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Innovation for Our Energy Future

State of the States 2009: Renewable Energy Development and the Role of Policy

Elizabeth Doris, Joyce McLaren, Victoria Healey, and Stephen Hockett

Technical Report
NREL/TP-6A2-46667
October 2009

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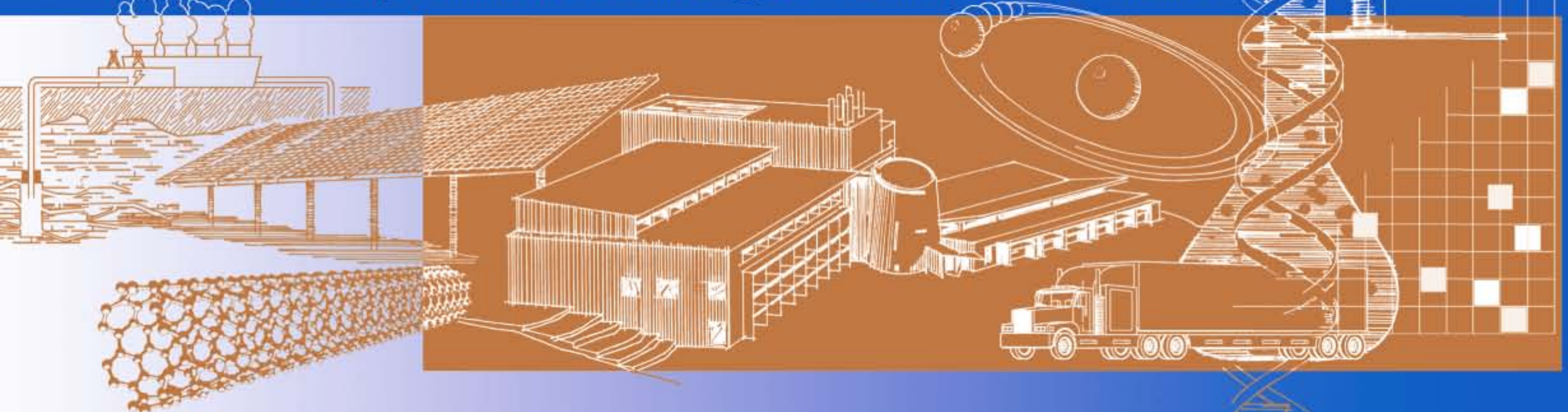

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Abstract

As U.S. states increasingly focus on developing renewable energy resources, there is a need to track the progress of development, as well as the policies and support mechanisms being implemented to encourage this development. Beyond tracking, the evaluation of policy measures is necessary to determine their effectiveness, guide future efforts, and efficiently allocate resources.

This report addresses each of these needs. It provides a detailed picture of the status of renewable energy development in each of the U.S. states using a variety of metrics and discusses the policies being used to encourage this development.

The report then explores the context in which renewable energy development occurs by discussing the factors that can affect the uptake of power generation technologies. The analysis offers suggestions on how policies can be used to address these variables, which leads to tailored policy support that considers the specific circumstances within each state.

The analysis presents results of several quantitative evaluation methods that have been designed to explore the link between policy implementation and actual development. These analyses are an attempt to move beyond designed-based policy evaluation and develop performance-based evaluation methods instead.

Finally, the report discusses contextual factors, aside from policy, that affect renewable energy development. Understanding contextual factors, which create the framework for renewable energy markets, is essential for effective policy design and implementation. The report concludes with a summary of the main points from each chapter, discussion of next steps, and a list of resources.

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List of Acronyms

ACEEE	American Council for an Energy-Efficient Economy
ACP	alternative compliance payment
ARRA	American Recovery and Reinvestment Act
AWEA	American Wind Energy Association
BLM	Bureau of Land Management
CESA	Clean Energy States Alliance
CHP	combined heat and power
DOE	Department of Energy (U.S.)
DSIRE	Database of State Incentives for Renewables and Efficiency
EERE	DOE Office of Energy Efficiency and Renewable Energy
EIA	Energy Information Administration
EISA	Energy Independence and Security Act
EPA	Environmental Protection Agency (U.S.)
EPAct	Energy Policy Act
FERC	Federal Energy Regulatory Commission
GHG	greenhouse gas
GSP	gross state product
GDP	gross domestic product
IAC	Industrial Assessment Centers
ICLEI	International Council for Local Environmental Initiatives
IEEE	Institute of Electrical and Electronics Engineers
IREC	Interstate Renewable Energy Council
ITP	Industrial Technologies Program
kWh	kilowatt-hour
LBNL	Lawrence Berkeley National Laboratory
MT	market transformation
MWh	megawatt-hour
NEPOOL	New England Power Pool
NARUC	National Association of Regulatory Utility Commissioners
NNEC	Network for New Energy Choices
NREL	National Renewable Energy Laboratory
PBF	public benefit fund
PBFRE	public benefit fund with renewable energy
PPA	power purchase agreement
PSC	public service commission
PTC	production tax credit
PUC	public utility commission
PV	photovoltaics
R&D	research and development
RE	renewable energy
REC	renewable energy certificate
RPS	renewable portfolio standard
SBC	systems benefit charge
SCEPA	State Clean Energy Policies Analysis

SOS08	State of the States 2008 (last year's edition of this report)
TAP	Technical Assistance Project
TOU	time of use
TWh	terawatt-hour
UCS	Union of Concerned Scientists
UL	Underwriters Laboratories
WGA	Western Governors' Association
WIP	Weatherization and Intergovernmental Program
WPA	Wind Powering America
WREGIS	Western Region Electricity Generation Information System

Executive Summary

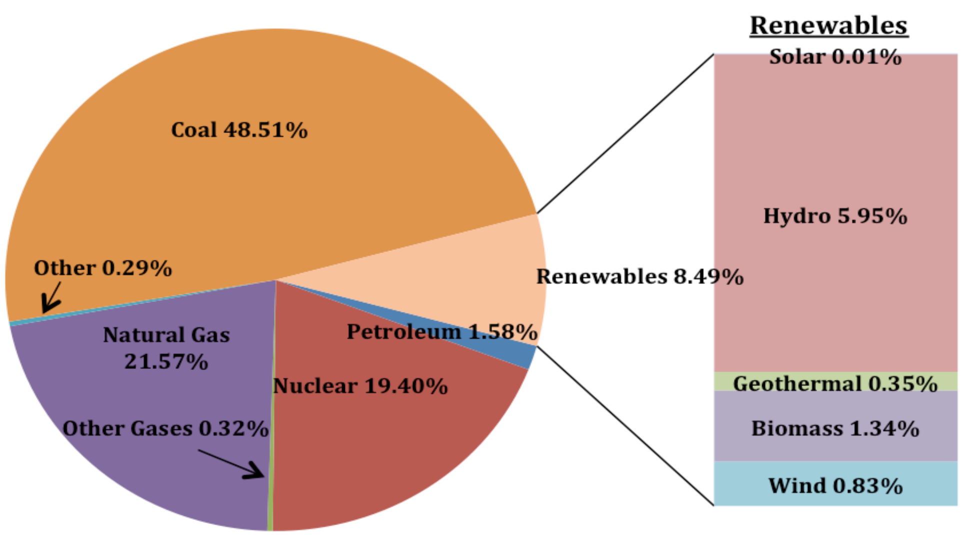
Increasing numbers of U.S. states and territories are implementing policy measures and dedicating funding to encourage the deployment of renewable energy technologies. The design and implementation of these incentives is varied – and so are the development trends.

This report tracks the progress of renewable energy development within the states, as well as the policies and support mechanisms implemented to encourage this development. Renewable resources supplied 8.5% of the total electricity generation in 2007, and hydroelectric generation continues to represent the largest portion at 70% (**Table ES-1, Figure ES-1**).

Table ES-1. U.S. National Renewable Energy Generation by Resource

Resource	Percent of Total U.S. Electricity Generation	Percent of Total Renewable Generation	MWh Generated
Biomass	1.34%	15.74%	55,538,579
Geothermal	0.35%	4.15%	14,637,213
Large-scale solar	0.01%	0.17%	611,793
Wind	0.83%	9.77%	34,449,927
Non-hydro renewable resources	2.53%	29.83%	105,237,512
Hydroelectric	5.95%	70.17%	247,509,975
Total renewable resources	**8.49%**	**100%**	**352,747,487**

Source: EIA 2009



Source: EIA 2009c

Figure ES-1. U.S. Electricity Generation by Source, 2007

Wind resources experienced the largest growth of the renewable energy technologies in recent years, increasing 30% from 2006 to 2007. Biomass and solar electricity generation has increased at a slower rate, with gains of 11.6% and 12.72% between 2001 and 2007, respectively. Net metering, interconnection standards, renewable portfolio standards, tax incentives, renewable energy access laws, and generation disclosure laws are the most prevalent renewable energy state policies.

Beyond tracking policy implementation and development, this report presents new approaches to policy evaluation. This analysis aims to augment traditional case-study and qualitative analyses to develop a quantitative understanding of policy impacts using statistical and empirical methods, as well as to open the door for more thorough analyses of policy options, inform future policy development, and ultimately optimize the market share of renewable energy resources.

Statistical analyses reveal several interesting results. States that implemented net-metering legislation in 2005 had significantly more renewable energy generation in 2007 than states without such a policy. Combining generation disclosure requirements with required green power programs is also connected with significantly higher levels of development. The analysis identifies several features (design elements) of renewable portfolio standard policies that significantly contribute to increased renewable energy development when looked at individually. However, this analysis does not find any single model for a renewable portfolio standard that is correlated with significant increases in development. Further research on each of these observations is warranted, along with developing more robust methodologies for exploring the effectiveness of policy portfolios and best practice designs.

The report shows positive correlations between the total number of market transformation policies within a given state (including both barrier reduction and technology accessibility policies) and the total megawatt-hours (MWh) of renewable energy generated within that state. This relationship is particularly true when considering individual renewable energy resources (e.g., wind, solar, biomass).

There are many contextual factors, other than policies, that affect renewable energy development. These include, but are not limited to, resource and technology availability, the economic context, land use and public perception issues, transmission availability, institutional structures, and financing. Understanding the contextual factors within which policies are placed is essential to defining the most appropriate policy features.

Chapter 1. Introduction and Background

As concerns about energy security, climate change, and the depletion of fossil fuel resources heighten, the development of renewable energy resources has become the subject of much discussion. Renewable energy (RE) not only provides a clean, sustainable source of energy production, but these technologies also benefit job creation, economic stimulation, increased rural development, health-related impacts, and positive spill-over effects to other sectors.

Despite the many benefits of renewable energy, development remains slow. Policies to stimulate the deployment of clean energy technologies are necessary for creating a level playing field by addressing market barriers, internalizing externalities, and creating levelized price structures and access to infrastructure.

Increasing numbers of U.S. states and territories are implementing policy measures and dedicating funding to encourage the deployment of renewable energy technologies. The design and implementation of these incentives is varied – and so are the development trends.

This report summarizes the current status of renewable energy development in the U.S. states, identifying trends and high-performing states based on a variety of measures (**Chapter 2**). It identifies the policies that are being used to encourage this development, and presents the current understandings of design-based best practices (**Chapter 3**). The analysis draws a connection between the policies and development, using a quantitative investigation of the relationship between policy implementation and actual generation, and a variety of statistical analyses (**Chapter 4**). The report explores other factors that affect renewable energy development to place the policy discussion within the broader context (**Chapter 5**). And, finally, the report provides overall conclusions, next steps, and a list of resources (**Chapter 6**).

The context of the report within existing literature

Significant efforts have been made to document success stories and lessons learned from past and recent policy implementations. These case studies provide important insights and inform the growing field of literature on policy design practices (e.g., Couture and Cory 2009, Hurlbut 2008, Lantz and Doris 2009, Wiser et al. 2007 and 2002). The general understanding regarding effective policy actions have been compiled into best practices and step-by-step guides that assist policymakers in their efforts to develop policies and programs tailored to their state clean energy goals. The Environmental Protection Agency (EPA) has published a "State and Local Guide to Action" that outlines a strategy for developing energy efficiency and renewable energy through planning and policy implementation and provides lessons learned for 16 commonly used policies (EPA 2008). Lawrence Berkeley National Laboratory (LBNL) has an extensive list of downloadable case studies on renewable energy project and policy implementation (LBNL 2009). The U.S. Department of Energy (DOE) also provides case studies and examples of energy efficiency and renewable energy projects (DOE 2009). These, and other resources, are listed at the end of this report.

What has been missing from the literature, however, is a quantitative link between the implementation of particular policies and the development that is spurred by those policies. A group of partner reports, which complement this *State of the States* report and are products of the State Clean Energy Policies Analysis (SCEPA) project, begin a quantitative exploration of the effects of individual policies on economic development, environmental, and energy security benefits (www.nrel.gov/applying_technologies/scepa.html). This report addresses remaining questions, targeting policy impact on renewable energy development, specifically:

- Which policies or combinations of policies are working, and to what degree are they increasing development?
- Can a quantitative approach to policy evaluation provide more insight into effective policy approaches?
- What methods are most applicable to a results-based policy evaluation?

The report takes an enhanced approach to the traditional case studies and qualitative policy analyses, moving toward a quantitative understanding of policy impact. This analysis opens the door for more thorough analyses of policy options; informs future policy development; and, ultimately, optimizes the market share of renewable energy resource use.

New Developments in State of the States (SOS) 2009

This second annual *State of the States* report updates and expands on the efforts initiated in last year's report. An overarching goal in this year's edition is to improve the accessibility of the information. The authors accomplish, through a reorganization of the sections, a streamlined format, and increased use of graphics.

The metrics used in the presentation of the generation trends and growth in development is updated to most recently available information, but otherwise unchanged from *State of the States* (SOS) 2008, which allows for easy comparison with the previous year's results. The authors restructured and expanded the policy discussion, and provide new understandings of best practices and policy developments within the states.

The authors also significantly expanded the quantitative analyses linking policy implementation with development trends has been built on. They revisited the statistical methodology, and took a different, more robust, approach to the analysis. In addition, the analysts explored linkages from several new angles, both for individual policies and for combinations of policies. This presentation does not represent an ideal method, but it represents progress in an ongoing effort to develop a robust methodology for quantitative policy evaluation.

The results of both qualitative and quantitative investigations of policy impact point to the extensive role that other contextual factors play in renewable energy development. Policies do not work in a vacuum; they are influenced by and also influence many other elements within the larger market and society. In the previous edition of this report (Brown and Busche 2008), these contextual factors were presented in an overview fashion. This year's report provides a more in-depth treatment of these factors, the way they interplay with each other, and the way they influence and are influenced by policy. Similar to the quantitative policy evaluation, this exploration of the contextual elements does not represent a complete work, but a stage in an ongoing effort.

The analysts conducted this work in the context of a volatile market, both generally and for renewable energy specifically. Major federal level changes in the strategy for promoting clean energy development are resulting in increased state-level interest and changes to existing policy. This report serves as a source of additional knowledge to inform decisions, spur creative solutions, and lead to an efficient allocation of resources, moving toward the goal of a sustainable energy system.

Chapter 2. Quantitative Trends in Renewable Energy Development

Introduction

This chapter discusses trends in renewable energy development based on the most recent renewable electricity generation and capacity data available (2007). A variety of metrics are used to explore the trends in development at the national and state levels. National renewable electricity generation is presented with and without large hydroelectric generation.[1] Generation for individual technologies is provided to reflect resource differences among states and emphasize the need to take advantage of available local resources.

To help compare data among states and to begin to account for the contextual differences among states, the state-by-state data is normalized for three parameters: percentage of total electricity generation, state population, and gross state product (GSP). Definitions of these metrics are given in the following sections. The analysis is presented in tables that rank the states as well as maps highlighting the top producers according to each metric.

In addition to annual data, the chapter provides renewable electricity generation growth figures, presented as percentage increases over time. The strength of this metric is that it lends more weight to growth in states reporting little or no renewable energy in the beginning year. While the actual improvements may be small in terms of actual capacity development, they are sometimes large in terms of resource development and, therefore, may represent significant steps in the transition to a clean energy economy.

Definitions of Resources for Data Gathering

The definition of renewable energy for this report includes biomass, geothermal, hydroelectric, solar (utility scale), and wind, as defined and tracked by the U.S. Department of Energy's Energy Information Administration (EIA). Also included in some tables, as noted, are distributed solar capacity data as tracked by the Interstate Renewable Energy Council (Sherwood 2008 and personal communication, June 8, 2009) and wind capacity data as tracked by the American Wind Energy Association (AWEA 2009a). The resource definitions used in this report are given below. It should be noted that some states may use different resource definitions.

Biomass

Agricultural crops and residues; dedicated energy crops (herbaceous and tree species); forestry products and residues; residues and byproducts from food, feed, fiber, wood, and materials processing plants [sawdust from sawmills, black liquor (a byproduct of paper making), cheese whey (a byproduct of cheese-making processes), and animal manures]; post-consumer residues and wastes, such as fats, greases, oils, construction and demolition wood debris and other urban wood waste, municipal solid wastes and wastewater, and landfill gases (Milbrandt 2008). The specific EIA definition includes landfill gas/MSW biogenic, wood, and wood derived fuels (EIA 2009a, 2008).

[1] Large-scale hydroelectric generation can be considered an established technology and may or may not be affected by current policy innovations. To accommodate this argument, the technology is presented both ways in this report.

Geothermal
Electricity produced centrally from heat in the earth.

Hydroelectric (conventional)
Electricity derived from the movement of water. The EIA defines a conventional plant as one in that "all of the power is produced from natural streamflow as regulated by available storage." (EIA 2009a) Pumped storage is not collected and reported under this definition, because the EIA considers it to use nonrenewable resources for operation (EIA 2009b). Hydroelectric generation, in particular, is considerably influenced by non-policy issues such as rainfall patterns and climate change. Consequently, in future issues of the report, hydroelectric capacity data will be included to account for variations in annual rainfall.

Solar (utility scale)
The radiant heat from the sun, which can be converted into electricity on a large scale, such as through concentrated solar power, concentrated photovoltaics (PV), or similar technologies.

Solar (distributed)
On-grid distributed solar electric noncentral electricity generation resources, including residential, commercial, and industrial applications. Primary technology is photovoltaics.

Wind
The extraction of kinetic energy from the wind for conversion into electricity.

Data Sources
The EIA dataset is considered the most comprehensive source for electricity generation information in the United States, and it is the primary source for trends information in this report (with noted exceptions). Other datasets were considered for inclusion in this report, including the International Energy Agency, but these did not include sub-national-level data, so were inadequate for use in this evaluation of state policies. There are a number of challenges in collecting renewable electricity generation information for the state level, and improving the dataset is an ongoing effort. The strength of the

Challenges with EIA Renewable Energy Data

EIA data is not entirely comprehensive, especially when it comes to renewable energy development. Although the agency is constantly working to improve data collection, there are limitations to the dataset used in this report:

- **Lack of Comprehensive Reporting from D.C. and U.S. Territories**. Initial analysis for this report included assembling data for the District of Columbia (D.C.) and five primary U.S. territories (American Samoa, Guam, Northern Marianas, Puerto Rico, and the U.S. Virgin Islands). Preliminary energy data for the territories, taken from EIA sources, were insufficient for this analysis in terms of specificity of generation and measurement. In an attempt to supplement these data, personal interviews were conducted with energy contacts from these locations; however, the data remain insufficient to include territories in this analysis. Refined reporting of territory data in the future could allow for the territories to be included within a state comparison.
- **Lack of Comprehensive Distributed Resource Data.** The EIA does not collect comprehensive data on distributed solar PV. As a result, only four states report solar resource development, when it is widely known that there is extensive smaller-scale solar development. While the agency improves data collection techniques, this report augmented the dataset with capacity for distributed PV collected by the Interstate Renewable Energy Council (IREC) with funding from the DOE Solar Energy Technologies Program (Sherwood 2008). It is anticipated that there are other distributed energy-related limitations of the data that are discussed for each technology and will be further explored in a later version of this report.

EIA dataset, and the reason it is employed here, is its standardization of definitions and data collection techniques, which allow for nationwide comparisons.

The EIA does not collect data on distributed solar electricity generation. Solar PV data presented in this report represent installed capacity for 2008 (**Table 2.16**), collected by the Interstate Renewable Energy Council using established methodologies described in Sherwood (2008).

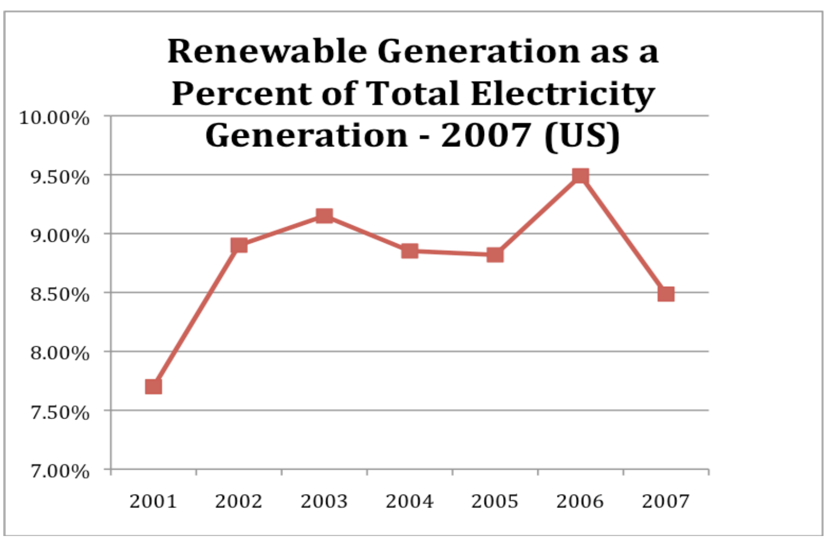
Data for installed wind capacity are taken from the American Wind Energy Association's (AWEA 2009b) projects database (**Table 2.20**). This represents the most recent state-level data concerning wind capacity installments and projects.

Sources of data for renewable-based electricity generation in the U.S. territories are limited. The data presented here are taken from the available information from EIA.

The data provided in this report represent the most recent publicly available information. Significant market changes between 2007 and 2009 are expected to have an impact on renewable energy generation, and these changes will be reported in later versions of this report as the data becomes available.

National Renewable Energy Generation Data

In 2007, generation from renewable resources in the United States constituted 8.49% (352,747,487 MWh) of total US electricity generation (4,156,669,475 MWh). This represents a decline from 2006 **(Figure 2.1).** This decline may be accounted for by the rapid rise in electricity demand, as well as a decline in hydroelectric generation as a result of retirements and reduced water resources for power generation due to drought.



Source: EIA 2009

Figure 2.1. Renewable Generation as a Percent of Total U.S. Electricity Generation, 2007

National Renewable Energy Growth Data

Renewable energy growth figures are presented below as percentage increase over time. The strength of this metric is that it lends more weight to growth in states reporting little or no renewable energy in the initial year. While the actual improvements may be small in terms of actual capacity development, they represent large strides in the growth of individual resource development.

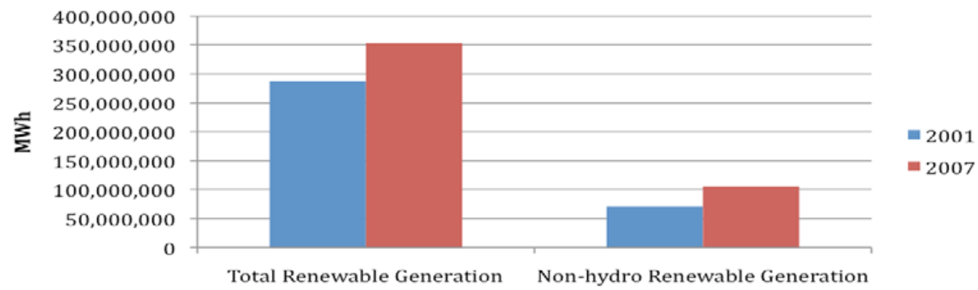
Percent changes in generation are given for the six-year period from 2001 to 2007 (**Figure 2.2)**, as well as during the one-year period from 2006 to 2007 (**Figure 2.3**). The 2006-2007 percent changes represent the improvements made since last year's version of this report.

These percent-change figures are considered valuable because single-year data do not sufficiently describe changing trends. The time-series data shows changes for specific technologies or within certain geographic regions. Highlighting these changes assists in analyzing the effects of technological development, policy implementation, or other variables at play in renewable energy deployment. The growth metrics also demonstrate how states are taking advantage of their available renewable resources and identify areas of opportunity.

The results show that overall renewable energy generation increased between 2001-2007, and the percentage of that generation being provided by hydroelectricity is declining. Non-hydroelectric renewable electricity generation as a percentage of GDP also increased during this time period, although this is not the case when hydroelectric generation is included in the mix. Wind energy experienced the largest growth in terms of its percentage of total renewable generation, while the proportions of hydroelectricity and biomass declined.

Data since last year's report indicate that overall renewable energy generation declined between 2006-2007, primarily due to a decrease in hydroelectric generation. Non-hydroelectric renewable energy experienced an increase in all the metrics (total generation, percent of total electricity, per capita, and per GDP). Wind energy made up the largest proportion of the growth; however, all technologies saw an increase in capacity development.

National Growth Data, 2001 – 2007



Source: EIA 2009

Figure 2.2. Total Renewable and Non-Hydroelectric Renewable U.S. Electricity Generation, 2001 and 2007

Total Renewable Electricity Growth (including hydroelectric)

- Thirty-six states have increased generation from total renewable resources between 2001-2007.
- Total renewable electricity generation increased 22.6%, to reach 352,747,487 MWh between 2001-2007.
- Total renewable electricity generation as a percent of total electricity increased 10.2% between 2001-2007.
- Total renewable electricity generation per capita increased 16% between 2001-2007.
- Total renewable electricity generation per GDP decreased 10.23% between 2001-2007.

Total Renewable Electricity Growth (excluding hydroelectric)

- Forty-five states increased electricity generation from non-hydroelectric renewable resources between 2001-2007.
- Non-hydro renewable electricity generation as a percent of total electricity generation increased 33.7% between 2001-2007.
- Non-hydro renewable electricity generation per capita increased 40.7% between 2001-2007.
- Non-hydro renewable electricity generation per GDP increased 8.9% between 2001-2007.
- Non-hydro renewable electricity generation increased 48.71%, from 70,768,659 MWh to 105,237,512 MWh between 2001-2007.
- Non-hydro renewable electricity generation as a percent of total renewable generation increased from 24.6% to 29.83% between 2001-2007.

Biomass Growth

- Thirty-two states increased electricity generation from biomass resources between 2001-2007.
- Total biomass electricity generation increased 11.6%, from 48,748,059 MWh to 55,538,579 MWh between 2001-2007.
- Total biomass generation as a percent of total renewable electricity generation decreased from 17.29% to 15.74% between 2001-2007.

Geothermal Growth

- Four states increased electricity generation from geothermal resources between 2001-2007.
- Geothermal electricity generation increased 6.53%, from 13,740,503 MWh to 14,637,213 MWh between 2001-2007.

Solar Growth

- Four states increased electricity generation from large-scale solar technologies between 2001-2007.
- Solar electricity generation increased 12.72%, from 542,760 MWh to 611,793 MWh between 2001-2007.

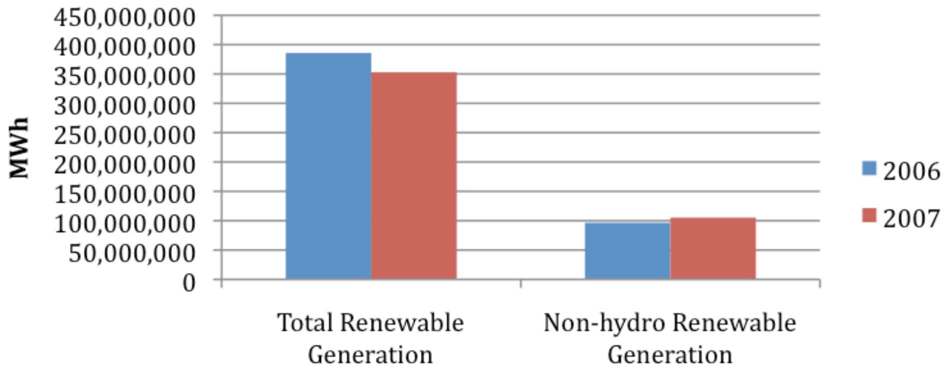
Wind Growth

- Twenty-eight states increased electricity generation from wind resources between 2001-2007.
- Wind electricity generation increased 411%, from 6,737,337 MWh to 34,449,927 MWh between 2001-2007.
- Wind electricity generation as a percent of total renewable generation increased from 2.34% to 9.77% between 2001-2007.
- Eleven states began producing electricity from wind for the first time between 2002 and 2006. One state (Maine) began producing electricity from wind for the first time in 2007.

Hydroelectric Growth

- Twenty-nine states increased electricity generation from hydroelectric resources.
- Hydroelectric generation increased 14.08%, from 216,961,046 MWh to 247,509,975 MWh between 2001-2007.
- Hydroelectric generation as a percent of total renewable generation decreased from 75.4% to 70.17% between 2001-2007.

National Growth Data, 2006 -2007



Source: EIA 2009

Figure 2.3. Renewable and Non-Hydroelectric Renewable U.S. Electricity Generation, 2006 and 2007

Total Renewable Electricity Growth (including hydroelectric)

- Eighteen states increased electricity generation from renewable resources from 2006-2007.
- Total renewable electricity generation decreased 8.56%, from 385,771,907 MWh to 352,747,487 MWh from 2006-2007.
- Total renewable electricity generation as a percent of total electricity decreased 10.6% (from 9.49% to 8.49%) from 2006-2007.
- Total renewable electricity generation per capita decreased 9.33% from 2006-2007.
- Total renewable electricity generation per GDP decreased 12.5% from 2006-2007.

Total Renewable Electricity Growth (excluding hydroelectric)

- Thirty-one states increased electricity generation from non-hydroelectric renewable resources from 2006-2007.
- Non-hydro renewable electricity generation increased 9.03%, from 96,525,492 MWh to 105,237,512 MWh from 2006-2007.
- Non-hydro renewable electricity generation as a percent of total electricity increased 6.6% (from 2.37% to 2.53%) from 2006-2007.
- Non-hydro renewable electricity generation as a percent of total renewable generation increased from 25% to 30% from 2006-2007.
- Non-hydro renewable electricity generation per capita increased 8.1% from 2006-2007.
- Non-hydro renewable electricity generation per GSP increased 4.33% from 2006-2007.

Biomass Growth

- Twenty-five states increased electricity generation from biomass resources from 2006-2007.
- Biomass electricity generation increased 1.24%, from 54,860,620 MWh to 55,538,579 MWh from 2006-2007.
- Biomass electricity generation as a percent of total renewable electricity generation increased from 14.22% to 15.74% from 2006-2007.

Geothermal Growth

- Two states increased electricity generation from geothermal resources from 2006-2007.
- Geothermal electricity generation increased 0.47%, from 14,568,029 MWh to 14,637,213 MWh from 2006-2007.

Solar Growth

- Three states increased generation from large-scale solar technologies from 2006-2007.
- Solar electricity generation increased 20.5%, from 507,706 MWh to 611,793 MWh from 2006-2007.

Wind Growth

- Twenty-four states increased electricity generation from wind resources from 2006-2007.
- Wind electricity generation increased 29.56%, from 26,589,137 MWh to 34,449,927 MWh from 2006-2007.
- Wind electricity generation as a percent of total renewable generation increased from 6.89% to 9.77% from 2006-2007.

Hydroelectric Growth

- Ten states have increased electricity generation from hydroelectric resources from 2006-2007.
- Hydroelectric generation decreased 14.43%, from 289,246,415 MWh to 247,509,975 MWh from 2006-2007.
- Hydroelectric generation as a percent of renewable generation decreased from 75% to 70% from 2006-2007.

State-by-State Renewable Energy Generation Data

This section shows state-by-state data for renewable energy generation.

In addition to total generation figures, the state-by-state data are normalized for three parameters:

- percentage of total state electricity generation,
- state population, and
- gross state product (GSP).

These metrics begin to account for the unique contexts within each state. Population data for the states are from the U.S. Department of Commerce Census Bureau (Census Bureau 2008). State GSP data are compiled from the U.S. Bureau of Economic Analysis (BEA 2009). And, unless otherwise noted, generation data are from the EIA (2009c).

Total Generation

The total state renewable electricity generation numbers are presented:

Table 2.1 – Total generation, including hydroelectric
Table 2.2 – Total generation, excluding hydroelectric

Total generation for each individual technology is presented:

Table 2.7 – Biomass
Table 2.10 – Hydroelectric
Table 2.13 – Geothermal
Table 2.17 – Wind

Renewable Energy as a Percentage of Total Generation

Relating renewable energy generation to the total in-state generation is a normalizing metric, which adds context to the state progress toward renewable-based electricity development:

Table 2.3 – Renewable energy percentages, including hydroelectric
Table 2.4 – Renewable energy percentages, excluding hydroelectric

When hydroelectric is included, northwestern states generate more than three-quarters of in-state generation from renewable resources. Large-scale hydroelectric developments are the primary contributors to this generation. When considering non large-scale hydroelectric –to focus on developing renewable energy markets – no state produces more than 26% of electricity from renewable resources, and most states generate less than 5%.

Renewable energy generation, as a percent of total generation, for each individual technology is presented:

Table 2.7 – Biomass percentage of total
Table 2.10 – Hydroelectric percentage of total
Table 2.13 – Geothermal percentage of total
Table 2.17 – Wind percentage of total

Generation per Capita

Generation per capita is another normalizing metric to gain insight into trends. States that generate a large amount of electricity from renewable sources relative to the size of their population top this list.

Generation per capita is presented for each individual technology:

Table 2.7 – Biomass generation per capita
Table 2.10 – Hydroelectric generation per capita
Table 2.13 – Geothermal generation per capita
Table 2.17 – Wind generation per capita

When all renewable resources are considered, hydroelectric resource use in the northwestern states launches Washington and Montana to more than 10 MWh of generation per person (**Table 2.1**). When those resources are removed, Maine has the highest generation per capita at 3.2 MWh per capita, with the vast majority of states generating less than one MWh per capita (**Table 2.2**).

Generation per Gross State Product (GSP)

Normalizing for economic context provides further insights into renewable electricity generation. **Table 2.1** also presents a metric that normalizes generation using GSP, a traditional measure of state economic output. Similar to population analysis, states that generate a large amount of electricity from renewable sources relative to their GSP will top this list. To rank higher, more economically productive states would need to generate a larger amount of renewable-based electricity.

Generation per GSP is presented for each individual technology:

Table 2.7 –Biomass generation per GSP
Table 2.10 – Hydroelectric generation per GSP
Table 2.13 – Geothermal generation per GSP
Table 2.17 – Wind generation per GSP

Renewable Energy Growth

"Growth" rankings provide information on the largest growth rates from 2001 to 2007, and 2006 to 2007. The former is designed to report champions in renewable growth during a six-year period. The latter is designed to highlight the states that have shown the most growth in the most recent single year period for which data is obtained. The data is separated into technology and then normalized for comparisons between technology and states.

To show the growth of each of the renewable energy technologies in the states, growth from 2001 to 2007, and from 2006 to 2007 is presented:

Tables 2.3 – 2.6 - Total renewable energy growth, including and excluding hydroelectric
Tables 2.8 – 2.9 – Biomass growth
Tables 2.11 – 2.12 - Hydroelectric growth
Tables 2.14 – 2.15 - Geothermal growth
Tables 2.18 – 2.19 - Wind growth

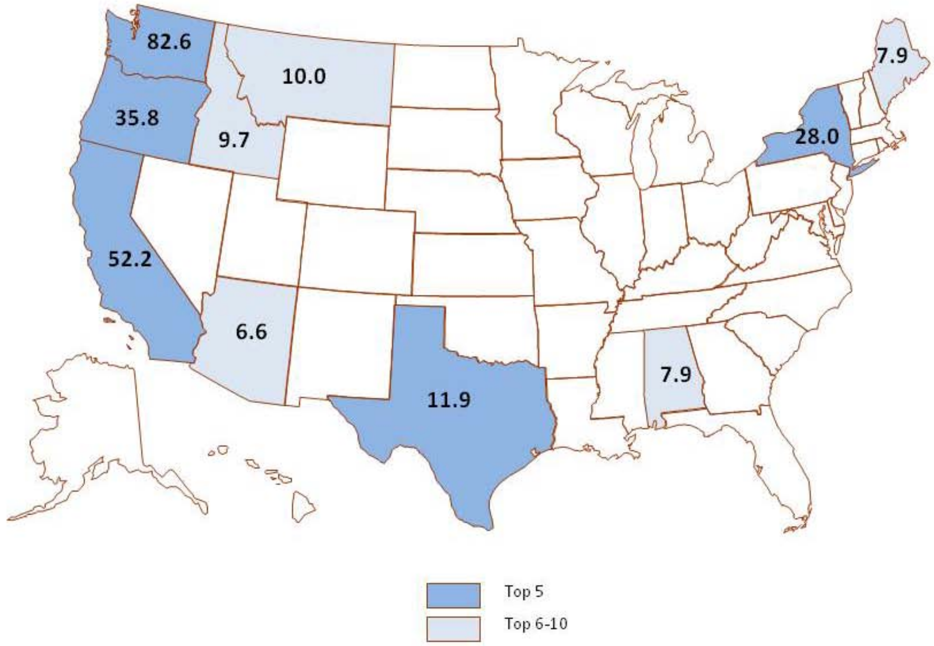
Table 2.1. Total Renewable Electricity Generation

MWh Generated (2007)			As a Percentage of Total State Electricity Generation (2007)		
Rank	**State**	**MWh**	**Rank**	**State**	**% of Total**
1	Washington	82,559,749	1	Idaho	84.2%
2	California	52,173,008	2	Washington	77.2%
3	Oregon	35,815,731	3	Oregon	65.0%
4	New York	28,027,638	4	South Dakota	50.0%
5	Texas	11,932,049	5	Maine	49.3%
6	Montana	9,971,057	6	Montana	34.5%
7	Idaho	9,674,539	7	California	24.7%
8	Maine	7,945,148	8	New York	19.2%
9	Alabama	7,936,734	9	Alaska	19.1%
10	Arizona	6,639,310	10	Vermont	19.1%

Per Capita (2007)			Per GSP (MWh/M$) (2007)		
Rank	**State**	**MWh/Capita**	**Rank**	**State**	**MWh/$M**
1	Washington	12.8	1	Montana	291.1
2	Montana	10.4	2	Washington	265.2
3	Oregon	9.6	3	Oregon	226.4
4	Idaho	6.5	4	Idaho	189.1
5	Maine	6.0	5	Maine	165.2
6	South Dakota	3.9	6	South Dakota	90.4
7	North Dakota	3.0	7	North Dakota	70.0
8	Wyoming	2.8	8	Arkansas	51.0
9	Alaska	1.9	9	Alabama	47.9
10	New Hampshire	1.8	10	Wyoming	47.1

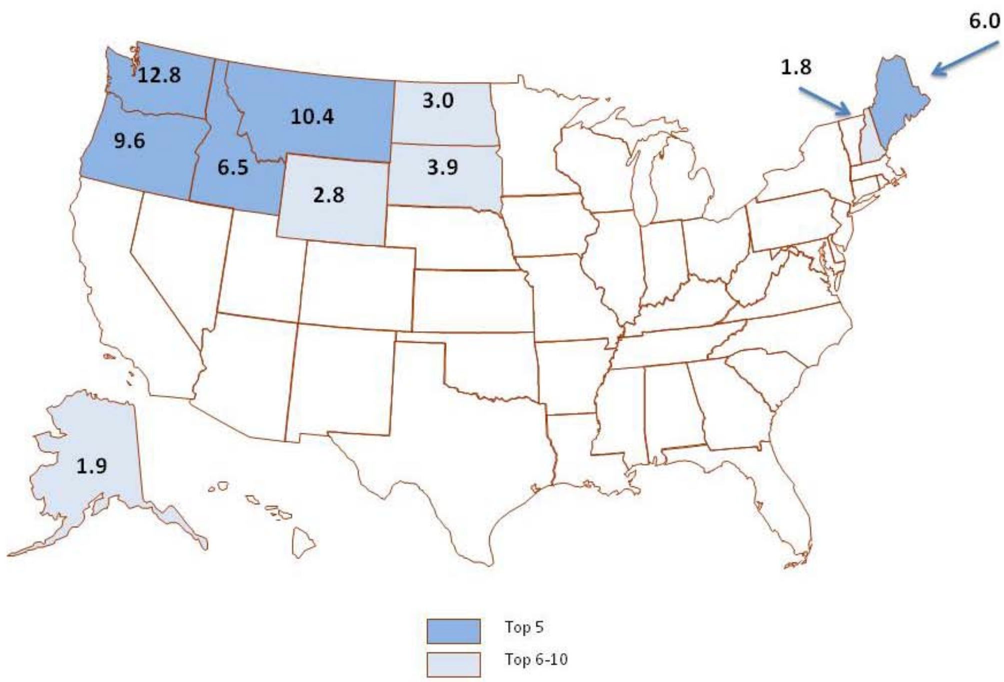
Source: EIA 2009

Table 2.2. Non-Hydroelectric Renewable Electricity Generation					
MWh Generated (2007)			As a Percentage of Total State Electricity Generation (2007)		
Rank	State	MWh	Rank	State	% of Total
1	California	24,845,257	1	Maine	26.1%
2	Texas	10,287,612	2	California	11.8%
3	Florida	4,302,817	3	Vermont	8.0%
4	Maine	4,206,980	4	Minnesota	7.2%
5	Minnesota	3,932,638	5	Hawaii	6.5%
6	Alabama	3,800,620	6	Iowa	5.8%
7	Washington	3,730,554	7	Idaho	5.7%
8	Georgia	3,415,421	8	New Hampshire	4.8%
9	Louisiana	2,979,883	9	Oregon	4.1%
10	Iowa	2,907,776	10	Nevada	4.0%
Per Capita (2007)			Per GSP (MWh/M$) (2007)		
Rank	State	MWh/Capita	Rank	State	MWh/$M
1	Maine	3.2	1	Maine	87.5
2	Wyoming	1.4	2	Wyoming	24.0
3	North Dakota	1.0	3	Alabama	22.9
4	Iowa	1.0	4	North Dakota	22.9
5	New Hampshire	0.9	5	Iowa	22.5
6	Alabama	0.8	6	New Hampshire	19.6
7	Minnesota	0.8	7	Vermont	18.9
8	Vermont	0.7	8	New Mexico	18.5
9	New Mexico	0.7	9	Montana	17.7
10	California	0.7	10	Arkansas	17.0
Source: EIA 2009					



Source: State of the States 2009

Figure 2.4. Total Renewable Energy Generation (TWh)



Source: State of the States 2009

Figure 2.5. Total Renewable Energy Generation (MWh/Capita)

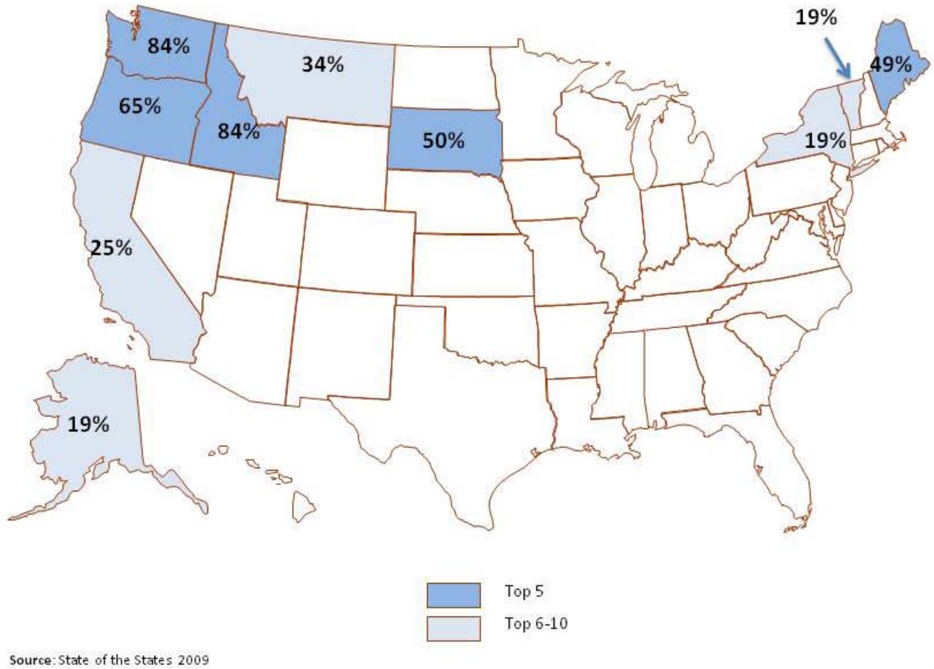


Figure 2.6. Percentage of Total State Electricity Generation: All Renewable Resources

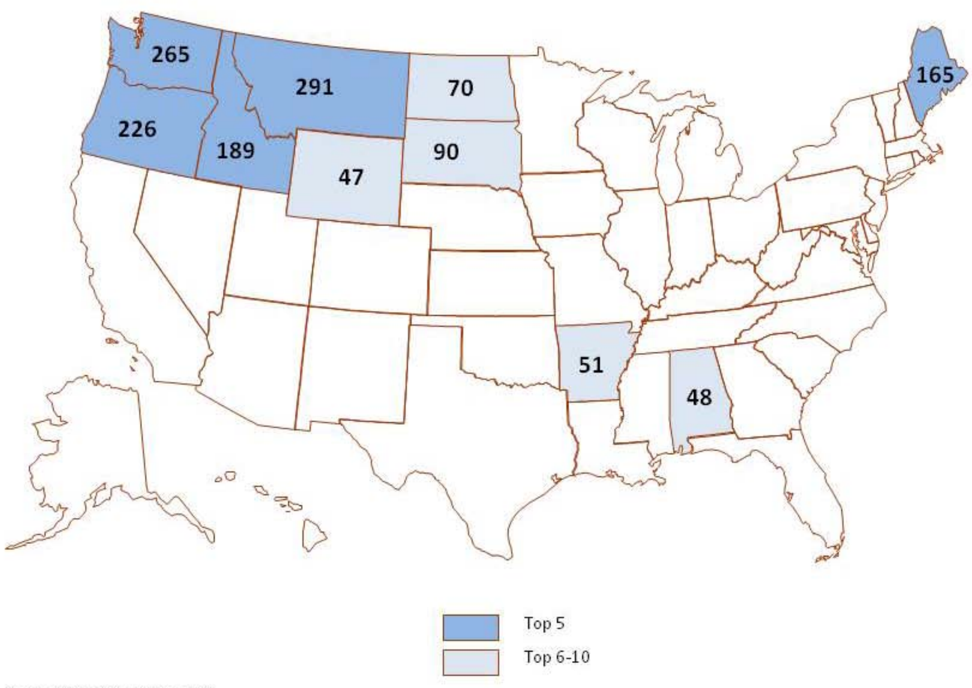


Figure 2.7. Total Renewable Energy Generation (MWh/M$ 2007 GSP)

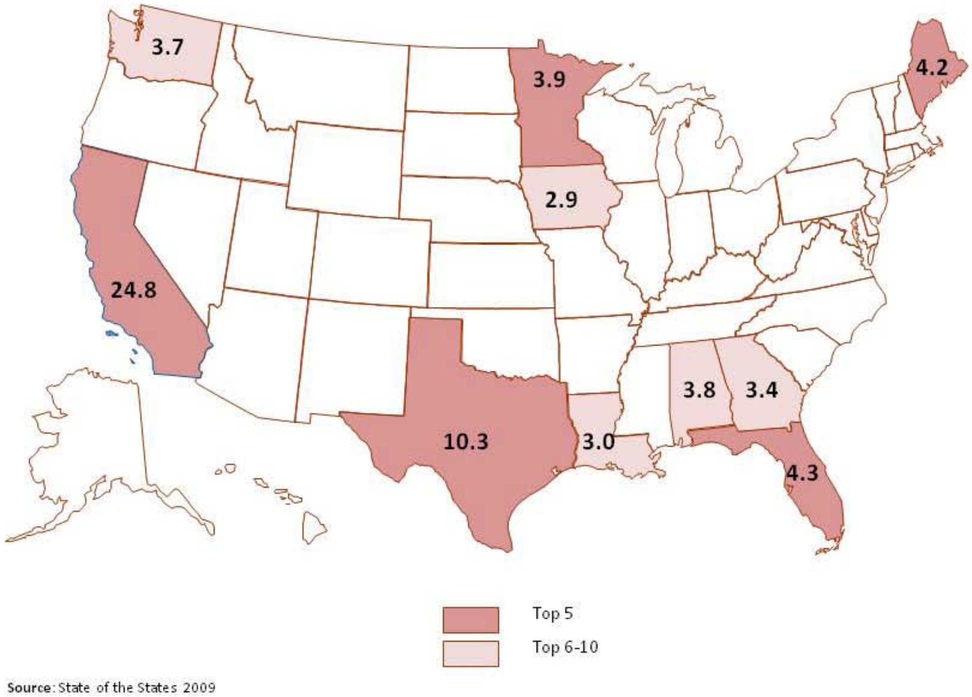


Figure 2.8. Non-Hydroelectric Renewable Electricity Generation (TWh)

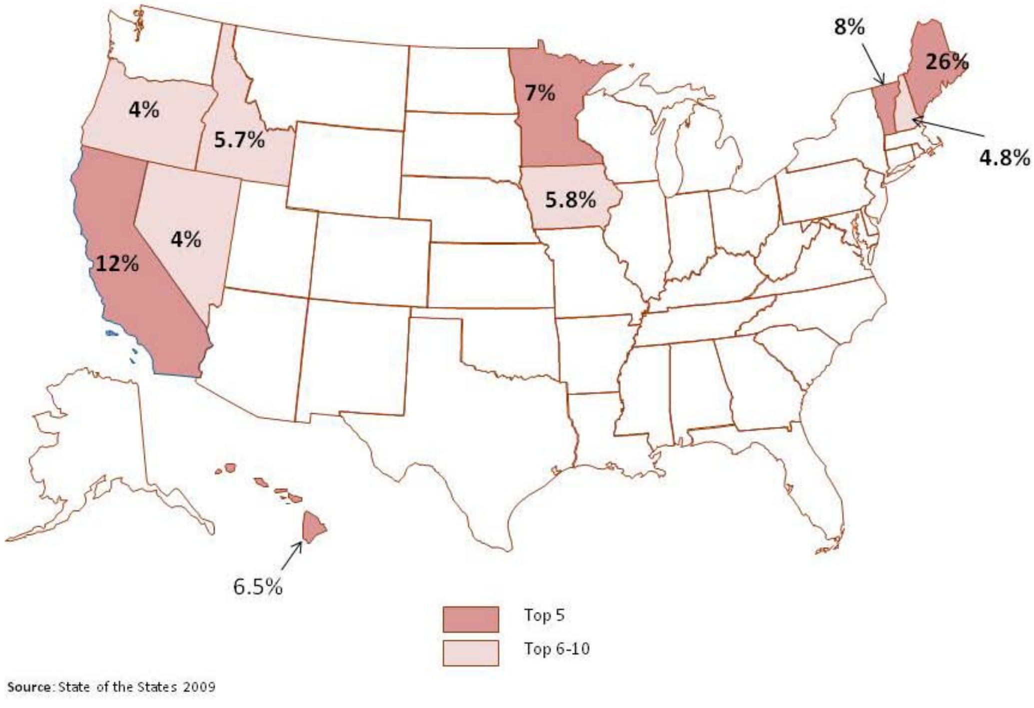


Figure 2.9. Percentage of Total Electricity Generation: Non-Hydroelectric Renewable Resources

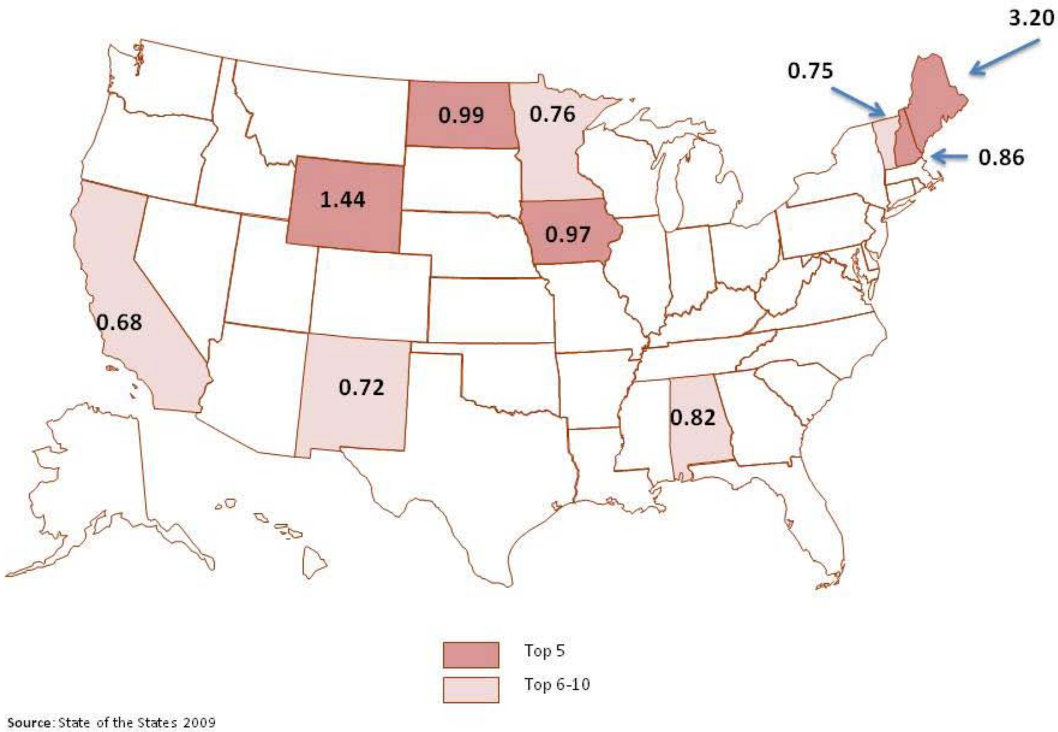


Figure 2.10. Total Non-Hydroelectric Renewable Energy Generation (MWh/Capita)

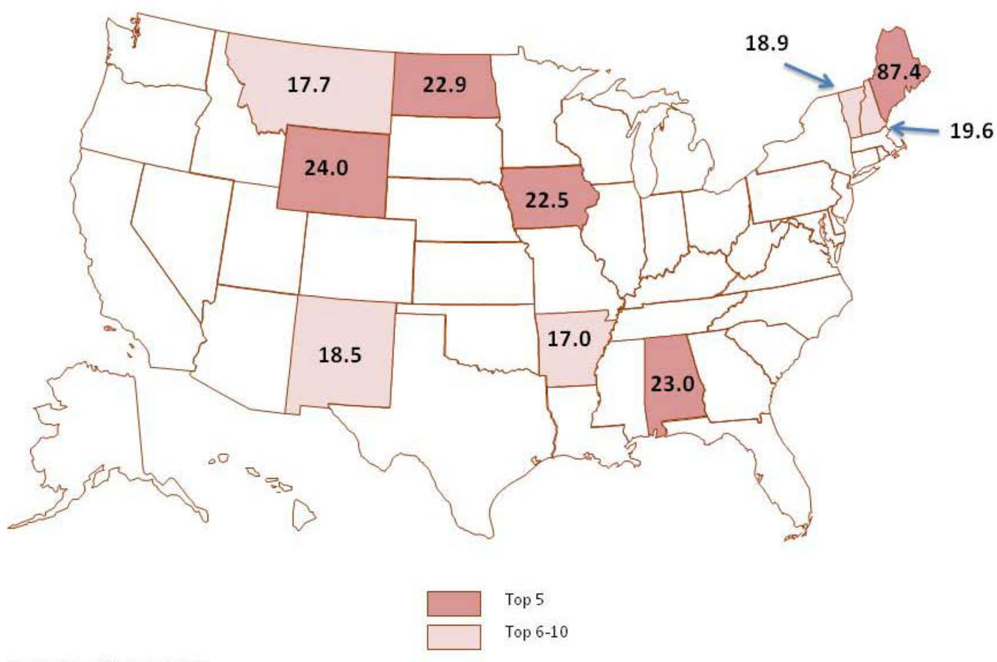


Figure 2.11. Non-Hydroelectric Renewable Energy Generation (MWh/M$ 2007 GSP)

State Growth Data

Table 2.3. Growth in Total Renewable Electricity Generation, 2001-2007*

Generation Percent Growth			As a Percent of Total State Electricity Generation		
Rank	State	% Change	Rank	State	% Change
1	Kansas	1,678.5%	1	Kansas	1,487.9%
2	New Mexico	555.2%	2	New Mexico	512.0%
3	Texas	252.9%	3	Texas	224.2%
4	Iowa	169.4%	4	Iowa	120.0%
5	Oklahoma	101.7%	5	Colorado	65.2%
6	Colorado	90.0%	6	Rhode Island	58.6%
7	Illinois	74.9%	7	Illinois	56.5%
8	South Carolina	67.6%	8	Oklahoma	53.0%
9	Minnesota	63.3%	9	Maine	48.9%
10	Montana	49.3%	10	Minnesota	45.4%

Per Capita			Per GSP (MWh/M$)		
Rank	State	% Change	Rank	State	% Change
1	Kansas	1,629.6%	1	Kansas	1,210.4%
2	New Mexico	510.1%	2	New Mexico	341.8%
3	Texas	215.8%	3	Texas	135.5%
4	Iowa	164.5%	4	Iowa	91.9%
5	Oklahoma	93.7%	5	Colorado	43.2%
6	Colorado	74.0%	6	Illinois	36.7%
7	Illinois	70.7%	7	Oklahoma	36.6%
8	Minnesota	57.0%	8	South Carolina	28.6%
9	South Carolina	54.6%	9	Minnesota	21.8%
10	Rhode Island	49.8%	10	Rhode Island	11.7%

*Delaware is not included because they did not produce renewable energy as recorded by the EIA in 2001; therefore, 2001-2007 growth numbers cannot be calculated.

