National Renewable Energy Laboratory

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Office of Energy Efficiency & Renewable Energy

Innovation for Our Energy Future

State of the States 2008: Renewable Energy Development and the Role of Policy

Elizabeth Brown and Sarah Busche

Technical Report
NREL/TP-670-43021
October 2008

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National Renewable Energy Laboratory
1617 Cole Boulevard, Golden, Colorado 80401-3393
303-275-3000 • www.nrel.gov

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Abstract

This report provides insights into the status of renewable energy development at the state level. Renewable resources are increasing in development overall, but state development varies by resource and rates of change. The factors contributing to renewable energy development at the state level are identified and discussed, including the challenges of understanding the role of different factors in development. The report also compiles and evaluates the status of "best-practice" state policy design and connects the existence of some policies with increased renewable energy development through correlation analysis. The report also proposes a strategy for better understanding the role of policy in renewable energy development, based on market-transformation principles. Correlation analysis illustrates the potential for further application of these principles to renewable energy. The final section provides resources for state policy makers for better understanding and developing renewable energy resources.

List of Acronyms

ACEEE	American Council for an Energy-Efficient Economy
DOE	Department of Energy
DSIRE	Database of State Incentives for Renewables and Efficiency
EERE	DOE Office of Energy Efficiency and Renewable Energy
EIA	Energy Information Administration
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
GSP	Gross state product
IEEE	Institute of Electrical and Electronics Engineers
IREC	Interstate Renewable Energy Council
LBNL	Lawrence Berkeley National Laboratory
MWh	Megawatt hour
NEPOOL	New England Power Pool
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
R&D	Research and development
RPS	Renewable portfolio standard
SBC	Systems benefit charge
SCEPA	State Clean Energy Policies Analysis
TAP	Technical Assistance Project
TWh	Terawatt hour
WGA	Western Governors' Association
WPA	Wind Powering America
WREGIS	Western Region Electricity Generation Information System

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Section 1. Purpose and Summary of Results/Conclusions

1.1 Purpose, Background, and Introduction

The initial purpose of this report was to rank states according to their use of the most effective policies promoting renewable-based electricity development: Those states with the most effective policy activity toward development of renewable energy would receive the highest rankings. The result would be similar to the American Council for an Energy-Efficient Economy's "Scorecard for Energy Efficiency" (Eldridge et al. 2006), but would consider the role of renewable energy policy as an extension of energy efficiency. The concept intended to identify those states that were leading the way with policy development to a clean energy economy. In the simplest terms, the tasks were to:

1) identify policies (and the specific high-impact elements within them) with the highest impact on the development of renewable energy, and
2) award points to states implementing those policies (and policy elements) and rank them along a well-designed, quantifiable scale.

The outcomes of the research would be a quantitative understanding of the policy environment within the states, insight into the leading jurisdictions for the promotion of clean energy, and a better understanding of how the policies have an impact on the development of renewable energy resources within the states. The results would move the research field from a case study and policy design-based development and implementation strategy to a more quantitative results-based (in the form of increased renewable-based electricity generation) development of policies.

This report does not present rankings of states and renewable energy policies, because there is no quantitatively designed connection between policy development and renewable energy development.[1] An effort to design a methodology led to identification of knowledge gaps in evaluating the quantitative impacts of renewable energy state policy for the purposes of applying successful policies in one jurisdiction to another. There are policy success stories for renewable energy development resulting from specific policies in specific situations as well as a field of literature on policy design practices. However, connecting those directly to renewable electricity development in a way that can inform effective policy design and implementation in other jurisdictions has not been developed.

It is necessary to fill the gaps between case studies and quantitative understanding of policy impact because increased market interest in renewable energy is leading to more policies for promoting renewable energy. To be effective in achieving goals, state policy makers need information on policy effectiveness within their own context. These knowledge gaps, when filled, answer the following types of questions: How does a policy

[1] Updates to the 2006 ACEEE scorecard, due out in 2008, and ongoing research are continuing the effort toward connecting energy efficiency and renewable energy into a comprehensive understanding of clean energy policy. However, at this time, a more similar model to renewable energy is not possible.

maker translate policy success in one jurisdiction to another? How can states learn from each other and develop policies that have a high likelihood of success, defined by increasing renewable electricity production facilities?

These quantification efforts are complementary to the ongoing qualitative and empirical efforts that are being used to identify the most effective aspects of policies and groups of policies, based on previous experience (e.g., EPA's "Guide to Clean Energy" menu for state policy makers, State Clean Energy Policy Analysis (SCEPA) project at NREL, RPS Collaborative for sharing effective renewable portfolio standard strategies). The quantitative effort provides a better understanding of where and when policies play a large role in development, and which policies have the largest impacts. Taken together, the qualitative, empirical, and quantitative efforts at understanding the role of policy in renewable energy development provide a fuller picture – and can contribute to maximizing the government investment in facilitating renewable energy development.

Instead of quantitatively ranked policy tables, this report identifies and begins to fill the existing knowledge gaps and presents the results of – and lessons learned – from the process described above. This process included three primary elements that form the results of this report:

- Understanding the current status of renewable electricity development at the state level, with consideration for contextual factors. For example, resource availability is a widely known contextual factor in renewable electricity development – availability of wind resource is a driver in the development of wind electricity-generation facilities.

- Identifying and defining contextual factors that contribute to renewable energy development, which will help in understanding the role of policy as a contextual factor in renewable energy development and,

- Collecting identifying policies and elements within policies that lead to renewable energy development.

The overall result of the report is to establish a quantitative connection between state renewable energy policy and renewable energy resource development (**Section 4**). That connection is built on understanding the status and recent market developments of renewable-based electricity generation at the state level **(Section 2),** and opening the discussion regarding the role of different contextual factors (including policy) in the development of renewable energy resources (**Section 3**). **Section 5** presents the overall next steps for research to better understand the role of policy in renewable energy development and inform state policy makers on the impact of policies (and portfolios of policies) to promote renewable energy within individual state contexts. The final section, **Section 6,** provides resources for state policy makers to better understand and maximize the use of renewable energy resources. The **Appendix** provides summary policy definitions, implementation status within states, and available policy design best practices that are referenced throughout the report.

1.2 Summary of Results

This report establishes the importance of quantitative understanding of generalized policy impact to inform state policy makers regarding the opportunities and limitations of policy in developing renewable energy resources. The primary results of this exploratory work are as follows:

Trends in renewable resource-based electricity development:

- Hydroelectric resources provided the largest portion of renewable energy development in the United States in 2006. However, the share of hydroelectric generation is shrinking due to growth of developing renewable energy resources and maximization of the larger-scale hydroelectric resources.
- Between 2001 and 2006, wind resource had the largest growth in renewable generation nationwide.
- Growth in electricity from biomass is primarily occurring in the southeastern areas of the United States, coincident with resource availability
- Renewable energy growth is largely outstripped by economic growth as measured by gross state product (GSP) and population growth.
- According to Energy Information Administration (EIA) data, between 2001 and 2006,
    - 24 states increased electricity generation from biomass resources.
    - 23 states from wind electricity production,
    - 4 states from geothermal electricity production, and
    - 2 states from large-scale solar electricity production (distributed solar not collected by EIA).

Data and method limitations in identifying trends:

- In general, 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). There are a number of challenges in collecting renewable electricity generation at the state level, but those are not the focus here. Instead, the strength of the dataset as a nationwide comparable source in terms of definitions and data collection techniques are the reasons for its use.
- Data for distributed solar electricity resource development are limited by lack of collection by EIA. (Solar PV data are the only presented in this report that are not from the Energy Information Administration. Data presented are installed capacity for 2007, which are collected by the Interstate Renewable Energy Council using established methodologies described in Sherwood 2008).
- Data on renewable-based electricity generation in the U.S. territories is limited. EIA data were supplemented with direct contact to territory energy offices, but no additional data were received by the authors.
- Most recent data are from 2006. Significant market changes between 2006 and 2008 are expected to have an impact on renewable energy generation and will be reported in later versions of this report.
- "Most Improved" rankings provide information on the largest growth rates between 2001 and 2006, leading to heavier weighting of states that began the development of

the particular renewable resource in that time frame. The purpose is to acknowledge the challenge of early-stage development. Alternative and additional methods are under consideration for future reports.

Trends in policy[2] development and identification of best practices

- Because many policies are in early stages of implementation, policy effectiveness is largely evaluated based on design elements seen as successful in previous policy applications. As the market develops, these policies will be evaluated on impact on the market (and other drivers for policy development, such as economic growth).
- High-level correlation analysis shows significant ($p<0.05$) connections between the existence of some state policies and in-state renewable energy-based electricity generation (or capacity, in the case of solar). But, as expected, no causality or direct clear connections between policy and generation increases (possibly due to misalignment of data on generation and policy availability as well as other contextual factors leading to increased renewable electricity generation (see **Cautions with Interpreting These Correlations**). Specific correlations described in the body of the report include:
    - Existence of a renewable portfolio standard (RPS) in a state is significantly correlated to higher wind-based electricity generation. However, policies with half or more of established best practices are not correlated to higher production. (Note that this "half-or-better" method is a preliminary approach, and the conclusion that a well-designed RPS does not correlate to higher renewable generation cannot be drawn from this result.)
    - Existence of an RPS is also significantly correlated to higher renewable percentages of overall electricity generation.
    - Line-extension analysis policies are correlated with higher wind capacity and generation. This result is interesting in that interviews with program administrators indicated that the policy was not intended to increase development of renewable resources, but to facilitate use of most economic "last-mile" electricity solutions.

Cautions with Interpreting These Correlations

Statistically significant ($p<0.05$) correlations are a tool to understand basic connections between different datasets. In this case, correlations are used to establish a quantitative connection between policies and renewable energy capacity and generation at the state level. However, correlations do not appoint causality (e.g., this policy results in higher capacity) and do not account for other contextual conditions. They are used in this report to establish connections, and to augment individual state experience in portions of the report where the role of policy and other contextual factors in renewable energy development are discussed. As with all statistical analysis, the authors encourage careful interpretation of results, and offer that throughout the report.

[2] Policy definitions are available in each policy section of the Appendix.

- Production incentives at the state level, while a small sample (n=6), are significantly correlated to higher renewable electric capacity and generation, as well as all individual resource categories.
- Interconnection policies meeting best practices as described in the Appendix (based on the Network for New Energy Choices method, NNEC 2008), are correlated with increased renewable energy capacity and generation overall, as well as individually with higher biomass, hydroelectric, and PV capacity.

1.3 Summary of Overall Conclusions and Next Steps

The following are the primary conclusions of this research. These preliminary observations indicate many areas of continued research to better understand the role of state policy in renewable energy development – those suggestions follow each of the conclusions.

- There is a quantified connection between policy and renewable energy development. Understanding the details of the connection to better inform policy development at the state level is the primary next step.
- In addition to policy, there are many other contextual factors driving the development of renewable energy resources at the state level. Better understanding the role of each of these factors and their variation across states will provide insight and understanding into the development of renewable energy resources, as well as the role of each in transformation of the clean energy market. The study of factors influencing renewable energy development and market transformation is the subject of upcoming research.
- Policy best practices are design based, not results based. Further investigation into policy outcomes and better understanding of policy design elements that are applicable across state contextual factors are critical to informing the development of state policies that are effective in increasing renewable energy. In addition, methodologies to better understand the connection between policy design and differences in overall impact are being developed.

The DOE-funded, NREL-implemented State Clean Energy Policies Analysis (SCEPA) project, as well as future versions of this report, will build on and develop next steps. The project teams appreciate input and participation by stakeholders. More information can be found on the SCEPA Web site at http://www.nrel.gov/applying_technologies/scepa.html.

Section 2. Quantitative Trends in Renewable Energy Development

This section discusses drivers for renewable energy development based on actual electrical generation from renewable resources. The analysis includes ranked tables of renewable energy electricity trends at the state level using the most recently available data (2006), as well as selected changes over the five-year period from 2001 to 2006. Renewable energy development is also divided into resources to reflect differing geographic availability of renewable resources. The goal is to provide state policy makers with a variety of metrics to inform understanding of clean energy market penetration relative to other states as well as recent historical changes in renewable energy development.

Most data and definitions of renewable energy are from the Department of Energy's statistical data agency, the Energy Information Administration (EIA 2008, Appendix). Distributed solar capacity data are from the Interstate Renewable Energy Council (Sherwood 2008) (see **Challenges with EIA Renewable Energy Data**).

> **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 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 territory energy contacts; 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 two 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 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.

Data for a single year do not sufficiently describe renewable energy trends in the United States. With the increased interest in renewable energy during the past five years, as well as increased policy activity, recent growth in renewable energy generation is an important indicator of successful development within each state. Renewable energy growth metrics demonstrate how states are taking advantage of their available renewable resources, and the analysis identifies areas for further development. There are a number of ways to report renewable energy growth over time. In this report, the metric used is 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 beginning year. While the actual improvements may be small in terms of actual capacity development, they represent large strides in the transition to a clean energy economy.

Multiple factors influence the development of renewable energy at the state level. The size and economic context of the state can be a large determinate of development. In later sections of the report, these possible drivers are discussed, including the main focus of the report – policies. To begin to address the contextual differences between states in a quantitative way, state renewable energy generation is normalized for population and gross state product to address economic contexts of individual states. For supply-side clean energy, resource availability is a limiting factor in development of renewable resources. Development is divided by resource (e.g., wind, biomass) to reflect resource differences among states and to begin to address the challenges of understanding how states take advantage of available local resources. In addition to these quantified renewable energy-development influencing factors, the subsequent chapter describes other factors, and the final section begins a quantitative exploration of the role of policy in renewable energy development.

2.1 Methodology

Renewable energy trends in the states are listed in the following tables based on 2006 renewable energy generation and the rate of change from 2001 to 2006. The definition of renewable energy for this report includes biomass, geothermal, hydroelectric, solar (central), and wind, as defined and tracked by the United States 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). These types of renewable energy are defined as:[3]

- 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 manure]; 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 derived fuels (2003a, 2008).
- Geothermal: electricity produced centrally from heat in the earth.
- Conventional Hydroelectric. comes 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."[4] Pumped storage is not collected and reported under this definition because the EIA considers it to use

[3] Note that the definition of renewable energy and renewable energy types are broad and differ depending on analysis and data needs.
[4] http://www.eia.doe.gov/glossary/glossary_c.htm

nonrenewable resources for operation.[5] In this report, low-impact and distributed hydro, which may have a large potential for electricity production,[6] is not included as a result of data limitations.

- Solar (central): the radiant heat from the sun, which can be converted into electricity on the large scale, such as through concentrated solar power, concentrated PV, or similar technologies.
- Solar (distributed): on- and off-grid distributed solar electric noncentral electricity generation resources, including residential, commercial, and industrial applications. Primary technology is photovoltaics (PV).
- Wind: the extraction of kinetic energy from the wind for conversion into electricity.

Due to the unique context in each state, the data are normalized for three parameters to aid in comparison among states: percentage of total electricity generation, state population, and gross state product. Population data for the states are from the U.S. Department of Commerce Census Bureau. State GSP data are compiled from the U.S. Bureau of Economic Analysis. Due to the recent rapid growth in wind energy development, total renewable energy growth during the past five years is skewed when all technologies are grouped together, resulting in a distortion of growth trends. To remedy this and show the growth of major renewable energy technologies in each state, the data for most improved from 2001 to 2006 are separated into technology and then normalized for comparisons between technology and states.

2.2 Quantitative Trend Results

The first section below ranks the states by total renewable generation based on 2006 generation data, percentage of total generation from renewable resources, generation per capita, and generation per gross state product (GSP). The following section presents renewable energy generation trends with states listed by "most improved" based on generation changes from 2001 to 2006. To reflect the resource contexts of states, rate of change for generation is presented by individual resource, with the exception of solar due to the insufficiency of data as described above. The results for each resource are presented in four tables listing the "most improved" states based on total renewable generation (MWh), renewable generation as a percentage of total generation (%), generation per capita, and generation per GSP.

2.2.1 2006 Renewable Energy Generation: MWh, % Total State Generation, Generation per Capita, and Generation per Gross State Product

Table 1 displays the EIA-collected data for grid-connected renewable electricity generation for each state in 2006 in total megawatt hours (MWh). The dataset includes generation from biomass, geothermal electricity, nondistributed solar, and wind. Distributed solar data are not collected by EIA, so are not included in this table.[7] Considering all renewable resources in the dataset, Washington ranks first with nearly 72

[5] http://www.eia.doe.gov/cneaf/solar.renewables/page/rea_data/rea_sum.html
[6] http://hydropower.inl.gov/hydrofacts/undeveloped_potential.shtml
[7] Distributed solar capacity is tracked by IREC USA and those data are referenced later in this report.

terawatt hours (TWh). Large-scale hydroelectric generation resources are more developed than most renewable resources and are removed from the dataset in **Table 2** to illustrate the development of other renewable resources at the state level. If hydroelectric resources are not included, California becomes the highest ranked with 24 TWh, and generates more than three times the renewable generation of any other state. Nonhydroelectric renewable generation in Arizona, Missouri, Alaska, and Delaware was less than 100,000 MWh in 2006.

Table 1. Total On-Grid Renewable Energy Generation (2006)

Rank	State	MWh		Rank	State	MWh
1	Washington	84,510,138		29	Colorado	2,687,435
2	California	71,937,993		30	Oklahoma	2,636,500
3	Oregon	39,720,153		31	New Hampshire	2,275,311
4	New York	29,951,143		32	Vermont	1,968,575
5	Idaho	11,941,587		33	North Dakota	1,894,063
6	Alabama	11,157,527		34	West Virginia	1,746,190
7	Montana	10,654,250		35	Wyoming	1,602,377
8	Texas	8,495,704		36	Mississippi	1,541,083
9	Tennessee	8,273,774		37	New Mexico	1,475,532
10	Maine	8,252,216		38	Connecticut	1,307,212
11	Arizona	6,846,471		39	Alaska	1,231,058
12	Georgia	6,011,830		40	Nebraska	1,206,647
13	North Carolina	5,673,914		41	Ohio	1,030,831
14	Pennsylvania	5,322,011		42	Illinois	1,022,125
15	Florida	4,575,897		43	Kansas	1,001,539
16	Michigan	3,972,381		44	Utah	952,280
17	Virginia	3,832,692		45	New Jersey	952,220
18	Louisiana	3,744,242		46	Hawaii	737,729
19	South Carolina	3,643,822		47	Indiana	709,829
20	Minnesota	3,629,208		48	Missouri	222,117
21	South Dakota	3,545,798		49	Rhode Island	154,822
22	Nevada	3,401,337		50	Delaware	*
23	Iowa	3,364,068		50	American Samoa	*
24	Arkansas	3,252,360		50	D.C.	*
25	Kentucky	3,051,091		50	Guam	*
26	Wisconsin	3,027,307		50	Northern Marianas	*
27	Massachusetts	2,791,473		50	Puerto Rico	*
28	Maryland	2,733,517		50	Virgin Islands	*

Source: EIA 2008
*Less than 500 kilowatt hours (kWh) total renewable electricity generation, or data unavailable

Table 2. Total Nonhydro Renewable Electricity Generation (2006)

Rank	State	MWh	Rank	State	MWh
1	California	23,890,613	29	Connecticut	763,320
2	Texas	7,833,733	30	Wyoming	759,061
3	Florida	4,372,475	31	New Hampshire	746,401
4	Maine	3,974,084	32	Idaho	699,215
5	Alabama	3,905,741	33	Maryland	629,242
6	Georgia	3,442,993	34	Hawaii	617,642
7	Minnesota	3,057,478	35	Tennessee	525,124
8	Louisiana	3,031,027	36	Montana	524,089
9	New York	2,606,488	37	Kentucky	459,390
10	Washington	2,502,509	38	Vermont	449,910
11	Virginia	2,481,498	39	Ohio	398,895
12	Pennsylvania	2,477,869	40	North Dakota	373,029
13	Iowa	2,454,720	41	Nebraska	313,261
14	Michigan	2,452,028	42	Indiana	220,314
15	Oklahoma	2,012,921	43	Utah	205,497
16	Oregon	1,869,856	44	West Virginia	173,757
17	South Carolina	1,836,874	45	South Dakota	148,965
18	North Carolina	1,834,902	46	Rhode Island	148,913
19	Arkansas	1,701,802	47	Arizona	53,567
20	Mississippi	1,541,083	48	Missouri	22,903
21	Wisconsin	1,348,709	49	Alaska	7,451
22	Nevada	1,343,711	50	Delaware	*
23	Massachusetts	1,278,828	50	American Samoa	*
24	New Mexico	1,277,321	50	D.C.	*
25	Kansas	991,890	50	Guam	*
26	New Jersey	916,784	50	Northern Marianas	*
27	Colorado	896,228	50	Puerto Rico	*
28	Illinois	848,853	50	U.S. Virgin Islands	*

Source: EIA 2008
*Less than 500 kilowatt hours (kWh) total renewable electricity generation, or data unavailable

Percentage of Total Generation

Percentage of total in-state generation is a normalizing metric to add context to the state progress toward renewable-based electricity development. **Table 3** presents the renewable percentages including hydroelectric resources, and **Table 4** presents percentages without 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 – in order to focus on developing markets – no state produces more than 25% of electricity from renewable resources, and most states generate less than 5%.

Table 3. Percentage of Total State Electricity Generation: All Renewable Resources (2006)

Rank	State	% Total State Gen.		Rank	State	% Total State Gen.
1	Idaho	89.2%		29	New Mexico	4.0%
2	Washington	78.1%		30	Nebraska	3.8%
3	Oregon	74.5%		31	Connecticut	3.8%
4	South Dakota	49.7%		32	Oklahoma	3.7%
5	Maine	49.1%		33	South Carolina	3.7%
6	Montana	37.7%		34	Wyoming	3.5%
7	California	33.2%		35	Michigan	3.5%
8	Vermont	27.8%		36	Mississippi	3.3%
9	New York	21.1%		37	Kentucky	3.1%
10	Alaska	18.4%		38	Rhode Island	2.6%
11	Nevada	10.7%		39	Pennsylvania	2.4%
12	New Hampshire	10.3%		40	Utah	2.3%
13	Tennessee	8.8%		41	Kansas	2.2%
14	Alabama	7.9%		42	Texas	2.1%
15	Iowa	7.4%		43	Florida	2.0%
16	Minnesota	6.8%		44	West Virginia	1.9%
17	Arizona	6.6%		45	New Jersey	1.6%
18	Hawaii	6.4%		46	Ohio	0.7%
19	Arkansas	6.2%		47	Indiana	0.5%
20	North Dakota	6.1%		48	Illinois	0.5%
21	Massachusetts	6.1%		49	Missouri	0.2%
22	Maryland	5.6%		50	Delaware	0.0%
23	Colorado	5.3%		50	American Samoa	0.0%
24	Virginia	5.2%		50	D.C.	0.0%
25	Wisconsin	4.9%		50	Guam	0.0%
26	North Carolina	4.5%		50	Northern Marianas	0.0%
27	Georgia	4.4%		50	Puerto Rico	0.0%
28	Louisiana	4.1%		50	Virgin Islands	0.0%

Table 4. Percentage of Total State Electricity Generation: Nonhydroelectric Renewable Resources (2006)

Rank	State	% Total State Gen.		Rank	State	% Total State Gen.
1	Maine	23.63%		29	Montana	1.86%
2	California	11.02%		30	South Carolina	1.85%
3	Vermont	6.35%		31	New York	1.83%
4	Minnesota	5.74%		32	Colorado	1.77%
5	Iowa	5.40%		33	Wyoming	1.67%
6	Hawaii	5.34%		34	New Jersey	1.51%
7	Idaho	5.22%		35	North Carolina	1.47%
8	Nevada	4.22%		36	Maryland	1.29%
9	Oregon	3.51%		37	North Dakota	1.21%
10	New Mexico	3.43%		38	Pennsylvania	1.13%
11	Virginia	3.40%		39	Nebraska	0.99%
12	New Hampshire	3.38%		40	Tennessee	0.56%
13	Louisiana	3.33%		41	Utah	0.50%
14	Mississippi	3.33%		42	Kentucky	0.47%
15	Arkansas	3.26%		43	Illinois	0.44%
16	Oklahoma	2.85%		44	Ohio	0.26%
17	Massachusetts	2.80%		45	West Virginia	0.19%
18	Alabama	2.77%		46	Indiana	0.17%
19	Rhode Island	2.50%		47	Alaska	0.11%
20	Georgia	2.49%		48	Arizona	0.05%
21	Washington	2.31%		49	Missouri	0.02%
22	Connecticut	2.20%		50	Delaware	*
23	Wisconsin	2.19%		50	American Samoa	*
24	Kansas	2.18%		50	D.C.	*
25	Michigan	2.18%		50	Guam	*
26	South Dakota	2.09%		50	Northern Marianas	*
27	Texas	1.96%		50	Puerto Rico	*
28	Florida	1.95%		50	Virgin Islands	*

Generation per Capita

Generation per capita is another normalizing metric to gain insight into trends. States with smaller populations and large renewable generation top this list. When all renewable resources are considered, hydroelectric resource use in the northwestern states launches Washington, Montana, and Oregon to more than 10 MWh of generation per person (**Table 5**). When those resources are removed, Maine has the highest generation per person at 3 MWh/capita, with the vast majority of states generating less than 1 MWh per capita (**Table 6**).

