Environmental and Renewable Energy Innovation Potential Among the States: State Rankings

by

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Abstract

States have increasingly been burdened with more policy responsibility in the past decade, especially policy involving energy and the environment. The Reagan administration's "new federalism" in the 1980's resulted in deregulation being the central focus. The federal government has pressured individual states to be accountable for their own policies and has expanded the states' role in policy decisions. "New federalism", for better or worse, demands that states turn inward for solutions to their social and economic problems, rather than turning to the federal government. Pertaining to environmental and energy policy, states have begun to take their own initiative in various ways. On the other hand, however, because of the lack of federal coercion, some states fall behind on progressive environmental and energy policies.

The purpose of this paper is to create an index ranking the 50 states based on environmental innovation *potential*. In other words—this research ***describes*** the factors that contribute to a states' potential for environmental and energy innovation. This research is important first because there is no such scale of this kind measuring innovation potential. Also, it should give policy makers, government officials, and the general public an understanding of which states are the most prepared to innovate for the environment and energy. Lastly, it should clarify what objectives increase states' potential and ability to innovate for the environment and energy.

This research found that California, Oregon, and Washington scores the highest and serve as the most innovative in the environment and energy sectors. Among the lowest scoring states are Kansas, Mississippi, and North Dakota. Also, preliminary results indicate that economic freedom is correlated with the index and should be explored.

About the Author

Daniel Reed graduated from East Tennessee State University with a Bachelor's degree in Political Science in 2006. He moved from Tennessee to Texas to enter the Master's of Public Administration program at Texas State University-San Marcos. He is a member of the American Society of Public Administrators (ASPA) as well as the Pi Alpha Alpha, Public Administration honor society. Daniel has served as the graduate student house leader for the Associated Student Government, Graduate House of Representatives for two consecutive years. Mr. Reed has also served as a Graduate Instructional Assistant to Dr. Kay Hofer for two years. In addition, he works as an assistant manager of Comanche Hill apartment complex at Texas State. He intends on entering the PhD program at the University of Tennessee in Natural Resources and Environmental Policy in the fall of 2009. He will also be working with the Department of Forestry, Wildlife, and Fisheries on a Life Cycle Assessment of switch grass bio-fuel pellets.

Author's Note

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For those of you reading this ARP currently in the MPA program, soldier on and push yourself hard—the end result is well worth it. You can contact me at: danielreed@tennessee.edu.

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Chapter 1 Introduction

Benjamin Franklin is one of America's most famous and accomplished innovators. Franklin played an integral role in the development of many "social innovations" (Mumford 2002, p.256). Social innovation "refers to the generation and implementation of new ideas about how people should organize interpersonal activities, or social interactions, to meet one or more common goals" (Mumford 2002, p.253). "Subscription Libraries", which eventually led to public libraries is an example of Franklin's social innovation. Another example is the "street light" design of an open-top glass-paned lamp (Mumford 2002). Today, people might think of these types of ideas as simple innovations; however, these ideas represent the cycle through single innovations can stimulate entire eras of inventions and new technologies.

Historically, America has an impressive reputation of social innovation. Some social innovations are important because they provide an atmosphere that can feed other inventions, technology, and creative processes. Periodically throughout American history, stimulation periods have occurred, which results in quick advancements of certain categories of innovation. For example, Alexander Bell's telephone completely transformed the way the world communicates. Henry Ford's model T car revolutionized the transportation industry and inspired a new generation in automobile manufacturing. Bill Gates' Windows operating system revolutionized the computing industry and initiated a new era in technology and personal computing.

The United States currently faces the important challenge (or opportunity) of producing energy without harming the environment. By realizing that the earth's natural resources are slowly being depleted, America faces the daunting challenge of entering its next period of social innovation—environmental and energy innovation. Some scholars might suggest America, along with the rest of the world, is in the first stages of this period. Fears of global warming, increasing pollution, and rising oil prices have stimulated the first stages of an environmental and energy innovation period. In fact, "green" movements that promote hybrid cars, green grocery bags, and the energy efficient light bulb may be the beginning of this social innovation movement.

Underscoring the timeliness, importance, and urgency of innovation in environmental and energy sectors, is a March 23rd, 2009 Associated Press article.[1] This article highlights President Barack Obama's view that energy innovation is critical to the country's economic recovery. In President Obama's 2009 stimulus plan, $20 billion is set aside for tax incentives for clean energy alone. Another $19 billion is allocated to the Department of Energy. The timeliness and popularity of this topic is further emphasized by the fact that private companies, state governments, politicians and non-profit organizations have inundated cable television with commercials addressing energy and environmental innovation. A collection of these commercials can be found at http://www.youtube.com/user/statepotentialindex.

Still, important questions have to be answered. First, and probably most importantly, how can public administrators invigorate environmental and energy innovation? Which ideas are the most promising? Should these innovations be left to the private sector? Would government encouragement stimulate private sector innovation? If so, what are the best types of government encouragement? These questions are unique because America is faced with a monumental challenge. However,

[1] See: Associated Press – March 23, 2009, *President Obama links budget to environment; Pushes for clean energy*

this problem is not insurmountable given America's history and wherewithal in meeting such challenges.

No longer is America in the phase of asking the question, "Do we need to take action?" Instead, states and even the federal government have begun to notice the growing national interest for innovation in energy and the environment.[2] Unfortunately, a state's potential to stimulate environmental and energy innovation is unknown. To date, no studies measure the potential for a state to be innovative, specifically for energy and the environment. The construction of an index that measures state environmental and energy innovation potential would be useful for administrators and lawmakers. Both successful and weak states could be identified. The index, for example, could help administrators understand if Portland, Oregon has more innovative capability than Portland, Maine.

Governments at any level cannot take credit for most of the past innovations, as they have originated in basements, offices, and Universities. Nevertheless, public administrators can ask, "How can government assist in the innovation process?" State governments are now starting to ask that question, specifically about energy and the environment, primarily because the federal government has left states to shoulder this responsibility.

[2] See Spacek (2004) for a Texas State University Applied Research Project on Texas environmental/litter policies.

Policy shift to the states

States have been burdened with more policy responsibility in the past decade, especially policy involving energy and the environment.[3] With the onset of the Reagan administration's "new federalism" in the 1980s—with deregulation as the central focus—the federal government pressured individual states to be accountable for their own policies and expanded the states' role in policy decisions. According to Lester (1986), "new federalism," for better or worse, demands that states turn inward for solutions to their social and economic problems rather than turning to the federal government. As a result, states have begun to take their own initiatives for environmental and energy policy. On the other hand, because of the lack of federal coercion, some states fall behind on progressive environmental and energy policies.

Another concern with "new federalism" is the key policy objectives involved—decentralization and defunding (Lester 1986). Because of these two objectives, "an explosion of innovation and initiatives by state and local governments has occurred since 1980 under President Reagan's policy of cutting back in federal domestic programs and regulatory requirements enacted over more than half a century"(Herbers 1987). On the other hand, the lack of federal financial support has most likely reduced spending on the environmental protection activities (Lester 1986). A heavy decentralizing policy shift to the states leaves to question how much effort each individual state will give to environmental protection and energy. States usually identify more pressing policy priorities as healthcare, higher education, social

[3] See Texas State Applied Research Project by Danny Batts (2005) "Attitudes and Perceptions of County Legislators Regarding Their Influence Over the Formulation and Implementation of Environmental Policy" for a in depth look at environmental policy responsibility at the local level.

programs, economic development, or housing. This policy responsibility shift either fosters or inhibits environmental and energy innovation state by state.

Research Purpose

The purpose of this paper is to create an index ranking the 50 states based on environmental innovation *potential*. In other words, this research ***describes*** the factors that contribute to a state's potential for environmental and energy innovation. This research is important because there is no such index measuring innovation potential. Also, it should give policy makers, government officials, and the general public an understanding of which states are the most prepared to innovate in the environmental and energy domain. Lastly, it should clarify what objectives increase states' potential and ability to innovate for energy and the environment.

Chapter Overviews

Chapter 2 reviews the literature describing factors that contribute to a state's potential for environmental and energy innovation. Chapter 3 discusses the methodology used to develop the index. The fourth chapter presents the findings. Chapter five presents conclusions and suggests future direction for related research.

Chapter 2 Literature Review

One could argue the United States federal government has been relatively idle in its response toward energy and the environment. In response, individual states have been put to task with their own actions for innovative energy and environmental solutions. Some states have been more proactive than others. Currently, there are no scales that measure environmental and energy innovation. Since a concrete measurement of innovation is not available, a set of categories that measure the potential for a state to be innovative should be established. A careful examination of literature enables clarification of the energy and environmental innovations states consider when they undertake environmental or energy innovation. This chapter describes those key issues. The scholarly literature makes it possible to identify a framework for an index that ranks the states' efforts to produce energy and environmental innovations.

What is Environmental and Energy Innovation?

Before defining *environmental innovation*, the meaning of *innovation* should be established. Innovation can take many forms, for example—production, procedural, administrative or systemic. Estrada-Flores (2008) provides a useful definition of innovation:

> *deliberative processes by firms, governments and others that add value to the economy or society by generating or recognising potentially beneficial knowledge and using such knowledge to improve products, services, processes or organisational forms (p. 4).*

Environmental and energy innovations can take the form of pollution abatement methods, policy innovations, or perhaps, more importantly, *energy* innovation. Cary Coglianese, the Chair of the Regulatory Policy Program in the Harvard Kennedy School of Government, acknowledged in the opening remarks to the Multi-state Working Group on Environmental Innovation (2005), "the need for innovation in the environmental protection system is widely accepted even as the existing system is widely valued" (p.6). As a relatively new paradigm, environmental innovation is drawing attention, particularly because the need for newer and cleaner energy production is so acute.

Bernauer et al. (2006) assert that innovations in the environmental arena are unlike other forms of innovations because they not only create the typical research and development spillover effects but also create "positive externalities." In other words, they can reduce environmental costs, specifically the costs of production of products. "Positive externalities" is also labeled by Rennings (1998) as a "double externality effect." Research and development often produce positive externalities (or spillover benefits). Rennings (1998) goes on to say that "the special character of eco-innovation processes is that they develop products and services which themselves cause external benefits (or: a smaller amount of external costs compared to competing goods and services on the market)" (p.9). Krozer and Nentjes (2006) maintain environmental goals for sustainable development have to be met with ambitious and vigorous initiative policy objectives. Krozer and Nenjes (2006) names environmental innovation as the key for achieving these environmental goals. Three theoretical approaches are distinguished for improving environmental innovation: neoclassic theory, evolutionary theory, and behavioral theory of the firm (Krozer and Nentjes 2006).

According to Krozer and Nentjes (2006), the neoclassic approach views public sector failure that occurs where governments fail to take appropriate action which result in environmental scarcities are not signaled either in the price of pollution or regulations (2006). “Welfare losses from pollution are unintended consequences of failures in market organization and in public sector performance” (Krozer and Nenjes 2006, p.165). Neoclassic economics would suggest putting a price on pollution to stimulate incentives. This theory is closely related to laissez-faire economics, which is best associated with the ideas of Milton Friedman.

On the other hand, evolutionary theory views technological development as “a process of search for technical options that follows a specific path” (Krozer and Nenjes 2006, p.166) These specific paths are seen to be a system of interlinked technologies that can emerge as innovations in one sector and spread to the others, *evolving* as it spreads (Krozer and Nenjes 2006). “The message of evolutionary theory that decision-makers can choose cleaner technology is appealing as it suggests a steering capability” (2006, p.168). Evolutionary theory of economics has foundational roots leading back to the ideals of Karl Marx, Charles Darwin and American pragmatist philosophers such as John Dewey, Charles Peirce, and William James.

Finally, behavioral theory of the firm uses three key concepts: satisfying, organizational slack, and conflict solution (Krozer and Nenjes 2006). In short, *satisfying behavior* means objectives of a particular department can be seen as aspiration levels that are primarily determined by results achieved in the past (Krozer and Nenjes 2006). Herbert Simon and the term he coined as “satisficing” popularized this concept of decision-making. The *organizational slack* concept offers a buffer for competing departmental objectives and aspiration levels. If a clear objective is not achieved, then *conflict solution* by the department that didn’t reach the aspiration level is charged with creating the solution to help avoid direct confrontation (Krozer and Nenjes 2006).

Environmental[4] and Energy Innovation Potential

Since concrete data on the number of actual environmental and energy innovations does not exist, a way to measure potential should be developed. Hence, available literature on environmental and energy innovation is used to construct an index that ranks the states according to their potential to produce environmental and energy innovations. The categories of the index are structured by relevant literature. These are basic components of innovation, structured by the literature, to help define environmental and energy innovation. Each subsection justifies an element's inclusion in supporting concepts that best define environmental innovation. The categories[5] are:

- **Economy & Spending**
    - Research and Development
    - Environmental Spending
- **Incentives**
    - Financial Incentives for Renewable Energy
    - Financial Incentives for Energy Efficiency
    - Rules, Regulation, Policy Incentives
- **Regulation Stringency**
- **Renewable/Alternative Energy Production**
- **Venture Capital**

While the literature on innovation, alone, is generally broad, writing on innovation relating to energy and the environment is relatively focused. This review spotlights the

[4] See Gunn (2004) for an Applied Research project on environmental policy in Austin, TX.
[5] One category also fairly apparent in the literature is the measurement of U.S. Patent data. This component is not included because of the nature of patent data not being categorical to specific environmental or energy patents.

categories that make up a state's potential to innovate for energy and the environment. When available, examples are presented.

Economy & Spending

Money makes the world go around. How states spend money can help explain the states' priorities and will in turn help determine the environmental and energy innovation potential of a state. Program resources within each state are allocated on a priority basis that public officials accord to different issues and problems (Nathan 1996; Gray 1999; Jacoby and Schneider 2001). There are two common ways governments and private firms spend their money to promote environmental and energy innovation: research and development (R&D), and environmental spending.

<u>Research and Development</u>

While it is apparent that Research and Development (R&D) does not necessarily equate to innovation per se, R&D is necessary condition for innovation. A successful outcome does not always come about from R&D; however, there is usually a positive outcome because knowledge is usually gained (Estrada-Flores 2008). Additionally, Cohen and Levinthal (1989) state, "while R&D obviously generates innovations, it also develops the firm's [or government's] ability to identify, assimilate, and exploit knowledge from the environment—what we call a firm's 'learning' or 'absorptive' capacity" (p. 21).

A study by Guellec and Van Pottelsberghe (2001) examined and assessed the effect of government spending on R&D that is funded and performed by business. The study found financial support and/or incentives for R&D to businesses is more effective rather than government research itself.[6] Also, a highly cited to study by Levy and Terleckyj (1983) estimated that "for every $1.00 of government contract R&D performed in industry induced about $.27 of private R&D expenditure" (p.551).

