solar-renewable-energy-certificates-srec/new-jersey-solar-renewable-energy. Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=NJ&&re=0&ee=0.	Yes *, **(¥)**	4.55
31	Santa Fe, New Mexico	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=NM&&re=0&ee=0.	Yes (¥**)**	6.25
32	Albany, New York	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=NY&&re=0&ee=0.	Yes (¥**)**	4.45
33	Raleigh, North Carolina	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=NC&&re=0&ee=0.	No **(¥)**	4.95
34	Bismarck, North Dakota	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=ND&&re=0&ee=0.	No **(¥)**	5.1
35	Columbus, Ohio	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=OH&&re=0&ee=0.	No **(¥)**	4.35
36	Oklahoma City, Oklahoma	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=OK&&re=0&ee=0.	No **(¥)**	5.3

37	Salem, Oregon	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=OR&&re=0&ee=0.	No (¥)	4.05
38	Harrisburg, Pennsylvania	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=PA&&re=0&ee=0.	Yes (¥)	4.6
39	Providence, Rhode Island	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=RI&&re=0&ee=0.	Yes (¥)	4.6
40	Columbia, South Carolina	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=SC&&re=0&ee=0.	No (¥)	4.95
41	Pierre, South Dakota	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=SD&&re=0&ee=0.	No (¥)	5.0
42	Nashville, Tennessee	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=TN&&re=0&ee=0.	No (¥)	4.95
43SC	Austin, Texas	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=TX&&re=0&ee=0.	Yes (¥)	5.1
44SC	Salt Lake City, Utah	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=UT&&re=0&ee=0.	No (¥)	5.45

45	Montpellier, Vermont	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=VT&&re=0&ee=0.	Yes (¥)	4.5
46	Richmond, Virginia	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=VA&&re=0&ee=0.	No (¥)	4.85
47	Olympia, Washington	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=WA&&re=0&ee=0.	Yes (¥)	3.6
48	Charleston, West Virginia	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=WV&&re=0&ee=0.	No (¥)	4.5
49SC	Madison, Wisconsin	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=WI&&re=0&ee=1.	Yes (¥)	4.6
50	Cheyenne, Wyoming	Retrieved 2012 from http://www.dsireusa.org/incentives/allsummaries.cfm?State=WY&&re=0&ee=1. Retrieved 2012 from http://wyia.org/projects/.	No (¥)	5.2

* = As apparent in the website for the jurisdiction, municipality, or given state.
¥ = Energy Information Association (EIA) (2011)
Ж = National Renewable Energy Laboratory (NREL) (1994). Retrieved 2012 from http://rredc.nrel.gov/solar/old_data/nsrdb/1961-1990/redbook/sum2/state.html. Data for kWh/m2/day are the calculated annual medians for solar radiation for flat-plate collectors facing south at a fixed-tilt.
SC = *solar city*, note that the total number of state capitals which were awarded solar city status is seven.

Appendix C: Designated Solar Cities Comprising Part of the Study Population

Table C1

Study Population with Financial Award, RPS, and Insolation Data Included

Row #	Solar City	Financial Award Amount and Year of Award	RPS Status in 2011 (Legislated (1), Planned (0), None (0)) and Amount, or Not Available (N/A) ȝ	Annual Median Insolation in terms of kWh/m^2/ day, based on Ж
1	Tucson, AZ	38 sites as of 2010. 1.1 megawatt capability. $200,000; 2007	Renewable Energy Incentive District (REID), enacted March 2012.	6.30
2	Berkeley, CA	$200,000; 2007	N/A	6.05
3	Sacramento, CA	$200,000; 2007	Permit fees waved for the period of 2007 through 2009.	5.85
4	San Diego, CA	$200,000; 2007	N/A	5.55
5	San Francisco, CA	$200,000; 2007	N/A	5.55
6	San Jose, CA	$200,000; 2008	N/A	6.10
7	Santa Rosa, CA	$200,000; 2008	N/A	5.80
8	Denver, CO	$200,000; 2008	Ordinances revamped in 2009	5.3
9	Orlando, FL	$200,000; 2008	Focus on solar since 1999	5.10
10	New Orleans, LA	$200,000; 2007	Implemented solar related policies in 2009	4.85
11	Boston, MA	$200,000; 2007	N/A	4.65
12	Ann Arbor, MI	$400,000; 2007	N/A	4.5