Table 2.4. Growth in Non-Hydroelectric Renewable Electricity Generation, 2001-2007*

Generation Percent Growth			As a Percent of Total State Electricity Generation		
Rank	State	% Change	Rank	State	% Change
1	South Dakota	17,123.7%	1	South Dakota	20,671.7%
2	North Dakota	8,175.0%	2	North Dakota	7,938.6%
3	New Mexico	7,455.4%	3	New Mexico	6,957.0%
4	Kentucky	4,774.6%	4	Kentucky	4,684.0%
5	Kansas	2,793.5%	5	Kansas	2,483.3%
6	Nebraska	1,341.1%	6	Nebraska	1,254.1%
7	Alaska	1,082.1%	7	Alaska	1,068.7%
8	Colorado	1,074.0%	8	Colorado	920.9%
9	West Virginia	979.3%	9	West Virginia	840.3%
10	Montana	827.4%	10	Montana	676.7%

Per Capita			Per GSP (MWh/M$)		
Rank	State	% Change	Rank	State	% Change
1	South Dakota	16,326.3%	1	South Dakota	12,035.8%
2	North Dakota	8,155.3%	2	North Dakota	5,429.7%
3	New Mexico	6,934.7%	3	New Mexico	4,993.8%
4	Kentucky	4,580.3%	4	Kentucky	3,539.4%
5	Kansas	2,713.9%	5	Kansas	2,031.9%
6	Nebraska	1,299.4%	6	Nebraska	933.4%
7	Alaska	999.1%	7	Colorado	784.7%
8	Colorado	974.9%	8	West Virginia	711.0%
9	West Virginia	972.8%	9	Alaska	606.6%
10	Oklahoma	786.2%	10	Oklahoma	524.8%

*Delaware is not included because they did not produce renewable energy as recorded by the EIA in 2001; therefore, 2001-2007 growth numbers cannot be calculated.

Table 2.5. Growth in Total Renewable Electricity Generation, 2006-2007

Generation Percent Growth			As a Percent of Total State Electricity Generation		
Rank	State	% Change	Rank	State	% Change
1	Delaware	11,438.6%	1	Delaware	9,610.7%
2	Missouri	452.7%	2	Missouri	456.0%
3	Oklahoma	97.3%	3	Oklahoma	91.3%
4	Arkansas	48.5%	4	Arkansas	41.9%
5	Illinois	40.7%	5	Texas	39.0%
6	Texas	40.7%	6	Illinois	35.2%
7	Minnesota	26.3%	7	Minnesota	23.5%
8	Kansas	16.1%	8	New Mexico	17.7%
9	Iowa	15.0%	9	Hawaii	14.9%
10	Hawaii	14.6%	10	Colorado	6.9%

Per Capita			Per GSP (MWh/M$)		
Rank	State	% Change	Rank	State	% Change
1	Delaware	11,315.4%	1	Delaware	11,485.3%
2	Missouri	448.9%	2	Missouri	444.1%
3	Oklahoma	95.6%	3	Oklahoma	90.7%
4	Arkansas	47.4%	4	Arkansas	43.0%
5	Illinois	40.2%	5	Illinois	36.1%
6	Texas	38.1%	6	Texas	31.3%
7	Minnesota	25.7%	7	Minnesota	21.2%
8	Kansas	15.2%	8	New Mexico	13.3%
9	Hawaii	14.8%	9	Colorado	10.8%
10	Iowa	14.6%	10	Kansas	10.6%

Table 2.6. Growth in Non-Hydroelectric Renewable Electricity Generation, 2006-2007

Generation Percent Growth			As a Percent of Total State Electricity Generation		
Rank	State	% Change	Rank	State	% Change
1	Delaware	11,438.6%	1	Delaware	9,610.7%
2	North Dakota	70.0%	2	North Dakota	68.2%
3	Illinois	51.4%	3	Washington	50.7%
4	Alaska	50.7%	4	Alaska	47.4%
5	New Hampshire	50.5%	5	Illinois	45.4%
6	Washington	49.1%	6	New Hampshire	42.7%
7	Colorado	47.8%	7	Colorado	39.0%
8	Texas	31.6%	8	Texas	30.0%
9	Minnesota	28.6%	9	Minnesota	25.6%
10	Missouri	22.3%	10	Vermont	25.3%

Per Capita			Per GSP (MWh/M$)		
Rank	State	% Change	Rank	State	% Change
1	Delaware	11,315.4%	1	Delaware	11,485.3%
2	North Dakota	69.9%	2	North Dakota	61.8%
3	Illinois	50.8%	3	New Hampshire	47.7%
4	New Hampshire	50.5%	4	Illinois	46.4%
5	Alaska	49.9%	5	Colorado	44.2%
6	Washington	47.3%	6	Washington	40.6%
7	Colorado	45.5%	7	Alaska	39.1%
8	Texas	29.2%	8	Minnesota	23.3%
9	Minnesota	27.9%	9	Texas	22.8%
10	Hawaii	22.1%	10	Missouri	20.4%

State Renewable Electricity Generation Data by Technology

Biomass Generation

Table 2.7. Biomass Electricity Generation

MWh Generated (2007)			As a Percentage of Total State Electricity Generation (2007)		
Rank	**State**	**MWh**	**Rank**	**State**	**% of Total**
1	California	5,712,644	1	Maine	25.5%
2	Florida	4,302,817	2	Vermont	7.8%
3	Maine	4,107,909	3	New Hampshire	4.8%
4	Alabama	3,800,620	4	Idaho	4.2%
5	Georgia	3,415,421	5	Virginia	3.3%
6	Louisiana	2,979,883	6	Louisiana	3.2%
7	Virginia	2,565,571	7	Mississippi	3.0%
8	Michigan	2,414,024	8	Arkansas	3.0%
9	Pennsylvania	2,076,178	9	California	2.7%
10	South Carolina	1,996,034	10	Alabama	2.6%
Per Capita (2007)			**Per GSP (MWh/M$) (2007)**		
Rank	**State**	**MWh/Capita**	**Rank**	**State**	**MWh/$M**
1	Maine	3.1	1	Maine	85.4
2	New Hampshire	0.9	2	Alabama	22.9
3	Alabama	0.8	3	New Hampshire	19.6
4	Vermont	0.7	4	Vermont	18.5
5	Louisiana	0.7	5	Arkansas	17.0
6	Arkansas	0.6	6	Mississippi	16.9
7	Mississippi	0.5	7	Louisiana	13.8
8	South Carolina	0.5	8	South Carolina	13.1
9	Georgia	0.4	9	Idaho	9.4
10	Virginia	0.3	10	Georgia	8.6

Source: EIA 2009

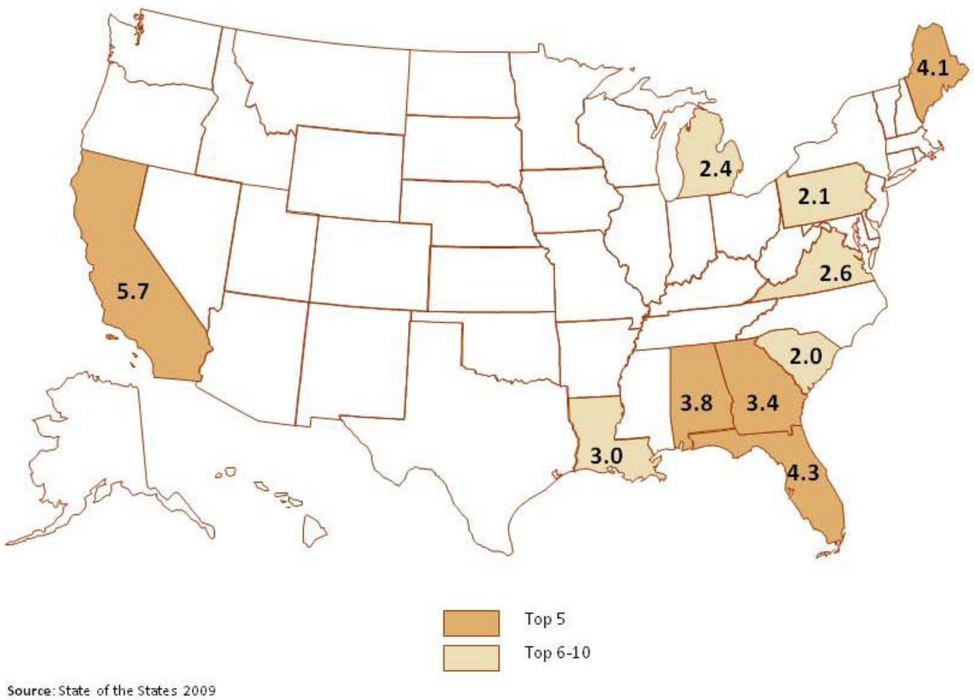


Figure 2.12. Biomass Generation – TWh (2007)

Table 2.8. Growth in Biomass Electricity Generation, 2001-2007*

Generation Percent Growth			As a Percent of Total State Electricity Generation		
Rank	State	% Change	Rank	State	% Change
1	Kentucky	4,774.6%	1	Kentucky	4,684.0%
2	Utah	464.6%	2	Utah	346.1%
3	Nebraska	267.6%	3	Nebraska	245.5%
4	Missouri	233.2%	4	Missouri	190.7%
5	South Carolina	123.2%	5	South Carolina	92.5%
6	Indiana	101.8%	6	Indiana	89.4%
7	North Dakota	76.2%	7	North Dakota	71.2%
8	Montana	69.6%	8	Rhode Island	58.9%
9	Maryland	61.8%	9	Maryland	58.1%
10	Rhode Island	49.4%	10	Montana	42.0%

Per Capita			Per GSP (MWh/M$)		
Rank	State	% Change	Rank	State	% Change
1	Kentucky	4,580.3%	1	Kentucky	3,539.4%
2	Utah	384.9%	2	Utah	274.6%
3	Nebraska	257.0%	3	Missouri	164.8%
4	Missouri	219.7%	4	Nebraska	163.6%
5	South Carolina	105.9%	5	South Carolina	71.3%
6	Indiana	95.1%	6	Indiana	59.9%
7	North Dakota	75.8%	7	North Dakota	17.8%
8	Montana	60.6%	8	Maryland	16.0%
9	Maryland	54.8%	9	Rhode Island	11.9%
10	Rhode Island	50.1%	10	Montana	11.2%

*Alaska and Delaware each began producing electricity from biomass for the first time after 2001. Therefore, growth numbers from 2001-2007 could not be calculated for these two states.

Table 2.9. Growth in Biomass Electricity Generation, 2006-2007

Generation Percent Growth

Rank	State	% Change
1	Delaware	11,438.6%
2	North Dakota	281.1%
3	Utah	108.7%
4	Alaska	53.3%
5	New Hampshire	50.5%
6	Minnesota	28.9%
7	Missouri	22.3%
8	Tennessee	21.8%
9	Nebraska	17.8%
10	Montana	17.5%

As a Percent of Total State Electricity Generation

Rank	State	% Change
1	Delaware	9,610.7%
2	North Dakota	276.9%
3	Utah	89.8%
4	Alaska	50.0%
5	New Hampshire	42.7%
6	Minnesota	25.9%
7	Vermont	25.5%
8	Missouri	23.0%
9	Tennessee	20.2%
10	Nebraska	15.0%

Per Capita

Rank	State	% Change
1	Delaware	11,315.4%
2	North Dakota	280.9%
3	Utah	101.7%
4	Alaska	52.5%
5	New Hampshire	50.4%
6	Minnesota	28.2%
7	Missouri	21.4%
8	Tennessee	20.3%
9	Nebraska	17.4%
10	Montana	16.3%

Per GSP (MWh/M$)

Rank	State	% Change
1	Delaware	11,485.2%
2	North Dakota	262.7%
3	Utah	93.1%
4	New Hampshire	47.7%
5	Alaska	41.6%
6	Minnesota	23.6%
7	Missouri	20.4%
8	Tennessee	18.9%
9	Nebraska	11.3%
10	Montana	10.9%

Hydroelectric Generation

Table 2.10. Hydroelectric Generation

MWh Generated (2007)			As a Percentage of Total State Electricity Generation (2007)		
Rank	**State**	**MWh**	**Rank**	**State**	**% of Total**
1	Washington	78,829,195	1	Idaho	78.6%
2	Oregon	33,587,439	2	Washington	73.7%
3	California	27,327,751	3	Oregon	61.0%
4	New York	25,252,555	4	South Dakota	47.5%
5	Montana	9,364,336	5	Montana	32.4%
6	Idaho	9,021,690	6	Maine	23.2%
7	Arizona	6,597,671	7	Alaska	18.9%
8	Tennessee	4,939,601	8	New York	17.3%
9	Alabama	4,136,114	9	California	13.0%
10	Maine	3,738,168	10	Vermont	11.1%

Per Capita (2007)			Per GSP (MWh/M$) (2007)		
Rank	**State**	**MWh/Capita**	**Rank**	**State**	**MWh/$M**
1	Washington	12.2	1	Montana	273.4
2	Montana	9.8	2	Washington	253.3
3	Oregon	9.0	3	Oregon	212.3
4	Idaho	6.0	4	Idaho	176.4
5	South Dakota	3.7	5	South Dakota	86.0
6	Maine	2.8	6	Maine	77.7
7	North Dakota	2.0	7	North Dakota	47.1
8	Alaska	1.9	8	Arkansas	33.9
9	Wyoming	1.4	9	Alaska	29.0
10	New York	1.3	10	Arizona	26.7

Source: EIA 2009

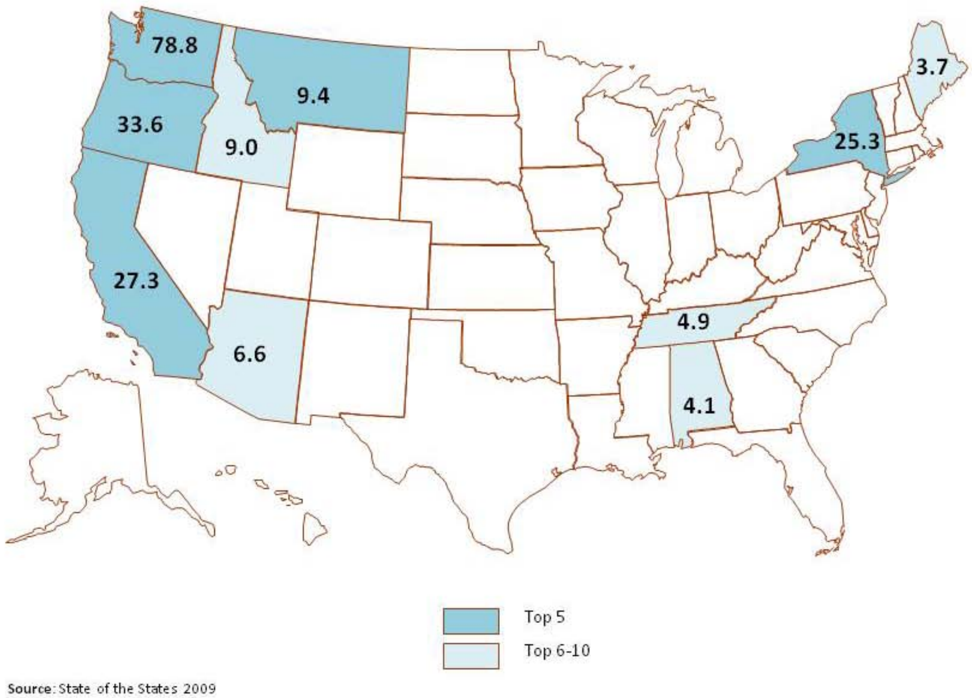


Figure 2.13. Conventional Hydroelectric Generation – TWh (2007)

Table 2.11. Growth in Hydroelectric Generation, 2001-2007

Generation Percent Growth

Rank	State	% Change
1	Washington	44.0%
2	Montana	41.6%
3	Maine	41.3%
4	Maryland	39.6%
5	Rhode Island	38.8%
6	Texas	37.0%
7	Pennsylvania	35.5%
8	West Virginia	31.8%
9	Oklahoma	30.8%
10	New Hampshire	27.7%

As a Percent of Total State Electricity Generation

Rank	State	% Change
1	Maine	71.4%
2	Rhode Island	47.8%
3	Maryland	36.4%
4	Texas	25.9%
5	Montana	18.6%
6	Pennsylvania	17.8%
7	Connecticut	16.6%
8	Virginia	16.4%
9	West Virginia	14.8%
10	Washington	11.8%

Per Capita

Rank	State	% Change
1	Rhode Island	39.6%
2	Maine	38.0%
3	Montana	34.1%
4	Pennsylvania	34.1%
5	Washington	33.8%
6	Maryland	33.5%
7	West Virginia	31.0%
8	Oklahoma	25.6%
9	Connecticut	24.7%
10	Texas	22.6%

Per GSP (MWh/M$)

Rank	State	% Change
1	Maine	9.1%
2	Washington	4.5%
3	Rhode Island	4.1%
4	Pennsylvania	3.8%
5	Maryland	0.1%
6	West Virginia	-1.0%
7	New Hampshire	-1.4%
8	South Carolina	-2.6%
9	Connecticut	-3.2%
10	Montana	-7.1%

Table 2.12. Growth in Hydroelectric Generation, 2006-2007

Generation Percent Growth			As a Percent of Total State Electricity Generation		
Rank	State	% Change	Rank	State	% Change
1	Missouri	504.5%	1	Missouri	508.1%
2	Oklahoma	391.7%	2	Oklahoma	376.8%
3	Texas	148.4%	3	Texas	145.4%
4	Arkansas	108.7%	4	Arkansas	99.5%
5	New Mexico	35.2%	5	New Mexico	40.0%
6	Louisiana	15.9%	6	Louisiana	13.8%
7	Minnesota	14.4%	7	Minnesota	11.8%
8	Kansas	8.8%	8	Alaska	3.2%
9	Iowa	5.8%	9	South Dakota	-0.2%
10	Alaska	5.5%	10	Kansas	-1.2%

Per Capita			Per GSP (MWh/M$)		
Rank	State	% Change	Rank	State	% Change
1	Missouri	500.3%	1	Missouri	495.1%
2	Oklahoma	387.5%	2	Oklahoma	375.2%
3	Texas	143.9%	3	Texas	131.9%
4	Arkansas	107.2%	4	Arkansas	101.0%
5	New Mexico	33.7%	5	New Mexico	34.7%
6	Minnesota	13.7%	6	Minnesota	9.7%
7	Louisiana	12.5%	7	Kansas	3.6%
8	Kansas	8.0%	8	Louisiana	3.6%
9	Iowa	5.4%	9	Iowa	1.7%
10	Alaska	5.0%	10	Alaska	-2.6%

Geothermal

Table 2.13. Geothermal Electricity Generation					
MWh Generated (2007)			As a Percentage of Total State Electricity Generation (2007)		
Rank	State	MWh	Rank	State	% of Total
1	California	12,990,711	1	California	6.2%
2	Nevada	1,252,691	2	Nevada	3.8%
3	Hawaii	229,886	3	Hawaii	2.0%
4	Utah	163,925	4	Utah	0.4%
Per Capita (2007)			Per GSP (MWh/M$) (2007)		
Rank	State	MWh/Capita	Rank	State	MWh/$M
1	Nevada	0.5	1	Nevada	9.8
2	California	0.4	2	California	7.2
3	Hawaii	0.2	3	Hawaii	3.7
4	Utah	0.1	4	Utah	1.6
Source: EIA 2009					

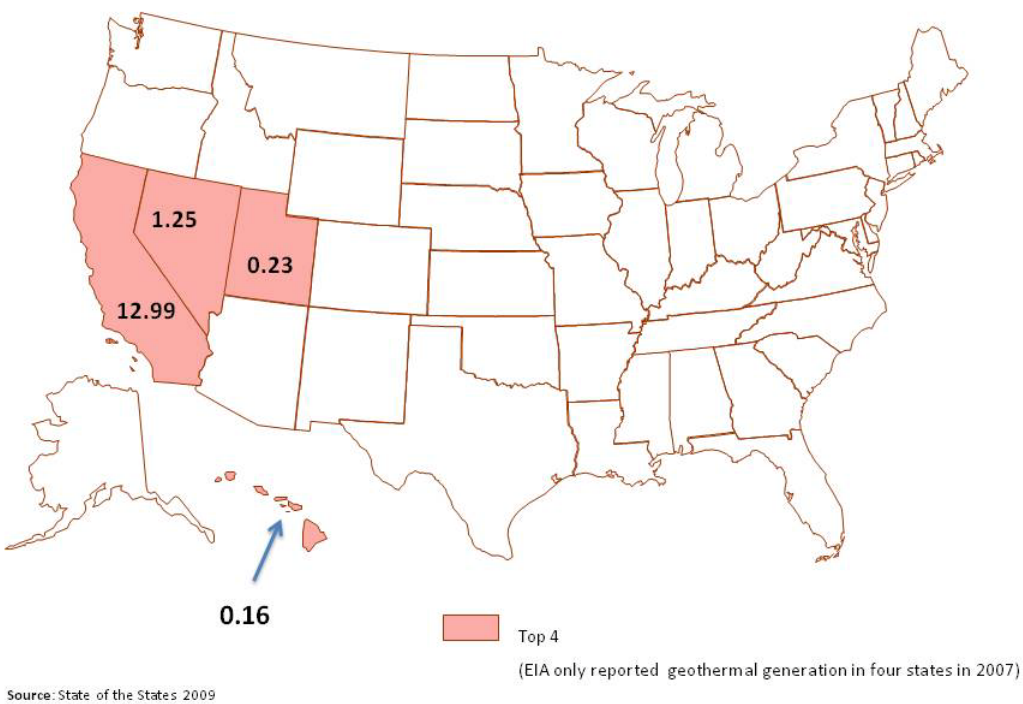


Figure 2.14. Geothermal Generation – TWh (2007)

Table 2.14. Growth in Geothermal Electricity Generation, 2001-2007

Generation Percent Growth			As a Percent of Total State Electricity Generation		
Rank	State	% Change	Rank	State	% Change
1	Hawaii	11.3%	1	Nevada	8.3%
2	Utah	7.3%	2	Hawaii	2.6%
3	California	6.6%	3	California	0.4%
4	Nevada	4.4%	4	Utah	-15.2%

Per Capita			Per GSP (MWh/M$)		
Rank	State	% Change	Rank	State	% Change
1	Hawaii	6.2%	1	California	-23.5%
2	California	1.2%	2	Hawaii	-24.4%
3	Utah	-7.8%	3	Utah	-28.8%
4	Nevada	-14.4%	4	Nevada	-36.6%

Table 2.15. Growth in Geothermal Electricity Generation, 2006-2007

Generation Percent Growth			As a Percent of Total State Electricity Generation		
Rank	State	% Change	Rank	State	% Change
1	Hawaii	8.3%	1	Hawaii	8.6%
2	California	1.3%	2	California	4.2%
3	Nevada	-6.8%	3	Nevada	-9.1%
4	Utah	-14.0%	4	Utah	-21.8%

Per Capita			Per GSP (MWh/M$)		
Rank	State	% Change	Rank	State	% Change
1	Hawaii	8.4%	1	Hawaii	2.6%
2	California	1.0%	2	California	-3.5%
3	Nevada	-9.0%	3	Nevada	-13.2%
4	Utah	-16.9%	4	Utah	-20.4%

Distributed Solar

Table 2.16. Grid-Connected Cumulative Installed Capacity, 2008 (kWdc)

Rank	State	kWdc	Rank	State	kWdc
1	California	528,262	23	District of Columbia	661
2	New Jersey	70,236	24	Montana	651
3	Colorado	35,730	25	Minnesota	635
4	Nevada	34,214	26	Rhode Island	574
5	Arizona	25,301	27	Tennessee	388
6	New York	21,882	28	Michigan	358
7	Hawaii	13,525	29	Maine	326
8	Connecticut	8,760	30	Virginia	212
9	Oregon	7,651	31	Utah	202
10	Massachusetts	7,527	32	New Hampshire	96
11	North Carolina	4,697	33	Wyoming	88
12	Texas	4,428	34	Mississippi	76
13	Pennsylvania	3,938	35	Missouri	65
14	Washington	3,673	36	Alabama	58
15	Maryland	3,129	37	Iowa	51
16	Wisconsin	3,078	38	Georgia	47
17	Florida	2,992	39	Idaho	41
18	Illinois	2,758	40	Arkansas	38
19	Delaware	1,824	41	Kentucky	37
20	Ohio	1,356	42	Indiana	19
21	Vermont	1,110	43	Oklahoma	6
22	New Mexico	1,040	44	South Carolina	1

Source: Sherwood 2008

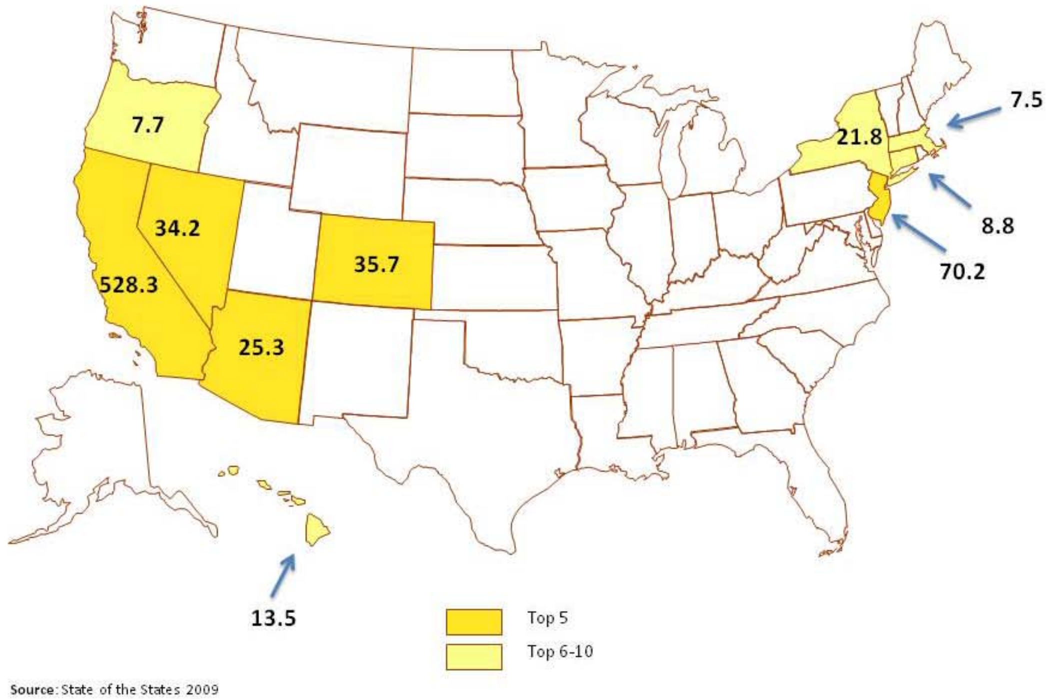


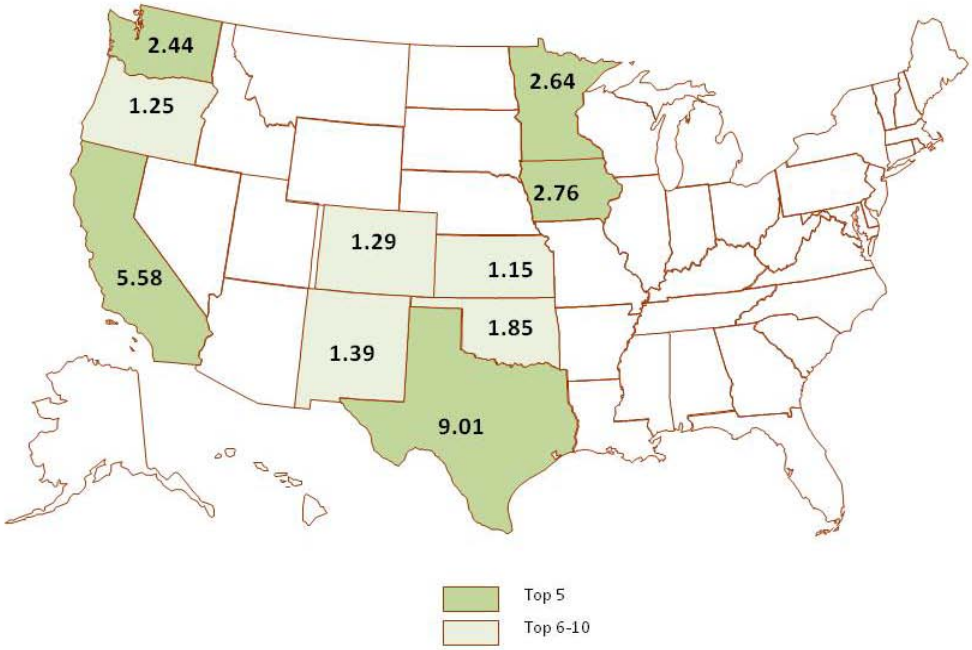
Figure 2.15. Grid-Connect Cumulative Installed Solar Capacity – MWdc (2008)

Wind

Table 2.17. Wind Electricity Generation

MWh Generated (2007)			As a Percentage of Total State Electricity Generation (2007)		
Rank	**State**	**MWh**	**Rank**	**State**	**% of Total**
1	Texas	9,006,383	1	Iowa	5.5%
2	California	5,584,933	2	Minnesota	4.8%
3	Iowa	2,756,676	3	New Mexico	3.9%
4	Minnesota	2,638,812	4	California	2.6%
5	Washington	2,437,823	5	Oklahoma	2.5%
6	Oklahoma	1,849,144	6	South Dakota	2.4%
7	New Mexico	1,393,239	7	Colorado	2.4%
8	Colorado	1,291,516	8	Kansas	2.3%
9	Oregon	1,246,994	9	Washington	2.3%
10	Kansas	1,152,538	10	Oregon	2.3%
Per Capita (2007)			**Per GSP (MWh/M$) (2007)**		
Rank	**State**	**MWh/Capita**	**Rank**	**State**	**MWh/$M**
1	Wyoming	1.4	1	Wyoming	24.0
2	North Dakota	1.0	2	North Dakota	22.4
3	Iowa	0.9	3	Iowa	21.4
4	New Mexico	0.7	4	New Mexico	18.3
5	Montana	0.5	5	Montana	14.5
6	Oklahoma	0.5	6	Oklahoma	13.3
7	Minnesota	0.5	7	Minnesota	10.3
8	Kansas	0.4	8	Kansas	9.8
9	Washington	0.4	9	Texas	7.9
10	Texas	0.4	10	Oregon	7.9

Source: EIA 2009



Source: State of the States 2009

Figure 2.16. Wind Generation – TWh (2007)

Table 2.18. Growth in Wind Electricity Generation, 2001-2007*

Generation Percent Growth

Rank	State	% Change
1	South Dakota	17,123.7%
2	Hawaii	11,108.7%
3	Nebraska	8,142.0%
4	Pennsylvania	4,106.4%
5	New York	3,957.8%
6	Illinois	3,591.3%
7	Oklahoma	3,324.3%
8	Kansas	2,793.5%
9	Colorado	2,555.3%
10	West Virginia	1,762.1%

As a Percent of Total State Electricity Generation

Rank	State	% Change
1	South Dakota	20,671.7%
2	Hawaii	10,233.7%
3	Nebraska	7,644.7%
4	New York	3,903.2%
5	Pennsylvania	3,557.3%
6	Illinois	3,384.7%
7	Oklahoma	2,751.5%
8	Kansas	2,483.3%
9	Colorado	2,208.9%
10	West Virginia	1,778.5%

Per Capita

Rank	State	% Change
1	South Dakota	16,326.3%
2	Hawaii	10,592.7%
3	Nebraska	7,903.6%
4	Pennsylvania	4,061.5%
5	New York	3,884.2%
6	Illinois	3,533.5%
7	Oklahoma	3,221.7%
8	Kansas	2,713.9%
9	Colorado	2,331.1%
10	West Virginia	1,752.1%

Per GSP (MWh/M$)

Rank	State	% Change
1	South Dakota	12,035.8%
2	Hawaii	7,518.3%
3	Nebraska	5,810.7%
4	Pennsylvania	3,121.1%
5	Illinois	2,990.1%
6	New York	2,874.5%
7	Oklahoma	2,442.7%
8	Kansas	2,031.9%
9	Colorado	1,900.8%
10	West Virginia	1,353.0%

* For states in which wind generation began after 2001, this report uses the first year that EIA reports wind generation in that state to create the baseline for determining the growth rankings. Baseline year 2002 - TN, WA, WV; baseline year 2003 - IL, NM, ND, OK; baseline year 2005 - OH; baseline year 2006 - ID, MT, NJ. Maine, which began generating wind in 2007, is not included in the growth rankings because its baseline year is the same as the year in which the most recent data for wind generation is available and, as a result, its rate of change could not be measured.

Table 2.19. Growth in Wind Electricity Generation, 2006-2007*

Generation Percent Growth		
Rank	State	% Change
1	Hawaii	198.9%
2	Illinois	161.0%
3	Washington	134.9%
4	North Dakota	68.0%
5	Colorado	49.2%
6	Texas	35.0%
7	Oregon	33.9%
8	Pennsylvania	30.2%
9	Alaska	28.4%
10	Minnesota	28.4%

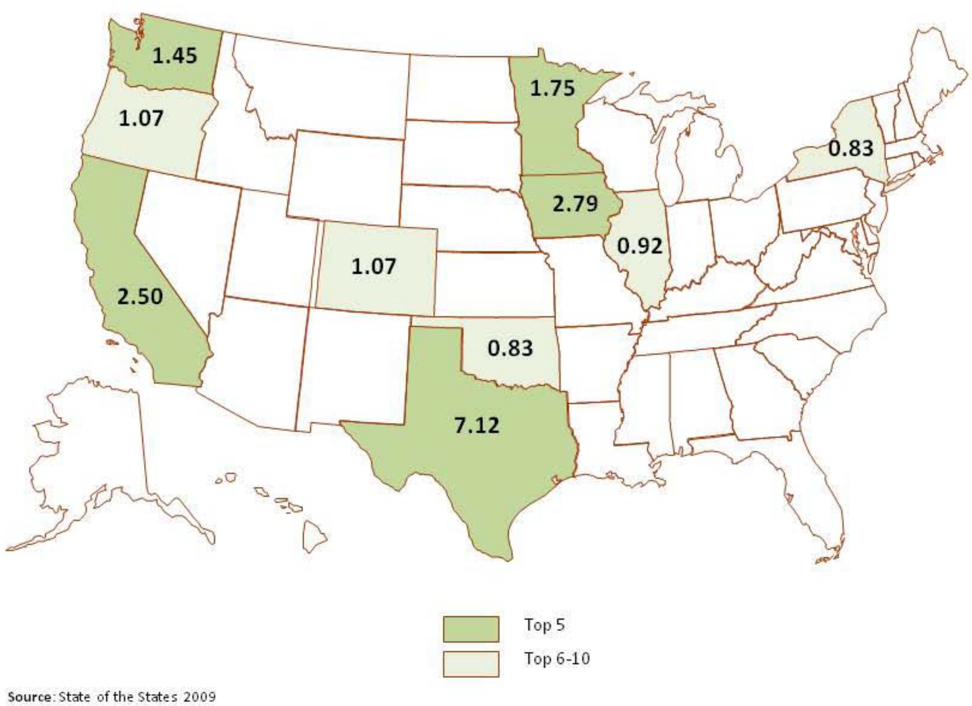
As a Percent of Total State Electricity Generation		
Rank	State	% Change
1	Hawaii	199.6%
2	Illinois	150.8%
3	Washington	137.6%
4	North Dakota	66.2%
5	Colorado	40.3%
6	Texas	33.4%
7	Oregon	29.7%
8	Pennsylvania	26.0%
9	Alaska	25.7%
10	Minnesota	25.5%

Per Capita		
Rank	State	% Change
1	Hawaii	199.2%
2	Illinois	160.0%
3	Washington	132.2%
4	North Dakota	67.9%
5	Colorado	46.9%
6	Texas	32.5%
7	Oregon	32.3%
8	Pennsylvania	30.0%
9	New Jersey	27.8%
10	Alaska	27.7%

Per GSP (MWh/M$)		
Rank	State	% Change
1	Hawaii	183.3%
2	Illinois	152.4%
3	Washington	121.5%
4	North Dakota	59.9%
5	Colorado	45.5%
6	Oregon	28.0%
7	Texas	26.0%
8	Pennsylvania	25.1%
9	New Jersey	24.3%
10	Minnesota	23.2%

*Maine not included because 2007 is its first year of wind generation

Table 2.20. Wind Capacity, 2008					
Rank	**State**	**MW**	**Rank**	**State**	**MW**
1	Texas	7,117.7	19	South Dakota	186.8
2	Iowa	2,791.3	20	Missouri	162.5
3	California	2,503.0	21	Indiana	130.5
4	Minnesota	1,753.4	22	Michigan	129.4
5	Washington	1,446.8	23	Idaho	75.3
6	Colorado	1,067.7	24	Nebraska	71.9
7	Oregon	1,067.2	25	Hawaii	63.1
8	Illinois	915.1	26	Maine	46.6
9	New York	831.8	27	Tennessee	29.0
10	Oklahoma	830.9	28	New Hampshire	25.4
11	Kansas	814.5	29	Utah	19.8
12	North Dakota	714.4	30	New Jersey	7.5
13	Wyoming	676.1	31	Ohio	7.4
14	New Mexico	497.5	32	Vermont	6.1
15	Wisconsin	394.9	33	Massachusetts	5.4
16	Pennsylvania	360.7	34	Alaska	3.3
17	West Virginia	330.0	35	Rhode Island	0.7
18	Montana	271.5	36	Arkansas	0.1
Source: AWEA 2009b					



Source: AWEA 2009b

Figure 2.17. Wind Cumulative Installed Capacity – GW (2008)

Summary of Overall Trends

National Renewable Resources

In 2007, generation from renewable resources constituted 8.49% of total national electricity generation, 1% less than in 2006, and 0.79% higher than in 2001. This can be explained by the 14% decline in hydroelectric generation from 2006 to 2007. Although generation from renewable resources as a percent of total national generation declined from 2006 to 2007, generation from non-hydroelectric renewable resources increased its share of total national generation from 2.37% to 2.53% (up from 1.89% in 2001).

Total renewable generation per capita declined 9.33% from 2006-2007 (from 1.29 MWh/person to 1.27 MWh/person), while non-hydroelectric renewable generation per capita increased by 8.11% (from 0.32 MWh/person to 0.35 MWh/person). Notably, non-hydroelectric renewable generation per capita has increased more than 40% from 2001 to 2007 (from 0.25 MWh/person to 0.35 MWh/person).

Renewable energy growth continues to be largely outstripped by economic growth as measured by gross state product and population growth. From 2006 to 2007, only 14 states had a positive percent change in generation from total renewable resources per GSP, and only 17 had a positive percent change in total renewable generation per capita.

Biomass

Forty-five states now use biomass resources for electricity production, and 25 states increased biomass generation between 2006-2007. Biomass development continues to grow across most regions of the United States, indicating the widespread nature of biomass resource as compared to wind, for example. The leading states in biomass generation growth from 2006-2007 are spread across the United States, from Delaware to Utah, Minnesota, and Alaska.

Hydroelectric

Hydroelectric resources continue to provide the largest portion of renewable energy generation in the United States in 2007, although it is down 14% from 2006 (**Figure 2.18**). In addition to many of the larger-scale hydroelectric resources that have already been developed, this decline could be the result of increased development of other renewable energy resources and drought conditions across the country. The decline of hydroelectric generation in 2007 was pronounced in: New England, Middle Atlantic, East North Central, South Atlantic, East South Central, Mountain, and the Pacific regions. Several of these regions typically produce a significant portion of the hydropower in the United States (Gielecki 2009).

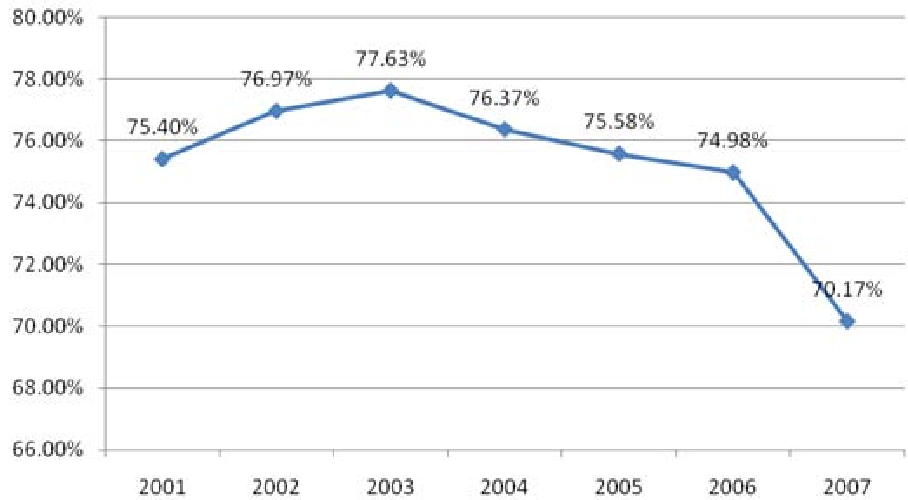


Figure 2.18. U.S. Hydroelectric Generation as a Percent of Total Renewable Energy Generation

Geothermal

Four states have developed geothermal resources: California, Nevada, Hawaii, and Utah. It should be noted that only large-scale geothermal resource development, as reported by the EIA, is considered in this report (see Challenges with EIA Data for details on Page 5).

Solar

Solar energy still represents a small but growing fraction of total renewable energy generation. Increasing numbers of concentrating solar power projects are being proposed, particularly in the Southwestern states; and increasing resources are being directed toward the development of large-scale solar projects (BLM 2009).

Wind

Wind energy accounted for the largest percentage of nationwide growth in renewable generation between 2001-2007, as well as between 2006-2007. Generation from wind resources grew by 411% from 2001 to 2007, and by 30% from 2006 to 2007 (**Figure 2.19**).

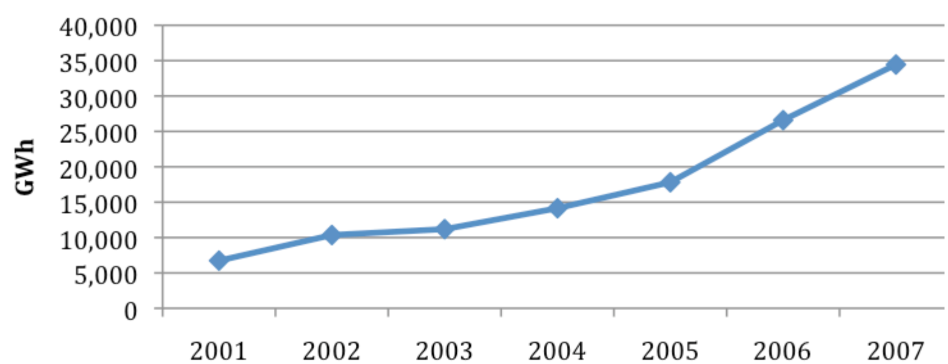


Figure 2.19. U.S. Wind Energy Generation (GWh)

Conclusion

This data provides state policymakers and other interested parties with a variety of metrics to inform understanding of clean energy market penetration relative to other states. It also presents the recent historical changes in renewable energy development to inform decisions and evaluate progress.

Multiple factors influence the development of renewable energy at the state level. As the data presented here show, the size and economic context of the state can be a large determinate of development. These possible drivers are discussed in more detail in **Chapter 5**. The driver that is the main focus of this report – policy – is the focus of the next chapter, **Chapter 3**.

Chapter 3. Policies Supporting Renewable Energy Development and Best Practices

Introduction

This chapter:

- Provides definitions of the various state policies used to encourage renewable energy development,
- Summarizes and synthesizes the current understandings of best practices and benefits of these policies, and
- Reports on the current status of implementation in each of the U.S. states.

Due to the limited time period and extent to which these policies have been in use – and the limited evaluation that has taken place – the most effective policy designs and their direct impacts on renewable energy development is not well understood. In addition to this lack of experience, policy is not the exclusive factor contributing to renewable energy development, as discussed in detail in the contextual factors chapter (Chapter 5) of this report. As a result, current best practices are largely based on the policy design that is expected or theorized to result in further renewable energy development, rather than on extensive experience.

Best practices are identified for equipment certification, interconnection standards, net metering, public benefit funds, renewable portfolio standards (RPS), and tax incentive policies. NREL researchers and analysts do not work in the realm of determining best practices related to policy. Therefore, in cases where best practices from the literature are lacking, analysts sought the expertise of program administrators to identify particular aspects of effective policies. This methodology builds off the previous report and is not meant to be a comprehensive and complete effort, but a further step toward understanding the best design practices for policies.

The remainder of this chapter provides, in alphabetical order, information on 15 policies. Each section sets out the policy definition, the status of implementation within the states, a discussion of the benefits, and the identified best practices.[2]

[2] For the purposes of this report, state policies are evaluated. Federal and utility programs are not included.

Policy: Contractor Licensing

Policy Description

Specific licensing for contractors who want to install renewable energy systems is available, guaranteeing that the contractors have the experience and knowledge necessary to ensure proper installation and maintenance (DSIRE 2009). Requirements for certification vary by state, but generally include defined minimum experience and an examination.

Policy Status

As of May 2009, nine states and Puerto Rico have implemented specific contractor-licensing requirements for renewable energy, reflecting the addition of one state/territory (Puerto Rico) subsequent to the research date for *State of the States 2008*. Contractor-licensing policies are focused on solar thermal and electric systems, including water heating, space heating, pool heating, daylighting, PV, solar thermal electric, radiant heat, and solar thermal process heat. In two states, Connecticut and Oregon, the solar licenses include wind. Oregon also includes fuel cells and small hydroelectric. States that have implemented this policy are illustrated in **Figure 3.1**.