As mentioned above, Cohen and Levinthal (1989, p. 594) suggest that there are two faces (dual roles) of R&D—new information and the enhancement of the firm's ability to assimilate and exploit existing information. Moreover, they argue "[the] recognition of the dual role of R&D also offers important implications for the analysis of the adoption and diffusion of innovations" (p. 594). For example, one important implication suggested by Cohen and Levinthal (1989) is innovation that is expressly capital embodied can be adopted at a much lower cost than more disembodied innovations as they require more pre-existing expertise an a particular area and more complementary efforts, internally. One more important implication suggested by Cohen and Levinthal (1989, p. 594) is that "a product innovation developed on the basis of a well established underlying knowledge base will diffuse more rapidly among users than one grounded in a more recently developed body of scientific or technological knowledge" (p. 594).

Jaffe and Palmer (1997) look at a narrower dimension, in which they discuss R&D devoted to environmental compliance. Their study discusses inconsistencies in their findings about regulation-inspired R&D and their ability to lead to lower costs of production or new innovations. The authors do suggest that if "environmental regulation-inspired R&D does increase productivity, then regulators may want to find a way to anticipate this benefit in their cost-benefit analyses of proposed environmental

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[6] Guellec and Van Pottelsberghe (2001) examine R&D as a whole and not specifically environmental R&D. The only component their study finds to not have a positive effect on business R&D is defense.

regulations" (p.18). In a later study, Jaffe et al (2002) argue that innovation, particularly at the invention stages, is accomplished principally in private firms through R&D. The literature strongly supports the idea that public R&D induces private R&D.[7] It thus follows there is more invention and innovation potential when public R&D expenditures are relatively high. This finding suggests that the potential for energy and environmental innovation is higher in states with greater relative expenditures on R&D.

Environmental Spending

Policymakers pass many environmental and energy policies; however, their obligation depends on dedicated resources that support those policies. Scholars have studied the relationship between environmental problems, political pressure, and spending on the environment. Bacot and Dawes (1997) evaluate state environmental management comparing spending and ranking measures for environmental effort. In their study, they find pollution output and the size of the state are the primary factors affecting the *environmental effort* of a state. On the other hand, Newmark and Witko (1996) examine aggregate spending and spending in several policy areas relating to the environment using multiple indicators of environmental problems. In other words, the authors study how the specific environmental problems affect spending in related areas. The authors conclude spending on the environment and/or natural resources is steadily influenced by the vigor of that state's environmental movement (Newmark and Witko 2007). To estimate the strength of the environmental movement in a state, this study uses the method used by Hall and Kerr (1991), which measures the number of members in various environmental groups per 1,000 residents.

[7] See for example David, Hall and Toole 2000; Guellec and Van Pottelsberghe 2001; Levy and Terleckyj 1983; Jaffe et al. 2002.

Environmental spending at the state or federal level can be a determinant of many different things such as environmental commitment, policy priority, or compliance efficiency. Literature[8] suggests a state's willingness to spend is also a good measurement and determination of *innovation willingness*.[9] According to DeWitt (1994), "virtually all states have taken some steps to go beyond federally imposed requirements, and some have taken the lead in several areas…. States seem to be more willing than the federal government to increase spending on environmental protection" (p. 80). Hahn and Stavins (1991) discuss economic "dynamic incentives" where "the effect of public policies on technological change may be among the most important determinants of success in environmental protection" (p. 10). In addition, Walley and Whitehead (1994) suggest state environmental challenges have always been expensive and difficult.

There is a commonality in the literature that suggests spending is a component of determining policy priority. Also, according to the literature, policy priority is a clear indication of a state's commitment to that area of government. Jacoby and Schneider (2001) define policy priorities as "the component of government decision making in which public officials allocate scarce resources, in the form of expenditures, to different program areas" [10] (p. 545).

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[8] See: Hahn and Stavins (1991), DeWitt (1994), Walley and Whitehead (1994)

[9] Innovation willingness refers to the individual state's willingness to produce innovation in any capacity. An indirect connection is made that environmental spending captures policy priority in which this study later hypothesizes is a determinant for successful innovation standings.

[10] For example, the policy priority differences between Hawaii and Kansas would be strikingly different, merely on geographical differences between the two states.

Incentives[11]

While it is clear spending demonstrates a policy priority, other ways of measuring a state's priorities examine the financial incentives offered. Incentives, by definition, encourage or motivate an action or person(s). In a report by the *Multi State Working Group on Environmental Performance (2005),* participants in a dialogue on environmental innovation noted the importance of incentives. Specifically, the report highlights that "state and federal innovative environmental incentive programs have improved environmental performance" (p. 2). Similarly, Scotchmer (2004) argues producing innovation, at any level, necessitates that government incentives help fund the work. According to Scotchmer, "if research leads to widespread benefits for citizens, governments may have an incentive to invest as part of their legitimate missions" (p. 2). In other words, innovation, in the long run, is an important investment and should be encouraged through financial and policy incentives. There are three main categories of incentives related to environmental and energy innovation: 1) financial incentives for renewable energy, 2) financial incentives for energy efficiency, and 3) rules, regulation, and policy incentives for energy efficiency.

Financial Incentives for Renewable Energy

Finding new and more efficient ways to produce renewable energy is an obvious innovative process. Consequently, governments that incentivize the production of renewable energy are clearly placing a higher priority on environmental innovation. "While the rationale for government intervention is strong, the ability of governments

[11] See Texas State Applied Research project by Chance Sparks (2007) "*Greening Affordable Housing: An Assessment of Housing under the Community Development Block Grant and HOME Investment Partnership Programs*" for an applied example of a Texas incentive based program.

to effectively promote technology innovation for commercial goods, such as power-generation technology, remains a daunting challenge" (Norberg-Bohm 2000, p.#). Fischer and Newell (2004) present five incentive based policies to support renewable energy: "generation subsidies for renewable energy, taxes on fossil fuel energy, portfolio standards, tradable performance standard, and subsidies for R&D"[12] (p. 5-6).

There are several other types of incentives available at all levels of government.[13] A rich collection of literature has examined the effectiveness of incentivizing practices such as using or installing renewable energy sources. While much of the literature suggests that tax credit programs, specifically, can decrease investment[14], Hassett and Metcalf (1995) argue that when controlling for fixed effects[15], tax incentives are significant and do enhance the probability of devoting resources in energy-efficient capital, which includes renewable energy. Examples of these incentives are: *personal tax, corporate tax, sales tax, property tax, rebates, grants* and *production incentives*.[16] Table 2.1 illustrates how these types of incentives are applied. Their label categorizes them by federal, state, local, and utility.

[12] Fischer and Newell (2004) initially present six policies. However, one policy pertains to climate change policy and not renewable energy.

[13] Some of these incentives overlap with Fischer and Newell's (2004) suggestions for promoting technology innovation for renewable energy.

[14] This opposite effect is described by Hassett and Metcalf (1995) as the "energy paradox" (EP) – "the seeming anomaly that very unattractive investment opportunities in energy-efficient capital, opportunities with high ex ante rates of return, are routinely passed up by investors." (p. 202) See also, for example, Williams and Ross (1980), Carlsmith et al (1990) and Sutherland (1991).

[15] Previous to this study, this control had not been included.

[16] The scope of this paper does not look at *loans, industry support*, or *bonds*, all of which are other types of incentives.

Table 2.1 – Financial Incentives for Renewable Energy

Incentive	Type	Label
26 USC § 45 - The federal Renewable Electricity Production Tax Credit (PTC) is a per-kilowatt-hour tax credit for electricity generated by qualified energy resources and sold by the taxpayer to an unrelated person during the taxable year.	Corporate Tax Credit	**Federal** (All States)
A.R.S. §43-1085 - The tax credit is equal to 10% of the installed cost of qualified "solar energy devices" and applies to taxable years beginning January 1, 2006 and extending through December 31, 2012.	Personal Tax Credit	**State** (Arizona)
Ordinance No. 7487 - In 2006, the City of Boulder established a solar sales and use tax rebate for photovoltaic (PV) and solar water heating installations. PV owners may receive a rebate (essentially a tax refund) drawn from the unrestricted tax revenues collected from solar energy sales.	Sales Tax Credit	**Local** (Boulder, CO)
Md Code: Property Tax § 9-242 - This statute allows counties and municipalities to provide a credit against the property tax for buildings which achieve at least a silver rating according to the U.S. Green Building Council's LEED* standards, or which meet other comparable green building guidelines or standards approved by the State.	Property Tax Credit	**State** (Maryland)
Rebate Program - Rebates for renewable-energy systems are available to residential and small commercial customers of all Wisconsin Public Power, Inc. (WPPI) utilities, including Independence Light & Power. Customers must reside in the service territory of the participating utility, and the system must be installed on the customer's property.	Utility Rebate Program	**Utility** (Wisconsin) (Public Power, Inc. WPPI utilities)
BEF Grant Program - Any private person, organization, local or tribal government located in the Pacific Northwest may participate. Projects that generate electricity are preferred. Acceptable projects include solar photovoltaics, solar thermal electric, wind, hydro, biomass and animal waste-to-energy.	Grants	**State** (Pacific Northwest) (Bonneville Environmental Foundation)
Production Incentive Program - Participating power distributors in TVA's Green Power Switch Generation Partners program offer production-based incentives for solar photovoltaics (PV) and wind projects to residential/small-commercial customers and incentives for PV projects to large commercial customers. The energy generated from participating projects will be counted toward the green power resources for TVA's green pricing program, *Green Power Switch*.	Production Incentive	**State** (Tennessee)

(Information compiled from: Database of State Incentives for Renewables & Efficiency - http://www.dsireusa.org/. State and local statutes are also found in that particular state or locality's code of laws.)

As shown above, all states have a federal incentive in the form of a corporate tax credit for renewable electricity production. At the state level, for example, Arizona has a tax credit for solar energy, which equals to 10% of the cost of the installation of solar devices. In Boulder, Colorado a local tax incentive in the form of a sales and use tax credit for, specifically, solar water heater use. In the Pacific Northwest, qualifying projects that produce energy using solar, photovoltaics, solar, wind, hydro, biomass and animal waste-to-energy are eligible for grant incentives.

Financial Incentives for Energy Efficiency

Financial incentives for energy efficiency can encourage better, more innovative ways to save energy. While the federal government plays a strong role in R&D and assistance to the states for efficiency objectives, governments at the state level play an integral role in addressing energy use and the arrangement of energy efficiency procedures (Brown et al. 2002). Given their fundamental role, states should make decisions that either address energy use or implement efficiency measures. Price et al. (2005) points out decisions to purchase energy-efficient technologies are primarily based on the cost of the technology rather than their expected cost savings from using the technology. Based on this rationale, tax relief for technology that promotes energy efficiency may actually be more useful than taxing energy per se (Price et al., 2005). However, De Beer (2000) cautions that these tax relief mechanisms have to be designed to avoid relief for technologies that are already established and profitable to avoid "free riders". Brown et al (2002) argues that tax credits have broader implications than just that of energy savings. Benefits of tax incentive programs are not limited to the pursuit of quality energy efficiency, but also extend to residents, state economies, and the environment (Brown et al 2002).

Most of the incentives for energy efficiency take the form of tax credits, rebates, grants, and loans.[17] For energy efficiency, there are also three main sources (Federal, State and Utility). Brown asserts that for short run benefits, incentive programs can increase the market share of a newer technology or practices that would otherwise be significantly harder to find by states and energy sources (Brown et al 2002). Table 2.2 presents applied examples of incentives that promote energy efficiency in some capacity.

[17] Bonds are also considered incentives, but they are not as common.

Table 2.2 - Financial Incentives for Energy Efficiency

Incentive	Type	Label
26 USC § 45L - The federal Energy Policy Act of 2005 established tax credits of up to $2,000 for builders of all new energy-efficient homes, including manufactured homes constructed in accordance with the Federal Manufactured Homes Construction and Safety Standards.	**Corporate Tax Credit**	**Federal** (All States)
NY CLS Tax, Article 1, § 19 - Green Building Tax Credit for business and personal income taxpayers. The credit can be applied against corporate taxes, personal income, insurance corporation taxes and banking corporation taxes. The incentive applies to owners and tenants of eligible buildings and tenant spaces, which meet certain "green" standards.	**Personal Tax Credit**	**State** (New York)
Conn. Gen. Stat. § 12-412k - Compact fluorescent light bulbs and certain "residential weatherization products" are exempt from the state sales and use tax.	**Sales Tax Credit**	**State** (Connecticut)
NRS § 701A.110 - partial abatement of property taxes for property that has a building or structure that meets or exceeds the United States Green Building Council's LEED* Silver rating system.	**Property Tax Credit**	**State** (Nevada)
Utility Rebate Program - Rebates are available for qualified dishwashers, clothes washers, air conditioners (central and room), ceiling fans with lighting, light fixtures (e.g., torchieres, hard-wired CFLs), heat pumps (air and ground source), dehumidifiers, refrigerators, and freezers.	**Rebates**	**Utility** (Minnesota, Blooming Prairie)
7 USC § 8106 - (1) grants and loan guarantees for energy efficiency improvements and renewable energy systems, and (2) grants for energy audits and renewable energy development assistance.	**Grants**	**Federal** (All States)
Utility Loan Program - City of Ashland Conservation Division has zero-interest loans to help its residential customers finance energy efficiency improvements to their homes.	**Loans**	**Utility** (Ashland, Oregon)

(Information compiled from: Database of State Incentives for Renewables & Efficiency - http://www.dsireusa.org/. State and local statutes are also found in that particular state or locality's code of laws.)

Green building programs, shown above, encourage resource efficiency and building practices that are sustainable which, in turn, make buildings fit for people and the environment (Brown et al 2002). Connecticut offers a tax incentive that eliminates sales and use taxes for compact florescent light bulbs and other "residential weatherization products". The city of Ashland, Oregon has made available zero-interest loans to help residential customers finance energy efficiency improvements to their own homes.

<u>Rules, Regulation, Policy Incentives</u>

Non-financial energy efficiency incentives can be found in a wide array of rules, regulations, and policies. The most discussed incentives relevant to this study's scope are: *public benefit funds, net metering, renewable portfolio standards* and *access laws*.[18] These types of incentives encourage energy efficiency and renewable energy that can motivate citizens and businesses to create cheaper or more efficient means of meeting the standards.

