

Reaping the Rewards

How State Renewable Electricity Standards Are Cutting Pollution, Saving Money, Creating Jobs and Fueling a Clean Energy Boom

U.S. PIRG Education Fund

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Written by:
Tony Dutzik, Frontier Group
Elizabeth Ridlington, Frontier Group
Rob Sargent, U.S. PIRG Education Fund

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Executive Summary

Renewable energy in the United States is on the rise. America now generates twice as much electricity from the wind and the sun as we did just four years ago, and 2007 promises to be another year of record growth.

The renewable energy boom is the result of a series of federal and state policies designed to promote cleaner sources of electricity, as well as technological improvements that have reduced the cost of renewable energy over the last three decades, rising fossil fuel prices, and increased concern about global warming. Renewable electricity standards (RES), which require increasing percentages of the electricity supplied to consumers to come from renewable resources, have been among the most important factors in encouraging the development of renewable energy.

Twenty-five states and the District of Columbia have adopted an RES. And while many of those policies are in their infancy, RES states have already begun to reap the benefits in increased renewable energy development, reduced pollution, cost savings and economic growth.

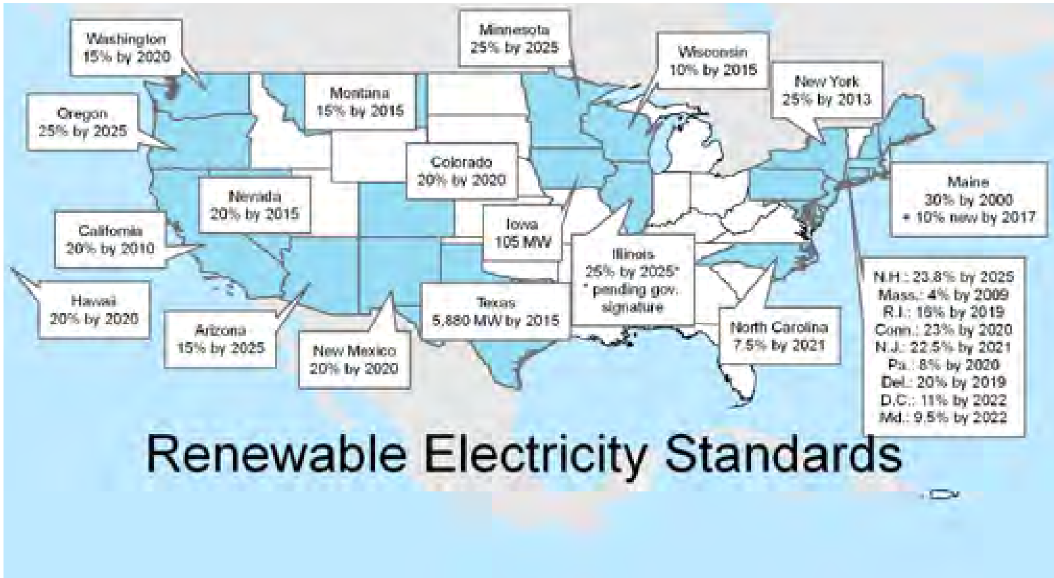
The 25 states that have adopted an RES are leading the nation in renewable energy development.[1]

- Approximately 54 percent of the electricity consumed in the United States is in states with RES policies.[2] States with RES programs, however, account for 75 percent of America's renewable energy generating capacity.[3]

- In 2006, more than two-thirds of all new renewable electric generating capacity in the United States was built in RES states. The same is likely to hold true in 2007, with more than 70 percent of planned renewable generation capacity expected to be built in RES states. (RES policies also spur renewable energy development in nearby states, while some renewable energy built in RES states is spurred by other public policies.)

- Renewable energy will make up a larger proportion of new power generation in RES states in 2007 than in states without RES policies. In 2007, renewable

Fig. ES-1. State Renewable Electricity Standards

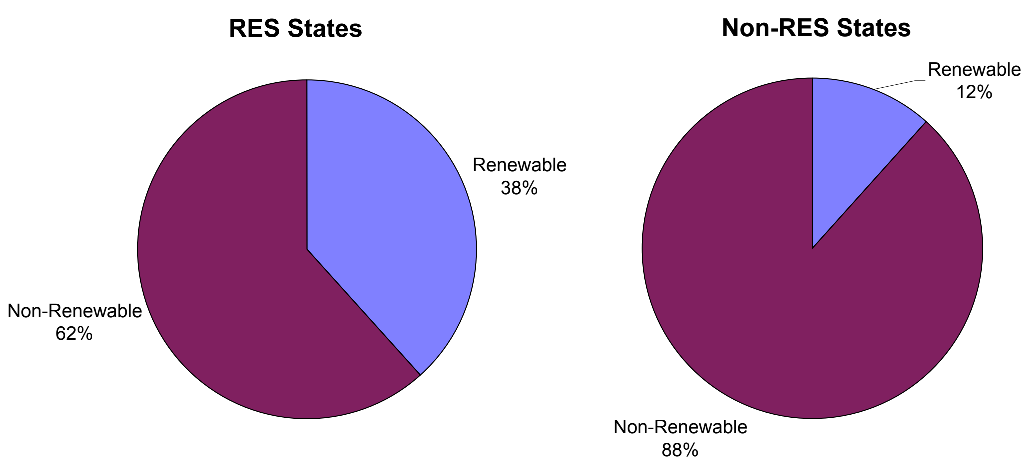


electricity generators account for about 38 percent of planned capacity additions in RES states, compared to just 12 percent in non-RES states.