Table 5. Renewable Electricity Generation (2006): MWh/Capita

Rank	State	MWh/Capita		Rank	State	MWh/Capita
1	Washington	13.257		29	North Carolina	0.640
2	Montana	11.253		30	Hawaii	0.577
3	Oregon	10.761		31	Colorado	0.564
4	Idaho	8.158		32	Wisconsin	0.543
5	Maine	6.276		33	Mississippi	0.532
6	South Dakota	4.497		34	Virginia	0.502
7	Vermont	3.171		35	Maryland	0.488
8	Wyoming	3.125		36	Massachusetts	0.434
9	North Dakota	2.971		37	Pennsylvania	0.429
10	Alabama	2.431		38	Michigan	0.393
11	California	1.985		39	Connecticut	0.374
12	Alaska	1.817		40	Utah	0.369
13	New Hampshire	1.734		41	Kansas	0.363
14	New York	1.553		42	Texas	0.363
15	Nevada	1.365		43	Florida	0.253
16	Tennessee	1.362		44	Rhode Island	0.146
17	Arkansas	1.158		45	Indiana	0.113
18	Iowa	1.132		46	New Jersey	0.110
19	Arizona	1.110		47	Ohio	0.090
20	West Virginia	0.965		48	Illinois	0.080
21	Louisiana	0.882		49	Missouri	0.038
22	South Carolina	0.842		50	Delaware	*
23	New Mexico	0.760		50	American Samoa	*
24	Oklahoma	0.737		50	D.C.	*
25	Kentucky	0.726		50	Guam	*
26	Minnesota	0.704		50	Northern Marianas	*
27	Nebraska	0.684		50	Puerto Rico	*
28	Georgia	0.644		50	Virgin Islands	*

Table 6. Nonhydroelectric Renewable Electricity Generation (2006): MWh/Capita

Rank	State	MWh/Capita	Rank	State	MWh/Capita
1	Maine	3.022	29	Connecticut	0.218
2	Wyoming	1.480	30	North Carolina	0.207
3	Alabama	0.851	31	Pennsylvania	0.200
4	Iowa	0.826	32	Massachusetts	0.199
5	Vermont	0.725	33	South Dakota	0.189
6	Louisiana	0.714	34	Colorado	0.188
7	California	0.659	35	Nebraska	0.178
8	New Mexico	0.658	36	Rhode Island	0.140
9	Arkansas	0.606	37	New York	0.135
10	Minnesota	0.593	38	Maryland	0.112
11	North Dakota	0.585	39	Kentucky	0.109
12	New Hampshire	0.569	40	New Jersey	0.106
13	Oklahoma	0.563	41	West Virginia	0.096
14	Montana	0.554	42	Tennessee	0.086
15	Nevada	0.539	43	Utah	0.080
16	Mississippi	0.532	44	Illinois	0.066
17	Oregon	0.507	45	Indiana	0.035
18	Hawaii	0.483	46	Ohio	0.035
19	Idaho	0.478	47	Alaska	0.011
20	South Carolina	0.424	48	Arizona	0.009
21	Washington	0.393	49	Missouri	0.004
22	Georgia	0.369	50	Delaware	*
23	Kansas	0.360	50	American Samoa	*
24	Texas	0.335	50	D.C.	*
25	Virginia	0.325	50	Guam	*
26	Michigan	0.243	50	Northern Marianas	*
27	Florida	0.242	50	Puerto Rico	*
28	Wisconsin	0.242	50	Virgin Islands	*

Generation per Gross State Product (GSP)

Normalizing for economic context provides further insights into renewable electricity generation. **Tables 7 and 8** normalize generation using gross state product (GSP), a traditional measure of state economic output. Similar to population analyses, states with relatively small output and high renewable generation will top this list. To rank higher, more economically productive states would need to generate a larger amount of renewable-based electricity.

Table 7. Renewable Generation per Gross State Product (MWh/$M, 2006 GSP)

Rank	State	MWH/$M		Rank	State	MWH/$M
1	Montana	329.63		29	North Carolina	15.15
2	Washington	287.91		30	Minnesota	14.84
3	Oregon	262.52		31	Wisconsin	13.32
4	Idaho	239.28		32	Hawaii	12.65
5	Maine	175.68		33	Colorado	11.66
6	South Dakota	109.68		34	Maryland	10.60
7	Vermont	81.30		35	Pennsylvania	10.43
8	North Dakota	71.79		36	Michigan	10.43
9	Alabama	69.49		37	Virginia	10.38
10	Wyoming	54.21		38	Utah	9.74
11	California	41.65		39	Kansas	8.97
12	New Hampshire	40.43		40	Massachusetts	8.27
13	Arkansas	35.41		41	Texas	7.97
14	Tennessee	34.76		42	Florida	6.41
15	West Virginia	31.37		43	Connecticut	6.40
16	Alaska	29.95		44	Rhode Island	3.39
17	Arizona	29.45		45	Indiana	2.85
18	New York	29.31		46	Ohio	2.23
19	Nevada	28.73		47	New Jersey	2.10
20	Iowa	27.14		48	Illinois	1.73
21	South Carolina	24.42		49	Missouri	0.98
22	Kentucky	20.90		50	Delaware	0.00
23	Oklahoma	19.58		51	American Samoa	0.00
24	New Mexico	19.44		51	D.C.	0.00
25	Louisiana	19.39		51	Guam	0.00
26	Mississippi	18.30		51	Northern Marianas	0.00
27	Nebraska	15.94		51	Puerto Rico	0.00
28	Georgia	15.84		51	Virgin Islands	0.00

Table 8. Nonhydroelectric Renewable Generation per Gross State Product (MWh/$M, 2006 GSP)

Rank	State	MWH/$M	Rank	State	MWH/$M
1	Maine	84.60	29	North Carolina	4.90
2	Wyoming	25.68	30	Pennsylvania	4.86
3	Alabama	24.32	31	South Dakota	4.61
4	Iowa	19.80	32	Nebraska	4.14
5	Vermont	18.58	33	Colorado	3.89
6	Arkansas	18.53	34	Massachusetts	3.79
7	Mississippi	18.30	35	Connecticut	3.74
8	New Mexico	16.83	36	Rhode Island	3.26
9	Montana	16.21	37	Kentucky	3.15
10	Louisiana	15.69	38	West Virginia	3.12
11	Oklahoma	14.95	39	New York	2.55
12	North Dakota	14.14	40	Maryland	2.44
13	Idaho	14.01	41	Tennessee	2.21
14	California	13.83	42	Utah	2.10
15	New Hampshire	13.26	43	New Jersey	2.02
16	Minnesota	12.50	44	Illinois	1.44
17	Oregon	12.36	45	Indiana	0.89
18	South Carolina	12.31	46	Ohio	0.86
19	Nevada	11.35	47	Arizona	0.23
20	Hawaii	10.59	48	Alaska	0.18
21	Georgia	9.07	49	Missouri	0.10
22	Kansas	8.88	50	Delaware	*
23	Washington	8.53	51	American Samoa	*
24	Texas	7.35	51	D.C.	*
25	Virginia	6.72	51	Guam	*
26	Michigan	6.44	51	Northern Marianas	*
27	Florida	6.13	51	Puerto Rico	*
28	Wisconsin	5.94	51	Virgin Islands	*

2.2.2 2006 and 2001-2006 Changes in Renewable Energy Generation Development by Resource

This section presents resource-specific renewable energy development at the state level as well as changes between 2001 and 2006. All data, with the exception of solar, is presented from EIA data available in the 2006 Renewable Energy Annual (EIA 2008).

Several factors impact the development of renewable resources at the state level. Resource availability is critically important to the economically feasible development of renewable resources, because transporting resource into the state can be a major expense.

While a potentially obvious observation, local development of local resources for electricity production is a fundamentally different electricity production and delivery infrastructure than the fossil-based electricity economy. Fossil fuels are transported from resource-rich locations to areas of high electricity demand before conversion to electricity. In the case of most renewable electricity generation, moving the resource is either not an option (e.g., wind, solar), or not an economical one over long distances (e.g., biomass).

As a result, the development of renewable energy resources could be linked directly to the availability of economically feasible resources. Complicating this matter is the necessary subsidization of most renewable technologies due to the inability of the free market to capture external benefits. Subsidies are not necessarily driven by resource availability, sometimes leading to the development of suboptimal resources within the jurisdiction of the subsidy. In addition, technology development is expanding the opportunity for less-optimal resources to become economically feasible. This is especially evident in the wind market where resources considered suboptimal less than a decade ago are now accessible due to resource-capturing technologies (e.g., more efficient wind turbines).

These complicated resource factors only partly describe the development of renewable resources (Section 3 provides more discussion of factors). Attempting to rank state resource development while qualitatively normalizing these resource availability factors, this section provides individual resource tables to identify leading states in resource development in the most recent year available (2006) and developments specific to recent years. This "most improved" ranking system intends to identify states that have excelled at individual resource development, but those accomplishments may be overlooked when mixed in with all states and all resources. It is a way of identifying and recognizing state efforts in developing economically feasible in-state resources.

For each resource, this section includes a ranking for 2006 generation in MWh as well as "most improved" 2001-2006 tables for:

- Total Generation
- Percentage of Total In-State Generation
- Generation per Capita
- Generation per Gross State Product

Overall, these tables illustrate resource-by-resource in-state development, as well as the development as it keeps pace with economic growth in the form of GSP and population between 2010 and 2006.

Biomass

Biomass sources can be defined as 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 manure]; post-consumer residues and wastes, such as fats, greases, oils, construction and demolition wood debris and other urban wood waste, municipal solid wastes/wastewater, and landfill gases (Milbrandt 2008). The EIA definition includes landfill gas/MSW biogenic, wood, and derived fuels (2003a, 2008).

Overall biomass generation in 2006 is listed in **Table 9.** California generated the most biomass-based electricity in 2006, followed by 18 other states that produced more than 1 million MWh from biomass-based electricity. Eight states and all of the territories either did not report generation or reported none. Recent developments of biomass-based electricity, as shown in the following 2001-2006 data tables, are occurring in the central and southern United States, where there is a wealth of resource (Milbrandt 2005).

Table 9. Biomass Generation (2006)

Rank	State	MWh	Rank	State	MWh
1	California	5,691,806	23	New Hampshire	746,402
2	Florida	4,372,476	24	Maryland	629,242
3	Maine	3,974,084	25	Illinois	594,282
4	Alabama	3,905,741	26	Idaho	529,598
5	Georgia	3,442,993	27	Tennessee	470,526
6	Louisiana	3,031,027	28	Kentucky	459,390
7	Virginia	2,481,498	29	Vermont	439,222
8	Michigan	2,449,816	30	Ohio	384,495
9	Pennsylvania	2,116,762	31	Hawaii	325,692
10	New York	1,951,116	32	Oklahoma	300,480
11	South Carolina	1,836,874	33	Indiana	220,314
12	North Carolina	1,834,902	34	Rhode Island	148,913
13	Arkansas	1,701,802	35	Iowa	136,899
14	Mississippi	1,541,083	36	Montana	88,119
15	Washington	1,464,859	37	Nebraska	52,014
16	Massachusetts	1,278,829	38	Arizona	40,433
17	Wisconsin	1,247,333	39	Colorado	30,692
18	Texas	1,163,217	40	Missouri	22,807
19	Minnesota	1,002,531	41	New Mexico	21,885
20	Oregon	938,637	42	Utah	14,889
21	New Jersey	900,793	43	Alaska	6,663
22	Connecticut	763,320	44	North Dakota	3,544

Source: EIA 2008

Total Generation
Table 10 presents state trends for improvement in total electricity generation (in MWh) from biomass, 2001 to 2006. Kentucky has experienced the largest increase in total electric generation from biomass during this period, followed by Nebraska and South Carolina. All other states with documented generation from biomass sources increased generation by less than 100% or demonstrated negative growth during this period. Reduction of bioenergy facilities may be the result of economic or resource availability challenges, transition of resources to other uses, closure of old technology facilities, or increasingly stringent environmental regulations.

Percentage of Total Generation
Table 11 lists states based on the rate of change of the percentage of total in-state generation from biomass sources from 2001 to 2006. Nineteen of the 44 states showed positive improvements for this metric, with Kentucky experiencing a substantially larger increase in biomass-based electricity use than any other state during this period.

Generation per Capita
In **Table 12**, the states are listed based on the increase of biomass-based electricity generation per capita from 2001 to 2006. Of the 20 states that experienced an increase for this metric, Kentucky increased generation per capita at an unprecedented rate of more than 4,700%. Twenty-three states experienced a decrease in per capita electricity generation from biomass sources.

Generation per Gross State Product
Table 13 lists the states based on improvement in electricity generated from biomass per GSP from 2001 to 2006. Kentucky leads the states, with six other states making positive improvements during the period.

Table 10. Most Improved – Total Biomass Electricity Generated, 2001-2006 [8]		
Rank	State	% Change
1	KY	4,709%
2	NE	211%
3	SC	101%
4	IN	69%
5	UT	54%
6	RI	44%
7	MT	35%
8	OK	30%
9	IA	22%
10	OR	19%
11	VT	19%
12	NM	17%
13	VA	16%
14	TX	15%
15	GA	14%
16	WA	14%
17	AR	13%
18	LA	10%
19	MS	8%
20	WI	5%

Table 11. Most Improved – Percentage of Total In-State Electricity Generation Generated from Biomass, Change from 2001-2006 [2]		
Rank	State	% Change
1	KY	4,545%
2	NE	199%
3	RI	81%
4	SC	80%
5	IN	59%
6	UT	34%
7	MS	24%
8	VA	17%
9	MT	16%
10	ME	13%
11	IA	9%
12	TX	7%
13	LA	7%
14	NM	6%
15	OK	2%
16	AR	2%
17	MD	2%
18	OR	1%
19	WI	0%
	GA	-2%

Table 12. Most Improved – Biomass Electricity Generation Per Capita, Change from 2001-2006		
Rank	State	% Change
1	KY	4,553%
2	NE	203%
3	SC	88%
4	IN	64%
5	RI	43%
6	UT	37%
7	MT	29%
8	OK	26%
9	IA	20%
10	VT	17%
11	LA	16%
12	OR	12%
13	NM	10%
14	VA	9%
15	AR	8%
16	WA	7%
17	MS	6%
18	TX	5%
19	GA	3%
20	WI	2%

Table 13. Most Improved – Biomass Electricity Generation per GSP, Change from 2001-2006 [2]		
Rank	State	% Change
1	KY	3,693%
2	NE	136%
3	SC	58%
4	IN	32%
5	UT	11%
6	RI	11%
	MT	-6%
	VT	-8%
	OK	-9%
	IA	-10%
	GA	-10%
	WA	-12%
	OR	-13%
	VA	-13%
	MI	-14%
	AR	-16%
	MS	-16%
	WI	-16%
	TX	-17%
	NM	-21%

[8] According to EIA data, there was no biomass generation in Alaska from 2001 through 2005, although biomass generation was reported for 2006. For this reason, Alaska is not included in the most improved rankings as the baseline year is the same as the year for which the most recent biomass generation data is available and, as a result, the states rate of change could not be measured. West Virginia generated electricity from biomass sources in 2001 but not in 2006, and, therefore, is not included in the biomass tables above.

Table 10. Most Improved – Total Biomass Electricity Generated, 2001-2006 [8]		
21	AZ	4%
22	NC	3%
23	CA	2%
24	MD	1%
	ID	-1%
	MI	-2%
	ME	-3%
	AL	-7%
	OH	-11%
	FL	-13%
	IL	-18%
	PA	-20%
	NY	-25%
	MN	-26%
	HI	-29%
	NJ	-31%
	NH	-31%
	MA	-39%
	TN	-43%
	CO	-52%
	ND	-54%
	CT	-57%
	MO	-63%
	DE	*
Sources: EIA 2003a, EIA 2008		

Table 11. Most Improved – Percentage of Total In-State Electricity Generation Generated from Biomass, Change from 2001-2006 [2]		
	MI	-3%
	NC	-3%
	CA	-7%
	VT	-8%
	AZ	-11%
	WA	-13%
	AL	-17%
	OH	-18%
	NY	-24%
	IL	-24%
	FL	-26%
	PA	-28%
	ID	-31%
	NJ	-32%
	MN	-33%
	HI	-34%
	TN	-42%
	MA	-48%
	NH	-53%
	ND	-55%
	CO	-56%
	CT	-62%
	MO	-68%
	DE	*
Sources: EIA 2003a, EIA 2003b, EIA 2007, EIA 2008		

Table 12. Most Improved – Biomass Electricity Generation Per Capita, Change from 2001-2006		
	MD	-3%
	CA	-3%
	MI	-3%
	NC	-5%
	ME	-5%
	AL	-10%
	ID	-10%
	AZ	-11%
	OH	-11%
	IL	-20%
	PA	-21%
	FL	-22%
	NY	-25%
	MN	-29%
	HI	-32%
	NJ	-32%
	NH	-34%
	MA	-39%
	TN	-46%
	ND	-54%
	CO	-56%
	CT	-58%
	MO	-65%
	DE	*
Sources: EIA 2003a, EIA 2008, USCB 2007		

Table 13. Most Improved – Biomass Electricity Generation per GSP, Change from 2001-2006 [2]		
	NC	-21%
	ME	-23%
	CA	-23%
	LA	-24%
	MD	-24%
	AZ	-26%
	OH	-28%
	ID	-29%
	AL	-31%
	IL	-34%
	PA	-36%
	FL	-40%
	NY	-40%
	MN	-43%
	NJ	-45%
	NH	-46%
	HI	-49%
	MA	-49%
	TN	-57%
	CO	-63%
	CT	-65%
	ND	-68%
	MO	-71%
	DE	*
Sources: EIA 2003a, EIA 2008, BEA 2008		

Hydroelectric Generation

The EIA dataset containing hydroelectric resources is limited to conventional hydroelectric, as are these tables. Hydroelectric generation (MWh) in 2006 is shown in **Table 14.** Geographically large states and states with large resources dominate the top of the overall generation rankings. Twenty-nine states generated more than 1 million MWh from hydro resources in 2006, the most of all renewable resources.

Table 14. Hydroelectric Generation (2006)

Rank	State	MWh	Rank	State	MWh
1	Washington	82,007,629	29	Alaska	1,223,607
2	California	48,047,380	30	Iowa	909,348
3	Oregon	37,850,297	31	Nebraska	893,386
4	New York	27,344,655	32	Wyoming	843,316
5	Idaho	11,242,372	33	Utah	746,783
6	Montana	10,130,161	34	Louisiana	713,215
7	Tennessee	7,748,650	35	Texas	661,971
8	Alabama	7,251,786	36	Ohio	631,936
9	Arizona	6,792,904	37	Oklahoma	623,579
10	Maine	4,278,132	38	Minnesota	571,730
11	North Carolina	3,839,012	39	Connecticut	543,892
12	South Dakota	3,396,833	40	Indiana	489,515
13	Pennsylvania	2,844,142	41	Florida	203,422
14	Kentucky	2,591,701	42	Missouri	199,214
15	Georgia	2,568,837	43	New Mexico	198,211
16	Maryland	2,104,275	44	Illinois	173,272
17	Nevada	2,057,626	45	Hawaii	120,087
18	South Carolina	1,806,948	46	New Jersey	35,436
19	Colorado	1,791,207	47	Kansas	9,649
20	Wisconsin	1,678,598	48	Rhode Island	5,909
21	West Virginia	1,572,433	49	Delaware	*
22	Arkansas	1,550,558	49	American Samoa	*
23	New Hampshire	1,528,910	49	D.C.	*
24	North Dakota	1,521,034	49	Northern Marianas	*
25	Michigan	1,520,353	49	Virgin Islands	*
26	Vermont	1,518,665	49	Mississippi	*
27	Massachusetts	1,512,645	49	Guam	*
28	Virginia	1,351,194	49	Puerto Rico	*

Total Generation

Table 15 lists states based on improvement in total hydroelectric power generation from 2001 to 2006. Northeastern states saw the most growth in hydroelectricity during this period, although the mature status of the market results in fewer large growth states. Northeastern states may also rank high on this list because of relatively small market penetration in 2001 as compared to 2006. Northwestern state generation also increased in this time period, possibly as a result of efficiency gains in generation or expansion of facilities.

Percentage of Total Generation

Table 16 lists states based on the rate of change of the percentage of total generation from hydroelectric sources, 2001 to 2006. Twenty-eight states reported increases in percentage of electricity generated from hydroelectric resources.

Generation per Capita

In **Table 17**, the states with hydroelectric generation are listed based on the rate of change in hydroelectric generation per capita during the five years from 2001 to 2006. In general, generation increases kept pace with population growth.

Generation per Gross State Product

Table 18 ranks states based on improvement in hydroelectric generation per GSP from 2001 to 2006. Some growth states experienced an increase in hydroelectric generation per GSP during this period at a lower increase than generation, indicating that economic growth outstripped hydroelectric production increases during these five years.