All of these incentives enhance the potential for environmental and energy innovation by advancing energy efficiency and promoting renewable energy technologies. Drawing on an historical perspective, Kushler and Nadal (2000) identify *public benefit funds* as a key strategy for advancing energy efficiency. Historically, as these public benefit fund programs' "reach and size grew.. [they] came to have a noticeable impact on electricity sales and peak demand, as well as utility budgets" (p. 1). Their inclusive study concludes that public benefit funds have a broad picture of success (Kushler and Nadal 2000).

"Net metering programs can be an appealing policy option for advancing renewable energy technologies." (Wan and Green 1998) Net metering programs represent "a simple, low-cost, and easily-administered method for encouraging direct customer investment in small-scale renewables" (Starrs 1996, p. 10). While the

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[18] There are other rules, regulations, and policies that can be considered incentive based. They include: *generation disclosure rates, interconnection standards, line extension analysis requirements, contractor licensing requirements* and *green power purchasing*. The literature available suggests that *public benefit funds*, *net metering*, *renewable portfolio standards* and *access laws* are the most relevant.

consensus of literature is that net metering programs are positive policies, there are still concerns of facing obstacles and uncertainties with these net metering programs. For example, “interconnection, liability insurance, and indemnification requirements demanded by utilities discourage net metering customers” (Wan and Green 1998, p. 7).

Renewable portfolio standards (RPS) “require utilities to use renewable energy or renewable energy credits (RECs) to account for a certain percentage of their retail electricity sales—or certain amount of generating capacity—within a specified timeframe (DSIREUSA 2008). A broad study by Wiser et al (2005) concludes, of the thirteen state RPS policies,[19] experience derived from these programs reveal that a solidly built and execution of RPS policies can provide ample stability for renewable energy.[20] An assumption that RPS programs are effective can be made. Literature suggests, however, implemented RPS programs may not be a mature enough to properly evaluate results (Berry and Jaccard 2000; Wiser et al., 2005).

Last, access laws (specifically solar and wind access) “are designed to protect a consumer’s right to install and operate a solar or wind energy system at a home or business”(DSIREUSA 2008). Literature on access laws, specifically relating to solar and wind access, is seemingly absent. Given the scope of this study, however, it is important to consider this variable as a significant incentive. Table 2.3 shows applied examples of each of these four incentives.

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[19] Thirteen states operated RPS programs at the time of their study.
[20] Wiser et al (2004) also comments on Texas’ approach being the most successful so far in driving new renewable capacity at reasonable cost.

Table 2.3 – Rules, Regulation, and Policy Incentives

Incentive	Type	Label
Public Benefit Fund – (Legisl. AB 1890) -California's 1996 electric industry restructuring legislation (AB 1890) directed the state's three major investor-owned utilities (Southern California Edison, Pacific Gas and Electric Company, and San Diego Gas & Electric) to collect a "public goods surcharge" on ratepayer electricity use from 1998 through 2001 to create public benefits funds for renewable energy ($540 million), energy efficiency ($872 million), and research, development & demonstration (RD&D) ($62.5 million).	**Public Benefit Funds**	**State** (California)
Policy No. 10.95 - The St. George City Council adopted a net-metering program in October 2005.* Net metering is available to residential and commercial customers that generate electricity using photovoltaic (PV) systems or wind-energy systems up to ten kilowatts (kW) in capacity. The utility will provide a single, bidirectional meter. Customers are credited for excess generation at the same rate as charged, unless at the end of a continuous 12 month period customers have generated an excess amount of kWh.	**Net Metering**	**Local** (St. George, Utah)
RPS - In 2003 San Antonio's municipal electric utility, City Public Service (CPS Energy) established a goal of meeting 15% of its electrical peak demand with renewable energy by 2020 under its Strategic Energy Plan. In June 2008 the utility announced plans to increase the overall renewables target to 20% by 2020 with at least 100 megawatts (MW) from non-wind renewable energy sources.	**Renewable Portfolio Standards**	**Utility** (San Antonio, TX)
NY CLS Real Property, Article 9 § 335-b - New York's real property laws allow for the creation of solar easements. Like those in many other states, these are voluntary contracts which must be entered into in order to ensure uninterrupted solar access for solar energy devices.	**Access Laws**	**State** (New York)

(Information compiled from: Database of State Incentives for Renewables & Efficiency - http://www.dsireusa.org/. State and local statutes are also found in that particular state or locality's code of laws.)

As shown in table 2.3, California has a Public Benefit Fund that directs the state's three major investor-owned utilities to collect a "public goods surcharge" on ratepayer electricity use to create a public benefit fund for renewable energy, energy efficiency, and R&D. At the local level, the city of St. George, Utah implemented a net-metering program, which credits customers that generate extra photovoltaic energy. Also shown above, CPS Energy in San Antonio, Texas established a renewable portfolio standard with a goal of meeting 15% of its electrical peak demand with renewable energy by 2020.

Regulation Stringency

The stringency of environmental and energy regulations can be another good indicator of the policy priorities of states. An influential study by Porter and Van der Linde (1995) provides the primary foundation of debate concerning environmental regulation stringency.[21] They trigger a vigorous discussion in later literature by popularizing a concept known as "win-win proposition".[22] Porter and Van der Linde and other[23] "win-win" theorists believe regulation presents a win-win situation for all parties involved. Specific to environmental innovation, they argue "regulation focused on information gathering can achieve major benefits by raising corporate awareness"(1995, p. 100). Moreover, they explain, "regulation reduces the uncertainty that investments to address the environment will be valuable. Greater certainty encourages investment in any area" (1995, p. 100). By using the "win-win" concept, Jaffe et al. (2002) speculates that regulation may also lead to "innovation offsets". These offsets, often times, lower the cost of complying with environmental regulations as well as show the way to the greatest advantages over foreign firms that are not held accountable by similar regulations (Porter and van der Linde 1995; Jaffe et al. 2002).

Numerous studies test the win-win model. Karagozoglu and Lindell (2000), for example, examine the core variables in the win-win model—regulatory factors, environmental strategy, and environmental innovativeness. While this study's findings fail to support the thesis that regulatory influences on a particular entity will lead to

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[21] Scholar (accessed Nov. 26th, 2008) lists this particular article (Porter and van der Linde, 1995) as being cited 1272 times.
[22] This paper does not evaluate or take a stance on either side of the "win-win" proposition—instead, this paper identifies stringency policies that are consistent with promoting environmental innovation.
[23] See for example: Porter and van der Linde (1995); Jaffe et al. (1997); Gardiner (1994); Meyer (1993)

environmental innovativeness, the authors maintain that when regulatory influences are combined with a progressive environmental strategy, a better indicator of environmental innovativeness[24] will be produced. (Karagozoglu and Lindell 2000).

<u>Building Codes</u>

Building codes[25] are an important part of regulation stringency, particularly because builders at the residential and commercial level play a vital role in the infrastructure development of energy systems. Building codes for residential and commercial settings can be far reaching; however, this paper will only examine environmental and energy related building codes. These types of building codes can be seen as indirect incentives because they require a certain level of green production, which may currently be expensive. Research into meeting the codes with a more cost efficient alternative (the innovation) is spurred, in turn, increasing use more widely.

Builders and planners alike many times find regulations (specifically, building codes) arduous and unnecessary (Gann et al. 1998). Gann et al. (1998), however, contends that regulations that include types of performance standards can motivate or suppress innovation. In fact, Gann et al. (1998) argues the poor record of industry investment in new technology is one reason for government intervention. Different from *product* innovation, *process* innovation is a method of inducing innovation through new ways of building or designing during construction (Gann et al. 1998). More important is a concept known as *systemic* innovation, which can occur when one

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[24] This finding is important, as it does not examine stringency on an individual basis for determining environmental innovativeness, but attempts to capture stringency in addition to progressive environmental strategies.
[25] See Dai et al. (2009) for a review of energy efficient planning in government buildings.

component of the whole cannot be changed without changing one or many other components, primarily because they are interconnected (Gann et al. 1998).

Environmental Commitment [26]

The basic commitment a state has to the environment can help explain how willing they are to innovate. Some studies use state expenditures to explain overall "effort" or commitment (Bacot and Dawes 1997). One influential study by Hays et al. (1996) examined variation in state commitment to protecting the environment. In this comprehensive study, the authors' methodology for explaining commitment is a list of six basic approaches: *environmental conditions, economic resources, political pressure, federal activity, elite ideology* and *institutional characteristics* (Hays et al. 1996).

For *environmental conditions*, Hays et al. (1996) focus on the severity of the states' environmental problems. The Hays et al. (1996) study concludes that states with dense populations, heavy manufacturing outputs, and larger populations generally have higher commitments to the environment. *Economic resources* help establish the array of options that are available to each state, particularly in different policy areas. The Hays et al. (1996) study showed that state GDP and the calculation of the state's debt burden should indicate their environmental protection will. *Political pressure* within a state can also identify the commitment to policy areas. In this case, the authors use Erikson, Wright and McIver's (1993) public opinion measure and examine environmental interest group activity.

[26] This study does not directly operationalize or measure environmental commitment because the nature of the other variables help make up the general commitment to the environment; however, it is important to note the factors that are defined by the literature making up environmental commitment.

Federal activity (grants and enforcement) can push state policymakers. Erikson, Wright and McIver (1993) relied on the idea that more liberal states usually require less federal coercive power regarding environmental concerns; more conservative states tend to be pressured by the federal government, therefore, sometimes receiving more pressure (Hays et al. 1996).

Concerning *elite ideology*, "the political elites approach assumes that the preferences of policymakers represent important independent influences on their decisions about environmental policy" (Hays et al. 1996, p. 49). Finally, Hays et al. (1996) discusses "institutional characteristics" in which they assume more professional government officials and policymakers help explain a states commitment to the environment. The authors identify "organization theory" and "new institutionalism" as the driving basis for this approach and use a legislative professionalism factor score to measure the level of professionalism (Hays et al. 1996).

Renewable/Alternative Energy Production

The next category used to determine a state's energy and environmental innovation potential is the production of renewable and alternative energy. The role of renewable energy is essential to innovation, environmental perspectives, and energy solutions and can be a clear measure of a state's potential to produce environmental and energy innovations. The U.S. Energy Information Administration defines renewable energy as:

> energy sources that are naturally replenishing but flow limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy sources include: biomass, hydro, geothermal, solar, wind, ocean thermal, wave action and tidal action. [27]

[27] http://www.eia.doe.gov/

The literature[28] about renewable energy as a measure of innovation is lacking. Fortunately existing literature demonstrates the importance of renewables and the relationship they have with innovations. Hence, there is support for using state production of renewable or alternative energy as a measurement for energy and environmental potential.

Smith (2007) writes in *The Environmental Policy Paradox*, "Energy experts are in agreement that a transition from fossil fuel dependence to renewable sources of energy is inevitable" (p. 149). Smith (2007) describes four main renewable energy sources in his book: hydroelectric, solar, wind and biomass. As newer technology continues to develop, there will certainly be financial risks. Combating these financial risks requires sustained research, projects, and experiments that can burden governments at start up; however, after the start up phase private firms share more of the costs as the project foresees completion (Smith 2007).

From an environmental perspective, the production of energy is the chief source of pollution. The US has had renewable energy technologies nearly thirty years. As a relatively new substantive form of energy, renewables, are created (and continue to be improved) through innovation. McVeigh et al. (1999)[29] attribute negative perceptions of renewable energy as the reason renewable energy policy has not taken root in America. The authors suggest two ways of using performance to measure the success of renewable technologies: 1) their performance related to renewable contribution meeting demand, and 2) their performance related to cost projections (McVeigh et al

[28] Smith (2007), McVeigh et al. (1999)

[29] It should be noted this article is presented as a scientific discussion paper for the purpose of information and discussion.

1999). McVeigh et al (1999) conclude by arguing financial incentives for technologies promoting renewable energy, particularly in the public-sector, can be seen as a safety measure to combat high energy prices, concerns about the environment, and vulnerability.

Venture Capital

Venture capital is the final category in the innovation potential index. Venture capital is defined as investments for innovative enterprises that may be risky and has a potentially high-yielding return. In terms of government venture capital, Borins (2001) assert, "[v]enture capital provides a dynamic and readily available source of funding to seed innovative initiatives, while compensation through share ownership enables startup firms, their investors, their employees, and, increasingly, their suppliers to reap large financial rewards from this activity" (p. 311).

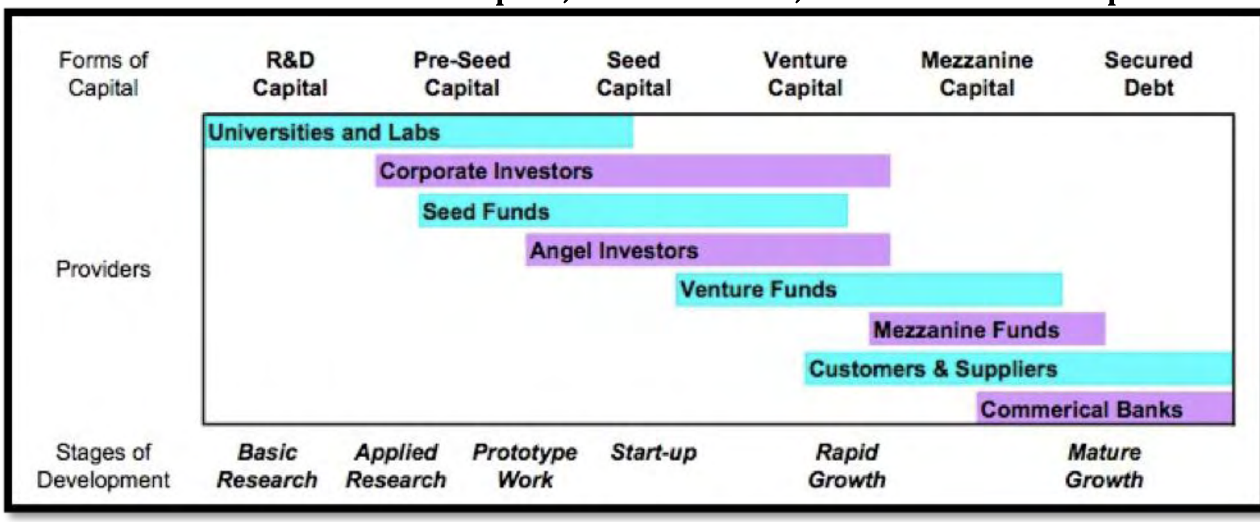
Kortum and Lerner (1998) empirically examine the impact of venture capital on innovation using industry and firm-level data. They found, taking into account patenting patterns, venture capital had a very significant effect on technological innovation. In fact, Kortum and Lerner (1998) forecast a wave of innovative activity resulting from a jump in venture capital disbursements taking place at the time (mid-nineties). Additionally, literature suggests that venture capital dollars are particularly useful for start-up costs of new companies attempting to perform innovatively.[30]

There are many different forms of capital, as perhaps best defined by a 2006 report on seed and venture capital by the National Association of Seed and Venture Funds (NASVF). The NASVF study defines the basic forms of risk capital as: R&D capital,

[30] See: Kortum and Lerner (1998); Borins (2001); Keuschnigg (2003); Niosi (2000)

pre-seed capital, seed capital, venture capital, mezzanine capital, and secured debt. Table 2.4 illustrates the basic forms of risk capital, how it is delivered, and overlaps.