- Of the top 20 utilities with long-term contracts for wind power in the United States, 17 of them are covered in whole or in part by RES policies.

- While many public policies have contributed to the growth of renewable energy, the RES has played an important role. The U.S. Department of Energy estimates that RES policies contributed to the construction of about half of the wind energy added in the United States between 2001 and 2006, with the share increasing to 60 percent in 2006.

Fig. ES-2. Proposed New Electric Generating Capacity Additions, 2007



State RES policies are reducing pollution and saving natural resources.

- Renewable energy sources built after the adoption of state RES policies reduce America's global warming emissions by approximately 8.4 million metric tons per year, the equivalent of taking more than 1.5 million cars off America's roads.

- Renewable generators in RES states also produce fewer emissions of health threatening pollutants that contribute to the formation of smog and soot than fossil fuel generators. Renewable energy, therefore, can reduce the overall cost of complying with federal limits on these pollutants and make it more possible to set tighter limits that are more protective of human health in the future.

- Renewable generators in RES states also save vast amounts of water—approximately 1.2 billion gallons per year.

Renewable energy development in RES states is boosting local economies.

- Over the last two years, several of the world's leading manufacturers of wind turbines and solar panels have either built new manufacturing facilities or expanded existing facilities in the United States. RES policies play an important role in luring manufacturing facilities, as they represent a long-term commitment to build the market for renewable energy technologies. Colorado, Pennsylvania, Oregon, Texas, and Massachusetts are among the RES states that have experienced increases in renewable energy manufacturing activity in recent years.

- Renewable energy development in RES states has had ripple effects that extend across the nation. Increased demand for renewable energy creates increased demand for raw materials, construction, accounting, engineering and a wide variety of services. While the benefits of renewable energy are strongest in local economies near manufacturing facilities and renewable energy installations, every state in the nation has at least one business that participates in the renewable energy economy and benefits from its growth.

- Renewable energy has had particular benefits for rural economies. Texas landowners, for example, now receive an estimated $9.5 million in royalty payments from wind farm operators, while one town in rural Colorado saw its tax base increase by 29 percent as a result of a wind farm development there.

State RES policies also have the potential to save electricity consumers money.

- A 2007 analysis by the energy research firm, Wood MacKenzie estimated that adoption of a 15 percent federal renewable electricity standard would save more than $100 billion in electricity costs by 2026, largely by driving down the cost of natural gas.

- In many states, such as Colorado and Washington, wind farms have proven to be the least-cost source of electricity, especially when all the likely future costs of fossil fuel-fired power plants are included (such as the risk of energy price spikes and the future cost of carbon dioxide emissions).

- Solar power, while currently more expensive than other forms of power generation, can play an important role in reducing demand for power at peak periods, when it is most expensive.

- Renewable energy development reduces upward pressure on natural gas prices.

A 2005 study by researchers at the Lawrence Berkeley National Laboratory estimated that the 18 state RES policies then in effect would produce savings of approximately $10 billion in lower natural gas bills as a result of reduced demand for natural gas.

Adoption of a national RES would increase the benefits of renewable energy to the environment and the economy.

- The United States should adopt a renewable electricity standard that calls for 25 percent of America's electricity to come from new renewable sources by 2025.

- States that have not yet adopted RES policies should consider doing so, while those that have adopted RES policies should consider strengthening them by increasing the required percentage of renewable energy, excluding non-renewable or polluting energy sources, and refining their policies to ensure that renewable energy targets are met.

- The state and federal governments should also adopt complementary policies to hasten the deployment of renewable energy along with policies to improve the energy efficiency of the American economy.

Introduction

Ten years ago, in 1997, oil was selling for less than $20 a barrel.[4] Natural gas could be had at one-third to one-half of today's prices.[5] The United States had built a grand total of 360 megawatts of wind power—about the size of one large wind farm—in the previous *decade*.[6] The market for other renewable energy sources—from solar power to geothermal energy—was stagnant.

A decade later, the energy world has been turned upside down. Wind turbines are sprouting on the plains of Texas and eastern Colorado, solar panels are popping up on rooftops from Jersey City to Los Angeles, vast fields of mirrored collectors are harvesting solar power from the desert Southwest, and people all across the country are investigating new ways to produce energy from wind, water, crops and the Earth's heat.

No single factor is responsible for triggering the renewable energy boom. Rising fossil fuel prices and increased concern about the impacts of global warming have been key drivers. Federal tax breaks have helped. The declining cost of renewable energy—made possible by technological innovations over the past several decades—has changed the economics of clean energy in fundamental ways.[7]

One thing is clear: America would not have come so far so quickly were it not for creative and bold leadership from the states. The adoption of state renewable electricity standards (RES, sometimes known as renewable portfolio standards or RPS) has played a major role in spurring the renewable energy renaissance, representing a new, long-term commitment to renewable energy as a key part of America's energy future.