Table 15. Most Improved – Total Hydroelectric Electricity Generated, 2001-2006		
Rank	State	% Change
1	MA	115.32%
2	NJ	96.86%
3	CT	89.92%
4	CA	88.11%
5	RI	88.01%
6	MD	77.80%
7	PA	72.37%
8	VT	71.75%
9	WV	65.18%
10	ME	61.74%
11	ID	55.64%
12	NH	54.34%
13	MT	53.17%
14	WA	49.83%
15	NC	47.90%
16	SC	47.45%
17	UT	46.89%
18	FL	37.71%
19	VA	33.22%

Table 16. Most Improved – Percentage of Total In-State Electricity Generation Generated from Hydroelectric, Change from 2001-2006		
Rank	State	% Change
1	RI	136.34%
2	NJ	92.71%
3	ME	88.17%
4	MA	81.70%
5	MD	78.18%
6	CA	72.32%
7	CT	66.97%
8	PA	54.86%
9	WV	44.09%
10	NC	38.78%
11	VA	35.11%
12	VT	32.87%
13	SC	32.44%
14	MT	31.42%
15	UT	27.63%
16	NY	19.83%
17	FL	17.52%
18	WA	15.00%
19	TN	14.29%

Table 17. Most Improved – Hydroelectric Electricity Generation Per Capita, Change from 2001-2006		
Rank	State	% Change
1	MA	114.43%
2	NJ	92.98%
3	RI	87.44%
4	CT	86.34%
5	CA	79.17%
6	PA	70.77%
7	MD	70.59%
8	VT	69.39%
9	WV	64.28%
10	ME	58.04%
11	NH	47.94%
12	MT	46.59%
13	WA	40.80%
14	ID	40.44%
15	SC	38.35%
16	NC	36.79%
17	UT	30.52%
18	VA	25.38%
19	FL	24.68%

Table 18. Most Improved – Hydroelectric Electricity Generation per GSP, Change from 2001-2006		
Rank	State	% Change
1	MA	78.93%
2	NJ	57.68%
3	CT	53.54%
4	RI	44.73%
5	CA	41.69%
6	PA	37.38%
7	VT	33.56%
8	MD	32.86%
9	WV	28.70%
10	ME	27.84%
11	NH	21.44%
12	SC	15.91%
13	WA	15.24%
14	NC	12.80%
15	ID	11.12%
16	MT	6.49%
17	UT	5.35%
18	OH	0.50%
	DE	0.00%

Table 15. Most Improved – Total Hydroelectric Electricity Generated, 2001-2006

Rank	State	% Change
20	OR	32.14%
21	OH	23.72%
22	IL	20.30%
23	CO	19.84%
24	HI	19.19%
25	NY	18.46%
26	ND	14.19%
27	TN	11.55%
28	IA	7.60%
	DE	0.00%
	Amer. Sam.	0.00%
	D.C.	0.00%
	N. Mar	0.00%
	VI	0.00%
	MS	0.00%
	GU	0.00%
	PR	0.00%
	SD	-1.02%

Table 16. Most Improved – Percentage of Total In-State Electricity Generation Generated from Hydroelectric, Change from 2001-2006

Rank	State	% Change
20	OH	13.23%
21	ND	12.16%
22	IL	12.06%
23	OR	11.60%
24	CO	10.80%
25	HI	9.64%
26	ID	8.68%
27	NH	5.45%
28	SD	2.71%
	DE	0.00%
	Amer. Sam.	0.00%
	D.C.	0.00%
	N. Mar.	0.00%
	VI	0.00%
	MS	0.00%
	GU	0.00%
	PR	0.00%
	MI	-3.28%

Table 17. Most Improved – Hydroelectric Electricity Generation Per Capita, Change from 2001-2006

Rank	State	% Change
20	OR	24.30%
21	OH	22.96%
22	IL	17.85%
23	NY	17.20%
24	ND	13.99%
25	HI	13.59%
26	CO	11.48%
27	IA	6.06%
28	TN	5.67%
29	LA	2.39%
	DE	0.00%
	Amer. Sam	0.00%
	D.C.	0.00%
	N. Mar.	0.00%
	VI	0.00%
	MS	0.00%
	GU	0.00%
	PR	0.00%

Table 18. Most Improved – Hydroelectric Electricity Generation per GSP, Change from 2001-2006

Rank	State	% Change
	Amer. Sam.	0.00%
	D.C.	0.00%
	N. Mar.	0.00%
	VI	0.00%
	MS	0.00%
	GU	0.00%
	PR	0.00%
	VA	-0.15%
	IL	-2.78%
	OR	-3.13%
	FL	-4.00%
	NY	-6.28%
	CO	-7.41%
	HI	-14.51%
	MI	-14.56%
	TN	-15.37%
	ND	-19.82%
	IA	-20.22%

Table 15. Most Improved – Total Hydroelectric Electricity Generated, 2001-2006		
Rank	State	% Change
	GA	-1.06%
	LA	-2.60%
	MI	-2.66%
	WY	-4.07%
	AK	-9.07%
	AZ	-10.90%
	AL	-13.22%
	IN	-14.22%
	NM	-16.48%
	NV	-18.14%
	WI	-18.37%
	NB	-20.53%
	MN	-31.25%
	KY	-32.78%
	AR	-39.15%
	TX	-44.85%
	KS	-62.25%
	OK	-73.40%
	MO	-81.96%

Table 16. Most Improved – Percentage of Total In-State Electricity Generation Generated from Hydroelectric, Change from 2001-2006		
Rank	State	% Change
	IA	-3.82%
	WY	-5.39%
	LA	-5.84%
	AK	-8.12%
	NV	-12.96%
	GA	-15.18%
	IN	-19.43%
	WI	-22.18%
	AL	-22.80%
	AZ	-23.26%
	NE	-23.50%
	NM	-24.67%
	K	-35.08%
	MN	-37.34%
	AR	-44.96%
	TX	-48.71%
	KS	-62.89%
	OK	-79.19%
	MO	-84.35%

Table 17. Most Improved – Hydroelectric Electricity Generation Per Capita, Change from 2001-2006		
Rank	State	% Change
	MI	-3.58%
	SD	-4.74%
	WY	-7.76%
	GA	-10.81%
	AK	-15.00%
	AL	-15.62%
	IN	-16.63%
	WI	-20.77%
	NM	-21.35%
	NE	-22.58%
	AZ	-23.39%
	NE	-31.19%
	MN	-33.53%
	KY	-34.97%
	AR	-41.73%
	TX	-49.72%
	KS	-63.00%
	OK	-74.24%
	MO	-82.56%

Table 18. Most Improved – Hydroelectric Electricity Generation per GSP, Change from 2001-2006		
Rank	State	% Change
	GA	-21.94%
	SD	-26.80%
	LA	-32.58%
	IN	-32.74%
	WI	-34.64%
	AL	-35.86%
	AZ	-36.62%
	WY	-38.53%
	NE	-39.70%
	AK	-41.14%
	NM	-43.49%
	MN	-46.52%
	NV	-46.56%
	KY	-46.99%
	AR	-54.33%
	TX	-60.56%
	KS	-70.79%
	OK	-81.37%
	MO	-85.43%

Geothermal

Data collection on geothermal is limited to large-scale generation in this dataset, and therefore there is no direct geothermal included. In 2006, the reported geothermal electricity generation occurred in four states (**Table 19).**

Table 19. Geothermal Generation (2006)

Rank	State	MWh
1	California	12,821,434
2	Nevada	1,343,711
3	Hawaii	212,276
4	Utah	190,608

Total Generation

Table 20 lists states based on improvement in total geothermal power generation from 2001 to 2006. According to the EIA data, only four states generated electricity from geothermal resources during this period. This is not a comprehensive list of states with resources, but the only states with reported generation. Of these, Utah experienced the greatest increase during the period with nearly 25% more MWh generated in 2006 than in 2001.

Percentage of Total Generation

Table 21 lists states based on the rate of change of the percentage of total generation from geothermal sources from 2001 to 2006. Of the four states with geothermal power generation, only Nevada and Utah made positive gains in increasing the percentage of in-state generation from geothermal sources during these five years.

Generation per Capita

In **Table 22**, the states with geothermal generation are listed based on the rate of change in geothermal generation per capita during the five years from 2001 to 2006. Of the four states with measured geothermal-based electricity generation, Utah experienced the largest increase while geothermal electricity generation per capita in Hawaii and Nevada decreased.

Generation per Gross State Product

Table 23 ranks states based on improvement in geothermal generation per GSP from 2001 to 2006. All four states experienced a decrease in geothermal electricity generation per GSP during this period, indicating that economic growth outstripped geothermal electricity production increases during these five years.

Table 20. Most Improved – Total Geothermal Electricity Generated, 2001-2006		
Rank	**State**	**% Change**
1	UT	25%
2	NV	12%
3	CA	5%
4	HI	3%
Sources: EIA 2003a, EIA 2008		

Table 21. Most Improved – Percentage of Total In-State Electricity Generation Generated from Geothermal, Change from 2001-2006		
Rank	**State**	**% Change**
1	NV	19%
2	UT	8%
	CA	-4%
	HI	-5%
Sources: EIA 2003a, EIA 2003b, EIA 2007, EIA 2008		

Table 22. Most Improved – Geothermal Electricity Generation Per Capita, Change from 2001-2006		
Rank	**State**	**% Change**
1	UT	11%
2	CA	0%
	HI	-2%
	NV	-6%
Sources: EIA 2003a, EIA 2008, USCB 2007		

Table 23. Most Improved – Geothermal Electricity Generation per GSP, Change from 2001-2006		
Rank	**State**	**% Change**
	UT	-10%
	CA	-21%
	HI	-26%
	NV	-27%
Sources: EIA 2003a, EIA 2008, BEA 2008		

Distributed Solar

EIA does not report data on capacity from distributed solar electricity production, primarily photovoltaics (PV). However, recent literature provides on- and off-grid capacity installation estimates by state for 2007 (Sherwood 2008) and those are shown in **Table 24.** No comprehensive state generation information was found in a literature review, so the reader is cautioned not to compare these numbers to other resources without applying appropriate conversions. California is the leading state for PV capacity installations, with six times the capacity than subsequent states. All but six states have less than 5 MW installed.

Table 24. Distributed Solar (On- and Off-Grid) by State (2007)

Rank	State	Capacity (MWdc)
1	California	328.8
2	New Jersey	43.6
3	Arizona	18.9
4	Nevada	18.8
5	New York	15.4
6	Colorado	14.6
7	Massachusetts	4.6
8	Hawaii	4.5
9	Texas	3.2
10	Connecticut	2.8
10	Oregon	2.8
12	Illinois	2.2
13	Florida	2,0
14	Washington	1.9
15	Wisconsin	1.4
16	Delaware	1.2
17	Ohio	1.0
18	Pennsylvania	0.9
19	Maryland	0.7
19	North Carolina	0.7
19	Vermont	0.7
22	Rhode Island	0.6
23	D.C.	0.5
23	Minnesota	0.5
23	Montana	0.5
23	New Mexico	0.5
27	Michigan	0.4
27	Tennessee	0.4
29	Maine	0.2
29	Utah	0.2
29	Virginia	0.2
32	Iowa	0.1
32	Mississippi	0.1
32	New Hampshire	0.1

Wind

Renewable electricity generation from wind has increased dramatically between 2001 and 2006, as a result of market and policy changes, as well as technology development, availability, and increasing volatility in traditional fossil markets. In addition to expansion of generation in states, 11 states that had no wind-based generation in 2001 had developed generation by 2006. To account for this, data from the first year in which recorded wind generation began after 2001 are included in the most-improved analyses for these states. **Table 25** lists the year in which the first data are available for each state to which these circumstances apply.

This method allows states with new development to be acknowledged for successes in creating an environment to promote early wind development and the paradigm shift from fossil to renewable technologies. Further complications arise as there are three states (Idaho, Montana, and New Jersey) in which reporting wind generation began in 2006. These improvements and successes of these states should not be ignored; but, because there is no base-year generation with which to compare the 2006 data, they are not listed in the "most-improved" tables. However, they are likely to be most-improved in later-year datasets.

Table 25. First Year of EIA-Recorded Wind Generation[9]

State	Year
Tennessee	2002
Washington	2002
West Virginia	2002
Illinois	2003
New Mexico	2003
North Dakota	2003
Oklahoma	2003
Ohio	2005
Idaho	2006
Montana	2006
New Jersey	2006

The weakness of this method is that it more heavily weights states that have made small strides from no wind to some wind, than it does states that have made larger generation-related strides and had an established generation capability in 2001. To balance the impact of this weighting for newer generation development in the tables, **Table 26** ranks overall generation from wind in 2006 by states reporting wind generation. The remainder of the section presents changes at the state level in the wind market from 2001 to 2006 and illustrates that the most recent percentage growth is occurring outside the highest-generating states in 2006.

[9] States not listed in **Table 25** either had wind generation in or previous to 2001, or did not have wind generation in either 2001 or 2006.

Table 26. Wind Generation Reported to EIA by State (2006)

Rank	State	MWh
1	Texas	6,670,515
2	California	4,882,801
3	Iowa	2,317,821
4	Minnesota	2,054,947
5	Oklahoma	1,712,441
6	New Mexico	1,255,436
7	Washington	1,037,651
8	Kansas	991,890
9	Oregon	931,219
10	Colorado	865,536
11	Wyoming	759,061
12	New York	655,371
13	Montana	435,970
14	North Dakota	369,485
15	Pennsylvania	361,108
16	Nebraska	261,247
17	Illinois	254,571
18	West Virginia	173,757
19	Idaho	169,617
20	South Dakota	148,965
21	Wisconsin	101,376
22	Hawaii	79,674
23	Tennessee	54,598
24	New Jersey	15,991
25	Ohio	14,401
26	Vermont	10,688
27	Michigan	2,212
28	Alaska	788
Source: EIA 2008		

Total Wind Generation

Table 27 lists states by the rate of change in total wind generation. 2001-2006. South Dakota and Nebraska experienced the largest increase in total generation, while Vermont and Alaska were the only two states experiencing a decrease in wind generation during this period.

Percentage of Total Generation

Table 28 lists states based on the rate of change of the percentage of total in-state generation from wind sources, 2001 to 2006. Twenty-three states increased the portion of total in-state electricity generated by wind during the period. Of these, South Dakota shows the most improvement with an increase of more than 170-fold.

Generation per Capita

Table 29 lists the states based on the rate of change in wind generation per capita from 2001 to 2006. Of the 23 states that increased wind generation per capita, South Dakota and Nebraska experienced substantially larger increases than all other states. Two states, Vermont and Alaska, experienced a decrease in wind generation per capita.

Generation per Gross State Product

Table 30 lists the states based on improvement in wind generation per GSP from 2001 to 2006. Twenty-three states increased generation per capita during this period, with South Dakota experiencing the largest increase at more than 12,000%. Per capita wind generation in both Vermont and Alaska decreased during this period.

Table 27. Most Improved – Total Wind Electricity Generated, 2001-2006[10]

Rank	State	% Change
1	SD	17,003%
2	NE	9,833%
3	HI	3,649%
4	PA	3,132%
5	NY	3,091%
6	OK	3,071%
7	KS	2,390%
8	WV	1,831%
9	CO	1,679%
10	IL	1,314%
11	TN	1,265%
12	OR	951%
13	MI	690%
14	NM	586%
15	ND	526%
16	TX	462%
17	IA	375%
18	WA	149%

Table 28. Most Improved – Percentage of Total In-State Electricity Generation from Wind, Change from 2001-2006[4]

Rank	State	% Change
1	SD	17,647%
2	NE	9,462%
3	HI	3,349%
4	NY	3,128%
5	PA	2,803%
6	OK	2,623%
7	KS	2,348%
8	WV	1,850%
9	CO	1,545%
10	TN	1,297%
11	IL	1,290%
12	OR	788%
13	MI	685%
14	ND	535%
15	NM	503%
16	TX	422%
17	IA	325%
18	WA	136%

Table 29. Most Improved – Wind Electricity Generation Per Capita, Change from 2001-2006[4]

Rank	State	% Change
1	SD	16,360%
2	NE	9,577%
3	HI	3,473%
4	PA	3,102%
5	NY	3,057%
6	OK	3,002%
7	KS	2,341%
8	WV	1,821%
9	CO	1,555%
10	IL	1,297%
11	TN	1,204%
12	OR	889%
13	MI	683%
14	NM	561%
15	ND	522%
16	TX	412%
17	IA	368%
18	WA	137%

Table 30. Most Improved – Wind Electricity Generation per GSP, Change from 2001-2006[4]

Rank	State	% Change
1	SD	12,549%
2	NE	7,437%
3	HI	2,589%
4	PA	2,476%
5	NY	2,424%
6	OK	2,336%
7	KS	1,827%
8	WV	1,462%
9	CO	1,275%
10	IL	1,124%
11	TN	998%
12	OR	671%
13	MI	593%
14	NM	419%
15	ND	414%
16	TX	302%
17	IA	252%
18	WA	96%

[10] 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 listed here and in **Table 25**: baseline year 2002 - TN, WA, WV; baseline year 2003 - IL, NM, ND, OK; baseline year 2005 - OH. The three states with wind generation beginning in 2006 (ID, MT, NJ) are not included in the most-improved rankings for wind because their baseline year is the same as the year in which the most recent data for wind generation is available and, as a result, their respective rates of change could not be measured.

Table 27. Most Improved – Total Wind Electricity Generated, 2001-2006[10]

19	MN	129%
20	WY	108%
21	WI	40%
22	CA	40%
23	OH	11%
	VT	-12%
	AK	-17%

Sources: EIA 2003a, EIA 2008

Table 28. Most Improved – Percentage of Total In-State Electricity Generation from Wind, Change from 2001-2006[4]

19	MN	109%
20	WY	105%
21	WI	34%
22	CA	28%
23	OH	12%
	AK	-16%
	VT	-32%

Sources: EIA 2003a, EIA 2003b, EIA 2007, EIA 2008

Table 29. Most Improved – Wind Electricity Generation Per Capita, Change from 2001-2006[4]

19	MN	122%
20	WY	100%
21	WI	36%
22	CA	33%
23	OH	11%
	VT	-13%
	AK	-22%

Sources: EIA 2003a, EIA 2008, USCB 2007

Table 30. Most Improved – Wind Electricity Generation per GSP, Change from 2001-2006[4]

19	MN	78%
20	WY	33%
21	WI	12%
22	OH	5%
23	CA	5%
	VT	-32%
	AK	-46%

Sources: EIA 2003a, EIA 2008, BEA 2008

2.3 Discussion/Overall Trends

Trends in renewable resource-based electricity development:

- Hydroelectric resources provided the largest portion of renewable energy development in the United States in 2006. However, the share of hydroelectric is shrinking due to growth of developing renewable energy resources and maximization of the larger-scale hydroelectric resources.
- Between 2001 and 2006, wind resource presents the largest growth in renewable generation nationwide.
- Growth in electricity from biomass is primarily occurring in the southeastern areas of the United States, coincident with resource availability.
- Renewable energy growth during this period was generally outstripped by economic growth as measured by gross state product (GSP) and population growth.
- According to EIA data, between 2001 and 2006,
    - 24 states increased electricity generation from biomass resources,
    - 23 states from wind electricity production,
    - 4 states from geothermal electricity production, and
    - 2 states from large-scale solar electricity production (distributed solar data is not collected by EIA).

Data and method limitations in identifying trends:

- In general, the Energy Information Administration (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). There are a number of challenges in collecting renewable electricity generation at the state level, but those are not the focus here. Instead, the strength of the dataset as a nationwide comparable source regarding definitions and data collection techniques are the reasons for its use.
- Data for distributed solar electricity resource development are limited by lack of collection by EIA. (Solar PV data are the only presented in this report that are not from the Energy Information Administration. Data presented are installed capacity for 2007, collected by the Interstate Renewable Energy Council using established methodologies described in Sherwood 2008).
- Data on renewable-based electricity generation in the U.S. territories is limited. EIA data were supplemented with direct contact to territory energy offices, but no additional data was received by the authors.
- Most recent data are from 2006. Significant market changes between 2006 and 2008 are expected to have an impact on renewable energy generation and will be reported in later versions of this report.
- “Most Improved” rankings provide information on the largest growth rates between 2001 and 2006, leading to heavier weighting of states that began the development of the particular renewable resource in that time frame. The purpose is to acknowledge the challenge of early-stage development. The analysts are considering alternative and additional methods for future reports.

Section 3. Contextual Factors Influencing Renewable Energy Development

The trends discussed in the previous section are the result of several interwoven factors leading to renewable energy development. The primary focus of this report is the role of policy in renewable energy development at the state level (described in detail in **Section 4**), but the importance of other drivers and their interaction cannot be overlooked. The body of literature associated with identifying and defining these factors is primarily divided by resource (e.g., WPA 2008 for wind, Margolis and Zuboy 2005 for solar) and geography [e.g., Wellinghoff 2007 for the Western Governors' Association (WGA)], but there are common (if not overlapping) factors throughout:

- **Resource availability.** The clearest influencing factor in renewable development is the role of resource availability: If a physical resource is not available, development cannot progress. In the case of renewable resources, however, the question of resource availability turns quickly to that of economically feasible resource availability, leading to interaction with other factors such as the cost to recover the feasible resources. In general, economic feasibility increases as the quality of the resource increases – in the absence of other factors.
- **Technology cost** (including transportation, product delivery, installation, etc). The cost of the technology that develops renewable resources also can be critical. Even in areas of excellent resource, technology price can be the limiting factor in development. As resource availability decreases, the cost of developing incremental units becomes more expensive, even as technology cost remains constant. This factor also interacts with policies (both immediate price reduction, and research and development), economic context (in the event of supply shortages and cost of competing technologies).[11]
- **Economic context.** In states with high electricity costs, the economics of renewable energy may be improved in comparison to low electricity cost areas (e.g., DOE 2008 and Bezdek 2007). In addition, the price of competing technologies has a role in economic context: In states with high coal resources, the cost of transporting and producing electricity will be lower than those states with fewer local resources. Using EIA data, this report also finds a correlation between states with high GSP/capita and high renewable generation, indicating the potential for population wealth factoring into development at the state level.
- **Policy.** Because the benefits of renewable energy are primarily a public good, policy can be a major driver for development of resources (e.g., DOE 2008, Bezdek 2007, McLaren Loring 2006). The multiple roles for policy are summarized here and discussed in more detail in the next section:
    - **Developing technologies.** Policies can create research and development programs for technology development that the private sector views as too

[11] In the solar industry, concern surrounding silicon (a key element in module production) shortages drove market prices up in the early years of the century (Gartner 2005). Wind technology suffered similar price increases in 2006, with demand for wind as well as competing steel (a key element in tower construction) leading to turbine shortages drove prices higher and reduced development (DOE 2007).

risky. Typically, this funding for basic sciences is distributed through the university and national laboratory systems in the United States. As technologies evolve from nascent to latter stages of development and demonstration, the failure risk is reduced and policies that promote partnership with private industry are established to move the technology closer to commercialization.

    - **Creating and facilitating markets.** Through mandates (e.g., RPS) government can ensure project investors that there will be a market for the renewable energy produced. In addition to mandates, financial-incentive policies can open or expand markets in areas of suboptimal solar resource (e.g., New Jersey policy impact on solar development). While policy is considered to be a major driver of renewable resources as is evident from increased solar capacity in nonhigh-solar resource areas that have large incentives (Sherwood 2006), the existence of renewable resources plays a role in many associated factors such as technology cost.
    - **Levelizing cost.** Financial-incentive (e.g., investment, production, and tax) policies are able to partly or totally remove first-cost barriers to renewable energy technologies, creating a level basis for investment decisions.
    - **Removing institutional barriers.** Policies for installation and product certification and streamlining of utility interconnection reduce transaction costs for project development.
    - **Informing**. Information and education policies educate and inform the public (and can be targeted to subgroups such as investors, local and state governments, and end users), removing uncertainty barriers and facilitating the development of renewable technologies and coordinated policies throughout the development cycle.
- **Financing and ownership structures.** Because of the high cost of electricity systems, developers must be able to finance projects. Financing structures will differ depending on end user and sector (e.g., public, private) and range from traditional loans to participation in policy-driven programs that value the public-good elements of renewable energy.
- **Champion/stakeholder buy-in.** This final factor is especially difficult to quantify because it involves human behavior and activities. Champions are internal actors (e.g., activists, policy makers, community members) with an understanding and position of influence of jurisdiction and energy issues. In this position, actors are able to identify workable opportunities for renewable energy (EST 2006). A planning study indicates that the existence of a champion or active stakeholder involvement in the state has an influential role in the development of renewable energy (McLaren Loring 2006).

To identify effective mechanisms that encourage the development of renewable energy, it would be optimal to understand the relative impacts of different factors. However, because the factors are interrelated and site specific, there are complications in understanding the interactions. First, the absolute presence or absence of one factor can make moot the other factors. That is, if the resource is physically unavailable, it is the limiting factor, and no reduction in technology cost or policy will increase resource availability. An alternative example occurs in resource-rich areas, where the importance of resource is minimized, and this changes the role of the other factors, sometimes so that even abundant resources cannot drive development. In the United Kingdom, for example, areas of good wind resource are often not developed due to land-use planning barriers and public opposition. In these cases, public education and the existence of a champion to facilitate stakeholder buy-in becomes the most important factor; and, without it, development does not occur (McLaren Loring 2006).

The second complication is that the interaction is not linear, but includes a number of feedback mechanisms. In the first example above, for instance, there is rarely such staunch limitation: Resources are rarely unavailable, more often they are uneconomical to recover. In that event, lowering technology costs through research, scale, or policy, are far from moot – changing one factor can have multiple impacts on the other factors.

Indeed, quantifying the impacts of these factors is challenging, and there are limits to the value of generalizing. The value, however, to this understanding is informing policy makers regarding the potential impact of policies and better understanding the costs and benefits of policies. The renewable energy market is rapidly expanding (DOE 2008), and state policy makers are working to implement policies with quantifiable impacts. Without understanding the role of policy in development at the state level (and possibly the site level), the impact of policies cannot be accurately projected.

Determining that complications of quantifying these context factors' interactions are too challenging denies the potentially valuable insight of quantitative understanding of the connection between the influencing factors and development. While the uncertainties of the roles should not be oversimplified, understanding the roles in different contexts contributes to effective policy design. As renewable energy becomes more mainstream in the energy decision-making arena, qualitative and quantitative impacts assessments become more valuable to contributing to overall increases in renewable energy development.

Section 4. Policy Role in Renewable Energy Development

4.1 Introduction/Theory

Understanding the relative weight of influencing factors described in the previous section is critical to maximizing impact of policy mechanisms to increase development of renewable resources. However, the interactions of these factors are highly localized and vary on a project-by-project basis. Policy mechanisms, on the other hand, are optimally designed with the broadest applicability while maintaining effectiveness at the project level. This discontinuity is partially responsible for the case-by-case basis on which policies are evaluated. It is also why the body of literature on policy effectiveness (in terms of connection to renewable energy development) and applicability to other jurisdictions is lacking. For example, a concentrated solar policy transplanted to Ohio from Arizona, where solar resource is plentiful, will have a different impact on development of the resource. In the same vein, a policy that works in California, where electricity is expensive and the demographic is interested in renewable development for the environmental benefits, will not have the same impact in Louisiana, where electricity is less expensive and the demographic is focused on other environmental priorities.