13	Minneapolis – St. Paul, MN	$200,000; 2008	Began with 1MW of capacity, in 2012 - just over 3MW	4.0
14	New York City, NY	2007, Phase 1 award of $726,199. Note, permit approval time reduced from 1 yr to 100 days.	N/A	4.7
15	Portland, OR	$200,000; 2007	N/A	3.85
16	Philadelphia, PA	$200,000; 2008	N/A	4.65
17	Pittsburgh, PA	$200,000; 2007	N/A	4.25
18	Knoxville, TN	$400,000; 2008	N/A	4.8
19	Austin, TX	$200,000; 2007	N/A	5.1
20	Houston, TX	$200,000; 2008	N/A	4.7
21	San Antonio, TX	$200,000; 2008	N/A	5.2
22	Salt Lake City, UT	$200,000; 2007	N/A	5.45
23	Seattle, WA	$200,000; 2008	N/A	3.8
24	Madison, WI	$350,000; 2007	N/A	4.6
25	Milwaukee, WI	$650,000; 2008	Has Milwaukee Shines program and Solar Program Manager since 2009	4.5

Ж = National Renewable Energy Laboratory (NREL) (1994). Retrieved 2012 from http://rredc.nrel.gov/solar/old_data/nsrdb/1961-1990/redbook/sum2/state.html. Data for $kWh/m^2/day$ are the calculated annual medians for solar radiation for flat-plate collectors facing south at a fixed-tilt.

ɮ = These data may be furnished via the survey responses, in which case this table will be revised.

1 Retrieved from http://cms3.tucsonaz.gov/energy/solarintucson

2 Retrieved from http://www.cpuc.ca.gov/NR/rdonlyres/0C43123F-5924-4DBE-9AD2-8F07710E3850/0/CASolarInitiativeCSIAnnualProgAssessmtJune2012FINAL.pdf
3 Retrieved from http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?&&&state=CA&page=1
4 Retrieved from http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?&&&state=CA&page=1
5 Retrieved from http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?&&&state=CA&page=1
6 Retrieved from http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?&&&state=CA&page=1
7 Retrieved from http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?&&&state=CA&page=1
8 Retrieved from http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?state=CO&=Search
9 Retrieved from http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?&&&state=FL
10 Retrieved from http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?state=LA&=Search
11 Retrieved from http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?state=MA&=Search
12 Solar Ann Arbor, 2010, Retrieved 2012 from http://www.a2gov.org/government/publicservices/systems_planning/energy/solarcities/Pages/default.aspx.
13 Retrieved from http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?state=MN&=Search
14 Retrieved 2012 from http://www1.cuny.edu/mu/sustainable-news/2011/12/12/nyc-wins-department-of-energy-%e2%80%98sunshot%e2%80%99-award-to-make-solar-energy-cost-competitive/
15 Retrieved from http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?state=OR&=Search
16 Retrieved from http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?state=PA&=Search
17 Retrieved from http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?state=PA&=Search
18 Retrieved from http://www.cityofknoxville.org/policy/solar/.
19 Retrieved from http://solaraustintexas.com/?page_id=47,

[20] Retrieved from
http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?state=TX&=Search
[21] Retrieved from
http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?state=TX&=Search
[22] Retrieved from
http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?state=UT&=Search
[23] Retrieved from
http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?state=WA&=Search
[24] Retrieved from http://www.cityofmadison.com/Sustainability/City/madiSUN/
[25] Content (2009). Retrieved from http://www.jsonline.com/business/66238682.html. Also refer to
http://www4.eere.energy.gov/solar/sunshot/resource_center/filter?state=WI&=Search.