What began as a pioneering effort by a small number of states has become a nationwide movement. As of this writing, 25 states have adopted RES policies and more than a dozen states have already revisited their original RES commitments to make them more aggressive.[8]

Many state RES policies are still in their infancy. But the impacts of the RES are beginning to be felt all across the country. States with RES policies are leading the nation in the deployment of new renewable electricity generating capacity and are reaping the benefits in reduced pollution and, in some cases, lower costs.

Unlike previous public policies to support renewable energy—such as "here today, gone tomorrow" federal subsidies—RES policies establish a long-term timetable for the addition of renewable energy to states' electricity mix. The private sector has responded to this commitment by pumping capital into new factories to manufacture renewable energy technologies in the United States, with much of that investment coming in states that have adopted RES policies. The result has been the addition of thousands of new, high-quality jobs in the American economy and a wide range of economic benefits to our communities.

This report documents the benefits that have already been achieved by states that have adopted renewable electricity standards. But the benefits achieved thus far are just a fraction of what can be achieved in the future with an aggressive national commitment to renewable energy development.

Renewable Energy in the States

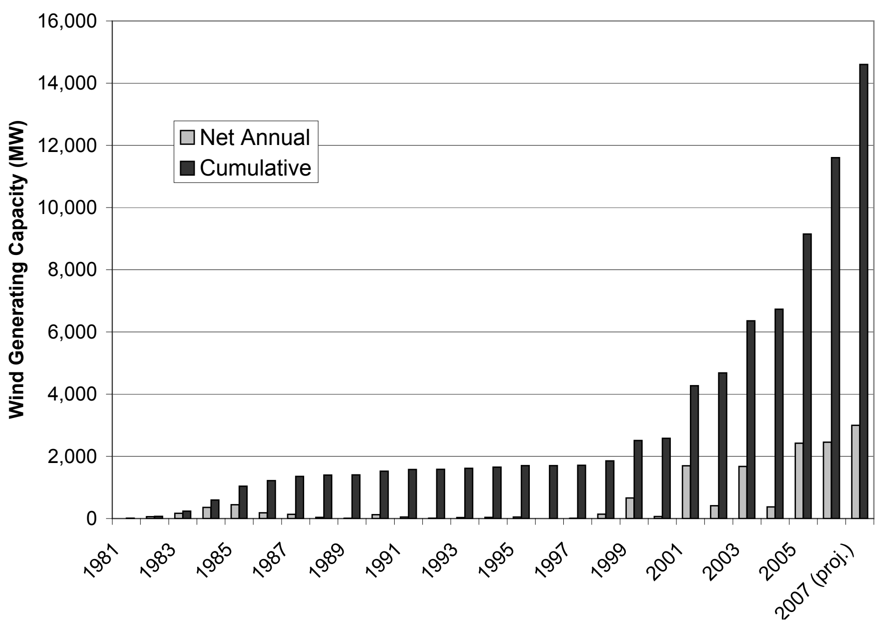
Renewable Energy on the Rise

Renewable energy has made remarkable gains in recent years. After more than a decade of stagnation, installation of many renewable energy technologies has been rising at a rapid clip, demonstrating the potential for the United States to receive a large share of its energy from renewable power.

Wind Power

Wind energy has moved in just the last decade from a bit player in America's energy picture to an important provider of

Fig. 1. Annual and Cumulative Installed Wind Power Capacity, United States[10]



electricity. Since 1996, the amount of wind generating capacity in the United States has increased nearly seven-fold, to more than 11,000 MW of capacity at the end of 2006.[9] More than 2,000 MW of wind generating capacity has been added in each of the last two years and another 3,000 MW is on tap to come on line during 2007. (See Fig. 1, page 7.)

Wind power is rapidly becoming an important part of the U.S. electric grid. In 2006, wind turbines accounted for 19 percent of all electric generating capacity added to the grid, a greater share of new capacity than any other type of generation except natural gas-fired power plants.[11]

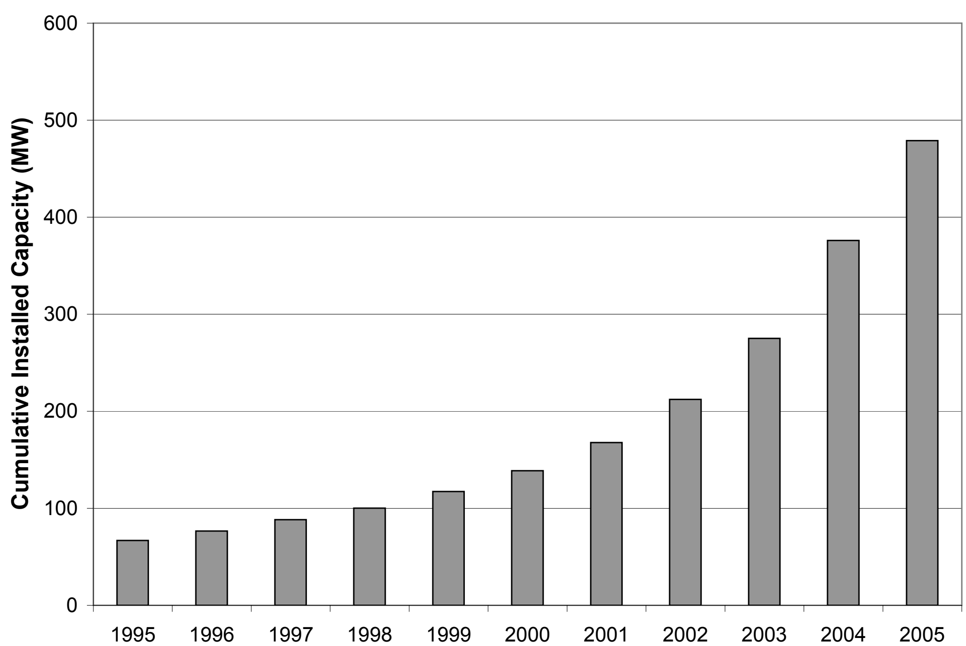
The past decades have seen dramatic advances in the technology of wind turbines, enabling wind turbines to generate more power at lower cost. The cost of wind power projects has been cut by about two-thirds over the past two and a half decades, and technological advances have made it possible to build turbines that are more efficient at generating electricity from the wind.[12]