This variation in the relative importance of the factors leading to renewable energy development makes identifying generally effective policy mechanisms at the state level challenging. The value, however, of quantifying the role of polices under different contextual models is that of maximum impact of government intervention for development of renewable energy. Maximizing the impact of investments that state governments make in renewable energy is increasingly important in an economically constrained environment.

These quantification efforts are complementary to the ongoing qualitative and empirical efforts used to identify the most effective aspects of policies and groups of policies based on state experience (e.g., EPA's "Guide to Clean Energy," State Clean Energy Policy Analysis project at NREL, RPS Collaborative for sharing effective RPS strategies). The quantitative effort complements with a focus on quantitative renewable development results of single and suites of policies.

Market transformation (MT) studies the effect of policy (and other integrated factors) in transforming energy efficiency (EE) markets and provides useful insight into the role of policy in transforming markets. MT focuses on strategies that promote EE development in terms of technology development and increasing consumer EE purchases, with the goal of creating "…lasting structural and behavioral changes in the marketplace…" (CEE No Date). Under MT, policies are designed with the goal to overcome market barriers to allow for development of a free energy market. Because MT is focused on sustainable market transformation, it begins with added weight on low-cost policies that restructure the market before removing economic barriers with financial incentives. Another key component of MT is that it does not require continuous intervention in the market (Blumstein et al. 2000). The goal is to create a lasting change so that the market does not regress, which can happen if financial incentives are removed before a market is sustainable (Geller and Nadel 1994).

4.2 Method

The information in this section is a high-level correlation analysis to help better understand the connection between renewable energy development and the role of policy within it. **Table 31** presents the states considered to have the policies, or the policies designed, with best practices. The details used to determine the results of the table are described in the remainder of this section:

- Definition of policies that impact renewable energy (4.2.1.),
- Identification of best practices in policy design and determining applicability in this study (4.2.2),
- Defining barrier-reduction policies and market-expansion policies within the market-transformation framework (4.2.3).

Table 31. Summary of States with Renewable Energy Policies and Selected Best Practices (Including Market-Transformation Categories)

	Market Preparation Policies											Technology Applicability Policies								
State	Contractor Licensing	Equipment Certification	Generation Disclosure	Interconnection	Land Access	Line Extension Analysis	Netmetering	PBF w/ RE	RPS	Vol.&Man. Green Power	Corp. Tax Incentives	Grants	Loans	Pers. Tax Incentives	Property Tax Incentives	Rebates	RE Prod. Incentives	Sales Tax Incentives	Sum Market Preparation	Sum Technology Access.
AL										•		•	•	•					1	3
AK					•					•			•	NA				NA	2	3
Amer Sam.																			0	0
AZ	•	•		•	•	•	•		•	•	•			•	•			•	8	4
AR							•			•									2	0
CA	•		•	•	•		•	•	•	•			•	•	•	•	•		8	5
CO				•	•	•	•		•	•									6	0
CT	•						•	•	•			•	•		•	•		•	4	5
D.C.				•					•			•							2	1
DE							•	•	•	•		•				•		NA	4	3
FL	•	•		•	•		•			•	•	•		NA		•		•	6	5
GA					•					•	•			•				•	2	3
GU																			0	0
HI	•				•				•	•	•	•	•	•					4	4
ID					•					•		•	•	•	•			•	2	5

IL			•	•				•	•	•					•	•			5	2
IN					•					•					•	•			2	2
IA			•		•		•	•	•	•	•	•	•	•	•			•	6	6
KS					•								•		•				1	2
KY					•		•			•	•			•				•	3	3
LA							•			•	•		•	•	•				2	4
ME			•		•		•		•			•	•			•			4	3
MD			•	•	•		•		•		•		•	•	•	•		•	5	6
MA				•	•		•	•	•	•	•	•	•	•	•	•		•	6	7
MI	•									•		•			•				2	2
MN		•	•		•			•	•	•			•		•	•	•	•	6	5
MS										•			•						1	1
MO					•		•			•	•		•						3	2
MT					•		•		•	•	•		•	•	•			NA	4	5
NE					•					•			•					•	2	2
NV	•		•		•		•		•	•				NA	•	•			6	3
NH					•		•		•				•	NA				NA	3	3
NJ			•	•	•		•		•				•			•		•	5	3
NM					•	•	•		•	•	•			•				•	5	3
NY			•	•	•		•		•		•	•	•	•	•	•	•	•	5	8
NC				•	•				•	•	•		•	•	•		•		4	5
ND					•						•			•	•				1	3
N. Mar.																			0	0
OH			•		•		•	•	•	•	•	•			•			•	6	4
OK										•	•		•						1	2
OR	•		•	•	•		•	•	•	•	•	•	•	•	•	•		NA	8	7
PA				•			•		•			•	•						3	2
PR		•													•			•	1	2
RI			•		•			•	•		•			•	•			•	4	4
SC										•	•	•	•	•		•	•	•	1	7
SD										•				NA	•				1	2
TN					•					•		•	•	NA	•				2	4
TX						•			•	•	•		•	NA	•				3	4
UT	•				•					•	•			•				•	3	3
VT				•			•	•		•	•	•	•			•		•	4	5
VI					•							•				•			1	2
VA					•		•												2	0
WA			•	•	•				•	•							•	•	5	2

WV										•									1	0
WI					•			•	•	•		•			•	•			4	3
WY							•			•						•			2	1

Correlation analysis, using SPSS software, compares this data to the trend data presented in **Section 2.** The first analyses identify correlations between individual policies and renewable energy development trends, and the second set of analyses combined policies under the tenets of market transformation (**see Section 3**) and compared those results to the same trends:

- Total generation 2006
- Nonhydro renewable electricity generation as percent generation
- Total generation per capita 2006
- Total generation per gross state product (GSP) 2006
- Generation by resource 2006[12]
- By resource, generation per capita 2006
- By resource, generation per gross state product (GSP) 2006

4.2.1 Definition of Policies and Policy Status

The list of policies considered in this analysis, in alphabetical order below, is drawn from the Database of State Incentives for Renewables and Efficiency (DSIRE 2008) and definitions compiled from the DSIRE database and select other resources as cited. Following the descriptions, policies status is listed as of June 2008.

- **Contractor licensing.** 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 Description 2008). ***Policy Status.*** As of June 2008, nine states have implemented specific contractor-licensing requirements for renewable energy. The 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. Requirements for certification vary by state, but generally include defined minimum experience and an examination. Most of the states offer separate certification for solar thermal and electric contractors.

- **Corporate tax incentives.** Corporate tax incentives provide tax incentives through credits or deductions for the cost of equipment and/or installation of renewable energy systems. The incentives range from 10% to 35% of the total cost, and rarely is there a cap set on the total incentive that an individual corporation can claim.

[12] Distributed solar resources are measured in capacity (MW) in 2007 as described in Section 2 and are included in the correlation analysis.

However, some states set a minimum on the investment that is needed to trigger a tax incentive (DSIRE Description 2008). ***Policy Status:*** As of June 2008, 23 states provide a corporate tax incentive to promote renewable energy development.

- **Equipment certification.** This policy requires that renewable energy equipment meets set standards, which ensures the quality of the equipment 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 Description 2008). ***Policy Status:*** As of June 2008, three states and Puerto Rico have implemented this policy. While this is a small number of states, this policy has the potential to spur technology development by making product minimum standards 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 (http://www.standardsasap.org/).

- **Generation disclosure.** Disclosure policies require utilities to provide customers with information about their energy 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. There also may be a requirement that the utility company 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 Description 2008). ***Policy Status:*** As of June 2008, 23 states have policies requiring generation disclosure in some form. The policies include reporting to end-use consumers frequently and making the information available on request.

- **Grants.** Generally available only to commercial, industrial, utility, education, and government sectors, various grant programs are offered to encourage either research and development of renewable technologies or to aid a project in achieving commercialization. Some grant programs are designated to support only a specific technology, while others are available for a wide range of renewable resources. The grants vary in amount from as little as $500 up to $1 million or more (DSIRE Description 2008). ***Policy Status:*** As of June 2008, 18 states, the District of Columbia, and the U.S. Virgin Islands provide some type of a renewable energy grant.

- **Green power purchasing:**[13] Many states require that a specific percentage of electricity used by state government buildings and other facilities is generated from renewable energy sources. Also, a small number of states allow local governments to operate a "Community Choice" system, which allows them to use the collective electricity demand for the community, or a group of communities, to form a larger green power-purchasing block. A few states mandate specific classes of utilities to

[13] Voluntary green power is a regulatory program, not a legislative policy, but known to have a large impact. Green power purchasing is described later in the paper, but not included in the ranking methodology.

offer customers an optional green power-purchasing choice, where the electricity is either generated from the utilities' own renewable energy sources, purchased under contract, or purchased as a credit from a certified renewable energy provider (DSIRE Description 2008). Voluntary green power programs are programs that may or may not be mandated by the state, but allow consumers to purchase green power through a utility program. ***Policy Status***: As of June 2008, eight states require that utilities offer green power to their customers. In addition, one state (Delaware) allows rural and cooperative utilities to create a green power program in lieu of RPS commitments, and two utilities in that state have opted for this option.

- **Interconnection.** Standards for connecting to the grid are necessary to maintain its safety and stability. 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. The standards include policy and technical requirements with which both the utility and system owner must comply. Setting uniform standards reduces the transaction costs[14] associated with interconnection. A national distribution-level standard does not exist for small-scale distributed generation (EPA CHP 2008, IEE 2008*,* NECC 2008, Haynes and Whitaker 2007*).* ***Policy Status.*** As of June 2008, 36 states and the District of Columbia have implemented interconnection standards. Because policy design and effectiveness vary across states, it is important for interconnection standards to be designed following best practices.

- **Line-extension analysis.** For off-grid customers who want to have access to electricity, the utility is required to provide the customer with the cost estimate for a line extension for grid power as well as information on the costs of alternative renewable energy options. For customers who want to be connected to the grid but are located in an area that is not serviced by the grid, they are charged a service fee for connection based on the distance covered to extend power lines. Because it can be less expensive to build an on-site renewable energy system to meet the customer's personal electricity needs, some states require that utilities provide such customers with information about renewable energy options at the time a customer requests a line extension (DSIRE Description 2008). ***Policy Status***. Four states have implemented line-extension analysis polices as of June 2008.

- **Net-metering policies.** Net metering allows consumers who have personal electricity-generating units to direct any excess electricity that they generated back into the grid. A single bidirectional meter is used to measure the electricity flowing to the consumer from the grid and from the consumer to the grid. At the end of the billing cycle, the consumer pays for the net electricity used from the grid, taking the amount that they used from the grid and subtracting the amount that they generated and directed into the grid. This results in the customer earning retail prices for the electricity delivered to the grid. If a customer is tied to the grid but does not have net

[14] Transaction costs are those costs associated with the time and effort taken to interconnect to the grid. These can be extensive and depend on multiple factors, including the size of project and paperwork associated with interconnection.

metering, there are usually two separate meters – one measures the flow of electricity in each direction, and the utility company can purchase the electricity from the customer at a negotiated rate. Under net metering, utilities usually restrict customers from producing more electricity than they use themselves over a set period (DSIRE Description 2008, Menz 2004). ***Policy Status***: As of June 2008, 42 states and the District of Columbia have net-metering policies. Net metering can be designed with many different underlying policies that can lead to its success or hinder its ability to promote renewable energy development. As a result, this policy can vary greatly from state to state in both design and effectiveness.

- **Personal tax incentives.** Several states provide personal tax credits or deductions of a set dollar amount – or up to a certain percentage of the total cost – for the purchase and/or installation of renewable energy equipment. Technologies eligible for and the magnitude of tax incentive vary by state (DSIRE Description 2008). ***Policy Status:*** Twenty states provide a personal tax incentive to promote renewable energy development. These tax incentives do not apply to the seven states that do not have personal income tax: Alaska, Florida, Nevada, New Hampshire, South Dakota, Tennessee, and Texas.

- **Property tax incentives.** Because property taxes are collected locally, this incentive applies only if local authorities are given the opportunity by the state to offer such an incentive. This incentive is generally offered as an exemption, exclusion, or a credit, often based on the difference between the value of the system installed and the value of a similar conventional system (DSIRE Description 2008). ***Policy Status:*** Twenty-five states and Puerto Rico provide a property tax incentive to promote renewable energy development, as of June 2008.

- **Public benefit fund (for renewable energy).** Also called a system benefits charge (SBC), a public benefit fund (PBF) is a state- or utility-level program that sets a customer charge – typically in cents per kilowatt hour (kWh) – for all electric utility customers. The funds are then directed to renewable energy and/or energy efficiency projects, including R&D, education programs, financial incentives such as grants and production incentives for large-scale projects, financing incentives for personal systems, and developing or strengthening programs associated with a green power market. For the purposes of this project, only state-mandated public benefit funds with funding for renewable energy are included (DSIRE Descriptions 2008, Menz 2004, PEW 2008a). For information and analysis of impacts of energy efficiency public benefits funds, see ACEEE's "Energy Efficiency Scorecard" (Eldridge et al. 2008). ***Policy Status:*** As of June, 15 states and the District of Columbia have a general PBF in place, and 13 have specific renewable energy sections. Maine has a similar fund; however, because it is based on voluntary funding, it is not considered in this analysis. Pennsylvania previously had a public benefit fund that was developed as part of a deregulation settlement. However, only one of the four funds in Pennsylvania continues to function, and payments are not made to it because it is self-sustaining through loan repayments and other returns on investment; therefore, Pennsylvania also is not considered to have a mandated PBF for the purpose of this analysis.

- **Rebates.** Rebate programs offer commercial and residential customers a rebate for installing certain renewable energy equipment, and generally are directed toward solar thermal and photovoltaic systems. While most rebate programs are designed for residential and commercial consumers, a few programs are available for industry, institutions, and government agencies. Rebates can range from $300 to more than $1 million and are usually offered by state agencies or municipally owned utility companies (DSIRE Description 2008, Menz 2004). ***Policy Status:*** As of June 2008, 18 states and the U.S. Virgin Islands provide renewable energy rebates.

- **Renewable energy access laws.** Renewable energy access laws consist primarily of solar and wind easement policies to ensure that those with access to solar or wind resources are not obstructed as a result of new development. The easement is transferred with the property title if a sale occurs. Furthermore, some communities also have implemented different mechanisms to protect access to all renewable sources such as street development orientation, zoning ordinances that limit building height, and access permits (DSIRE Descriptions 2008, Menz 2004). ***Policy Status***. As of June 2008, 34 states and the U.S. Virgin Islands have access laws in place.

- **Renewable energy production incentives.** Production incentives are financial incentives based on performance instead of capital investment and can be in the form of a tax credit or deduction or a direct cash payment. These incentives are based on the amount of electricity produced in terms of $/kWh generated or, for renewable fuels, in terms of $/gallon produced (DSIRE Description 2008, SERC 2004, Menz 2004). ***Policy Status***: As of June 2008, six states have production-incentive policies promoting renewable energy development. As of 2005, Minnesota's production incentive is no longer accepting new applicants. However, because generators are still receiving production incentives, the policy is included in this analysis as a production incentive.

- **Renewable portfolio standards.** A renewable portfolio standard (RPS) sets the minimum amount of electricity generated from renewable sources that electricity providers must meet by a certain date. Most RPS policies focus on the percentage of electricity generation, although some set the requirement based on total capacity. The definition of renewable sources that qualify to meet an RPS varies by state and some states allow electricity providers to meet their requirements through the purchase of renewable energy credits (DSIRE Description 2008, Pew 2008b). ***Policy Status***: As of June 2008, 26 states and the District of Columbia have this policy type enacted. There also are six states and one territory (Guam) that have a similar policy with nonbinding goals. Because there are a multitude of different elements that can be included in an RPS, the design is integral to its success in promoting renewable energy development.

- **Sales tax incentives.** A sales tax incentive allows any purchase of renewable energy equipment to be exempt from state sales tax (DSIRE Description 2008). ***Policy Status:*** As of June 2008, 21 states and Puerto Rico provide a sales tax incentive to promote renewable energy development. Five states (Alaska, Delaware, Montana, New Hampshire, and Oregon) do not have a sales tax from which to exempt renewable energy purchases and, therefore, this type of incentive does not apply to these states.

4.2.2 Use of Best Practices

Well-designed policies can be an integral part of the strategy to remove market barriers, create and expand markets, and internalize the social and environmental costs of energy generation [e.g., Komor 2004, EPA 2008 (clean energy guide), Brown and Mosey 2008]. For these reasons, it is imperative that policies are designed effectively and in a way so that the many policies in a state's renewable energy development portfolio work in concert. Best-practice design and empirical studies develop an argument that the policy requires more than just being "in place," but must be well-designed to have an impact. Identification and definition of best practices for policies exists at different levels of completeness. The Appendix compiles existing information on best practices by policy, and suggests possibilities for quantifying the impact of best practices. The remainder of this section discusses where and how policy best practices were incorporated into this study.

Because of the complications in equitably establishing best practices within and across policies, for this version of the report, most policies are considered existing if they are being implemented at the state level. The notable exceptions are in the cases where there is direct evidence that certain policy design elements can stymie the growth of renewable energy, and those are accounted for in the analysis – interconnection and net-metering policies can be designed to discourage renewable energy growth (NNEC 2008). To remove potentially detrimental policies, but include a wide range of existing policies, this analysis uses the NNEC ranking of "C" or better to define states that have interconnection and net-metering policies that contribute to the development of renewable energy facilities. For details of the NNEC ratings, see the interconnection and net-metering sections of the Appendix and NNEC 2008.

In addition to policies that are potentially detrimental to renewable energy development, some policies apply partly to renewable energy. The only example in this analysis is public benefits funds. Only those funds with explicit mention of renewable energy are included in this analysis. A notable addition to this definition is the Iowa Power Fund, implemented through the Iowa Office of Energy Independence. While not a specific public benefits fund targeting renewable energy, the fund is included because of the focus on clean and sustainable energy.[15]

4.2.3 Defining Policies within the Market-Transformation Framework

The interactive and multipurpose aspects of renewable energy policies create challenges for a hard-line separation between barrier and market-expansion policies. This analysis

[15] http://www.energy.iowa.gov/Power_Fund/about_IPF.html

uses the division in **Table 32** as an introduction to how policies can be categorized through the MT framework. The primary factor in determining the categorization is whether the policy breaks down barriers or expands the market. The remainder of this section provides justification to the structure. Future planned analyses include redefining the categories to provide additional insights.

Table 32. 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	

4.2.3.1 Market Preparation

While contexts create differences in necessary policies and policy impacts for states, there are barriers that exist in all states (e.g., business models of utilities, legacy of centralized grid). Ideally, these foundation policies are applicable across all states and lead to market transformation by preparing the market for renewable energy technologies.

Policies considered in this analysis are listed by the primary market-preparation barrier that is targeted (note that full policy definitions are available in the policy-by-policy Appendix):

- Access
    - **Interconnection**. These policies remove grid-access barriers by creating and streamline power producer access.
    - **Land access.** These policies – which focus on wind and solar resources but are potentially applicable to all resources – focus on allowing access to the land or resource to potential producers.
    - **Voluntary and mandatory green power programs.** These policies and programs give early-adopting consumers access to renewable energy. Generally, this access is granted at a premium through utility companies, but more innovative programs are relieving consumers of volatile fuel-adjustment costs, which gives them the added benefit of less volatile, and sometimes, lower electricity bills.
    - **Line-extension analysis.** This policy allows access to rural markets by requiring utilities to provide cost estimates of alternative electrification strategies.
- Education and Information Barriers
    - **Generation disclosure.** Generation disclosure policies provide information to consumers about the origin of electricity.

- **Public benefit funds with renewable energy (PBFRE).** These policies are technically funding mechanisms for a variety of programs. The policies are listed here to capture the education component of many PBFRE implementation plans, because the financial incentive portions will be captured under that category.
- **Contractor licensing.** Lack of educated and informed contractors results in less access to renewable energy technologies for consumers.
- **Equipment certification.** Similar to contractor certification, equipment certification makes renewable energy products a known quantity and reduces the barrier of uncertainty.

- Market Barriers
  - **Renewable portfolio standards (RPS).** This mandate for renewable energy mechanism provides investment certainty for project developers and infrastructure planners, which creates a market for renewable energy within the jurisdiction.[16]
  - **Net metering.** This policy creates an avenue for retrieving the value of electricity delivered to the grid, which expands the market for renewable energy.

4.2.3.2 Technology Accessibility

With barrier-reduction policies in place, access to high first-cost technologies becomes the final barrier to market transformation. These accessibility policies are often financial incentives that make renewable energy technologies 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

4.3 Results

Results from the correlation analysis include both analyses:

- Identification of correlations between individual policies and increased renewable development.
- Identification of possible policy combinations that are connected with increased renewable energy development. The portfolios considered barrier reduction and incentives packages based on theories of market transformation described above.

[16] 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, but more information can be found in Brown, Cory, and Arent 2007.

High-level correlation analysis shows significant ($p<0.05$) connections between the existence of some individual state policies and in-state renewable energy-based electricity generation (or capacity in the case of solar). But, as expected, there were no causality or direct clear connections between policy and generation increases (possibly due to misalignment of data on generation and policy availability, as well as other contextual factors leading to increased renewable electricity generation). Specific correlations include:

- Existence of a renewable portfolio standard (RPS) in a state is significantly correlated to higher wind-based electricity generation. However, policies with half or more of established best practices are not correlated to higher production. (Note that this "half-or-better" method is a preliminary approach, and the conclusion that a well-designed RPS does not correlate to higher renewable generation cannot be drawn from this result.)
- Existence of an RPS is also significantly correlated to higher renewable percentages of overall electricity generation
- Line-extension analysis policies are correlated with higher wind capacity and generation. This result is interesting in that interviews with program administrators indicated that the policy was not intended to increase development of renewable resources, but to facilitate use of the most economic "last-mile" electricity solutions.
- Production incentives at the state level, while a small sample ($n=6$), are significantly correlated to higher renewable electric capacity and generation, as well as all individual resource categories.
- Interconnection policies meeting best practices as described in the Appendix, based on the Network for New Energy Choices method (NNEC 2008), are correlated with increased renewable energy capacity and generation overall, as well as individually with higher biomass, hydroelectric, and PV capacity.

In addition to the individual policy results, findings indicate that the portfolio development theory warrants more research as market-transformation theory applies to renewable energy policy. Correlation analysis shows a significant ($p<0.05$) connection between states with renewable energy barrier-reduction policies and high renewable energy development (as measured by generation, generation per capita, and generation per GSP). There is no significant correlation between renewable energy development encouraging policies on their own, but there is one between high numbers of overall policies and increased development. These results illustrate a connection between barrier reduction and generation, and indicate that incentive policies do not increase development in the absence of barrier-reduction policies.

Section 5. Discussion of Next Steps

The results of this report show that there is a quantifiable connection between renewable energy development and state-level policy development. The value of the connection varies on a number of interactive factors, including resource availability, presence of a champion, technology cost, economic context, and available financing and ownership structures. Further research involves better understanding the connection and value of policy development at the state level through the following:

- **Better understanding of renewable energy development through better data use and historical information.** Incorporating solar PV data in the analysis provides more detail on that resource development, and more targeted state data may be available for additional resources. Included data collection improvements are: more detailed biomass data, inclusion of low-impact and distributed hydroelectric data, better U.S. territory data, and better distributed electricity-generation and resource-use data.
- **Better understanding of the impacts of the contextual factors that contribute to the development of renewable energy.** Information and quantification regarding the value and connection of these factors to the development of renewable energy will contribute to maximizing interaction and development.
- **Individual policy impact on development.** While policies are only one aspect of development, useful insight into the effectiveness of policies and their role in development could be gained by comparing detailed policy practice data to renewable generation or capacity. Building on the empirical and design elements of renewable energy policies, the development of quantifiable energy development impact is underway. This analysis informs further development and understanding of overall policy portfolios as well.
- **Development of detailed and alternative policy portfolios**. This effort will help understand how combinations of policies interact and lead to renewable energy development.
- **Recent policy impacts on recent development.** Further research is investigating potential links between generation development and specific and alternative policy portfolios as well as innovative and new policies over time as the market evolves.

NREL is interested in feedback from states and territories and other experts regarding this analysis, as well as steps that the lab and DOE can take to improve this approach in partnership with states and territories.

Section 6. Resources for State Policy Makers

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 to all information related to types of 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 to reach more industrial customers and increase energy efficiency through the delivery of tools and resources. The core issues, markets, constraints, and opportunities for doing business and addressing energy and environmental needs are local. As such, it will take local organizations and entities to truly impact change.
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.