Appendix D: Capital Cities, and Steps Associated with Solar Permit Application Procedures

Table D1

Steps For Permit Application For Appendix D

Row #	City & State	Specific Permit Process / Type	Steps to complete and submit application	Clicks to arrive at application	Total "investment" (steps and clicks). This = I from equation 5.	Website link or URL
1	Montgomery, Alabama	UNKN	30	30	60	http://www.montgomeryal.gov/index.aspx?page=4
2	Juneau, Alaska	Building Permit	2	6	8	http://www.juneau.org/cddftp/documents/PermitExemptions_000.pdf
3	Phoenix, Arizona	Building Permit	7	26	33	http://phoenix.gov/sustainability/solarproj.html
4	Little Rock, Arkansas	UNKN	30	30	60	http://www.littlerock.org/CityManager/Divisions/SpecialProjects/
5 SC	Sacramento, California	Solar Permit	9	12	21	http://www.cityofsacramento.org/dsd/customer-service/documents/Complete_Solar_GuidePacket_revised_121911.pdf

6 SC	Denver, Colorado	Solar Permit	4	8	12	http://www.denvergov.org/developmentservices/DevelopmentServices/Contractors/ContractorvsDIY/tabid/436706/Default.aspx
7	Hartford, Connecticut	Home Improvement Application Permit	9	12	21	http://www.ct.gov/dcp/lib/dcp/pdf/applications_added_2012/cpfr-13_hic_application_aug_2012.pdf_new.pdf
8	Dover, Delaware	Green Energy Permit	7	2	9	http://www.dnrec.delaware.gov/energy/services/Documents/DPL%20Grant%20Application/Solar%20Hot%20Water%20Grant%20Application%20-%20DPL.pdf
9	Tallahassee, Florida	Small PV System Permit	2	9	11	http://www.tecsolarman.com/
10	Savannah, Georgia	Solar Permit	3	3	6	http://www.georgiapower.com/about-energy/energy-sources/solar/solar-faqs.cshtml
11	Honolulu, Hawaii	Alternative Energy	2	3	5	https://www.realpropertyhonolulu.com/content/rpadcms/documents/exemption/bfsrpp5d.pdf.
12	Boise, Idaho	Net Meter Application	5	12	17	http://www.idahopower.com/pdfs/BusinessToBusiness/netMetering_Application.pdf
13	Springfield, Illinois	Solar Permit	2	3	5	www.illinoissolar.org/.../FY13RERPRebateGuidelinesFINAL.doc
14	Indianapolis, Indiana	Interconnection	2	17	19	http://www.iplpower.com/content.aspx?id=313

15	Des Moines, Iowa	Solar Permit	4	11	15	http://www.dasolar.com/solar-panel-installation/iowa/des-moines
16	Topeka, Kansas	Solar Permit	9	22	21	http://ks-kdoc.civicplus.com/DocumentView.aspx?DID=305
17	Frankfort, Kentucky	UNKN	30	30	60	http://energy.ky.gov/Energy%20Plan/Strategy%202%20-%20Increase%20Kentucky%27s%20use%20of%20renewable%20energy.pdf
18	Baton Rouge, Louisiana	Solar Permit	9	5	14	http://brgov.com/dept/dpw/inspections/pdf/SolarInfo.pdf
19	Augusta, Maine	Solar Energy Rebate	2	7	9	http://www.efficiencymaine.com/docs/renewables/solarapplicationform.pdf
20	Annapolis, Maryland	Renewable Energy	2	8	10	http://energy.maryland.gov/Residential/cleanenergygrants/index.html
21 SC	Boston, Massachusetts	Solar Permit	3	3	6	http://www.solar-massachusetts.org/home/residential-solar-request/
22	Lansing, Michigan	Electrical Permit	4	23	27	http://www.lansingmi.gov/Lansing/pnd/bldgsafety/FY13ElecApp.pdf
23 SC	St. Paul, Minnesota	Solar Permit	14	18	32	http://www.minneapolismn.gov/www/groups/public/@regservices/documents/webcontent/convert_272925.pdf