While wind power has grown tremendously in the past decade, there is ample room for further growth. As of the end of 2006, wind power produced less than 1 percent of America's electricity, compared to approximately 7 percent in Germany, 9 percent in Spain and more than 20 percent in Denmark.[13] America has vast amounts of untapped wind energy potential. The nation's total wind energy potential has been estimated at 10 trillion kilowatt-hours per year—more than twice as much electricity as is currently generated annually in the United States.[14]

Solar Power

Solar power has also experienced dramatic growth in recent years, albeit on a much smaller scale than wind power. America had more than seven times the amount of solar photovoltaic (PV) generating capacity at the end of 2005 as it did 10 years earlier.[15] Between 2004 and 2005, America's

Fig. 2. Cumulative Installed Solar Photovoltaic Capacity, United States[16]



PV generating capacity increased by more than 27 percent. (See Fig. 2.) In addition to increases in the number of solar panels that can be found on rooftops, other forms of solar power—including various forms of solar thermal generating plants in the desert Southwest—have seen renewed interest in recent years.

Solar power generally remains more expensive than wind power, but utilities and consumers are coming to recognize the unique benefits of solar photovoltaic systems to the environment and to the electric grid. Because solar panels tend to generate power when it is most needed—during hot summer days when demand for electricity typically peaks—they can alleviate strain on the grid and the high cost of delivering "peaking" power.

As with wind power, prices for solar photovoltaic panels have fallen dramatically over time, with the price of photovoltaic modules declining by about 80 percent since 1980.[17]

Biomass Energy

Biomass is the second-largest source of renewable electricity in the United States, trailing only hydroelectric power. Historically, the largest source of biomass energy has been waste from the pulp and paper industry, but in recent years, other forms of biomass energy have attracted interest.[18] The number of landfills that capture and burn waste gases has more than doubled over the last decade, while farmers are experimenting with ways to capture methane gas from manure and use it for energy.[19] Landfill gas and "biogas" projects can make an important contribution to reducing global warming pollution because they reduce emissions of methane, which is a potent greenhouse gas.

Geothermal Energy

Geothermal energy uses hot water stored deep underground to produce electricity. America's best geothermal resources are in the western United States, though there is potential to use the heat stored in underground rock (so-called "enhanced geothermal") to generate electricity in a wider variety of locations across the country.

After a period of stagnation, the geothermal energy industry is expanding again in the United States. More than 2,400 MW of geothermal generating capacity is in the planning or development stage in the United States, the vast majority of it in several states with RES policies, including California, Hawaii, Nevada, New Mexico and Oregon.[20]

Hydroelectric Power

Hydroelectric power is currently the largest source of renewable energy in the United States, accounting for 6.5 percent of the nation's electricity supply.[21] However, conventional hydroelectric power—in which large dams are used to impound water and generate electricity—does not have a large role to play in the expansion of renewable energy in the United States. First, most of the major opportunities for hydroelectric development in the United States have already been tapped. More importantly, hydroelectric dams often cause major disruption to the environment, ecosystems, water supplies, and human communities, making them undesirable for future expansion.

Non-traditional hydroelectric technologies may make a contribution to achieving the goals of state RES policies. Some states allow low-impact or "run-of-the-river" hydroelectric power (which does not require damming) or incremental improvements to the efficiency of existing hydroelectric plants to count toward requirements for new renewable electricity under the RES. Even these options, however, can have adverse environmental impacts in some circumstances. With the exception of a few relatively small projects, there has thus far been little growth in hydroelectric generating potential in RES states.

The Role of Renewable Electricity Standards

Renewable electricity standards are among the many policies that have been used successfully to promote renewable energy development in the United States. Other public policy actions—including tax incentives and other financial inducements, programs to allow the voluntary purchase of renewable energy, proper regulatory treatment of renewable energy, and investments in infrastructure such as transmission lines that can bring renewable energy to market—can help states achieve their renewable energy goals.