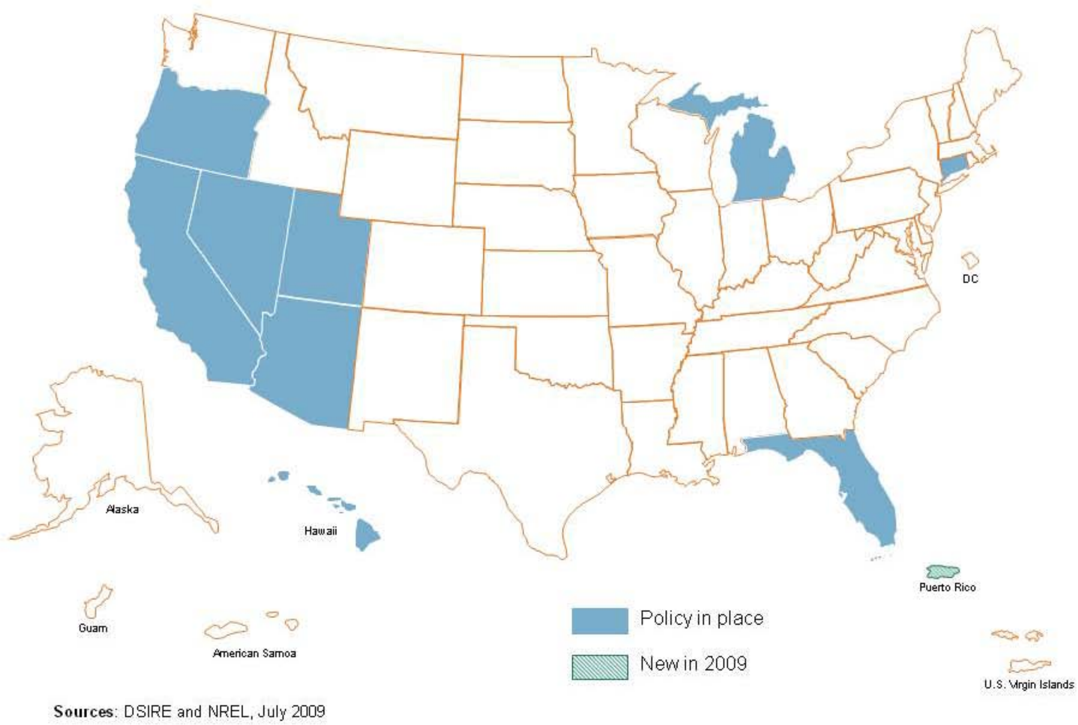


Figure 3.1. States with Contractor-Licensing Policies

Benefits of Contractor-Licensing Policy

Certification requirements are important for renewable energy development because they ensure proper installation and maintenance of systems, which leads to maximum possible returns on investment (Beck and Martinot 2004). These policies can play an important role in increasing the efficiency of renewable energy systems. Properly installed systems and optimal system performance will improve the experience that consumers have with renewable energy technologies.

Policy Best Practices

The data available is insufficient to determine the impacts that a contractor-licensing policy has on renewable energy development, and there has been little to no analysis of best practices. Further analysis of this policy would create a better understanding of the impacts and importance that it might have on renewable energy development in the states. As renewable energy generation goals in states' RPS policies increase, and development of renewable energy sources grow to meet the demand, this policy may become important to have in every state.

Policy: Equipment Certification

Policy Description

Equipment-certification policy requires that renewable energy equipment meets set standards, which ensures that quality equipment is sold to consumers and reduces the problems associated with inferior equipment – issues that can result in a negative view of renewable energy technologies. Equipment requirements can be regulator-designed or modeled off nationally recognized standards (DSIRE 2009).

Policy Status

As of May 2009, three states and Puerto Rico have implemented equipment-certification policy. While this is a small number of states, this policy has the potential to spur technology development by making minimum standards for products more uniform. In other markets, such as that of energy-efficient appliances, minimum standards have been found to have profound effects on consumer energy use and market development (Appliance Standards Awareness Project 2009). States that have implemented this policy are illustrated in **Figure 3.2**.

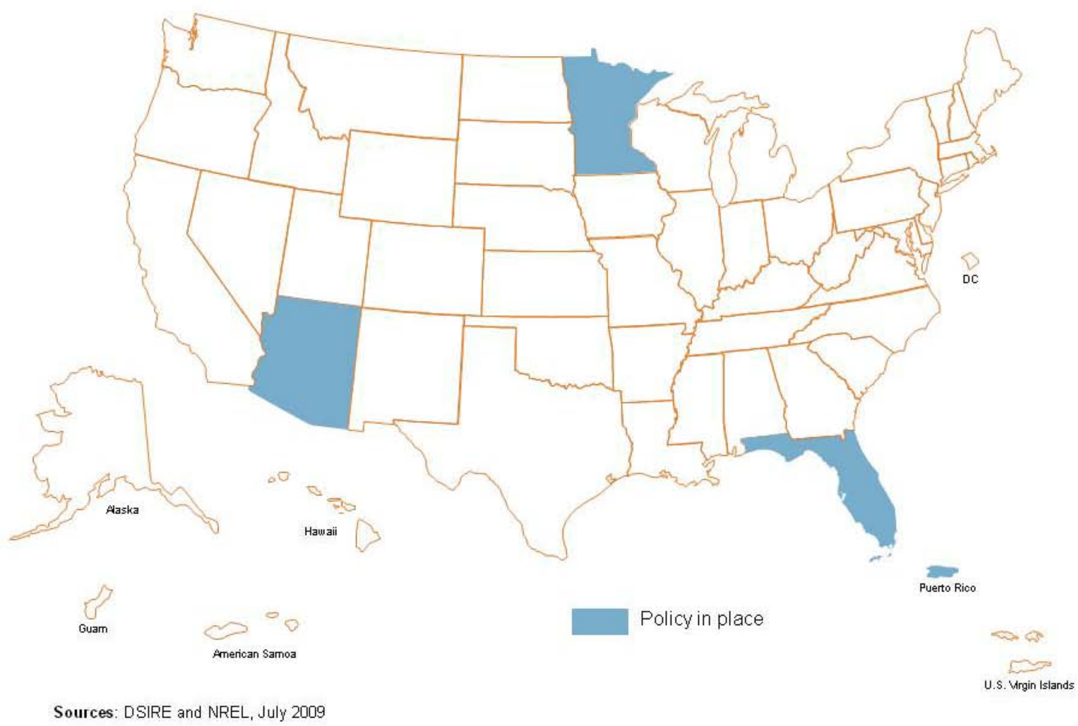


Figure 3.2. States with Equipment-Certification Policies

Benefits of Equipment-Certification Policy

Although this policy is used in only a few states and one territory, it can be implemented to partner with incentive policies and other mandates to ensure that the market for renewable energy technologies maximizes efficiency and protects consumers from fraudulent installations.

Policy Best Practices

A literature review resulted in no published works defining best practices, so policy implementers and certification experts were asked to identify success metrics within the effective policies. Implementers who were interviewed to determine best practices for this policy agreed that certification systems for renewable energy products protect consumers from fraudulent installations and create a market for quality renewable energy products. Implementers provided the following list of design aspects that are necessary to ensure effective equipment-certification polices:

- Use pre-established national standards for equipment. The strategy reduces implementation costs and creates a standard market across the states.
- Allow the same certification to apply to all equipment. Because federal incentives typically require certification, allowing the same certification to apply to all equipment, rather than just those that qualify for tax credits, will reduce transaction costs to the installer/consumer in the credit-retrieval process.
- Establish technology coverage that blankets the full range of renewable energy technologies. This should occur as more states implement equipment certification policies.
- Ensure policy enforcement.
- Evaluate impacts of equipment-certification policy on renewable energy development. This can be done through data collection and tracking systems that quantify policy success.

Policy: Generation Disclosure

Policy Description

Disclosure policies require utilities to provide customers with information about their electricity supply. This information, which is often included on the monthly bill, can include an explanation of fuel mix percentages and information on the related emissions. In states where the electricity market has been restructured, generation disclosure provides customers with valuable information that allows them to make informed choices on the electricity and provider they choose. Additionally, there may be a requirement that the utility provide certification that any renewable energy sources that they use are certified as renewable. The Green-e certification, offered by the Center for Resource Solutions, is one example of a verifiable certification that can be used by utility companies (DSIRE 2009).

Policy Status

As of May 2009, 22 states and the District of Columbia have policies requiring generation disclosure in some form. The policies include reporting to end-use consumers frequently and making the information available on request. **Figure 3.3** illustrates states implementing generation-disclosure policies.

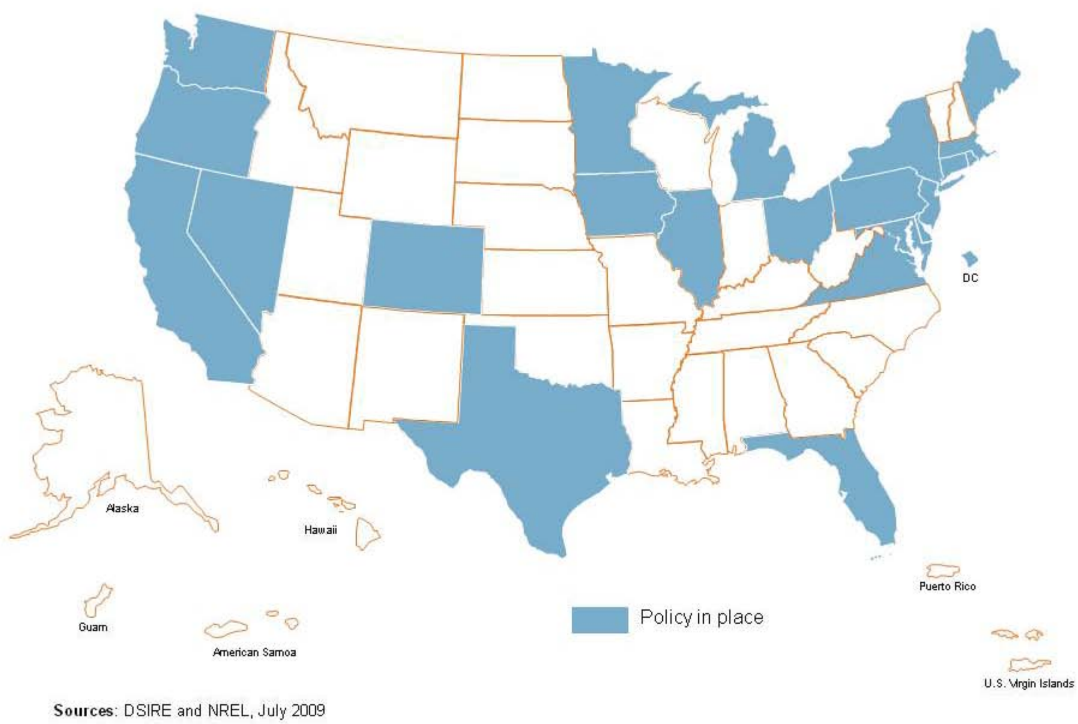


Figure 3.3. States with Generation-Disclosure Policies

Benefits of Generation-Disclosure Policy

Although it is difficult to determine the full impact that consumer education has on energy use and behavioral change, there are studies indicating that consumers will change behavior if they have information on the amount and kind of energy they use (Darby 2006). It is possible that well-designed and implemented versions of generation-disclosure policy would facilitate renewable energy development.

Policy Best Practices

There are no specific best practices defined for generation-disclosure policy. However, using best practices in information dissemination and labeling can apply to the implementation of generation-disclosure policy and improve the way information is translated to the consumer (McNeill and Wilke 1979). Two primary elements of this best practice are accessibility to the information and a standard format for information illustration.

Policy: Grants

Policy Description

States offer an assortment of grant programs designed to foster the development of renewable energy technologies. Most grants are purposed to pay down the cost of equipment or systems. A few others are offered to encourage either research or development of renewable technologies, or to aid a project in achieving commercialization. Most grant programs are available for a range of renewable resources, while a few are designated to support an individual technology, such as wind or PV. Amounts are variant and dependent on structure of the grant. Grants are primarily available only to commercial, industrial, utility, education, and government sectors (DSIRE 2009).[3]

Policy Status

As of May 2009, 22 states and the Virgin Islands provide some type of renewable energy grant. This reflects a net addition of four states subsequent to the research date for the *State of the States 2008* report. The newly added states are: Alaska, California, Minnesota, New York, and North Carolina. Since the 2008 report, South Carolina suspended its Renewable Energy Revolving Loan Program with the intent to update and re-establish the program in spring 2009. The District of Columbia supplanted its grant program with a renewable energy incentive program. States that have implemented this policy are shown in **Figure 3.4.**

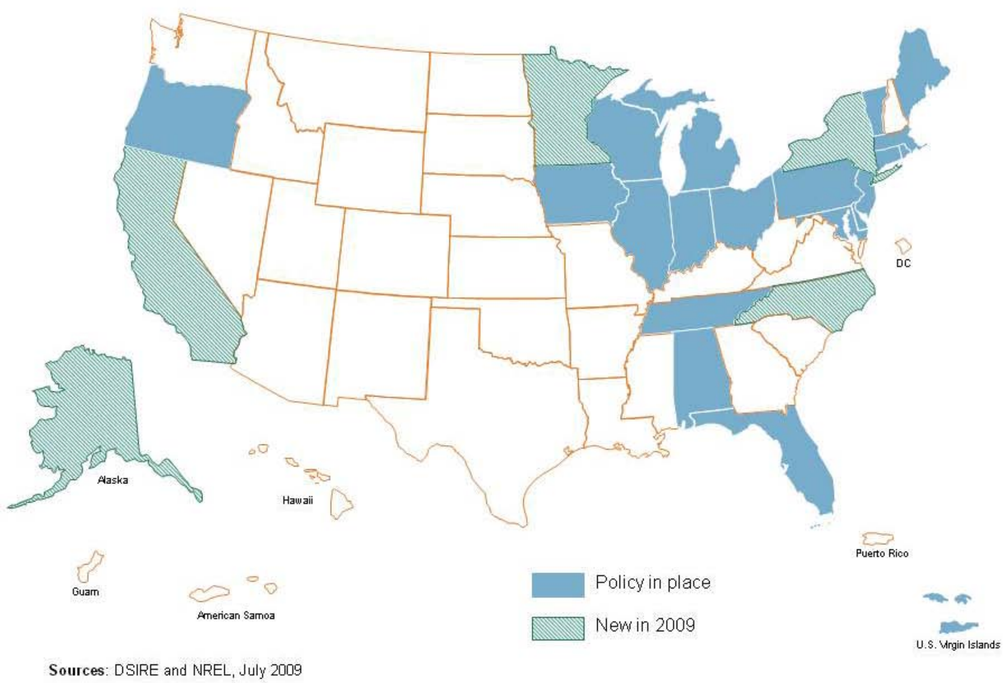


Figure 3.4. States with Grant Programs

[3] One-time requests for proposals (RFPs) are not included in the definition of grants for this study.

Benefits of Grant Programs
Grants act as a financial incentive mechanism for boosting renewable energy development – especially small, customer-sited projects – by effectively reducing high up-front capital costs frequently associated with renewable energy installations. Unlike production incentives, grants do not require a long-term policy and financial commitment to a specific project, which allows for flexible support based on changes in the market (Wiser and Pickle 1997).

Policy Best Practices
A review of the literature provided insufficient information to develop best practices for grant policies or to determine the impact that grant policies have on renewable energy development. To maximize the effectiveness of grant program policies, it is essential that the grants are designed to complement and work with other policies to address different market barriers. Continued research and analysis are needed for development of best practices.

Policy: Green Power Purchasing and Aggregation Policies

Policy Description

Governments at all levels can play a significant role in supporting renewable energy by buying electricity from renewable resources, or by buying renewable energy credits (RECs). Many state and local governments, as well as the federal government, have committed to buying green power to account for a certain percentage of their electricity consumption. A few states allow local governments to aggregate the electricity loads of an entire community to buy green power and, potentially, to join with other communities to form an even larger purchaser of green power – a concept known as "community choice." Green power purchases are typically executed by contracts with green power marketers or project developers, with utility green power programs, or through community aggregation (DSIRE 2009).

Policy Status

As of May 2009, nine states have implemented this policy. States with green power purchasing policies are shown in **Figure 3.5.**

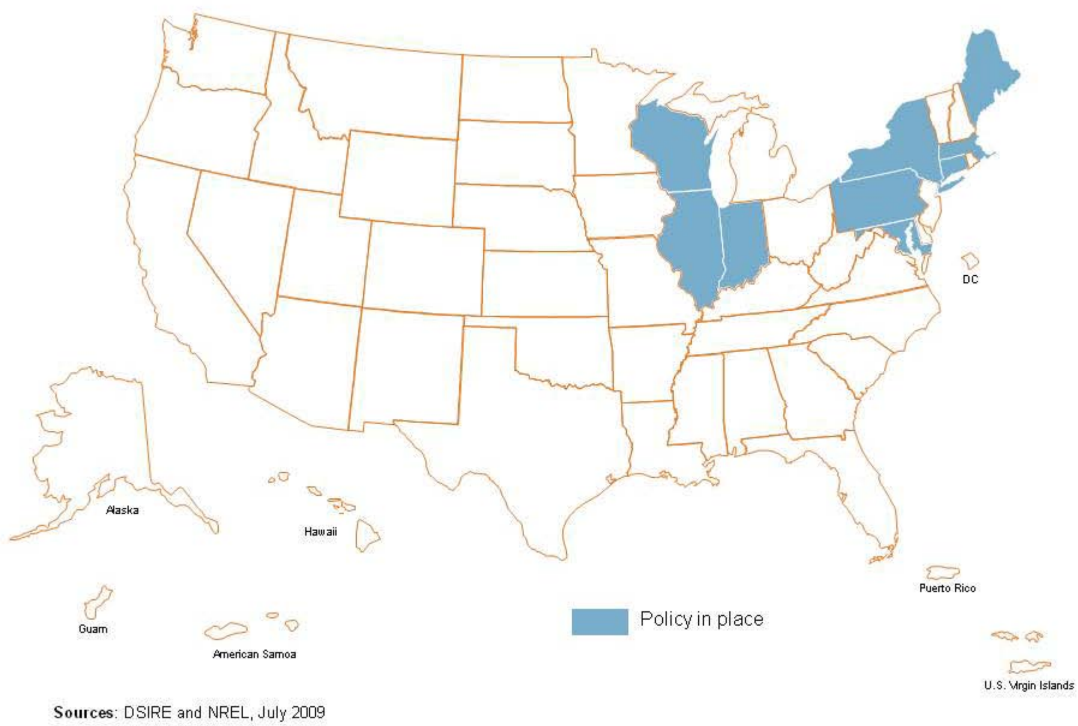


Figure 3.5. States with Green Power Purchasing

Benefits of Green Power Purchasing

Green power purchasing provides benefits to both the generator and the consumer. Green power can help organizations meet environmental, financial, stakeholder relations, economic development, and national security objectives. By purchasing green power, organizations can reduce long-term production costs and transform markets for renewable energy technologies (DOE 2004). The voluntary green power market is exhibiting strong growth. Utility programs that offer fuel price stability benefits to consumers, and community challenges that encourage consumers to buy green power, are significant factors in continued growth of the industry (Bird et al. 2008a) (Bird et al. 2008b).

Policy Best Practices
There is extensive information on practices for developing, implementing, and evaluating successes of green power programs on EERE's Green Power Web site (http://www.eere.energy.gov/greenpower/). The wide range of benefits and goals of green power purchasing programs makes it difficult to identify a single metric for best practices because at least a portion of the benefit is increased consumer knowledge and awareness about renewable energy options.

Policy: Interconnection

Policy Description

Interconnection standards govern the technical and procedural process by which an electric customer connects an electric-generating system to the grid (NNEC 2008).[4] Interconnection standards specify the technical, contractual, metering, and rate rules with which system owners and utilities must comply. Standards for systems interconnected at the distribution level are typically adopted by state public utility commissions, while the Federal Energy Regulatory Commission (FERC) has adopted standards for systems interconnected at the transmission level (DSIRE 2009).

Policy Status

As of May 2009, 39 states, the District of Columbia, and Puerto Rico have implemented interconnection standards. Subsequent to the research date for *State of the States 2008*, Nebraska and Kentucky implemented interconnection standards, as did the commonwealth of Puerto Rico. States that have implemented interconnection standards are shown in **Figure 3.6.**

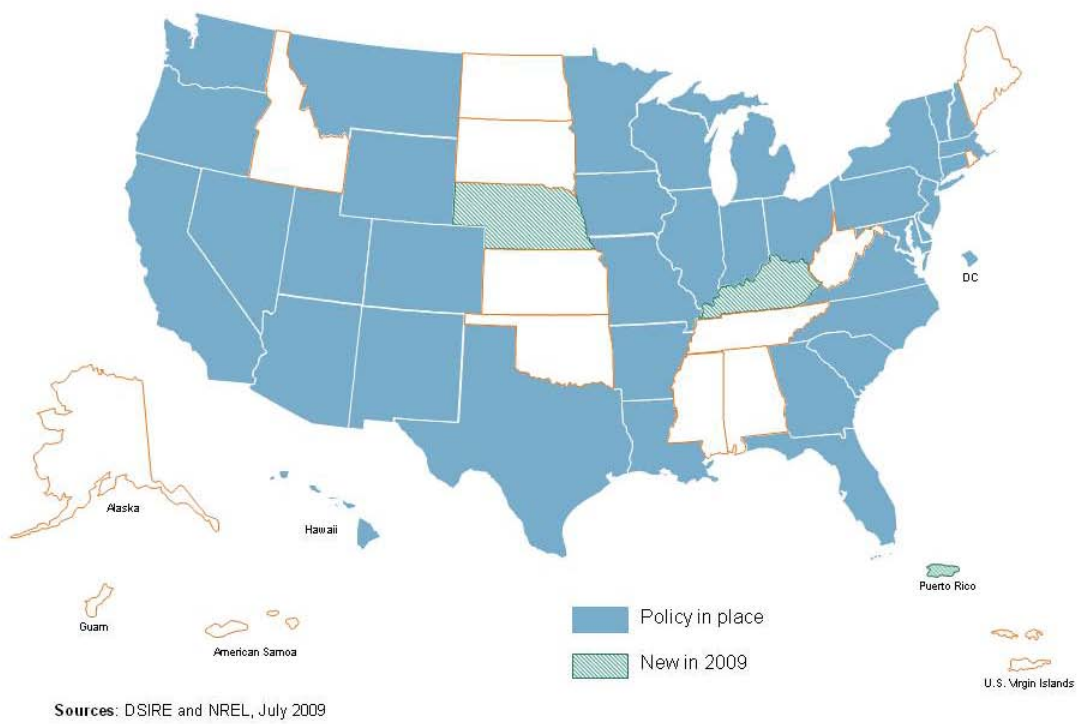


Figure 3.6. States with Interconnection Standards

[4] Subsequent to the research conducted for this report, updated best practices were published in NNEC 2009.

Benefits of Interconnection Standards

Policies incorporating interconnection standards play an important role in effectively removing market barriers to renewable energy development. Well-designed interconnection standards ensure a safe, stable, and economical connection to the grid for distributed generation systems. Sufficient grid connection decreases uncertainties associated with the reliability of renewable energy systems, which makes investment and development more economical. Streamlined interconnection standards allow customers who want to connect their personal electric-generation system to the grid to do so through a transparent and equitable process.

Policy Best Practices

Best practices for interconnection standards are summarized in the Network for New Energy Choices' *Freeing the Grid: Best and Worst Practices in State Net-Metering Policies and Interconnection Standards 2008* (NNEC 2008). While many states have an interconnection policy, not all align their policy implementation with best practices. In their report, NNEC provides a comprehensive review and ranking of states with interconnection policy, and how implementation of best practices can have a positive impact on renewable energy development within a state. Best practices are defined as follows:

> *Eligible Technology*: Although public policy typically focuses on renewable energy, the system and engineering impacts of a system should be assessed solely on their own merits. To do otherwise introduces complexity and may limit innovation. If a generator complies fully with the relevant technical standards, there is no operational or safety justification to deny it interconnection.
>
> *Individual System Capacity:* Interconnection standards should be less rigid for small, simple systems and more rigid as systems increase in size and complexity. However, standards should also permit systems that are sized to meet even large on-site loads for such applications as hospitals, office parks, and college campuses.
>
> *"Breakpoints" for Interconnection Process:* It is most efficient to break a single overall interconnection process into separate "tracks" based on generator capacity, which relieves complexity for the smallest systems while preserving conservative and thorough studies for larger installations. The emerging consensus is to fragment applicants at four breakpoints: 10 kW, 2 MW, 10 MW (non-exporting systems), and 20 MW.
>
> *Timelines:* Paperwork and permit approvals are time-consuming and present a significant barrier to quick and easy system installation. FERC standards establish a timeline for each step of the application process, for each type of generator. States can elect to reduce the amount of time allowed for the different steps, such as establishing a shorter time allotment for the read-through of an application with small generators using Underwriters Laboratories (UL)-listed equipment.

Interconnection Charges: Interconnection processing and study fees can add up to a prohibitive expense, especially for small systems. Additionally, uncapped or unknown fees can make it impossible to obtain financing for larger projects. The FERC standards that establish reasonable fee levels are recommended guidelines for setting fee structure.

Engineering Charges: An interconnection standard may require an engineering review for certain systems. When it does, it is important to provide full disclosure of the applicable fees to all involved parties beforehand.

External Disconnect Switch: In the event of grid failure, all modern inverters that meet Institute of Electrical and Electronics Engineers (IEEE) standards shut down interconnected systems automatically. Therefore, external disconnect switches are nonessential.

Certification: It is important for state decision makers to be cautious when developing policies with certification requirements and ensure that additional technical requirements do not conflict with nationally accepted standards (Underwriters Laboratories, Institute of Electrical and Electronics Engineers). Departure from these standards could affect safety and security of the grid.

Technical Screens: The FERC standards provide a thorough set of technical screens that has been copied by many jurisdictions. Any significant revision of these guidelines introduces difficulties to the process, and may increase system costs, because configurations or programming must be changed to differ from these widely used benchmarks.

Spot Network Interconnection/Area Network Interconnection: A spot network is designed to serve a large single location, while an area network describes the power distribution system in an area dense with users. These types of networks are designed to increase reliability by creating more potential paths from generation to load.

Standard-Form Agreement: It is important to have a standard-form agreement that simplifies the interconnection process. If the standard is too complex or inimical toward the customer, the standard will lose merit.

Insurance Requirements: Excessive insurance requirements imposed on customer-sited generators tend to discourage customers from investing in renewable energy systems. Exorbitant premiums could potentially exceed economic benefits derived from having the system.

Dispute Resolution: Best standards provide a low-cost means of expert resolution to resolve disputes that evolve in the interconnection process.

Rule Coverage: Interconnection standards that apply to all utilities in the state are ideal.

Policy: Line-Extension Analysis

Policy Description

When an electric customer requests service for a home or facility that is not currently serviced by the electric grid, the customer typically is required to pay a distance-based fee for the cost of extending power lines to the home or facility. Frequently, it is more economical to use an on-site renewable energy system to supply a prospective customer's electricity needs. Certain states require utilities to provide information about renewable energy options when the customer requests a line extension (DSIRE 2009).

Policy Status

As of May 2009, three states have line-extension analysis policies in place. States with a line-extension analysis policy are shown in **Figure 3.7.**

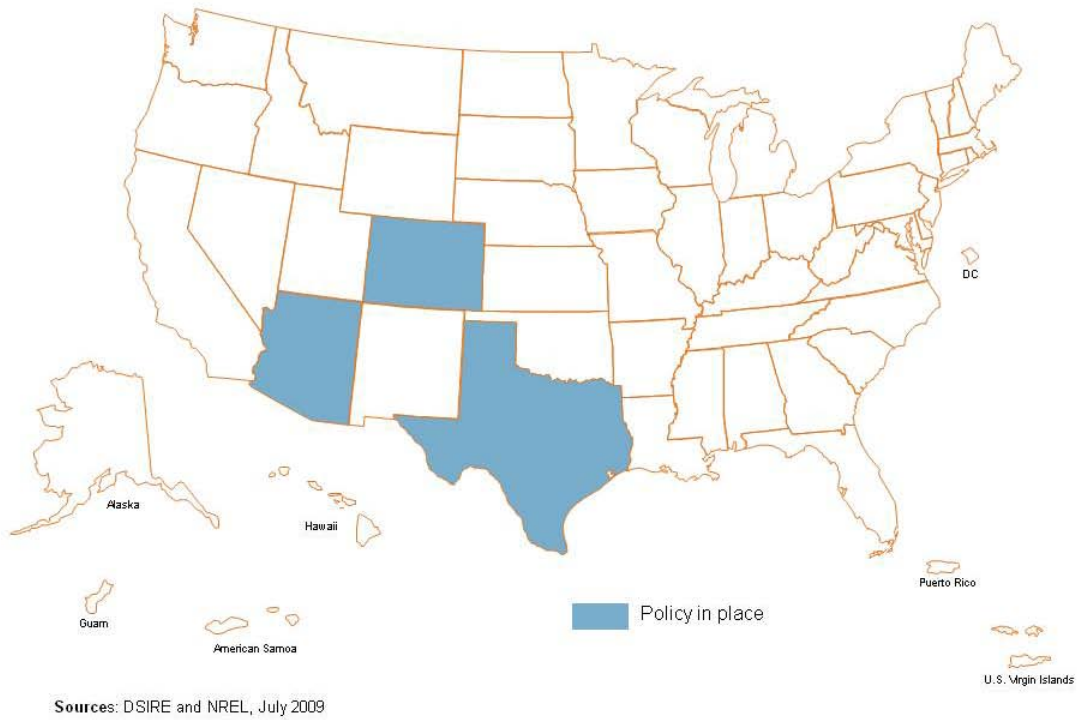


Figure 3.7. States with Line-Extension Analysis

Benefits of Line-Extension Analysis

Distributed renewable energy options may be less expensive for rural customers than extending the central distributed lines. Line-extension policies provide customers with information on this option. Installing renewable energy systems can provide a more energy-efficient choice for consumers in rural areas with a relatively low electricity demand. Also, line-extension policy analysis could lead to increased development of distributed renewable energy generation, which alleviates stress on the nation's aging grid infrastructure.

Policy Best Practices

A review of the literature and interviews with policy implementers (Williamson 2008) did not reveal best practices for this policy. The policy is not implemented on a broad enough scale to determine a correlation in policy effectiveness with renewable energy development.

Policy: Mandatory Utility Green Power Consumer Option

Policy Description

Several states require that specific classes of electric utilities offer customers the option of buying electricity generated from renewable resources. Typically, utilities offer green power generated from renewable resources owned by the utility or purchased under contract. They may also buy renewable energy credits (RECs) from a renewable energy provider certified by a state public utilities commission (DSIRE 2009).

Policy Status

As of May 2009, eight states have implemented mandatory utility green power policy.[5] States with this policy are shown in **Figure 3.8.**

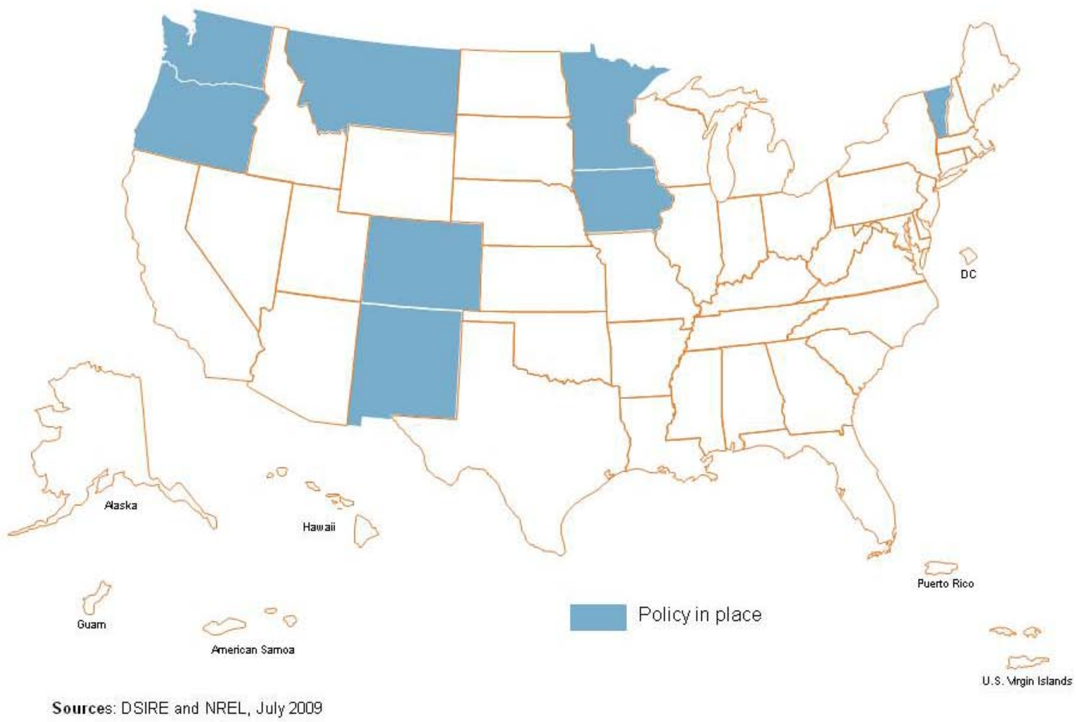


Figure 3.8. States with Mandatory Utility Green Power Consumer Option

Benefits of Mandatory Utility Green Power

The utility green power option can help organizations meet environmental, financial, stakeholder relations, economic development, and national security objectives. By buying green power, organizations can reduce long-term production costs and transform markets for renewable energy technologies (DOE 2004). Indicators show that customer power-choice programs are an effective stimulus for growth in renewable energy supply and demand. In 2008, total utility green power sales exceeded 5 billion kilowatt-hours (kWh),

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[5] Data are from DSIRE in May 2009. Other data sources providing summaries on this policy may differ slightly.

about a 20% increase over 2007. Participating in green power programs is one way that consumers can reduce their environmental footprint (Bird et al. 2008a, Bird et al. 2008b).

Policy Best Practices

While specific best practices have not been defined, trends indicate that persistent and creative marketing strategies – including utility partnerships with independent green power marketers – have contributed to the success of utility green power programs. Additionally, utility programs that offer fuel price stability benefits to consumers, and community challenges that encourage consumers to purchase green power, are significant factors in continued growth of the industry. Ongoing declines in the rate premium that customers pay for green power is a proven incentive (Bird et al. 2008a, Bird et al. 2008b).

Policy: Net Metering

Policy Description

For electric customers who generate their own electricity, net metering allows for the flow of electricity both to and from the customer. Typically, this process is accomplished through a single, bidirectional meter. During times when a customer's generation exceeds the customer's use, net metering allows for electricity to flow from the customer back to the grid, offsetting electricity consumed by the customer at a different time. In effect, the customer uses excess generation to offset electricity that the customer otherwise would have to buy at the utility's full retail rate (DSIRE 2009).

Policy Status

As of May 2009, 42 states, four territories, and the District of Columbia have net-metering policies. Subsequent to the research date for *State of the States 2008*, three additional states have implemented this policy. The states are Arizona, Kansas, and Nebraska. States with this policy are shown in **Figure 3.9.**

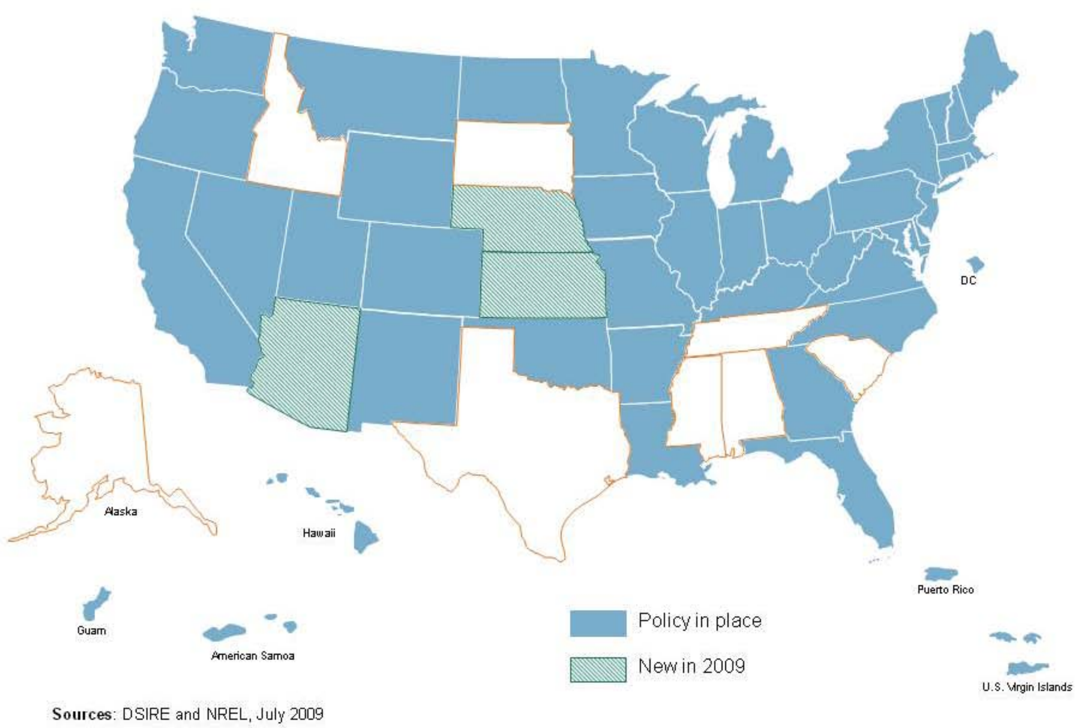

Figure 3.9. States with Net Metering

Benefits of Net Metering

Net-metering policies can play an important role in effectively removing market barriers to renewable energy development. Net metering can provide benefit to the customer and the utility, if there are enough systems to impact electricity supply. However, net metering can potentially impose negative impacts on utilities. If a large number of customer energy-generating systems are installed, the utility could sustain significant revenue losses. Net-metering policies that follow best practices improve the financial environment by increasing the return on investment for distributed-generation systems. Because the supply of renewable energy may not coincide with the demand placed on the system, net-metering policies smooth out this irregularity in the most cost effective way for the individual generator.

Policy Best Practices

The best practices for net metering are taken from methods described in NNEC 2008. While most states have a net-metering policy, not all align their policy implementation with best practices. In its report, NNEC provides a comprehensive review and ranking of states with net-metering policies, and how implementation of best practices can have a positive impact on renewable energy development within a state.

Individual System Capacity: Uniform limits in size reduce regulatory confusion, while promoting the widespread population of renewable energy systems. Increasing the eligible facility size for nonresidential systems also could encourage participation in net-metering programs by large investors

Program Capacity Limits: Capacity limits artificially restrict the expansion of on-site renewable generation and curtail the market for new renewable energy systems. Best practice is to not limit the total aggregate capacity eligible for net metering, either statewide or for individual given utilities.

Rollover Restrictions: The most effective state programs allow for customers to “roll over” excess generation when they generate more electricity during a monthly billing period than they consume. The utility carries forward any excess generation until it is consumed.

Metering Issues: As a best practice, customer-sited generators may use their existing meters. When this is not possible, the utility should provide a new meter free of charge. Time-of-use (TOU) meters with time bin carryovers can create situations that reward generators who produce during peak demand periods when electricity is most expensive

Renewable Energy Credit (REC) Ownership: The best practice for REC ownership allows the owner of the distributed-generation system to maintain ownership of the REC. Ownership provides a potential stream of revenue for owners of systems that generate electricity with renewable resources

Eligible Technology: All renewable energy technologies and other zero-emissions technologies should be eligible.

Eligible Customers: There should be no restrictions on eligible classes. Allowing nonresidential customers to net meter is essential to jump-starting new renewable energy markets.

Policy: Public Benefit Fund (PBF) /System Benefit Charge (SBC)

Policy Description

Public benefit funds (PBFs), or system benefit charges (SBCs), are state-level programs that were typically developed during electric utility restructuring in the late 1990s. Some states used these programs to ensure continued support for renewable energy resources, energy efficiency initiatives, and low-income energy programs.[6] These funds are most commonly supported through a small surcharge on electricity consumption. PBFs commonly support rebate programs for renewable energy systems, loan programs, research and development, and energy education programs (DSIRE 2009). PBFs are sometimes used to fund grants and investment policies. Key elements of a clean energy fund include the funding source, the entity that administers the fund, and the model for allocating the funds. Three basics funding models are used to allocate funding (EPA 2007):

1. The investment model uses state loans and equity to provide initial investment in clean energy companies and projects.
2. The project development model directly promotes clean energy project installation by providing production incentives and grants or rebates.
3. The industry development model uses business development grants, marketing support programs, research and development grants, resource assessments, technical assistance, consumer education, and demonstration projects to facilitate market transformation.

Policy Status

As of May 2009, 17 states and the District of Columbia have implemented public benefit funds programs. Maine's PBF program is based on voluntary funding, and Pennsylvania's PBF is self-sustaining through loan repayments and other returns on investment. States with this policy are shown in **Figure 3.10.**

[6] For this report, only the PBFs specific to renewable energy are examined. PBFs are also designed to support energy efficiency.

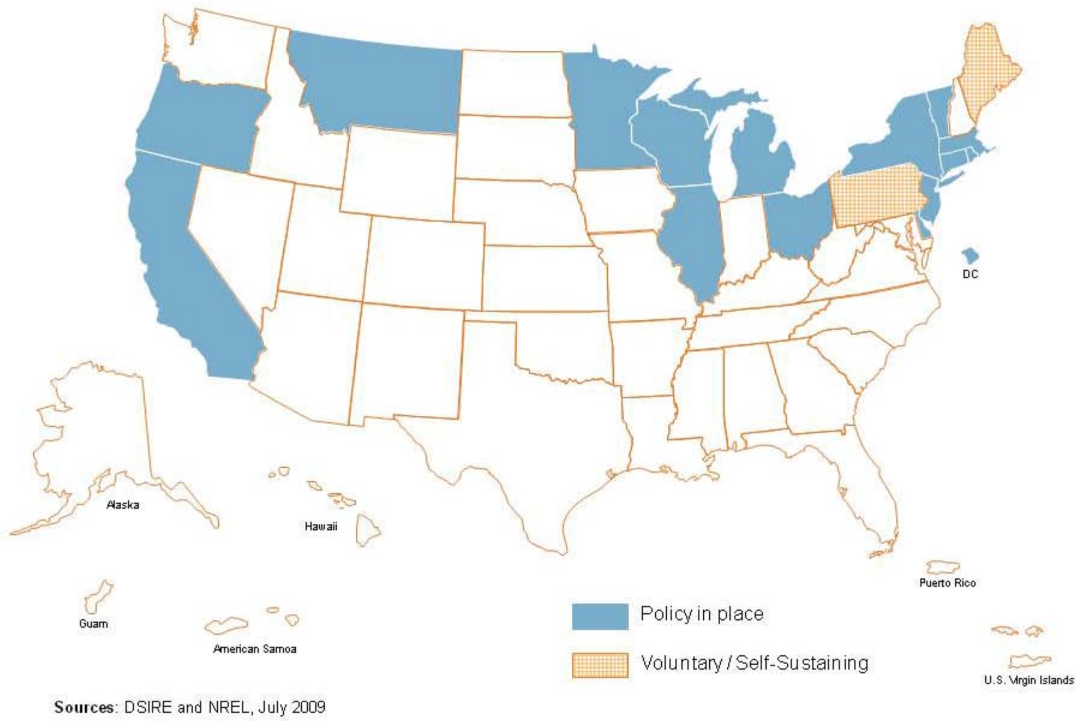

Figure 3.10. States with Public Benefit Funds

Benefits of Public Benefit Funds

Clean energy funds can be used to provide funding to narrow any gaps between the market price of electricity and the generating costs of clean energy technologies; address technical, regulatory, and market barriers for emerging technologies; stimulate the development of companion industries and infrastructure that are crucial to the success of clean energy; and promote consumers' awareness of clean energy. Additionally, well-designed clean energy funds provide a state with strategic opportunities. By combining a range of clean energy support programs and funding mechanisms "under one roof," states can develop a cohesive strategy to address a range of clean energy market issues. While many clean energy policies are aimed at jump-starting markets for commercially ready technologies, clean energy funds can be designed to fund initiatives with longer-term benefits, such as research and development and technology demonstration. Because of their flexibility, clean energy funds can be used to complement and leverage other state and federal policies. For example, clean energy funds can be used to increase the effectiveness of other policies, such as federal tax incentives, a renewable portfolio standard (RPS), and net-metering standards by reducing equipment costs, addressing market barriers, and providing consumer education and outreach (EPA 2007).

Policy Best Practices

Based on the experiences of states that have developed public benefit funds, a number of best practices have emerged for designing effective funds (EPA 2007). The best practices identified are:

Establish a working group of interested stakeholders, such as electric utilities, the state public utility commission (PUC), clean energy advocates, project developers, state energy offices, and state environmental agencies, to develop recommendations for design and administration of the funding mechanism.

Develop draft legislation for consideration by the state legislature, if legislation is required to implement a systems benefit charge (SBC).

Based on the state's specific clean energy goals, determine both the stage of technology development and the type of incentives needed to support each technology. State clean energy funds often include a portfolio of program options to support both emerging and technically proven technologies.

Design funding sources to promote consistency in funding from year to year. The ability to carry forward excess annual contributions can be an important feature, especially during early years when activities are ramping up. Employ mechanisms, such as set percentage tariffs, that help ensure consistent funding levels and protect against the diversion of funding to other state needs.

Develop programs that will complement other state and federal clean energy initiatives, such as RPS, tax credits, and loan programs. This coordination can include policies that allow developers to leverage other funding sources without activating "double-dipping" clauses, which prevent developers from taking advantage of multiple federal or state incentives simultaneously.

Develop measurable targets, such as green power participation rates, infrastructure development measured in megawatts of new capacity, peak load reduction from clean DG, and monitor progress toward reaching these targets.

Be willing and able to shift funding priorities and develop new or modified programs in response to changes in markets or technologies as they develop.

Publicize success stories and goals that have been achieved. Make sure that state officials, office holders, and the public remain aware of the clean energy fund and know that it is achieving the desired results.

Policy: Rebate Programs

Policy Description

Rebates are offered to promote the installation of renewable energy systems. The majority of rebate programs that support renewable energy are administered by states, municipal utilities, and electric cooperatives. These programs commonly provide funding for solar water heating and/or photovoltaic (PV) systems. Rebate amounts vary widely based on the technology and program administrator (DSIRE 2009).

Policy Status

As of May 2009, 18 states, the District of Columbia, and the U.S. Virgin Islands have state rebate programs. Subsequent to the research date for *State of the States 2008*, New Hampshire and Pennsylvania implemented this policy. South Carolina also discontinued the residential solar initiative for EarthCraft homes rebate, and Indiana discontinued the residential geothermal heat pump rebate. States that have rebate programs are shown in **Figure 3.11.**

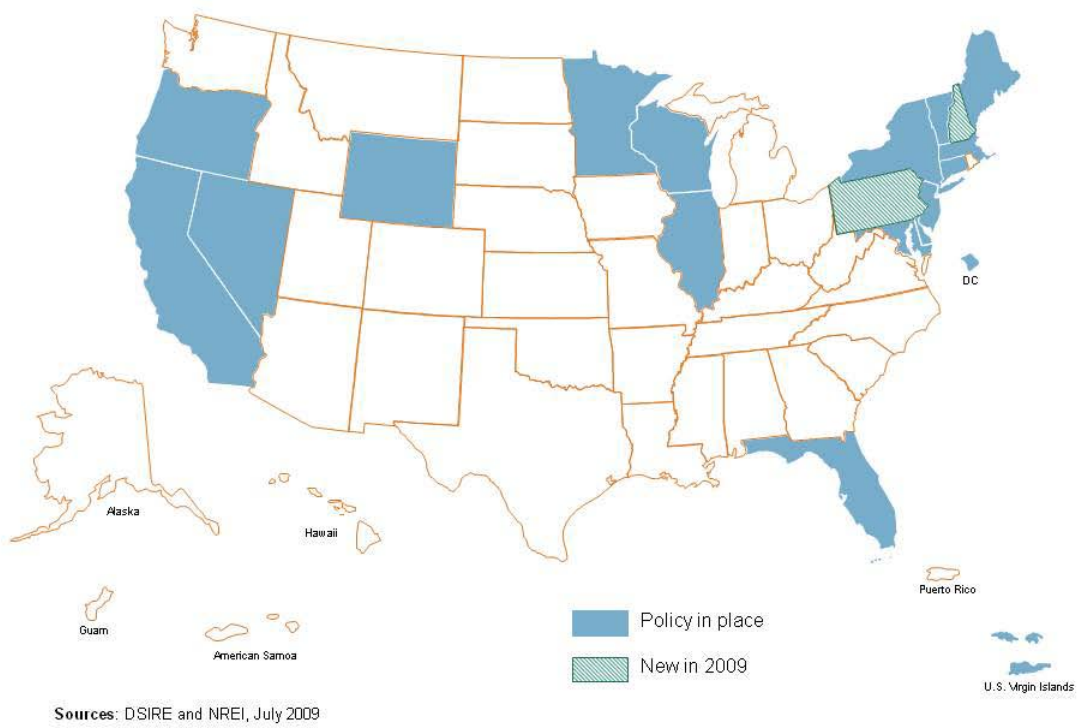

Figure 3.11. States with Rebate Programs

Benefits of Rebate Programs

Rebates act as a financial incentive mechanism for boosting renewable energy development – especially small, customer-sited projects – by effectively reducing high capital costs frequently associated with renewable energy installations. Unlike production incentives, rebates do not require a long-term policy and financial commitment to a specific project, which allows for flexible support based on changes in the market (Wiser and Pickle 1997).

Policy Best Practices

Rebates have been a widely used public-financing mechanism for distributed renewable energy. State experiences in administering these programs have resulted in the creation of established best practices. The following is a list of best practices compiled by the Clean Energy Group of the Clean Energy States Alliance (CESA 2009).

> ***Ensure Program Continuity***: It's important that rebate programs run for several years (with few changes) to build market awareness and dealer support. Renewable energy systems have high up-front costs and long purchase-decision cycles.
>
> ***Partner with Dealers and Installers***: These partnerships work to both the program and market's advantage by building consumer confidence, increasing competition, and lowering the costs of installation (eventually allowing for reduced rebate levels).
>
> ***Promote Technology-Friendly Policies***: Rebates by themselves will not help build a market if potential customers are thwarted by policy barriers ranging from unfriendly local building code and zoning restrictions to restrictive net-metering and interconnection rules.
>
> ***Provide Clear, Consistent Eligibility Rules***: Rebates can offer differential support based on project location, ownership type, and system size; but these distinctions should be clear, equitable and simple.
>
> ***Ensure System Performance***: Rebates should be provided only for approved equipment and/or installers. Hold back a portion of the rebate amount until local building officials or other designated agencies verify systems are operating properly.

Policy: Renewable Energy Access Laws

Policy Description

Renewable energy access laws typically apply to solar and wind resources. Solar and wind access laws are designed to protect a consumer's right to install and operate a solar or wind energy system at a home or business. Some solar access laws also ensure a system owner's access to sunlight. In some states, access rights prohibit homeowners associations, neighborhood covenants, or local ordinances from restricting a homeowner's right to use solar energy. Easements, the most common form of solar access law, allow for the rights to existing access to a renewable resource on the part of one property owner to be secured from an owner whose property could be developed in such a way as to restrict that resource. An easement is usually transferred with the property title (DSIRE 2009).