Table 2.4 – Basic Forms of Risk Capital, How Delivered, and Forms of Overlap



(Source: NASVF Report on Seed and Venture Capital, State Experiences and Options, May 2006)

Universities and Labs, for example, use R&D capital, pre-seed capital, and seed capital for 4 main stages of development—basic research, applied research, prototype work, and start-up. On the other hand, Table 2.4 shows that commercial banks only use mezzanine capital and secured debt in the mature growth stage of development.

NASVF (2006) also defines these labels. R&D capital is aimed at supporting basic research. Pre-seed capital is intended for research and support of new product development. Seed Capital investment helps with operations, new product launches, and continuing R&D for young companies. Venture Capital is long-term capital in widely expanding enterprises that have an expectation of gains in innovation. Mezzanine Capital is investment in a structure involving debt in established companies.

Universities and research laboratories are perhaps one of the most important enablers and users of venture capital investments. Since universities play such a large role in the cycle of venture capital and innovation, the next section details the role of universities and laboratories.

Research Universities

An important component of venture capital is the use of universities and labs. Much of venture capital investments go to research universities. Keuschnigg (2003) points out that "the VC [venture capital] industry tends to be geographically concentrated in the neighborhood of universities and other centers of basic research" (pg. 3). Further, research universities play an "important role as a source of fundamental knowledge and, occasionally, industrially relevant technology in modern knowledge-based economies" (Mowery and Sampat 2005, p. 1). In addition "universities play important roles in the 'knowledge-based' economies of modern industrial and industrializing states as sources of trained 'knowledge workers' and ideas flowing from both basic and more applied research activities" (Mowery and Sampat 2005, p. 26). For these reasons, the inclusion of this category is important to the scale construction for the energy and environmental innovation *potential* of a state.

The Bayh-Dole Act in 1980 started a new era for the ways research universities influence innovation, specifically stronger collaborations with technology diffusions (Mowery and Sampat, 2005). The Bayh-Dole act gave universities, small businesses, and research based non-profit groups intellectual property rights or control over their inventions and other intellectual property resulting from public funding. Mowery and Ziedonis (2002) examines the academic patent quality and quantity before and after the

Bayh-Dole act. They concluded US universities have significantly "expanded their programs to patent and license the results of federally and industrially-funded research" (2002).

The literature[31] also suggests that American universities have traditionally been autonomous in nature, which, in turn, has allowed for the fostering of entrepreneurial focuses. Furthermore, Mowery and Sampat (2005) note universities have started to enact policies that strengthen the way research universities enhance the commercialization of industrial technology. These types of policies have also encouraged regional compacts (or clusters) such as Silicon Valley in California and the Research Triangle in North Carolina.

Conceptual Framework

The purpose of this research is to describe the components that contribute to a state's potential for environmental and energy innovation. These components become the *descriptive categories* of a conceptual framework.[32] These descriptive categories allow for a framework to organize what can often be a "complex and multifaceted nature of public management and policy" (Shields and Tajalli 2006, p. 25). A review of the scholarly literature produced categories and sub categories that describe environmental and energy innovation. The categories and associated literature are summarized in Table 2.5.

[31] See: Rosenberg (1999), Ben-David (1968), Mowery and Ziedonis (2002), Mowery and Sampat (2005)
[32] See: Shields (1998)

Table 2.5 – Conceptual Framework linked to Literature

Descriptive Categories	Literature
Economy and Spending	Nathan (1996), Gray (1999), Jacoby and Schneider (2001)
Research and Development (R&D)	Estrada-Flores (2008), Cohen and Levinthal (1989), Guellec and Van Pottelsberghe (2001), Levy and Terleckyj (1983), David et al. (2000), Jaffe and Palmer (1997), Jaffe et al (2002),
Environmental Spending	Bacot and Dawes (1997), Newmark and Witko (1996), Hall and Kerr (1991), DeWitt (1994), Hahn and Stavins (1991), Walley and Whitehead (1994), Jacoby and Schneider (2001)
Incentives	Scotchmer (2004), Multistate (2005), Sparks (2007)
Incentives for Renewable Energy	Norberg-Bohm (2000), Fischer and Newell (2004), Hassett and Metcalf (1995), Williams and Ross (1980), Carlsmith et al. (1990), Sutherland (1991), DSIREUSA (2008)
Incentives for Energy Efficiency	Brown et al (2002), Price et al. (2005), De Beer (2000),
Rules, Regulations, Policy Incentives for Energy Efficiency	Kushler and Nadal (2000), Wan and Green (1998), Starrs (1996), Wiser et al (2005), DSIREUSA (2008), Berry and Jaccard 2000
Regulation Stringency	Porter and van der Linde (1995), Jaffe et al (2002), Karagozoglu and Lindell (2000), Gardiner (1994), Meyer (1993)
Building Codes	Gann et al (1998), Dai et al. (2009)
Renewable Energy	Smith (2007), McVeigh et al (1999)
Venture Capital	Ben-David (1968), Borins (2001), Mowery and Ziedonis (2002), Kortum and Lerner (1998), Niosi (2000), NASVF (2006) , Niosi (2000), Keuschnigg (2003)
Research Universities	Ben-David (1968), Mowery and Sampat (2005), Mowery and Ziedonis (2002), Keuschnigg (2003), Rosenberg (1999)

Summary

This review identified the key issues that make up environmental and energy innovation. Not only do these key issues help define environmental and energy innovation, they also provide a framework that allows for a construction of an index to evaluate a state's potential to produce environmental and energy innovation. The issues presented are: economy and spending, research and development, environmental spending, incentives, incentives for renewable energy, incentives for energy efficiency, rules/regulations/policy incentives for energy efficiency, regulation stringency, building codes, renewable energy, and environmental commitment.

Chapter 3 Methodology

This chapter describes the steps taken to rank each state in environmental and energy innovation potential. The primary method used in this study is the analysis of existing data. Each component and sub-component that makes up the conceptual framework is operationalized in order to construct the scale. Table 3.1 depicts the operationalization of the innovation potential index. It identifies each component (e.g., economy and spending, incentives, stringency) and explains how the components are measured and weighted. In addition, the data sources (e.g., National Science Foundation, Environmental Council of the States) are cited.

The remainder of the chapter explains how the index is weighted and shows the state-by-state value and meaning of the variables that make up the index.

Table 3.1: Operationalization of the Conceptual Framework

Descriptive Categories	Measurement	Weight	Source
Economy and Spending			
Research and Development (R&D)	State renewable energy R&D expenditures (Per Capita)	5 pts. (12.5%)	National Science Foundation (State Agency Research and Development Expenditures: Fiscal Year 2006)
Environmental Spending	State environmental spending (Per Capita)	5 pts. (12.5%)	Environmental Council of the States (ECOS) (State Environmental Expenditures, 2005-2008)
Incentives			
Incentives for Renewable Energy	***Incentives** by category*: federal, state, local, non-profit, utility	4 pts. (10%)	Database of State Incentives for Renewables & Efficiency (North Carolina State University http://www.dsireusa.org/)
Incentives for Energy Efficiency	***Incentives** by category*: federal, state, utility	4 pts. (10%)	Database of State Incentives for Renewables & Efficiency (North Carolina State University http://www.dsireusa.org/)
Rules, Regulations, Policy Incentives	***Incentives** by category*: state, local, utility	4 pts. (10%)	Database of State Incentives for Renewables & Efficiency (North Carolina State University http://www.dsireusa.org/)
Regulation Stringency			
Building Codes	**Stringency and Compliance Efforts Scoring** – *State score: 1 – 5* (Scoring methodology as prescribed in 2008 ACEEE scorecard)	6 pts. (15%)	2008 Energy Efficiency Scorecard (American Council for an Energy-Efficient Economy's energy efficiency scorecard)
Renewable Energy			
Energy Production	State output (Per Capita)	6 pts. (15%)	Energy Information Administration (http://www.eia.doe.gov/)
Venture Capital			
Venture Capital Spending	Venture Capital expenditures (Per Capita)	6 pts. (15%)	New State Economy Index (2008)
	Weight Total	40 pts. (100%)	

Index Construction

Indices use many variables, or indicators, and are useful when theoretical concepts need to be related and "single, unambiguous, direct, operational definitions" do not exist (McCally 1996). This study operationalizes the categories mentioned in the literature review chapter. Those categories are: research and development; environmental spending; incentives for renewable energy; incentives for energy efficiency; rules, regulations, and policy incentives; regulation stringency; renewable energy production; and venture capital. The formula for the index, organized by weight groups, is presented below:

$$I_p = \sum \left\{ \begin{array}{l} \left[\dfrac{40X_1(.125)}{X_1^{\max}} + \dfrac{40X_2(.125)}{X_2^{\max}} \right] \\ + \left[\dfrac{40X_3(.10)}{X_3^{\max}} + \dfrac{40X_4(.10)}{X_4^{\max}} + \dfrac{40X_5(.10)}{X_5^{\max}} \right] \\ + \left[\dfrac{40X_6(.15)}{X_6^{\max}} + \dfrac{40X_7(.15)}{X_7^{\max}} + \dfrac{40X_8(.15)}{X_8^{\max}} \right] \end{array} \right\}$$

Where:
I_p = State Innovation Potential
X_1 = Renewable Energy Research and Development (R&D)
X_2 = Environmental Spending
X_3 = Incentives for Renewable Energy
X_4 = Incentives for Energy Efficiency
X_5 = Rules, Regulation, and Policy Incentives
X_6 = Regulation Stringency
X_7 = Renewable Energy Production
X_8 = Venture Capital Expenditure
$X_i^{\max}$ = Maximum category weight

The index is constructed using the combined scores of all eight categories (see: Appendix A). The weights of the individual categories were assigned according to the perceived importance found from the literature. The maximum value of 40 makes it possible to assign single digit scores for each category. The number 40 was chosen arbitrarily. The sources, definitions, weighting and scoring methodology of the operationalized measurements are presented below.

Research and Development (R&D)

The most current data available (FY2006) were used in the construction of this index. The National Priorities Project Database[33] collected expenditure data from the Census Bureau's *Consolidated Federal Funds Report*[34] in the following areas: renewable energy R&D; regional biomass energy programs; solar energy partnership support and barrier elimination; and geothermal technologies R&D. The original data, collected by the National Priorities Database, were captured in expenditures dollar (thousands).

In constructing the index, these R&D expenditure amounts were divided by the population of the state, giving a per capita dollar amount, as shown in Table 3.2. This per capita conversion is important because expenditure spending between states with high populations and states with lower populations is equalized. For example, Alaska has a particularly low population compared with New York, so the data should account for this population difference. Examining the dollar amount per capita, instead of full state expenditures, allows for a fair analysis. The variable X_1 represents R&D expenditures in the formula.

[33] http://www.nationalpriorities.org/
[34] http://www.census.gov/govs/www/cffr.html

Table 3.2 –Renewable Energy R&D Expenditures and Scores (Top and Bottom Ten States)

	Top Ten States	Data*	Score		Bottom Ten States	Data*	Score
1	Nevada	13.52	5.00	39	California	0.16	0.06
2	Delaware	5.41	2.00	39	Florida	0.15	0.06
3	Alaska	5.11	1.89	43	Kentucky	0.10	0.04
4	Mississippi	4.00	1.48	44	Arizona	0.09	0.03
5	Montana	3.12	1.15	45	Oklahoma	0.03	0.01
6	Michigan	2.90	1.07	45	Tennessee	0.03	0.01
7	North Dakota	1.81	0.67	45	New Hampshire	0.02	0.01
8	Missouri	1.73	0.64	48	Rhode Island	0.00	0.00
9	Connecticut	1.67	0.62	48	South Dakota	0.00	0.00
10	Massachusetts	1.60	0.59	48	West Virginia	0.00	0.00

***Renewable Energy R&D Programs –Expenditures Dollar (Per Capita)**
Data originally compiled from http://www.nationalpriorities.org/ and converted to per capita expenditures.

Weight and Scoring

Each category (or indicator) within the index was given both a weight and consequently a score based on that weight. If all eight categories carried the same weight, the score for each would be 5 points. The literature, however, suggests R&D spending, when compared to the other categories one on one, was a bit more important in evaluating a state's energy and environmental innovation potential.

In this case, renewable energy R&D expenditures were given a 12.5% weight and score of 5 out of a total 40 points. The 12.5% weight was determined by evaluating the importance of this category in relation to the others. In other words, for this index, renewable energy R&D expenditures made up 12.5% of the total score for each state. The variable in the formula, X_1, is appropriately multiplied by 0.125 to adjust for this assigned weight (12.5%). The scores, however, need to first be equally distributed among the states. To equalize scores, a "benchmarking" technique is used and described below.

As indicated above by Table 3.2, Nevada had the highest per capita expenditure of $13.52. To create an equal distribution of scores, Nevada's score is used as a "benchmark" to assign scores to the rest of the states. The highest score a state could receive, according to the assigned weight, was 5. In this category, $13.52 (indicated in the formula as X_1^{max}) divided by the highest possible score of 5 is 2.704. The rest of the state's expenditure totals divided by 2.704 give an equal distribution of scores based on the benchmark (or highest expenditure). Since Nevada serves as the benchmark for this category, it is awarded most available points, which is a score of five.

Environmental Spending

The Environmental Council of the States (ECOS) publishes reports on state environmental spending. For this index, state environmental agency budgets and expenditures were compiled from an ECOS database[35] using FY2006 data. Like the previous category, to equalize the expenditures, the amounts are divided by the state population. This gives a per capita amount, as shown in Table 3.3. The variable X_2 represents environmental spending in the formula.