Renewable electricity standards are the linchpin in many states' policies to promote renewable energy, representing a firm commitment to steady growth in deployment of clean energy resources. A strong renewable electricity standard can encourage the development of renewable energy in its own right. It can also serve as a benchmark to evaluate a state's progress toward a clean energy economy, leading policy-makers to identify and correct misaligned public policies that may be hampering the development of renewable energy in a particular location.

History of the RES

Efforts to promote renewable energy in the United States began in earnest during the energy crises of the 1970s. Increased investment in government research and development programs, tax incentives for renewable energy development, and changes in utility regulatory policy (such as the Public Utilities Regulatory Policy Act of 1978) were all designed to give a boost to renewable energy technologies. In the early 1980s, however, federal support for renewable energy research, development and deployment was dramatically scaled back, slowing progress toward affordable renewable energy.

Fig. 3. Policies to Promote Renewable Energy

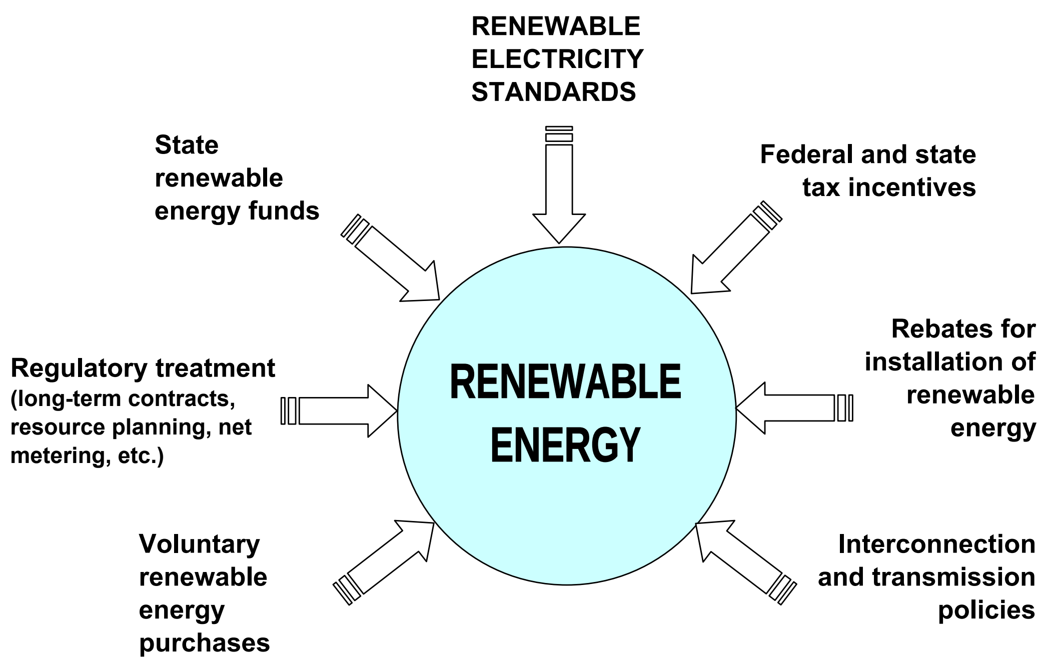
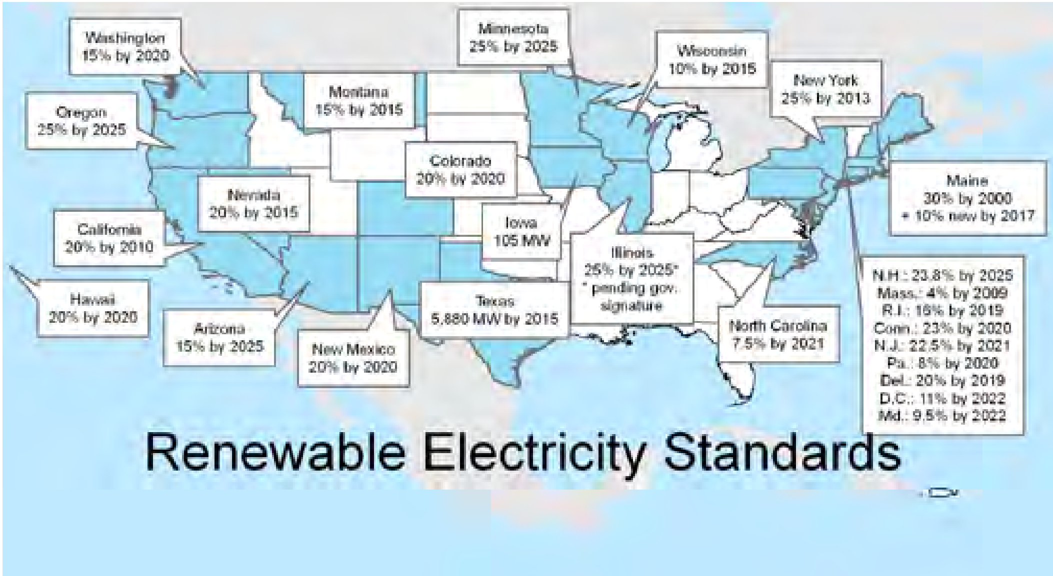


Fig. 4. State Renewable Electricity Standards[24]



In the absence of federal leadership, states began to take action. In 1983, Iowa became the first state to require utilities to develop specific amounts of renewable energy capacity.[22] Iowa was followed by Minnesota in 1994, which imposed a renewable energy requirement on that state's largest utility as part of a settlement agreement over the storage of waste from a nuclear power plant.