Policy Status

As of May 2009, 35 states and the U.S. Virgin Islands have renewable access laws. Subsequent to the research date for *State of the States 2008*, Vermont has implemented this policy. States with public access laws are shown in **Figure 3.12.**

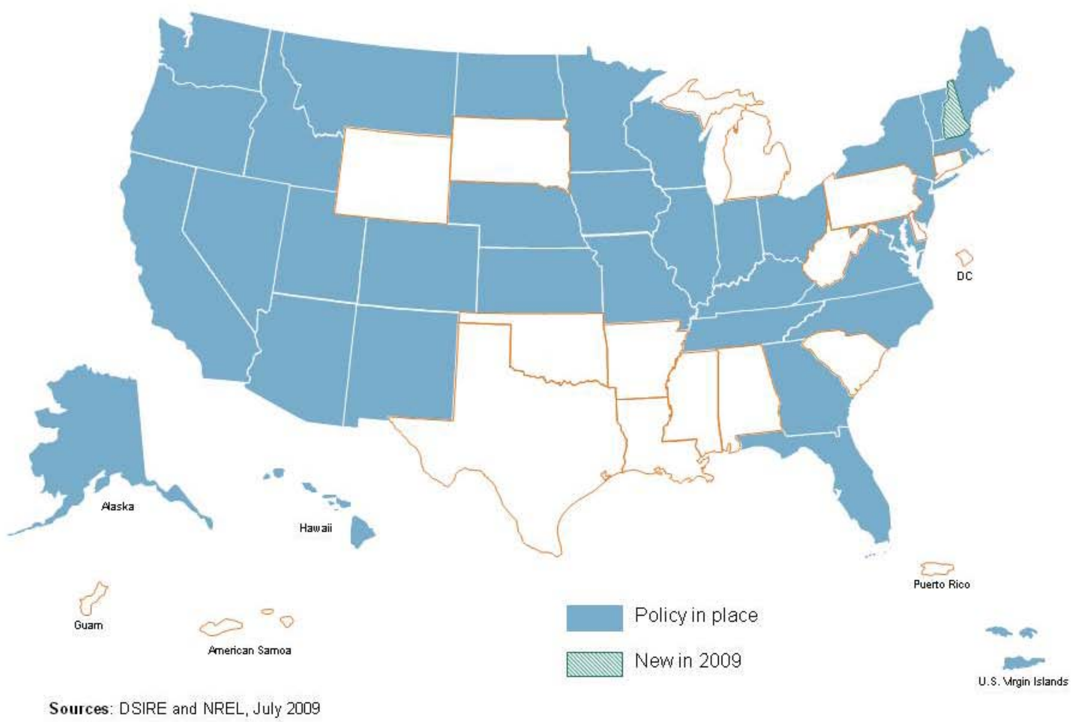

Figure 3.12. States with Renewable Energy Access Laws

Benefits of Renewable Energy Access Laws

Because this policy is difficult to enforce and is often based on voluntary agreements between parties, there is insufficient data regarding its effect on renewable energy development and the best practices for policy implementation. However, this policy has potential to have significant impact if enforcement issues are addressed.

Policy Best Practices

The best practices for policies on access law are taken from suggested standards developed by the Solar America Board for Codes and Standards. Best practices were identified based on effective laws implemented in various states (Kettles 2008).

Clearly Define Solar Equipment: Policy should clearly and thoroughly define a solar energy device. It would specify the equipment and requisite hardware that provide and are used for collecting, transferring, converting, storing, or using incident solar energy for water heating, space heating, cooling, generating electricity, or other applications that would otherwise require the use of a conventional source of energy.

Solar Site Planning: Solar-access policies should be adopted within the framework of comprehensive land-use plans. Solar easements are the prevalent method for ensuring solar access. Where solar easements are voluntary rather than mandated, a solar registration process for system owners can effectively work as a solar access tool. By recording or registering ownership of a solar energy system, the owner is allowed to establish a solar easement.

Solar Rights: Policies designed to protect the right of homeowners to install solar energy systems will address restrictive local government ordinances, as well as private land-use restrictions, such as covenants, conditions, and restrictions in deeds; and declarations in condominium documents. Restrictive covenants and conditions that prohibit the use of solar will not be upheld where state or local law provides otherwise through a solar rights statute.

Zoning: Policies should include zoning provisions that encourage the use of solar systems and protect solar access by regulating the orientation of streets, lots, and buildings; maximum building heights; minimum building set-back requirements; limitations on the height and placement of vegetation; and other provisions. Solar systems would be exempt from these restrictions.

Policy: Renewable Energy Production Incentives

Policy Description

Production incentives provide cash payments based on the number of kilowatt-hours (kWh) a renewable energy system generates. To ensure project quality, payments based on a system's actual performance are generally more effective than payments based on a system's rated capacity. Production incentives are also known as performance-based incentives **(**DSIRE 2009)**.**

Policy Status

As of May 2009, six states have implemented production incentives. Additionally, on May 27, 2009, Vermont enacted a production incentive policy that effective September 30, 2009. While Minnesota's program was closed to new applicants on January 1, 2005, generators who are already enrolled in the program continue to receive production incentives. States with this policy are shown in **Figure 3.13.**

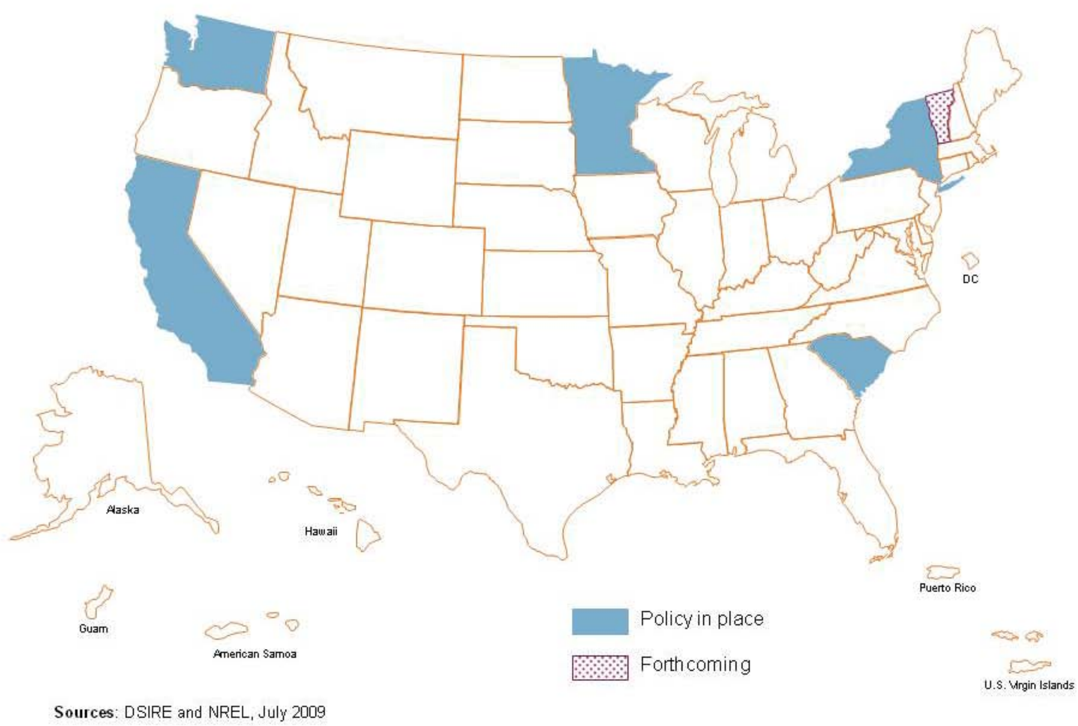

Figure 3.13. States with Production-Incentive Policies

Benefits of Production-Incentive Policies

Production incentives are included as a potentially effective policy in a state renewable energy portfolio. Utility-scale renewable energy development requires long-term revenue certainty for developers to obtain appropriate financing (Wiser et al. 2002). Production incentives can provide a portion of this necessary revenue in coordination with other revenue certainty, generally derived from a long-term power purchase agreement (PPA).

To this end, production incentives promote renewable energy development because they encourage efficient, maximum generation from renewable energy facilities.

Policy Best Practices

A literature review returned insufficient information to develop a list of best practices for state production incentives that are directed toward the promotion of renewable energy development.

Policy: Renewable Portfolio Standards

Policy Description

Renewable portfolio standard (RPS) policies require utilities to own or acquire renewable energy or renewable energy certificates to account for a certain percentage of their retail electricity sales, or a certain amount of generating capacity, within a specified timeframe. Renewable portfolio goals are similar to RPS policies, but renewable portfolio goals are not legally binding. The term "set-aside" or "carve-out" refers to a provision within an RPS that requires utilities to use a specific renewable resource – typically, solar energy – to account for a certain percentage of retail electricity sales, or a certain amount of generating capacity, within a specified timeframe (DSIRE 2009).

Policy Status

As of May 2009, 29 states and the District of Columbia have renewable portfolio standards, while five additional states and Guam have renewable portfolio goals. Subsequent to the research date for *State of the States 2008*, Michigan, Missouri, and Kansas enacted RPS policy. States with this policy are shown in **Figure 3.14.**

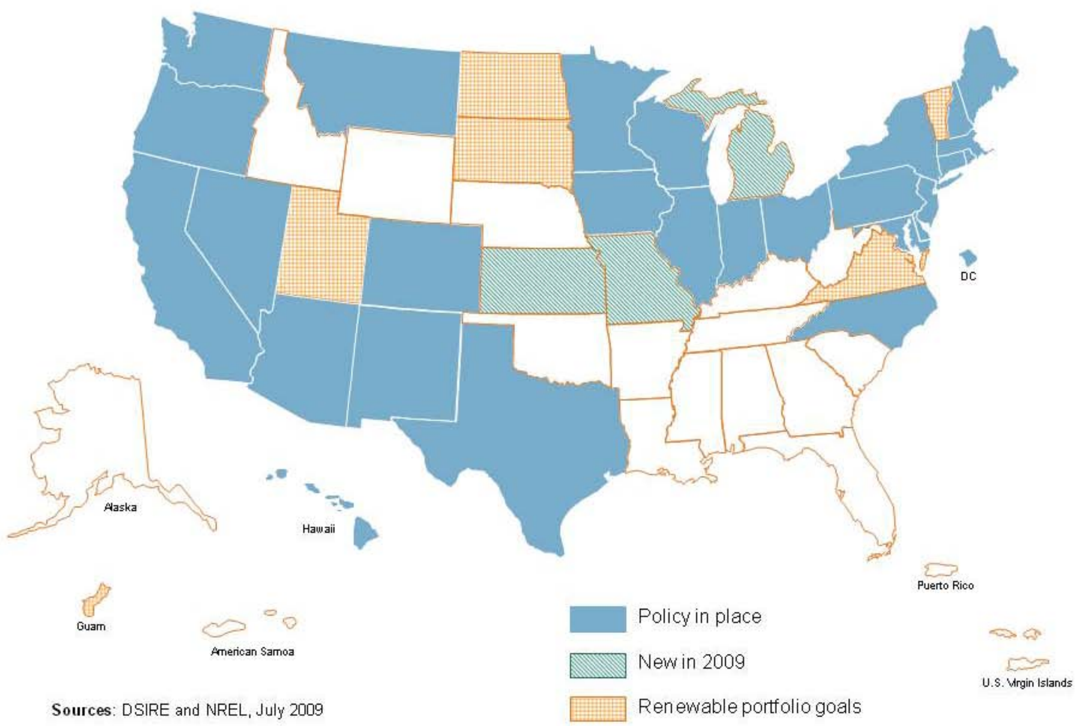

Figure 3.14. States with Renewable Portfolio Standards and Goals

Benefits of Renewable Portfolio Standards

Renewable portfolio standards, one of the most popular policies used to promote renewable energy development at the state level, provide state policymakers with the flexibility to design a policy that reflects individual state goals. This policy is widely considered to be included among the most important policies leading to increased renewable energy capacity (Wiser and Barbose 2008).

Policy Best Practices

The best policy practices for renewable portfolio standards are taken from recommendations provided by a State/Federal RPS Collaborative supported by the Energy Foundation and the U.S. Department of Energy through the National Renewable Energy Laboratory. The following list provides the most current collaborative best practices available. The collaborative identified best practices based on state experiences with RPS policy (State and Federal RPS Collaborative 2009).

RPS Targets:

RPS targets should be stable, ramp up steadily over time, and not be subject to sudden or uncertain shifts.

RPS targets should be achievable and encourage renewable resource development beyond existing available resources, given developable resource potential, transmission constraints, interconnection barriers, availability of complementary mechanisms that support project development, and potential siting challenges.

Compliance periods should be at least one year to allow all renewable energy technologies to participate and be counted, including those resources that are seasonal by nature.

Program Duration:

An RPS program should be of sufficient duration to allow for long-term contracting and financing.

RPS rules should be stable, with any changes to policy occurring only after ample notice and lead-time.

Covered Entities:

An RPS program should apply to all load-serving entities: investor owned, municipal, and electric cooperatives, including suppliers of last resort.

In restructured markets, all suppliers to retail loads should be obligated to participate.

Resource and Geographic Eligibility:

The eligibility of specific renewable energy technologies under an RPS should be well-defined.

Fuel technology and vintage eligibility decisions should be guided by an assessment of the social benefits of the particular resources and technologies. They should also be evaluated by the need of those projects to generate additional revenue from selling into an RPS market.

Customer-sited renewable generation should be eligible for RPS programs if all other RPS requirements are met.

Eligibility of existing renewable generation should be limited to support new renewable project development.

RPS rules on the treatment of out-of-state resources should be well-defined and legally defensible.

Tradable Renewable Energy Credits (RECs)

Use of tradable renewable energy credits for RPS compliance should be considered as a mechanism to provide for contracting flexibility, to lower compliance costs, and to simplify verification.

RPS rules and tracking systems should ensure that there is no double counting of RECs in compliance and voluntary markets.

An RPS program should, whenever possible, require the use of a robust tracking system for registering and tracking RECs.

An RPS program should explicitly define the environmental attributes that must be included in a REC used to comply with the state's RPS.

Cost Recovery and Allocation of Costs

An RPS program should ensure that prudently incurred RPS compliance costs can be recovered in electricity rates.

Long-term contracting standards for regulated utilities should be established, supported, and encouraged.

The cost of RPS compliance should be allocated fairly across all utility customers.

Program Administration and Enforcement

Success of RPS implementation is dependent on strong political and regulatory support.

An RPS program should be mandatory and impose repercussions on those entities that fail to meet requirements.

Measures to control compliance costs, such as alternative compliance payments, should be considered.

RPS rules should authorize the program administrator to accommodate the possible creation of a federal RPS program in the future.

Policy: Tax Incentives

Note: Due to the similarity of the mechanisms, the various types of tax incentives – including corporate, industry, personal, property and sales tax – have been consolidated and presented under this heading.

Policy Description

Renewable energy systems may be eligible for multiple types of tax incentives. The five primary categories that apply to renewable energy development are corporate, industry recruitment and support, personal, property, and sales tax incentives. The income tax incentives are divided into two categories (personal and corporate) because the size of technology and incentive size depend on the end user. Property and sales tax incentives are included because they are fundamentally different mechanisms from income tax incentives. The tax incentives are not separated by resource because, ideally, state policies reflect best practice design within the context of the state. Each type of tax incentive is described below.

Corporate Tax Incentives. Corporate tax incentives include corporate tax credits, deductions, and exemptions. These incentives are available in some states to corporations that purchase and install eligible renewable energy or energy efficiency equipment, or construct green buildings. In a few cases, the incentive is based on the amount of energy produced by an eligible facility. Some states allow the tax credit only if a corporation has invested a minimum amount in an eligible project. Typically, there is a maximum limit on the dollar amount of the credit or deduction (DSIRE 2009).

Industry Recruitment and Support Incentives. To promote economic development and the creation of jobs, some states offer financial incentives to recruit or cultivate the manufacturing and development of renewable energy systems and equipment. These incentives commonly take the form of tax credits, tax exemptions, and grants. In some cases, the amount of the incentive depends on the amount of eligible equipment that a company manufactures. Most of these incentives apply to several renewable energy technologies, but a few states target specific technologies, such as wind or solar. These incentives are usually designed as temporary measures to support industries in their early years, and they commonly include a sunset (or termination) provision to encourage the industries to become self-sufficient (DSIRE 2009).

Personal Tax Incentives. Personal tax incentives include personal income tax credits and deductions. Many states offer these incentives to reduce the expense of buying and installing renewable energy systems and equipment. The percentage of the credit or deduction varies by state; and, in most cases, there is a maximum limit on the dollar amount of the credit or deduction. An allowable credit may include carryover provisions, or it may be structured so that the credit is divided over a certain number of years (DSIRE 2009).

Property Tax Incentives. Property tax incentives include exemptions, exclusions, and credits. The majority of property tax incentives require excluding the added value of a renewable energy system from the valuation of the property for taxation purposes. Because property taxes are collected locally, some states grant local taxing authorities the option of allowing a property tax incentive for renewable energy systems (DSIRE 2009).

Sales Tax Incentives. Sales tax incentives typically provide an exemption from the state sales tax, or sales and use tax, for the purchase of a renewable energy system. Several states have established an annual "sales tax holiday" for energy efficiency measures by allowing a temporary exemption, typically for one or two days, from the state sales tax (DSIRE 2009).

Policy Status

States can provide many variations of tax incentives as well as a combination of multiple types and sectors. The design of the individual incentives and the portfolio of incentives are integral in determining the effectiveness of these policies for promoting renewable energy. As of May 2009:

- Twenty-four states and Puerto Rico provide a corporate tax incentive to promote renewable energy. Puerto Rico enacted this policy subsequent to the research date for *State of the States 2008.* States with this policy are shown in **Figure 3.15.**
- Fifteen states and Puerto Rico have industry recruitment and support incentives. States with this policy are shown in **Figure 3.16.**
- Twenty states and Puerto Rico provide a personal tax incentive. Subsequent to the research date for *State of the States* 2008, Vermont and Puerto Rico implemented this policy. On June 5, 2009, West Virginia enacted a personal tax credit for residential solar energy, effective July 1, 2009. These tax incentives are not applicable to the nine states that do not have a personal income tax: Alaska, Florida, Nevada, New Hampshire, South Dakota, Tennessee, Texas, Washington, and Wyoming. States with this policy are shown in **Figure 3.17**.
- Thirty-two states and Puerto Rico provide a property tax incentive to promote renewable energy development. Subsequent to the *State of the States 2008* report, Colorado, Florida, and New Jersey implemented this policy. States with this policy are shown in **Figure 3.18.**
- Twenty-six states and Puerto Rico provide a sales tax incentive to promote renewable energy development. Subsequent to the research date for *State of the States 2008*, Colorado, Nevada, and North Carolina have implemented this policy. The states of Alaska, Delaware, Montana, New Hampshire, and Oregon do not have a state sales tax. States with this policy are shown in **Figure 3.19.**

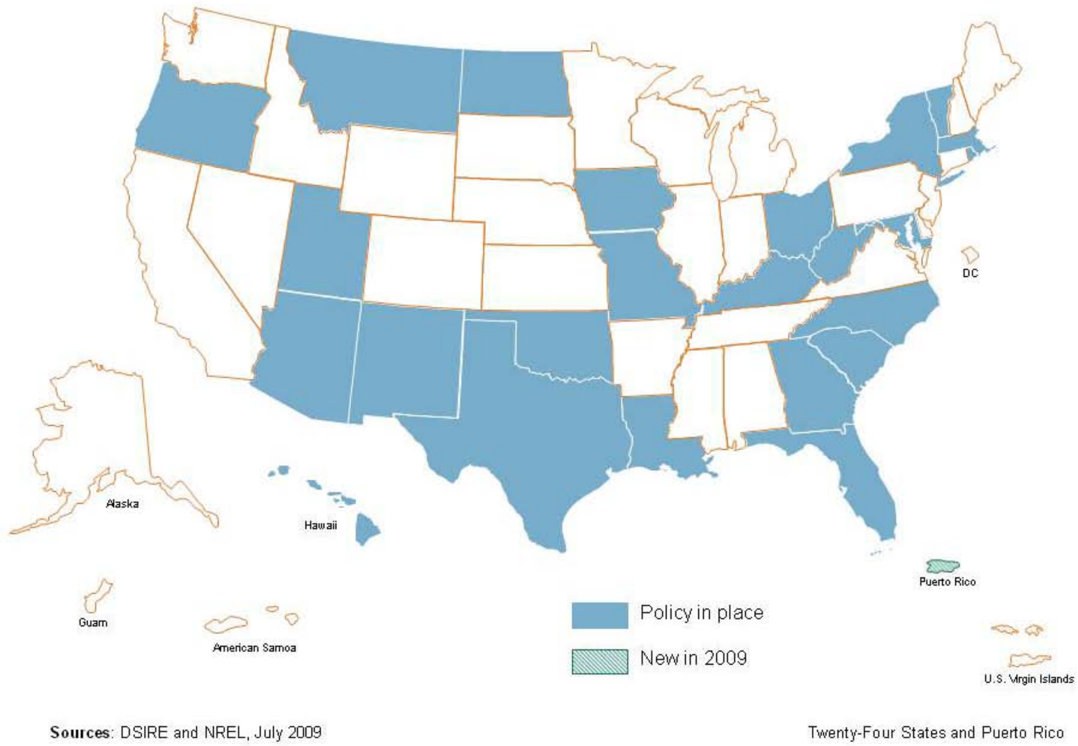

Figure 3.15. States with Corporate Tax Incentives

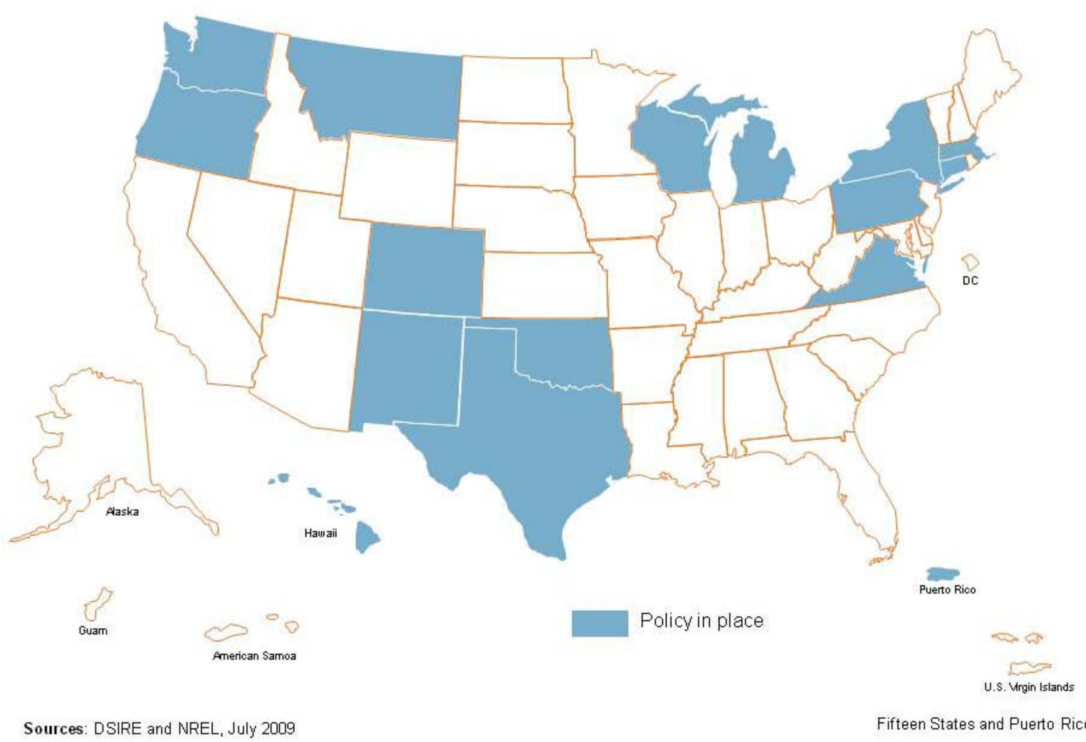

Figure 3.16. States with Industry Recruitment and Support Incentives

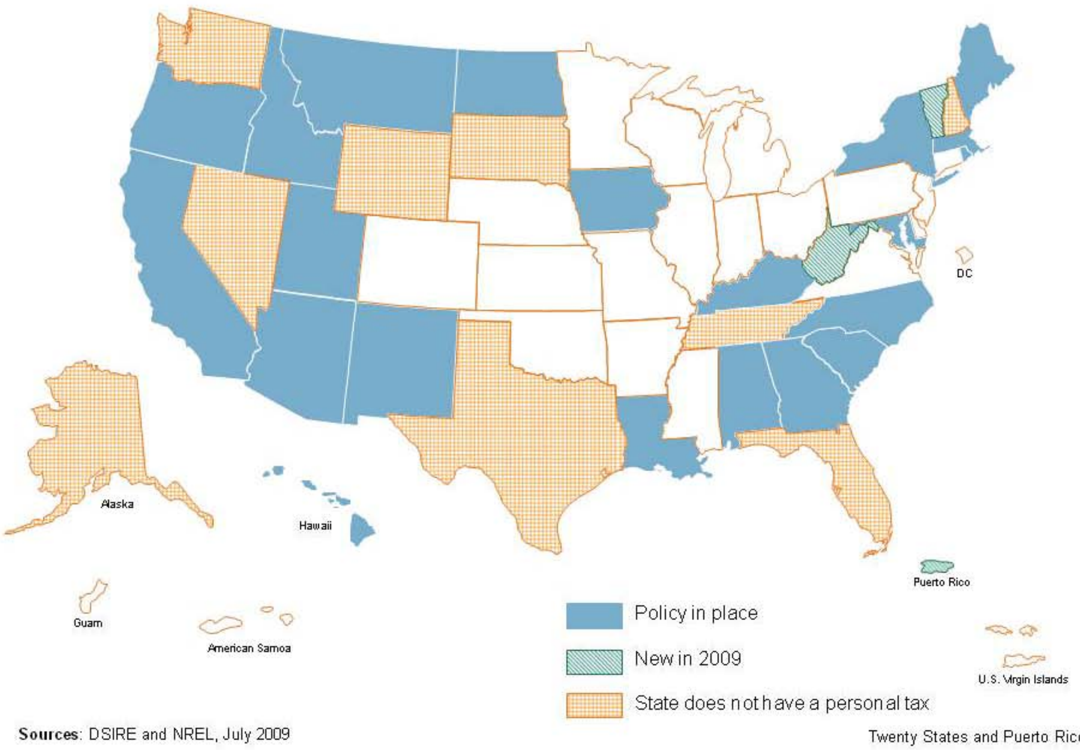

Figure 3.17. States with Personal Tax Incentives

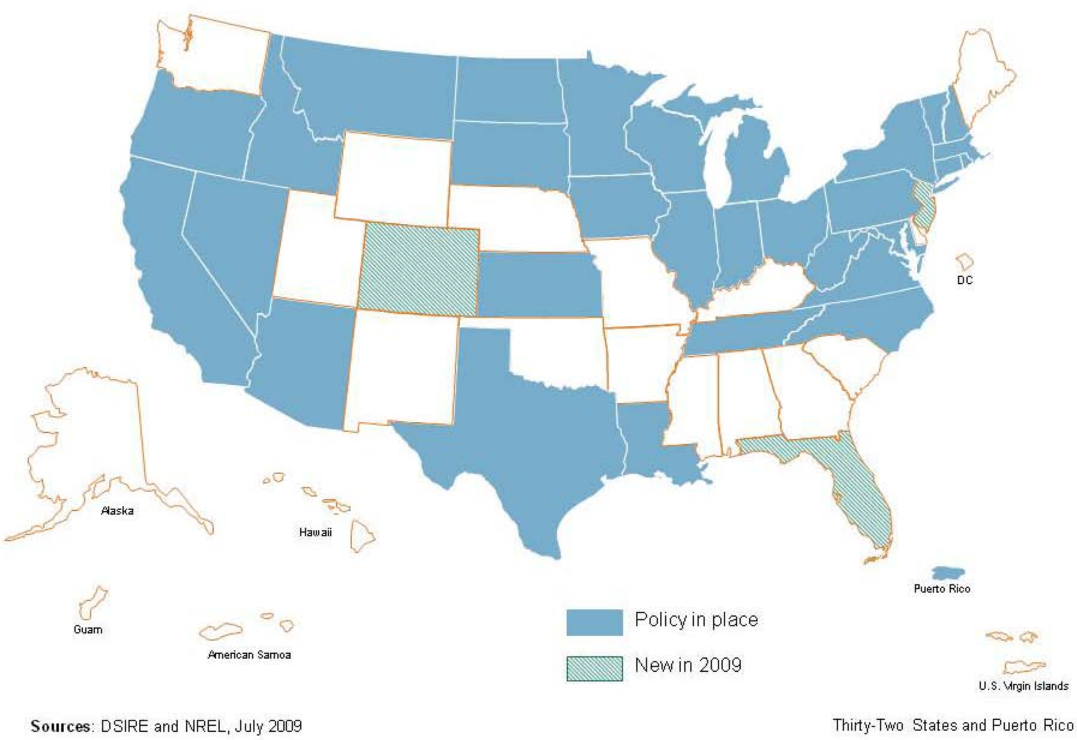

Figure 3.18. States with Property Tax Incentives

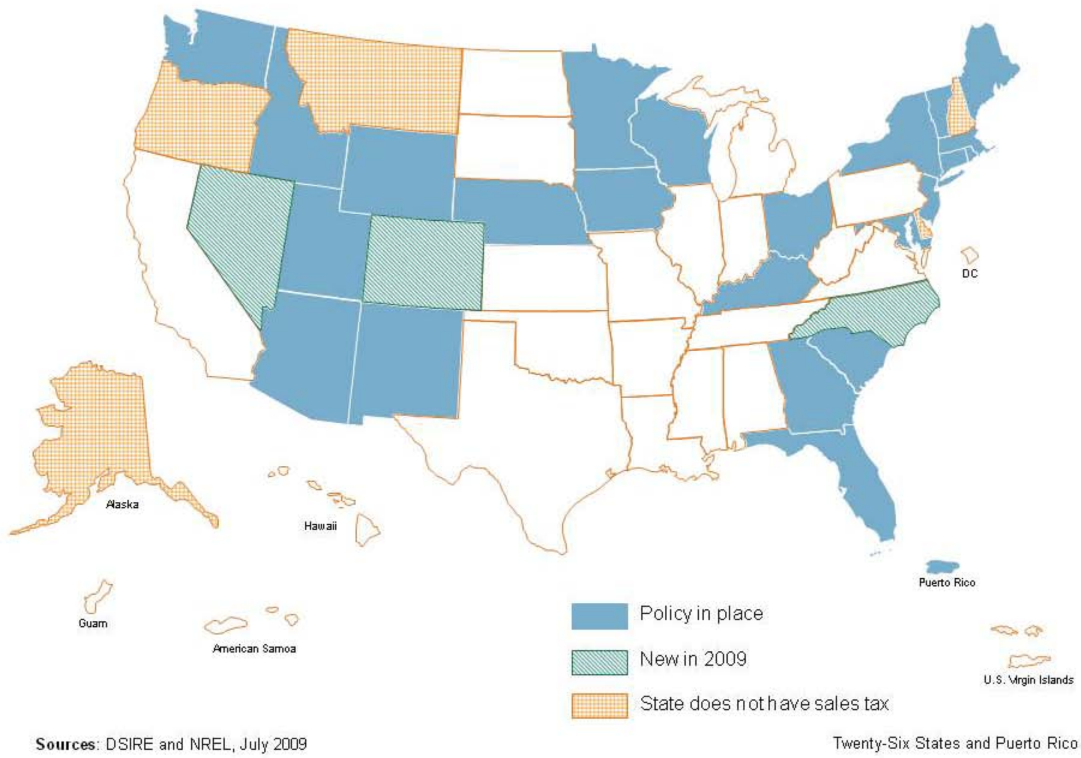

Figure 3.19. States with Sales Tax Incentives

Benefits of Tax Incentives

Tax incentives can be integral in renewable energy development because they offer policymakers flexible mechanisms for promoting increases in both the supply and demand sides of the market (Clemmer et al. 2001). Because they are rarely the sole motive for consumers to invest and, therefore, are insufficient if they are the only policy in place, tax incentives, if designed properly, can complement other policies. The design flexibility allows policymakers to direct financial support to a specific technology or sector that best fits the state's goals as well as fiscal and resource needs. Due to the relatively high capital cost associated with many renewable energy technologies, tax incentives are a good policy choice to reduce the capital cost by a sufficient increment to increase the development in projects. Tax incentives also are effective because they generally are easy for consumers to understand and use. These incentives, if designed properly and phased out at the appropriate rate, can aid in creating a sustainable market for renewable energy.

Policy Best Practices

Well-designed tax incentives can play an important role in increasing market penetration of renewable energy if implemented as a piece of a policy portfolio. A literature review resulted in sparse information regarding the best practices for tax incentives for renewable energy development. Because the design of these policies is integral in their effectiveness, further, more refined analysis of the design components will lead to more detailed information for policymakers to use when developing renewable energy tax-incentive programs. For this report, the best practices for tax incentives for the promotion of energy efficiency were identified and are used in an attempt to supplement the gap (Brown et al. 2004).

***Resources*:** This may be especially important for sales tax incentives, because they are more effective if they are designed to support technologies for which the state has excellent resources (Bird et al. 2005).

Complements Other Policies: Tax incentives are not generally considered in the literature to be effective when they are used as the sole policy to support renewable energy development. Further, to maximize effectiveness of tax incentives, it is imperative that the incentives are designed to coordinate with other policies to address market barriers.

Sized Appropriately: The appropriate incentive size will depend on the context of the respective market, which will make it unique to each state. It is not sufficient to merely have a tax incentive; it must be large enough to increase investment without being so large as to overdraw the state's resources. Also, the policy should be designed so that the incentives are not larger than the amount that a consumer owes. This could create an insufficient tax liability, which prevents the consumer from taking full advantage of the incentive (Clement et al. 2005).

Adequate Cap: The financial incentive is adequately capped to reflect the fiscal realities in the state. This also reduces market risk to consumers of not receiving the incentive if the demand is greater than expected (Brown et al. 2004).

Appropriate Time Span: Tax incentives should be designed with a time horizon long enough to provide consistency to the market without becoming a crutch for the industry. Policies that are designed to last for too long are unlikely to provide the initial jump-start in investment that is often a desired goal of these types of programs. However, policies that offer incentives for too brief of a period, or have uncertainty surrounding short-term extensions, can be ineffective in providing the market stability that is desired. This scenario has been well-documented with the uncertainty of the extensions of the federal production tax credit (PTC) and the resultant boom-bust cycle in wind development (Wiser et al. 2007).

Program Evaluation: Proper evaluation allows better understanding of the impacts of incentive programs and provides guidance to implementers on necessary programmatic changes – this will optimize the incentive. It is impossible to measure the effectiveness without a well-designed process for program evaluation (Mann and Hymel 2006).

Appropriate Technology: Meeting relevant national certification standards should be a requirement of benefiting from a state tax incentive. This ensures market certainty for manufacturers developing and marketing technologies and provides consumer protection for buyers of renewable systems.

Appropriate within State Context: The policy should fit the state context. For example, a sales tax incentive may be an ineffective policy in states with low sales tax.

Administration Cost: The policy should be designed to include adequate budget for administration, marketing, and educating the public about both the incentive and eligible technology options (Gouchoe et al. 2003).

Non-taxed Sector Eligibility: Incentives are designed so that non-taxed sectors (i.e., schools, nonprofits, etc.) are eligible to participate (Clement et al. 2005).

Conclusion

This chapter provides an overview of the state policies used to encourage renewable energy development, summarizes the current knowledge regarding best practices, and gives a status update of their implementation within U.S. states. Although some of the policies are fairly mature and have been implemented across a broad range of states, others are relatively untested. There is still a lot of work to be done to define best practices and formulate an understanding of their impacts and interactions within the U.S. context. The following table **(Table 3.1)** provides a summary of the status of renewable energy policy implementation as of May 2009, which is divided by individual states and U.S. territories.

Table 3.1. Summary of State Policies to Encourage Renewable Energy Development

	Summary of State Renewable Energy Development Policies																				
State	Bonds	Contractor Licensing	Corporate Tax Incentives	Equipment Certification	Generation Disclosure	Grants	Green Power Purchasing	Industry Support	Interconnection Standards	Line Extension Analysis	Loans	Net-Metering	Public Benefit Funds	Personal Tax Incentives	Property Tax Incentives	RE Access Laws	RE Production Incentives	Rebates	Required Green Power	RPS	Sales Tax Incentives
AL						•					•			•							
AK						•					•			NA		•					NA
Am. Sam.												•									
AZ		•	•	•					•	•		•		•	•	•				•	•
AR									•			•									
CA		•			•	•			•		•	•	•		•	•	•	•		•	
CO					•			•	•	•		•			•	•			•	•	•
CT		•			•	•	•	•	•		•	•	•		•			•		•	•
D.C.					•				•		•	•	•					•		•	
DE					•	•			•			•	•					•		•	NA
FL		•	•	•	•	•			•			•		NA	•	•		•			•
GA			•						•			•		•		•					•
GU												•								•	
HI		•	•					•	•		•	•		•		•				•	
ID	•													•	•	•					•
IL					•	•	•		•			•	•		•			•		•	
IN						•	•		•			•			•	•					
IA			•		•	•			•		•	•		•	•	•			•	•	•
KS											•	•			•	•				•	
KY			•						•			•		•		•					•
LA			•						•		•	•		•	•						
ME					•	•	•				•	•	•			•		•		•	•
MD			•		•		•		•		•	•		•	•	•		•		•	•
MA			•		•	•	•	•	•		•	•	•	•	•	•		•		•	•
MI		•			•	•		•	•			•	•		•					•	
MN				•	•	•			•		•	•	•		•	•	•	•	•	•	•
MS											•										
MO			•						•		•	•				•				•	
MT			•					•	•		•	•	•	•	•	•			•	•	NA
NE									•		•	•				•					•

State	Bonds	Contractor Licensing	Corporate Tax Incentives	Equipment Certification	Generation Disclosure	Grants	Green Power Purchasing	Industry Support	Interconnection Standards	Line Extension Analysis	Loans	Net-Metering	Public Benefit Funds	Personal Tax Incentives	Property Tax Incentives	RE Access Laws	RE Production Incentives	Rebates	Required Green Power	RPS	Sales Tax Incentives
	Summary of State Renewable Energy Development Policies																				
NV		•			•				•			•		NA	•	•		•		•	•
NH									•		•	•		NA	•	•		•		•	NA
NJ					•				•		•	•	•		•	•	•	•		•	•
NM	•		•					•	•			•		•		•			•	•	•
NY			•		•	•	•	•	•		•	•	•	•	•	•	•	•		•	•
NC			•			•			•		•	•		•	•	•				•	•
ND			•									•		•	•	•				•	
N. Mar.																					
OH			•		•	•			•			•	•		•	•				•	•
OK			•					•			•	•									
OR		•	•		•	•		•	•		•	•	•	•	•	•		•	•	•	NA
PA				•	•	•	•	•	•		•	•	•		•			•		•	
PR		•	•					•	•			•		•	•						•
RI			•		•	•					•	•	•	•	•	•				•	•
SC			•						•					•			•				•
SD														NA	•					•	
TN						•					•			NA	•	•					
TX			•		•			•	•	•	•			NA	•					•	
UT		•	•						•			•		•		•				•	•
VT			•			•			•		•	•	•	•	•	•	•	•	•	•	•
VI						•						•				•		•	•		
VA					•			•	•			•			•	•				•	
WA					•			•	•			•		NA		•	•		•	•	•
WV			•									•		•	•						
WI						•	•	•	•			•	•		•	•		•		•	•
WY									•					NA				•			•
COUNT	2	10	25	4	23	23	9	16	40	3	27	47	18	22	34	36	7	20	8	36	27

Chapter 4. Statistical Analyses of State Policy Impact on Renewable Energy Development

Introduction/Summary

This chapter outlines the methodologies and results of a variety of statistical analyses, which are designed to identify significant relationships between policy implementation and increased renewable energy development at the state level. The analyses presented in this chapter build on those presented last year and represent a more advanced and in-depth methodology.

In the *State of the States 2008* report, analysts used correlation analysis to investigate relationships between policies and renewable energy generation. In this report, a more appropriate “t-test methodology” is used for most of the analyses. This method gives a more accurate representation of relationships when evaluating nominal-type independent variables (e.g., present or not present, categorical, or non-quantitative) with ratio-type dependent variables (quantitative variables on a meaningful scale with a nonarbitrary absolute zero).

The selection of the alternative statistical method is partially responsible for considerable difference between this year’s results and those presented in last year’s report. For example, last year’s report found a correlation between energy production incentive and increased renewable energy generation and capacity. This year’s t-test methodology found no relationship between the same data. The analysts think that this year’s methodology provides more valid insights into the connections between energy policy and generation.

As more data becomes available each year, the analysts expect that the methodologies will be refined, and more thorough understandings of the results will be developed; and, ultimately, they will be able for make clearer connections between renewable energy policy and renewable energy development. As it stands now, the current dataset is too sparse and dependent on too much unrepresented contextual information to create a high confidence in the statistical inference. As the dataset grows over the years and incorporates more quantified contextual information, the results will be less provisional. It may be most appropriate to consider these current analyses as exploratory “data mining” aimed at producing insights into potential relationships in the data, rather than rigorous statistical hypothesis testing.

The analyses in this report produced insightful results concerning the relationship between policy and renewable energy development:

- The time-lag analysis offers insight into the amount of time between when a policy is implemented and when renewable energy development may be observed.
- The time-lag analysis also identifies a connection between the implementation of net-metering policy and subsequent increase in non-hydroelectric renewable generation, according to a variety of metrics that control different variables.

- The policy portfolio analysis uses both theoretical insight and empirical research regarding effective policy combinations. It also takes important steps toward identifying the most effective set of policies for addressing contextual issues and reducing the barriers to renewable energy development.
- The best-practice policy design analysis indicates that several components of an RPS policy may be particularly effective at increasing development.
- Removing outlying states from certain distributions highlights the importance of contextual factors that often overshadow the role of policy in influencing renewable energy development.
- Additional data and research is needed to reach more valid conclusions concerning policy and its influence on renewable energy development. Future versions of this report will be improved not only by expanded and additional methodologies, but also by allowing adequate time for states to develop policy portfolios and for the policies to mature and impact renewable energy development. As the renewable energy field continues to develop, connections between policy and the ensuing development will only become more evident.

Methodology

In this year's report, time-lag analysis is added to most of the statistical analyses to account for the time taken for policies to impact development. Last year, policies that were implemented in 2007 were compared to the generation data from the previous year. This means that some of the policies may not have been in place – or had not been in place for very long – when the generation was measured.

This year, the method is improved by adding a time lag to most of the analyses (i.e., policies that were implemented in 2005 were run against generation data for 2007). The theory behind this is that, because of the time needed to plan and build energy projects, there may be several years of lag time between the implementation of a policy and any new generation that would occur as a result of that policy.

In addition to the incorporation of a time lag into most of the analyses, the types of analyses have been expanded from last year's report. Five different in-depth methodologies to identify connections between policy and development are employed in this report (see **Table 4.1** to see which statistical analysis is conducted within each methodology). No single approach is touted as better or more complete than another; they simply represent different methods by which the relationships can be explored. The five analyses are:

1) **Impact of Individual Policies (without and with a time lag).** This analysis was conducted without and with a time-lag element. For this analysis, t-tests are conducted between individual policies and various renewable energy development indicators. For the analysis without a time lag, policies under implementation in 2008 are run against renewable energy generation and development indicators for 2007. For the analysis with a time lag, policies under implementation in 2005 are run against renewable energy generation and development indicators for 2007. Graphical illustrations of each of the

relationships that emerge as significant through the t-tests are then interpreted to lend further understanding of the relationships.

2) **Impact of Policy Portfolios.** This analysis explores the effectiveness of various policy combinations, e.g., policy portfolios. With this aim, t-tests and correlation tests are conducted to identify portfolio combinations that are related to high levels of renewable energy development. This analysis was conducted both with and without a time-lag component (i.e., relationships between 2008 policy combinations and 2007 renewable energy generation data, as well as 2005 policy combinations against 2007 renewable energy generation data). Several policy portfolio combinations were explored, specifically:

   - ***Market Transformation Portfolio*** – this portfolio categorizes policies as either barrier-reduction policies or policies that increase technology accessibility.
   - ***RPS Centered Portfolio*** – this portfolio consists of an RPS as a center policy accompanied by other policies theorized to complement an RPS.
   - ***Tax Incentive Centered Portfolio*** – this portfolio consists of combinations of tax incentives accompanied by other complementary policies.

3) **Effectiveness of Individual Policy Best Practice Design Elements.** This analysis explores the effectiveness of policy best practices, exploring whether a policy that meets best practice guidelines results in more renewable energy development. T-tests are performed to examine whether policies that follow a majority of the best practice guidelines result in significantly higher levels of development. This method is also used to investigate individual best practice components of policies. Correlation tests are also conducted to identify relationships between the "grades" assigned to the policies and the level of development achieved.

4) **Impact of the Age of an RPS.** This analysis examines the impact of the age of an RPS on renewable energy development. Correlation tests are used to identify relationships between how long an RPS policy has been in place and the renewable energy development indicators.

5) **Removal of Outlying States**. Because renewable energy development may be greatly influenced by various contextual factors (see **Chapter 5**) that vary significantly across the states, this analysis explores the impact of removing outlying states (e.g., states with significantly more or less generation than the rest). The analysts remove the top 10% and bottom 10% renewable energy-producing states and then look for significant relationships between policy and renewable energy development within the remainder of the states. The theory is that removing the outliers eliminates the states that most benefitted or suffered from relevant contextual factors, such as environmental conditions or

political landscapes. The remaining states, it is hypothesized, are less affected by contextual factors.

The rest of this section describes, in detail, the methodologies used for each of the analyses.

Table 4.1. Type of Statistical Analysis Used in Each Methodology

Statistical Analysis	Methodology				
	Individual Policies	Policy Portfolios	Policy Best Practice Design Elements	RPS Age Analysis	Removal of Outlying States
T-test Analysis	√	√	√		√
Time-lag t-test Analysis	√	√			
Correlation Analysis		√	√	√	
Graphical Validation (box plots)	√*				
*graphical validation is only performed on the time-lag individual policies					

1a) Impact of Individual Policies (No time-lag)

In *State of the States 2008*, analysts used the most recently available data to establish correlations. The analysis described here is the closest in methodology to the 2008 analysis; however, in this analysis, t-tests are used instead of correlation analysis, for reasons explained above. Here, relationships are explored between individual policies implemented by 2008 and renewable energy development indicators based on 2007 data. In each t-test, an independent variable (policy existence) is tested against a dependent variable (renewable energy generation). The independent variables include each of the state policies.[7] The dependent variables include 2007 renewable energy generation numbers by source, various growth numbers by source, and an assortment of other metrics designed to measure development from a variety of angles (see **Table 4.2** for a list of the dependent variables and their respective abbreviations that are used throughout the results section). The independent variables are classified as nominal-level variables, while the dependent variables are classified as ratio-level variables.

[7] The independent variables include the implementation of the following policies (as defined by DSIRE): construction and design, contractor licensing, equipment certification, generation disclosure, green power purchasing, interconnection, land access, line-extension analysis, net metering, public benefits fund (PBF) for renewable energy, required green power, renewable portfolio standard (RPS), bonds, corporate tax incentive, grants, industry support, loans, personal tax incentive, property tax incentive, rebates, and RE production incentive.

Table 4.2. Renewable Energy Development Indicators (Dependent Variables)

Renewable Energy Development Indicators (Dependent Variables)	Abbreviation
biomass generation 2007	biomass generation
geothermal generation 2007	geothermal generation
grid-connected solar capacity 2008	solar capacity
wind generation 2007	wind generation
hydroelectric generation 2007	hydro generation
non-hydro renewable generation 2007	non-hydro generation
total renewable generation 2007	total RE generation
biomass generation percent change from 2001 to 2007	biomass % chg 01-07
geothermal generation percent change from 2001 to 2007	geothermal % chg 01-07
grid-connected solar capacity percent change from 2005 to 2008	solar % chg 05-08
wind generation percent change from 2001 to 2007	wind % chg 01-07
hydroelectric generation percent change from 2001 to 2007	hydro % chg 01-07
non-hydro renewable generation percent change from 2001 to 2007	non-hydro % chg 01-07
total renewable generation percent change from 2001 to 2007	total RE % chg 01-07
biomass generation percent change from 2006 to 2007	biomass % chg 06-07
geothermal generation percent change from 2006 to 2007	geothermal % chg 06-07
grid-connected solar capacity percent change from 2006 to 2008	solar % chg 06-08
wind generation percent change from 2006 to 2007	wind % chg 06-07
hydroelectric generation percent change from 2006 to 2007	hydro % chg 06-07
non-hydro renewable generation percent change from 2006 to 2007	non-hydro % chg 06-07
total renewable generation percent change from 2006 to 2007	total RE % chg 06-07
biomass generation as a percent of total state generation 2007	biomass as % of generation
wind generation as a percent of total state generation 2007	wind as % of generation
hydroelectric generation as a percent of total state generation 2007	hydro as % of generation
non-hydro renewable generation as a percent of total generation 2007	non-hydro as % of generation
total renewable generation as a percent of total generation 2007	total RE as % of generation
biomass generation per capita 2007	biomass per capita

Renewable Energy Development Indicators (Dependent Variables) (continued)	Abbreviation (continued)
wind generation per capita 2007	wind per capita
hydroelectric generation per capita 2007	hydro per capita
non-hydro renewable generation per capita 2007	non-hydro per capita
total renewable generation per capita 2007	total RE per capita
biomass generation per GSP 2007	biomass per GSP
wind generation per GSP 2007	wind per GSP
hydroelectric generation per GSP 2007	hydro per GSP
non-hydro renewable generation per GSP 2007	non-hydro per GSP
total renewable generation per GSP 2007	total RE per GSP
wind capacity (March) 2009	wind capacity

The analyst tests all of the independent variables against all of the dependent variables, using SAS Enterprise Guide 4 software. This approach determines whether the presence of a policy has contributed to stronger performance in terms of renewable energy development. A two-sample t-test compares the mean values of the dependent variable (e.g., renewable energy generation 2007) for states with and without the independent variable (e.g., a particular policy in place). The output provides a p-value, which shows whether the difference in the means is statistically significant at a specified level (0.05 or 0.1 level) of analysis. A t-test is considered significant at the 0.1 level if the resulting p-value is less than or equal to 0.1. Similarly, a t-test is considered significant at the 0.05 level if the resulting p-value is less than or equal to 0.05.

The p-value is the probability of the sample result, assuming that the null hypothesis (that there is no relationship between the variables) is true. In other words, when examining the relationship between a policy and a dependent variable (e.g., renewable energy generation), a p-value of 0.05 indicates that there is a 5% probability that the observed relationship occurred due to chance (Doane and Seward 2006). Accordingly, a smaller p-value is associated with a stronger relationship. If the means are significantly different, then the t-value, or test statistic, is examined to see how confidently the null hypothesis can be rejected.[8]

1b) Impact of Individual Policies (Time-lag Analysis)

Time-lag analysis accounts for the time taken between when a policy is implemented and when resulting new generation occurs. This time-lag analysis conducts t-tests between policies implemented by 2005 and the 2007 renewable energy development indicators. Thus, there is an incorporated assumption that policy effectiveness is better analyzed by observing generation data in the years subsequent to the policy implementation.

[8] At the 0.1 level of significance, +/-1.645 is the t-value threshold for rejecting the null hypothesis. The null hypothesis can be rejected more confidently as the resulting t-value deviates further from that threshold. At the 0.05 level of significance, +/-1.96 becomes the threshold.

To form the dataset for this analysis, a "snapshot" was taken of policies that had been implemented in each state as of May 5, 2005. The independent variables are the same as in the previous methodology; however, many states have either implemented, changed, or discontinued various policies since 2005, which is not reflected in this methodology (see Future Efforts in **Chapter 6**).

Every t-test conducted in the time-lag analysis is graphically reproduced in the form of a box-plot graph. The box-plot graph provides a visual representation of the distribution of observations, thus allowing for further analysis of the connection between the policy and the respective renewable energy development indicator.