[35] http://www.ecos.org/section/states/spending

Table 3.3 – Environmental Spending (Top and Bottom Ten States)

	Top Ten States	Data*	Score		Bottom Ten States	Data*	Score
1	Wyoming	1077.85	5.00	40	Kentucky	23.07	0.47
2	Delaware	247.58	5.00	42	South Carolina	22.10	0.45
3	New Hampshire	136.25	2.75	43	Maryland	18.25	0.37
4	South Dakota	118.69	2.40	44	Massachusetts	17.74	0.36
5	Montana	96.43	1.95	45	Arkansas	16.32	0.33
6	West Virginia	89.48	1.81	46	Georgia	15.76	0.32
7	Alaska	86.35	1.74	47	Ohio	15.00	0.30
8	Florida	77.91	1.57	47	Oklahoma	14.97	0.30
9	Rhode Island	65.05	1.31	49	Alabama	12.09	0.24
10	Hawaii	64.43	1.30	49	Colorado	11.79	0.24

* **Environmental Spending –Expenditures Dollar (Per Capita)**
Data originally compiled from http://www.ecos.org/section/states/spending/ and converted to per capita expenditures.

Weight and Scoring

For this category, the literature suggests that environmental spending was a very important component of assessing environmental and energy innovation potential; yet, not particularly more important than renewable energy R&D expenditures. For this reason, environmental spending is given the same weight and score as renewable energy R&D expenditures, 12.5% and a maximum score of 5. The variable in the formula, X_2, is appropriately multiplied by 0.125 to adjust for this assigned weight (12.5%). The scores, however, need to first be equally distributed among the states. To equalize scores, a "benchmarking" technique is used and described below.

Table 3.3 shows that Wyoming has an abnormally high per capita expenditure for environmental spending of $1077.85. Wyoming has a particularly low state population, which probably explains most of the high per capita expenditure. Wyoming's expenditure is an outlier for this category and can skew and greatly affect the distribution of scores. For this reason, the next highest state expenditure is used (Delaware with $247.58) for the “benchmark” to assign scores to the rest of the states. The highest score available in this category is 6. The benchmark of $247.58 (indicated in the formula as X_2^{max}) is divided by 6, which gives 49.51. By dividing each state’s expenditure by this amount (49.51), it allows for an equal distribution of scoring is developed. Consequently, Delaware and Wyoming receive the highest possible score of 5 for this category.

Incentives for Renewable Energy

The Database of State Incentives for Renewables & Efficiency (DSIRE)[36] serves as a comprehensive source for government incentives that are specific for renewable energy and energy efficiency. The incentives, while categorized as financial incentives, were counted by the number of incentives offered by a state, as compiled by DSIRE. Types of incentives that were counted include: *personal tax, corporate tax, sales tax, property tax, rebates, grants* and *production incentives.*[37] This collection of incentives is shown in Table 3.4. The variable X_3represents environmental spending in the formula.

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[36] http://www.dsireusa.org/summarytables

[37] Federal incentives were not counted in this category as every state receives federal incentives and would not affect state scores.

Table 3.4 – Incentives for Renewable Energy (Top and Bottom Ten States)

	Top Ten States	Data*	Score		Bottom Ten States	Data*	Score
1	California	56	4.00	39	Wyoming	5	0.36
2	Oregon	42	3.00	42	Alaska	4	0.29
3	Washington	37	2.64	42	Louisiana	4	0.29
4	Indiana	26	1.86	42	Maine	4	0.29
5	Minnesota	25	1.79	42	Nebraska	4	0.29
6	New York	25	1.79	46	Delaware	3	0.21
7	Florida	24	1.71	46	Virginia	3	0.21
8	Iowa	24	1.71	48	Kansas	2	0.14
9	Maryland	24	1.71	48	West Virginia	2	0.14
10	Colorado	21	1.50	50	Arkansas	0	0.00

***Number of Incentives**

Data originally compiled from http://www.dsireusa.org/summarytables/.

Weight and Scoring

Incentives for renewable energy are one of three categories that measured the number of certain types of incentives at state and local levels. The literature places great importance on incentives, as the very nature of the word *incentive* is to encourage. Since three types of incentives are used in this index, there was no particular reason to give one more importance than the other. For this reason, each of these incentive based categories is given the same weight of 10% and consequently a score of 4 out of 40. The variable in the formula, X_3, is appropriately multiplied by 0.10 to adjust for this assigned weight (10%). The scores, however, need to first be equally distributed among the states. To equalize scores, a "benchmarking" technique is used and described below.

Table 3.4 shows that California has the highest number of incentives with 56. For this reason, California becomes the "benchmark" state for this category. The highest possible score for this category is 4. California's "benchmark" number of incentives, 56 (indicated in the formula as $X_3^{\max}$), is divided by 4—which gives 14. In turn, the other states are divided by 14 to produce an equal distribution. Consequently, California gets the highest points available of four.

Incentives for Energy Efficiency

DSIRE also gathers information at the federal, state, and local levels about incentives for energy efficiency. Types of incentives counted for this category were: tax incentives, rebates, grants, and loans. Just like the previous category, incentives for energy efficiency were counted not in dollar amounts, but in number of incentives offered. This collection of incentives is shown in Table 3.5. The variable X_4 represents environmental spending in the formula.

Table 3.5 – Incentives for Energy Efficiency (Top and Bottom Ten States)

	Top Ten States	Data*	Score		Bottom Ten States	Data*	Score
1	Washington	86	4.00	39	North Dakota	5	0.23
2	California	82	3.81	39	Ohio	5	0.23
3	Minnesota	82	3.81	43	Kansas	4	0.19
4	Oregon	67	3.12	43	Michigan	4	0.19
5	Tennessee	46	2.14	43	Nebraska	4	0.19
6	Texas	44	2.05	43	Nevada	4	0.19
7	Indiana	35	1.63	43	Virginia	4	0.19
8	Massachusetts	31	1.44	48	Louisiana	3	0.14
9	Georgia	26	1.21	49	Delaware	2	0.09
10	Missouri	26	1.21	50	West Virginia	1	0.05

* **Number of Incentives**
Data originally compiled from http://www.dsireusa.org/summarytables/.

Weight and Scoring

Again, the literature placed great importance on incentives, as the very nature of the word *incentive* is to encourage. This category is the second of three categories measuring the number of incentives a state offers. There is no particular reason to give one more importance than the other. For this reason, this category was given the same weight of 10% and consequently a score of 4 out of 40. The variable in the formula, X_4, is appropriately multiplied by 0.10 to adjust for this assigned weight (10%). The scores, however, need to first be equally distributed among the states. To equalize scores, a "benchmarking" technique is used and described below.

As Table 3.5 illustrates, Washington offers the highest number of individual incentives for this particular category with 86 incentives. Just like the last category, the highest score available for this category is 4. Since Washington's number of 86 is the "benchmark", 86 (indicated in the formula as X_4^{max}) is divided by 4, which gives 21.5. All other states are divided by this number (21.5) to appropriately distribute the scores among the rest of the states. Consequently, Washington receives the full value of points—four.

Rules, Regulations, and Policy Incentives

The last category that measures a type of incentives is the rules, regulation, and policy incentive category. Just like the previous two categories, different types of incentives are included. The main types of incentives are classified as public benefit funds, net metering, renewable portfolio standards, and access laws. These types were counted in Table 3.6 for each state. The variable X_5 represents environmental spending in the formula.

Table 3.5 – Rules, Regulation, and Policy Incentives (Top and Bottom Ten States)

	Top Ten States	Data*	Score		Bottom Ten States	Data*	Score
1	California	13	4.00	37	Nebraska	2	0.62
2	Oregon	7	2.15	42	Alabama	1	0.31
3	Arizona	6	1.85	42	Arkansas	1	0.31
4	Colorado	6	1.85	42	Kansas	1	0.31
5	Utah	6	1.85	42	Oklahoma	1	0.31
6	Alaska	5	1.54	42	South Dakota	1	0.31
7	Delaware	5	1.54	42	Tennessee	1	0.31
8	Montana	5	1.54	42	West Virginia	1	0.31
9	New Jersey	5	1.54	42	Wyoming	1	0.31
10	New York	5	1.54	50	Mississippi	0	0.00

***Number of Incentives**
Data originally compiled from http://www.dsireusa.org/summarytables/.

Weight and Scoring

The third and final category measuring incentives is given no more or less weight than the previous incentive categories. This final incentive category, like the previous two incentive based categories, was given the same weight of 10% and consequently a score of 4 out of 40. The variable in the formula, X_6, is appropriately multiplied by 0.10 to adjust for this assigned weight (10%). The scores, however, need to first be equally distributed among the states. To equalize the scores, a "benchmarking" technique is used and described below.

For this category, the state with the highest number of incentives was California with thirteen. Using the same "benchmarking" methodology as the previous categories, California's score, 13 (indicated in the formula as $X_5^{\max}$), is divided by the highest score available (4) for a 3.25 result. The other states are divided by 3.25 to equally distribute scores among the states. Consequently, California sets the "benchmark" and receives the full amount of points—four, for this category.

Regulation Stringency

As indicated in the literature, the stringency a state places on environmental concerns, primarily building energy codes, are indicative of whether the priorities lie with energy efficiency and commitment to the environment. Much of the literature indicates that stringency alone is a significant indicator and perpetuator of innovation. The American Council for an Energy-Efficient Economy (ACEEE)[38] captures the stringency of a state's building energy codes largely scoring states on a "meets or exceeds" evaluation basis. In addition to their evaluation on stringency, ACEEE also scored states' level of efforts to comply with their own codes by relying on building code experts. The highest score ACEEE awards in their evaluation is a score of eight. The assigned point value depends on the "meet or exceed" scoring methodology. If a state has no mandatory state energy code, a score of zero resulted; these scores are shown in Table 3.7. The variable X_6 represents building energy code stringency scores in the formula.

Table 3.7– Building Energy Code Stringency (Top and Bottom Ten States)

	Top Ten States	Data*	Score		Bottom Ten States	Data*	Score
1	California	8	6.00	36	Maine	3	2.25
2	Oregon	8	6.00	42	Michigan	2	1.50
3	Washington	8	6.00	43	Indiana	1.5	1.13
4	Wisconsin	8	6.00	43	Missouri	1.5	1.13
5	Florida	7	5.25	45	Tennessee	1	0.75
6	Idaho	6	4.50	46	Alabama	0.5	0.38
7	Kentucky	6	4.50	47	Mississippi	0	0.00
8	Utah	6	4.50	47	North Dakota	0	0.00
9	Vermont	6	4.50	47	South Dakota	0	0.00
10	Georgia	5.5	4.13	47	Wyoming	0	0.00

* **Number of Incentives**

Data originally compiled from http://www.aceee.org.

[38] http://www.aceee.org

Weight and Scoring

Since the literature suggested that policy stringency has a close connection to encouraging innovation at many levels, a heavier weight and score assigned to this category. Along with renewable energy production and venture capital, stringency seems to be the most important of the categories. For this reason, this category was given the heaviest weight of all the categories, 15% and consequently the highest score of 6 out of 40. The variable in the formula, X_6, is appropriately multiplied by 0.15 to adjust for this assigned weight (15%). The scores, however, need to first be equally distributed among the states. To standardize the scores, a "benchmarking" technique is used and described below.

There were four states that set the "benchmark" for this category with the maximum points available of eight—California, Washington, Wisconsin, and Oregon. The "benchmark" state, as in the other categories, sets the standard by which the other states are scored. The "benchmark" state scores of 8 (indicated in the formula as $X_6^{\max}$) is divided by 6 (the highest point value available for this index), giving the number 1.33. Following the same methodology as the other categories, the other states are divided by this number (1.33), normalizing the scores based on the "benchmark" value for this category. Consequently, the four states that set the "benchmark" (California, Wisconsin, Oregon, and Washington), receive the same maximum score for this category—six.

Energy Production

The amount of renewable energy a state produces is a good indicator of how committed it may already be in the pursuit of newer, cleaner energy and environmental technologies. The literature defines the types of renewable energy and suggests it is an important category to consider when evaluating a particular state's priorities, policy or otherwise. Renewable energy output per millions BTU (per capita) is shown in Table 3.8. The variable X_7 represents energy production output in the formula.

Table 3.8– Renewable Energy Output (Top and Bottom Ten States)

	Top Ten States	Data*	Score		Bottom Ten States	Data*	Score
1	Washington	161.36	6.00	41	Texas	8.88	0.33
2	Oregon	130.39	4.85	41	Indiana	8.75	0.33
3	Montana	130.35	4.85	43	Kansas	7.75	0.29
4	Maine	119.14	4.43	44	Ohio	7.57	0.28
5	Idaho	107.55	4.00	45	Utah	7.09	0.26
6	Alabama	60.47	2.25	45	Illinois	6.92	0.26
7	South Dakota	52.73	1.96	47	Rhode Island	5.88	0.22
8	Vermont	41.06	1.53	48	Missouri	5.48	0.20
9	North Dakota	37.47	1.39	49	New Jersey	3.59	0.13
10	Arkansas	36.28	1.35	50	Delaware	1.88	0.07

*** Energy Output Per Capita**
Data originally compiled from DoE

Weight and Scoring

Since renewable energy is an innovative process in itself, it is evident why this category should be included and considered as one of the more important for evaluating a state's environmental and energy innovation potential. The literature on this category backs this claim, as well. While the category is very important, the literature insinuates there is no particular reason to give it a heavier weight than stringency. Just as stringency is seen as a very important indicator, renewable energy output is given the same weight of 15% and, consequently, a highest score of 6 out of 40. The variable in the formula, X_7, is appropriately multiplied by 0.15 to adjust for this assigned weight (15%). The scores, however, need to first be equally distributed among the states. To standardize scores, a "benchmarking" technique is used and described below.

As seen in Table 3.8, Washington has the highest energy output with 161.36, thus setting the "benchmark" for this category. This "benchmark" amount of 161.36 (indicated in the formula as X_7^{max}) is divided by 6 (the highest point value available for this index), giving the number 26.89. Following the same methodology as the other categories, all states are divided by this number (26.89), normalizing the scores based off the "benchmark" value in this category. Consequently, the "benchmark" state of Washington receives the maximum score for this category—six.

Venture Capital

Literature suggests that venture capital is strongly related to innovation. Substantial amounts of venture capital dollars go into Universities and labs, seed funds, venture funds, and corporate investors who shop for new technologies. The literature suggests that venture capital carries a heavy weight when considering innovation potential of a state. For this reason, like the previous two categories, venture capital is given the heaviest weight of 15%, and a consequent score of 6 out of 40. This category is a measurement of an eleven-year total investment (1995-2005). One reason for capturing several years of investment is venture capital investment dollars can drastically decrease or increase from year to year. Capturing data of several past years can give a better idea of the willingness of a state to invest in venture capital. Venture capital is reported in millions of dollars per capita for each state, as presented in Table 3.9. The variable X_8 represents building energy code stringency scores in the formula.