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-services 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 cross-cutting 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_091208.pdf

The **State Best Practices: Clean Energy Policy Analysis** project is evaluating the environmental, economic, and energy security impacts of a broad range of state policies to help policy-makers to 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 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 their air quality programs.
www.eere.energy.gov/wip/air_quality.cfm

Data, analysis, maps, and tools are provided by the EERE Weatherization and Intergovernmental Program, which 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

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 for Oregon.
http://apps1.eere.energy.gov/states/state_information.cfm

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's **Builders Challenge** has posed a challenge to the homebuilding industry – to build 220,000 high performance homes by 2012. The initiative is called the Builders Challenge, and 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. **Northwest Building Efficiency Center** http://www.nwbuildings.org/ and **Southern Energy Efficiency Center** http://www.southernbuildings.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 Office of Electricity Delivery and Energy Reliability (OE)'s mission with **State and Regional Policy Assistance** is to provide, on an as-requested basis, technical assistance and analysis to states and regions. This includes assistance with state electricity policies, market mechanisms, and programs that facilitate electricity delivery infrastructure investment needed to support competitive, reliable, environmentally sensitive, customer-friendly electric markets.
http://www.oe.energy.gov/state_assist.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 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 those seeking to make 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 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 alternative fuels requirements under the Energy Policy Act of 1992 and 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 developments. 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. Policy Implementation Status and Design Best-Practice Compilation

Introduction

This Appendix summarizes and synthesizes known best practices for individual renewable energy policies. Because of lack of experience with the policies, their direct impacts on renewable energy development are hard to analyze; also, policy is not the only factor contributing to RE development as described in the body of this report. As a result, current best practices are largely based on effective policy design that is expected to result in further renewable energy development.

Also note that in this Appendix, the term "point" refers to the dot in Table 31, not a quantitative pointing system.

In the event that best practices from the literature were lacking, analysts contacted program administrators and asked them to identify the aspects of policies that are effective. Each of the following summaries includes:

- Policy definition
- Policy status (as of June 2008)
- Renewable policy justification (what makes this a renewable policy?)
- Summary of available best practices
- Areas for further study to improve quantitative evaluation in relation to increased renewable development.

Policy: Contractor Licensing

Policy Description. Specific licensing for contractors who want to install renewable energy systems, which guarantees that the contractors have the experience and knowledge necessary to ensure proper installation and maintenance (DSIRE Description 2008).

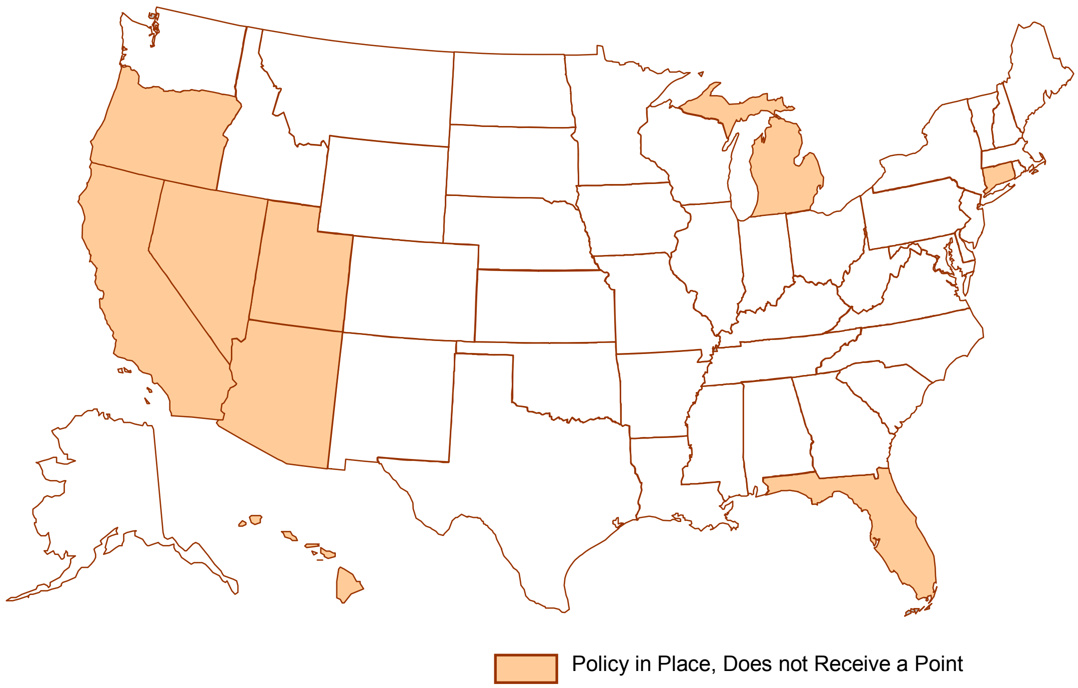
Policy Status. Nine states have implemented specific contractor-licensing requirements for renewable energy. The policies are focused on solar thermal and electric systems, including water heating, space heating, pool heating, daylighting, PV, solar thermal electric, radiant heat, and solar thermal process heat. In two states, Connecticut and Oregon, the licenses include wind. Oregon also includes fuel cells and small hydroelectric. Requirements for certification vary by state, but generally include a defined minimum experience and an examination. Most of the states offer separate certification for solar thermal and electric contractors.

Renewable Policy Justification. Certification requirements are important for renewable energy development because they ensure proper installation and maintenance of systems, leading to maximum possible returns on investment (Beck and Martinot 2004). Improperly installed systems can result in less than optimal performance and a negative stigma associated with the technology. However, this policy is not included in the analysis due to a lack of data on the effect it has on increasing the development of renewable energy.

Results. The states that have implemented this policy are listed in **Table A1** and **Figure A1**.

Table A1. Summary of States with Contractor-Licensing Policies

State/ Territory	Point Received
Arizona	N/A
California	N/A
Connecticut	N/A
Florida	N/A
Hawaii	N/A
Michigan	N/A
Nevada	N/A
Oregon	N/A
Utah	N/A



Source: National Renewable Energy Laboratory, July 2008

Figure A1. States with Contractor-Licensing Policies

Alternative/Future Best Practices. Suggested areas for data analysis that would lead to improved quantitative analysis include:

*Effectiveness***.** A comparison of the efficiency of renewable energy systems installed in states without contractor-licensing requirements versus the efficiency of installments in those states with those requirements could provide quantifiable data on the improvement in efficiency levels of renewable installations as a result of these policies.

Applications for Licensing. Data on the demand for relevant contractor licensing in the states with enacted policies would provide a basis for the market demand for licensed contractors and, therefore, demonstrate the importance placed on having the additional licensing.

Demand in Nonpolicy States. Data collection on consumer demand for licensed contractors in states that have, as of yet, not implemented a contractor-licensing policy may provide insight regarding the importance that consumers place on using specialized contractors to install and maintain renewable systems. Along this vein, the availability of data on consumers who decided against renewable installations as a result of a lack of licensed contractors might provide a proxy for the importance consumers place on specialized contractors for their renewable energy needs.

Conclusions. Because there are insufficient data on the impacts this policy has on renewable energy development, and there has been little to no analysis of best practices for contractor licensing policies, this policy has not been included in the state policy analysis. Further analysis of this policy would create a better understanding of its impacts and the importance that it may play in renewable energy development in the states. As the renewable energy generation goals in a state RPS increase and development of renewable energy sources increases to meet this demand, this policy may become increasingly important to have in every state. Contractor-licensing policies can play an important role in increasing the efficiency of renewable energy systems and in improving the experience that consumers have with renewable systems.

Policy: Equipment Certification

Policy Description. This policy requires that renewable energy equipment meets set standards, which ensures the quality of the equipment sold to consumers and reduces the problems associated with inferior equipment – issues that can result in a negative view of renewable energy technologies. These requirements can be regulator-designed or modeled off nationally recognized standards (DSIRE Description 2008).

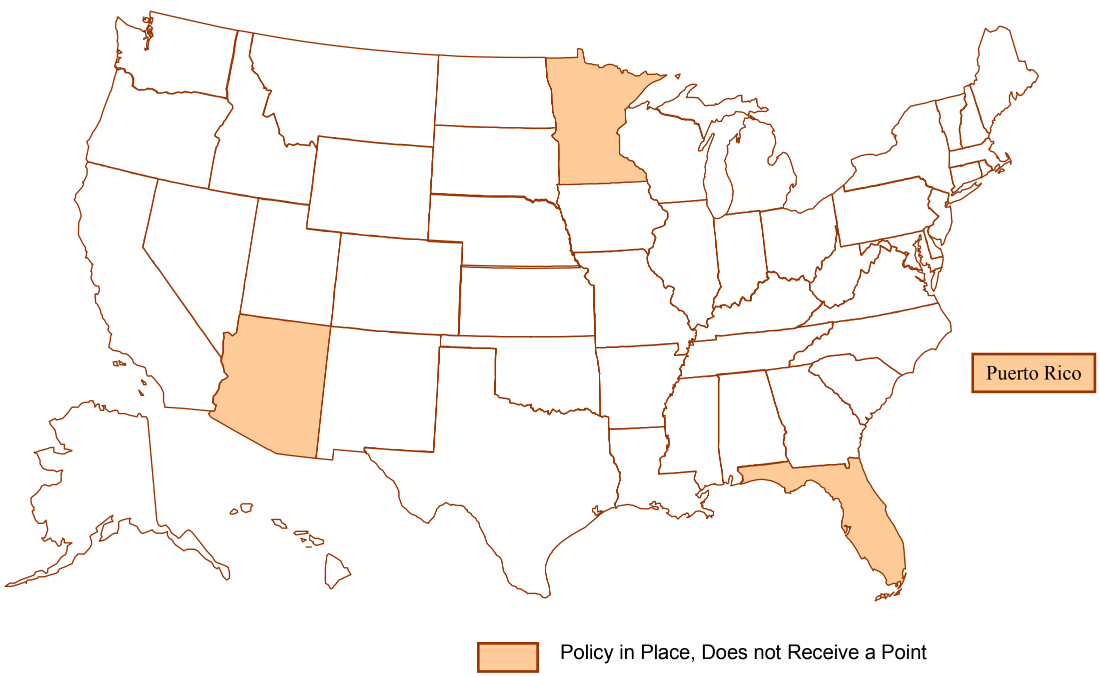
Policy Status. Three states and Puerto Rico have implemented this policy. While this is a small number of states, this policy has the potential to spur technology development by making product minimum standards more uniform. In other markets, such as that of energy-efficient appliances, minimum standards have been found to have profound effects on consumer energy use and market development (http://www.standardsasap.org/).

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

Result. The states that have implemented this policy are listed in **Table A2** and **Figure A2**.

Table A2. Summary of States with Equipment-Certification Policies

State/ Territory	Point Received	Notes
Arizona	Y	Covers solar and wind
Florida	Y	Covers solar. The Florida policy does not specifically use a nationally recognized standard, but models closely to it, and so receives a point.
Minnesota	Y	Covers solar
Puerto Rico	Y	Covers solar



Source: National Renewable Energy Laboratory, July 2008

Figure A2. States with Equipment-Certification Policies

Alternative/Future Best Practices. The importance of this policy may grow in the future as the market penetration of renewable energy increases. Implementers were solicited to determine which design aspects are necessary for equipment-certification policies to be effective. The conclusions are listed below, along with other areas of research in which there are data gaps, in hopes of providing a basis for best-practice development.

Using Preestablished National Standards. Implementers agreed that a best practice for this policy is to model or directly cite preestablished, nationally recognized standards for equipment. This strategy reduces implementation costs and challenges and creates a standard market across states, allowing manufacturers to maximize product generalization. A further benefit is that federal incentives generally require certification, and allowing the same certification to apply to all equipment (not just those qualifying for tax credits) reduces transaction costs to the installer/consumer in retrieving that credit.

Technology Coverage. Because the policy is represented in only four states/territories, the types of resources covered are not currently incorporated into best practices. As the market for renewable energy technologies advances, it is expected that demand for uniform certification will increase, and more technologies will be covered. As the policy develops, a best-practice metric for states that cover a wide variety of technologies is anticipated.

Enforcement. Due to a lack of data and the limited number of states with the policy, there is little quantitative evidence that these policies are enforced. In the case of renewable energy technologies qualifying for federal incentives, the certification is enforced through presentation of proof to apply. However, in cases where there is no incentive to be gained, it is an implementation challenge to identify whether all equipment is certified. At this stage, we assume there is minimal development of systems without the incentives, so that we can assume a high level of policy enforcement. As policies develop, this aspect may become increasingly important and good enforcement may be considered a best practice.

Evaluation. In general, states are not tracking all renewable energy facilities in a uniform way. As data develops and tracking systems are implemented, evaluating the impact of mandated minimum standards on the amount of renewable energy on the grid may become possible. Understanding those policy impacts can assist in identifying policy success regarding project development, and those factors could be used to evaluate best practices.

Conclusions. Renewable technology standards are a relatively unused policy mechanism, due, at least in part, to minimum standards being required to receive incentive packages. As the market evolves and more projects are funded without incentives, minimum standards for technologies will become increasingly important to protect consumers and ensure efficient renewable energy market development. For this analysis, there is insufficient data on the effect that this policy has on renewable energy development, and it is therefore not included. It is expected that, as the market develops, further criteria will be incorporated to the best practices for this policy, including categorizing applicable minimum standards, multiple renewable resource coverage (e.g., solar and wind certification systems), as well as effective enforcement and policy evaluation.

Policy: Generation Disclosure

Policy Description. Disclosure policies require utilities to provide customers with information about their energy 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. There also may be a requirement that the utility company 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 Description 2008).

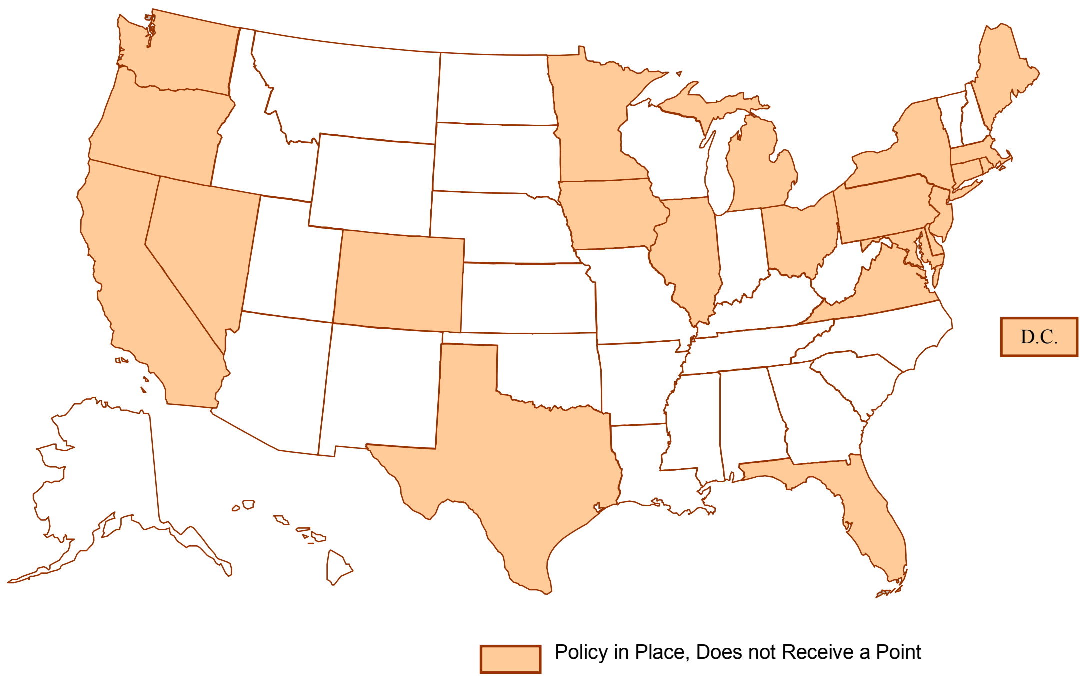
Policy Status. Twenty-three states have policies requiring generation disclosure in some form The policies include reporting to end-use consumers frequently and making the information available on request.

Renewable Policy Justification. While education is known to have an impact on energy use and behavior change, the value of information availability in the case of generation disclosure is unknown. There are studies that illustrate that consumers will change behavior if they have information on the amount of energy they are using (e.g., Darby 2006); it is unclear, though, that understanding the makeup of the fuels creating their electricity will lead to reduced electricity use or increased interest in renewable energy. Note that this is not to indicate that well-designed and implemented versions of this policy do not have an impact on consumer behavior, only that the direct impact on renewable energy development is sufficiently uncertain at this time.

Results. Despite the lack of direct connection between renewable energy development and generation disclosure policies, there is a known connection between information availability and consumer decision making (Darby 2003, Egan and Brown 2001). There are, however, known best practices within information dissemination and labeling that can apply to the implementation of this policy and improve the way that the information is translated to the consumer (McNeill and Wilke 1979). Two primary elements of this are accessibility to the information and a standard format for illustrating it. **Table A3** and **Figure A3** illustrate states that have implemented generation-disclosure policies.

Table A3. States with Generation-Disclosure Policies

States receiving point	
California	Minnesota
Colorado	Nevada
Connecticut	New Jersey
D.C.	New York
Delaware	Ohio
Florida	Oregon
Illinois	Pennsylvania
Iowa	Rhode Island
Maine	Texas
Maryland	Virginia
Massachusetts	Washington
Michigan	



Source: National Renewable Energy Laboratory, July 2008

Figure A3. States with Generation-Disclosure Policies

Alternative/Future Best Practices. Connecting disclosure directly to the impact on renewable energy development is critical to understanding the role of this policy within the renewable energy state policy portfolio. Historically, connecting information to behavior changes, and furthermore the transition from individual behavior changes to large-scale utility level energy procurement, is a challenge. Quantifying the overall connection between information and RE development is a large effort that need only be undertaken if the magnitude of the impact is large enough to justify the cost. To determine that, studies need to be completed on how consumers use the labels and the importance of label accessibility and label standardization across the state.

Conclusion. Generation disclosure is a widely used policy for delivering information to consumers on the fuel makeup of the electricity used. While there is a wealth of research on the effect of labeling on behavior, there is little directly connected to generation disclosure – and even less connecting directly to renewable energy development. Further research connecting consumer labeling to renewable energy development could help quantify the value of this policy to the state policy portfolio.

Policies: Grants and Rebates

Note: Grants and rebates are presented together due to similar evaluation efforts. A later version of the report will divide the two types of incentives.

Policy Description. *Grants.* Generally available only to commercial, industrial, utility, education, and government sectors, various grant programs are offered to encourage either research and development of renewable technologies or to aid a project in achieving commercialization. Some grant programs are designated to support only a specific technology while others are available for a wide range of renewable resources. The grants vary in amount from as little as $500 up to $1 million or more (DSIRE Description 2008).

Rebates. Rebate programs offer commercial and residential customers a rebate for installing certain renewable energy equipment, and generally are directed toward solar thermal and photovoltaic systems. While most rebate programs are designed for residential and commercial consumers, a few programs are available for industry, institutions, and government agencies. Rebates can range from $300 to more than $1 million and are usually offered by state agencies or municipally owned utility companies (DSIRE Description 2008, Menz 2004).

Policy Status. States can provide a variety of renewable energy grants and rebates. The design of the individual incentives and the portfolio of incentives is integral in determining the effectiveness of these policies at promoting renewable energy development. Currently:

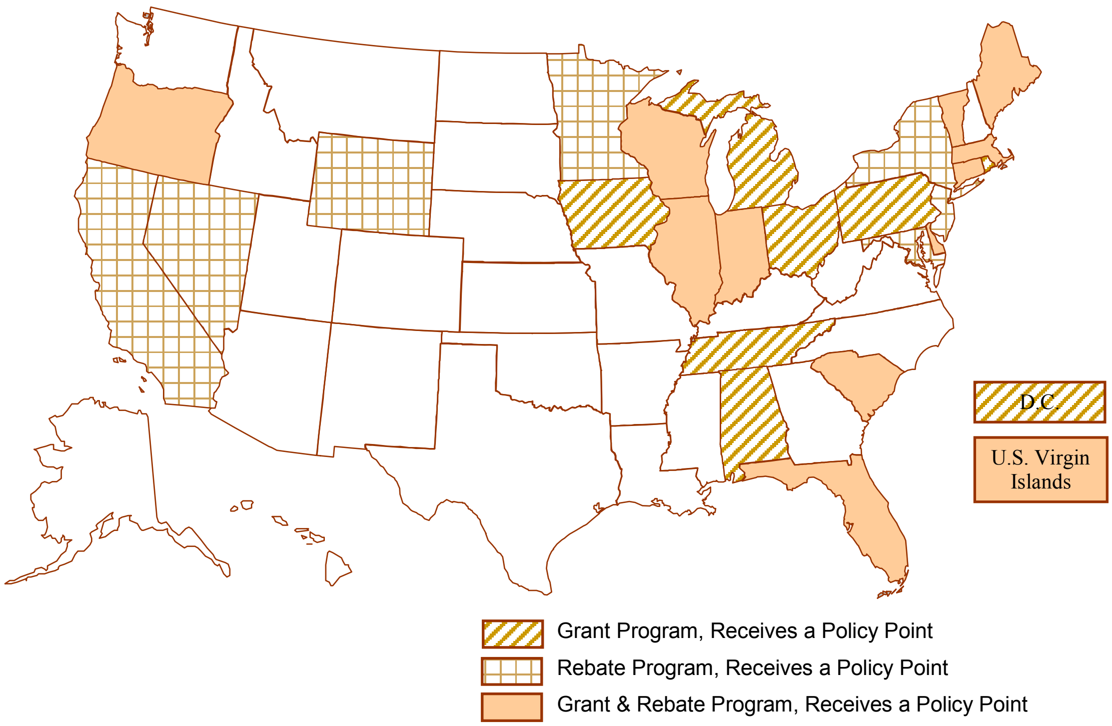
- Eighteen states, the District of Columbia, and the U.S. Virgin Islands provide some type of a renewable energy grant.
- Eighteen states and the U.S. Virgin Islands provide renewable energy rebates.

Renewable Energy Policy Justification. Financial incentives, grants, and rebates can be integral in increasing renewable energy development (especially small, customer-sited projects), because they effectively reduce the high capital costs often associated with renewable energy installations. Unlike production incentives, grants and rebates do not require a long-term policy and financial commitment to a specific project, allowing for flexible support based on changes in the market (Wiser and Pickle 1997).

Best-Practices Methodology and Results. A literature review returned insufficient information to develop best practices for grant and rebate policies and better connect the mechanism with renewable energy development. Therefore, for the purposes of the analysis in the body of this report, all states and territories with either a grant or rebate program are awarded a point (**Table A4** and **Figure A4**). Future research for the development of best practices is outlined in the following section.

Table A4. Summary of States Receiving Points for Grant and Rebate Programs

State/ Territory	Grants	Rebates
Alabama	Y	
California		Y
Connecticut	Y	Y
District of Columbia	Y	
Delaware	Y	Y
Florida	Y	Y
Illinois	Y	Y
Indiana	Y	Y
Iowa	Y	
Maine	Y	Y
Maryland		Y
Massachusetts	Y	Y
Michigan	Y	
Minnesota		Y
Nevada		Y
New Jersey		Y
New York		Y
Ohio	Y	
Oregon	Y	Y
Pennsylvania	Y	
Rhode Island	Y	
South Carolina	Y	Y
Tennessee	Y	
Vermont	Y	Y
Virgin Islands	Y	Y
Wisconsin	Y	Y
Wyoming		Y



Source: National Renewable Energy Laboratory, July 2008

Figure A4. States with Grant and Rebate Programs

Alternative/Future Best Practices. At their foundation, all financial incentives that target first-cost reduction share similar structures. For that reason, the best practices below are derived from those for tax incentives for energy efficiency (Brown et al. 2004) as applied to renewable energy tax incentives (see Tax Incentive Policies Section). Modified to fit grants and rebate programs, these next steps and research opportunities are intended to provide guidance for future analysis and data collection to refine understanding of grant and rebate effectiveness.

Renewable Resource Access and Availability. In future studies, it may be appropriate to rate the policies based on a quantitative analysis of resource availability to determine whether the policy is promoting development of appropriate technologies within the state's context.

Coordination with other Policies. To maximize the effectiveness of financial incentives, it is imperative that the incentives are designed to work with other policies to address different market barriers. For example, one study of renewable energy policies in six states found that those lacking interconnection policies faced difficulties in connecting renewable energy to the grid, severely compromising the effectiveness of renewable energy incentives (Gouchoe et al. 2003). States should design their financial incentives to complement other incentives and mandates at the local, state, and federal levels.