24	Jackson, Mississippi	UNKN	30	30	60	http://www.jacksonms.gov/services/search?cx=013442873861491878440%3Aygawcia2n3y&q=solar+panels&cof=FORID%3A9
25	Jefferson City, Missouri	Solar Permit	4	10	14	http://mosolarapps.com/about-mo-solar.asp
26	Helena, Montana	Building Permit	12	17	29	http://www.helenamt.gov/fileadmin/user_upload/City_Com_Dev/Building/Building_Division_Documents/Residential_Plan_Submittal.pdf
27	Lincoln, Nebraska	Solar Permit	13	29	42	http://www.ci.lincoln.ca.us/pagedownloads/Solar%20Panel%20Install.pdf
28	Carson City, Nevada	Renewable Energy	29	13	42	http://energy.nv.gov/uploadedFiles/energynvgov/content/Documents/Meetings/Tax_Abatement/FRV-SpectrumSolarTaxAbatementPreapplication.pdf
29	Concord, New Hampshire	Solar Permit	20	12	32	http://www.puc.state.nh.us/Sustainable%20Energy/Forms/Pre-Installation%20Incentive%20Application%20100209.pdf
30	Trenton, New Jersey	Solar Permit	8	10	18	http://www.infinitysolarpowernj.com/new-jersey-solar-panel-installation.php
31	Santa Fe, New Mexico	Photovoltaic Permit	5	7	12	http://www.santafenm.gov/DocumentCenter/Home/View/5531

32	Albany, New York	UNKN	30	30	60	http://albanyny.gov/forms.aspx
33	Raleigh, North Carolina	Building Permit	4	5	12	http://www.solar-north-carolina.org/home-solar-power-facts/solar-installation-panels-roof-process/
34	Bismarck, North Dakota	UNKN	30	30	60	http://www.bismarck.org/Search.aspx?SearchString=solar+enegry
35	Columbus, Ohio	UNKN	30	30	60	http://www.okc.gov/access/
36	Oklahoma City, Oklahoma	UNKN	30	30	60	http://bzs.columbus.gov/DocListing.aspx?id=26482
37	Salem, Oregon	Renewable Energy	2	15	17	http://www.co.marion.or.us/NR/rdonlyres/308FB3AA-812A-4B16-8C7D-3CD924CEB792/0/E01RERenewableEnergyPermitApplication.pdf
38	Harrisburg, Pennsylvania	UNKN	30	30	60	http://harrisburgpa.gov/
39	Providence, Rhode Island	Photovoltaic Permit	6	12	18	http://www.energy.ri.gov/documents/renewable/APPLICATION_FOR_PV_SYSTEM_CERTIFICATION.pdf
40	Columbia, South Carolina	UNKN	30	30	60	http://www.sciway.net/gov/sc-building-permits.html
41	Pierre, South Dakota	Solar Permit	5	15	20	http://www.dasolar.com/solar-energy/solar-panel-installation

42	Nashville, Tennessee	Clean Energy Permit	2	28	30	http://www.tn.gov/environment/energygrants/recipients.shtml
43 SC	Austin, Texas	Electrical Permit	2	18	20	http://www.austintexas.gov/sites/default/files/files/Planning/Applications_Forms/fax-request-electrical-permit.pdf
44 SC	Salt Lake City, UT	Permit Other	2	12	19	https://www.southsaltlakecity.com/uploads/documents/Miscellaneous_Permit_1.pdf
45	Montpellier, VT	Renewable Energy	6	8	14	http://www.revermont.org/main/vermont-solar-consumer-guide/photovoltaic/
46	Richmond, VA	Renewable Energy	15	19	34	http://lis.virginia.gov/cgi-bin/legp604.exe?000+cod+10.1-1197.6
47	Olympia, WA	Building Permit	22	30	52	http://olympiawa.gov/documents/CPD/FORMS/CommercialBuildingPermitDesignandApplicationSubmittalRequirementsI-Codes2012.pdf
48	Charleston, WV	Passive Solar Design Permit	2	3	5	http://www.nrel.gov/docs/legosti/old/17352.pdf
49 SC	Madison, WI	Solar Permit	5	3	8	http://www.cityofmadison.com/sustainability/city/madisun/step.cfm
50	Cheyenne, WY	Passive Solar Design Permit	2	5	7	http://www.nrel.gov/docs/legosti/old/17360.pdf

Note 1: In some cases the cell containing the web site for specific process steps for permitting will also contain a note as evidence that the hyperlink provided came from the web site from the specific capital city.