Figure 4.1 provides an example of the graphical representation of the t-test performed between the construction and design policy and biomass generation 2007. The t-test p-value is given above the graph. The p-value of 0.685 indicates that the relationship is not significant. The y-axis represents electricity generated from biomass sources in 2007, in terms of megawatt-hours. The x-axis has two values: zero and one. Zero indicates states that did not have a construction and design policy in 2005. One indicates states that had implemented a construction and design policy by 2005. Each red dot represents one observation (one state). The location of the dot indicates whether that state had a construction and design policy in 2005, and the amount of electricity that was generated from biomass sources in 2007. The graph also includes maximum and minimum lines that indicate outlying observations, a median, and a lower and upper quartile line. Each graph is analyzed to provide a validation check for the significant relationships that emerge from time-lag t-test analysis.

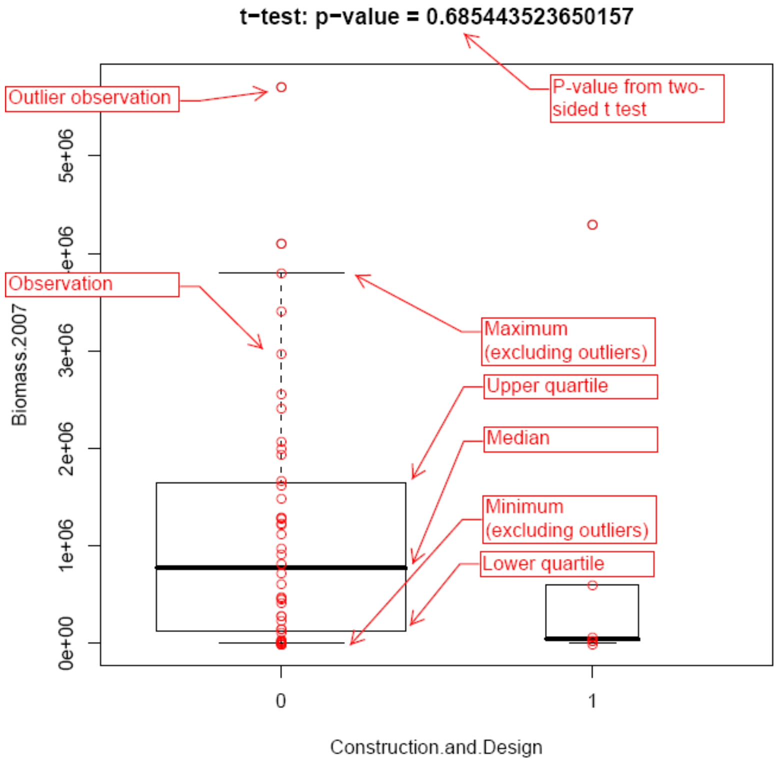

Figure 4.1. Biomass Generation (2007) and the Presence of a Construction and Design Policy (2005) – with notes on interpreting the box-plots

2) Effectiveness of Policy Portfolios

Experience indicates that, just as a policy alters market conditions to address a particular barrier to technological development, policies also act to change the conditions in which other policies function. In other words, policies do not act in a vacuum; instead, they interact with both the market and with each other. While some policy combinations may support each other to produce better results, other policies may be counteractive. Understanding these policy interactions is key to selecting, designing, and implementing effective policies that alter market conditions in predictable and desirable ways.

Most knowledge of effective policy design has been derived from experience in individual cases or is based on theoretical understandings. This analysis combines theoretical knowledge, prior experience, and statistical analyses of actual policy results. This information helps identify portfolios that can serve as guides to stakeholders and decision makers when evaluating current policies and making future policy decisions.

This analysis is based on the theory that states with a specific suite of policies will optimize renewable energy development by addressing barriers to development at various stages in the process and by avoiding counteractive policy interactions. This year's work expands on the market transformation analysis presented in the 2008 report, which grouped policies into barrier-reduction policies (e.g., interconnection, RPS) and technology accessibility policies (e.g., grants, loans, incentives) and then tested for effectiveness using a correlation analysis. This year, the analysis explores the effectiveness of more combinations of policy portfolios, which will help identify meaningful connections between groups of policies and increased renewable energy development. In particular, it investigates market transformation, RPS, and tax incentive portfolios.

Market-Transformation Portfolio

This analysis is designed to determine whether the *quantity* of barrier reduction or technology accessibility policies is correlated with increased renewable energy generation. Just as in 2008, the policies are categorized into the two types. The interactive and multipurpose aspects of renewable energy policies create challenges for a hard-line separation; this analysis uses the division in **Table 4.3** as an introduction to how policies can be categorized through the market-transformation (MT) framework. The following discussion justifies this categorization.

Table 4.3. Market-Transformation Policy Division in Analyses

Market Preparation	Technology Accessibility
Contractor Licensing	Corporate Tax Incentives
Equipment Certification	Grants
Generation Disclosure	Loans
Interconnection	Personal Tax Incentives
Land Access	Property Tax Incentives
Line Extension Analysis	Rebates
Net Metering	Renewable Energy Production Incentives
Public Benefit Fund with RE	Sales Tax Incentives
Renewable Portfolio Standard	
Voluntary and Mandatory Green Power	

Market Preparation

Although the contextual situation of a state necessitates that policies are custom-tailored and that their impacts will vary somewhat in each case, there are certain commonalities and barriers to development that exist in all states (e.g., transmission grid issues, challenges due to institutional structures). Ideally, the market preparation policies are "foundation policies" that are applicable across all states. Their goal is to lead to market transformation by preparing the market for renewable energy technologies.

These policies are defined by reducing one or more of these general barriers. The policies are listed here according to the primary market-preparation barrier that is targeted by the policy:

Access

- Interconnection. These policies remove grid-access barriers by creating and streamlining access for power producers.
- Land access. These policies – which generally focus on wind and solar resources but are potentially applicable to all resources – ensure that potential producers have access to the land or energy resource.
- Voluntary and mandatory green power programs. These policies and programs provide an opportunity for early-adopting consumers to buy electricity generated by renewable resources. Generally, this is granted at a premium price through the utility companies. More innovative programs protect consumers against volatile fuel costs, which gives them the added benefit of more predictable – and sometimes lower – electricity bills.
- Line-extension analysis. This policy requires utilities to provide cost estimates of alternative electrification strategies for rural areas, which ensures that these areas can consider renewable energy as an alternative.

Education and Information Barriers

- Generation disclosure. Generation-disclosure policies provide information to consumers about the origin of the electricity they are consuming.
- Public benefit funds with renewable energy (PBFRE). These policies are technically funding mechanisms for a variety of programs. The policies are listed here to account for the education component of many PBFRE implementation plans (the financial incentive portions are also considered under that category).
- Contractor licensing. This policy ensures that contractors working with renewable energy technologies are well-trained and informed regarding the issues specific to the technologies, which reduces the risk to consumers and increases the accessibility of the technologies.
- Equipment certification. Similar to contractor certification, equipment certification reduces consumer risk and provides standardization of technical equipment, which reduces uncertainty and risk and makes technology choice easier for the consumer.

Market Barriers

- Renewable portfolio standard (RPS). An RPS mandates the provision of a certain level of renewable energy, which increases investment certainty for project developers and infrastructure planners by creating a market for renewable energy within the jurisdiction.[9]
- Net metering. This policy provides an avenue for renewable energy producers to retrieve the value of electricity delivered to the grid, which expands the market for renewable energy.

[9] A similar policy for the fuels sector is the state renewable fuels standard. Because the focus of this report is electricity production, these policies are not covered. However, more information can be found in Brown et al. 2007.

Technology Accessibility
Once the market is prepared through the barrier-reduction policies discussed above, the major remaining barrier to renewable technologies is related to their high initial capital costs. The accessibility policies, listed below, address this barrier by providing financial incentives that make renewable energy technologies more economically accessible and competitive in the market:

- Grants
- Loans
- Rebates
- Renewable energy production incentives
- Corporate tax incentives
- Personal tax incentives
- Property tax incentives
- Sales tax incentives

Statistical Analyses Method
In this analysis, the independent ratio variables are:

1) The number of market preparation policies that a state has implemented.
2) The number of technology accessibility policies that a state has implemented.
3) The number of all policies that a state has implemented.

Using SAS software, each independent variable is correlated with each of the dependent variables. The dependent variables are the same as in the previous two methods (see **Table 4.2** for a list of the dependent variables). The resulting p-value and Pearson's correlation coefficient are analyzed to determine whether there is a positive relationship between the number of policies that a state has implemented, and various renewable energy development indicators. In this analysis, only relationships found significant at the 0.05 level of significance are accepted.[10] The corresponding correlation coefficient, which ranges from -1 to 1, indicates direction and strength of the relationship. A correlation coefficient of -1 indicates a very strong inverse relationship between the variables, while a correlation coefficient of 1 indicates a very strong positive relationship. Extending the time-lag methodology into this analysis, policy sums from 2005 are used in addition to policy sums from 2008.

RPS and Tax Incentive Portfolios

In this analysis, t-tests are conducted to determine whether specific combinations (i.e., portfolios) of policies can be linked with higher levels of renewable energy development. The methodology and the dependent variables used are the same as for the analyses of the individual policies outlined above (see **Table 4.2** for a list of the dependent variables). The only difference is that combinations of policies are tested against renewable energy

[10] It is important to note that, because of the large number of statistical tests performed here, approximately 5% of the p-values can be expected to be less than 0.05. This is also due to the natural variation in the data under the null hypothesis

development indicators, rather than individual policies. The analysis is conducted both without and with the time-lag element (described above).

The policy portfolios are each made up of a "center policy" and one or more "supporting policies." Not all policies can have the role of being a center policy, but many policies complement a center policy and play an important role in doing so. These supporting policies can be critical to the effectiveness of the entire policy program. The two center policies investigated here are an RPS and tax incentives. A discussion regarding the selection of these portfolios follows.

RPS is a relatively common policy used to support renewable energy development within the United States. As of July 2009, 35 states, one territory, and Washington, D.C., used some type of RPS. As a result, the understandings of the best practices and policy interactions with RPS policy are continuing to grow. RPS policies are thought to be most effective in states that have abundant, low-cost resources (or good out-of-state transmission and institutional coordination), good state resource knowledge, and a concrete plan for development of the resources (perhaps including identified renewable energy development zones). Green power purchasing policy and financing assistance may also support or complement an RPS policy (Cory et. al. 2009, State and Federal RPS Collaborative 2009, Hurlbut 2008).

This portfolio analysis explores various combinations of an RPS policy plus the following supporting policies to identify significant relationships with high levels of renewable energy development indicators:[11]

- required green power purchasing,
- land access,
- generation disclosure,
- interconnection,
- line-extension analysis,
- grants and loans.

The analysis also considered portfolios that had tax incentives as a main policy. Many states, as well as the federal government, use tax incentives to encourage renewable energy development. These incentives, which have a longer track record than many renewable energy policies, can be provided on several levels, including: corporate, personal, property, and sales tax incentives. Some states do not have one of the four types of taxes, so a tax incentive for that category was not applicable in this analysis.

[11] The independent variables in the policy portfolio analysis include RPS + land access, RPS + generation disclosure, RPS + interconnection, RPS + line extension analysis, RPS + green power purchasing, RPS + net metering, RPS + RE production incentive, RPS + land access + interconnection, RPS + required green power + generation disclosure, required green power + generation disclosure, RPS + interconnection + generation disclosure, RPS + land access + generation disclosure, RPS + interconnection + generation disclosure, RPS + interconnection + required green power, RPS + grants + loans, grants + loans, 3 of 4 tax incentives, 3 of 4 tax incentives + grants + loans.

For this portfolio analysis, a t-test is run to determine whether the implementation of three out of four possible types of tax incentives within a state is significantly related to increased renewable energy development. Grants and loans are tested as supporting policies to tax incentives, because these can provide assistance during the financing stage of project development. This is one of the most commonly cited barrier points for renewable energy projects, and a policy area that may be complementary to tax incentives.

Statistical t-tests are used to investigate whether the implementation of the test portfolios described above are significantly related to higher amounts of renewable energy development. The analysts run various tests to see which combinations of policies resulted in statistically significant higher development levels.

3) Effectiveness of Individual Policy Best Practice Policy Design Elements

This analysis provides a method to connect policy design to policy performance. Historical policy analyses have largely been based on the structure of the policy. As increased data is collected and renewable energy markets develop, analyses that evaluate the actual effectiveness of the policies in terms of renewable energy resource development are made possible. The 2008 report offered a limited analysis of the best practices policy designs, which included best practices for only interconnection and net metering policies. For both years, the analysis uses the NNEC report (2008), the industrial standard for net-metering and interconnection best practices. This year, similar analyses are completed for RPS policies, based on Wiser and Barbose (2008).

RPS Best Practices Methodology

Design best practices for RPS policy are defined in the literature (see below for citations). At this stage of RPS implementation, these best practices are the best understood determinates of policy success. This analysis attempts to move toward a quantitative understanding of the impacts of these policy designs by comparing best practice-designed policies to actual renewable energy generation in the state.

Each state RPS policy is defined according to the 12 indicators listed in **Table 4.4.** Definitions for the indicators can be found in the RPS best practices section (**Chapter 3)**.

The analysis considers the significance of each individual best practice feature on increased renewable energy development, as well as whether implementing more than half (7) of the best practices significantly increases development. A more detailed weighting of the importance of each of these features would be helpful; however, the necessary understandings have not yet been developed to make a more detailed weighting possible. This warrants further study through this and other projects. Future editions of this report will incorporate lessons learned from other analyses as both the policies and the understanding of their impacts evolves.

Table 4.4. RPS Best Practices Criteria and State Status, as of 2007 (1=yes, 0=no)

	Implemented	ACP/ Penalty[1]	REC Trading	REC Tracking[2]	Utility Reporting[3]	RPS Review[4]	Distributed Generation	Encouraging Project Financing[5]	% of state sales covered[6]	In-state (Does not require in state)[7]	Transmission Policies	Solar Specific	Compliance[8]
AZ	2007	0	1	1	0	0	1	0	0	1		1	0
CA	2003	1	0	0	0	0	0	1	1	1	1	0	1
CO	2004	0	1	1	0	0	1	1	1	1	1	1	
CT	1998	1	1	1	0	0	0	1	1	1	0	0	0
DC	2005	1	1	1	1	0	0	0	1	1	0	1	
DE	2008	1	1	1	1	0	1	0	0	1	0	1	
HI	2003	0	0	0	0	1	0	0	1	0	0	0	
IL	2007	0	0	1	0	0	0	1	0	1	0	0	
IA	1983	0	1	1	0	0	0	1	0	0	0	0	1
ME	2000	1	1	1	0	1	0	0	1	1	0	0	1
MD	2008	1	1	1	0	0	0	1	1	1	0	1	1
MA	2003	1	1	1	1		0	1	0	1	0	0	0
MN	2007	0	1	1	1	1	0	0	1	1	0	0	
MT	2006	1	1	1	0	0	1	1	0	1	0	0	
NV	2002	0	1	1	0	0	0	1	0	1	1	1	0
NH	2007	1	1	1	1	1	0	0	1	1	0	1	
NJ	2001	1	1	1	1	0	1	0	1	1	0	1	1
NM	2007	0	1	1	1	0	1	0	0	1	1	1	1
NY	2004	0	0	0	0	1	1	1	0	1	0	1	0
NC	2008	0	1	0	1	1	0	1	1	1	0	1	
OH	2009	1	1	1	0	1	0	0	0	1	0	1	
OR	2007	1	1	1	1	0	0	0	1	1	0	0	
PA	2005	1	1	1	0	1	1	1	1	1	0	1	1
RI	2004	1	1	1	0	0	0	1	1	1	0	0	
TX	1999	1	1	1	0	0	0	0	0	1	1	1	1
WA	2006	1	1	1	0	0	1	0	0	1	0	1	
WI	2001	1	1	1	0	0	0	0	1	1	0	0	1

1. ACP/Penalty: has either a financial penalty for noncompliance and/or allows utilities to make an alternative compliance payment (ACP) to reach compliance (the financial penalty must either be an ACP or an explicit financial penalty as defined by Wiser and Barbose 2008, p. 24 (states w/ only discretionary financial penalties or legislative authority w/o specific rules are not given a point)
2. REC Tracking: States were given a 1 if they were covered by a REC tracking system according to Wiser and Barbose 2008, p. 25. (note: NY's is under development, and they currently manually track bundled energy and attributes) (CA is planning on using WREGIS once it is considered verifiable)
3. Utility Reporting: gets a 1 if the applicable providers are required to turn in reports (often annual or biennial)
4. RPS Review: gets a 1 if there is a defined procedure for review of the RPS, or if the governing board is authorized to modify or adjust implementation standards
5. Encouraging Project Financing: States are given a 1 if they are listed on Table 2 of Wiser and Barbose 2008, p. 28 as having implemented policies to encourage long-term project financing
6. Percent of state sales covered: they get a 1 if more than 90% of the state sales are covered (Source: Wiser and Barbose 2008, Table 2, p. 9)
7. In-State: only gets a zero if it requires in-state (Source: Wiser and Barbose 2008, Table 3, p. 10)
8. Compliance: for states that had compliance obligations in 2006, they get a 1 if they had 95% compliance. Blank boxes indicate no early compliance target for the policy. Source: Wiser and Barbose 2008, with data through 2007, p. 16.

Note: KS, MO, and MI currently have an RPS policy, but they did not at the time that this table was created, so they are not included in the analysis. In addition, VT, ND, SD, VA, and UT have renewable energy goals; but because they are not mandated goals, they do not meet our definition of an RPS policy and are not included in the analysis. Similarly, FL is also excluded from the analysis because its policy does not encompass the whole state and is, therefore, not considered a state policy. MO and MI are excluded because of incomplete data about the policies.

Refer to the RPS best practices section of **Chapter 3** for definitions of the indicators.

Net-Metering and Interconnection Best Practices Methodology

This section summarizes statistical analyses performed to determine whether the implementation of net-metering and interconnection policies, specifically, may lead to significant renewable energy resource development. The analysis used t-tests and correlations to identify relationships between best practice features within policies and renewable energy generation development indicators. The following independent variables are examined:

- Net-metering or interconnection implementation
- Net-metering and interconnection simultaneous implementation
- Net-metering and/or interconnection best practices

This analysis uses the NNEC 2008 report to define best practice policy design. Based on a literature review, the NNEC report is determined to be the most comprehensive listing of best practices for the development of interconnection and net-metering policies. However, the report methodology is not universally agreed to, and the definition of "best" in best practices is clearly weighted toward the increased development of renewable energy technologies. However, because the goal of many net-metering and interconnection policies, as stated in the legislation (e.g., Minnesota), is to increase distributed generation on the grid, using this version of best practices to determine the likelihood of increased renewable energy on the grid is logical. As more information on the policies is published, further analysis in this area using different methodologies could be conducted.

In the NNEC 2008 report, each net-metering policy is either awarded or penalized a number of points depending on its design with regard to the following best practices. Total points relate to a letter grade score. Some of the points are awarded based on tiered levels for the category and others are awarded simply if the policy follows that best practice. More detailed information can be found in the NNEC report, but the system is summarized below:

- Size Restrictions: Policies with the least-restrictive arbitrary size restrictions are awarded more points than those with more stringent policies. The best practice is to restrict the size of the system so that it does not exceed the consumer's demand.
- Capacity Limits: Points are awarded based on the percentage of peak demand that can be generated from distributed generation. Policies with a higher allowable percentage are awarded more points.
- Rollover Restrictions: Policies that allow for more flexible rollover of excess generation are awarded positive points. Those with restrictive rollover policies and those that are designed so that the excess generation passes to the utility without any compensation to the generator are penalized with negative points.
- Metering Issues: Various points are awarded or subtracted based on the specific metering regulations regarding new meter requirements and time-of-use meters.

- REC Ownership: The best practice for REC ownership is that the owner of the distributed-generation system maintains ownership of the REC. All other procedures are penalized.
- Eligible Technology: Points are awarded if all renewable energy technologies and other zero-emissions technologies are eligible.
- Eligible Customers: Policies with the fewer sector restrictions are awarded more points, while those with excessive restrictions are penalized.
- Fees: Policies are penalized if they charge fees for net metering.
- Rule Coverage: Policies that apply to all utilities are awarded points.

The set of best practices for interconnection standards in the NNEC 2008 report is selected because it follows the generally accepted Interstate Renewable Energy Council (IREC) model interconnection standards. The method penalizes policies that do not promote interconnection for renewable energy technologies. The following 14 points are included in the NNEC review of interconnection policies:

- Eligible Technology: A negative point is awarded if the policy applies only to renewable energy systems and not all customer generators.
- Individual System Capacity: Varying levels of negative points are awarded if the maximum size of the eligible system is limited to 10 MW or less.
- Breakpoints: Policies that have four categories of technical requirements based on installation capacity receive a positive point, and policies with two or fewer categories receive negative points.
- Timelines: Positive or negative points are awarded based on whether the policy surpasses or fails to comply with the established FERC standards.
- Interconnection Charges: Positive points are awarded if interconnection fees are waived for net-meter customers or are at least less than FERC standards. Policies are penalized if the fees are greater than FERC standards
- Engineering Charges: For projects in which an engineering review is applicable, policies are awarded a point if the associated fees are fixed.
- External Disconnect Switch: Because an external disconnect switch is considered to be a redundant safety measure, policies that prohibit an external disconnect switch are awarded a point while policies that require it receive negative points.
- Certification: Negative points are awarded to policies with certification requirements that conflict with nationally accepted standards. [Underwriters Laboratories (UL)/Institute of Electrical and Electronics Engineers (IEEE)].
- Technical Screens: FERC has established technical interconnection screen standards, and negative points are awarded to a policy if anything other than the FERC screens is used.
- Spot Network Interconnection/Area Network Interconnection: Although different limits are awarded points, allowing interconnection in the two different types of networks gains a point.
- Standard Form Agreement: Policies with established standard-form agreements with “friendly clauses” receive a point. Policies with unnecessarily complex standard-form agreements are penalized with negative points.

- Insurance Requirements: Positive points are awarded to policies that prohibit the requirement of extra insurance policies, while policies that require additional insurance are penalized.
- Dispute Resolution: Policies with clearly defined, inexpensive, and efficient dispute resolution guidelines receive positive points. If dispute resolution is handled at the utility's discretion, the policy is penalized.
- Rule Coverage: Policies that apply to all utilities are awarded points.

For each of these criteria, the NNEC method awards points, and total points relate to a letter grade score. More detailed information can be found in the NNEC report.

For the analysis conducted here, the data is explored in several ways. First, each letter grade for both net-metering policies and interconnection standards is numerically coded, and a correlation analysis is run between the individual grades and various renewable energy development indicators. Additionally, a t-test is used to determine whether states whose policy received a "C" grade or better perform stronger in terms of renewable energy generation and other development indicators. This is determined by grouping policies that received an "A," "B," or "C" in one group and those that received a "D" or "F" in another group.[12] The same methodology is used for both net-metering and interconnection policy analysis.

4) Impact of the Age of and RPS Policy

Intuitively, a policy is more likely to influence renewable energy development the longer it has been in effect. In this analysis, RPS policies are binned according to how long they have been in effect: 1-3 years, 4-6 years, 7-9 years, and 10 or more years, which considers the time it takes between policy implementation and actual development of renewable resources. It is hypothesized that states with longer-standing policies will have a stronger correlation with higher levels of renewable energy generation. Correlation analysis is then used to reveal any significant relationships in the data.

5) Removal of Outlying States

This analysis investigates whether removing the states with the highest and lowest renewable generation and capacity from the distribution of dependent variables further clarifies the relationship between policy implementation and renewable energy development. Once the 10% tails are removed, t-tests are performed again. Removing

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[12] For the net-metering policies, only those policies with a grade of a "C" or better are selected in this part of the analysis, because it represents a minimum policy design for effective net-metering rules while excluding policies with a negative impact on renewable energy development. A policy earning a "C" is defined as one that consists of "…adequate net metering rules, but…(may have)…some significant fees or other obstacles that undercut the value or make the process of net metering more difficult." For interconnection standards, a grade of "C" is chosen because it meets the minimum FERC standard as well as satisfactorily removes market barriers for renewable energy development. A policy earning a "C" is described as one that is "…adequate for interconnection although systems incur higher fees and longer delays than necessary. There are likely a few systems that will be precluded from interconnection because of remaining barriers in the interconnection rules."

the outliers is theorized to control for instances where contextual factors, such as resource availability or socio-political climate, affect renewable energy development aside from policy. For example, if the cultural landscape of a state favors renewable energy development, despite which policies are being implemented, then including this state in the dataset might skew the results of a test meant to identify the relationship between policy and development. It was hypothesized that by removing the highest and lowest performing states in a distribution, some of the variation in the distribution is eliminated, which may tighten the focus onto the variables of interest and provide further insights.

A t-test is used to first look at the relationship between policy implementation in all states and the following three dependent variables:

- Total RE Generation 2007
- Percent Change in Total RE Generation from 2001 – 2007
- Total RE Generation per Capita 2007

Next, the states for which performance (in terms of the dependent variable) falls within the top 10% or bottom 10% are removed from the dataset. **Figure 4.2** shows the distribution of states for the dependent variable, "total renewable energy generation 2007." Each dot represents a state. The y-axis denotes total renewable energy generation in 2007, in terms of megawatt hours. As the figure indicates, there are a few very high-performing states, as well as a number of relatively low-performing states. After removing these outliers, the analysts rerun the t-test and compare results.

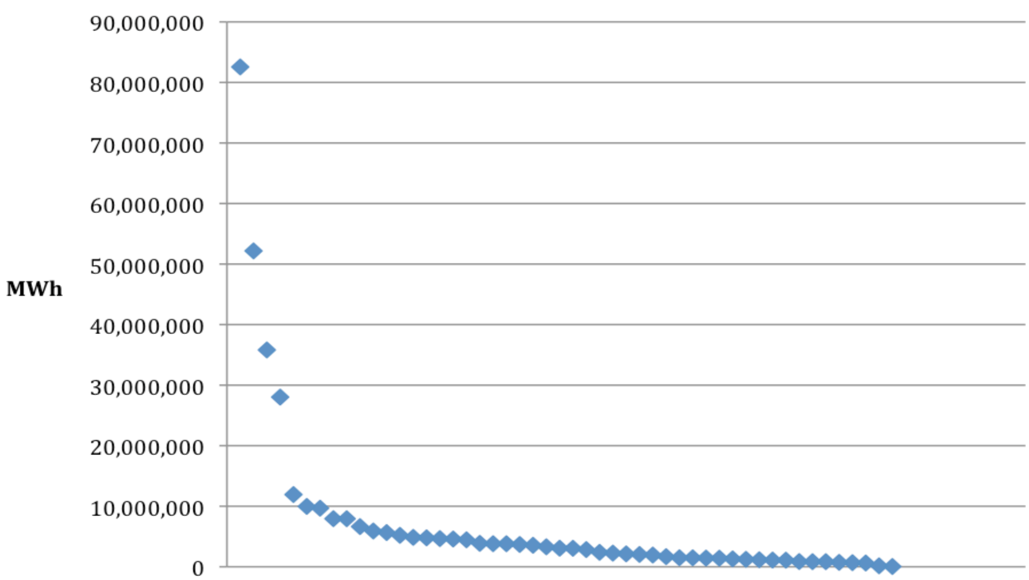

Figure 4.2. Distribution of Total Renewable Energy Generation by State, 2007

Results

1a) Impact of Individual Policies (No Time Lag)

Individual policy analysis found 41 statistically significant relationships between individual policy implementation and renewable energy development indicators. These relationships indicate that states that have implemented the policy also demonstrate significantly stronger performance in terms of the listed renewable energy development indicator. The relationships are shown in **Table 4.5**. Only relationships that are significant at the 0.1 level or better are shown.

Table 4.5. Relationships between Policy and Performance

2008	No. of Positive Relationships	Renewable Energy Development Indicators
Required Green Power	11	wind generation**, non-hydro as % of generation*, wind per capita**, hydro per capita*, non-hydro per capita **, total per capita*, wind per GSP**, hydro per GSP*, non-hydro per GSP**, total per GSP*, wind capacity 2009*
Generation Disclosure	6	biomass generation*, wind generation**, non-hydro generation**, total generation*, hydro % chg 01-07**, wind capacity 2009**
RPS	5	wind generation*, total generation*, hydro % chg 01-07**, non-hydro as % of generation*, wind capacity 2009**
Loans	4	non-hydro % chg 01-07**, biomass as % generation*, non-hydro as % generation**, biomass per capita*
Construction and Design	3	non-hydro generation*, total generation*, hydro % chg 01-07**
Personal Tax Incentive	3	hydro per capita*, total RE per capita*, hydro per GSP*
Corporate Tax Incentive	2	wind per capita*, wind per GSP*
Land Access	2	hydro generation* total generation*
Grants	1	biomass generation**
Green Power Purchasing	1	wind generation*
Industry Support	1	hydro % chg 01-07*
Property Tax Incentive	1	wind capacity 2009*
Rebates	1	biomass generation*
*significant at 0.1 level		
**significant at 0.05 level		
Note: Policy definitions are listed in **Chapter 3**		
See **Table 4.2** for a list of the indicators and their abbreviations		

1b) Impact of Individual Policies (With Time Lag)

The time-lag approach highlights 28 relationships between policy and performance. The very different results of the analysis when a time lag is included indicate the potential importance of considering the delay in detectable results after the implementation of a policy. The time-lag method likely provides more insight into the effectiveness of policy because it accounts for the time it may take for a policy to influence renewable energy development.

Table 4.6 lists the significant relationships found. Only relationships that are at least at the 0.1 level are given.

Table 4.6. Relationships between Policy and Performance: Time-Lag Analysis

2005	No. of Relationships	Renewable Energy Development Indicators
Net Metering	7	wind generation*, non-hydro as % gen**, wind per capita**, non-hydro per capita**, wind per GSP**, non-hydro per GSP**, wind capacity 2009*
Required Green Power	7	wind generation*, hydro % chg 01-07**, wind as % of generation**, wind per capita**, non-hydro per capita**, wind per GSP**, non-hydro per GSP**
Generation Disclosure	4	wind generation*, hydro %chg 01-07**, non-hydro as % generation*, wind capacity 2009*
Interconnection	3	wind generation*, non-hydro generation*, total generation*
Personal Tax Incentive	2	hydro generation**, total generation*
Rebates	2	hydro generation*, total generation*
Sales Tax Incentive	2	wind per capita*, wind per GSP*
Corporate Tax Incentive	1	hydro %change 01-07*
*significant at 0.1 level		
**significant at 0.05 level		
Note: Policy definitions are listed in **Chapter 3**		
See **Table 4.2** for a list of the indicators and their abbreviations		

The graphical reproductions of t-tests conducted during the time-lag analysis contribute to the analysis by further validating relationships or trends that emerge in the t-tests. Additionally, they help to flush out spurious and misleading relationships that may exist between the variables.

Time-lag t-test analysis indicates that a trend may exist between the net-metering policy and generation from non-hydroelectric renewable sources. States that had a net-metering policy in 2005 performed significantly stronger in terms of three different metrics that are each designed to measure non-hydro renewable generation in 2007: non-hydro renewable generation as a percent of total state generation, non-hydro renewable generation per capita, and non-hydro renewable generation per GSP.

The graphical reproductions of the t-tests further validate these relationships. The graph of the t-test between net metering and non-hydroelectric renewable generation as a percent of total state generation is shown in **Figure 4.3**; net metering and non-hydro renewable generation per capita in **Figure 4.4**; and net metering and non-hydro renewable generation per GSP in **Figure 4.5**. Each figure includes the p-value that resulted from the t-tests, the test statistic (t-value), the mean value of states that had implemented a net- metering policy by 2005, and the mean value of states that had not implemented a net- metering policy by 2005. (Refer to the Time-Lag Analysis Methodology section, above, for help with interpreting the graph.)

p-value = 0.0275**; t value = -2.30
Mean of states with policy = 4.1%
Mean of states without policy = 1.8%

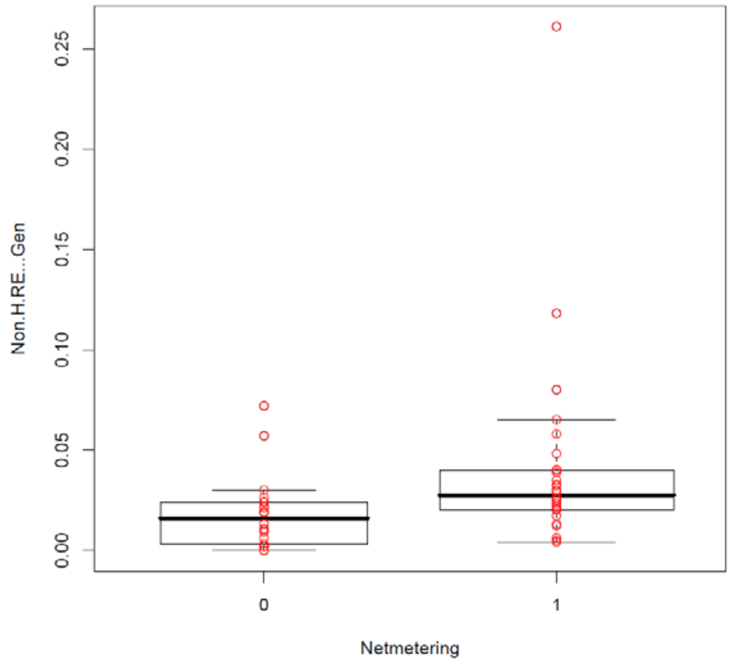

Figure 4.3. Non-Hydroelectric Renewable Generation as a Percent of Total State Generation (2007) and the Presence of a Net-Metering Policy (2005)

The t-test, p-value, and test statistic indicate that this relationship is significant at the 0.05 level, and that the null-hypothesis (that there is no relationship) can be rejected. In addition, the t-test identifies that states that did not have a net-metering policy in 2005 had a mean value of 1.8% in terms of non-hydroelectric renewable generation as a percent of total state generation in 2007. Alternatively, states that did have a net-metering policy in 2005 had a mean value of 4.1%, which represents a 128% increase. The graph presents a visualization of the distribution of observations. Clearly, states with a net-metering policy in 2005 are concentrated higher up on the graph. This indicates that, as a group, they generally produced a higher percentage of total state electricity from non-hydro renewable resources. This does not verify that the net-metering policy results in the development of increased renewable energy generation; it only indicates that there is a correlation between the implementation of the policy (over time) and the increasing development of renewable energy resources.

Thus, there is a reasonable indication that the relationship between implementing a net-metering policy in 2005 and performing stronger in non-hydroelectric renewable generation as a percent of total state generation in 2007 is not by chance.

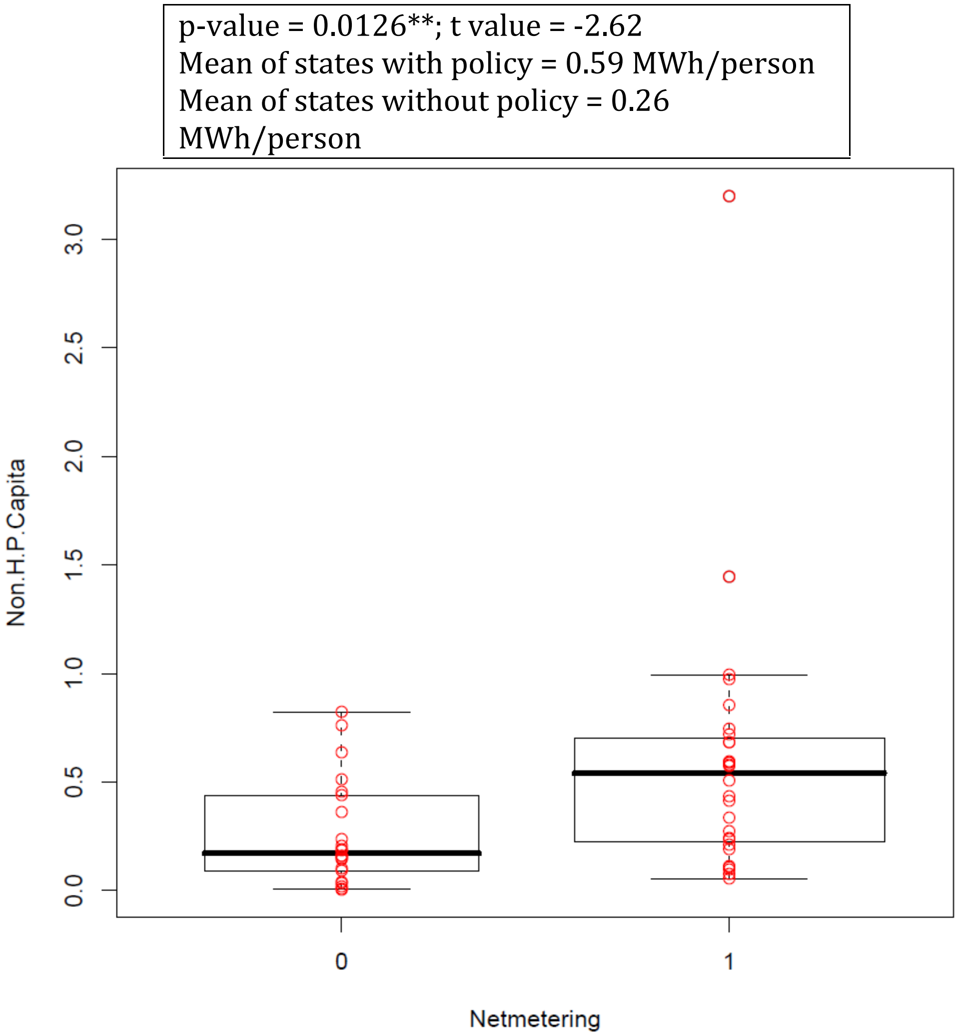

Figure 4.4. Non-Hydroelectric Renewable Generation per Capita (2007) and the Presence of a Net-Metering Policy (2005)

The t-test, p-value, and test statistic indicate that this relationship is significant at the 0.05 level, and the null-hypothesis (that there is no relationship) can be rejected. In addition, the t-test identifies that states that did not have a net-metering policy in 2005 had a mean value of 0.26 MWh/person in terms of non-hydro renewable generation per capita in 2007. Alternatively, states that did have a net metering policy in 2005 had a mean value of 0.59 MWh/person – a 127% increase. The graph presents a visualization of the distribution of observations. Clearly, states with a net-metering policy in 2005 are concentrated higher up on the graph. This indicates that, as a group, they generally produced more electricity per person from non-hydro renewable resources.

Thus, there is a reasonable indication that the relationship between having a net-metering policy in 2005 and performing stronger in non-hydroelectric renewable generation per capita in 2007 is not by chance.

p-value = 0.0456**; t value = -2.07
Mean of states with the policy = 13.6 MWh/M$ GSP
Mean of states without the policy = 6.7 MWh/M$ GSP

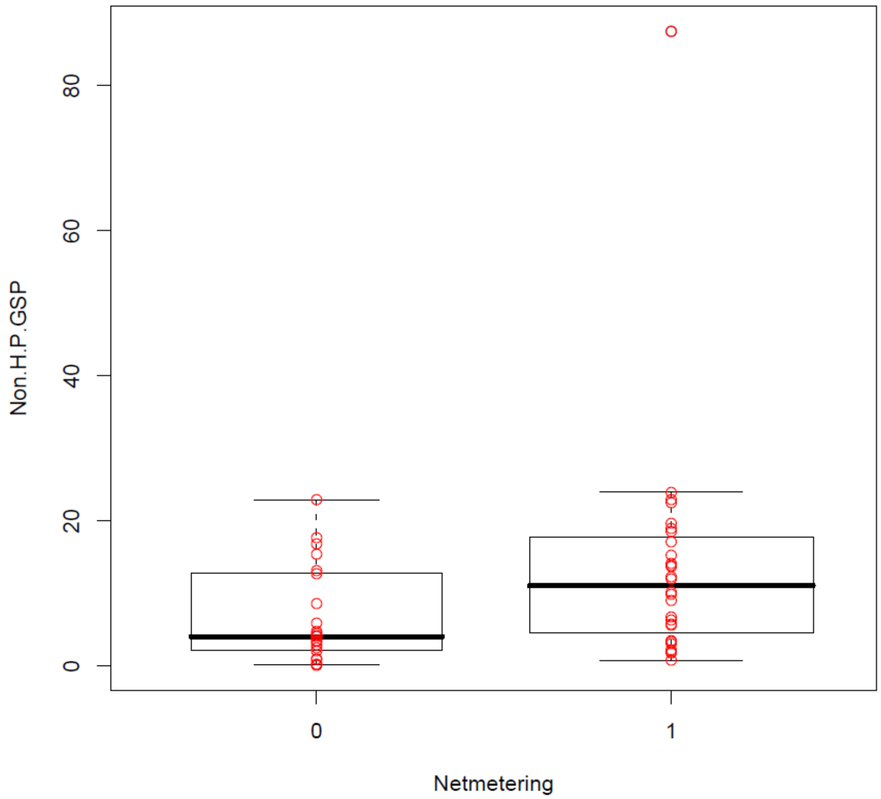

Figure 4.5. Non-Hydroelectric Renewable Generation per GSP (2007) and the Presence of a Net-Metering Policy (2005)

The t-test, p-value, and test statistic indicate that this relationship is significant at the 0.05 level of significance, and the null-hypothesis (there is no relationship) can be rejected. In addition, the t-test identifies that states that did not have a net-metering policy in 2005 had a mean value of 6.7 MWh/M$GSP in terms of non-hydroelectric renewable generation per M$GSP in 2007. Alternatively, states that did have a net-metering policy in 2005 had a mean value of 13.6 MWh/M$GSP – a 103% increase. The graph presents a visualization of the distribution of observations. Clearly, states with a net-metering policy in 2005 are concentrated higher up on the graph. This indicates that, as a group, they generally produced more electricity per $GSP from non-hydro renewable resources.

Thus, there is a reasonable indication that the relationship between having a net-metering policy in 2005 and performing stronger in non-hydroelectric renewable generation per GSP in 2007 is not by chance.

It is important to note that the relationship between the presence of a net-metering policy in 2005, and the higher level of non-hydroelectric renewable electricity generation as a percent of total generation in 2007, is reinforced by the relationships that emerged between the same policy and the other two metrics of non-hydro renewable generation (i.e., per capita and per GSP). In other words, the triangulation of the results provides additional validation of the relationship between net-metering policy and renewable energy development. The fact that the presence of a net-metering policy in 2005 resulted in higher levels of non-hydro renewable generation in 2007 for all three metrics substantiates the claim that net-metering policy supports renewable energy development.

In interpreting these results, however, it should be recalled that net-metering policies are generally limited to smaller renewable energy projects, which would exclude many large-scale wind energy projects from being affected by the policy. Therefore, it could be argued that the relationship seen between net-metering policy and increased generation is not valid. To verify the relationship, a more detailed analysis must account for the specific elements of the policies and whether the projects that were responsible for the increase in generation were eligible for the benefits provided by the policy. Until this more detailed work is conducted, the analysis can't make definitive conclusions about the relationship. It could be hypothesized, however, that part of the relationship is because states that have implemented the net-metering policy are perhaps more generally supportive of renewable energy development than those that have not implemented the policy.

2) Impact of Policy Portfolios

Market-Transformation Portfolio

This analysis compares two categories of policies – market preparation (barrier reduction) and technology accessibility (defined in the methodology, above) – to see whether there is a connection between the *number* of policies implemented and increased renewable energy development. The significant positive correlations with 2008 policies (no time lag) are presented in **Table 4.7**. The significant positive correlations with 2005 policies (time lag) are presented in **Table 4.8**.

More positive correlations are identified through the time-lag analysis than without the time lag (19, as compared to four). For the time-lag analysis, positive correlations are found between total number of policies implemented in 2005 and renewable electricity generation (from various sources, as well as cumulative) in 2007. Moreover, most of the correlations are with 2007 generation numbers by source, indicating a noticeable trend between total number of policies and improved generation for each individual source of renewable energy.

Table 4.7. Policy Correlation Table: Market-Transformation Portfolio (No Time Lag)

2008	No. of Positive Relationships	Renewable Energy Development Indicators
Correlations	4	
Sum Market Prep Policies (correlation)	2	total generation*, hydro % chg 01-07*
Sum Tech Access Policies (correlation)	1	hydro % chg 01-07*
Sum Total Policies (correlation)	1	hydro % chg 01-07*

*significant at 0.05 level

**significant at 0.01 level
See **Table 4.2** for a list of the indicators and their abbreviations

Table 4.8. Policy Correlation Table: Market-Transformation Portfolio (Time Lag)

2005	No. of Positive Relationships	Renewable Energy Development Indicators
Correlations	19	
Sum Market Prep Policies (correlation)	7	geothermal generation*, solar capacity*, wind generation**, non-hydro generation**, total RE generation*, non-hydro as % of generation*, wind capacity**
Sum Tech Access Policies (correlation)	5	geothermal generation**, solar capacity**, hydro generation*, non-hydro generation**, total RE generation**
Sum Total Policies (correlation)	7	geothermal generation**, solar capacity**, wind generation**, hydro generation*, non-hydro generation**, total RE generation**, wind capacity*

*significant at 0.05 level

**significant at 0.01 level

See **Table 4.2** for a list of the indicators and their abbreviations

RPS and Tax Incentive Portfolios

This analysis runs t-tests on specific combinations of policies to determine whether portfolios of policies can be related to increased renewable energy development indicators. The analysis is conducted both without and with a time-lag component (see the discussion of the time-lag method, above).

Similar to the results for the individual policies, the number of significant relationships identified is greater for the analysis without the time lag than the analysis with the time lag. One explanation for more relationships emerging without the time lag is that there are more policies implemented with time, and the increasing number of policies lends an increased chance for relationships to emerge. Not all of these relationships, however, may be valid. It should be reemphasized that for the analysis without the time lag, policies in place in 2008 are tested against generation from 2007, which means that not all of the policies were necessarily in place when the generation was measured. Thus, the results of the analysis without the time lag should be carefully critiqued. The significant relationships found for the analysis with no time lag are presented in **Table 4.9**.

The time-lag portfolio t-test analysis identified six significant relationships (shown in **Table 4.10**). One of the combinations was responsible for four of these positive relationships. Interestingly, that portfolio did not include either of the center policies. ***Required Green Power programs plus Generation Disclosure policies were found to be significantly related to the renewable energy development indicators: hydroelectric generation percent change between 2001-2007, non-hydroelectric renewable generation per capita, wind generation per capita, and wind generation per GSP.*** Theoretically, this combination of policies is complementary, because disclosing the resource mix of the electricity to customers provides information that may encourage them to participate in the required green power programs; this can lead to increased demand and deployment of renewable energy. This theory is supported by this analysis. More research regarding these combinations of policies, however, is warranted, particularly as more data becomes available over the years.

Table 4.9. Portfolio T-test Results Summary Table (No Time Lag)

2008	No. of Positive Relationships	Renewable Energy Development Indicators
Portfolio 1	59	
RPS and Required Green Power	12	wind generation**, wind as % generation**, non-hydro as % generation, wind per capita**, hydro per capita*, non-hydro per capita**, total RE per capita*, wind per GSP**, hydro per GSP*, non-hydro per GSP**, total RE per GSP*, wind capacity 2009*
RPS, Interconnection, and Required Green Power	10	wind generation**, non-hydro as % generation*, wind per capita**, hydro per capita*, non-hydro per capita**, total RE per capita*, wind per GSP**, non-hydro per GSP**, total RE per GSP*, wind capacity 2009*
RPS and Generation Disclosure	5	wind generation**, non-hydro generation*, total generation*, hydro % chg 01-07**, wind capacity 2009**
RPS, Interconnection, and Generation Disclosure	5	wind generation**, non-hydro generation*, total RE generation*, hydro % chg 01-07*, wind capacity 2009**
RPS, Land Access, and Generation Disclosure	4	hydro generation*, total RE generation*, hydro % chg 01-07**, non-hydro as % generation*
RPS and Land Access	4	hydro generation*, total RE generation*, hydro % chg 01-07**, non-hydro as % generation*
RPS, Required Green Power, and Generation Disclosure	4	wind generation**, wind per capita**, wind per GSP**, wind capacity**
Required Green Power and Generation Disclosure	4	wind generation**, wind per capita**, wind per GSP**, wind capacity**
RPS and Interconnection	3	wind generation**, total RE generation*, wind capacity 2009**
RPS, Land Access, and Interconnection	2	hydro generation*, total RE generation*
RPS, Grants and Loans	2	hydro % chg 01-07*, non-hydro as % generation*
RPS and Net Metering	2	hydro % chg 01-07**, non-hydro as % generation*
RPS and Green Power Purchasing	1	hydro % chg 01-07*
RPS and RE Production Incentive	1	wind capacity*
Portfolio 2	2	
3 of 4 Tax Incentives*** and Grants and Loans	2	biomass generation*, non-hydro as % generation*

*significant at 0.1 level

**significant at 0.05 level

***States that have three of the four possible tax incentives: personal, corporate, property, and sales.

See **Table 4.2** for a list of the indicators and their abbreviations

Table 4.10. Portfolio T-test Results Summary Table (Time Lag)

2005	No. of Positive Relationships	RE Development Indicators
Portfolio 1	5	
Required Green Power, Generation Disclosure	4	hydro % chg 01-07*, wind per capita*, non-hydro per capita*, wind per GSP*
RPS and Generation Disclosure	1	hydro % chg 01-07*
Portfolio 2	1	
Grants and Loans	1	hydro % chg 01-07**
*significant at 0.1 level **significant at 0.05 level See **Table 4.2** for a list of the indicators and their abbreviations		

3) Effectiveness of Individual Policy Best Practice Design Elements

RPS Best Practices

The findings on the impacts of policy design best practices relative to the overall impact of the RPS policies are challenging to interpret. This is not only because of the relative newness of the policies (Iowa started an RPS in 1983, but most RPS policies have been implemented in the past 10 years, see **Table 4.4**), but also because RPS exists in a contextual environment that can have an effect on overall policy impact. In general, however, the following conclusions can be drawn from this year's analysis:

Seven of the policy features (defined in the methodology) are found to be significant with at least one of the renewable energy development indicators, for a total of 12 significant observations (**Table 4.11**).

Table 4.11. RPS Best Practices T-test Results: Significant Policy Features

Policy Feature	Significant Indicator
ACP Penalty	biomass generation 2007* total RE per capita* total RE per GSP*
Does Not Require In-State	biomass generation 2007** hydro generation 2007** total RE generation 2007**
REC Trading	total RE per GSP*
REC Tracking	total RE per GSP*
% of State Sales Covered	biomass generation 2007*
More than ½ of best practices in policy	total RE per GSP*
GSP=Gross State Product *Significant at the 0.1 level **Significant at the 0.05 level	
Note: Policy feature definitions are found in RPS best practices section in **Chapter3**	
See **Table 4.2** for a list of the indicators and their abbreviations	

The interpretation provided here is based on analytic expertise and consideration of external and contextual factors, in addition to the results themselves.

The connection of elements of RPS design best practices to biomass and hydroelectric generation in 2007 stands out as one of the outcomes from the t-test analysis. Because these generators are typically not "new" generation by the requirements of the RPS (typically renewable generation eligible to meet RPS must be in place after 1996), it is unlikely that the results reflect an actual connection between the policy and the development of these specific resources. Instead, it is likely that states having extensive experience with renewable technologies historically may be more comfortable and interested in developing renewable energy policies due to that previous experience. As a result, the statistical results are not seen to improve the understanding of the role of best practice design in policy effectiveness for renewable energy generation.

Setting the significant t-tests with specific technologies aside, the remaining significant observations are generally related to the variables "total renewable energy generation per capita" and "per gross state product (GSP)." Normalizing the renewable energy growth across states based on the economic variable GSP allows for removal of state financial capabilities to support increase renewable energy. This allows for a clearer understanding of other factors, such as the role of policy (including specifically designed best practices policy) and resource availability.