Table 3.9– Venture Capital Investment (Top and Bottom Ten States)

	Top Ten States	Data*	Score		Bottom Ten States	Data*	Score
1	Massachusetts	5597.76	6.00	41	Idaho	111.52	0.12
2	California	4232.92	4.54	41	Indiana	107.75	0.12
3	Colorado	2705.35	2.90	43	Nebraska	106.59	0.11
4	Washington	1745.42	1.87	43	Montana	102.86	0.11
5	New Hampshire	1739.62	1.86	45	South Dakota	88.76	0.10
6	Connecticut	1471.74	1.58	46	North Dakota	59.17	0.06
7	Virginia	1234.91	1.32	47	West Virginia	48.50	0.05
8	Maryland	1227.34	1.32	47	Iowa	44.90	0.05
9	New Jersey	1218.19	1.31	49	Arkansas	30.04	0.03
10	New York	1005.09	1.08	50	Wyoming	11.34	0.01

* **Venture Capital Investment (Per Capita)**
Data originally compiled from

Weight and Scoring

Venture capital is described by the literature to be somewhat of an equivalent to innovation. After all, the definition of venture capital is money invested for innovative enterprises. For this reason, like the previous two categories it was given a weight of 15% and a consequent score of 6 out of 40. The variable in the formula, X_8, is appropriately multiplied by 0.15 to adjust for this assigned weight (15%). The scores, however, need to first be equally distributed among the states. To equalize scores, a "benchmarking" technique is used and described below.

Table 3.9 shows that Massachusetts has the highest per capita venture capital investment with $5997.76 to set the "benchmark" for this category. This "benchmark" amount of 5997.76 (indicated in the formula as X_8^{max}) is divided by 6 (the highest point value available for this index), resulting in the number 999.63. Following the same methodology as the other categories, all states are divided by this number (999.62), normalizing the scores based on the “benchmark” value in this category. Consequently, the “benchmark” state of Massachusetts receives the maximum score for this category—six.

Strengths and Weaknesses

This research defines the descriptive categories used to construct an index environmental and energy potential for the 50 states. As with all research, there are strengths and weaknesses associated with this study. This study relies on existing data to measure each of the categories that make up the index. While there are no missing data in any of the categories, still outdated data is a serious concern. All of the data from the categories use the latest available data (most of which is 2006 data). The only category that strayed from this consistency was venture capital, which used an eleven-year total (1995-2005) of investments. Another weakness is the objectivity of the weighting for each category. While this study justifies the weighting methodology with the existing literature—there are many different ways weights for each of the categories could be justified.

There are several strengths of this particular study. First, the index did not have missing data for any of the eight categories. Second, the “benchmarking” technique creates a unique way of normalizing the scoring method, which eliminates the problem when several states having the same exact score. Finally, when monetary data is reported in this index, per capita calculations are always used to control for the overall difference in spending between highly populated and scarcely populated states.

Human Subjects Protection

Human subjects protection is not applicable to this study, only content analysis of existing data is involved.

Chapter Summary

This chapter presented the methodology to construct the state environmental and energy innovation potential index. The next chapter discusses how the states fall in the index.

Chapter 4 Results

This chapter describes the where states fall on the innovation potential index. Chapter three finalized the conceptual framework of categories, which were needed to construct the index. The results will be shown after weighting to reveal the rankings of the states in each category. The final index is shown after the sum all of the variable scores. The complete index can be found in the Appendix A. In addition, this chapter explores some correlations between this index and other indices (policy liberalism, economic freedom, and green). The next section shows the weighted state rankings for each component of the scale.[39]

Renewable Energy R & D Expenditure Scores

Table 4.1 shows that Nevada holds the number one ranking for R&D renewable energy expenditures. As explained in the previous chapter, all the other scores were determined using Nevada's expenditure as a benchmark. Compared to Nevada's expenditure, Delaware comes the closest in meeting the benchmark, essentially spending less than half of what Nevada spends per capita. Several states tied in this category as they offered the same number of incentives. Rhode Island, South Dakota, and West Virginia all receive zero points for this category as do not have spending programs for R&D for renewable energy. Also shown in Table 4.1, the majority of states do not come close to the benchmark. For this reason, the majority of states receive a low score in this category.

[39] While the weight for each individual category is only significant when considering all the categories together, all the states still receive the same weight in each category. Thus, the rankings of each category are still appropriate to discuss individually.

Table 4.1 – Renewable Energy R&D Expenditure Scores

States	Rank	Score	States	Rank	Score
Nevada	1	5.00	Arkansas	26	0.19
Delaware	2	2.00	Maryland	26	0.19
Alaska	3	1.89	Texas	28	0.18
Mississippi	4	1.48	Iowa	29	0.16
Montana	5	1.15	South Carolina	29	0.16
Michigan	6	1.07	New Jersey	31	0.15
North Dakota	7	0.67	Wyoming	32	0.14
Missouri	8	0.64	North Carolina	33	0.13
Connecticut	9	0.62	Alabama	34	0.11
Massachusetts	10	0.59	Wisconsin	34	0.11
Colorado	11	0.50	Hawaii	36	0.09
Indiana	12	0.49	Louisiana	37	0.08
New Mexico	13	0.45	Washington	38	0.07
Ohio	14	0.41	Nebraska	39	0.06
Vermont	15	0.39	Kansas	39	0.06
Minnesota	15	0.39	California	39	0.06
Georgia	17	0.38	Florida	39	0.06
Pennsylvania	17	0.38	Kentucky	43	0.04
Virginia	19	0.37	Arizona	44	0.03
Idaho	20	0.34	Oklahoma	45	0.01
Illinois	21	0.30	Tennessee	45	0.01
Maine	22	0.27	New Hampshire	45	0.01
Utah	23	0.25	Rhode Island	48	0.00
Oregon	23	0.25	South Dakota	48	0.00
New York	25	0.21	West Virginia	48	0.00

Environmental Spending Scores

Table 4.2 presents the scores for state spending on the environment. Two states scored the highest score possible—Wyoming and Delaware. Alabama and Colorado are among the lowest scoring states for this category. This category is based on per capita spending amounts. Interestingly, as shown in Table 4.2, lower populated states tend to have scored higher in this category.

Table 4.2 – Environmental Spending Scores

States	Rank	Score	States	Rank	Score
Wyoming	1	5.00	California	26	0.76
Delaware	1	5.00	Utah	26	0.76
New Hampshire	3	2.75	Iowa	28	0.70
South Dakota	4	2.40	New Jersey	28	0.70
Montana	5	1.95	Mississippi	30	0.68
West Virginia	6	1.81	Illinois	31	0.63
Alaska	7	1.74	Washington	32	0.56
Florida	8	1.57	Tennessee	32	0.56
Rhode Island	9	1.31	Minnesota	34	0.55
Hawaii	10	1.30	Arizona	35	0.54
Nevada	11	1.27	Louisiana	36	0.52
Vermont	12	1.23	North Dakota	37	0.51
Missouri	13	1.11	Texas	38	0.49
Nebraska	13	1.10	Kansas	39	0.48
New Mexico	15	1.04	Virginia	40	0.47
Oregon	16	0.92	Kentucky	40	0.47
Indiana	17	0.89	South Carolina	42	0.45
Pennsylvania	18	0.88	Maryland	43	0.37
Wisconsin	18	0.88	Massachusetts	44	0.36
North Carolina	20	0.86	Arkansas	45	0.33
Maine	20	0.86	Georgia	46	0.32
Idaho	22	0.82	Ohio	47	0.30
Michigan	23	0.81	Oklahoma	47	0.30
New York	24	0.79	Alabama	49	0.24
Connecticut	25	0.77	Colorado	49	0.24

Incentives for Renewable Energy Scores

Table 4.3 presents the sequential scores for incentives for renewable energy. California earns the top score in this category with Oregon trailing just behind. Most of the states in this category earn less than a point in this category because California sets such a high benchmark score. There are also quite a few ties in this category, as several states offered the same number of incentives. Arkansas is the only state that is not awarded any points at all for this category, as they offered zero incentives for renewable energy.

Table 4.3 – Incentives for Renewable Energy Scores

States	Rank	Score	States	Rank	Score
California	**1**	4.00	Hawaii	**26**	0.64
Oregon	**2**	3.00	Idaho	**26**	0.64
Washington	**3**	2.64	Missouri	**26**	0.64
Indiana	**4**	1.86	South Dakota	**26**	0.64
Minnesota	**5**	1.79	Utah	**26**	0.64
New York	**5**	1.79	Vermont	**26**	0.64
Florida	**7**	1.71	Alabama	**32**	0.57
Iowa	**7**	1.71	Illinois	**32**	0.57
Maryland	**7**	1.71	Rhode Island	**32**	0.57
Colorado	**10**	1.50	New Hampshire	**35**	0.50
Massachusetts	**11**	1.36	Oklahoma	**35**	0.50
Pennsylvania	**12**	1.29	Mississippi	**37**	0.43
Kentucky	**13**	1.21	North Dakota	**37**	0.43
Wisconsin	**13**	1.21	Nevada	**39**	0.36
Montana	**15**	1.14	Tennessee	**39**	0.36
Arizona	**16**	1.07	Wyoming	**39**	0.36
Ohio	**17**	1.00	Alaska	**42**	0.29
Connecticut	**18**	0.93	Louisiana	**42**	0.29
South Carolina	**18**	0.93	Maine	**42**	0.29
Texas	**20**	0.86	Nebraska	**42**	0.29
Georgia	**21**	0.79	Delaware	**46**	0.21
New Mexico	**21**	0.79	Virginia	**46**	0.21
Michigan	**23**	0.71	Kansas	**48**	0.14
New Jersey	**23**	0.71	West Virginia	**48**	0.14
North Carolina	**23**	0.71	Arkansas	**50**	0.00

Incentives for Energy Efficiency Scores

Table 4.4 presents scores and ranks for incentives for energy efficiency. Washington sets the benchmark for this category and gets a perfect score of four, however, California and Minnesota tie for second with scores of 3.81. Several states tied in this category because several of the states offered the same number of incentives. Among the bottom scoring states in this category are Delaware and West Virginia.

Table 4.4 – Incentives for Energy Efficiency Scores

States	Rank	Score	States	Rank	Score
Washington	1	4.00	Utah	25	0.51
California	2	3.81	Mississippi	27	0.47
Minnesota	2	3.81	Pennsylvania	27	0.47
Oregon	4	3.12	South Carolina	27	0.47
Tennessee	5	2.14	New Jersey	30	0.42
Texas	6	2.05	Maryland	31	0.37
Indiana	7	1.63	New Mexico	31	0.37
Massachusetts	8	1.44	Alaska	33	0.33
Georgia	9	1.21	Wyoming	33	0.33
Missouri	9	1.21	Maine	35	0.28
Connecticut	11	1.16	Oklahoma	35	0.28
Florida	11	1.16	Rhode Island	35	0.28
Iowa	11	1.16	South Dakota	35	0.28
Kentucky	14	1.07	Arkansas	39	0.23
Idaho	15	1.02	Hawaii	39	0.23
Alabama	16	0.98	North Dakota	39	0.23
New Hampshire	16	0.98	Ohio	39	0.23
Wisconsin	16	0.98	Kansas	43	0.19
Colorado	19	0.93	Michigan	43	0.19
North Carolina	20	0.84	Nebraska	43	0.19
New York	21	0.74	Nevada	43	0.19
Illinois	22	0.70	Virginia	43	0.19
Vermont	23	0.65	Louisiana	48	0.14
Montana	24	0.60	Delaware	49	0.09
Arizona	25	0.51	West Virginia	50	0.05

Rules, Regulation, and Policy Incentive Scores

Table 4.5 presents the sequential scores of rules, regulation, and policy incentives. While California came out on top, many of the states in this category received the same scores because they offered the same number of incentives. Mississippi, by not offering any state or local incentives for this category, received zero points.

Table 4.5 – Rules, Regulation, and Policy Incentive Scores

States	Rank	Score	States	Rank	Score
California	1	4.00	Illinois	24	0.92
Oregon	2	2.15	Iowa	24	0.92
Arizona	3	1.85	Maryland	24	0.92
Colorado	3	1.85	Massachusetts	24	0.92
Utah	3	1.85	Michigan	24	0.92
Alaska	6	1.54	Nevada	24	0.92
Delaware	6	1.54	New Hampshire	24	0.92
Montana	6	1.54	North Dakota	24	0.92
New Jersey	6	1.54	Pennsylvania	24	0.92
New York	6	1.54	South Carolina	24	0.92
Ohio	6	1.54	Vermont	24	0.92
Florida	12	1.23	Georgia	37	0.62
Idaho	12	1.23	Indiana	37	0.62
Maine	12	1.23	Kentucky	37	0.62
Minnesota	12	1.23	Louisiana	37	0.62
Missouri	12	1.23	Nebraska	37	0.62
New Mexico	12	1.23	Alabama	42	0.31
North Carolina	12	1.23	Arkansas	42	0.31
Rhode Island	12	1.23	Kansas	42	0.31
Texas	12	1.23	Oklahoma	42	0.31
Virginia	12	1.23	South Dakota	42	0.31
Washington	12	1.23	Tennessee	42	0.31
Wisconsin	12	1.23	West Virginia	42	0.31
Connecticut	24	0.92	Wyoming	42	0.31
Hawaii	24	0.92	Mississippi	50	0.00

Regulation Stringency Scores

Table 4.6 presents the sequential scores for regulation stringency. California, Oregon, Washington, and Wisconsin all set the benchmark for this category and receive the highest score of 6 for this category. Many states hold the same stringency score creating several sets of ties. Wyoming, North and South Dakota, and Mississippi receive zero points for having the worst stringency scores.

Table 4.6 – Regulation Stringency Scores

States	Rank	Score	States	Rank	Score
California	1	6.00	Rhode Island	21	3.38
Oregon	1	6.00	West Virginia	21	3.38
Washington	1	6.00	Arkansas	28	3.00
Wisconsin	1	6.00	Connecticut	28	3.00
Florida	5	5.25	Louisiana	28	3.00
Idaho	6	4.50	Nebraska	28	3.00
Kentucky	6	4.50	Oklahoma	28	3.00
Utah	6	4.50	Hawaii	33	2.63
Vermont	6	4.50	Massachusetts	33	2.63
Georgia	10	4.13	Ohio	33	2.63
Minnesota	10	4.13	Alaska	36	2.25
New York	10	4.13	Arizona	36	2.25
Iowa	13	3.75	Colorado	36	2.25
Montana	13	3.75	Delaware	36	2.25
Nevada	13	3.75	Kansas	36	2.25
New Jersey	13	3.75	Maine	36	2.25
New Mexico	13	3.75	Michigan	42	1.50
South Carolina	13	3.75	Indiana	43	1.13
Texas	13	3.75	Missouri	43	1.13
Virginia	13	3.75	Tennessee	45	0.75
Illinois	21	3.38	Alabama	46	0.38
Maryland	21	3.38	Mississippi	47	0.00
New Hampshire	21	3.38	North Dakota	47	0.00
North Carolina	21	3.38	South Dakota	47	0.00
Pennsylvania	21	3.38	Wyoming	47	0.00

Renewable Energy Production Scores

Table 4.7 presents sequential scores for state renewable energy output. Washington sets the benchmark for this category earning six points. Oregon and Montana both hold second place with 4.85 points. Several states in this category hold the same scores, consequently tying in the ranks. New Jersey and Delaware are among the lowest scoring states for renewable energy output.