By the mid to late 1990s, many states were considering restructuring of their electricity industries in order to encourage competition. Several states adopted "renewable portfolio standards" as part of their restructuring plans to ensure that renewable energy would play an important role in the electricity mix. These portfolio standards often differed from the earlier Iowa and Minnesota efforts in that many of the standards required a certain percentage of electricity sold to consumers to come from renewable resources, as opposed to requiring utilities to build a certain amount of renewable generating capacity.

In the years since, states with both restructured and traditionally regulated utilities have come to adopt renewable electricity standards as a way to ensure that their states reap the benefits of renewable energy. Today, 25 states have RESs or functionally similar policies on the books.[23] (See Fig. 4.) Other states, such as Vermont, have adopted voluntary renewable energy goals.

Each state has placed its own unique stamp on the RES and no two state policies are exactly the same. The most effective state RES policies, however, set ambitious targets, include only truly renewable and environmentally responsible resources, focus on the development of new renewable energy, provide flexibility without undermining the goals of the program, cover as broad a range of utilities as possible, and include strong penalties for non-compliance.

How it Works

Simply put, a renewable electricity standard requires retail providers of electricity to obtain a certain percentage or amount of the electricity they sell to consumers from renewable resources. By placing the onus on retail electricity suppliers, RES policies apply equally well to states that

Colorado and Washington: Tapping Public Support for Renewable Energy

Renewable energy enjoys broad public support. In Colorado, efforts by renewable energy advocates to win a renewable electricity standard in the state legislature were vigorously opposed by utilities, the coal industry and their allies. In 2004, supporters of renewable energy in Colorado tested public support by placing Amendment 37, Colorado's renewable electricity standard, on the ballot through the state's initiative process. Opposition to the measure was fierce: Xcel Energy included inserts in customers' utility bills opposing the measure, while other utilities and the locally powerful coal industry weighed in forcefully.[25] Colorado voters, however, were undaunted, adopting the RES by a margin of 54 percent to 46 percent.

Renewable energy supporters in Washington state, including U.S. Rep. Jay Inslee (center), announce that they have collected enough signatures to put the state's renewable electricity standard on the 2006 ballot. Voters in Washington later approved the measure, making it the second state to adopt an RES by popular referendum.

In 2007, building off the momentum of the Amendment 37 campaign and the demonstrated success of renewable energy development in Colorado, the state legislature voted – this time with the support of Xcel Energy – to boost the RES requirement from 10 percent to 20 percent.

In 2006, clean energy supporters in Washington state placed an RES on their state's ballot. Initiative 937 included a 15 percent RES as well as measures to encourage energy efficiency. Washington voters adopted the measure by a 52 percent to 48 percent margin, confirming once again public support for renewable energy.

have restructured their retail electricity industries and those that retain traditional, regulated utility monopolies.

State RES policies vary in the types of energy that are considered "renewable," the targets and timelines for achieving various renewable energy thresholds, the mechanism for demonstrating compliance, the range of utilities covered, and the consequences for non-compliance, among other factors.

What Is "Renewable?"

The best state RES policies promote only clean, renewable sources of energy. Clean renewable energy includes the following sources of power:

- Solar power (both photovoltaic and concentrating thermal)
- Wind power
- Landfill gas
- Geothermal energy
- Clean biomass[26]
- Fuel cells using hydrogen derived from renewable resources
- Tidal, wave and ocean current energy and ocean thermal power (though these energy forms are more speculative and may require additional environmental review)

Not all forms of renewable energy are necessarily good for the environment. Large hydroelectric dams can have damaging impacts on fish populations and natural ecosystems and should not receive credit under an RES. (Incremental efficiency improvements in hydroelectric power production, along with "low-impact" hydroelectric power, often have smaller environmental impacts and have been included in some state RES policies.)

Municipal solid waste and other waste products—from tires to coal waste—produce toxic air emissions when burned and are not truly "renewable" forms of energy. Despite these problems, which should preclude them from receiving support under a state RES, these forms of waste have been included in some state renewable electricity or "alternative energy" standards.

In other cases, RES policies have included technologies that, while desirable, are not "renewable energy." Energy efficiency improvements, combined heat-and-power, and fuel cells powered by fossil fuel-derived hydrogen can deliver environmental benefits compared with traditional fossil fuel-fired electricity generation. While these technologies also deserve public policy support, that support should not undermine the need to expand renewable energy production. Where these technologies are included in an RES or similar policy, they should be included in a separate tier of resources (see "Tiers, Carve-Outs and Bonuses," below.)

Keeping less attractive sources of energy out of the RES is critical for ensuring the policy's success. Otherwise, non-renewable energy sources can crowd clean renewable energy out of the market, reducing the amount of clean energy that is developed.

New Renewable Electricity: When and How Much?

The prime objective of an RES should be to stimulate the production of new renewable energy. Thus, to be successful, an RES must have specific thresholds for new renewable energy development.