Appropriate Size. Appropriately sized incentives are critical to encouraging growth of the market while balancing state fiscal resources and minimizing free-ridership. The appropriate incentive size will depend on the context of the respective market, which will make it unique to each state, resource, and technology. The development of a method for quantifying the impact of rebates in different regions for different technologies is required to gain a better understanding of the impact of different size incentives. Such a methodology would have broad applicability across all first-cost reduction incentives.

Adequate Cap. A cap is the finite funding for the entire rebate program. Financial incentives need to be adequately capped to balance the fiscal restraints of the state with the risk to consumers of not receiving the incentive if the demand is greater than expected (Brown et al. 2004). Increased risk to consumers of not receiving the rebate will reduce the effectiveness of the incentive.

Appropriate Incentive Lifetime. Grant and rebate programs should be designed with a time horizon long enough to provide consistency to the market without creating a disincentive to market development leading to price reductions. The appropriate incentive length depends largely on the market and technology status. Therefore, a method needs to be developed to balance the risk-reduction benefits of the rebate or grant with the state's fiscal restraints, as well as changes to the market that reduce the impact of the incentive.

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

Appropriate Technology. As a best practice, if a national certification standard exists for the technology, all eligible technologies must be required to meet certification standards. This ensures market certainty for manufacturers in development and marketing of technologies and provides consumer protection for purchases of renewable systems. There is no repository for information on rebate programs that contains this information in a usable way. Collection of this data is a necessary next step for including this best practice in the policy evaluation.

Administration Costs. The policy should be designed to include adequate budget for administration, marketing, and educating the public about the incentive and eligible technology options (Gouchoe et al. 2003). There is no collected data identifying funding distribution design. Data collection on each rebate policy and defining what constitutes an "adequate budget" are required to incorporate this best practice into the policy evaluation methodology.

Conclusions. Grant and rebate programs can provide a reduction in the costs associated with renewable energy to increase market penetration. For this analysis, all states with a policy received a point. However, as the design of these policies is integral in their effectiveness, more refined analysis of the design components will lead to more detailed information for policy makers to use when developing grant and rebate policies for the promotion of renewable energy. To strengthen the evaluation of the effectiveness of these programs, more data on different aspects of the programs (e.g., budget distribution, cost caps, time horizons) as well as development of methods to identify the relative impact of those criteria are necessary for more detailed analysis of these policies.

Policy: Interconnection

Policy Description. Standards for connecting to the grid are necessary to maintain its safety and stability. 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. The standards include policy and technical requirements with which both the utility and system owner must comply. Setting uniform standards reduces the transaction costs[17] associated with interconnection. A national distribution level standard does not exist for small-scale distributed generation (EPA CHP 2008, IEE 2008, NECC 2008, Haynes and Whitaker 2007*)*.

Policy Status. Thirty-six states and the District of Columbia have implemented interconnection standards. Because policy design and effectiveness vary across states, it is important for interconnection standards to be designed following best practices.

Renewable Energy Policy Justification. This policy is included in the analysis because it is critical in removing market barriers to renewable energy. Well-designed interconnection standards ensure safe, economical, and equitable connection to the grid for distributed-generation systems. Grid connection provides a backup to renewable energy generators when they are unable to produce sufficient energy or if their system malfunctions. This decreases the uncertainty associated with renewable energy technologies, making investment and development more economical. A study of renewable energy policy effectiveness found that states without interconnection standards faced difficulties in connecting renewable energy to the grid, resulting in the effectiveness of their renewable energy policies being severely compromised (Gouchoe et al. 2003).

Best-Practices Methodology and Results. The best practices for interconnection standards are summarized from New Energy Choices' Freeing the Grid 2008 best practices (NNEC forthcoming). Data provided here was kindly provided in advance by the NNEC. This method is selected because it follows the generally accepted Interstate Renewable Energy (IREC 2008) model interconnection standards as the ideal, and it penalizes policies that do no promote interconnection and, therefore, do not have a positive impact on renewable energy development through the reduction of market barriers. 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.

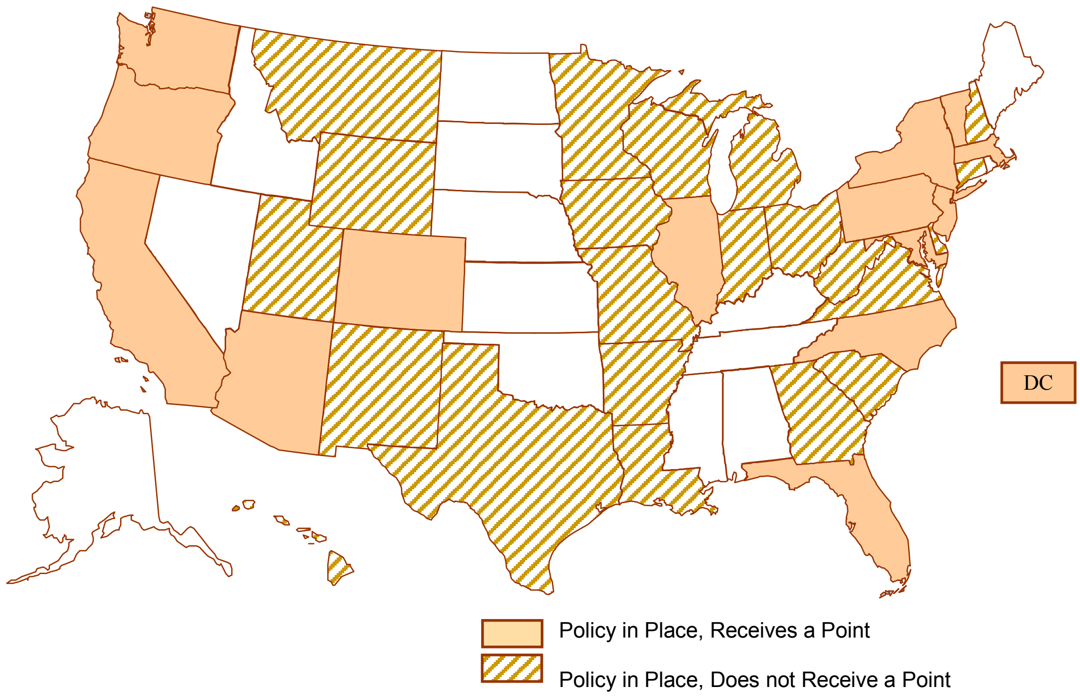
[17] Transaction costs are those costs associated with the time and effort taken to interconnect to the grid. These can be extensive and depend on multiple factors, including the size of project and paperwork associated with interconnection.

- *Timelines*: Positive or negative points are awarded based on whether the policy surpasses or fails to comply with the established Federal Energy Regulatory Commission (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 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 this analysis, policies were awarded a point if they received a “C” or better according to the method. 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.” A grade of C is chosen for the minimum requirement because it meets the minimum FERC standard as well as satisfactorily removes market barriers for renewable energy development. **Table A5** and **Figure A5** list the states with interconnection policies, indicating those that received a point.

Table A5. Summary of States Receiving Points for Interconnection Standards

State/Territory	Point Received
Arizona	Y
Arkansas	
California	Y
Colorado	Y
Connecticut	
D.C.	Y
Delaware	
Florida	Y
Georgia	
Hawaii	
Illinois	Y
Indiana	
Iowa	
Louisiana	
Maryland	Y
Massachusetts	Y
Michigan	
Minnesota	
Missouri	
Montana	
New Hampshire	
New Jersey	Y
New Mexico	
New York	Y
North Carolina	Y
Ohio	
Oregon	Y
Pennsylvania	Y
South Carolina	
Texas	
Utah	
Vermont	Y
Virginia	
Washington	Y
West Virginia	
Wisconsin	
Wyoming	



Source: National Renewable Energy Laboratory, July 2008

Figure A5. States with Interconnection Standards

Alternative/Future Best Practices. To improve the robustness of this policy rating, the following are suggested areas for future analysis.

Performance Based. Statistical analysis of renewable energy development in states with this policy and in states without this policy could provide a performance-based metric for this policy. Because this policy is not designed to be resource-specific, such an analysis also may reveal that this policy benefits specific resources over others.

Nonpolicy States. A comparison of the barriers for interconnection between states with policies and without policies may provide valuable insight regarding the benefits to individuals and renewable energy development created by implementing standard interconnection policies.

Conclusions. States lacking interconnection standards have faced difficulties when trying to increase the amount of grid-connected renewable energy (Gouchoe et al. 2003). For this reason, it is imperative for policy makers who want to increase renewable energy development to implement well-designed interconnection policies.

Policy: Line-Extension Analysis

Policy Description. For off-grid customers who want to have access to electricity, the utility is required to provide the customer with the cost estimate for a line extension for grid power as well as information on the costs of alternative renewable energy options. For customers who want to be connected to the grid but are located in an area that is not serviced by the grid, they are charged a service fee for connection based on the distance covered to extend power lines. Because it can be less expensive to build an on-site renewable energy system to meet the customer's personal electricity needs, some states require that utilities provide such customers with information about renewable energy options at the time a customer requests a line extension (DSIRE Description 2008).

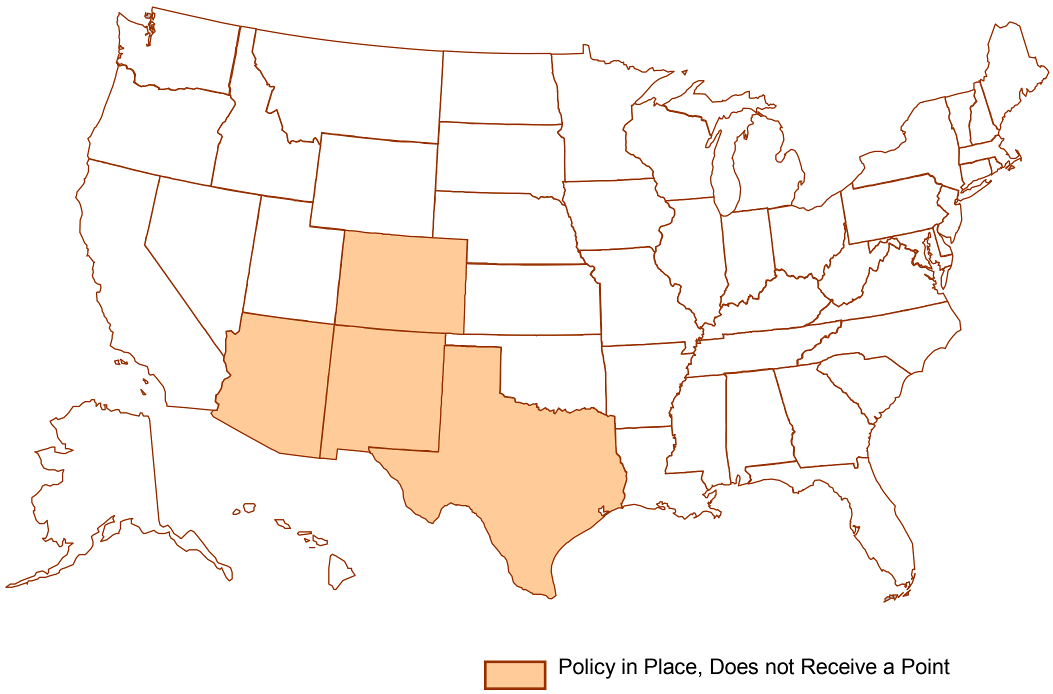
Policy Status. Four states have implemented line-extension analysis polices.

Renewable Policy Justification. Because a literature review resulted in no published works defining best practices or outlining effectiveness of policies, policy implementers were asked to identify success metrics within the effective policies. Interviews were conducted with policy makers in three of the four states regarding the policy in their respective state. The conclusion from the interviews is that the states collect no data on the implementation or results of this policy. Implementers agreed that there is insufficient data to determine how successful the policy has been at promoting the development of renewable energy.

Results. The states that have implemented this policy are listed below in **Table A6** and **Figure A6**.

Table A6. Summary of States with Line-Extension Analysis Policies

State/ Territory
Arizona
Colorado
New Mexico
Texas



Source: National Renewable Energy Laboratory, July 2008

Figure A6. States with a Line-Extension Analysis Policy

Alternative/Future Best Practices. To include this policy in future analyses, sufficient data collection on policy implementation as well as its impact on renewable energy installations is necessary. Below are suggested areas for data analysis or future use of the policy.

Grid Accessibility. Analysts could collect data to determine what percentage of the population does not have access to the grid. Difficulties in measuring this may arise when attempting to differentiate between residents who are not connected to the grid due to inaccessibility versus those who are off the grid due to personal choice

Line-Extension Requests. Analysts could collect data on the number of people who request a line extension and qualify for a line-extension analysis per year, which would provide an understanding of the demand for electricity to areas currently not serviced by the grid. Data collected on the percentage of people requesting a line extension who chose the renewable alternative will add further refinement to the analysis.

Renewable Energy Impacts. Understanding the impacts of this policy on renewable energy development requires an understanding of the comparative metrics used for costs of renewable energy systems relative to power line extensions. Because these policies are not tracked, it is not known how options are weighted. To understand how renewable energy technologies might be considered as an option, the method and assumptions for the analysis must be better understood.

Conclusions. The implementers who were interviewed all stated that there was a lack of data on the use of this provision. However, with aging grid infrastructure and increasing drivers for distributed renewable energy, this policy may increase in importance and impact on renewable energy installations. To better understand the role of this policy, it is necessary for the policy to have broader application and potential impact as well as data to be collected on the implementation and success of this policy in regards to renewable energy development.

Policy: Mandatory and Voluntary Green Power Purchasing

Policy Description.

Many states require that a specific percentage of electricity used by state government buildings and other facilities is generated from renewable energy sources. Also, a small number of states allow local governments to operate a "Community Choice" system, which allows them to use the collective electricity demand for the community, or a group of communities, to form a larger green power-purchasing block. A few states mandate specific classes of utilities to offer customers an optional green power-purchasing choice, where the electricity is either generated from the utilities' own renewable energy sources, purchased under contract, or purchased as a credit from a certified renewable energy provider (DSIRE Description 2008).

Voluntary green power programs are programs that may be mandated by the state, but allow consumers to purchase green power through a utility program.

Policy Status. Eight states require utilities to offer green power to their customers. In addition, one state (Delaware) allows rural and cooperative utilities to create a green power program in lieu of RPS commitments, and two utilities in that state have opted for this option.

Renewable Policy Justification. While there are successes with mandatory green power programs, they are not shown to be effective in leading to the development of renewable energy on their own. However, voluntary green power programs are shown to have an impact on the market for renewable energy (Bird, Dagher, and Swezey 2007). Because of this impact and the importance of these programs against the primary metric for success in this report – renewable energy development – these policies are noted in this review.

Best-Practice Methodology. There is extensive information on green power programs, practices for developing and implementing them, and evaluation of success (http://www.eere.energy.gov/greenpower/). The challenge for this methodology is that there is a wide range of both benefits and goals of green power programs. It is difficult to single out a metric for best practices in the development of new renewable energy resources resulting from these programs, because at least a portion of the benefit of the program is reducing consumer information and education barriers. In addition, green power programs are typically only a contributing factor to the development of renewable energy (as policy is), so there are limitations to determining direct impacts of the programs.

Table A7 and **Figure A7** present a listing of states that have at least one green power program and those that have mandatory policies.

Table A7. Summary of States Receiving Policy Points for Green Power Programs

State/Territory
Alabama
Alaska
Arizona
Arkansas
California
Colorado
Delaware
Florida
Georgia
Hawaii
Idaho
Illinois
Indiana
Iowa
Kentucky
Louisiana
Massachusetts
Michigan
Minnesota
Mississippi
Missouri
Montana
Nebraska
Nevada
New Mexico
North Carolina
North Dakota
Ohio
Oklahoma
Oregon
South Carolina
South Dakota
Tennessee
Texas
Utah
Vermont
Washington
West Virginia
Wisconsin
Wyoming
Note: Shading indicates mandatory legislative-based program

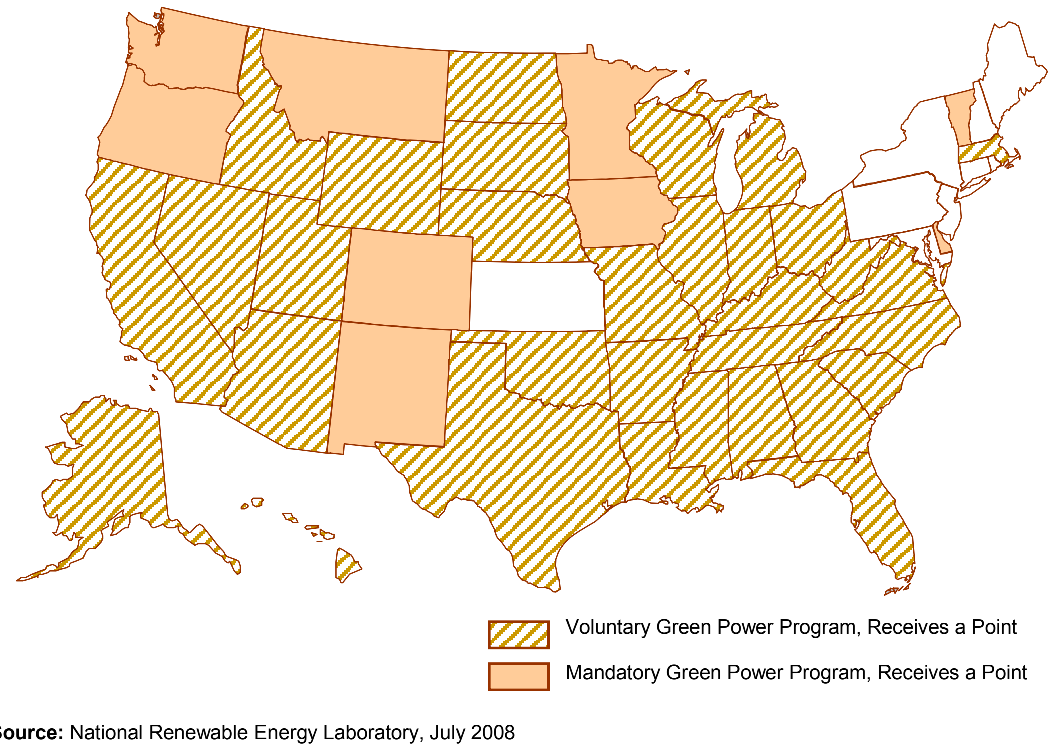


Figure A7. States with Consumer Access to Green Power Programs

Alternative/Future Best Practices. For a more rigorous evaluation of mandatory and voluntary green power policies and programs regarding effectiveness on the development of renewable energy, several factors could be considered:

Direct Impacts on Development. As these programs have matured, there is increasing direct evidence of contribution to renewable energy development. A portion of this could be directly attributed to these programs and could be calculated to gain insight into the aspects of policies and designs of programs that maximize development.

Indirect Impact on Development. Quantifying the programmatic impact on the market for renewable energy development, including indirect impacts such as consumer education and accessibility to renewable energy as well as the understanding of consumer demand on the utility side, could contribute to identifying the most effective programs.

Conclusions. While mandatory green power programs are shown to be less effective than programs with both utility support and a renewable energy champion (e.g., utility executive), green power programs more generally are shown to be effective at reflecting consumer demands and contributing to the development of renewable energy installations. Exact quantification of these benefits is not currently available, so points are not distributed for current programs. Future methodology development could focus on best practices that maximize the impact of mandatory and voluntary green power programs on the development of renewable energy resources.

Policy: Net Metering

Policy Description. Net metering allows consumers who have personal electricity-generating units to direct any excess electricity that they generated back into the grid. A single bidirectional meter measures the electricity flowing to the consumer from the grid and from the consumer to the grid. At the end of the billing cycle, the consumer pays for the net electricity used from the grid, taking the amount that they used from the grid and subtracting the amount that they generated and directed into the grid. This results in the customer earning retail prices for the electricity delivered to the grid. If a customer is tied to the grid but does not have net metering, there are usually two separate meters – one measures the flow of electricity in each direction, and the utility company can purchase the electricity from the customer at a negotiated rate. Under net metering, utilities usually restrict customers from producing more electricity than they use themselves over a set period (DSIRE Description 2008, Menz 2004).

Policy Status. Forty-two states and the District of Columbia have net-metering policies. Net metering can be designed with many different underlying policies that can lead to its success or hinder its ability to promote renewable energy development. As a result, this policy can vary greatly from state to state in both design and effectiveness.

Renewable Policy Justification. This policy is included in the analysis because it breaks down some of the market barriers to renewable energy development. In addition, net metering can provide benefit to the customer and the utility, if there are enough systems to impact electricity supply. For example, 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 economical way for the individual generator.

Best-Practices Methodology and Results. The best practices for net metering are derived from methods described by the Network for New Energy Choices' Freeing the Grid report (NNEC 2008). Data provided here were provided in advance by the NNEC. Policies are either awarded or penalized a set number of points depending on their design with regard to the following best practices. 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.

- *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.

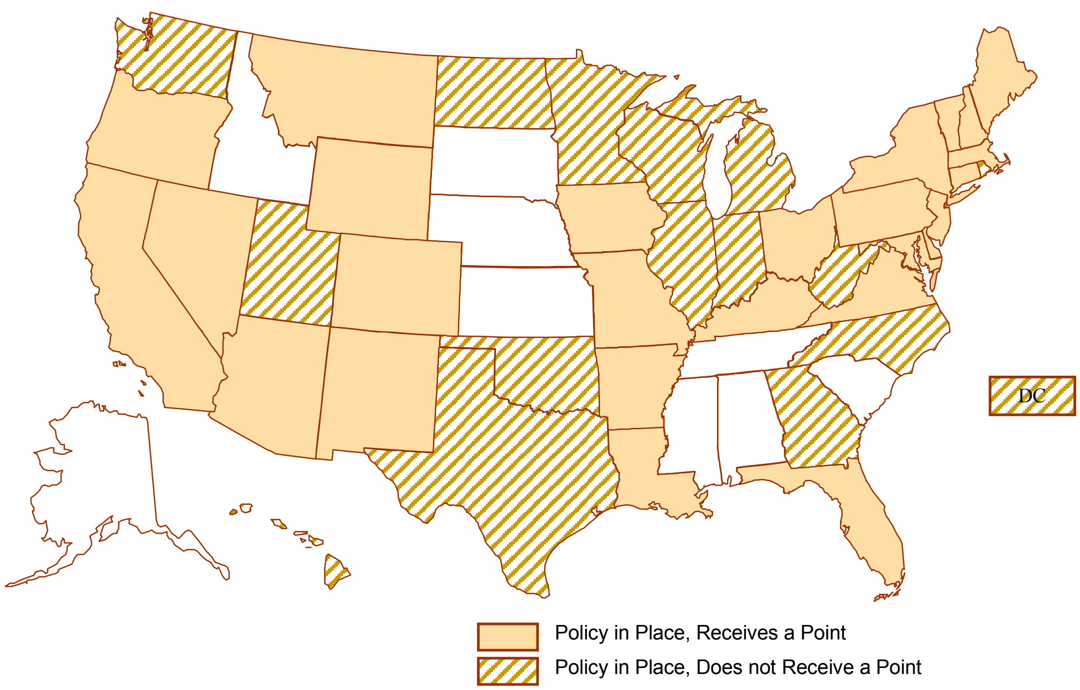
- *Metering Issues*: Various points are awarded or subtracted based on the specific metering regulations regarding new meter requirements and time-of-use meters.
- *REC Ownership*: The best practice for REC ownership is that the owner of the distributed-generation system maintains ownership of the REC. 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.

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 this analysis, policies are awarded a point if they received a "C" or better according to the method. 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." A minimum score of C is chosen so that only states with constructive net-metering policies receive a point.
A grade of a C is chosen for the minimum requirement because it represents a minimum policy design for effective net-metering rules while excluding policies with a negative impact on renewable energy development (**Table A8** and **Figure A8**).

Table A8. Summary of States Receiving Policy Points for Net Metering

State/Territory	Point Received
Arizona	Y*
Arkansas	Y
California	Y
Colorado	Y
Connecticut	Y
D.C.	
Delaware	Y
Florida	Y
Georgia	
Hawaii	
Illinois	
Indiana	
Iowa	Y
Kentucky	Y
Louisiana	Y
Maine	Y
Maryland	Y
Massachusetts	Y
Michigan	
Minnesota	
Missouri	Y
Montana	Y
Nevada	Y
New Hampshire	Y

New Jersey	Y
New Mexico	Y
New York	Y
North Carolina	
North Dakota	
Ohio	Y
Oklahoma	
Oregon	Y
Pennsylvania	Y
Rhode Island	
Texas	
Utah	
Vermont	Y
Virginia	Y
Washington	
West Virginia	
Wisconsin	
Wyoming	Y
*Assumes adoption of draft rules	



Source: National Renewable Energy Laboratory, July 2008

Figure A8. States with Net Metering

Alternative/Future Best Practices. To improve the robustness of this policy rating, the following are suggested areas for future analysis.