Table 4.7 – Renewable Energy Production Scores

States	Rank	Score	States	Rank	Score
Washington	1	6.00	Virginia	26	0.70
Oregon	2	4.85	Arizona	27	0.59
Montana	2	4.85	Kentucky	28	0.55
Maine	4	4.43	Oklahoma	28	0.55
Idaho	5	4.00	Nebraska	30	0.53
Alabama	6	2.25	West Virginia	30	0.53
South Dakota	7	1.96	Hawaii	32	0.51
Vermont	8	1.53	Connecticut	33	0.49
North Dakota	8	1.39	Florida	34	0.46
Arkansas	10	1.35	Michigan	35	0.45
Wyoming	11	1.32	Pennsylvania	36	0.39
Louisiana	12	1.28	New Mexico	36	0.39
California	13	1.17	Colorado	38	0.36
Nevada	14	1.08	Maryland	38	0.36
New Hampshire	15	0.98	Massachusetts	40	0.34
Alaska	16	0.97	Texas	41	0.33
Georgia	16	0.97	Indiana	41	0.33
Iowa	18	0.94	Kansas	43	0.29
South Carolina	19	0.93	Ohio	44	0.28
New York	20	0.90	Utah	45	0.26
Tennessee	21	0.85	Illinois	45	0.26
Mississippi	22	0.82	Rhode Island	47	0.22
Wisconsin	22	0.82	Missouri	48	0.20
Minnesota	24	0.79	New Jersey	49	0.13
North Carolina	25	0.72	Delaware	50	0.07

Venture Capital Expenditure Scores

Table 4.8 presents the sequential scoring for state venture capital investments. Massachusetts sets the benchmark for this category and holds the top rank for this category. California ranks number two with 4.54. There were only a few states that tied in this category receiving the same score. Wyoming and Arkansas, on the other hand, are among the lowest scoring states for venture capital.

Table 4.8 – Venture Capital Expenditure Scores

States	Rank	Score	States	Rank	Score
Massachusetts	1	6.00	Hawaii	25	0.29
California	2	4.54	South Carolina	25	0.29
Colorado	3	2.90	Ohio	28	0.28
Washington	4	1.87	Vermont	29	0.22
New Hampshire	5	1.86	Alabama	30	0.20
Connecticut	6	1.58	Kansas	31	0.19
Virginia	7	1.32	Alaska	32	0.18
Maryland	8	1.32	New Mexico	33	0.17
New Jersey	9	1.31	Michigan	33	0.17
New York	10	1.08	Nevada	35	0.16
Utah	11	1.04	Wisconsin	36	0.15
Texas	12	1.00	Louisiana	36	0.15
Minnesota	13	0.93	Kentucky	38	0.14
Georgia	13	0.93	Oklahoma	38	0.14
North Carolina	15	0.83	Mississippi	40	0.13
Pennsylvania	16	0.81	Idaho	41	0.12
Oregon	17	0.80	Indiana	41	0.12
Illinois	18	0.62	Nebraska	43	0.11
Florida	19	0.56	Montana	43	0.11
Delaware	20	0.51	South Dakota	45	0.10
Arizona	21	0.48	North Dakota	46	0.06
Rhode Island	22	0.47	West Virginia	47	0.05
Missouri	23	0.43	Iowa	47	0.05
Tennessee	24	0.37	Arkansas	49	0.03
Maine	25	0.29	Wyoming	50	0.01

The Index

As discussed at length in chapter three, eight categories were operationalized and measured to construct the final index that ranks the states in energy and environmental innovation potential. Table 4.9 shows the results of the measurement total of all of the categories.

Table 4.9 – Index of State Environmental and Energy Innovation Potential

Rank Order	Rank	Total Score	Rank Order	Rank	Total Score
California	1	24.34	Kentucky	26	8.60
Washington	2	22.38	Pennsylvania	27	8.50
Oregon	3	21.08	Virginia	28	8.25
Montana	4	15.10	New Mexico	29	8.18
Massachusetts	5	13.63	South Carolina	30	7.89
Minnesota	6	13.62	Wyoming	31	7.46
Nevada	7	12.73	Rhode Island	32	7.45
Idaho	8	12.68	Illinois	33	7.37
Florida	9	12.01	Arizona	34	7.33
Delaware	10	11.68	Indiana	35	7.05
New Hampshire	11	11.38	Ohio	36	6.67
Wisconsin	12	11.37	Hawaii	37	6.62
New York	13	11.17	Missouri	38	6.59
Colorado	14	10.52	West Virginia	39	6.26
Vermont	15	10.08	Louisiana	40	6.08
Maine	16	9.90	Nebraska	41	5.89
Texas	17	9.88	Michigan	42	5.83
Utah	18	9.82	South Dakota	43	5.68
Connecticut	19	9.48	Arkansas	44	5.44
Iowa	20	9.40	Tennessee	45	5.35
Georgia	21	9.33	Oklahoma	46	5.09
Alaska	22	9.18	Alabama	47	5.03
New Jersey	23	8.70	North Dakota	48	4.22
North Carolina	23	8.70	Mississippi	49	4.01
Maryland	25	8.61	Kansas	50	3.90

Perhaps one of the most distinguishing characteristics of this index is the clear separation of the top three states (California, Oregon, and Washington) from the other states. As presented in Table 4.1, there is a significant separation of the top three states from the others by almost six points. After the top three states, there seems to be a consistent distribution of scores. Only two states, however, tied in the index—New Jersey and North

Carolina with a score of 8.70. Consequently, New Jersey and North Carolina both hold 23rd place on the index. Some states come very close to scoring the same score. Massachusetts and Minnesota, for example, are only separated by one-tenth of a point. Kansas, Mississippi, North Dakota, and Alabama are among the lowest scoring states for innovation potential.

Also, even the highest scoring state, California, which scored 24.34 on the index, did not approach the highest score available of forty. An examination of states exhibiting lower scores in one variable or another can be a good indicator of how that particular state can improve their innovation potential.

Chapter Summary

This chapter discussed the results of eight operationalized descriptive categories, which made it possible to construct a final index that measures state environmental and energy innovation potential. The next chapter discusses conclusions based on the results of the index. The next chapter will also summarize the results of the index and discuss possible future research suggestions.

Chapter 5 Conclusion

The purpose of this paper was to create an index ranking the 50 states based on environmental innovation *potential*. In other words, this research ***described*** the factors that contributed to a state's potential for environmental and energy innovation and then used these factors to create an index that ranked the states. The first chapter of this study introduced the research topic, and Chapter 2, Literature Review, discusses the scholarly literature that supports the organization of categories that makes up a state's environmental and energy innovation potential. Chapter two also presents the conceptual framework and organizational structure of the index. The key components of the index are:

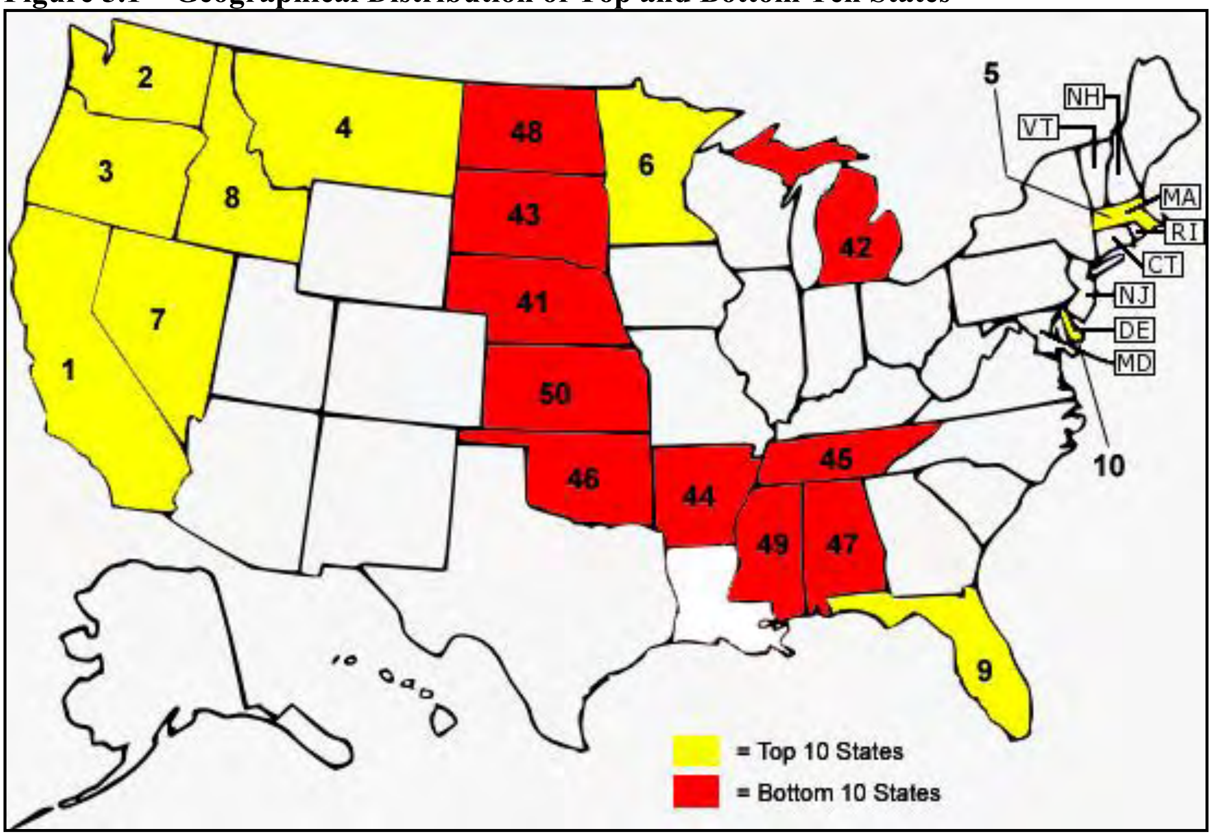
- **Economy & Spending**
  - Research and Development
  - Environmental Spending
- **Incentives**
  - Financial Incentives for Renewable Energy
  - Financial Incentives for Energy Efficiency
  - Rules, Regulation, Policy Incentives
- **Regulation Stringency**
- **Renewable/Alternative Energy Production**
- **Venture Capital**

Chapter three (Methodology) introduces the steps taken to construct the index that ranks the 50 United States according to their environmental and energy innovation potential. Chapter four (Results) presents the rankings of the eight individual descriptive categories after weighting. Further, chapter four presents the final index, after combining the eight category totals.

This research is important because currently there is no such index measuring innovation potential. Also, this study gives policy makers, government officials, and the general public an understanding of which states are the most prepared to innovate in the environmental and energy domain. Lastly, this study clarified what objectives increase states' potential and ability to innovate for energy and the environment.

There are some interesting observations about the final index. For example, as presented in Figure 5.1, there seem to be regional associations of the top and bottom ten states. The Pacific and western states make up six of the top ten states. Also, all of the bottom states are central or southern states. This geographical illustration (Table 5.1) of the index suggests that an association does exist for not only the top ten states but also those with the least potential to innovate in the energy and environmental arenas.

Figure 5.1 – Geographical Distribution of Top and Bottom Ten States



Another interesting observation of the results of the index is related to the top three scoring states: California, Washington, and Oregon. A Seattle Times news article by Jennifer

Sullivan[40] on March 8, 2009[41] reported that the governors of the same three states (California, Washington, and Oregon) were collaborating to transform a major interstate running through all three states into a eco-friendly freeway providing alternative fueling stations. This type of innovation-based approach to transportation provides support for the results of the index. The top three state profiles are briefly discussed next.

Top Three State Profiles

The top three ranking states are all west coast states. It would be useful to examine the demographic profiles and explore what is happening inside each of these states. This section will briefly examine and explore the profile of the top three performing states on the index.

1 – California

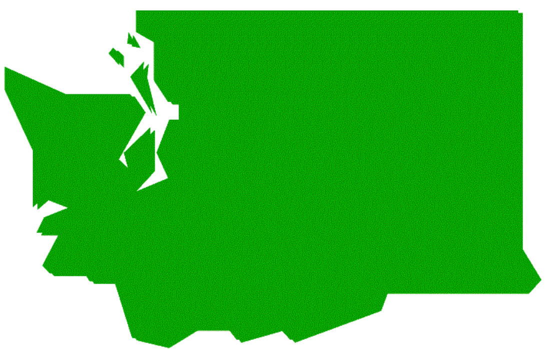
- *Population, 2007 est. – 36,553,215*
- *Per capita money income (1999) - $22,711*
- *Land area, 2000 (square miles) – 155,959*
- *Persons per square mile, 2000 – 217.2*

It is no great surprise to see California as the top scorer on the index. California has a pace setting reputation for state for environmental and energy issues. The state also has a strong base in research for energy and the environment. The University of California at Berkeley houses a center for energy and environmental innovation. In addition, the University of California at Berkeley houses a center for energy, resources and economic sustainability (CERES). In a report

[40] http://seattletimes.nwsource.com/html/localnews/2008827158_greenfreeway08m.html

[41] Ironically, March 8th 2009 is the same day the index was compiled and completed.

examining energy efficiency, innovation, and job creation in California, Roland-Holst (2008) identified some of California's unique strengths in this arena. He found that California has made significant leaps in energy efficiency that has allowed the state to reduce its energy import dependence and therefore create jobs in newer, innovative energy sectors in the state. Next 10, a non-profit organization examined and constructed the "California Green Innovation Index Report."[42] This report highlighted California's ability in the past 30 years to create jobs and cut energy usage and greenhouse gas emissions per capita. California's dedication to increasing renewable energy is also evident by Next 10's report. Renewable power generation increased 19 percent from 2002 to 2007.