Note 2: In the event a specific permitting process for Solar Use was absent, but there was evidence to conclude Solar fell under Electrical, Building, Renewable Energy or Other such categories, these categories were recorded as considered valid processes for the purpose of this study.

Note 3: There was 100% success in arriving at each of the respective web sites for each capital city with only two clicks, one click from the Google search page and one click to enter the web by entering the City and State, and then performing the search. This does not include the various steps and clicks actually required to submit a permit application. This total is noted in Appendix D.

Note 4: The next process from each capital city web site was to enter each of the four search criteria in Table 1 Appendix D, until a hit or link to an internal *.pdf* form or external web page was obtained detailing the steps required to complete and submit an application.

Note 5: The next step in this portion of research, following the preceding process steps did not yield any result. This step involved returning to the Google Search page and repeat steps 2 through 5 by entering each of the syntax in each step followed by the state and capital city until a hit was obtained. This may warrant further study in separate research.

Appendix E: Survey Participant Response Data

Table E1

Participant Responses From Appendix A Survey For Appendix E Data Table

Participant Jurisdiction	Quantity of Applications	Quantity of Permits	Percentage of permits approved	RPS form – City	RPS form - State	Median Insolation	Calculated ROI
1*	0	0	0.00	0	0	5.10	0.09
2*	0	0	0.00	0	0	3.15	0.39
3* Ω	168	120	71.43	1	1	6.35	0.19
4* Ω	1	1	100.00	0	1	6.30	0.19
5*	2	2	100.00	0	0	4.80	0.08
6* Ω	0	0	0.00	0	0	6.05	0.29
7₴	0	0	0.00	0	0	5.85	0.28
8₴	23	23	100.00	1	0	5.55	0.26
9₴	0	0	0.00	0	0	6.10	0.29
10₴	0	0	0.00	0	0	5.80	0.28
11₴	0	0	0.00	0	0	5.30	0.44
12₴	0	0	0.00	0	0	4.60	0.22
13₴	0	0	0.00	1	1	4.45	0.49
14₴	0	0	0.00	0	0	4.85	0.44
15₴	0	0	0.00	0	0	4.90	0.82
16₴	0	0	0.00	0	0	5.35	0.31
17₴	0	0	0.00	1	1	4.85	0.97
18₴	0	0	0.00	1	1	4.75	0.32
19₴	0	0	0.00	1	1	4.90	0.23
20₲	0	0	0.00	0	0	4.65	0.08
21₲	0	0	0.00	0	0	4.80	0.34
22₲	0	0	0.00	0	0	4.85	0.35
23₲	0	0	0.00%	1	1	4.65	0.78
24₲	0	0	0.00%	1	1	4.50	0.17
25₲	0	0	0.00%	1	1	4.35	0.16
26₲	0	0	0.00%	1	1	4.75	0.15
27₲	0	0	0.00%	0	0	5.05	0.08
28₲	2	2	100.00%	1	1	4.95	0.35