Performance Based. Statistical analysis of renewable energy development in states with this policy and in states without this policy could provide a performance-based metric for net metering. Because this policy is not designed to be resource-specific, such an analysis also may reveal that this policy benefits specific resources over others.

Nonpolicy States. A comparison of how the economics of distributed generation are affected in states with net-metering standards versus states without these policies may provide insight regarding the quantitative effect of well-designed net-metering policies.

Conclusions. Net-metering policies are prevalent throughout the states. However, according to this report, use of the NNEC grading policies in only 26 of the 42 states and territories with these policies follow best practices and are considered to have a positive impact on renewable energy development within the state. States with policies that do not follow the best practices could strengthen their renewable energy policy portfolios by improving the design of their net-metering policies based on the best practices defined by NNEC and listed above.

Policy: Public Benefit Fund

Policy Description. Also called a systems benefit charge (SBC), a public benefit fund (PBF) is a state- or utility-level program that sets a customer charge (typically in cents/kWh) for all electric utility customers. The funds are then directed to renewable energy and/or energy efficiency projects, including R&D, education programs, financial incentives such as grants and production incentives for large-scale projects, financing incentives for personal systems, and developing or strengthening programs associated with a green power market. For this project, only state-mandated public benefit funds with funding for renewable energy are included (DSIRE Descriptions 2008, Menz 2004, PEW 2008a). For information and analysis of impacts of energy efficiency public benefits funds, see ACEEE's "Energy Efficiency Scorecard" (Eldridge et al. 2008).

Types of PBF Models (Bolinger et al. 2001): (PBFs can incorporate multiple models)

- *Investment Model* – Using loans, near-equity, and equity investments to support renewable energy companies and projects, with the goal that the fund will become sustainable from returns on investment. The Connecticut Clean Energy Fund is an example of an investment model.
- *Project Development Model* – Using financial incentives such as production incentives and grants to directly subsidize and stimulate renewable energy project installation. The PBF in California uses this approach.
- *Industry and Infrastructure Development Model* – Using business development grants, marketing support programs, R&D grants, resource assessments, technical assistance, education, and demonstration projects to build renewable energy industry infrastructure. Wisconsin's program is indicative of this approach.

Policy Status. Fifteen states and the District of Columbia have a PBF. Maine has a similar fund; however, because it is based on voluntary funding, it is not considered in this analysis. Pennsylvania previously had a public benefit fund that was developed as part of a deregulation settlement. However, only one of the four funds in Pennsylvania continues to function, and payments are not made to it because it is self-sustaining through loan repayments and other returns on investment; therefore, Pennsylvania also is not considered to have a mandated PBF for the purpose of this analysis.

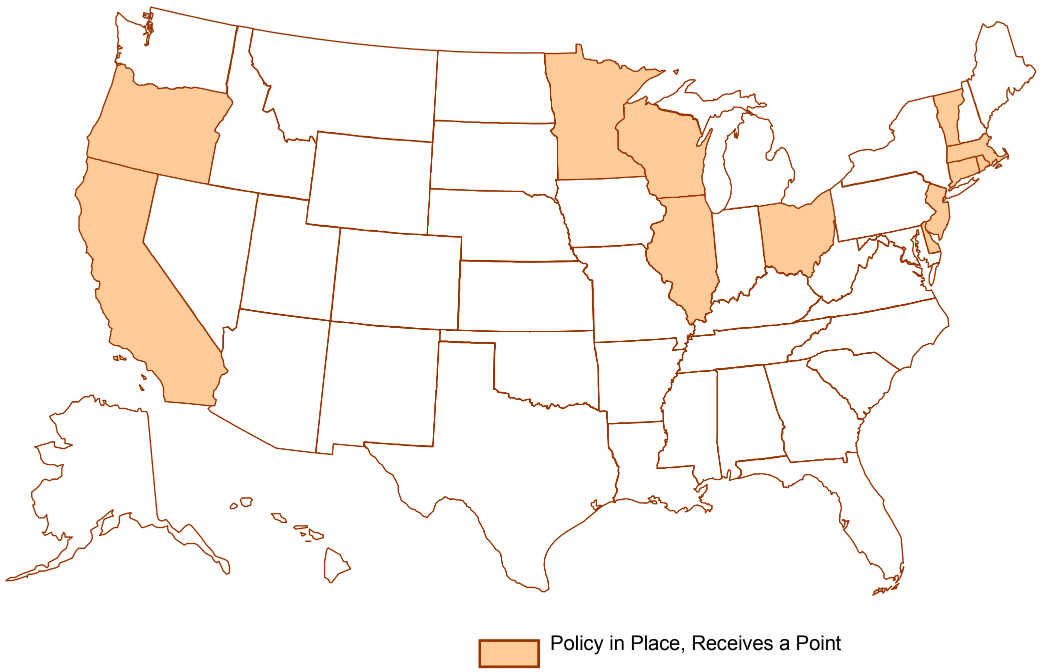
Renewable Policy Justification. This policy creates a market for renewable technologies by providing dependable funding for new projects. This method for establishing continuous funding is well-established as a high-impact and straightforward policy for increasing the use of clean energy, including renewable energy (EPA 2008). Of the several benefits of PBFs, the market certainty that the long-term funding can provide is integral in attracting investors for renewable energy projects. In addition, programs funded through PBFs help break down the market barriers (e.g., high information costs, uncertainty of performance, and limited access to financing) (York and Kushler 2005).

Best-Practices Methodology and Results. For this policy, states are awarded a policy point for a PBF that includes a requirement for funding of renewable energy programs and projects (**Table A9** and **Figure A9**). Public benefit funds for energy efficiency are well-established, and there are associated best policy-design practices. While the next section discusses the potential to measure these policies against best practices, renewable energy PBFs require further study before they can be judged by their policy design.

Table A9. Summary of States Receiving Points for Public Benefit Funds[18]

State/ Territory	Point Received	Notes
California	Y	
Connecticut	Y	
Delaware	Y	
DC		Majority of funding goes to low income energy assistance programs with little to none going to RE
Illinois	Y	
Maine		Voluntarily funded
Massachusetts	Y	
Michigan		Not required to fund RE
Minnesota	Y	Funded by Excel, based on the amount of spent material from the nuclear plant stored at the Prairie Island Facility
Montana		
New Jersey	Y	
New York		The funds may go to RE but the program no longer supports RE
Ohio	Y	
Oregon	Y	
Pennsylvania		
Rhode Island	Y	
Vermont	Y	Funded by Vermont Yankee Nuclear plant, in return for waste storage rights
Wisconsin	Y	

[18] The only PBFs included in this analysis have at least a designated portion of funding that is set aside to support renewable energy development. Other PBFs may provide minimal funding to renewable energy development, but without annual designated funding, it is not clear whether or not funding is used to support renewable energy every year.



Source: National Renewable Energy Laboratory, July 2008

Figure A9. States with a Public Benefit Fund

Alternative/Future Best Practices. Experience with energy efficiency PBFs and increasingly with renewable energy PBFs has resulted in a set of established best practices. These are not used in this analysis because of the relative newness and lack of data surrounding renewable energy-focused or inclusive renewable energy public benefit funds. However, they are listed here and the remainder of this section identifies data gaps and opportunities to further develop renewable energy PBF best practices for future versions of this analysis.

Administration. While the design of the administration overseeing the PBF is relatively inconsequential based on the literature, it is important that it be comprised of experienced, full-time staff and that there is a defined amount of funding set aside to cover administration costs, equaling no more than 10% of the total fund (Wiser et al. 2003).

Fund Collection. The collection process for the fund is designed to be equitable and non-bypassable (Wiser et al. 2003).

Consistent Funding. The fund is established to provide a minimum of five years of funding to provide market stability (Hamrin et al. 2006, Wiser et al. 2003).

Reappropriation Barriers. The fund is designed to prevent the reappropriation of funds, as has occurred previously in Connecticut, Massachusetts, Ohio, Rhode Island, and Wisconsin (Hamrin et al. 2006, Wiser et al. 2003).

Clearly Designed. The PBF should have clearly designed goals and strategies, and there should be no ambiguity in the definition of eligible projects. These design aspects help to create market certainty and increase the probability of investment in renewable energy (Wiser et al. 2003).

Decreasing Incentives. To create a sustainable market for renewable energy projects, it is necessary that the incentives decrease over time to prevent the funding from becoming a crutch for projects (Wiser et al. 2003).

Spending Minimum. As experience grows with renewable energy-focused PBFs, a best practice based on policy design could transition into a results-based criteria, evaluating policies based on per capita spending. Current understanding of these policies has not resulted in a clear picture of what spending per person is optimal for renewable energy development. Renewable energy PBF per capita spending ranges from $0.28 in Ohio to $11.77 annually in New Jersey (**Table A10**). There is likely a minimum of funding necessary to create lasting benefits, but a cutoff for best practices has not been established. Further analysis of the minimum amount of per capita spending necessary for substantial renewable energy development will strengthen the best practices for PBFs.

Table A10. Per Capita PBF Spending (est. 2007)

Estimated 2007 PBF Per Capita Spending ($/Capita)	
New Jersey	11.77
Vermont	10.63
California	9.13
Connecticut	6.87
Delaware	4.10
Massachusetts	3.89
Oregon	3.25
Minnesota	3.10
Rhode Island	2.07
Wisconsin	0.99
Illinois	0.43
Ohio	0.28
Source: DSIRE, Census 2002	

Conclusions. PBFs that target renewable energy are an emerging policy that provides consistent funding to renewable energy programs and reduces investment risk. These policies have proven to be very effective for energy efficiency programs (York and Kushler 2005), but the relative newness of renewable energy-focused programs leaves a gap in data availability for analyzing these programs. For this analysis, PBFs with dedicated renewable energy funding are considered best-practice policies and are awarded a point. In the future, best policy-design practices could be applied to renewable energy funds as data on these funds becomes available.

Policy: Renewable Energy Access Laws

Policy Description. Renewable energy access laws consist primarily of solar and wind easement policies to ensure that those with access to solar or wind resources are not obstructed as a result of new development. The easement is transferred with the property title if a sale occurs. Furthermore, some communities also have implemented different mechanisms to protect access to all renewable sources such as street development orientation, zoning ordinances that limit building height, and access permits (DSIRE Descriptions 2008, Menz 2004).

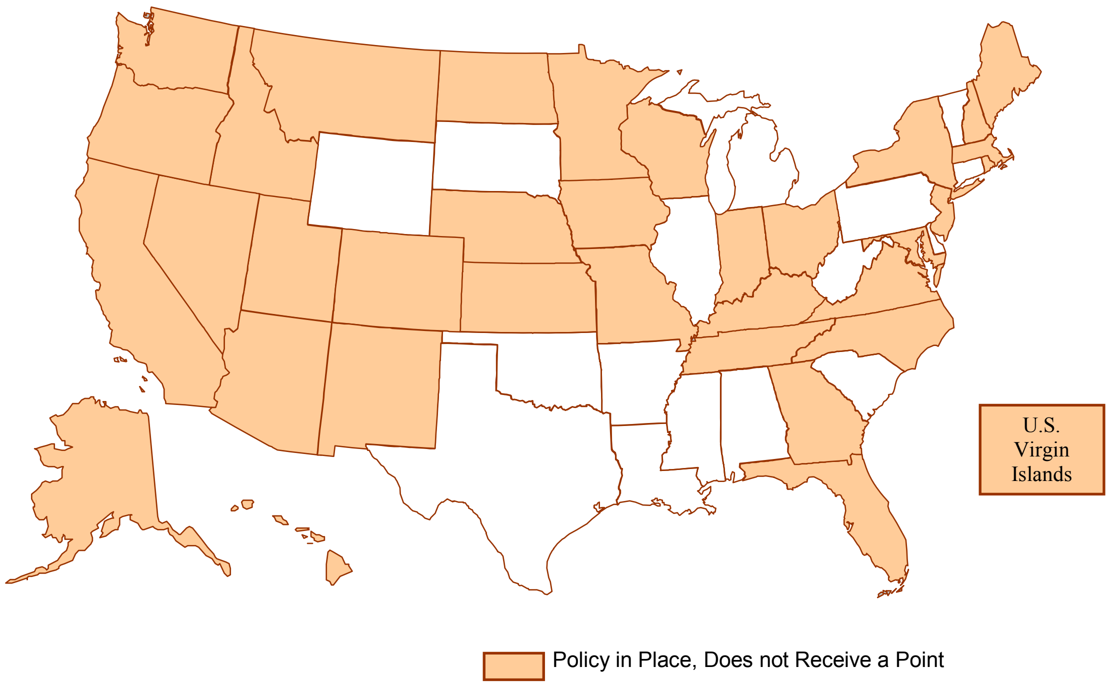
Policy Status. Thirty-four states and the U.S. Virgin Islands have access laws in place.

Renewable Policy Justification. 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 a large impact if enforcement details can be worked out.

Results. Table A11 and **Figure A10** list states that have this policy. Only wind and solar resources are the subject of these policies, but the authors expect expansion to other resources – all resources will be included in future versions of this report.

Table A11. Summary of States with Solar and/or Wind Access Laws

State/Territory	
Alaska	Nebraska
Arizona	Nevada
California	New Hampshire
Colorado	New Jersey
Florida	New Mexico
Georgia	New York
Hawaii	North Carolina
Idaho	North Dakota
Indiana	Ohio
Iowa	Oregon
Kansas	Rhode Island
Kentucky	Tennessee
Maine	Utah
Maryland	U.S. Virgin Islands
Massachusetts	Virginia
Minnesota	Washington
Missouri	Wisconsin
Montana	



Source: National Renewable Energy Laboratory, July 2008

Figure A10. States with Solar and Wind Access Laws

Alternative/Future Best Practices. In the solar access law area, identification of best practices, largely focused on enforceability and effect on market promotion, are in development (Kettles 2008). In the future, policies could be measured against such individually focused resource analysis and best practices. In addition, sufficient data collection on policy implementation is necessary. Below are suggested areas for data analysis.

Enforcement. An analysis of the enforceability of this policy in each state may provide insight regarding the frequency with which individuals use access laws to protect their access to renewable resources. This data also would demonstrate how effective each state is in enforcing these policies, a crucial component of this policy's ability to promote renewable energy development.

Nonpolicy States. A comparison of the number of resource access disputes in states lacking resource access laws with the number of disputes in states with access laws would provide information regarding the contrast between the effectiveness of the policy to protect resource access.

Conclusions. Further research is necessary before states can be evaluated on their implementation of access laws and on the policy's impact on renewable energy development.

Policy: Renewable Energy Production Incentives

Policy Description. Production incentives are financial incentives based on performance instead of capital investment and can be in the form of a tax credit or deduction or a direct cash payment. These incentives are based on the amount of electricity produced in terms of $/kWh generated or, for renewable fuels, in terms of $/gallon produced (DSIRE Description 2008, SERC 2004, Menz 2004).

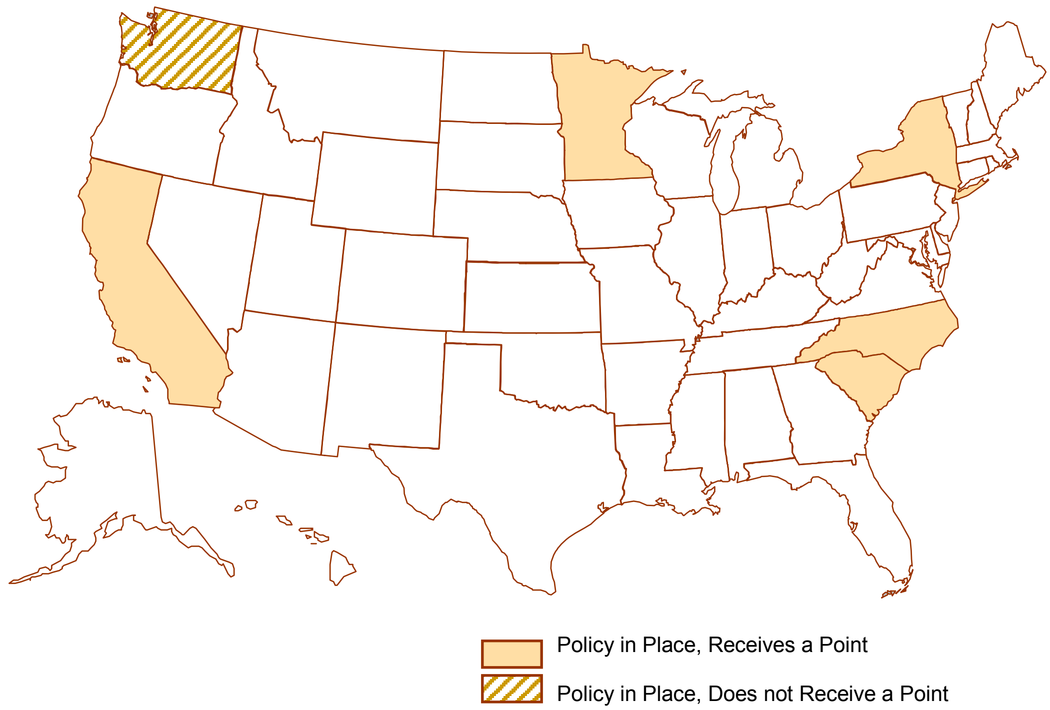
Policy Status. Six states have production-incentive policies promoting renewable energy development. As of 2005, Minnesota's production incentive is no longer accepting new applicants. However, Because generators are still receiving production incentives, the policy is included in this analysis as a production incentive.

Renewable Policy Justification. 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.

Best Practices Methodology. A literature review returned insufficient information to fully develop a list of best practices for state production incentives directed toward the promotion of renewable energy development. States were awarded a policy point for having a production incentive, with the exception of Washington. This state's policy is designed such that once the maximum funding is subscribed, new eligible applicants are still accepted and the total funding to all projects is reduced and divided among all applicants based on kWh production. While this has not occurred, the funding design does not provide market certainty because project developers could lose a portion of their funding as new projects are developed. **Table A12** and **Figure A11** summarize best practices for renewable energy production-incentive policies.

Table A12. Summary of States Receiving Points for Production-Incentive Policies

State/ Territory	Point Received	Notes
California	Y	Feed-in-tariff
Minnesota	Y	No longer accepting new applicants
New York	Y	
North Carolina	Y	Note: These programs may be removed in future versions, as a result of lack of program funding stability.
South Carolina	Y	
Washington		This policy does not receive a point as funding distribution design does not promote market certainty



Source: National Renewable Energy Laboratory, July 2008

Figure A11. States with Production-Incentive Policies

Alternative/Future Best Practices. More analysis on effective design components is necessary to provide guidance to states wanting to develop or redesign production incentives. Suggestions for future analysis include:

PPA Requirement. By requiring the applicant to have a signed power purchase agreement with a credible financer before a production incentive contract will be awarded, states can increase the probability of project success because there will be the necessary revenue certainty (Wiser et al 2002).

Project Selection. There are many ways in which the project-selection process can be designed. A first-come, first-served process provides the most certainty in the market regarding funding availability, but other options such as competitive auctions or administrator discretion provide other benefits. Further analysis of the selection options may provide information as to which process is the most successful in promoting funding certainty and renewable energy development (Wiser and Pickle 1997).

Complementary Policies. Production incentives are not effective if they are the only policy in place and may be more effective if implemented in coordination with specific policies. Further research on these interactions will provide policy makers with more in-depth information regarding the design of policy portfolios.

Conclusions. Production incentives, in coordination with other policies, can provide funding stability sufficient to promote renewable energy development. Because the incentive is based on output, these policies encourage generators to develop efficient projects. Further research is necessary to develop best practices to aid policy makers in designing future production incentives.

Policy: Renewable Portfolio Standards

Policy Description. A renewable portfolio standard (RPS) sets the minimum amount of electricity generated from renewable sources that electricity providers must meet by a certain date. Most RPS policies focus on the percentage of electricity generation, although some set the requirement based on total capacity. The definition of renewable sources that qualify to meet an RPS varies by state and some states allow electricity providers to meet their requirements through the purchase of renewable energy credits (DSIRE Description 2008, Pew 2008b)

Policy Status. Twenty-six states and the District of Columbia have enacted this policy type. There also are six states and one territory (Guam) that have a similar policy with nonbinding goals. Because there are a multitude of different elements that can be included in an RPS, the design of an RPS is integral to its success in promoting renewable energy development.

Policy Inclusion Justification. Renewable portfolio standards, one of the most popular policies used to promote renewable energy development at the state level, provide state policy makers with the flexibility to design the policy to reflect the 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).

Best Practices Methodology and Results. For this policy, states are rated on best practices as defined in the literature (see criteria for citations). RPS policies eventually will be considered successful based on the amount of renewable energy generated through the policy (see the Compliance item in the Alternative/Future section). At this early stage of development, however, policy design best practices are the best understood determinates of policy success. The policy and best practices for developing a ranking scheme (synthesized from a variety of existing literature) are defined here, as well as the resulting ranks for each policy regarding policy design relative to best practices. Each state is first rated on whether their RPS follows the best practices of each of the following policy components:

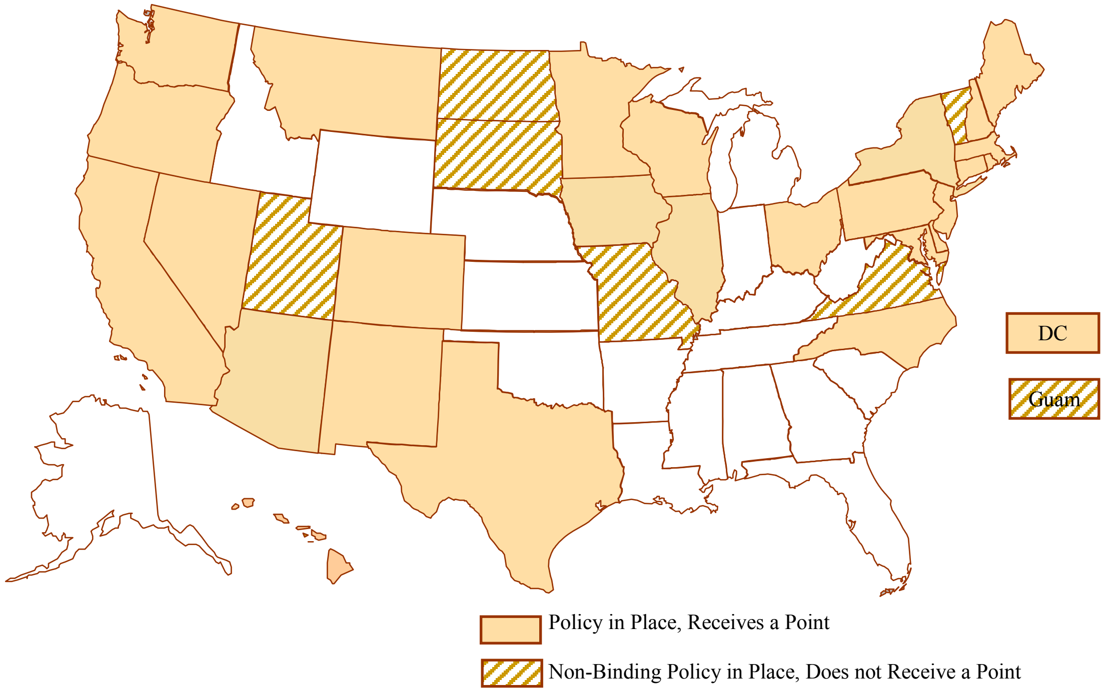
- *REC Trading:* Allows for compliance to be met through the purchase of renewable energy certificates.
- *REC Tracking:* Verifies the validity of RECs through the use of a REC tracking system [e.g., New England Power Pool (NEPOOL), Western Region Electricity Generation Information System (WREGIS)].
- *Financial Penalties:* Allows for compliance to be met with an alternative compliance payment and/or has mandated financial penalties for noncompliance. States that have financial penalties but do not specify the amount are not awarded a point for this policy element because the uncertainty of the penalty does not promote market certainty (Cory and Swezey 2007).
- *Utility Reporting:* Requires utilities to provide periodic reports on their compliance status.
- *RPS Review:* Authorizes an appropriate board to review the success of the RPS and modify or adjust implementation standards as necessary to meet the state's goals.