In the case of RPS policies, t-test analysis indicates that states with an RPS policy in 2005 did not perform significantly stronger in terms of any of the 2007 renewable development indicators. However, when broken down into best practices policy features, several individual features emerge as significant components. The feature "does not require in-state," which specifies that eligible projects are not restricted to only in-state development, proved to be a significant feature of an RPS policy. Posing an in-state requirement may contribute to the economic development within that state, but perhaps at the expense of renewable energy development at the national level. The findings indicate that the states that do not pose this requirement performed stronger in three of the metrics.

States with several of the features (ACP penalty, REC trading, REC tracking), as well as those states with an RPS policy with the majority of the features, produced significantly more renewable energy per GSP than states without those individual features or without an RPS policy having the majority of the features. While not a clear indication of causation that RPS with the majority of best practices features are related to increased renewable energy when normalized for economic conditions, this result warrants further analysis in future reports (with more data on the progress of RPS policies) to further explore this connection.

Using multiple regression analysis, an attempt was made to develop a working model to predict renewable energy generation. The modeling used all possible combinations of best practice policy design elements. However, none of the individual best practice design elements qualified for a model that adequately predicts any of the renewable energy development indicators. Consequently, ***the analyses suggest that although some of the features of a well-designed RPS policy are found to significantly contribute to renewable energy development when looked at individually, none of them can be combined into a model that adequately predicts any of the renewable energy generation indicators.***

The addition of more states with RPS policies as well as the continued implementation of current policies (see the discussion on the time lag in the methodology overview and methodology detailed description sections) may lead to increased data and more insights that can be informative to the effectiveness of RPS policy and the connection to best practice policy design features. Moreover, the development of alternative design techniques may increase the effectiveness of policies and should be considered in the development of future policies and analyses.

Net-Metering and Interconnection Best Practices

Results of this analysis indicate that there is no significant relationship between policy and development for the states that currently have a net-metering and/or interconnection policy.[13] In addition, whether or not a state received a high policy grade or followed exceptional best practice guidelines has no significant affect.

Theory and policy analysts (NNEC 2008, Wiser and Barbose 2008) assert that the effectiveness of a policy is largely determined by whether it follows best practice guidelines. A policy can be reinforced, or undermined, by the presence, or absence, of a specific attribute or component that may greatly influence the actions of renewable energy developers. However, the findings of this analysis do not support a direct connection between a policy and increased generation in the same year.

Based on the findings that a time lag could be an important element, it is hypothesized that states that followed best practice guidelines for net-metering and interconnection policies in 2005 would perform stronger in renewable energy development indicators in the following years. This, however, was not tested. Next steps for future versions of this report include gathering a record of states that followed net-metering and interconnection policy best practice guidelines in 2005, and testing whether or not they performed stronger in the following years.

4) Impact of the Age of an RPS Policy

The age of an RPS policy is found to be positively correlated with installed wind capacity. The correlation test p-value of 0.0423 indicates that the relationship is significant at the 0.05 level, while the corresponding correlation coefficient of 0.40102 indicates that the relationship is moderate in strength and positive in direction. In other words, as the age of the RPS policy increases, so does the amount of installed wind capacity. This relationship indicates that wind development may be particularly

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[13] See the section discussing the analysis on individual policies, above, for a description of the general findings for individual policies, not accounting for best practice elements.

responsive to an RPS policy. One factor may be that an RPS mandates the provision of a certain amount of renewable energy generation, yet this does not necessarily mean that subsidies are available for construction; because wind energy is one of the most competitive renewable energy technologies, it is a common technological option taken to fulfill RPS mandates.

5) Removal of Outlying States

Fewer positive relationships between policy and renewable energy generation are found once the outlying states, or "tails," are omitted from the analysis (see Methodology section for details). Before removing the tails, there are 15 significant positive relationships between policies and the three dependent renewable generation variables. After removing the 10% tails from each distribution, respectively, the findings indicate only three significant positive relationships, which are 12 fewer than before (see **Table 4.12**).

Table 4.12. Removal of Outlying States: T-test and Correlation Results

Significant Relationships Between Policy and Total RE Generation	
Results Prior to Removing Tail-ends	**Results After Removing Tail-ends**
Construction and Design	Equipment Certification
Generation Disclosure	Personal Tax Incentive
Land Access	
RPS	
RPS and Land Access	
RPS and Generation Disclosure	
RPS and Interconnection	
RPS, Land Access, and Interconnection	
RPS, Interconnection, and Generation Disclosure	
RPS, Land Access, and Generation Disclosure	
Significant Relationships Between Policy and Total RE Generation per Capita	
Results Prior to Removing Tail-ends	**Results After Removing Tail-ends**
Required Green Power	Personal Tax Incentive
Personal Tax Incentive	
RPS and Required Green Power	
RPS and Personal Tax Incentive	
RPS, Interconnection, and Required Green Power	
Significant Relationships Between Policy and Total RE Generation % Change from 2001-2007	
Results Prior to Removing Tail-ends	**Results After Removing Tail-ends**
none	none

The renewable energy "powerhouse" states are responsible for significant positive relationships between policy and renewable energy development indicators; and removing these states from the analysis resulted in far fewer relationships between policy and development. The fact that so few relationships between policy and development occur once the tails are removed means that policy implementation has not significantly spurred development in a majority of states. This suggests that although policy often acts as a catalyst for renewable energy generation and development, contextual factors also contribute substantially to the amount of development achieved. It is possible that, in removing the tail-ends of the distribution, the most important contributing factors to development were also removed.

In sum, eliminating the tail-ends did not strengthen the previously observed relationship between policy and renewable energy generation and development, as was hypothesized. ***The findings suggest that at this early stage of renewable energy development, contextual factors may prove to be stronger indicators of renewable energy generation and development than policy.***

Discussion and Conclusions

The development of the quantitative methodologies presented is an attempt to expand policy evaluation beyond qualitative methods and increase the understanding of policy effectiveness. The statistical analyses identified significant connections between state policies and renewable energy development indicators. However, many connections that were hypothesized to exist did not appear, and some relationships that did emerge appear trivial after viewing the graphical representations. Overall, several conclusions can be drawn from the analyses (see **Table 4.13** for a summary of conclusions):

- The time-lag analysis contributes to the understanding of how long it takes before the effects of a policy can be observed.
- The time-lag analysis also reveals that states that had a net-metering policy in 2005 had significantly more renewable energy generation in 2007 (in terms of total generation, as a percent of total electricity generation, and per capita) than states without the policy.
- Portfolio analysis identifies significant relationships between the number of market-transformation policies (including both barrier reduction and technology accessibility policies) and the total renewable energy generation. This is particularly true when considering individual technologies.
- Policy portfolio analysis using a time- lag supports, in particular, the effectiveness of combining generation-disclosure requirements with required green power programs; however, this observation warrants further research.
- Some of the features of a well-designed RPS policy are found to significantly contribute to renewable energy development when looked at individually; however, none of them can be combined into a model that adequately predicts any of the renewable energy generation indicators.
- The result of the methodology that omits outlying states emphasizes the role of contextual factors in renewable energy development, whether they're

sociological, political, economic, or geographic. This highlights the importance of understanding the contextual factors involved and identifying the most effective set of policies for addressing contextual issues and reducing the barriers to renewable energy development. These are discussed further in the following chapter.

Table 4.13. Summary of Conclusions

Analysis	Goal	Notable Results
Impact of Individual Policies	• Explore impact of individual policy implementation.	• Net-metering policy is related to increased non-hydro renewable generation.
Impact of Policy Portfolios	• Explore effects of policy interactions.	• Number of policies is related to increased generation. • Combining generation disclosure and required green power related to increased generation.
Impact of Policy Design (RPS, Net metering, Interconnection Policies)	• Explore effects of best practice design features.	• Some RPS best practice design features related to increased renewable generation; however, no successful model for combining the features was identified.
Impact of Policy Age (RPS)	• Explore effects of policy age.	• As the age of the RPS increases, wind capacity significantly increases.
Removal of Outlying States	• Explore the influence of contextual factors.	• Removing the highest- and lowest-performing states reduces the number of relationships seen between policy and generation. Thus, contextual factors other than policy may be stronger indicators of development than policy.

Based on these conclusions, more in-depth analysis can be done in the future to refine the connections between policy and renewable energy generation development.

In particular, best practices in policy design do not appear to have a large impact on policy effectiveness (given the metrics considered in this study). However, the connection may be overshadowed because of insufficient time for a policy to be in effect before seeing the results of the best practice elements. Next steps to explore this issue should include:

- Expanding the database to include a more comprehensive listing of exactly when each state policy was implemented.
- Using a time-lag approach for best practice design analysis.
- The inclusion of many more contextual factors as quantified independent variables.

This improved methodology will account for many of the remaining explanatory variables and provide a clearer insight into effectiveness of state renewable energy policy.

In addition, policy portfolio analysis provides insight into identifying quantitative trends that may exist regarding effective policy combinations. Although a limited number of trends are found using the time-lag approach to portfolio analysis, allowing for more time for many of the policies to take effect and impact the markets will contribute to the understanding of how long it takes for policies to take effect. It will also provide insight on which policy combinations work best together and foster renewable energy development.

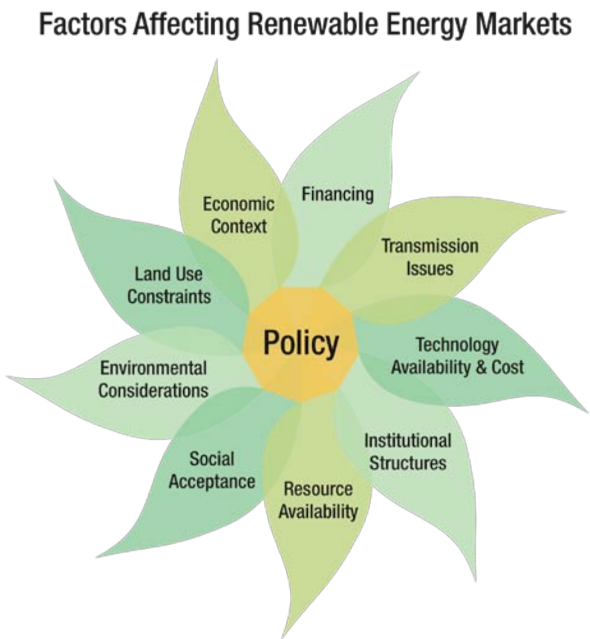
Finally, the demonstrated importance of contextual factors, and accounting for these factors within the statistical analysis, may provide additional insights into policy effectiveness. Next steps will include methodologies for quantifying contextual factors, where possible.

Chapter 5. Contextual Factors Affecting Renewable Energy Development

Introduction

Contextual factors are the existing natural resource, economic, environmental, and social conditions that set the stage for renewable energy development. They define the framework for renewable energy markets, and can be either barriers or accelerators to renewable energy development.

State policymakers who understand contextual factors are in a better position to design and implement policies with beneficial outcomes within their state. Each state has a unique set of contextual factors, and the particular mix determines which policies should be implemented to optimize the deployment of renewable energy resources.



This chapter identifies and summarizes 14 contextual factors that impact renewable energy development in a positive, negative, or neutral way (see **Table 5.1**). While the focus of this chapter is on contextual factors, state policies that can be effective within the framework of these factors are also briefly discussed (policies are reviewed in greater detail in **Chapter 3**).

Table 5.1. Renewable Energy Contextual Factors

1. **Resource Availability** – The natural resources that exist in a state that can be used to produce renewable energy.
2. **Technology Availability** – The commercial availability of technically proven renewable energy hardware.
3. **Technology Cost** – The cost of building and maintaining renewable energy facilities.
4. **Energy Costs** – Prices paid by consumers for energy produced from renewable energy and competing power generation technologies.
5. **Economic Factors** – Economic health of a state and energy consumers in that state.
6. **Project Financing Options** – Financing mechanisms to fund renewable energy installations.
7. **Ownership Options** – Project ownership structures that allow for maximum use of available incentives.
8. **Transmission Issues** – Transmission lines and infrastructure that transport electricity from the renewable resource power production location to end-use electricity markets.
9. **Environmental Considerations** – The impacts of renewable energy on the natural environment.
10. **Institutional Structures** – The attitudes and policies of existing utility companies and regulatory organizations toward renewable energy.
11. **Land-Use Issues and Constraints** – Land availability and land-use laws and zoning.
12. **Information Dissemination** – The availability of information about renewable energy technologies, resource availability, financial incentives, and regulatory hurdles in a state.
13. **Social Acceptance** – Public support for, or opposition to, renewable energy development.
14. **Larger Policy Context** – Federal action on incentives and regulatory issues that set the background for how states implement renewable energy policies.

Contextual Factors

Resource Availability

The opportunities for renewable energy development and generation vary by state and are based on available natural resources. A state must identify its renewable resources before determining which policies to enact that will promote the development of those resources – policy formulation should be tailored to the available resources. Examples of how renewable resources vary across the United States include:

- **Solar** – The southwestern states and parts of California have abundant insolation and can take advantage of solar energy (thermal and photovoltaic).
- **Wind** – The potential for wind energy production is high in the Great Plains region of the United States – a large expanse stretching from North Dakota to north Texas, often called the "wind belt."
- **Biomass** – Biomass is abundant in the eastern states and some parts of the Pacific Northwest (NREL 2009, DOE 2009a, AWEA 2009b).

- **Geothermal** – Geothermal energy is abundant in several western states (DOE 2006).

Renewable resource data and maps are available from the National Renewable Energy Laboratory (NREL 2009) and the U.S. Department of Energy (DOE 2009a). Through these sources, renewable energy resource assessments and site-prospecting programs are widely available to the developer community.

States need to consider the specific location of a resource within their borders. In some cases, resources are in remote areas far from large population centers, which can require that new transmission lines be built to transport the electricity to consumers. Other factors that may affect the development of resources are land-use constraints, environmental considerations, local economic factors, institutional structures, and local public acceptance. These contextual factors are discussed in more detail in subsequent sections of this chapter.

Many renewable energy policies – such as financial incentives, renewable portfolio standards (RPS), and production credits – can be used to promote a wide range of renewable energy technologies. However, other policies can be tailored to address specific state issues and resources. These policies include those related to transmission access, interconnection, net metering, and land use. The focus of state policies can be adjusted to address specific resource availability.

Different types of renewable energy technologies can have significantly different capacities, and these capacity differences need to be considered when designing policies. For example, policies directed toward solar energy development may not encourage the development of utility-scale wind energy or other large capacity renewable energy systems. Because rooftop photovoltaic installations are typically smaller in capacity than wind or biomass systems, a 100 kW limit for standard interconnection and net metering may be sufficient to promote residential and commercial solar development; however, it may be too low to encourage the development of wind or biomass. State policymakers need to carefully consider the type of resources that are available within their state to ensure that proper policies are enacted to promote the use of these resources.

Technology Availability

The availability of highly efficient and cost-effective renewable technologies is an important foundation for increased development of renewable energy. A healthy renewable energy market is dependent on the commercial availability of reliable equipment from multiple vendors. In recent years, there have been several significant advancements that have improved the technical performance and reduced the cost of wind turbines, solar PV, and other renewable energy technologies. New equipment suppliers have entered the market, which results in a wider range of product offerings but also keeps prices competitive. However, the renewable energy market is far from fully commercialized, and equipment prices and performance are expected to show continued improvement as the market expands.

There have been growing pains in renewable energy markets. For example, access to sufficient raw materials has hampered technology availability in some cases. Shortages of pure silicon, and competition for the resource with the growing semiconductor industry, have affected the manufacturing costs and availability of crystalline photovoltaic cells. As production capacity of crystalline silicon has increased during the past few years, the shortage has eased. Shortages of steel and other raw materials due to increased global demand also have increased production costs of and lengthened the lead time for procuring wind turbines (Kanellos 2008). However, the recent worldwide economic recession has eased many materials constraints.

Some manufacturers have been hesitant to invest in new factories, fearing that demand will fall as financial incentives sunset. An insufficient production infrastructure could hamper expectations for a robust increase in the deployment of renewable energy technologies.

Several policies can ease problems with technology availability: Research and development support spurs advancements; manufacturing incentives and commercialization assistance will promote production; and extended timeframes for production incentives, tax incentives, and mandatory production policies increase market stability and ease supplier concerns about demand fluctuations.

Technology Cost

The technology used to recover energy from a renewable resource varies significantly between each type of resource. Solar PV, solar thermal, wind, biomass, and geothermal resources require different conversion technologies, and the equipment costs vary greatly depending on the resource type as well as the resource scale (e.g., large-scale wind compared to rooftop or distributed wind; residential solar compared to utility-scale solar power).

A continuing issue for renewable energy technologies is that they tend to have higher up-front capital costs compared to fossil-fuel technologies. However, renewable technologies generally have lower operation and maintenance (O&M) and lower (or even nonexistent) fuel costs compared to conventional technologies. Given higher up-front costs for renewable energy technologies and relatively low prices for oil and natural gas – at least based on current market conditions – renewable energy development may be seen as too expensive (Wald 2009).

Solar PV systems tend to have the highest costs per kilowatt of installed capacity, followed by solar thermal, geothermal, biomass, and wind, which has the lowest cost (EIA 2001). However, a true comparison of energy costs should be made on the basis of total “life-cycle” costs. Life-cycle costs account for the initial capital costs, O&M costs, and any fuel costs over the entire equipment lifetime. In many cases, life-cycle costs show that renewable energy sources are comparable to conventional sources (Beck and Martinot 2004).

Environmental costs are often not included when comparing renewable energy to fossil fuels. The environmental impacts of fossil fuels can lead to societal costs such as adverse human-health effects (due to harmful air emissions), infrastructure decay (from acid rain), declining forests and fisheries, and rising sea levels (resulting from climate change). Although environmental impacts and the associated costs are sometimes included in economic comparisons between renewable and fossil-fuel energy sources, investors rarely include such costs in bottom-line investment decisions.

Various policies can compensate for the higher capital costs of renewable energy technologies and account for their environmental benefits. Grants can be used to buy-down the initial capital costs of renewable equipment and encourage investment. Feed-in tariffs, tax incentives, loan guarantees, and production requirements can work to improve financing options and costs. Some states may also provide research and development incentives to companies that manufacture renewable technologies, with the goal of reducing technology costs and stimulating in-state job growth. Emission trading (or '"cap-and trade") programs also help level the playing field for renewable energy technologies by imposing a monetary cost to the emission of greenhouse gases (GHGs) from fossil-fired plants – a cost not imposed on renewable energy technologies.

Energy Costs

An important contextual factor that impacts the development of renewable energy projects is the relative cost of energy produced from renewable resources compared to the cost of electricity from conventional power generation plants. Contextual factors such as technology costs (discussed previously) have a direct influence on the cost that consumers pay for electricity generated from renewable resources. Transactional costs, which can be higher for renewable energy projects compared to conventional power plants, are another factor that influences the cost of renewable energy. Transactional costs cover project development activities such as siting assessments, permitting, financing, and negotiating power-purchase contracts. Transactional costs tend to be relatively flat regardless of project size; therefore, a small-capacity renewable energy project will have a higher transaction-cost burden (measured in ¢/kWh) compared to a large-capacity plant. Transactional costs, combined with capital cost differentials, often lead to higher costs on a per kilowatt-hour basis for renewable energy projects compared to conventional power plants.

Cost implications can pose a dilemma for policymakers in some states. For example, it may turn out that states with an abundance of coal-generated or hydroelectric power may have low electricity costs, and policymakers in these states may be reluctant to promote renewable energy development that could increase the cost of electricity (EIA 2003). In contrast, policymakers in states with high electricity prices will generally be motivated to invest in alternative forms of energy as they seek to reduce costs (EIA 2007).

Economic Factors

The health of state energy budgets and the amount of discretionary income that state residents have are two factors that can influence investments in renewable energy. In general, the environment for stimulating investments in renewable energy will be best in those states that have stable or expanding government budgets, as well as those that have relatively low unemployment rates and relatively high household incomes.

States with healthy budgets have more options for considering how, and to what level, renewable technologies can be supported. The potential for economic growth from renewable energy development is considerable; and with recent shifts in manufacturing and the increase in unemployment rates, some states are placing high value on the opportunity for economic growth and job creation (as well as increasing renewable energy project development) by attracting renewable energy technology manufacturers to their state (Lantz 2009).

A report by the Political Economy Research Institute shows that the skills necessary for laborers in the renewable energy sector are largely the same as those for the existing labor pool. This means that local laborers can apply their existing skills to renewable energy development with limited retraining (Pollin and Wiks-Lim 2008). The jobs that can be created through increased renewable energy deployment include positions for metal workers, electricians, welders, assemblers, construction equipment operators, truck drivers, and first-line production supervisors, procurement specialists, and engineers.

The American Solar Energy Society issued a report that investigates the current and future state of renewable energy jobs and economics in the United States (Bezdek 2009). The conclusions indicate a potentially significant number of jobs and revenue growth as a result of increased renewable energy deployment. According to the report, renewable energy gross revenues totaled nearly $43 billion in 2007, with the number of jobs created by the sector exceeding 500,000. Figures indicate that the renewable energy industry grew twice as fast as the overall U.S. economy between 2006 and 2007.

State policymakers can attract renewable energy businesses and manufacturing to their state through industrial recruitment policies such as tax credits and grants. Long-term policies may be more effective in attracting businesses to a particular state than short-term policies and incentives, because they send a signal to investors that the state has a long-term commitment to renewable energy development, thereby reducing uncertainty and perceived risk. State policymakers can also adopt mandatory green power purchasing rules, government procurement programs, and RPS policies, which are all steps that can increase the market penetration of renewable resources. States can also implement public benefit charges, and use the resulting funds for research and development activities. This effort can lead to accelerated technology advancements and the creation of in-state jobs for private companies, universities, and other organizations that conduct research and development.

Project-Financing Options

The high initial capital cost of most renewable energy projects means that the availability of financing is a critical issue for most developers, who are typically not in a position to self-finance. Today, project financing is most often a barrier, rather than a stimulator, to renewable energy development. Project financing for conventional central power plants typically involves sums greater than $500 million. However, renewable energy projects are typically on a smaller financial scale. For these smaller projects, high administrative and transaction costs of financing can be prohibitive.

Lenders are often uncomfortable with the perceived risk of renewable energy technologies, which are frequently viewed as new and unfamiliar technologies that are rapidly evolving. Lenders look for long-term testing and verification of technologies and predetermined acceptance in the marketplace, which are not always criteria that evolving renewable energy technologies can meet. Some technologies are manufactured by small start-up companies with a short credit record, or the manufacturer and project owner may be the same – both of these increase the perceived risk to lenders. Perceived risk is further increased if there is no long-term power purchasing contract, if the utility company purchasing the power does not have a high credit rating, if tax credits or other incentives are not guaranteed for the long term, or if there is uncertainty in the resource availability or environmental impacts of the project (UNDP and SEFI 2008).

Policies designed to provide financing support to renewable energy technologies need to address specific challenges. Examples of policies that address financing barriers include low-interest financing, loan guarantees, and loan=-softening programs. Technical assistance programs that build the capacity of the actors along the financing chain can reduce perceived risk through education, and help build an experienced lender base. Longer terms on production incentives, tax credits, mandated generation, and net-metering provisions provide additional risk reduction that makes financing easier to obtain and may lower the cost of capital. Grants and rebates can lower the amount of capital that developers require, thereby reducing financial costs.

State renewable energy policies can be designed to create incentives for different types of ownership structures, corporate tax structures (e.g., nonprofit versus for-profit organizations), and changing market conditions. One significant barrier that has been cited to the creation of effective policies (particularly low-interest loans) is the potential loss of state and federal tax credits under subsidized financing programs (Wiser et al. 2002). Policy interactions of this type should be considered closely when creating these financing programs. Creative solutions can be established, such as decoupling tax incentives from power generation, which allows tax-exempt entities to benefit from project-financing incentives by transferring tax credits to tax-paying entities such as banks or developers.

Ownership Options

There are a variety of different ownership structures applicable to renewable energy installations. Large installations may be constructed and owned by electric utilities or third-party developers, which may lease public land or pay rent to landowners. Alternatively, developers may transfer ownership to a landowner after construction. Other options that have been implemented with success in Europe are the "share offers" and "cooperative ownership" structures. Individuals wanting to invest in renewable energy may buy shares in a large project that is managed by a single company, or may own shares as part of a cooperative that manages the continued operation of the project (McLaren Loring 2007). Smaller renewable energy systems (<10 kW) are typically owned by individual landowners or homeowners. However, some municipal utility companies have programs through which they own and maintain residential photovoltaic systems by renting out the homeowner's rooftop. Increasing numbers of government agencies are also installing renewable energy on their facilities, sometimes funded through clean energy bonds (Cory 2008).

The feasibility of various ownership schemes is often dependent on financing structures, the ability to take advantage of incentives, the ease with which grid connection can be established, and the availability to establish long-term contracts for power sales. States can provide opportunities for increased development by reducing barriers to alternative ownership options, raising awareness of alternative ownership arrangements, and ensuring that state incentives are available to a wide audience.

It should be noted that the ownership structure that is chosen can significantly impact public perception and acceptance of a renewable energy project. A cooperative or jointly owned project is more likely to gain public acceptance, because more local community members feel a sense of ownership and have a financial stake in the project. The installation of systems by banks, schools, and government entities can improve public acceptance as well, as more segments of the public gain familiarity with the technologies.

Transmission Issues

The issues regarding the interconnection of renewable energy projects with the transmission grid are complex, yet their resolution is essential to the greening of the electricity system. A few of the barriers that must be overcome include the need for grid expansions, ensuring fair tariff structures, and clarifying procedures for transmission access and use by renewable energy generators. Continued research into the incorporation of intermittent power generation resources such as wind and solar into the grid – as well as the development of "smart-grid" technologies – are essential to increased deployment of renewable resources.

Relatively little investment in transmission infrastructure has been made during the past 15 to 20 years, and lack of transmission access is a barrier to increased renewable energy development in some areas (DOE 2007). If a renewable energy system is located at or near the place of consumption, transmission issues may be easier to address. However, much of the country's wind resource is located in the Midwest, where the population is sparse. Building new transmission lines to these remote areas can be a challenging and lengthy process, due to transmission access rulings and right-of-way disputes. The long lead times often associated with transmission grid expansion projects can delay renewable energy projects from coming online (NPR 2009).

Even when transmission lines are nearby, grid connection can be prohibitively expensive for some projects. The power markets in the United States are currently governed by more than 200 different tariffs that set the rules and conditions for access to, and use of, the electric grid. Many of these tariffs assign fixed costs to incremental transactions and impose non-cost-based penalties on generators that deviate from predetermined schedules. Because variable electricity is not scheduled like standard resources, these tariffs cause variable sources like wind and solar to bear a high share of the costs of expanding and operating the grid (Swisher 2004).

In addition, institutional structures and utility attitudes can affect the ease with which renewable energy generators obtain grid access. Some utilities have been reluctant to approve significant quantities of renewable energy interconnection, due to concerns of increased system instability. However, as more sophisticated equipment and smart-grid technologies are developed, and as more research is completed on the amount of variable electricity the grid can handle, many of the concerns are being displaced.

In an increasing number of states, standardized requirements have been enacted, which provide specific guidelines, timeframes, and cost structures for the interconnection of renewable energy systems. These policies reduce the risk and uncertainty for new projects and can create more level playing fields across technologies.

Some states are even proactively developing the transmission infrastructure needed to accommodate new renewable energy development in remote areas. Texas began identifying and creating competitive renewable energy zones in 2006; these zones define areas where significant renewable resources exist and where transmission infrastructure will be built in advance of installed generation (DOE 2007). The identification of appropriate zones for renewable energy development, through the consideration of a variety of factors, is also occurring as part of the Western Renewable Energy Zones Initiative by the Western Governors' Association (WGA) and the Department of Energy (WGA 2009).

The development of a smart grid is another potentially critical component of renewable energy development. Improved capacity of the grid to receive and manage dispersed and intermittent generation could provide a major boost to renewable development. Smart-grid development is a federal priority, with $4.5 billion tagged for electricity delivery and reliability in Title IV of the 2009 American Recovery and Reinvestment Act (DOE 2009b).

Environmental Considerations

Because of the air quality benefits of renewable energy technologies over conventional fossil fired sources of electricity, states have embraced renewable energy development as a mechanism to reduce criteria pollutants (negative impact on human health) and greenhouse gas emissions (connected with climate change). However, issues such as water scarcity and sensitive landscapes also need to be considered when selecting which technologies are appropriate for a particular region within a state. For example, some designs for concentrating solar power plants use significant amounts of water, and water is in scarce supply in desert environments where concentrating solar power plants are often considered for siting. Concerns also exist regarding the effects of tidal energy systems on aquatic ecosystems, and the effects of wind turbines on bird and bat species. In some cases, stakeholder working groups are addressing these specific issues (BWEC 2009, NWCC 2009). In general, environmental impacts associated with renewable energy resources continue to decline as ecologists formulate better understandings of the impacts on habitats, and as researchers improve system designs to mitigate unwanted impacts.

Weighing the environmental benefits and hazards of deploying renewable energy systems is not straightforward and involves assessing multiple technologies and environmental parameters. Decision makers are tasked with balancing broader air quality, water quality and greenhouse gas reduction benefits of renewable energy with the potential impact on local ecosystems.

Institutional Structures

Electric utilities and regulatory agencies can greatly influence the development of renewable energy in a state. State public utility commissions (PUCs), or public service commissions (PSCs), regulate utility rates and associated policies. PUCs and PSCs that are strongly inclined toward renewable energy can use their regulatory power to require interconnection standards, rates, and other policies that will allow and encourage renewable development. Utilities may be less willing to encourage renewable energy due to factors including lack of experience and information, concerns about the ability to control renewable generators, economic risk, and a lack of adequate planning tools.

Some utilities have not had significant direct experience with renewable energy, and may not be aware of recent technology and performance improvements, as well as approaches for dealing with the variable nature of renewable energy resources. Therefore, these utilities may still regard renewable energy technologies as being too risky (Parsons and Wan 1993). While conventional generating units can be dispatched to meet the system maintenance schedule and other operational requirements, many renewable generation technologies lack this operating flexibility. However, there is substantial utility experience with the use of variable resources, and this information can be valuable to utilities that are considering the addition of renewable resources. Although a significant amount of grid-operating experience with renewable technologies has been accumulated during the past couple of decades, information about these utility experiences is not always widely available to utilities and regulatory bodies. Utilities may also lack adequate planning tools to evaluate the cost and impact of incorporating renewable technologies into their resource planning.

Some of these issues can be managed through increased information dissemination and by accelerating technology transfer activities. States can take an active role in disseminating information on performance characteristics and best practices of utility use of renewable technologies and resource planning with renewable energy. States also can establish interconnection and net-metering policies to reduce the contractual costs and risks for renewable energy producers. The design of these policies can vary widely, and states are encouraged to consider the lessons learned and best practices that have been developed for net-metering policies (see Chapter 3) (DSIRE 2009).

Land-Use Issues and Constraints

Planning laws and zoning regulations can reduce barriers to renewable energy development, or vice versa, greatly inhibit their development. Often, renewable energy projects face long application timeframes, as well as costly delays and appeals, which cause many projects to be delayed or canceled.

Experience has shown that public dissent can be high for some renewable energy proposals (BWEC 2009, McLaren Loring 2007). Anytime there is competition for land use, there will be conflict. Site selection for renewable energy technologies must consider not only resource availability and transmission issues, but other competing land-use needs. Whether the issues surround aesthetics, noise, property values, habitat destruction, and water or land use, tradeoffs must often be made and the issues weighed carefully.

Research has shown that early-stage community involvement in planning discussions helps address potential conflicts before issues become inflamed and goes a long way to reducing controversy. Open public discussions are more effective than one-way information dissemination and may result in creative solutions to potential problems that are acceptable to all parties involved (McLaren Loring 2007). This translates into time and money saved for all parties involved.

In addition to early-stage stakeholder involvement, there are a number of other specific measures that planning authorities can use to reduce planning barriers that renewable energy projects often face:

- Ensure that zoning laws do not inhibit the installation of distributed generation technologies, such as small wind turbines.
- Consider passing solar access laws to ensure that solar resources are available to those who want to take advantage of them.
- Ensure that planning regulations are consistent with industry-wide construction and safety standards.
- Identify specific zones in which renewable energy project applications are welcome, and fast-track applications in these zones.

- Develop and publicize chosen procedures for analyzing the impacts of renewable energy projects.
- Establish planning goals and targets for the use of green energy technologies, which will clarify priorities and reduce perceived risks of potential investors; also link goals and targets with state and national goals, when possible (Mueller 2009, APA 2004).

Information Dissemination

Even if state governments offer generous incentives, significant investment will be hampered if potential investors and developers do not have access to the information needed to weigh the costs and benefits of the technologies – or if procedures are unclear or overly complex (Sawin 2004). Ensuring that clear, accurate information about renewable energy technologies and incentives is readily available can reduce misunderstandings and empower action to spur further development.

There are several different audiences to which information should be directed, including: political decision makers, project developers, electric utilities, financing institutions, and the general public. Each of these audiences will have varying degrees of prior knowledge, as well as different informational needs. Thus, it is important that the information is tailored to the intended audience.

The EPA State Best Practices Web site (EPA 2009) and the International Council for Local Environmental Initiatives' (ICLEI) online information (ICLEI 2009) are good resources that can help state and local governments assist decision makers in weighing options and taking steps toward renewable energy development. The online Database of State Incentives for Renewables and Efficiency (DSIRE 2009) compiles information on state and federal policies.

State and city governments can help promote information dissemination by ensuring that the policies listed in DSIRE and other databases are current, and by directing stakeholders to the relevant information for their specific area. Creating a one-stop shop for renewable energy information within each state for various end users can demystify the development process and encourage development. Useful topics to address include:

- Detailed resource availability
- Technological developments and applications
- Policy and incentive details
- Relevant application and permitting processes
- Applicable fees and taxes
- Training programs
- Electricity suppliers offering renewable energy options
- Fuel mix of the electricity supply

U.S. electricity-sector restructuring policies mandate that information be disseminated to customers about choice of electricity providers and the characteristics of electricity being provided, such as emissions levels and fuel types (ICLEI 2009). In many states, general education to raise customer awareness about renewable energy and the environmental impacts of energy generation is required, typically via Web sites and printed materials. States that have not gone through the restructuring process can encourage customer choice by enacting these same policies. State programs that provide resource, transmission, zoning, and permitting assessments may also help to spur new renewable energy developments. These assessment programs have been credited with stimulating early wind energy development in California (McLaren Loring 2007).

Social Acceptance

Despite evidence of general support for the greening of the electricity system, individual technological applications and specific renewable energy projects are often subject to intense public dissent. In the United States, this has been seen in cases such as the highly publicized controversy surrounding the Cape Wind project in Nantucket Sound (Cape Wind 2009).

Public opposition is based on a variety of issues, which range from visual and noise pollution, effects on wildlife, concerns regarding the devaluing of nearby property, or competing land-use issues. Renewable energy installations are, by nature, often more visible than conventional energy sources. For instance, wind turbines and PV panels are generally in open spaces and are needed in large numbers, while traditional power plants are often sited in remote areas and shielded from view by fences or buildings. The smaller-capacity, more dispersed nature of renewable energy technologies necessitates a larger number of siting decisions, increasing the chances and likelihood of public opposition.

Opposition may come from national or local interest groups or individuals who feel strongly about a proposed project. A number of prominent nonprofit organizations, such as the Sierra Club, Nature Conservancy, and the Union of Concerned Scientists have taken positions on renewable energy (Nature Conservancy 2009, UCS 2009).

Planning decision processes are designed to consider and weigh the various interests and issues that occur when new projects are proposed. Planning processes that encourage inclusive and open discourse during early stages can help strengthen support among the public and avoid conflict. Renewable energy projects with a higher rate of public participation in the decision-making process have been shown to have a higher likelihood of success. The use of alternative ownership structures is also an effective way to give communities a sense of connection to a project and increase public acceptance. In Europe, the construction of visitor centers connected with renewable energy installations have created a sense of community pride in, and income from, new projects – and worked to avoid potential conflicts during the project planning phase (McLaren Loring 2007).

In some cases, laws and regulations can be used to ensure fair access to resources and a level playing field for renewable energy technologies. For example, covenant laws can be structured to prohibit neighborhoods from explicitly restricting the installation or use of renewable energy equipment, while access and easement laws can help to create a balance between the use of a renewable resource, such as water, for energy production and competing needs. Policies that address street orientation and building height can facilitate infrastructure that is amenable to renewable energy and responsive to public concerns.

Larger Policy Context

Policies on the federal, state, and local levels all influence renewable energy development. These policies interact, but it is often difficult to anticipate or determine the effects of one policy on another – and impossible to anticipate how policies on one level will change over time.

Federal policies that provide incentives and funding for renewable energy include the Energy Policy Act of 2005, the Energy Independence and Security Act of 2007, and the American Recovery and Reinvestment Act of 2009 (EPAct 2005, EISA 2007, ARRA 2009). In addition to these federal policies, there are myriad state and local incentives.

States can structure their incentives and programs so that they can be used in conjunction with – and complement – national level incentives. State funding can leverage national funds with the goal of developing a particular regional resource or meeting specific state goals. States may also establish higher mandates or more aggressive development goals than required at the national level. Existing stakeholders or industries may encourage state policymakers to enact support mechanisms for the technologies already being produced or developed within the state.

Policymakers must carefully consider the selection and design of state policies to avoid unwanted policy interactions with federal rules. For example, state policymakers will generally not want to craft policies that exclude recipients of state funds from qualifying for federal incentives. Policies that have provisions for tax incentives frequently overlap with state and federal rules, and policymakers should pay particular attention to policies that include tax relief to ensure that desired outcomes are achieved.

Conclusions

This chapter provides an overview of 14 contextual factors that may affect renewable energy development and policy effectiveness at the state level. Each state has a unique set of circumstances, and the same contextual factors may affect states differently, depending on specific state conditions. From a qualitative perspective, all 14 factors influence the bottom-line economics for renewable energy projects. The interplay among the various contextual factors is less quantified at this point. An increased understanding of these interactions – and how policies can be used to account for and take advantage of the interactions – will improve the future effectiveness of policy design and implementation.

Chapter 6: Conclusions and Future Efforts

This report summarizes the status of renewable energy development in the U.S. states, identifying trends and high-performing states based on a variety of metrics (**Chapter 2**). It identifies the policies that are being used to encourage development, and presents the current understandings of design-based best practices (**Chapter 3**). A connection is then drawn between the policies and development, using a quantitative investigation of the relationship between policy implementation and actual generation, and a variety of statistical analyses (**Chapter 4**). This report explores other factors that affect renewable energy development are explored to place the policy discussion within the broader context (**Chapter 5**). And, finally, the report provides overall conclusions, next steps, and a list of resources (**this chapter**).

Main Conclusions of the Chapters

Chapter 2 – Quantitative Trends in Renewable Energy Development

- Washington maintains its position at No. 1 for total renewable generation in 2007, while California maintains its spot at No. 1 for non-hydroelectric renewable generation in 2007.
- Idaho and Maine each secured the No. 1 spots for total renewable generation as a percent of total state generation, and non-hydroelectric generation as a percent of total state generation, respectively.
- Washington and Maine each secured the No. 1 spot for total renewable generation per capita and non-hydroelectric renewable generation per capita, respectively.
- Montana and Maine each secured the No. 1 spot for total renewable generation per GSP and non-hydroelectric renewable generation per GSP, respectively.
- Hydroelectric generation continues to represent the largest portion of renewable generation in the United States at 70%. Wind has experienced the most growth of the renewable energy technologies in recent years, growing 30% from 2006-2007.
- Overall, national hydroelectric generation declined by more than 14% from 2006 to 2007. A portion of this decline can be attributed to a lack of rainfall in various parts of the country. The decline of hydroelectric generation was concentrated in areas that have experienced moderate to severe drought conditions during that timeframe. In 2007, hydroelectric generation was significantly lower in the following areas: New England, Middle Atlantic, East North Central, South Atlantic, East South Central, Mountain, the Pacific regions. Much of the hydroelectric generation within the United States occurs in some of these regions (Mark Gielecki – from EIA). It is also important to recognize that climate change may cause more weather irregularities in the future, leading to generation numbers that may seem inconsistent and volatile. In addition, El Niño, a seasonal weather fluctuation, is expected to arrive in late 2009. Unstable El Niño weather conditions may also influence renewable energy generation in 2009-2010.

Chapter 3 – Supporting Renewable Energy Development Through State-Level Policy

- Net metering, interconnection standards, renewable portfolio standards, tax incentives, renewable energy access laws, and generation-disclosure laws are the most commonly implemented renewable energy policies within the U.S. states.
- Net metering, tax incentives, and renewable portfolio standards were the most commonly added state renewable energy policies during the past year.
- As more policies are implemented on various levels, policymakers must pay increasing attention to the interactions between federal and state policies, as well as between policies of different types.
- Due to the limited time period and extent to which renewable energy policies have been in use, and the limited evaluation that has taken place, the most effective policy designs and their direct impacts on renewable energy development are not always well understood.
- The current understandings of best practices in policy design are presented in Chapter 3. Evaluating policy design continues to be an important area of research.

Chapter 4 – Statistical Analyses of State Policy Impact on Renewable Energy Development

- This chapter presents four statistical and empirical methodologies to explore the link between state-level policy and renewable energy deployment. These methods build on those presented in last year's report, with the goal of furthering the development of qualitative methodologies for policy evaluation.
- The time-lag analysis contributes to the understanding of how long it may take before the resulting effects of a policy can be observed.
- Time-lag analysis also reveals that states that had implemented net-metering legislation in 2005 had significantly more renewable energy generation in 2007 (in terms of total generation, as a percent of total electricity generation, and per capita) than states without the policy.
- An analysis is conducted to determine the effectiveness of best practice design elements for three individual policies: RPS, net metering, and interconnection. Some of the features of a well-designed RPS policy are found to significantly contribute to renewable energy development when looked at individually; however, none of them can be combined into a model that adequately predicts any of the renewable energy generation indicators.
- Various policy portfolio combinations are examined, which provides insight into effective policy combinations. Time-lag analysis of policy portfolios supports, in particular, the effectiveness of combining generation-disclosure requirements with required green power programs; however, this observation warrants further research.

Chapter 5 – Identification and Description of Contextual Factors Related to Renewable Energy Development

- There are many contextual factors, other than policy, that affect renewable energy development. These include – but are not limited to – resource and technology availability, the economic context, land-use and public-perception issues, transmission availability, institutional structures, and financing.
- Understanding the contextual factors within which policy will be set is essential to defining the most appropriate policy features.
- The complex and changing interactions between contextual factors, and between these factors and policy measures, necessitates flexibility and creativity in policy design.

Future efforts

The results of the analyses presented here contribute to the understanding of the impact of policy on renewable energy development in the United States. In addition, they demonstrate that many factors other than policy can affect development. Future efforts for this analysis include augmenting the methodologies employed in this report and formulating more robust methods.

Aside from method development, future efforts will focus on obtaining a more comprehensive dataset. In particular, developing a dataset that spans multiple years will assist in strengthening the time-lag analysis. This would include a more thorough record of when the policies being considered are implemented, changed, or discontinued, as well as an enhanced historical record of renewable energy generation and development data. This will contribute to a more valid analysis of the time lag between policy implementation and the resulting renewable energy development, as well as a better understanding of the impact of policy on development.

Future efforts regarding best practice policy designs include continuing research to broaden the understandings of best practices, as well as integrating time-lag analysis with this methodology. Discovering when certain states began following the best practice guidelines for any given policy should contribute greatly to the understanding of policy design and its impact on renewable energy development.

Future efforts include enhancing the methodologies used in this report, but also using new methodologies. *State of the States 2009* attempted to normalize the renewable energy development data for state population and wealth using per capita and per GSP statistics. However, it is clear that other contextual factors also greatly influence the development of renewable energy in the states (see Chapter 6 on contextual factors). Consequently, future efforts also include a more thorough approach that quantifies and includes as many contextual factors and explanatory variables as possible. This will allow a clearer picture to emerge of how policy affects renewable energy development.

Although time-lag analysis is included in this report to the extent possible, it is hypothesized that additional time is needed before strong conclusions can be made concerning the influence of policy on renewable energy development. The renewable energy policy field is still quite infantile in many respects. Many states have only implemented policy and begun generating electricity from renewable sources in recent years, which leaves connections between policy and development vague or uncertain. Consequently, future versions of this report will be improved not only by expanded and additional methodologies, but also by increased time; this will allow the effects of state policy portfolios to be seen. As the renewable energy field continues to develop, connections between policy and the ensuing development will become more evident.

Resource List

FUNDING SOURCES

Grants.gov lists funding opportunities from all federal agencies at a single online portal.
www.Grants.gov

The **EERE Financial Opportunities** home page is the main portal for information related to EERE financial assistance available, how to apply, and the funding and awards process.
http://www1.eere.energy.gov/financing/

The **Industrial Technologies Program Save Energy Now States** initiative provides funding to state energy offices, state economic development entities, regional energy efficiency groups, utilities, academic institutions, and not-for-profits in to reach more industrial customers and increase energy efficiency through the delivery of tools and resources.
http://www1.eere.energy.gov/industry/financial/solicitations_active.html

The following programs provide DOE funding to states, local governments, and Indian tribes based on yearly allocations by Congress. They are managed through the EERE **Weatherization and Intergovernmental Program (WIP).**

The **State Energy Program** dispenses annual grants to states for their energy efficiency and renewable energy programs, and competitive grants for innovative state and regional initiatives.
www.eere.energy.gov/state_energy_program

The **Weatherization Assistance Program** provides funding and guidance to states to administer their weatherization programs for low-income families. States and local weatherization service providers can find all of the information needed to administer the program from the Weatherization Assistance Program Technical Assistance Center.
www.waptac.org

The **Tribal Energy Program** offers financial and technical assistance to Indian tribes through government-to-government partnerships for energy and economic development projects.
www.eere.energy.gov/tribalenergy

The **Renewable Energy Production Incentive** administers incentives for public utilities and electrical cooperatives to generate electricity from renewable energy.
www.eere.energy.gov/repi

CROSSCUTTING RESOURCES

The **Technical Assistance Project (TAP)** for state and local officials provides quick, short-term access to experts at DOE national laboratories for technical assistance with their renewable energy and energy efficiency policies and programs. TAP provides assistance with crosscutting issues that are not addressed by individual EERE technology programs.
www.eere.energy.gov/wip/tap.cfm

The **Renewable Energy Data Book** includes information about renewable energy capacity, generation, investment, and other useful information.
http://www1.eere.energy.gov/maps_data/pdfs/eere_databook.pdf

The **State Clean Energy Policies Analysis (SCEPA)** project is evaluating the environmental, economic, and energy security impacts of a broad range of state policies to help policymakers select and design policies to best achieve state priorities.
www.nrel.gov/applying_technologies/scepa.html

The **State Renewable Energy Market Development** project facilitates discussions between the Clean Energy States Alliance (CESA) and administrators of state renewable portfolio standards and with states that are considering establishing renewable standards.
www.cleanenergystates.org/jointprojects.html

The **Clean Energy and Air Quality Integration** project helps states build on their experience by including clean energy projects that support air quality programs.
www.eere.energy.gov/wip/air_quality.cfm

The EERE Weatherization and Intergovernmental Program (WIP) publishes an online list of **energy models, databases, and documents** that are ready for immediate use by state- and local-level energy analysts, officials, and decision makers.
www.eere.energy.gov/wip/resources.cfm

NREL's **Renewable Energy Data and Analysis Tools** include datasets for national wind resources, tools to assist in renewable energy project planning, and various tools to determine the potential for generating electricity using photovoltaics at a specific site or home.
http://www.nrel.gov/gis/data_analysis.html

NREL's **Renewable Energy Resource Maps** provide information on renewable resources across the United States.
http://www.nrel.gov/gis/maps.html

The **EERE State Information Summaries** contain hundreds of Web pages with state-specific information such as an overview of energy consumption, listing of energy efficiency goals under the Energy Policy Act (EPAct) of 2005, a summary of the status of

renewable energy and energy efficiency policies, and a list of political leaders and state agency administrators who shape energy policy in some states
http://apps1.eere.energy.gov/states/state_information.cfm

ICLEI-Local Governments for Sustainability is an international association of local governments and other organizations committed to sustainable development. They provide training, consulting, information, and campaigns to build capacity and support governments in working toward local sustainable development.
http://www.icleiusa.org/

Information on **state-by-state electricity costs** is available on the Energy Information Administration (EIA) Web site.
http://www.eia.doe.gov/fuelelectric.html

The Energy Information Administration also maintains information on **state coal production**.
http://www.eia.doe.gov/cneaf/coal/statepro/imagemap/usaimagemap.htm

The American Wind Energy Association (AWEA) has information available on the **top 20 wind-producing states, current installations, and fact sheets** with general information about wind energy production and reliability.
http://www.awea.org/pubs/factsheets.html

The **American Planning Association** is a resource for information on planning and zoning issues related to renewable energy development.
http://www.planning.org/

Western Renewable Energy Zones Initiative is an effort by the Western Governors' Association and the U.S. Department of Energy to identify renewable resources in the West.
http://www.westgov.org/wga/initiatives/wrez/

The EPA has published a **State and Local Guide to Action** that outlines a strategy for developing energy efficiency and renewable energy through planning and policy implementation and provides lessons learned for 16 commonly used policies.
http://www.epa.gov/cleanenergy/energy-programs/state-and-local/state-best-practices.html

CASE STUDIES

Lawrence Berkeley National Laboratory has an extensive list of downloadable case studies on renewable energy project and policy implementation.
http://eetd.lbl.gov/ea/emp/cases/

The **U.S. Department of Energy** also provides case studies and examples of energy efficiency and renewable energy projects.
http://www1.eere.energy.gov/femp/renewable_energy/renewable_casestudies.html; http://www1.eere.energy.gov/tribalenergy/guide/case_studies.html

BUILDING TECHNOLOGIES

The **EERE Building Technologies Program** sets efficiency standards for equipment and appliances and works cooperatively with states and local jurisdictions to improve building energy codes. The program supports initiatives to improve the energy performance of schools, hospitals, homes, and commercial buildings, and it publishes an online publications database and software directory.
www.eere.energy.gov/buildings

Energy efficiency design guidelines provide builders with a series of best practices for building new homes that are durable, comfortable, and energy efficient in every climate found in North America.
www.eere.energy.gov/buildings/building_america/

DOE has initiated **The Builders Challenge** to the homebuilding industry – to build 220,000 high-performance homes by 2012. Homes that qualify must meet a 70 or better on the EnergySmart Home Scale (E-Scale). The E-Scale is a scale that allows homebuyers to understand – at a glance – how the performance of a particular home compares to that of others.
http://www1.eere.energy.gov/buildings/challenge/index.html

The **Building Technologies Application Centers** provide technical, best practice, marketing, and other information to states to accelerate the widespread market adoption and implementation of advanced energy-efficient building technologies and practices.
http://www.energycodes.gov/implement/btac.stm

Northwest Building Efficiency Center provides information on energy efficiency technologies to builders, code officials, public building managers and other building professionals.
http://www.nwbuildings.org/

ELECTRIC POWER

The mission of the DOE **Office of Electricity Delivery and Energy Reliability** is to lead national efforts to modernize the electric grid; enhance security and reliability of the energy infrastructure; and facilitate recovery from disruptions to energy supply.
http://www.oe.energy.gov/index.htm

The **Green Power Network** publishes tables and maps showing green power programs by state and publishes news about progress in the green power industry.
www.eere.energy.gov/greenpower

The **National Action Plan for Energy Efficiency** is a public-private initiative involving more than 120 organizations that are making an aggressive commitment to energy efficiency. EERE supports this effort by publishing guidelines that state and local governments, regulators, and utilities can use to plan their energy efficiency programs.
www.eere.energy.gov/office_eere/napee.html

The **utility technical assistance** project schedules seminars with utility regulators covering topics such as performance-based regulation, demand-side management, and green pricing through the Regulatory Assistance Project.
www.raponline.org

INDUSTRIAL TECHNOLOGIES

The **Industrial Technologies Program (ITP) State Activities Web site** provides users with a summary of all ITP-related activities by state. In addition, this Web site provides a summary of the industrial profile and energy-use trends within each state. Moreover, the site has a listing of key state contacts that can provide assistance to industrial manufactures to help improve their energy efficiency.
http://www1.eere.energy.gov/industry/about/state_activities/main_map.asp

The EERE Industrial Technologies Program provides the **States Incentives and Resources Database.** This database is a repository of energy incentives, tools, and resources for commercial and industrial managers. Incentives and resources are available at the national, state, county, and local levels. Utilities, private companies, and nonprofits also offer incentives for energy efficiency measures including rebates, waived fees, tax credits, and loans. Resources include analysis tools, education, training programs, and energy audits. This database is designed to help people making energy efficiency upgrades to their facilities.
http://www1.eere.energy.gov/industry/about/state_activities/incentive_search.asp

Save Energy Now provides U.S. industrial companies with energy assessments free of charge. Save Energy Now is a national initiative to reduce the energy intensity of American industry by 25% in 10 years. Through Save Energy Now, DOE energy experts identify opportunities for savings in energy-intensive processes such as manufacturing.
www.eere.energy.gov/industry/saveenergynow

The **Industrial Assessment Centers** (IACs), sponsored by EERE's Industrial Technologies Program, provide eligible small- and medium-sized manufacturers with no-cost energy assessments.
http://www1.eere.energy.gov/industry/bestpractices/iacs.html

COMBINED HEAT AND POWER TECHNOLOGIES

The following combined heat and power (CHP) regional centers were created by DOE to assist states in the adoption of combined cooling, heating, and power technologies.