29Ǥ	0	0	0.00%	0	0	4.80	0.17
30Ǥ	0	0	0.00%	0	0	5.05	0.12
31Ǥ	15	15	100.00%	1	1	5.80	0.14
32Ǥ	0	0	0.00%	1	1	4.70	0.15
33Ǥ	0	0	0.00%	1	1	4.55	0.25
34Ǥ	0	0	0.00%	1	1	6.25	0.52
35Ǥ	0	0	0.00%	1	1	4.45	0.07
36Ǥ	0	0	0.00%	1	1	4.70	0.08
37Ǥ	33	33	100.00%	1	1	4.95	0.41
38Ǥ	0	0	0.00%	1	1	3.85	0.23
39Ǥ	0	0	0.00%	1	1	4.05	0.24
40Ǥ	0	0	0.00%	1	1	4.65	0.08
41Ǥ	0	0	0.00%	0	0	5.00	0.25
42Ǥ	0	0	0.00%	0	0	4.95	0.17
43Ǥ	3	3	100.00%	0	0	4.80	0.16
44Ǥ	0	0	0.00%	1	1	5.10	0.26
45Ǥ	0	0	0.00%	1	1	4.70	0.24
46Ǥ	0	0	0.00%	1	1	5.20	0.26
47Ǥ	0	0	0.00%	0	0	5.45	0.29
48Ǥ	8	8	100.00%	0	0	4.50	0.32
49Ǥ	0	0	0.00%	0	0	4.85	0.14
50Ǥ	0	0	0.00%	1	1	3.80	0.07
51Ǥ	0	0	0.00%	1	1	3.60	0.07
52Ǥ	0	0	0.00%	0	0	4.50	0.90
53Ǥ	15	15	100.00%	1	1	4.60	0.58
54Ǥ	0	0	0.00%	1	1	4.50	0.56
55Ǥ	0	0	0.00%	0	0	3.20	0.46

* = a randomly selected jurisdiction used for the beta test of the survey, taken from the calculated sample population for the study.
ƻ = data from completed and returned survey.
Ǥ = data from DSIRE database for the study period as survey was either not returned or incomplete.
Ω = solar city.
L = Legislated RPS.

Appendix F: Casewise Diagnostics Table for Analysis # 5

Table F

Casewise Diagnostics Table for Analysis # 5

Case Number	Std. Residual	Percentage approved	Predicted Value	Residual
1	-.961	.00	.4719	-.47189
2	-1.245	.00	.6113	-.61125
3	.405	.71	.5111	.19888
4	.993	1.00	.5126	.48744
5	1.049	1.00	.4850	.51500
6	-1.165	.00	.5720	-.57198
7	.597	.86	.5669	.29310
8	.907	1.00	.5548	.44517
9	.850	1.00	.5825	.41750
10	.416	.78	.5755	.20449
11	.740	1.00	.6366	.36337
12	-1.098	.00	.5393	-.53931
13	-1.289	.00	.6328	-.63278
14	.749	1.00	.6323	.36767
15	.205	.89	.7893	.10067
16	.848	1.00	.5836	.41644
17	.337	1.00	.8343	.16567
18	-1.152	.00	.5656	-.56563
19	-1.079	.00	.5300	-.52999
20	-.982	.00	.4821	-.48213
21	-1.203	.00	.5907	-.59066
22	-1.212	.00	.5953	-.59526
23	-1.536	.00	.7542	-.75415
24	-1.021	.00	.5014	-.50145
25	-1.010	.00	.4959	-.49589
26	-1.009	.00	.4956	-.49560
27	-.990	.00	.4860	-.48595
28	.856	1.00	.5799	.42010
29	-1.060	.00	.5206	-.52063

30	-1.023	.00	.5024	-.50243
31	1.015	1.00	.5015	.49847
32	-1.008	.00	.4951	-.49512
33	-1.089	.00	.5349	-.53488
34	-1.349	.00	.6624	-.66236
35	-.936	.00	.4598	-.45978
36	-.950	.00	.4663	-.46629
37	.805	1.00	.6046	.39539
38	.978	1.00	.5199	.48006
39	.965	1.00	.5260	.47402
40	1.088	1.00	.4658	.53419
41	-1.131	.00	.5555	-.55550
42	.973	1.00	.5221	.47793
43	.985	1.00	.5165	.48349
44	.928	1.00	.5443	.45574
45	.668	.86	.5322	.32780
46	.926	1.00	.5452	.45478
47	.863	1.00	.5763	.42372
48	.856	1.00	.5795	.42045
49	1.000	1.00	.5088	.49125
50	1.113	1.00	.4536	.54644
51	1.117	1.00	.4516	.54835
52	.268	.95	.8185	.13154
53	.669	1.00	.6713	.32871
54	.566	.94	.6621	.27791
55	.764	1.00	.6248	.37522

a. Dependent Variable: Percentage approved