- *Solar Support:* Directs specific policies solely toward the development of solar technologies.
- *Distributed-Generation Support:* Directs specific policies solely toward the development of distributed generation.
- *Long-term Project Financing:* Includes policies designed to encourage long-term financing through contract duration requirements, central procurement, credit protection policies and/or renewables fund support (as defined by Wiser 2008).
- *Applies to Most Load Serving Entities:* Covers a minimum of 90% of the state's electricity sales under the RPS (as defined by Wiser 2008).
- *Out-of-State Projects:* Does not restrict projects to only in-state development, although there may be a percentage of projects that are required to be developed in state.
- *Transmission:* Applies complementary proactive transmission policies (e.g., state transmission authority, renewable energy zones).
- *Short-Year Compliance:* Applies short-year compliance standards. States with short-year compliance obligations in 2006 were considered to be following best practices if they had achieved a minimum of 95% compliance with their goals. Not only is it important for states to have short-year binding goals, it is also integral that they meet these goals, indicating that they are on target to meet the end goal. Further refinement of this criterion is necessary as more information is known about existing policies and their status concerning compliance with short-term goals. The current methodology rewards states that have met their compliance goals, but also may put new policies at a disadvantage because they have not had sufficient time to meet a short-year goal.

These elements are known to have different levels of potential impact based on the context in the state (policy goals, resource availability, and regulatory environment). **Table A13** summarizes the results, and **Figure A12** presents a map of states that have a policy.

Table A13. States Receiving a Point for Renewable Portfolio Standards

State/Territory with RPS	
Arizona	Nevada
California	New Hampshire
Colorado	New Jersey
Connecticut	New Mexico
D.C.	New York
Delaware	North Carolina
Hawaii	Ohio
Illinois	Oregon
Iowa	Pennsylvania
Maine	Rhode Island
Maryland	Texas
Massachusetts	Washington
Minnesota	Wisconsin
Montana	



Source: National Renewable Energy Laboratory, July 2008

Figure A12. States with a Renewable Portfolio Standard

Alternative/Future Best Practices.
Consistency. While some adjustments to an RPS may be necessary to guarantee that the policy promotes an individual state's goals, policy inconsistency can cause damage to the renewable energy market because investors and developers value a consistent market. Some policy elements that can lead to inconsistency concerns include ambiguously defined provisions for compliance waivers, vague definitions of financial penalties, and changing eligibility rules. For example, when Connecticut altered its eligible technology to include several preexisting biomass facilities, the REC market price fell, causing instability for the REC market in the NEPOOL trading system in New England (Cory and Swezey 2007).

New Project Support. The eligibility of renewable energy projects to be used to meet the RPS varies with each policy. Several states place restrictions on eligible facilities based on the year in which it was built, while other states allow differing percentages of renewable credits to be generated at existing facilities. For example, the difficulty arises in that some states allow qualifying facilities to be considered new if they were built after 1998, while others require different year constraints. To increase renewable energy development, it is important for policies to specifically promote new projects.

Compatibility with Other Policies. Because there are many policies at the state, regional, and federal levels, it is integral that an RPS is compatible with these other policies to be effective. Due to a lack of data on compatibility, this was not included in the best practices for an RPS. However, if an RPS is designed in a way that conflicts with other policies, this is not a best practice and should be revised to guarantee that multiple policies are complementary.

Compliance. Compliance with the policy will become a more important metric to measure success than adherence to best practices in policy design. This will be determined by the state's ability to meet compliance standards for both short-year and end-year goals. This metric was partially included in the best practices because states that had short-term obligations and achieved at least 95% compliance are given a point. However, the states that had short-term goals but were not in compliance are not additionally penalized at this stage of analysis. Further difficulty arises as each state may have distinct years in which compliance goals must be met.

Policy Element Weighting. There are likely certain policy elements that are more critical to the success of the RPS than others. The policy elements have not been ranked for this analysis, thus favoring an RPS with the highest number of policy design elements without differentiating between policies that may be integral for success and ancillary policies. There are a number of challenges in determining which policy elements are the most critical to a successful policy. Among them are regional differences (transmission is critical in constrained environments such as Texas), regulatory context (the stage of utility regulation creates different best practices for policies), and resources (a state with a large market for solar and excellent resource may require a set-aside to ensure market development).

Conclusions. Renewable portfolio standards are a popular policy mechanism among the states. As states fine-tune their RPS policies and other states move toward designing a new RPS, the design of the policy will be fundamental to its success.

Policy: Tax Incentives

Note: Tax incentives are presented here as a group due to similarity of the mechanisms.

Policy Description. There are multiple types of tax incentives for which renewable energy systems may be eligible. The four primary categories of tax incentives that apply to renewable energy development are corporate, 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 targeted because, ideally, state policies reflect best practice design within the context of the state. Each category of tax incentive is described below.

Corporate Tax Incentives. Corporate tax incentives provide tax incentives regarding either credits or deductions for the cost of equipment and/or installation of renewable energy systems. The incentives range from 10% to 35% of the total cost, and rarely is there a cap set on the total incentive that an individual corporation can claim. However, some states set a minimum on the investment that is needed to trigger a tax incentive (DSIRE Description 2008).

Personal Tax Incentives. Several states provide personal tax credits or deductions of a set dollar amount, or up to a certain percentage of the total cost for the purchase and/or installation of renewable energy equipment. Technologies eligible for and the magnitude of tax incentives vary by state (DSIRE Description 2008).

Property Tax Incentives. Because property taxes are collected locally, this incentive applies only if local authorities are given the opportunity by the state to offer such an incentive. This incentive is generally offered as an exemption, exclusion, or a credit often based on the difference between the value of the system installed and the value of a similar conventional system (DSIRE Description 2008).

Sales Tax Incentives. A sales tax incentive allows any purchase of renewable energy equipment to be exempt from state sales tax (DSIRE Description 2008).

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 development. Currently:

- Twenty-three states provide a corporate tax incentive to promote renewable energy development.
- Twenty states provide a personal tax incentive to promote renewable energy development. These tax incentives do not apply to the seven states that do not have personal income tax: Alaska, Florida, Nevada, New Hampshire, South Dakota, Tennessee, and Texas.
- Twenty-five states and Puerto Rico provide a property tax incentive to promote renewable energy development.

- Twenty-one states and Puerto Rico provide a sales tax incentive to promote renewable energy development. Five states (Alaska, Delaware, Montana, New Hampshire, and Oregon) do not have a sales tax from which to exempt renewable energy purchases so this type of incentive does not apply to these states.

Policy Inclusion Justification. Tax incentives can be integral in renewable energy development because they offer policy makers 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 policy makers to direct financial support to a specific technology or sector that best fits the state's goals as well as fiscal and resource contexts. 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.

Property Tax Incentives. Property tax incentives can be especially important as capital-intensive technologies result in a significantly higher tax burden per kilowatt hour, as is the case with many renewable energy projects (Clement et al. 2005). A possible problem associated with property tax incentives is that they reduce the direct financial benefit to the local community that is derived from the project, although other benefits may be created as a result of the development (i.e., job creation, reduced pollution) (Bird et al. 2005). If the policy is not designed effectively, the community may view the property tax break as lost community resources, possibly leading to a decline in community support for renewable energy projects. Local option policies are not included in this analysis.

Sales Tax Incentives. Sales tax can be particularly beneficial in states with excellent resources in the technology to which the incentive applies, because it can reduce the price enough to bring the technology within a competitive range with conventional options (Bird et al. 2005).

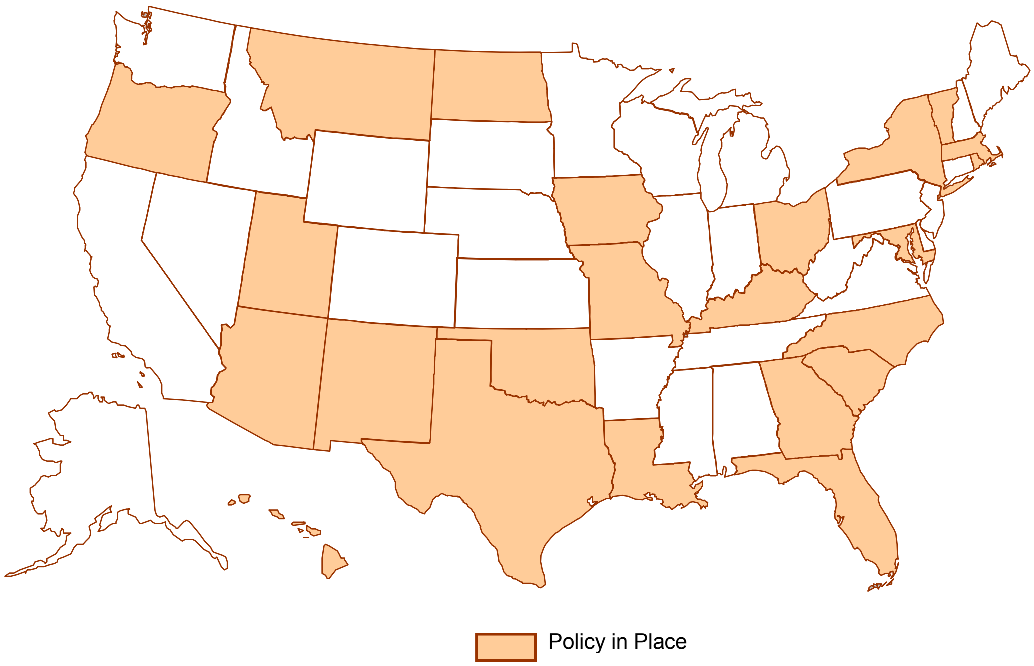
Best Practices Methodology and Results. A literature review resulted in sparse information regarding the best practices for tax incentives for renewable energy development. The best practices for tax incentives for the promotion of energy efficiency were used in an attempt to supplement this gap (Brown et al. 2004). However, due to the many difficulties associated with gathering adequate data to determine whether each state's policy follows best practices, for this analysis, states receive a point if they offer a tax incentive for at least two-thirds of the tax types that are relevant to the state tax environment (**Table A14**).[19] The following section describes the best practices and the associated data needed to evaluate policies based on those. **Figures A13-16** show the states that offer each type of tax incentive for renewable energy. The states that receive a point based on this methodology are presented in **Table A14** and **Figure A17**.

Table A14. Summary of States Receiving Points for Tax Incentives

	Tax Incentive Offered			
State	**Corporate**	**Personal**	**Property**	**Sales**
Alabama		•		
Alaska				
American Samoa				
Arizona	•	•	•	•
Arkansas				
California		•	•	
Colorado				
Connecticut			•	•
D.C.				
Delaware				
Florida	•			•
Georgia	•	•		•
Guam				
Hawaii	•	•		
Idaho		•	•	•
Illinois			•	
Indiana			•	
Iowa	•	•	•	•
Kansas			•	
Kentucky	•	•		•
Louisiana	•	•	•	
Maine				
Maryland	•	•	•	•
Massachusetts	•	•	•	•
Michigan			•	
Minnesota			•	•

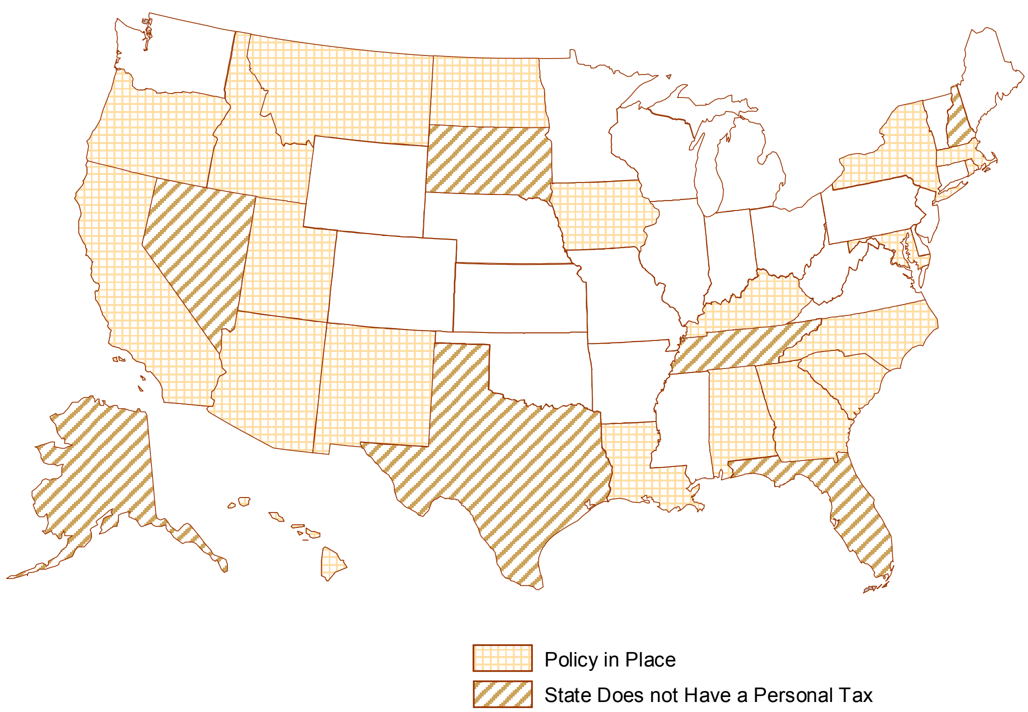
[19] For states that have a personal, corporate, property, and sales tax, they must offer a renewable energy tax incentive in three of the four categories to receive a point for this analysis. For states that do not have either a personal or sales tax, states receive a point if they offer a renewable energy tax incentive in two of the three categories. Two states, Alaska and New Hampshire, do not have either a personal or a sales tax. Because neither of these states offers any renewable energy tax incentives, they do not receive a point. If, in the future, either of these states offer renewable energy tax incentives, the methodology for determining the breadth of tax incentives necessary for these states to qualify for a point must be revisited.

State	Tax Incentive Offered			
	Corporate	Personal	Property	Sales
Mississippi				
Missouri	•			
Montana	•	•	•	
Nebraska				•
Nevada			•	
New Hampshire				
New Jersey				•
New Mexico	•	•		•
New York	•	•	•	•
North Carolina	•	•	•	
North Dakota	•	•	•	
Northern Marianas				
Ohio	•		•	•
Oklahoma	•			
Oregon	•	•	•	
Pennsylvania				
Puerto Rico			•	•
Rhode Island	•	•	•	•
South Carolina	•	•		•
South Dakota			•	
Tennessee			•	
Texas	•		•	
Utah	•	•		•
Vermont	•			•
Virgin Islands				
Virginia				
Washington				•
West Virginia				
Wisconsin			•	
Wyoming				



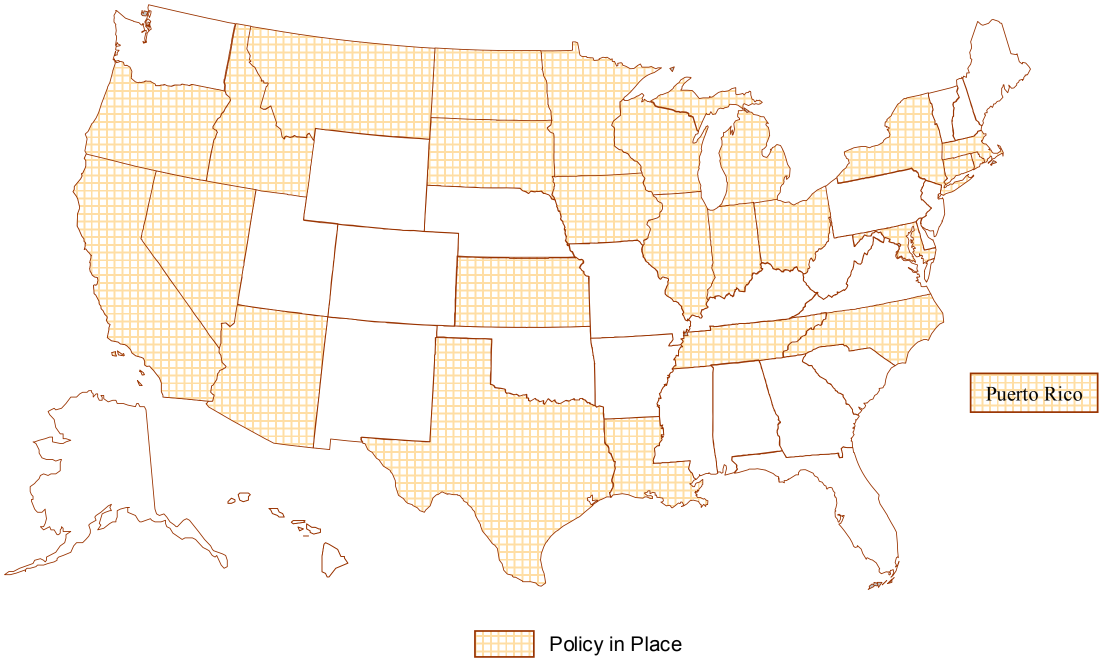
Source: National Renewable Energy Laboratory, July 2008

Figure A13. States with Corporate Tax Incentives



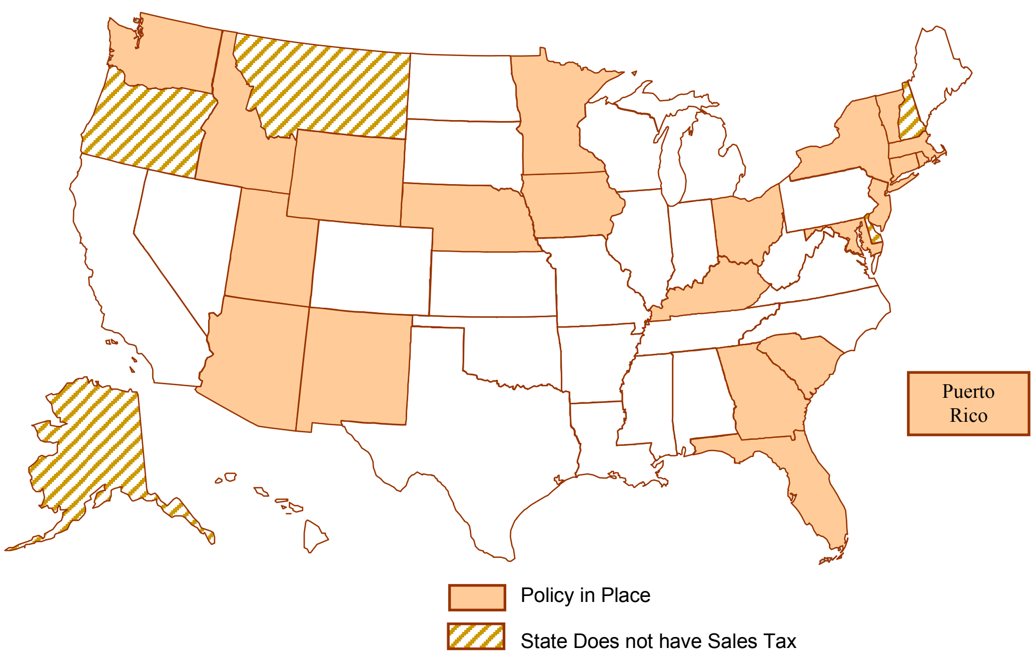
Source: National Renewable Energy Laboratory, July 2008

Figure A14. States with Personal Tax Incentives



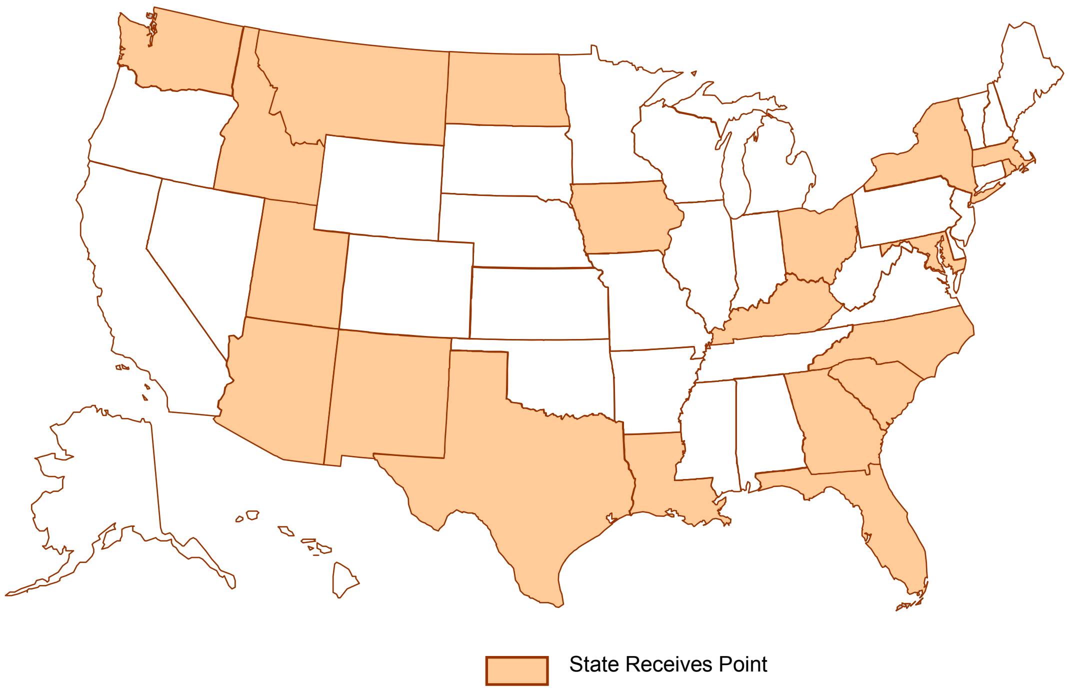
Source: National Renewable Energy Laboratory, July 2008

Figure A15. States with Property Tax Incentives



Source: National Renewable Energy Laboratory, July 2008

Figure A16. States with Sales Tax Incentives



Source: National Renewable Energy Laboratory, July 2008

Figure A17. Summary of States Receiving a Policy Point for Tax Incentives

Alternative/Future Best Practice. The categories below, derived mainly from the best practices for tax incentives for energy efficiency (Brown et al. 2004) and previous experience with tax incentive design (Bird et al. 2005, Clement et al. 2005, Mann and Hymel 2006) provide guidance for future analysis and refinement of this analysis.

Resources. In future studies, it may be appropriate to rate the policies based on a quantitative analysis of resource availability to determine whether the policy is promoting development of appropriate technologies within the state's context. 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).

Coordinates with other Policies. As noted above, tax incentives are not effective as the sole policy supporting 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. For example, one study of renewable energy policies in six states found that states lacking interconnection policies faced difficulties in connecting renewable energy to the grid, severely compromising the effectiveness of renewable energy incentives (Gouchoe et al. 2003). States should design their tax incentives to complement other incentives offered at the local, state, and federal levels.[20]

Appropriate Size. 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 because this creates an insufficient tax liability, and the consumer is unable to take full advantage of the incentive (Clement et al. 2005).

Adequately Capped. The financial incentive is adequately capped to reflect the fiscal realties in the state and reduce 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 and the resultant boom-bust cycle in wind development (Wiser, Bolinger and Barbose 2007).

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

Appropriate Technology. As a best practice, if a national certification standard exists for the technology, all eligible technologies must be required to meet certification standards. This ensures market certainty for manufacturers in development and marketing of technologies and provides consumer protection for purchasers 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 Costs. 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).

Nontaxed Sector Eligibility. Incentives are designed so that nontaxed sectors (i.e., schools, nonprofits, etc) are eligible to participate (Clement et al. 2005).

[20] Extensive listngs of existing state and federal clean energy policies are found at http:// www.dsireusa.org

Production Based. Historically, tax incentives have been awarded based on capacity; however, the literature suggests that they may be more effective if production-based provisions are included, especially for large systems (Clement et al. 2005).

Conclusions. 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. For this analysis, states that offer a minimum of 66% of the applicable tax incentives receive a point. However, 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 policy makers to use when developing renewable energy tax-incentive programs.

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E. Brown and S. Busche

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This report provides insights into the status of renewable energy development at the state level. Renewable resources are increasing in development overall, but state development varies by resource and rates of change. The factors contributing to renewable energy development at the state level are identified and discussed, including the challenges of understanding the role of different factors in development. The report also compiles and evaluates the status of “best practice” state policy design and connects the existence of some policies with increased renewable energy development through correlation analysis. The report also proposes a strategy for better understanding the role of policy in renewable energy development, based on market-transformation principles. Correlation analysis illustrates the potential for further application of these principles to renewable energy. The final section provides resources for state policy makers for better understanding and developing renewable energy resources.

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