Intermountain CHP Center – for the states of Arizona, Colorado, New Mexico, Utah, and Wyoming.
www.intermountainchp.org/

Mid-Atlantic CHP Application Center – for the District of Columbia and the states of Delaware, Maryland, New Jersey, Pennsylvania, Virginia, and West Virginia.
www.chpcentermw.org/home.html

Gulf Coast CHP Application Center – for the states of Texas, Louisiana, and Oklahoma.
www.gulfcoastchp.org

Northeast CHP Application Center – for the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.
www.northeastchp.org/nac/index.htm

Northwest CHP Application Center – for the states of Alaska, Oregon, Washington, Idaho, and Montana.
www.chpcenternw.org/

Pacific Region CHP Application Center – for the states of California, Hawaii, and Nevada.
www.chpcenterpr.org/

Southeast CHP Application Center – for the states of Kentucky, Arkansas, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, and Georgia.
www.chpcenterse.org/home.html

VEHICLE TECHNOLOGIES

The **EERE Vehicle Technologies Program** helps states meet requirements for alternative fuels under the Energy Policy Act of 1992. It also provides a comprehensive clearinghouse of data, publications, tools, and information related to advanced transportation technologies through the Alternative Fuels and Advanced Vehicles Data Center.
www.eere.energy.gov/afdc

Clean Cities Tiger Teams provide local solutions to reducing petroleum consumption in the transportation sector. Clean Cities is a nationwide network of more than 85 coalitions that are partly supported by DOE. Sometimes coalitions encounter problems that slow progress in their regions, or vehicle fleet owners who want to implement alternative fuels projects experience technical problems. When solutions cannot be found locally, experts from Clean Cities Tiger Teams can help. Their assistance can be used to evaluate the feasibility of complex projects, fueling station design and fire safety, and operation and maintenance of alternative fuel vehicles.
www.eere.energy.gov/cleancities/technical_assistance.html

SOLAR TECHNOLOGIES

The **Solar America Showcases** project provides hands-on technical assistance to enable states and local agencies to implement their large, high-impact solar installations. www.eere.energy.gov/solar/solar_america/solar_america_showcases.html

WIND TECHNOLOGIES

Wind Powering America coordinates with wind energy stakeholders in key states to overcome market barriers to wind development. Wind Powering America also publishes online wind data and lists activities by state.
www.eere.energy.gov/windandhydro/windpoweringamerica/

HYDROGEN AND FUEL CELLS TECHNOLOGIES

The **Hydrogen and Fuel Cells Program** provides regular educational programs about hydrogen that involve stakeholders in the states.
www.eere.energy.gov/hydrogenandfuelcells/education

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Appendix

List of Tables

Total Renewable Resources

Table 7.1. Total Renewable Electricity Generation (2007)

Rank	State	MWh		Rank	State	MWh
1	Washington	82,559,749		26	Colorado	3,054,362
2	California	52,173,008		27	Wisconsin	2,845,601
3	Oregon	35,815,731		28	New Hampshire	2,388,501
4	New York	28,027,638		29	Maryland	2,255,677
5	Texas	11,932,049		30	Kentucky	2,134,210
6	Montana	9,971,057		31	Massachusetts	2,037,706
7	Idaho	9,674,539		32	North Dakota	1,939,672
8	Maine	7,945,148		33	New Mexico	1,677,211
9	Alabama	7,936,734		34	Mississippi	1,493,365
10	Arizona	6,639,310		35	Wyoming	1,484,305
11	Tennessee	5,910,128		36	Illinois	1,438,479
12	Georgia	5,651,609		37	West Virginia	1,421,985
13	Oklahoma	5,194,860		38	Alaska	1,302,453
14	Arkansas	4,860,497		39	Missouri	1,233,635
15	Pennsylvania	4,782,178		40	Kansas	1,163,039
16	North Carolina	4,656,378		41	Vermont	1,110,154
17	Minnesota	4,586,460		42	Connecticut	1,093,101
18	Florida	4,457,263		43	New Jersey	864,487
19	Iowa	3,870,122		44	Hawaii	845,690
20	Virginia	3,813,835		45	Ohio	845,579
21	Louisiana	3,806,525		46	Utah	733,737
22	Michigan	3,686,736		47	Indiana	681,183
23	South Carolina	3,551,946		48	Nebraska	625,468
24	Nevada	3,299,849		49	Rhode Island	159,121
25	South Dakota	3,067,301		50	Delaware	48,116

Source: EIA 2009

Table 7.2. Renewable Electricity Generation as a Percentage of Total State Electricity Generation (2007)					
Rank	State	% of Total	Rank	State	% of Total
1	Idaho	84.2%	26	Wisconsin	4.5%
2	Washington	77.2%	27	Massachusetts	4.3%
3	Oregon	65.0%	28	Louisiana	4.1%
4	South Dakota	50.0%	29	Georgia	3.9%
5	Maine	49.3%	30	North Carolina	3.6%
6	Montana	34.5%	31	South Carolina	3.4%
7	California	24.7%	32	Connecticut	3.3%
8	New York	19.2%	33	Wyoming	3.3%
9	Alaska	19.1%	34	Michigan	3.1%
10	Vermont	19.1%	35	Mississippi	3.0%
11	New Hampshire	10.3%	36	Texas	2.9%
12	Nevada	10.1%	37	Kansas	2.3%
13	Arkansas	8.9%	38	Rhode Island	2.3%
14	Minnesota	8.4%	39	Kentucky	2.2%
15	Iowa	7.8%	40	Pennsylvania	2.1%
16	Hawaii	7.3%	41	Florida	2.0%
17	Oklahoma	7.1%	42	Nebraska	1.9%
18	Tennessee	6.2%	43	Utah	1.6%
19	North Dakota	6.2%	44	West Virginia	1.5%
20	Arizona	5.9%	45	New Jersey	1.4%
21	Colorado	5.7%	46	Missouri	1.4%
22	Alabama	5.5%	47	Illinois	0.7%
23	Virginia	4.9%	48	Delaware	0.6%
24	New Mexico	4.7%	49	Ohio	0.5%
25	Maryland	4.5%	50	Indiana	0.5%

Table 7.3. Renewable Electricity Generation per Capita (2007)					
Rank	State	MWh/Capita	Rank	State	MWh/Capita
1	Washington	12.8	26	Hawaii	0.7
2	Montana	10.4	27	Colorado	0.6
3	Oregon	9.6	28	Georgia	0.6
4	Idaho	6.5	29	North Carolina	0.5
5	Maine	6.0	30	Mississippi	0.5
6	South Dakota	3.9	31	Wisconsin	0.5
7	North Dakota	3.0	32	Kentucky	0.5
8	Wyoming	2.8	33	Texas	0.5
9	Alaska	1.9	34	Virginia	0.5
10	New Hampshire	1.8	35	Kansas	0.4
11	Vermont	1.8	36	Maryland	0.4
12	Arkansas	1.7	37	Pennsylvania	0.4
13	Alabama	1.7	38	Michigan	0.4
14	New York	1.4	39	Nebraska	0.4
15	Oklahoma	1.4	40	Massachusetts	0.3
16	California	1.4	41	Connecticut	0.3
17	Iowa	1.3	42	Utah	0.3
18	Nevada	1.3	43	Florida	0.2
19	Arizona	1.0	44	Missouri	0.2
20	Tennessee	1.0	45	Rhode Island	0.2
21	Minnesota	0.9	46	Illinois	0.1
22	Louisiana	0.9	47	Indiana	0.1
23	New Mexico	0.9	48	New Jersey	0.1
24	South Carolina	0.8	49	Ohio	0.1
25	West Virginia	0.8	50	Delaware	0.1

Table 7.4. Renewable Electricity Generation per Gross State Product (2007)					
Rank	State	MWh/$M	Rank	State	MWh/$M
1	Montana	291.1	26	Mississippi	16.9
2	Washington	265.2	27	Georgia	14.3
3	Oregon	226.4	28	Kentucky	13.8
4	Idaho	189.1	29	Hawaii	13.7
5	Maine	165.2	30	Colorado	12.9
6	South Dakota	90.4	31	Wisconsin	12.3
7	North Dakota	70.0	32	North Carolina	11.7
8	Arkansas	51.0	33	Texas	10.5
9	Alabama	47.9	34	Virginia	10.0
10	Wyoming	47.1	35	Kansas	9.9
11	Vermont	45.2	36	Michigan	9.7
12	New Hampshire	41.7	37	Pennsylvania	9.0
13	Oklahoma	37.3	38	Maryland	8.4
14	Iowa	30.0	39	Nebraska	7.8
15	Alaska	29.3	40	Utah	6.9
16	California	28.8	41	Florida	6.1
17	Arizona	26.9	42	Massachusetts	5.8
18	Nevada	25.9	43	Missouri	5.4
19	New York	25.4	44	Connecticut	5.1
20	West Virginia	24.6	45	Rhode Island	3.4
21	Tennessee	24.2	46	Indiana	2.8
22	South Carolina	23.2	47	Illinois	2.4
23	New Mexico	22.0	48	New Jersey	1.9
24	Minnesota	18.0	49	Ohio	1.8
25	Louisiana	17.6	50	Delaware	0.8

Total Renewable Resources Growth, 2001-2007

Table 7.5. Growth in Total Renewable Electricity Generation, 2001-2007*

Rank	State	% Change		Rank	State	% Change
1	Kansas	1678.5%		26	New York	12.6%
2	New Mexico	555.2%		27	Missouri	10.9%
3	Texas	252.9%		28	Louisiana	10.8%
4	Iowa	169.4%		29	California	10.6%
5	Oklahoma	101.7%		30	Utah	10.1%
6	Colorado	90.0%		31	North Carolina	7.1%
7	Illinois	74.9%		32	Mississippi	4.3%
8	South Carolina	67.6%		33	Massachusetts	1.1%
9	Minnesota	63.3%		34	Georgia	0.9%
10	Montana	49.3%		35	New Jersey	0.3%
11	Rhode Island	49.1%		36	Indiana	-0.6%
12	Washington	47.6%		37	Alaska	-3.3%
13	West Virginia	47.0%		38	Michigan	-6.0%
14	Maryland	44.9%		39	Connecticut	-8.6%
15	North Dakota	44.8%		40	Wisconsin	-9.9%
16	Hawaii	41.6%		41	Ohio	-10.2%
17	Virginia	38.1%		42	South Dakota	-10.7%
18	Pennsylvania	34.9%		43	Nevada	-11.1%
19	Idaho	24.7%		44	Vermont	-12.4%
20	Maine	22.8%		45	Arizona	-13.4%
21	Oregon	21.5%		46	Tennessee	-23.9%
22	Arkansas	19.7%		47	Alabama	-36.7%
23	Wyoming	19.3%		48	Kentucky	-44.8%
24	New Hampshire	18.5%		49	Nebraska	-45.3%
25	Florida	13.2%				

*Delaware is not included because they did not produce renewable energy as tracked by the EIA in 2001; therefore, 2001-2007 growth numbers cannot be calculated. However, Delaware produced 48,116 MWh from RE in 2007.

Table 7.6. Growth in Renewable Electricity Generation as a Percent of Total State Generation,2001-2007*

Rank	State	% Change	Rank	State	% Change
1	Kansas	1,487.9%	26	Arkansas	3.5%
2	New Mexico	512.0%	27	Idaho	1.5%
3	Texas	224.2%	28	Oregon	-0.6%
4	Iowa	120.0%	29	Missouri	-3.3%
5	Colorado	65.2%	30	North Carolina	-3.3%
6	Rhode Island	58.6%	31	Florida	-4.1%
7	Illinois	56.5%	32	Alaska	-4.4%
8	Oklahoma	53.0%	33	New Jersey	-4.9%
9	Maine	48.9%	34	Indiana	-6.7%
10	Minnesota	45.4%	35	Nevada	-7.9%
11	South Carolina	44.5%	36	Michigan	-11.9%
12	Maryland	41.6%	37	Utah	-13.0%
13	North Dakota	40.6%	38	Connecticut	-15.9%
14	Virginia	30.6%	39	Wisconsin	-16.5%
15	Hawaii	30.6%	40	Massachusetts	-17.4%
16	West Virginia	28.1%	41	Vermont	-17.5%
17	Montana	25.0%	42	Ohio	-17.7%
18	Pennsylvania	17.3%	43	Georgia	-17.7%
19	Wyoming	17.1%	44	Tennessee	-23.0%
20	Washington	14.5%	45	New Hampshire	-23.3%
21	Mississippi	11.4%	46	Arizona	-31.3%
22	New York	11.1%	47	Alabama	-44.9%
23	South Dakota	7.8%	48	Kentucky	-45.8%
24	Louisiana	5.2%	49	Nebraska	-48.6%
25	California	4.2%			

Source: EIA 2009

*Delaware is not included because they did not produce renewable energy as tracked by the EIA in 2001; therefore, 2001-2007 growth numbers cannot be calculated. However, Delaware produced 48,116 MWh from RE in 2007.

Table 7.7. Growth in Renewable Electricity Generation per Capita, 2001-2007*						
Rank	**State**	**% Change**		**Rank**	**State**	**% Change**
1	Kansas	1,629.6%		26	Idaho	10.1%
2	New Mexico	510.1%		27	Missouri	6.4%
3	Texas	215.8%		28	California	5.0%
4	Iowa	164.5%		29	Mississippi	1.9%
5	Oklahoma	93.7%		30	Florida	1.7%
6	Colorado	74.0%		31	Massachusetts	0.2%
7	Illinois	70.7%		32	New Jersey	-1.5%
8	Minnesota	57.0%		33	North Carolina	-2.8%
9	South Carolina	54.6%		34	Indiana	-3.9%
10	Rhode Island	49.8%		35	Utah	-5.5%
11	West Virginia	46.1%		36	Michigan	-6.4%
12	North Dakota	44.4%		37	Alaska	-10.1%
13	Montana	41.4%		38	Connecticut	-10.1%
14	Maryland	38.6%		39	Georgia	-10.7%
15	Washington	37.0%		40	Ohio	-10.9%
16	Hawaii	35.1%		41	Wisconsin	-13.0%
17	Pennsylvania	33.4%		42	Vermont	-13.6%
18	Virginia	29.0%		43	South Dakota	-14.8%
19	Maine	19.9%		44	Nevada	-27.1%
20	Arkansas	13.8%		45	Arizona	-27.7%
21	New Hampshire	13.5%		46	Tennessee	-28.8%
22	Louisiana	13.0%		47	Alabama	-39.0%
23	Oregon	12.9%		48	Nebraska	-46.9%
24	Wyoming	12.4%		49	Kentucky	-47.0%
25	New York	10.6%				
Source: EIA 2009						

*Delaware is not included because they did not produce renewable energy as tracked by the EIA in 2001; therefore, 2001-2007 growth numbers cannot be calculated. However, Delaware produced 48,116 MWh from RE in 2007.

Table 7.8. Growth in Renewable Electricity Generation per GSP, 2001-2007*						
Rank	**State**	**% Change**		**Rank**	**State**	**% Change**
1	Kansas	1,210.4%		26	Michigan	-17.7%
2	New Mexico	341.8%		27	Massachusetts	-19.3%
3	Texas	135.5%		28	California	-20.6%
4	Iowa	91.9%		29	Indiana	-21.3%
5	Colorado	43.2%		30	New Jersey	-21.8%
6	Illinois	36.7%		31	Mississippi	-22.3%
7	Oklahoma	36.6%		32	Florida	-23.3%
8	South Carolina	28.6%		33	North Carolina	-23.4%
9	Minnesota	21.8%		34	Georgia	-23.8%
10	Rhode Island	11.7%		35	Utah	-27.0%
11	West Virginia	10.4%		36	Ohio	-27.8%
12	Washington	7.0%		37	Wyoming	-28.3%
13	Maryland	3.9%		38	Wisconsin	-29.4%
14	Pennsylvania	3.3%		39	Connecticut	-30.2%
15	Virginia	-0.2%		40	Louisiana	-31.5%
16	Montana	-2.1%		41	Vermont	-32.8%
17	North Dakota	-3.3%		42	South Dakota	-37.0%
18	Hawaii	-3.7%		43	Arizona	-42.0%
19	Maine	-5.2%		44	Alaska	-42.2%
20	New Hampshire	-8.5%		45	Tennessee	-43.7%
21	Missouri	-11.9%		46	Nevada	-46.0%
22	Idaho	-13.1%		47	Alabama	-54.7%
23	Arkansas	-13.5%		48	Kentucky	-58.8%
24	Oregon	-14.9%		49	Nebraska	-60.8%
25	New York	-17.4%				
Source: EIA 2009						

*Delaware is not included because they did not produce renewable energy as tracked by the EIA in 2001,;therefore, 2001-2007 growth numbers cannot be calculated. However, Delaware produced 48,116 MWh from RE in 2007.

Total Renewable Resources Growth, 2006-2007

Table 7.9. Growth in Total Renewable Electricity Generation, 2006-2007					
Rank	State	% Change	Rank	State	% Change
1	Delaware	11,438.6%	26	Indiana	-4.0%
2	Missouri	452.7%	27	South Carolina	-4.5%
3	Oklahoma	97.3%	28	Georgia	-5.6%
4	Arkansas	48.5%	29	New York	-6.4%
5	Illinois	40.7%	30	Montana	-6.5%
6	Texas	40.7%	31	Michigan	-7.0%
7	Minnesota	26.3%	32	Wyoming	-7.4%
8	Kansas	16.1%	33	New Jersey	-9.2%
9	Iowa	15.0%	34	Oregon	-9.7%
10	Hawaii	14.6%	35	Pennsylvania	-10.1%
11	New Mexico	13.7%	36	South Dakota	-13.5%
12	Colorado	13.7%	37	Connecticut	-16.4%
13	Alaska	5.8%	38	Maryland	-17.4%
14	New Hampshire	5.0%	39	North Carolina	-17.8%
15	Louisiana	3.6%	40	West Virginia	-18.6%
16	Rhode Island	2.8%	41	Idaho	-18.9%
17	North Dakota	2.4%	42	Ohio	-22.5%
18	Virginia	0.1%	43	Utah	-23.0%
19	Florida	-1.7%	44	Massachusetts	-27.0%
20	Washington	-2.3%	45	California	-27.5%
21	Nevada	-3.0%	46	Alabama	-28.7%
22	Arizona	-3.0%	47	Kentucky	-30.0%
23	Mississippi	-3.1%	48	Tennessee	-31.0%
24	Wisconsin	-3.4%	49	Vermont	-43.6%
25	Maine	-3.7%	50	Nebraska	-48.2%

Table 7.10. Growth in Renewable Electricity Generation as a Percentage of Total State Electricity, 2006-2007						
Rank	State	% Change		Rank	State	% Change
1	Delaware	9,610.7%		26	Wyoming	-7.8%
2	Missouri	456.0%		27	South Carolina	-8.3%
3	Oklahoma	91.3%		28	Montana	-8.7%
4	Arkansas	41.9%		29	New York	-8.7%
5	Texas	39.0%		30	Georgia	-10.3%
6	Illinois	35.2%		31	Mississippi	-10.5%
7	Minnesota	23.5%		32	Arizona	-10.7%
8	New Mexico	17.7%		33	New Jersey	-12.1%
9	Hawaii	14.9%		34	Michigan	-12.2%
10	Colorado	6.9%		35	Connecticut	-12.6%
11	Kansas	5.5%		36	Oregon	-12.6%
12	Iowa	5.1%		37	Pennsylvania	-13.0%
13	Alaska	3.5%		38	Rhode Island	-13.0%
14	Louisiana	1.7%		39	West Virginia	-18.7%
15	North Dakota	1.3%		40	Maryland	-19.4%
16	South Dakota	0.5%		41	North Carolina	-20.9%
17	Maine	0.5%		42	Ohio	-22.3%
18	New Hampshire	-0.5%		43	California	-25.5%
19	Washington	-1.2%		44	Kentucky	-28.9%
20	Florida	-2.4%		45	Massachusetts	-29.3%
21	Indiana	-4.1%		46	Utah	-29.9%
22	Nevada	-5.4%		47	Alabama	-30.2%
23	Idaho	-5.5%		48	Vermont	-31.4%
24	Wisconsin	-6.0%		49	Tennessee	-31.8%
25	Virginia	-6.7%		50	Nebraska	-49.4%

Table 7.11. Growth in Renewable Electricity Generation per Capita, 2006-2007						
Rank	State	% Change		Rank	State	% Change
1	Delaware	11,315.4%		26	Arizona	-5.9%
2	Missouri	448.9%		27	South Carolina	-6.1%
3	Oklahoma	95.6%		28	Michigan	-6.5%
4	Arkansas	47.4%		29	New York	-7.1%
5	Illinois	40.2%		30	Georgia	-7.4%
6	Texas	38.1%		31	Montana	-7.4%
7	Minnesota	25.7%		32	New Jersey	-9.1%
8	Kansas	15.2%		33	Wyoming	-9.2%
9	Hawaii	14.8%		34	Pennsylvania	-10.2%
10	Iowa	14.6%		35	Oregon	-10.8%
11	New Mexico	12.4%		36	South Dakota	-14.3%
12	Colorado	11.9%		37	Connecticut	-16.2%
13	Alaska	5.2%		38	Maryland	-17.6%
14	New Hampshire	4.9%		39	West Virginia	-18.6%
15	Rhode Island	3.6%		40	North Carolina	-19.4%
16	North Dakota	2.3%		41	Idaho	-20.7%
17	Louisiana	0.5%		42	Ohio	-22.6%
18	Virginia	-0.7%		43	Utah	-25.5%
19	Florida	-2.5%		44	Massachusetts	-27.4%
20	Washington	-3.4%		45	California	-27.8%
21	Maine	-3.7%		46	Alabama	-29.3%
22	Wisconsin	-3.8%		47	Kentucky	-30.6%
23	Mississippi	-3.8%		48	Tennessee	-31.8%
24	Indiana	-4.5%		49	Vermont	-43.6%
25	Nevada	-5.3%		50	Nebraska	-48.3%

Table 7.12. Growth in Renewable Electricity Generation per GSP, 2006-2007					
Rank	**State**	**% Change**	**Rank**	**State**	**% Change**
1	Delaware	11,485.3%	26	Washington	-7.9%
2	Missouri	444.1%	27	Arizona	-8.7%
3	Oklahoma	90.7%	28	Georgia	-9.7%
4	Arkansas	43.0%	29	Nevada	-9.7%
5	Illinois	36.1%	30	New Jersey	-11.6%
6	Texas	31.3%	31	Montana	-11.7%
7	Minnesota	21.2%	32	Wyoming	-13.1%
8	New Mexico	13.3%	33	New York	-13.3%
9	Colorado	10.8%	34	Pennsylvania	-13.6%
10	Kansas	10.6%	35	Oregon	-13.7%
11	Iowa	10.5%	36	South Dakota	-17.6%
12	Hawaii	8.6%	37	Maryland	-20.7%
13	New Hampshire	3.0%	38	Idaho	-20.9%
14	Rhode Island	0.1%	39	Connecticut	-21.1%
15	Alaska	-2.3%	40	West Virginia	-21.5%
16	North Dakota	-2.5%	41	North Carolina	-23.0%
17	Indiana	-3.1%	42	Ohio	-23.3%
18	Virginia	-3.5%	43	Utah	-28.7%
19	Florida	-4.5%	44	Massachusetts	-29.9%
20	Wisconsin	-5.5%	45	California	-30.9%
21	Maine	-5.9%	46	Alabama	-31.0%
22	South Carolina	-6.7%	47	Tennessee	-32.6%
23	Michigan	-7.2%	48	Kentucky	-33.8%
24	Louisiana	-7.5%	49	Vermont	-44.4%
25	Mississippi	-7.8%	50	Nebraska	-51.0%

Non-Hydroelectric Renewable Resources

Table 7.13. Non-Hydroelectric Renewable Electricity Generation (2007)

Rank	State	MWh	Rank	State	MWh
1	California	24,845,257	26	Massachusetts	1,240,224
2	Texas	10,287,612	27	Kansas	1,152,538
3	Florida	4,302,817	28	New Hampshire	1,123,272
4	Maine	4,206,980	29	Tennessee	970,527
5	Minnesota	3,932,638	30	New Jersey	843,578
6	Alabama	3,800,620	31	Wyoming	754,881
7	Washington	3,730,554	32	Hawaii	753,347
8	Georgia	3,415,421	33	Connecticut	729,840
9	Louisiana	2,979,883	34	Idaho	652,849
10	Iowa	2,907,776	35	North Dakota	634,279
11	New York	2,775,083	36	Montana	606,721
12	Virginia	2,565,571	37	Maryland	603,461
13	Pennsylvania	2,546,196	38	Kentucky	465,623
14	Michigan	2,416,747	39	Vermont	463,549
15	Oregon	2,228,292	40	Ohio	435,143
16	Oklahoma	2,128,998	41	Nebraska	278,024
17	South Carolina	1,996,034	42	Indiana	231,247
18	North Carolina	1,672,219	43	Utah	194,955
19	Arkansas	1,623,744	44	West Virginia	167,588
20	Mississippi	1,493,365	45	Rhode Island	154,757
21	New Mexico	1,409,233	46	South Dakota	150,018
22	Wisconsin	1,329,518	47	Delaware	48,116
23	Colorado	1,324,829	48	Arizona	41,639
24	Nevada	1,296,658	49	Missouri	29,309
25	Illinois	1,284,752	50	Alaska	11,230

Table 7.14. Non-Hydroelectric Renewable Electricity Generation as a Percentage of Total State Electricity Generation (2007)					
Rank	State	% of Total	Rank	State	% of Total
1	Maine	26.1%	26	Rhode Island	2.2%
2	California	11.8%	27	Wisconsin	2.1%
3	Vermont	8.0%	28	Montana	2.1%
4	Minnesota	7.2%	29	North Dakota	2.0%
5	Hawaii	6.5%	30	Michigan	2.0%
6	Iowa	5.8%	31	South Carolina	1.9%
7	Idaho	5.7%	32	Florida	1.9%
8	New Hampshire	4.8%	33	New York	1.9%
9	Oregon	4.1%	34	Wyoming	1.7%
10	Nevada	4.0%	35	New Jersey	1.4%
11	New Mexico	3.9%	36	North Carolina	1.3%
12	Washington	3.5%	37	Maryland	1.2%
13	Virginia	3.3%	38	Pennsylvania	1.1%
14	Louisiana	3.2%	39	Tennessee	1.0%
15	Mississippi	3.0%	40	Nebraska	0.9%
16	Arkansas	3.0%	41	Illinois	0.6%
17	Oklahoma	2.9%	42	Delaware	0.6%
18	Alabama	2.6%	43	Kentucky	0.5%
19	Massachusetts	2.6%	44	Utah	0.4%
20	Texas	2.5%	45	Ohio	0.3%
21	Colorado	2.5%	46	West Virginia	0.2%
22	South Dakota	2.4%	47	Indiana	0.2%
23	Georgia	2.4%	48	Alaska	0.2%
24	Kansas	2.3%	49	Arizona	0.0%
25	Connecticut	2.20%	50	Missouri	0.0%

Table 7.15. Non-Hydroelectric Renewable Electricity Generation per Capita (2007)					
Rank	State	MWh/Capita	Rank	State	MWh/Capita
1	Maine	3.2	26	Colorado	0.3
2	Wyoming	1.4	27	Michigan	0.2
3	North Dakota	1.0	28	Wisconsin	0.2
4	Iowa	1.0	29	Florida	0.2
5	New Hampshire	0.9	30	Connecticut	0.2
6	Alabama	0.8	31	Pennsylvania	0.2
7	Minnesota	0.8	32	Massachusetts	0.2
8	Vermont	0.7	33	South Dakota	0.2
9	New Mexico	0.7	34	North Carolina	0.2
10	California	0.7	35	Tennessee	0.2
11	Louisiana	0.7	36	Nebraska	0.2
12	Montana	0.6	37	Rhode Island	0.1
13	Oregon	0.6	38	New York	0.1
14	Oklahoma	0.6	39	Kentucky	0.1
15	Hawaii	0.6	40	Maryland	0.1
16	Washington	0.6	41	Illinois	0.1
17	Arkansas	0.6	42	New Jersey	0.1
18	Mississippi	0.5	43	West Virginia	0.1
19	Nevada	0.5	44	Utah	0.1
20	South Carolina	0.5	45	Delaware	0.1
21	Idaho	0.4	46	Ohio	0.0
22	Texas	0.4	47	Indiana	0.0
23	Kansas	0.4	48	Alaska	0.0
24	Georgia	0.4	49	Arizona	0.0
25	Virginia	0.3	50	Missouri	0.0

Table 7.16. Non-Hydroelectric Renewable Electricity Generation per Gross State Product (2007)					
Rank	State	MWh/$M GSP	Rank	State	MWh/$M GSP
1	Maine	87.5	26	Michigan	6.3
2	Wyoming	24.0	27	Florida	5.9
3	Alabama	22.9	28	Wisconsin	5.7
4	North Dakota	22.9	29	Colorado	5.6
5	Iowa	22.5	30	Pennsylvania	4.8
6	New Hampshire	19.6	31	South Dakota	4.4
7	Vermont	18.9	32	North Carolina	4.2
8	New Mexico	18.5	33	Tennessee	4.0
9	Montana	17.7	34	Massachusetts	3.5
10	Arkansas	17.0	35	Nebraska	3.5
11	Mississippi	16.9	36	Connecticut	3.4
12	Minnesota	15.4	37	Rhode Island	3.3
13	Oklahoma	15.3	38	Kentucky	3.0
14	Oregon	14.1	39	West Virginia	2.9
15	Louisiana	13.8	40	New York	2.5
16	California	13.7	41	Maryland	2.3
17	South Carolina	13.1	42	Illinois	2.1
18	Idaho	12.8	43	Utah	1.9
19	Hawaii	12.2	44	New Jersey	1.8
20	Washington	12.0	45	Indiana	0.9
21	Nevada	10.2	46	Ohio	0.9
22	Kansas	9.8	47	Delaware	0.8
23	Texas	9.0	48	Alaska	0.3
24	Georgia	8.6	49	Arizona	0.2
25	Virginia	6.7	50	Missouri	0.1

Non-Hydroelectric Renewable Resources Growth, 2001-2007

Table 7.17. Growth in Non-Hydroelectric Renewable Electricity Generation, 2001 – 2007*

Rank	State	% Change	Rank	State	% Change
1	South Dakota	17,123.7%	26	Virginia	46.9%
2	North Dakota	8,175.0%	27	Pennsylvania	34.3%
3	New Mexico	7,455.4%	28	Utah	23.2%
4	Kentucky	4,774.6%	29	Idaho	22.4%
5	Kansas	2,793.5%	30	Vermont	21.2%
6	Nebraska	1,341.1%	31	Wisconsin	20.6%
7	Alaska	1,082.1%	32	Tennessee	18.1%
8	Colorado	1,074.0%	33	California	14.9%
9	West Virginia	979.3%	34	Georgia	13.7%
10	Montana	827.4%	35	Florida	13.5%
11	Oklahoma	822.9%	36	Louisiana	10.2%
12	Iowa	391.5%	37	Maine	10.0%
13	Texas	371.7%	38	New Hampshire	9.5%
14	Missouri	233.2%	39	Nevada	8.1%
15	Washington	205.5%	40	Arkansas	7.4%
16	Oregon	165.4%	41	Arizona	5.6%
17	South Carolina	123.2%	42	Mississippi	4.3%
18	Wyoming	106.7%	43	Michigan	2.3%
19	Indiana	101.8%	44	Ohio	1.0%
20	Minnesota	98.9%	45	New Jersey	0.0%
21	Illinois	89.3%	46	North Carolina	-4.5%
22	Maryland	61.8%	47	Massachusetts	-5.5%
23	New York	54.1%	48	Alabama	-9.3%
24	Hawaii	51.8%	49	Connecticut	-19.7%
25	Rhode Island	49.4%			

*Delaware is not included because they did not produce renewable energy as tracked by the EIA in 2001; therefore, 2001-2007 growth numbers cannot be calculated. However, Delaware produced 48,116 MWh from RE in 2007.

Table 7.18. Growth in Non-Hydroelectric Renewable Electricity Generation as a Percent of Total State Electricity Generation, 2001 – 2007*

Rank	State	% Change		Rank	State	% Change
1	South Dakota	20,671.7%		26	Virginia	38.9%
2	North Dakota	7,938.6%		27	Maine	33.4%
3	New Mexico	6,957.0%		28	Tennessee	19.4%
4	Kentucky	4,684.0%		29	Pennsylvania	16.8%
5	Kansas	2,483.3%		30	Vermont	14.0%
6	Nebraska	1,254.1%		31	Nevada	12.1%
7	Alaska	1,068.7%		32	Wisconsin	11.8%
8	Colorado	920.9%		33	Mississippi	11.4%
9	West Virginia	840.3%		34	California	8.2%
10	Montana	676.7%		35	Louisiana	4.6%
11	Oklahoma	600.2%		36	Idaho	-0.4%
12	Texas	333.4%		37	Utah	-2.6%
13	Iowa	301.4%		38	Florida	-3.8%
14	Missouri	190.7%		39	Michigan	-4.1%
15	Washington	137.1%		40	New Jersey	-5.2%
16	Oregon	117.1%		41	Arkansas	-7.2%
17	Wyoming	102.8%		42	Georgia	-7.3%
18	South Carolina	92.5%		43	Ohio	-7.4%
19	Indiana	89.4%		44	North Carolina	-13.8%
20	Minnesota	77.2%		45	Arizona	-16.2%
21	Illinois	69.5%		46	Alabama	-20.9%
22	Rhode Island	58.9%		47	Massachusetts	-22.8%
23	Maryland	58.1%		48	Connecticut	-26.2%
24	New York	52.0%		49	New Hampshire	-29.1%
25	Hawaii	39.9%				

*Delaware is not included because they did not produce renewable energy as tracked by the EIA in 2001; therefore, 2001-2007 growth numbers cannot be calculated. However, Delaware produced 48,116 MWh from RE in 2007.

Table 7.19. Growth in Non-Hydroelectric Renewable Electricity Generation per Capita, 2001 – 2007*						
Rank	**State**	**% Change**		**Rank**	**State**	**% Change**
1	South Dakota	16,326.3%		26	Virginia	37.2%
2	North Dakota	8,155.3%		27	Pennsylvania	32.8%
3	New Mexico	6,934.7%		28	Vermont	19.5%
4	Kentucky	4,580.3%		29	Wisconsin	16.5%
5	Kansas	2,713.9%		30	Louisiana	12.4%
6	Nebraska	1,299.4%		31	Tennessee	10.5%
7	Alaska	999.1%		32	California	9.0%
8	Colorado	974.9%		33	Idaho	8.1%
9	West Virginia	972.8%		34	Maine	7.4%
10	Oklahoma	786.2%		35	Utah	5.8%
11	Montana	778.4%		36	New Hampshire	4.9%
12	Iowa	382.7%		37	Arkansas	2.1%
13	Texas	322.2%		38	Florida	2.0%
14	Missouri	219.7%		39	Michigan	1.9%
15	Washington	183.7%		40	Mississippi	1.9%
16	Oregon	146.7%		41	Georgia	0.6%
17	South Carolina	105.9%		42	Ohio	0.2%
18	Indiana	95.1%		43	New Jersey	-1.8%
19	Wyoming	94.8%		44	Massachusetts	-6.4%
20	Minnesota	91.3%		45	Nevada	-11.4%
21	Illinois	84.8%		46	Arizona	-11.9%
22	Maryland	54.8%		47	Alabama	-12.5%
23	New York	51.3%		48	North Carolina	-13.4%
24	Rhode Island	50.1%		49	Connecticut	-21.1%
25	Hawaii	44.8%				

*Delaware is not included because they did not produce renewable energy as tracked by the EIA in 2001; therefore, 2001-2007 growth numbers cannot be calculated. However, Delaware produced 48,116 MWh from RE in 2007.

Table 7.20. Growth in Non-Hydroelectric Renewable Electricity Generation per GSP, 2001 – 2007*						
Rank	**State**	**% Change**		**Rank**	**State**	**% Change**
1	South Dakota	12,035.8%		26	Hawaii	3.1%
2	North Dakota	5,429.7%		27	Pennsylvania	2.8%
3	New Mexico	4,993.8%		28	Wisconsin	-5.5%
4	Kentucky	3,539.4%		29	Vermont	-7.0%
5	Kansas	2,031.9%		30	Michigan	-10.4%
6	Nebraska	933.4%		31	Tennessee	-12.6%
7	Colorado	784.7%		32	Georgia	-14.1%
8	West Virginia	711.0%		33	Idaho	-14.7%
9	Alaska	606.6%		34	Maine	-15.1%
10	Oklahoma	524.8%		35	New Hampshire	-15.4%
11	Montana	508.4%		36	California	-17.6%
12	Iowa	250.2%		37	Utah	-18.2%
13	Texas	214.9%		38	Ohio	-18.9%
14	Missouri	164.8%		39	New Jersey	-22.0%
15	Washington	121.5%		40	Mississippi	-22.3%
16	Oregon	86.1%		41	Arkansas	-22.4%
17	South Carolina	71.3%		42	Florida	-23.1%
18	Indiana	59.9%		43	Massachusetts	-24.6%
19	Minnesota	48.4%		44	Arizona	-29.3%
20	Illinois	48.0%		45	North Carolina	-31.7%
21	Wyoming	24.2%		46	Louisiana	-31.8%
22	Maryland	16.0%		47	Nevada	-34.3%
23	New York	12.9%		48	Alabama	-35.1%
24	Rhode Island	11.9%		49	Connecticut	-38.7%
25	Virginia	6.1%				

*Delaware is not included because they did not produce renewable energy as tracked by the EIA in 2001; therefore, 2001-2007 growth numbers cannot be calculated. However, Delaware produced 48,116 MWh from RE in 2007.

Non-Hydroelectric Renewable Resources Growth, 2006-2007

Table 7.21. Growth in Non-Hydroelectric Renewable Electricity Generation, 2006-2007					
Rank	State	% Change	Rank	State	% Change
1	Delaware	11,438.6%	26	California	3.9%
2	North Dakota	70.0%	27	Vermont	3.0%
3	Illinois	51.4%	28	Pennsylvania	3.0%
4	Alaska	50.7%	29	Kentucky	1.5%
5	New Hampshire	50.5%	30	South Dakota	0.7%
6	Washington	49.1%	31	Louisiana	0.6%
7	Colorado	47.8%	32	Georgia	-0.1%
8	Texas	31.6%	33	Wyoming	-0.6%
9	Minnesota	28.6%	34	Florida	-0.6%
10	Missouri	22.3%	35	Michigan	-1.1%
11	Hawaii	22.0%	36	Alabama	-2.2%
12	Oregon	21.8%	37	Massachusetts	-3.0%
13	Tennessee	19.7%	38	Mississippi	-3.1%
14	Iowa	18.5%	39	Nevada	-3.5%
15	Kansas	16.2%	40	Maryland	-3.6%
16	Montana	14.4%	41	West Virginia	-3.7%
17	New Mexico	10.3%	42	Connecticut	-4.4%
18	New York	6.9%	43	Ohio	-5.1%
19	Maine	6.0%	44	Utah	-5.1%
20	Oklahoma	5.9%	45	Idaho	-5.4%
21	Wisconsin	5.1%	46	Arkansas	-5.8%
22	Indiana	5.0%	47	New Jersey	-8.0%
23	South Carolina	4.5%	48	North Carolina	-8.5%
24	Virginia	4.4%	49	Nebraska	-11.3%
25	Rhode Island	3.9%	50	Arizona	-22.3%

Table 7.22. Growth in Non-Hydroelectric Renewable Electricity Generation as a Percentage of Total State Electricity Generation, 2006-2007					
Rank	**State**	**% Change**	**Rank**	**State**	**% Change**
1	Delaware	9,610.7%	26	Oklahoma	2.7%
2	North Dakota	68.2%	27	Wisconsin	2.2%
3	Washington	50.7%	28	South Carolina	0.3%
4	Alaska	47.4%	29	Connecticut	0.0%
5	Illinois	45.4%	30	Pennsylvania	-0.4%
6	New Hampshire	42.7%	31	Wyoming	-1.1%
7	Colorado	39.0%	32	Louisiana	-1.2%
8	Texas	30.0%	33	Florida	-1.4%
9	Minnesota	25.6%	34	Virginia	-2.7%
10	Vermont	25.3%	35	West Virginia	-3.8%
11	Missouri	23.0%	36	Alabama	-4.2%
12	Hawaii	22.2%	37	Ohio	-5.0%
13	Tennessee	18.2%	38	Georgia	-5.0%
14	Oregon	18.0%	39	Nevada	-5.9%
15	South Dakota	17.1%	40	Maryland	-6.0%
16	New Mexico	14.3%	41	Massachusetts	-6.1%
17	Montana	11.7%	42	Michigan	-6.7%
18	Maine	10.6%	43	Arkansas	-9.9%
19	Idaho	10.3%	44	Mississippi	-10.5%
20	Iowa	8.2%	45	New Jersey	-10.9%
21	California	6.8%	46	North Carolina	-12.0%
22	Kansas	5.5%	47	Rhode Island	-12.0%
23	Indiana	4.9%	48	Nebraska	-13.4%
24	New York	4.2%	49	Utah	-13.7%
25	Kentucky	3.1%	50	Arizona	-28.4%

Table 7.23. Growth in Non-Hydroelectric Renewable Electricity Generation per Capita, 2006-2007

Rank	State	% Change	Rank	State	% Change
1	Delaware	11,315.4%	26	Vermont	3.0%
2	North Dakota	69.9%	27	Pennsylvania	2.8%
3	Illinois	50.8%	28	South Carolina	2.7%
4	New Hampshire	50.5%	29	Kentucky	0.7%
5	Alaska	49.9%	30	South Dakota	-0.2%
6	Washington	47.3%	31	Michigan	-0.5%
7	Colorado	45.5%	32	Florida	-1.4%
8	Texas	29.2%	33	Georgia	-2.0%
9	Minnesota	27.9%	34	Louisiana	-2.4%
10	Hawaii	22.1%	35	Wyoming	-2.6%
11	Missouri	21.4%	36	Alabama	-2.9%
12	Oregon	20.4%	37	Massachusetts	-3.5%
13	Tennessee	18.3%	38	West Virginia	-3.8%
14	Iowa	18.0%	39	Mississippi	-3.8%
15	Kansas	15.3%	40	Maryland	-3.9%
16	Montana	13.2%	41	Connecticut	-4.2%
17	New Mexico	9.1%	42	Ohio	-5.2%
18	New York	6.1%	43	Nevada	-5.8%
19	Maine	6.0%	44	Arkansas	-6.5%
20	Oklahoma	5.0%	45	Idaho	-7.4%
21	Rhode Island	4.8%	46	New Jersey	-7.9%
22	Wisconsin	4.6%	47	Utah	-8.3%
23	Indiana	4.5%	48	North Carolina	-10.3%
24	Virginia	3.6%	49	Nebraska	-11.5%
25	California	3.5%	50	Arizona	-24.6%

Table 7.24. Growth in Non-Hydroelectric Renewable Electricity Generation per GSP, 2006-2007					
Rank	**State**	**% Change**	**Rank**	**State**	**% Change**
1	Delaware	11,485.3%	26	New York	-1.0%
2	North Dakota	61.8%	27	California	-1.0%
3	New Hampshire	47.7%	28	Pennsylvania	-1.1%
4	Illinois	46.4%	29	Michigan	-1.3%
5	Colorado	44.2%	30	Florida	-3.5%
6	Washington	40.6%	31	Kentucky	-3.9%
7	Alaska	39.1%	32	South Dakota	-4.1%
8	Minnesota	23.3%	33	Georgia	-4.4%
9	Texas	22.8%	34	Alabama	-5.2%
10	Missouri	20.4%	35	Ohio	-6.1%
11	Tennessee	16.9%	36	Wyoming	-6.7%
12	Oregon	16.5%	37	Massachusetts	-6.9%
13	Hawaii	15.6%	38	West Virginia	-7.1%
14	Iowa	13.8%	39	Maryland	-7.5%
15	Kansas	10.6%	40	Idaho	-7.7%
16	New Mexico	9.9%	41	Mississippi	-7.8%
17	Montana	7.9%	42	Arkansas	-9.2%
18	Indiana	6.1%	43	Connecticut	-9.8%
19	Maine	3.5%	44	Louisiana	-10.1%
20	Wisconsin	2.8%	45	Nevada	-10.2%
21	Oklahoma	2.4%	46	New Jersey	-10.4%
22	South Carolina	2.0%	47	Utah	-12.2%
23	Vermont	1.7%	48	North Carolina	-14.2%
24	Rhode Island	1.2%	49	Nebraska	-16.1%
25	Virginia	0.6%	50	Arizona	-26.9%

Biomass Resources

Table 7.25. Biomass Generation (2007)					
Rank	State	MWh	Rank	State	MWh
1	California	5,712,644	26	Maryland	603,461
2	Florida	4,302,817	27	Idaho	480,582
3	Maine	4,107,909	28	Kentucky	465,623
4	Alabama	3,800,620	29	Vermont	453,038
5	Georgia	3,415,421	30	Ohio	420,395
6	Louisiana	2,979,883	31	Hawaii	285,277
7	Virginia	2,565,571	32	Oklahoma	279,854
8	Michigan	2,414,024	33	Indiana	231,247
9	Pennsylvania	2,076,178	34	Rhode Island	154,757
10	South Carolina	1,996,034	35	Iowa	151,100
11	New York	1,941,607	36	Montana	110,945
12	North Carolina	1,672,219	37	Nebraska	61,259
13	Arkansas	1,623,744	38	Delaware	48,116
14	Mississippi	1,493,365	39	Arizona	32,990
15	Minnesota	1,293,826	40	Colorado	31,105
16	Washington	1,292,731	41	Utah	31,030
17	Texas	1,281,229	42	Missouri	29,309
18	Massachusetts	1,240,224	43	New Mexico	15,994
19	Wisconsin	1,220,235	44	North Dakota	13,507
20	New Hampshire	1,123,272	45	Alaska	10,218
21	Oregon	981,298	46	Kansas	0
22	Tennessee	920,590	47	Nevada	0
23	New Jersey	823,166	48	South Dakota	0
24	Connecticut	729,840	49	West Virginia	0
25	Illinois	620,325	50	Wyoming	0

Source: EIA 2009

Table 7.26. Biomass Electricity Generation as a Percentage of Total State Electricity Generation (2007)					
Rank	**State**	**% of Total**	**Rank**	**State**	**% of Total**
1	Maine	25.5%	24	North Carolina	1.3%
2	Vermont	7.8%	25	Washington	1.2%
3	New Hampshire	4.8%	26	Maryland	1.2%
4	Idaho	4.2%	27	Tennessee	1.0%
5	Virginia	3.3%	28	Pennsylvania	0.9%
6	Louisiana	3.2%	29	Delaware	0.6%
7	Mississippi	3.0%	30	Kentucky	0.5%
8	Arkansas	3.0%	31	Oklahoma	0.4%
9	California	2.7%	32	Montana	0.4%
10	Alabama	2.6%	33	Texas	0.3%
11	Massachusetts	2.6%	34	Illinois	0.3%
12	Hawaii	2.5%	35	Iowa	0.3%
13	Minnesota	2.4%	36	Ohio	0.3%
14	Georgia	2.4%	37	Nebraska	0.2%
15	Connecticut	2.2%	38	Indiana	0.2%
16	Rhode Island	2.2%	39	Alaska	0.1%
17	Michigan	2.0%	40	Utah	0.1%
18	South Carolina	1.9%	41	Colorado	0.1%
19	Wisconsin	1.9%	42	New Mexico	0.0%
20	Florida	1.9%	43	North Dakota	0.0%
21	Oregon	1.8%	44	Missouri	0.0%
22	New York	1.3%	45	Arizona	0.0%
23	New Jersey	1.3%			

Table 7.27. Biomass Electricity Generation per Capita (2007)					
Rank	**State**	**MWh/Capita**	**Rank**	**State**	**MWh/Capita**
1	Maine	3.12	24	Tennessee	0.15
2	New Hampshire	0.86	25	Rhode Island	0.15
3	Alabama	0.82	26	Montana	0.12
4	Vermont	0.73	27	Kentucky	0.11
5	Louisiana	0.68	28	Maryland	0.11
6	Arkansas	0.57	29	New York	0.10
7	Mississippi	0.51	30	New Jersey	0.10
8	South Carolina	0.45	31	Oklahoma	0.08
9	Georgia	0.36	32	Delaware	0.06
10	Virginia	0.33	33	Texas	0.05
11	Idaho	0.32	34	Iowa	0.05
12	Oregon	0.26	35	Illinois	0.05
13	Minnesota	0.25	36	Ohio	0.04
14	Michigan	0.24	37	Indiana	0.04
15	Florida	0.24	38	Nebraska	0.03
16	Hawaii	0.22	39	North Dakota	0.02
17	Wisconsin	0.22	40	Alaska	0.02
18	Connecticut	0.21	41	Utah	0.01
19	Washington	0.20	42	New Mexico	0.01
20	Massachusetts	0.19	43	Colorado	0.01
21	North Carolina	0.18	44	Arizona	0.01
22	Pennsylvania	0.17	45	Missouri	0.00
23	California	0.16			

Table 7.28. Biomass Electricity Generation per Gross State Product (2007)					
Rank	State	MWh/$M	Rank	State	MWh/$M
1	Maine	85.39	24	Rhode Island	3.30
2	Alabama	22.92	25	Montana	3.24
3	New Hampshire	19.59	26	California	3.15
4	Vermont	18.46	27	Kentucky	3.02
5	Arkansas	17.03	28	Maryland	2.25
6	Mississippi	16.87	29	Oklahoma	2.01
7	Louisiana	13.79	30	New Jersey	1.77
8	South Carolina	13.06	31	New York	1.76
9	Idaho	9.40	32	Iowa	1.17
10	Georgia	8.61	33	Texas	1.12
11	Virginia	6.70	34	Illinois	1.02
12	Michigan	6.32	35	Indiana	0.94
13	Oregon	6.20	36	Ohio	0.90
14	Florida	5.86	37	Delaware	0.80
15	Wisconsin	5.25	38	Nebraska	0.76
16	Minnesota	5.07	39	North Dakota	0.49
17	Hawaii	4.64	40	Utah	0.29
18	North Carolina	4.19	41	Alaska	0.23
19	Washington	4.15	42	New Mexico	0.21
20	Pennsylvania	3.91	43	Arizona	0.13
21	Tennessee	3.77	44	Colorado	0.13
22	Massachusetts	3.53	45	Missouri	0.13
23	Connecticut	3.37			

Biomass Resources Growth, 2001-2007

Table 7.29. Growth in Biomass Electricity Generation, 2001-2007						
Rank	**State**	**% Change**		**Rank**	**State**	**% Change**
1	Delaware	11,438.6%		24	Pennsylvania	10.1%
2	Kentucky	4,774.6%		25	New Hampshire	9.5%
3	Utah	464.6%		26	New York	9.1%
4	Nebraska	267.6%		27	Arkansas	7.4%
5	Missouri	233.2%		28	Maine	7.4%
6	South Carolina	123.2%		29	Washington	5.9%
7	Indiana	101.8%		30	California	5.7%
8	North Dakota	76.2%		31	Mississippi	4.3%
9	Montana	69.6%		32	Michigan	2.2%
10	Maryland	61.8%		33	Hawaii	-0.8%
11	Rhode Island	49.4%		34	New Jersey	-2.4%
12	Virginia	46.9%		35	Ohio	-2.5%
13	Iowa	45.6%		36	North Carolina	-4.5%
14	Oregon	30.7%		37	Massachusetts	-5.5%
15	Texas	29.0%		38	Illinois	-8.6%
16	Vermont	22.3%		39	Alabama	-9.3%
17	Oklahoma	21.3%		40	Idaho	-9.9%
18	Minnesota	19.8%		41	New Mexico	-14.3%
19	Wisconsin	18.5%		42	Arizona	-15.3%
20	Georgia	13.7%		43	Connecticut	-19.7%
21	Florida	13.5%		44	Colorado	-51.6%
22	Tennessee	12.0%		45	Alaska	-34.2%
23	Louisiana	10.2%		46	West Virginia	-100.0%

Note: The first year for biomass generation for Alaska and Delaware was 2002 and 2006, respectively. Therefore, the baseline year used to calculate their growth numbers were 2002 and 2006, respectively. South Dakota, Kansas, Nevada, and Wyoming did not produce biomass in 2001 or 2007.