RES policies that do not target ambitious levels of new renewable energy end up largely supporting existing forms of generation. For example, the state of Maine has the nation's strongest RES on paper, requiring 30 percent of electricity to come from renewable resources. However, as a result of the state's historic reliance on hydroelectric power and electricity generated from paper mill wastes, both of which were included as eligible energy sources under the state's RES, Maine had already surpassed its RES percentage targets at the time they were implemented. As a result, until recent changes that set a threshold for new renewable resources in the state, Maine's superficially ambitious RES actually required no new renewable energy.

In addition to requiring new renewable resources, RES policies should require a steady ramp-up in renewable energy, thereby ensuring that renewable energy additions occur on a consistent and continual basis. Generally speaking, requiring that at least 1 percent of electricity needs be met by new renewable energy each year is a reasonable path for most states.

Tiers, Carve-Outs and Bonuses

Some forms of renewable energy receive special support in state RES policies. There are three ways in which state RESs differentiate among sources of energy—by separating different types of energy into "tiers," by creating "carve-outs" for specific types of energy, or by giving extra credit to certain types of renewable energy.

RESs sometimes include two or more tiers of resources. The cleanest sources of renewable energy are assigned to a top tier, with its own separate percentage requirement. Other sources of energy (or sometimes energy efficiency) are allowed to qualify for the RES in a second tier, but often under less advantageous conditions. (For example, the percentage of second-tier resources required may not increase over time.)

RES policies may also include "carve-outs" that set separate percentage thresholds for particular technologies, most commonly solar power. The idea of establishing a carve-out is to ensure that more than one renewable energy technology is used to achieve the goals of the RES and to provide early market support to particularly promising technologies.

Finally, RES policies may use bonus credits to provide advantages to particular technologies or particular producers of energy. For example, Colorado's RES provides rural cooperatives and municipal utilities with triple credit for solar power installations (prior to 2015) and 150 percent credit for small-scale, locally owned projects.[27]

Compliance: Renewable Energy Credits and Contract Lengths

RES policies should allow for a certain amount of flexibility for complying power suppliers, especially since some areas of the country are better endowed with renewable resources than others. As a result, many states have adopted the use of renewable energy credits (RECs) as the means of compliance with the RES. A REC is issued to a power producer every time a megawatt-hour of renewably generated electricity is produced. Retail electricity suppliers must then create or purchase enough RECs to meet their RES requirement, even if they do not contract to purchase the actual electricity. One of the major benefits of RECs is that they can be issued for renewable energy products in multiple states, meaning that a utility in one state can purchase RECs generated in another state, even if there is no possible way for them to receive delivery of the power. The use of RECs ensures that the RES succeeds in increasing the production of renewable energy, but gives utilities flexibility about where that electricity is produced.

RES policies spur renewable energy development by sending the message that there will be a consistent market for renewable energy in the states. However, state RES policies that rely on short-term purchases of RECs for compliance can undermine that message by failing to provide the kind of long-term revenue certainty renewable energy developers need to ensure financing for their projects. The result can be that fewer renewable energy projects are built, thus triggering a scarcity of RECs and causing the cost of complying with the RES to rise.

States should require utilities complying with the RES to achieve a significant share of their renewable energy targets through long-term contracts. Long-term contracts can encourage renewable energy development, thereby ensuring that an adequate number of RECs are created to supply the renewable energy market.

Who Is Covered?

The best state RES policies include all providers of electricity in a state, whether they are investor-owned utilities, private power marketers, municipal utilities or rural cooperatives. Most state RES policies exempt one or more of these categories of electricity providers from compliance with the program, while others set separate standards for municipal or cooperative utilities or require those utilities to adopt their own standards. In any case, renewable energy has the potential to benefit all electricity users and should be required for all power suppliers.

Loopholes

RES policies are intended to ensure that a given percentage or amount of electricity supplied in a state comes from renewable power. Yet loopholes and exemptions can make the percentage target an empty promise rather than a firm commitment. Among the most common loopholes are cost caps, which are intended to serve as a ceiling for the additional costs imposed by renewable energy development. If the price of purchasing a renewable energy certificate exceeds the cost cap, the utility has the option, in some state RES policies, to pay the amount of the cap into an "alternative compliance fund," which the state can then use to promote renewable energy development. In other states, the utility is exempted from compliance with the RES altogether when costs exceed the cap.

One problem with cost caps is that, if set too low, they can actually discourage utilities from engaging in practices that can lower the cost of renewable energy—for example, by entering into long-term contracts with renewable energy developers. More fundamentally, cost caps erode a state's commitment to achieve a given level of renewable energy development.

Force majeure clauses in RES policies are another type of problematic loophole. *Force majeure* refers to instances in which a utility cannot comply with an RES due to forces beyond its control. In the context of an RES, *force majeure* can be used to reduce the percentage target if it is judged that there is inadequate renewable energy capacity or constraints in transmission. The presence of a *force majeure* clause gives utility regulators discretion over whether to enforce an RES, opening up the possibility that they will relax the standard when it is merely inconvenient, rather than impossible, for utilities to comply.

In many cases, cost caps, alternative compliance payments, and *force majeure* clauses are adopted as part of the series of compromises that results in the passage of state RES policies. Where they are implemented, it is important that states design the policies narrowly, so that they apply only to truly extraordinary circumstances. Given the abundance of low-cost renewable energy options available across the country, these circumstances should be rare.