1 - Washington

- *Population, 2007 est. – 6,468,424*
- *Per capita money income (1999) - $22,973*
- *Land area, 2000 (square miles) – 66,544*
- *Persons per square mile, 2000 – 88.6*

Washington State is being applauded for their emerging leadership in "smart grid" innovation. In fact, reported at Washington's Innovation Summit in 2009, twenty-eight organizations in Washington are currently working on this smart grid innovation and is touted as being the bedrock of future green innovations. [43] Sustainability is also a large focus in Washington State. The Congressman from Washington's 9th district, Adam Smith, is on the record claiming, "we've put the money in places where it can best be used to continue and move the U.S. forward on innovation and technology." While California's primary focus

[42] See: http://www.next10.org/environment/greenInnovation.html
[43] See: http://energypriorities.com/entries/2009/04/wtc_wis09_cleantech.php#1

seems to be in energy efficiency, Washington State's focus, on the surface seems to center around sustainability approaches.

3 - Oregon

- *Population, 2007 est. – 3,747,455*
- *Per capita money income (1999) - $20,940*
- *Land area, 2000 (square miles) – 90,996*
- *Persons per square mile, 2000 – 35*

Oregon is home to Portland, which is arguably one of the greenest, most environmentally friendly cities in America. Oregon's commitment to energy and environmental innovation is evident in the key goal cited in the state's "2009 Innovation Plan," written by the Oregon Innovation Council (INC). [44] The plan names "connectivity" as the key goal for 2009, showcasing solar energy development with hopes of making Oregon a leader in solar manufacturing and renewable energy. The INC innovation plan lays out a great demographic profile of Oregon and provides a great discussion on Oregon's key economic assets for innovation. For example, the report highlights Oregon's diverse natural resource base, public research institutions, people, and industrial base. While this innovation plan includes innovation in a wide array of sectors—the majority of the innovation discussed in past and future goals were concerning energy and the environment. This effort illustrates Oregon's potential for innovating for the environmental and energy sectors.

Suggested Future Research

[44] See: http://www.oregoninc.org/index.shtml

There are several areas of this research that could be explored and expanded upon. Working hypotheses can present examples of various directions of the expansion of this research. Three such correlation related examples are:

WH_1 – Environmental Innovation Potential is correlated to a states' level of liberalism.

WH_2 – Environmental Innovation Potential is correlated to a states' level of economic freedom.

WH_3 – Environmental Innovation Potential is correlated to a states' level of greenness.

Preliminary correlation tests of this index compared to three other indices were run for exploratory purposes. Table 5.2 presents the correlation test results for three other indices: state policy liberalism, state economic freedom, and greenest state.

Table 5.2 – Correlation of Indices

		Environmental Innovation Potential	Liberalism	Economic Freedom	Green State
Environmental Innovation Potential	Correlation Coefficient	1.000	.069	.576**	.193
	N	50	50	50	50

** Correlation is significant at the 0.01 level (2-tailed).

A policy liberalism index explained and constructed by Gray et al. (2004) measures and ranks states' level of liberalism. The correlation test between the index developed in this study and the liberalism index produced a coefficient of .069. This shows a very weak correlation between these two indices.

An economic freedom index constructed by Sorens and Ruger (2009) measures and ranks states on their public policies affecting, specifically, economic freedom. The correlation test between the index developed in this study and the economic freedom index produced a coefficient of .576, which is significant at $\alpha = .01$. This is a strong correlation and is statistically significant. With an indication of such a strong correlation to economic freedom, further research could examine this relationship and explore the reasons.

Finally, Forbes magazine[45] ranked the 50 U.S. states on their level of "greenness" based on six categories: carbon footprint, air quality, water quality, hazardous waste management, policy initiatives and energy consumption. The correlation test between the index developed in this study and Forbes green index produced a weak correlation coefficient of .193. This weak correlation suggests that environmental commitment alone does not act alone in creating potential for a state to innovate for energy and the environment, but could be explored further.

These above mentioned working hypothesis (in addition to an exploration into the geographic make-up of the top and bottom scoring states) gives a solid foundation to future research around the formation of this index.

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[45] http://www.forbes.com/2007/10/16/environment-energy-vermont-biz-beltway-cx_bw_mm_1017greenstates.html

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Appendix A - Index

	Renewable Energy Per Capita	Score 0 - 6	Renewable R & D program expenditures (Per Capita	Score 0 - 5	Financial Incentives for Renewable Energy	Score 0 - 4	Financial Incentives for Energy Efficiency	Score 0 - 4	Rules, Regulations, & Policy as Incentives	Score 0 - 4	ACEEE Stringency Score	Score 0 - 6	Environmental Spending (Per Capita)	Score 0 - 5	Venture Capital Per Capita	Score 0 - 6	Alpha Order	Total Score	Rank Order	Rank	Total Score
Alabama	60.47	2.25	0.30	0.11	8	0.57	21	0.98	1	0.31	0.5	0.38	12.09	0.24	185.09	0.20	Alabama	5.03	California	1	24.34
Alaska	26.07	0.97	5.11	1.89	4	0.29	7	0.33	5	1.54	3	2.25	86.35	1.74	163.81	0.18	Alaska	9.18	Washington	2	22.38
Arizona	15.96	0.59	0.09	0.03	15	1.07	11	0.51	6	1.85	3	2.25	26.89	0.54	452.13	0.48	Arizona	7.33	Oregon	3	21.08
Arkansas	36.28	1.35	0.52	0.19	0	0.00	5	0.23	1	0.31	4	3.00	16.32	0.33	30.04	0.03	Arkansas	5.44	Montana	4	15.10
California	31.34	1.17	0.16	0.06	56	4.00	82	3.81	13	4.00	8	6.00	37.66	0.76	4232.92	4.54	California	24.34	Massachusetts	5	13.63
Colorado	9.61	0.36	1.35	0.50	21	1.50	20	0.93	6	1.85	3	2.25	11.79	0.24	2705.35	2.90	Colorado	10.52	Minnesota	6	13.62
Connecticut	13.23	0.49	1.67	0.62	13	0.93	25	1.16	3	0.92	4	3.00	38.30	0.77	1471.74	1.58	Connecticut	9.48	Nevada	7	12.73
Delaware	1.88	0.07	5.41	2.00	3	0.21	2	0.09	5	1.54	3	2.25	247.58	5.00	480.35	0.51	Delaware	11.68	Idaho	8	12.68
Florida	12.44	0.46	0.15	0.06	24	1.71	25	1.16	4	1.23	7	5.25	77.91	1.57	525.45	0.56	Florida	12.01	Florida	9	12.01
Georgia	26.06	0.97	1.02	0.38	11	0.79	26	1.21	2	0.62	5.5	4.13	15.76	0.32	866.81	0.93	Georgia	9.33	Delaware	10	11.68
Hawaii	13.80	0.51	0.25	0.09	9	0.64	5	0.23	3	0.92	3.5	2.63	64.43	1.30	274.53	0.29	Hawaii	6.62	New Hampshire	11	11.38
Idaho	107.55	4.00	0.92	0.34	9	0.64	22	1.02	4	1.23	6	4.50	40.79	0.82	111.52	0.12	Idaho	12.68	Wisconsin	12	11.37
Illinois	6.92	0.26	0.82	0.30	8	0.57	15	0.70	3	0.92	4.5	3.38	31.28	0.63	575.15	0.62	Illinois	7.37	New York	13	11.17
Indiana	8.75	0.33	1.33	0.49	26	1.86	35	1.63	2	0.62	1.5	1.13	44.14	0.89	107.75	0.12	Indiana	7.05	Colorado	14	10.52
Iowa	25.33	0.94	0.44	0.16	24	1.71	25	1.16	3	0.92	5	3.75	34.61	0.70	44.90	0.05	Iowa	9.40	Vermont	15	10.08
Kansas	7.75	0.29	0.17	0.06	2	0.14	4	0.19	1	0.31	3	2.25	23.69	0.48	174.56	0.19	Kansas	3.90	Maine	16	9.90
Kentucky	14.91	0.55	0.10	0.04	17	1.21	23	1.07	2	0.62	6	4.50	23.07	0.47	131.55	0.14	Kentucky	8.60	Texas	17	9.88
Louisiana	34.53	1.28	0.22	0.08	4	0.29	3	0.14	2	0.62	4	3.00	25.77	0.52	141.33	0.15	Louisiana	6.08	Utah	18	9.82
Maine	119.14	4.43	0.72	0.27	4	0.29	6	0.28	4	1.23	3	2.25	42.44	0.86	274.92	0.29	Maine	9.90	Connecticut	19	9.48
Maryland	9.56	0.36	0.51	0.19	24	1.71	8	0.37	3	0.92	4.5	3.38	18.25	0.37	1227.34	1.32	Maryland	8.61	Iowa	20	9.40
Massachusetts	9.09	0.34	1.60	0.59	19	1.36	31	1.44	3	0.92	3.5	2.63	17.74	0.36	5597.76	6.00	Massachusetts	13.63	Georgia	21	9.33
Michigan	12.23	0.45	2.90	1.07	10	0.71	4	0.19	3	0.92	2	1.50	40.35	0.81	155.68	0.17	Michigan	5.83	Alaska	22	9.18
Minnesota	21.14	0.79	1.05	0.39	25	1.79	82	3.81	4	1.23	5.5	4.13	27.47	0.55	871.15	0.93	Minnesota	13.62	New Jersey	23	8.70
Mississippi	22.09	0.82	4.00	1.48	6	0.43	10	0.47	0	0.00	0	0.00	33.87	0.68	121.98	0.13	Mississippi	4.01	North Carolina	24	8.70
Missouri	5.48	0.20	1.73	0.64	9	0.64	26	1.21	4	1.23	1.5	1.13	54.96	1.11	396.91	0.43	Missouri	6.59	Maryland	25	8.61
Montana	130.35	4.85	3.12	1.15	16	1.14	13	0.60	5	1.54	5	3.75	96.43	1.95	102.86	0.11	Montana	15.10	Kentucky	26	8.60
Nebraska	14.29	0.53	0.17	0.06	4	0.29	4	0.19	2	0.62	4	3.00	54.36	1.10	106.59	0.11	Nebraska	5.89	Pennsylvania	27	8.50
Nevada	29.08	1.08	13.52	5.00	5	0.36	4	0.19	3	0.92	5	3.75	62.96	1.27	149.83	0.16	Nevada	12.73	Virginia	28	8.25
New Hampshire	26.40	0.98	0.02	0.01	7	0.50	21	0.98	3	0.92	4.5	3.38	136.25	2.75	1739.62	1.86	New Hampshire	11.38	New Mexico	29	8.18
New Jersey	3.59	0.13	0.40	0.15	10	0.71	9	0.42	5	1.54	5	3.75	34.57	0.70	1218.19	1.31	New Jersey	8.70	South Carolina	30	7.89
New Mexico	10.44	0.39	1.21	0.45	11	0.79	8	0.37	4	1.23	5	3.75	51.44	1.04	155.69	0.17	New Mexico	8.18	Wyoming	31	7.46
New York	24.14	0.90	0.57	0.21	25	1.79	16	0.74	5	1.54	5.5	4.13	39.20	0.79	1005.09	1.08	New York	11.17	Rhode Island	32	7.45
North Carolina	19.36	0.72	0.35	0.13	10	0.71	18	0.84	4	1.23	4.5	3.38	42.78	0.86	778.02	0.83	North Carolina	8.70	Illinois	33	7.37
North Dakota	37.47	1.39	1.81	0.67	6	0.43	5	0.23	3	0.92	0	0.00	25.05	0.51	59.17	0.06	North Dakota	4.22	Arizona	34	7.33
Ohio	7.57	0.28	1.12	0.41	14	1.00	5	0.23	5	1.54	3.5	2.63	15.00	0.30	258.33	0.28	Ohio	6.67	Indiana	35	7.05
Oklahoma	14.74	0.55	0.03	0.01	7	0.50	6	0.28	1	0.31	4	3.00	14.97	0.30	129.54	0.14	Oklahoma	5.09	Ohio	36	6.67
Oregon	130.39	4.85	0.66	0.25	42	3.00	67	3.12	7	2.15	8	6.00	45.44	0.92	742.74	0.80	Oregon	21.08	Hawaii	37	6.62
Pennsylvania	10.49	0.39	1.02	0.38	18	1.29	10	0.47	3	0.92	4.5	3.38	43.67	0.88	752.82	0.81	Pennsylvania	8.50	Missouri	38	6.59
Rhode Island	5.88	0.22	0.00	0.00	8	0.57	6	0.28	4	1.23	4.5	3.38	65.05	1.31	434.31	0.47	Rhode Island	7.45	West Virginia	39	6.26
South Carolina	24.87	0.93	0.44	0.16	13	0.93	10	0.47	3	0.92	5	3.75	22.10	0.45	272.56	0.29	South Carolina	7.89	Louisiana	40	6.08
South Dakota	52.73	1.96	0.00	0.00	9	0.64	6	0.28	1	0.31	0	0.00	118.69	2.40	88.76	0.10	South Dakota	5.68	Nebraska	41	5.89
Tennessee	22.76	0.85	0.03	0.01	5	0.36	46	2.14	1	0.31	1	0.75	27.81	0.56	349.15	0.37	Tennessee	5.35	Michigan	42	5.83
Texas	8.88	0.33	0.48	0.18	12	0.86	44	2.05	4	1.23	5	3.75	24.19	0.49	933.86	1.00	Texas	9.88	South Dakota	43	5.68
Utah	7.09	0.26	0.69	0.25	9	0.64	11	0.51	6	1.85	6	4.50	37.52	0.76	970.68	1.04	Utah	9.82	Arkansas	44	5.44
Vermont	41.06	1.53	1.05	0.39	9	0.64	14	0.65	3	0.92	6	4.50	60.85	1.23	205.64	0.22	Vermont	10.08	Tennessee	45	5.35
Virginia	18.84	0.70	1.01	0.37	3	0.21	4	0.19	4	1.23	5	3.75	23.50	0.47	1234.91	1.32	Virginia	8.25	Oklahoma	46	5.09
Washington	161.36	6.00	0.19	0.07	37	2.64	86	4.00	4	1.23	8	6.00	27.97	0.56	1745.42	1.87	Washington	22.38	Alabama	47	5.03
West Virginia	14.20	0.53	0.00	0.00	2	0.14	1	0.05	1	0.31	4.5	3.38	89.48	1.81	48.50	0.05	West Virginia	6.26	North Dakota	48	4.22
Wisconsin	21.92	0.82	0.29	0.11	17	1.21	21	0.98	4	1.23	8	6.00	43.33	0.88	143.56	0.15	Wisconsin	11.37	Mississippi	49	4.01
Wyoming	35.45	1.32	0.38	0.14	5	0.36	7	0.33	1	0.31	0	0.00	1077.85	5.00	11.34	0.01	Wyoming	7.46	Kansas	50	3.90