Table 7.30. Growth in Percentage of Total In-State Electricity Generated from Biomass, 2001-2007						
Rank	State	% Change		Rank	State	% Change
1	Delaware	9,610.7%		24	California	-0.5%
2	Kentucky	4,684.0%		25	Florida	-3.8%
3	Utah	346.2%		26	Michigan	-4.2%
4	Nebraska	245.5%		27	Pennsylvania	-4.2%
5	Missouri	190.7%		28	Arkansas	-7.2%
6	South Carolina	92.5%		29	Georgia	-7.3%
7	Indiana	89.4%		30	New Jersey	-7.5%
8	North Dakota	71.2%		31	Oklahoma	-8.0%
9	Rhode Island	58.9%		32	Hawaii	-8.6%
10	Maryland	58.1%		33	Ohio	-10.6%
11	Montana	42.0%		34	North Carolina	-13.8%
12	Virginia	38.9%		35	Alaska	-16.9%
13	Maine	30.3%		36	Washington	-17.8%
14	Iowa	18.9%		37	Illinois	-18.2%
15	Texas	18.5%		38	New Mexico	-19.9%
16	Vermont	15.1%		39	Alabama	-20.9%
17	Tennessee	13.3%		40	Massachusetts	-22.8%
18	Mississippi	11.4%		41	Connecticut	-26.2%
19	Wisconsin	9.8%		42	Idaho	-26.7%
20	New York	7.6%		43	New Hampshire	-29.1%
21	Oregon	6.9%		44	Arizona	-32.8%
22	Minnesota	6.7%		45	Colorado	-57.9%
23	Louisiana	4.6%		46	West Virginia	-100.0%

Note: The first year for biomass generation for Alaska and Delaware was 2002 and 2006, respectively. Therefore, the baseline year used to calculate their growth numbers were 2002 and 2006, respectively. South Dakota, Kansas, Nevada, and Wyoming did not produce biomass in 2001 or 2007.

Table 7.31. Growth in Biomass Electricity Generation Per Capita, 2001-2007					
Rank	State	% Change	Rank	State	% Change
1	Delaware	11,315.4%	24	Maine	4.9%
2	Kentucky	4,580.3%	25	Tennessee	4.8%
3	Utah	384.9%	26	Arkansas	2.1%
4	Nebraska	257.0%	27	Florida	2.0%
5	Missouri	219.7%	28	Mississippi	1.9%
6	South Carolina	105.9%	29	Michigan	1.8%
7	Indiana	95.1%	30	Georgia	0.6%
8	North Dakota	75.8%	31	California	0.3%
9	Montana	60.6%	32	Washington	-1.7%
10	Maryland	54.8%	33	Ohio	-3.2%
11	Rhode Island	50.1%	34	New Jersey	-4.2%
12	Iowa	43.0%	35	Hawaii	-5.4%
13	Virginia	37.2%	36	Massachusetts	-6.4%
14	Oregon	21.5%	37	Illinois	-10.8%
15	Vermont	20.6%	38	Alabama	-12.5%
16	Oklahoma	16.5%	39	North Carolina	-13.4%
17	Texas	15.4%	40	New Mexico	-20.2%
18	Minnesota	15.2%	41	Idaho	-20.4%
19	Wisconsin	14.5%	42	Connecticut	-21.1%
20	Louisiana	12.4%	43	Alaska	-21.8%
21	Pennsylvania	9.0%	44	Arizona	-29.3%
22	New York	7.1%	45	Colorado	-55.6%
23	New Hampshire	4.9%	46	West Virginia	-100.0%

Note: The first year for biomass generation for Alaska and Delaware was 2002 and 2006, respectively. Therefore, the baseline year used to calculate their growth numbers were 2002 and 2006, respectively. South Dakota, Kansas, Nevada, and Wyoming did not produce biomass in 2001 or 2007.

Table 7.32. Growth in Biomass Electricity Generation per GSP, 2001-2007					
Rank	**State**	**% Change**	**Rank**	**State**	**% Change**
1	Delaware	11,485.3%	24	Maine	-17.1%
2	Kentucky	3,539.4%	25	Oklahoma	-17.9%
3	Utah	274.6%	26	New York	-20.1%
4	Missouri	164.8%	27	Ohio	-21.6%
5	Nebraska	163.7%	28	Mississippi	-22.3%
6	South Carolina	71.3%	29	Arkansas	-22.4%
7	Indiana	59.9%	30	Florida	-23.1%
8	North Dakota	17.8%	31	Washington	-23.2%
9	Maryland	16.0%	32	New Jersey	-23.9%
10	Rhode Island	11.9%	33	California	-24.2%
11	Montana	11.3%	34	Massachusetts	-24.6%
12	Virginia	6.1%	35	Illinois	-28.6%
13	Iowa	3.8%	36	North Carolina	-31.7%
14	Vermont	-6.2%	37	Louisiana	-31.9%
15	Wisconsin	-7.2%	38	Hawaii	-32.6%
16	Oregon	-8.4%	39	Alabama	-35.1%
17	Michigan	-10.5%	40	Idaho	-37.2%
18	Minnesota	-10.6%	41	Connecticut	-38.7%
19	Texas	-13.9%	42	New Mexico	-42.2%
20	Georgia	-14.1%	43	Arizona	-43.3%
21	New Hampshire	-15.4%	44	Alaska	-49.8%
22	Pennsylvania	-15.7%	45	Colorado	-63.5%
23	Tennessee	-17.1%	46	West Virginia	-100.0%

Note: The first year for biomass generation for Alaska and Delaware was 2002 and 2006, respectively. Therefore, the baseline year used to calculate their growth numbers were 2002 and 2006, respectively. South Dakota, Kansas, Nevada, and Wyoming did not produce biomass in 2001 or 2007.

Biomass Resources Growth, 2006-2007

Table 7.33. Growth in Biomass Electricity Generation, 2006-2007

Rank	State	% Change	Rank	State	% Change
1	Delaware	11,438.6%	24	Louisiana	0.6%
2	North Dakota	281.1%	25	New York	0.0%
3	Utah	108.7%	26	California	-0.1%
4	Alaska	53.3%	27	Georgia	-0.1%
5	New Hampshire	50.5%	28	Florida	-0.6%
6	Minnesota	28.9%	29	Michigan	-1.1%
7	Missouri	22.3%	30	Pennsylvania	-1.7%
8	Tennessee	21.8%	31	Alabama	-2.2%
9	Nebraska	17.8%	32	Massachusetts	-3.0%
10	Montana	17.5%	33	Mississippi	-3.1%
11	Texas	11.6%	34	Maryland	-3.6%
12	Iowa	10.4%	35	Connecticut	-4.4%
13	Oregon	9.3%	36	Ohio	-5.4%
14	Indiana	5.0%	37	Arkansas	-5.8%
15	Wisconsin	4.8%	38	Oklahoma	-5.9%
16	South Carolina	4.5%	39	Idaho	-7.6%
17	Illinois	4.4%	40	North Carolina	-8.5%
18	Virginia	4.4%	41	New Jersey	-8.6%
19	Rhode Island	3.9%	42	Washington	-11.8%
20	Maine	3.5%	43	Hawaii	-12.4%
21	Vermont	3.2%	44	Arizona	-18.4%
22	Kentucky	1.5%	45	New Mexico	-26.9%
23	Colorado	1.4%	46	West Virginia	-100.0%

Table 7.34. Growth in Percentage of Total In-State Electricity Generated from Biomass, 2006-2007

Rank	State	% Change		Rank	State	% Change
1	Delaware	9,610.7%		24	Louisiana	-1.2%
2	North Dakota	276.9%		25	Florida	-1.4%
3	Utah	89.8%		26	New York	-2.5%
4	Alaska	50.0%		27	Virginia	-2.7%
5	New Hampshire	42.7%		28	Alabama	-4.2%
6	Minnesota	25.9%		29	Colorado	-4.7%
7	Vermont	25.5%		30	Pennsylvania	-4.9%
8	Missouri	23.0%		31	Georgia	-5.0%
9	Tennessee	20.2%		32	Ohio	-5.2%
10	Nebraska	15.0%		33	Maryland	-6.0%
11	Montana	14.7%		34	Massachusetts	-6.1%
12	Texas	10.3%		35	Michigan	-6.7%
13	Maine	8.0%		36	Oklahoma	-8.7%
14	Idaho	7.7%		37	Arkansas	-9.9%
15	Oregon	5.9%		38	Mississippi	-10.5%
16	Indiana	4.9%		39	Washington	-10.8%
17	Kentucky	3.1%		40	New Jersey	-11.5%
18	California	2.8%		41	North Carolina	-12.0%
19	Wisconsin	1.9%		42	Rhode Island	-12.0%
20	Iowa	0.8%		43	Hawaii	-12.2%
21	South Carolina	0.3%		44	New Mexico	-24.3%
22	Illinois	0.3%		45	Arizona	-24.9%
23	Connecticut	0.0%		46	West Virginia	-100.0%

Table 7.35. Growth in Biomass Electricity Generation per Capita, 2006-2007					
Rank	State	% Change	Rank	State	% Change
1	Delaware	11,315.4%	24	California	-0.4%
2	North Dakota	280.9%	25	Michigan	-0.6%
3	Utah	101.7%	26	New York	-0.7%
4	Alaska	52.5%	27	Florida	-1.4%
5	New Hampshire	50.5%	28	Pennsylvania	-1.8%
6	Minnesota	28.2%	29	Georgia	-2.0%
7	Missouri	21.4%	30	Louisiana	-2.4%
8	Tennessee	20.3%	31	Alabama	-2.9%
9	Nebraska	17.4%	32	Massachusetts	-3.5%
10	Montana	16.3%	33	Mississippi	-3.8%
11	Iowa	10.0%	34	Maryland	-3.9%
12	Texas	9.6%	35	Connecticut	-4.2%
13	Oregon	8.0%	36	Ohio	-5.5%
14	Rhode Island	4.8%	37	Arkansas	-6.5%
15	Indiana	4.5%	38	Oklahoma	-6.7%
16	Wisconsin	4.3%	39	New Jersey	-8.5%
17	Illinois	4.0%	40	Idaho	-9.6%
18	Virginia	3.6%	41	North Carolina	-10.3%
19	Maine	3.5%	42	Hawaii	-12.3%
20	Vermont	3.2%	43	Washington	-12.8%
21	South Carolina	2.7%	44	Arizona	-20.8%
22	Kentucky	0.7%	45	New Mexico	-27.7%
23	Colorado	-0.3%	46	West Virginia	-100.0%

Table 7.36. Growth in Biomass Electricity Generation per GSP, 2006-2007					
Rank	**State**	**% Change**	**Rank**	**State**	**% Change**
1	Delaware	11,485.3%	24	Florida	-3.5%
2	North Dakota	262.7%	25	Kentucky	-3.9%
3	Utah	93.1%	26	Georgia	-4.4%
4	New Hampshire	47.7%	27	California	-4.8%
5	Alaska	41.6%	28	Alabama	-5.2%
6	Minnesota	23.6%	29	Pennsylvania	-5.5%
7	Missouri	20.4%	30	Ohio	-6.4%
8	Tennessee	18.9%	31	Massachusetts	-6.9%
9	Nebraska	11.3%	32	New York	-7.3%
10	Montana	10.9%	33	Maryland	-7.5%
11	Indiana	6.1%	34	Mississippi	-7.8%
12	Iowa	6.1%	35	Oklahoma	-9.0%
13	Oregon	4.5%	36	Arkansas	-9.2%
14	Texas	4.2%	37	Connecticut	-9.8%
15	Wisconsin	2.5%	38	Idaho	-9.9%
16	South Carolina	2.0%	39	Louisiana	-10.1%
17	Vermont	1.8%	40	New Jersey	-11.0%
18	Rhode Island	1.2%	41	North Carolina	-14.2%
19	Maine	1.1%	42	Washington	-16.8%
20	Illinois	1.0%	43	Hawaii	-17.0%
21	Virginia	0.6%	44	Arizona	-23.2%
22	Colorado	-1.2%	45	New Mexico	-27.2%
23	Michigan	-1.3%	46	West Virginia	-100.0%

Hydroelectric Resources

Table 7.37. Hydroelectric Generation (2007)					
Rank	**State**	**MWh**	**Rank**	**State**	**MWh**
1	Washington	78,829,195	26	Michigan	1,269,989
2	Oregon	33,587,439	27	New Hampshire	1,265,229
3	California	27,327,751	28	West Virginia	1,254,397
4	New York	25,252,555	29	Virginia	1,248,264
5	Montana	9,364,336	30	Missouri	1,204,326
6	Idaho	9,021,690	31	Iowa	962,346
7	Arizona	6,597,671	32	Louisiana	826,642
8	Tennessee	4,939,601	33	Massachusetts	797,482
9	Alabama	4,136,114	34	Wyoming	729,424
10	Maine	3,738,168	35	Minnesota	653,822
11	Arkansas	3,236,753	36	Vermont	646,605
12	Oklahoma	3,065,862	37	Utah	538,782
13	North Carolina	2,984,159	38	Indiana	449,936
14	South Dakota	2,917,283	39	Ohio	410,436
15	Georgia	2,236,188	40	Connecticut	363,261
16	Pennsylvania	2,235,982	41	Nebraska	347,444
17	Nevada	2,003,191	42	New Mexico	267,978
18	Colorado	1,729,533	43	Florida	154,446
19	Kentucky	1,668,587	44	Illinois	153,727
20	Maryland	1,652,216	45	Hawaii	92,343
21	Texas	1,644,437	46	New Jersey	20,909
22	South Carolina	1,555,912	47	Kansas	10,501
23	Wisconsin	1,516,083	48	Rhode Island	4,364
24	North Dakota	1,305,393	49	Delaware	0
25	Alaska	1,291,223	50	Mississippi	0

Table 7.38. Hydroelectric Generation as a Percent of Total In-State Generation (2007)					
Rank	State	% of Total	Rank	State	% of Total
1	Idaho	78.6%	25	Massachusetts	1.7%
2	Washington	73.7%	26	Wyoming	1.6%
3	Oregon	61.0%	27	Virginia	1.6%
4	South Dakota	47.5%	28	Georgia	1.5%
5	Montana	32.4%	29	South Carolina	1.5%
6	Maine	23.2%	30	West Virginia	1.3%
7	Alaska	18.9%	31	Missouri	1.3%
8	New York	17.3%	32	Minnesota	1.2%
9	California	13.0%	33	Utah	1.2%
10	Vermont	11.1%	34	Connecticut	1.1%
11	Nevada	6.1%	35	Nebraska	1.1%
12	Arkansas	5.9%	36	Michigan	1.1%
13	Arizona	5.8%	37	Pennsylvania	1.0%
14	New Hampshire	5.4%	38	Louisiana	0.9%
15	Tennessee	5.2%	39	Hawaii	0.8%
16	Oklahoma	4.2%	40	New Mexico	0.7%
17	North Dakota	4.2%	41	Texas	0.4%
18	Maryland	3.3%	42	Indiana	0.3%
19	Colorado	3.2%	43	Ohio	0.3%
20	Alabama	2.9%	44	Illinois	0.1%
21	Wisconsin	2.4%	45	Florida	0.1%
22	North Carolina	2.3%	46	Rhode Island	0.1%
23	Iowa	1.9%	47	New Jersey	0.0%
24	Kentucky	1.7%	48	Kansas	0.0%

Table 7.39. Hydroelectric Generation per Capita (2007)					
Rank	State	MWh/capita	Rank	State	MWh/capita
1	Washington	12.22	25	Iowa	0.32
2	Montana	9.79	26	Maryland	0.29
3	Oregon	8.99	27	Wisconsin	0.27
4	Idaho	6.03	28	Georgia	0.23
5	South Dakota	3.67	29	Missouri	0.20
6	Maine	2.84	30	Utah	0.20
7	North Dakota	2.05	31	Nebraska	0.20
8	Alaska	1.90	32	Louisiana	0.19
9	Wyoming	1.39	33	Pennsylvania	0.18
10	New York	1.30	34	Virginia	0.16
11	Arkansas	1.14	35	New Mexico	0.14
12	Vermont	1.04	36	Michigan	0.13
13	Arizona	1.04	37	Minnesota	0.13
14	New Hampshire	0.96	38	Massachusetts	0.12
15	Alabama	0.89	39	Connecticut	0.10
16	Oklahoma	0.85	40	Hawaii	0.07
17	Tennessee	0.80	41	Indiana	0.07
18	Nevada	0.78	42	Texas	0.07
19	California	0.75	43	Ohio	0.04
20	West Virginia	0.69	44	Illinois	0.01
21	Kentucky	0.39	45	Florida	0.01
22	Colorado	0.36	46	Rhode Island	0.00
23	South Carolina	0.35	47	Kansas	0.00
24	North Carolina	0.33	48	New Jersey	0.00

Table 7.40. Hydroelectric Generation per GSP (2007)					
Rank	State	MWh/M$ GSP	Rank	State	MWh/M$ GSP
1	Montana	273.4	25	Colorado	7.3
2	Washington	253.3	26	Wisconsin	6.5
3	Oregon	212.3	27	Maryland	6.1
4	Idaho	176.4	28	Georgia	5.6
5	South Dakota	86.0	29	Missouri	5.2
6	Maine	77.7	30	Utah	5.1
7	North Dakota	47.1	31	Nebraska	4.3
8	Arkansas	33.9	32	Pennsylvania	4.2
9	Alaska	29.0	33	Louisiana	3.8
10	Arizona	26.7	34	New Mexico	3.5
11	Vermont	26.3	35	Michigan	3.3
12	Alabama	24.9	36	Virginia	3.3
13	Wyoming	23.1	37	Minnesota	2.6
14	New York	22.9	38	Massachusetts	2.3
15	New Hampshire	22.1	39	Indiana	1.8
16	Oklahoma	22.0	40	Connecticut	1.7
17	West Virginia	21.7	41	Hawaii	1.5
18	Tennessee	20.3	42	Texas	1.4
19	Nevada	15.7	43	Ohio	0.9
20	California	15.1	44	Illinois	0.3
21	Kentucky	10.8	45	Florida	0.2
22	South Carolina	10.2	46	Rhode Island	0.1
23	North Carolina	7.5	47	Kansas	0.1
24	Iowa	7.5	48	New Jersey	0.0

Hydroelectric Resources Growth, 2001-2007

Table 7.41. Growth in Hydroelectric Electricity Generation, 2001-2007

Rank	State	% Change	Rank	State	% Change
1	Washington	44.0%	25	Missouri	9.1%
2	Montana	41.6%	26	California	7.0%
3	Maine	41.3%	27	Illinois	6.7%
4	Maryland	39.6%	28	Utah	6.0%
5	Rhode Island	38.9%	29	Florida	4.6%
6	Texas	37.0%	30	North Dakota	-2.0%
7	Pennsylvania	35.5%	31	Alaska	-4.1%
8	West Virginia	31.8%	32	Hawaii	-8.3%
9	Oklahoma	30.8%	33	Arizona	-13.5%
10	New Hampshire	27.7%	34	Georgia	-13.9%
11	Arkansas	27.0%	35	South Dakota	-15.0%
12	South Carolina	27.0%	36	Wyoming	-17.0%
13	Connecticut	26.9%	37	Michigan	-18.7%
14	Idaho	24.9%	38	Ohio	-19.7%
15	Virginia	23.1%	39	Nevada	-20.3%
16	Oregon	17.3%	40	Indiana	-21.2%
17	New Jersey	16.2%	41	Minnesota	-21.4%
18	Colorado	15.7%	42	Wisconsin	-26.3%
19	North Carolina	15.0%	43	Vermont	-26.9%
20	Iowa	13.9%	44	Tennessee	-28.9%
21	Massachusetts	13.5%	45	Alabama	-50.5%
22	New Mexico	12.9%	46	Kentucky	-56.7%
23	Louisiana	12.9%	47	Kansas	-58.9%
24	New York	9.4%	48	Nebraska	-69.1%

Table 7.42. Growth in Percentage of Total In-State Electricity Generation from Hydroelectric, 2001-2007						
Rank	**State**	**% Change**		**Rank**	**State**	**% Change**
1	Maine	71.4%		25	North Dakota	-4.8%
2	Rhode Island	47.8%		26	Missouri	-4.8%
3	Maryland	36.4%		27	Alaska	-5.1%
4	Texas	25.9%		28	Iowa	-7.0%
5	Montana	18.6%		29	Massachusetts	-7.2%
6	Pennsylvania	17.8%		30	Florida	-11.4%
7	Connecticut	16.6%		31	Hawaii	-15.5%
8	Virginia	16.4%		32	Utah	-16.3%
9	West Virginia	14.8%		33	New Hampshire	-17.3%
10	Washington	11.8%		34	Nevada	-17.4%
11	New Jersey	10.1%		35	Wyoming	-18.6%
12	Arkansas	9.8%		36	Michigan	-23.8%
13	South Carolina	9.5%		37	Indiana	-26.0%
14	New York	7.9%		38	Ohio	-26.3%
15	Louisiana	7.2%		39	Tennessee	-28.1%
16	New Mexico	5.5%		40	Georgia	-29.8%
17	North Carolina	3.8%		41	Minnesota	-30.0%
18	South Dakota	2.5%		42	Vermont	-31.2%
19	Idaho	1.7%		43	Arizona	-31.4%
20	California	0.8%		44	Wisconsin	-31.7%
21	Colorado	0.6%		45	Alabama	-56.9%
22	Oklahoma	-0.8%		46	Kentucky	-57.5%
23	Oregon	-4.1%		47	Kansas	-63.3%
24	Illinois	-4.5%		48	Nebraska	-71.0%

Table 7.43. Growth in Hydroelectric Electricity Generation per Capita, 2001-2007					
Rank	State	% Change	Rank	State	% Change
1	Rhode Island	39.6%	25	North Carolina	4.3%
2	Maine	38.0%	26	Illinois	4.2%
3	Montana	34.1%	27	California	1.6%
4	Pennsylvania	34.1%	28	North Dakota	-2.2%
5	Washington	33.8%	29	Florida	-6.1%
6	Maryland	33.5%	30	Utah	-9.0%
7	West Virginia	31.0%	31	Alaska	-10.8%
8	Oklahoma	25.6%	32	Hawaii	-12.6%
9	Connecticut	24.7%	33	South Dakota	-18.9%
10	Texas	22.6%	34	Michigan	-19.0%
11	New Hampshire	22.4%	35	Ohio	-20.2%
12	Arkansas	20.7%	36	Wyoming	-21.8%
13	South Carolina	17.1%	37	Indiana	-23.8%
14	Louisiana	15.1%	38	Georgia	-23.8%
15	Virginia	15.0%	39	Minnesota	-24.4%
16	New Jersey	14.0%	40	Arizona	-27.8%
17	Massachusetts	12.5%	41	Vermont	-27.9%
18	Iowa	11.8%	42	Wisconsin	-28.8%
19	Idaho	10.3%	43	Tennessee	-33.5%
20	Oregon	9.0%	44	Nevada	-34.6%
21	New York	7.4%	45	Alabama	-52.3%
22	Colorado	5.9%	46	Kentucky	-58.5%
23	New Mexico	5.1%	47	Kansas	-60.1%
24	Missouri	4.7%	48	Nebraska	-70.0%

Table 7.44. Growth in Hydroelectric Electricity Generation per GSP, 2001-2007					
Rank	**State**	**% Change**	**Rank**	**State**	**% Change**
1	Maine	9.1%	25	California	-23.2%
2	Washington	4.5%	26	New Mexico	-23.9%
3	Rhode Island	4.1%	27	Michigan	-28.8%
4	Pennsylvania	3.8%	28	Florida	-29.2%
5	Maryland	0.1%	29	Utah	-29.7%
6	West Virginia	-1.0%	30	Louisiana	-30.2%
7	New Hampshire	-1.4%	31	North Dakota	-34.5%
8	South Carolina	-2.6%	32	Georgia	-35.0%
9	Connecticut	-3.2%	33	Ohio	-35.4%
10	Montana	-7.1%	34	Indiana	-37.6%
11	Arkansas	-8.2%	35	Hawaii	-37.7%
12	Texas	-8.6%	36	South Dakota	-40.1%
13	Massachusetts	-9.4%	37	Minnesota	-41.3%
14	New Jersey	-9.4%	38	Arizona	-42.1%
15	Virginia	-11.1%	39	Wisconsin	-42.3%
16	Oklahoma	-11.5%	40	Alaska	-42.7%
17	Colorado	-12.8%	41	Vermont	-43.9%
18	Idaho	-13.0%	42	Tennessee	-47.3%
19	Missouri	-13.3%	43	Wyoming	-50.1%
20	Illinois	-16.6%	44	Nevada	-51.6%
21	North Carolina	-17.8%	45	Alabama	-64.6%
22	Oregon	-17.8%	46	Kentucky	-67.7%
23	Iowa	-18.9%	47	Kansas	-69.7%
24	New York	-19.8%	48	Nebraska	-77.8%

Hydroelectric Resources Growth, 2006-2007

Table 7.45. Growth in Hydroelectric Electricity Generation, 2006-2007

Rank	State	% Change	Rank	State	% Change
1	Missouri	504.5%	25	South Carolina	-13.9%
2	Oklahoma	391.7%	26	South Dakota	-14.1%
3	Texas	148.4%	27	North Dakota	-14.2%
4	Arkansas	108.8%	28	Michigan	-16.5%
5	New Mexico	35.2%	29	New Hampshire	-17.3%
6	Louisiana	15.9%	30	Idaho	-19.8%
7	Minnesota	14.4%	31	West Virginia	-20.2%
8	Kansas	8.8%	32	Pennsylvania	-21.4%
9	Iowa	5.8%	33	Maryland	-21.5%
10	Alaska	5.5%	34	North Carolina	-22.3%
11	Nevada	-2.7%	35	Hawaii	-23.1%
12	Arizona	-2.9%	36	Florida	-24.1%
13	Colorado	-3.4%	37	Rhode Island	-26.2%
14	Washington	-3.9%	38	Utah	-27.9%
15	Montana	-7.6%	39	Connecticut	-33.2%
16	Virginia	-7.6%	40	Ohio	-35.1%
17	New York	-7.7%	41	Kentucky	-35.6%
18	Indiana	-8.1%	42	Tennessee	-36.3%
19	Wisconsin	-9.7%	43	New Jersey	-41.0%
20	Oregon	-11.3%	44	Alabama	-43.0%
21	Illinois	-11.3%	45	California	-43.1%
22	Maine	-12.6%	46	Massachusetts	-47.3%
23	Georgia	-13.0%	47	Vermont	-57.4%
24	Wyoming	-13.5%	48	Nebraska	-61.1%

Table 7.46. Growth in Percentage of Total In-State Electricity Generation from Hydroelectric, 2006-2007					
Rank	**State**	**% Change**	**Rank**	**State**	**% Change**
1	Missouri	508.1%	25	Illinois	-14.8%
2	Oklahoma	376.8%	26	North Dakota	-15.1%
3	Texas	145.4%	27	Georgia	-17.2%
4	Arkansas	99.5%	28	South Carolina	-17.3%
5	New Mexico	40.0%	29	West Virginia	-20.3%
6	Louisiana	13.8%	30	Michigan	-21.2%
7	Minnesota	11.8%	31	New Hampshire	-21.6%
8	Alaska	3.3%	32	Hawaii	-22.9%
9	South Dakota	-0.2%	33	Maryland	-23.4%
10	Kansas	-1.2%	34	Pennsylvania	-23.9%
11	Washington	-2.8%	35	Florida	-24.6%
12	Iowa	-3.3%	36	North Carolina	-25.2%
13	Nevada	-5.1%	37	Connecticut	-30.2%
14	Idaho	-6.5%	38	Utah	-34.4%
15	Indiana	-8.2%	39	Kentucky	-34.6%
16	Maine	-8.9%	40	Ohio	-34.9%
17	Colorado	-9.2%	41	Tennessee	-37.1%
18	Montana	-9.8%	42	Rhode Island	-37.5%
19	New York	-9.9%	43	California	-41.5%
20	Arizona	-10.5%	44	New Jersey	-42.9%
21	Wisconsin	-12.2%	45	Alabama	-44.1%
22	Virginia	-13.9%	46	Vermont	-48.2%
23	Wyoming	-14.0%	47	Massachusetts	-48.9%
24	Oregon	-14.1%	48	Nebraska	-62.0%

Table 7.47. Growth in Hydroelectric Generation per Capita, 2006-2007					
Rank	**State**	**% Change**	**Rank**	**State**	**% Change**
1	Rhode Island	39.6%	25	North Carolina	4.3%
2	Maine	38.0%	26	Illinois	4.2%
3	Montana	34.1%	27	California	1.6%
4	Pennsylvania	34.1%	28	North Dakota	-2.2%
5	Washington	33.8%	29	Florida	-6.1%
6	Maryland	33.5%	30	Utah	-9.0%
7	West Virginia	31.0%	31	Alaska	-10.8%
8	Oklahoma	25.6%	32	Hawaii	-12.6%
9	Connecticut	24.7%	33	South Dakota	-18.9%
10	Texas	22.6%	34	Michigan	-19.0%
11	New Hampshire	22.4%	35	Ohio	-20.2%
12	Arkansas	20.7%	36	Wyoming	-21.8%
13	South Carolina	17.1%	37	Indiana	-23.8%
14	Louisiana	15.1%	38	Georgia	-23.8%
15	Virginia	15.0%	39	Minnesota	-24.4%
16	New Jersey	14.0%	40	Arizona	-27.8%
17	Massachusetts	12.5%	41	Vermont	-27.9%
18	Iowa	11.8%	42	Wisconsin	-28.8%
19	Idaho	10.3%	43	Tennessee	-33.5%
20	Oregon	9.0%	44	Nevada	-34.6%
21	New York	7.4%	45	Alabama	-52.3%
22	Colorado	5.9%	46	Kentucky	-58.5%
23	New Mexico	5.1%	47	Kansas	-60.1%
24	Missouri	4.7%	48	Nebraska	-70.0%

Table 7.48. Growth in Hydroelectric Generation per GSP, 2006-2007

Rank	State	% Change	Rank	State	% Change
1	Missouri	495.1%	25	Michigan	-16.7%
2	Oklahoma	375.2%	26	South Dakota	-18.2%
3	Texas	131.9%	27	North Dakota	-18.3%
4	Arkansas	101.0%	28	New Hampshire	-18.8%
5	New Mexico	34.7%	29	Wyoming	-18.9%
6	Minnesota	9.7%	30	Idaho	-21.7%
7	Kansas	3.6%	31	West Virginia	-23.1%
8	Louisiana	3.6%	32	Pennsylvania	-24.5%
9	Iowa	1.7%	33	Maryland	-24.7%
10	Alaska	-2.6%	34	Florida	-26.3%
11	Colorado	-5.8%	35	North Carolina	-27.1%
12	Indiana	-7.2%	36	Hawaii	-27.1%
13	Arizona	-8.6%	37	Rhode Island	-28.1%
14	Washington	-9.4%	38	Utah	-33.3%
15	Nevada	-9.4%	39	Ohio	-35.8%
16	Virginia	-10.9%	40	Connecticut	-37.0%
17	Wisconsin	-11.7%	41	Tennessee	-37.8%
18	Montana	-12.8%	42	Kentucky	-39.1%
19	Illinois	-14.2%	43	New Jersey	-42.6%
20	New York	-14.4%	44	Alabama	-44.8%
21	Maine	-14.7%	45	California	-45.8%
22	Oregon	-15.2%	46	Massachusetts	-49.4%
23	South Carolina	-15.9%	47	Vermont	-58.0%
24	Georgia	-16.7%	48	Nebraska	-63.2%

Geothermal Resources

Table 7.49. Geothermal Electricity Generation

MWh Generated (2007)			As a Percentage of Total State Electricity Generation (2007)		
Rank	**State**	**MWh**	**Rank**	**State**	**% of Total**
1	California	12,990,711	1	California	6.2%
2	Nevada	1,252,691	2	Nevada	3.8%
3	Hawaii	229,886	3	Hawaii	2.0%
4	Utah	163,925	4	Utah	0.4%

Per Capita (2007)			Per GSP (MWh/M$) (2007)		
Rank	**State**	**MWh/Capita**	**Rank**	**State**	**MWh/$M**
1	Nevada	0.5	1	Nevada	9.8
2	California	0.4	2	California	7.2
3	Hawaii	0.2	3	Hawaii	3.7
4	Utah	0.1	4	Utah	1.6

Source: EIA 2009

Table 7.50. Growth in Geothermal Electricity Generation: 2001-2007

Generation Percent Growth			As a Percent of Total State Electricity Generation		
Rank	**State**	**% Change**	**Rank**	**State**	**% Change**
1	Hawaii	11.3%	1	Nevada	8.3%
2	Utah	7.3%	2	Hawaii	2.6%
3	California	6.6%	3	California	0.4%
4	Nevada	4.4%	4	Utah	-15.2%

Per Capita			Per GSP (MWh/M$)		
Rank	**State**	**% Change**	**Rank**	**State**	**% Change**
1	Hawaii	6.2%	1	California	-23.5%
2	California	1.2%	2	Hawaii	-24.4%
3	Utah	-7.8%	3	Utah	-28.8%
4	Nevada	-14.4%	4	Nevada	-36.6%

Table 7.51. Growth in Geothermal Electricity Generation, 2006-2007					
Generation Percent Growth			As a Percent of Total State Electricity Generation		
Rank	State	% Change	Rank	State	% Change
1	Hawaii	8.3%	1	Hawaii	8.5%
2	California	1.3%	2	California	4.2%
3	Nevada	-6.8%	3	Nevada	-9.1%
4	Utah	-14.0%	4	Utah	-21.8%
Per Capita			Per GSP (MWh/M$)		
Rank	State	% Change	Rank	State	% Change
1	Hawaii	8.4%	1	Hawaii	2.6%
2	California	1.0%	2	California	-3.5%
3	Nevada	-9.0%	3	Nevada	-13.2%
4	Utah	-16.9%	4	Utah	-20.4%

Distributed Solar

Table 7.52. Grid-Connected Cumulative Installed Capacity, 2008 (kWdc)

Rank	State	kWdc	Rank	State	kWdc
1	California	528,262	23	District of Columbia	661
2	New Jersey	70,236	24	Montana	651
3	Colorado	35,730	25	Minnesota	635
4	Nevada	34,214	26	Rhode Island	574
5	Arizona	25,301	27	Tennessee	388
6	New York	21,882	28	Michigan	358
7	Hawaii	13,525	29	Maine	326
8	Connecticut	8,760	30	Virginia	212
9	Oregon	7,651	31	Utah	202
10	Massachusetts	7,527	32	New Hampshire	96
11	North Carolina	4,697	33	Wyoming	88
12	Texas	4,428	34	Mississippi	76
13	Pennsylvania	3,938	35	Missouri	65
14	Washington	3,673	36	Alabama	58
15	Maryland	3,129	37	Iowa	51
16	Wisconsin	3,078	38	Georgia	47
17	Florida	2,992	39	Idaho	41
18	Illinois	2,758	40	Arkansas	38
19	Delaware	1,824	41	Kentucky	37
20	Ohio	1,356	42	Indiana	19
21	Vermont	1,110	43	Oklahoma	6
22	New Mexico	1,040	44	South Carolina	1

Wind Resources

Table 7.53. Wind Generation Reported to EIA by State, 2007

Rank	State	MWh	Rank	State	MWh
1	Texas	9,006,383	16	Pennsylvania	470,018
2	California	5,584,933	17	Hawaii	238,184
3	Iowa	2,756,676	18	Nebraska	216,765
4	Minnesota	2,638,812	19	Idaho	172,267
5	Washington	2,437,823	20	West Virginia	167,588
6	Oklahoma	1,849,144	21	South Dakota	150,018
7	New Mexico	1,393,239	22	Wisconsin	109,283
8	Colorado	1,291,516	23	Maine	99,071
9	Oregon	1,246,994	24	Tennessee	49,937
10	Kansas	1,152,538	25	New Jersey	20,412
11	New York	833,476	26	Ohio	14,748
12	Wyoming	754,881	27	Vermont	10,511
13	Illinois	664,427	28	Michigan	2,723
14	North Dakota	620,772	29	Alaska	1,012
15	Montana	495,776			

Table 7.54. Wind Generation as a Percent of Total In-state Generation, 2007

Rank	State	% of Total	Rank	State	% of Total
1	Iowa	5.54%	16	Idaho	1.50%
2	Minnesota	4.84%	17	Nebraska	0.67%
3	New Mexico	3.87%	18	Maine	0.61%
4	California	2.65%	19	New York	0.57%
5	Oklahoma	2.54%	20	Illinois	0.33%
6	South Dakota	2.44%	21	Pennsylvania	0.21%
7	Colorado	2.40%	22	Vermont	0.18%
8	Kansas	2.30%	23	West Virginia	0.18%
9	Washington	2.28%	24	Wisconsin	0.17%
10	Oregon	2.26%	25	Tennessee	0.05%
11	Texas	2.22%	26	New Jersey	0.03%
12	Hawaii	2.07%	27	Alaska	0.01%
13	North Dakota	1.99%	28	Ohio	0.01%
14	Montana	1.71%	29	Michigan	0.00%
15	Wyoming	1.65%			

Table 7.55. Wind Generation per Capita, 2007						
Rank	State	MWh/capita		Rank	State	MWh/capita
1	Wyoming	1.44		16	Nebraska	0.12
2	North Dakota	0.97		17	Idaho	0.12
3	Iowa	0.92		18	West Virginia	0.09
4	New Mexico	0.71		19	Maine	0.08
5	Montana	0.52		20	Illinois	0.05
6	Oklahoma	0.51		21	New York	0.04
7	Minnesota	0.51		22	Pennsylvania	0.04
8	Kansas	0.41		23	Wisconsin	0.02
9	Washington	0.38		24	Vermont	0.02
10	Texas	0.38		25	Tennessee	0.01
11	Oregon	0.33		26	New Jersey	0.00
12	Colorado	0.27		27	Alaska	0.00
13	South Dakota	0.19		28	Ohio	0.00
14	Hawaii	0.19		29	Michigan	0.00
15	California	0.15				

Table 7.56. Wind Generation per GSP, 2007						
Rank	State	MWh/M$ GSP		Rank	State	MWh/M$ GSP
1	Wyoming	23.95		16	California	3.08
2	North Dakota	22.39		17	West Virginia	2.90
3	Iowa	21.37		18	Nebraska	2.71
4	New Mexico	18.29		19	Maine	2.06
5	Montana	14.47		20	Illinois	1.09
6	Oklahoma	13.27		21	Pennsylvania	0.88
7	Minnesota	10.35		22	New York	0.76
8	Kansas	9.83		23	Wisconsin	0.47
9	Texas	7.89		24	Vermont	0.43
10	Oregon	7.88		25	Tennessee	0.20
11	Washington	7.83		26	New Jersey	0.04
12	Colorado	5.47		27	Ohio	0.03
13	South Dakota	4.42		28	Alaska	0.02
14	Hawaii	3.87		29	Michigan	0.01
15	Idaho	3.37				

Wind Resource Growth, 2001-2007

Table 7.57. Growth in Wind Electricity Generation, 2001 - 2007*

Rank	State	% Change		Rank	State	% Change
1	South Dakota	17,123.7%		15	New Mexico	661.3%
2	Hawaii	11,108.7%		16	Texas	658.4%
3	Nebraska	8,142.0%		17	Washington	484.6%
4	Pennsylvania	4,106.4%		18	Iowa	465.1%
5	New York	3,957.8%		19	Minnesota	194.2%
6	Illinois	3,591.3%		20	Wyoming	106.7%
7	Oklahoma	3,324.3%		21	California	59.6%
8	Kansas	2,793.5%		22	Wisconsin	51.2%
9	Colorado	2,555.3%		23	New Jersey	27.7%
10	West Virginia	1,762.1%		24	Montana	13.7%
11	Oregon	1,307.7%		25	Ohio	13.5%
12	Tennessee	1,148.4%		26	Alaska	6.5%
13	North Dakota	952.2%		27	Idaho	1.6%
14	Michigan	872.5%		28	Vermont	-13.4%

* For states in which wind generation began after 2001, the first year in which the EIA reports wind generation in that state is used to create the baseline to determine the most-improved rankings. The baseline years for each state are: baseline year 2002 - TN, WA, WV; baseline year 2003 - IL, NM, ND, OK; baseline year 2005 - OH; baseline year 2006 - ID, MT, NJ. Maine, which began generating wind in 2007, is not included in the most-improved rankings because its baseline year is the same as the year in which the most recent data for wind generation is available and, as a result, its rate of change could not be measured.

Table 7.58. Growth in Percentage of Total In-State Electricity Generation from Wind, 2001-2007

Rank	State	% Change
1	South Dakota	20,671.7%
2	Hawaii	10,233.8%
3	Nebraska	7,644.7%
4	New York	3,903.2%
5	Pennsylvania	3,557.3%
6	Illinois	3,204.0%
7	Oklahoma	2,498.1%
8	Kansas	2,483.3%
9	Colorado	2,208.9%
10	West Virginia	1,522.3%
11	Tennessee	1,163.0%
12	Oregon	1,051.4%
13	North Dakota	922.1%
14	Michigan	811.7%
15	New Mexico	611.1%
16	Texas	596.9%
17	Iowa	361.4%
18	Washington	353.8%
19	Minnesota	162.0%
20	Wyoming	102.8%
21	California	50.3%
22	Wisconsin	40.2%
23	New Jersey	21.0%
24	Alaska	5.3%
25	Ohio	4.0%
26	Montana	-4.8%
27	Idaho	-17.3%
28	Vermont	-18.5%

Table 7.59. Growth in Wind Electricity Generation per Capita, 2001-2007					
Rank	**State**	**% Change**	**Rank**	**State**	**% Change**
1	South Dakota	16,326.3%	15	New Mexico	608.9%
2	Hawaii	10,592.7%	16	Texas	578.8%
3	Nebraska	7,903.6%	17	Iowa	455.0%
4	Pennsylvania	4,061.5%	18	Washington	443.0%
5	New York	3,884.2%	19	Minnesota	182.9%
6	Illinois	3,502.3%	20	Wyoming	94.8%
7	Oklahoma	3,188.3%	21	California	51.5%
8	Kansas	2,713.9%	22	Wisconsin	46.0%
9	Colorado	2,331.1%	23	New Jersey	25.3%
10	West Virginia	1,750.8%	24	Ohio	12.6%
11	Oregon	1,208.4%	25	Montana	7.7%
12	Tennessee	1,068.3%	26	Alaska	-1.0%
13	North Dakota	949.7%	27	Idaho	-10.3%
14	Michigan	868.4%	28	Vermont	-14.6%

Table 7.60. Growth in Wind Electricity Generation per GSP, 2001-2007					
Rank	**State**	**% Change**	**Rank**	**State**	**% Change**
1	South Dakota	12,035.8%	15	New Mexico	413.3%
2	Hawaii	7,518.3%	16	Texas	406.2%
3	Nebraska	5,810.7%	17	Washington	324.0%
4	Pennsylvania	3,121.1%	18	Iowa	302.6%
5	New York	2,874.5%	19	Minnesota	119.5%
6	Illinois	2,785.2%	20	Wyoming	24.3%
7	Oklahoma	2,218.5%	21	Wisconsin	18.4%
8	Kansas	2,031.9%	22	California	14.5%
9	Colorado	1,900.8%	23	New Jersey	-0.5%
10	West Virginia	1,299.2%	24	Ohio	-8.8%
11	Oregon	886.7%	25	Montana	-25.4%
12	Tennessee	824.4%	26	Idaho	-29.3%
13	Michigan	751.5%	27	Vermont	-33.5%
14	North Dakota	603.1%	28	Alaska	-36.3%

Wind Resource Growth, 2006-2007

Table 7.61. Growth in Wind Electricity Generation, 2006-2007*

Rank	State	%Change	Rank	State	%Change
1	Hawaii	199.0%	15	Kansas	16.2%
2	Illinois	161.0%	16	California	14.4%
3	Washington	134.9%	17	Montana	13.7%
4	North Dakota	68.0%	18	New Mexico	11.0%
5	Colorado	49.2%	19	Oklahoma	8.0%
6	Texas	35.0%	20	Wisconsin	7.8%
7	Oregon	33.9%	21	Ohio	2.4%
8	Pennsylvania	30.2%	22	Idaho	1.6%
9	Alaska	28.4%	23	South Dakota	0.7%
10	Minnesota	28.4%	24	Wyoming	-0.6%
11	New Jersey	27.7%	25	Vermont	-1.7%
12	New York	27.2%	26	West Virginia	-3.6%
13	Michigan	23.1%	27	Tennessee	-8.5%
14	Iowa	18.9%	28	Nebraska	-17.0%

*Maine not included because 2007 is its 1st year of wind generation

Table 7.62. Growth in Percentage of Total In-State Electricity Generation from Wind, 2006-2007

Rank	State	%Change	Rank	State	%Change
1	Hawaii	199.6%	15	California	17.6%
2	Illinois	150.8%	16	South Dakota	17.1%
3	Washington	137.6%	17	Michigan	16.1%
4	North Dakota	66.2%	18	New Mexico	14.9%
5	Colorado	40.3%	19	Montana	11.0%
6	Texas	33.4%	20	Iowa	8.7%
7	Oregon	29.7%	21	Kansas	5.5%
8	Pennsylvania	26.0%	22	Wisconsin	4.8%
9	Alaska	25.7%	23	Oklahoma	4.7%
10	Minnesota	25.5%	24	Ohio	2.6%
11	New York	24.0%	25	Wyoming	-1.1%
12	New Jersey	23.6%	26	West Virginia	-3.7%
13	Vermont	19.6%	27	Tennessee	-9.7%
14	Idaho	18.38%	28	Nebraska	-19.0%

Table 7.63. Growth in Wind Electricity Generation per Capita, 2006-2007					
Rank	State	% Change	Rank	State	% Change
1	Hawaii	199.3%	15	Kansas	15.3%
2	Illinois	160.0%	16	California	14.0%
3	Washington	132.2%	17	Montana	12.6%
4	North Dakota	67.9%	18	New Mexico	9.7%
5	Colorado	46.9%	19	Wisconsin	7.3%
6	Texas	32.6%	20	Oklahoma	7.1%
7	Oregon	32.3%	21	Ohio	2.3%
8	Pennsylvania	30.0%	22	South Dakota	-0.2%
9	New Jersey	27.8%	23	Idaho	-0.6%
10	Alaska	27.7%	24	Vermont	-1.7%
11	Minnesota	27.7%	25	Wyoming	-2.6%
12	New York	26.2%	26	West Virginia	-3.6%
13	Michigan	23.7%	27	Tennessee	-9.6%
14	Iowa	18.5%	28	Nebraska	-17.3%

Table 7.64. Growth in Wind Electricity Generation per GSP, 2006-2007					
Rank	State	% Change	Rank	State	% Change
1	Hawaii	183.3%	15	Kansas	10.6%
2	Illinois	152.5%	16	New Mexico	10.6%
3	Washington	121.6%	17	California	9.0%
4	North Dakota	59.9%	18	Montana	7.3%
5	Colorado	45.5%	19	Wisconsin	5.5%
6	Oregon	28.0%	20	Oklahoma	4.4%
7	Texas	26.0%	21	Ohio	1.3%
8	Pennsylvania	25.1%	22	Idaho	-0.9%
9	New Jersey	24.3%	23	Vermont	-3.0%
10	Minnesota	23.2%	24	South Dakota	-4.1%
11	Michigan	22.8%	25	Wyoming	-6.7%
12	Alaska	18.6%	26	West Virginia	-7.0%
13	New York	17.8%	27	Tennessee	-10.7%
14	Iowa	14.3%	28	Nebraska	-21.6%

Wind Capacity

Table 7.65. Wind Capacity, 2008					
Rank	**State**	**MW**	**Rank**	**State**	**MW**
1	Texas	7,117.7	19	South Dakota	186.8
2	Iowa	2,791.3	20	Missouri	162.5
3	California	2,503.0	21	Indiana	130.5
4	Minnesota	1,753.4	22	Michigan	129.4
5	Washington	1,446.8	23	Idaho	75.3
6	Colorado	1,067.7	24	Nebraska	71.9
7	Oregon	1,067.2	25	Hawaii	63.1
8	Illinois	915.1	26	Maine	46.6
9	New York	831.8	27	Tennessee	29.0
10	Oklahoma	830.9	28	New Hampshire	25.4
11	Kansas	814.5	29	Utah	19.8
12	North Dakota	714.4	30	New Jersey	7.5
13	Wyoming	676.1	31	Ohio	7.4
14	New Mexico	497.5	32	Vermont	6.1
15	Wisconsin	394.9	33	Massachusetts	5.4
16	Pennsylvania	360.7	34	Alaska	3.3
17	West Virginia	330.0	35	Rhode Island	0.7
18	Montana	271.5	36	Arkansas	0.1

Source: AWEA 2009b

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14. ABSTRACT *(Maximum 200 Words)*
As U.S. states increasingly focus on developing renewable energy resources, there is a need to track the progress of development, as well as the policies and support mechanisms being implemented to encourage this development. Beyond tracking, the evaluation of policy measures is necessary to determine their effectiveness, guide future efforts, and efficiently allocate resources. This report addresses each of these needs. It provides a detailed picture of the status of renewable energy development in each of the U.S. states using a variety of metrics and discusses the policies being used to encourage this development. The report then explores the context in which renewable energy development occurs by discussing the factors that can affect the uptake of power generation technologies. The analysis offers suggestions on how policies can be used to address these variables, which leads to tailored policy support that considers the specific circumstances within each state. The analysis presents results of several quantitative evaluation methods that have been designed to explore the link between policy implementation and actual development. Finally, the report discusses contextual factors, aside from policy, that affect renewable energy development. The report concludes with a summary of the main points from each chapter, discussion of next steps, and a list of resources.

15. SUBJECT TERMS
renewable energy; analysis; state policy; renewable energy resources; power generation; renewable energy development; renewable portfolio standards; net metering; market transformation; interconnection standards; green power purchasing; contractor licensing; equipment certification; generation disclosure; grant programs; line-extension analysis; electric utilities; production incentives; rebate programs; public benefit funds; tax incentives; NREL

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