Enforcement

For RES policies to have "teeth" they must include strong provisions for enforcement. In many states, utilities can simply avoid compliance with the RES by paying into an "alternative compliance fund." When the alternative compliance payment is too low, making the payments can become an easier and more attractive option for utilities than making investments in renewable energy development. Indeed, utilities that are not held to least-cost procurement principles may simply find it easier to pay money into the alternative compliance fund than to develop new renewable sources of energy—

even when renewable energy might be less expensive. RES policies should include tough penalty provisions that set the cost of penalties well above the cost of obtaining renewable power, thus sending the proper signals to utilities regarding compliance with the standards.

Conclusion

Renewable electricity standards have played an important role in fueling the development of renewable energy in the United States, as will be discussed in the next section. However, not all RES policies are created equal, and the details of those policies matter. The very best RES policies have succeeded in driving large amounts of renewable energy development at relatively low cost. States across the country are now experiencing the benefits of those policies in a cleaner electricity mix, robust economic development, and in some cases, electricity cost savings.

RES States Are Leading the Way

The dramatic increase in renewable power development over the last several years has been triggered by many factors—declining prices for renewable technology, increased prices for fossil fuels, renewal of the federal production tax credit for renewable energy, and other state policy initiatives. Unquestionably, however, states that have adopted RES policies are leading the way toward a new energy future powered by renewable energy.

RES Policies Are Spurring New Renewable Energy Development

RES policies have played an important role in the recent growth of renewable energy in the United States.

Approximately 54 percent of the electricity consumed in the United States is in states with RES policies.[28] States with RES programs, however, account for 75 percent of America's renewable energy generating capacity.[29]

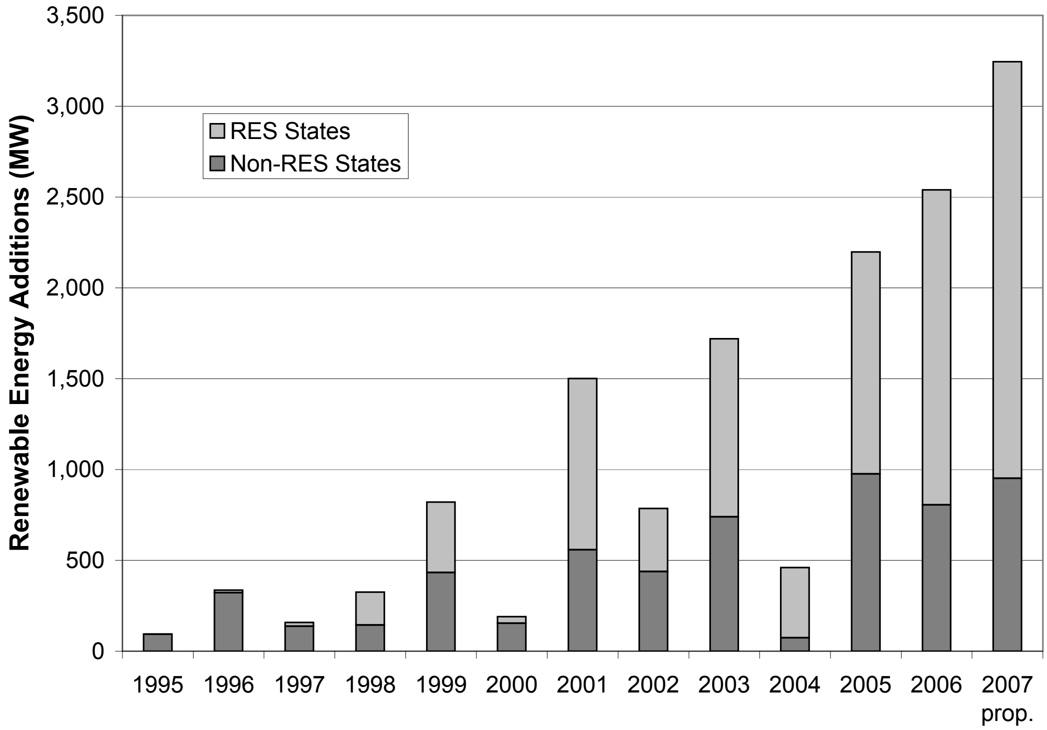
According to Black & Veatch, an energy industry consulting firm, half of all renewable electricity generation added in the United States since the late 1990s has been in states with RES policies.[30] Between 2001 and 2006, approximately half of all wind power additions were motivated to some degree by state RES policies, with the percentage increasing to 60 percent in 2006.[31]

RES States and Their Utilities Are Responsible for Most New Renewable Energy

In recent years, RES states and the utilities they regulate have taken the lead in additions of renewable energy capacity. In 2006, more than two-thirds of all new renewable electric generating capacity in the United States was built in RES states. The same trend is likely to hold true in 2007, with more than 70 percent of planned renewable generation capacity expected to be built in RES states. (See Fig. 5, next page.)

It is important to note that renewable energy development in RES states is not a

Fig. 5. New Renewable Generation Capacity by Year[32]



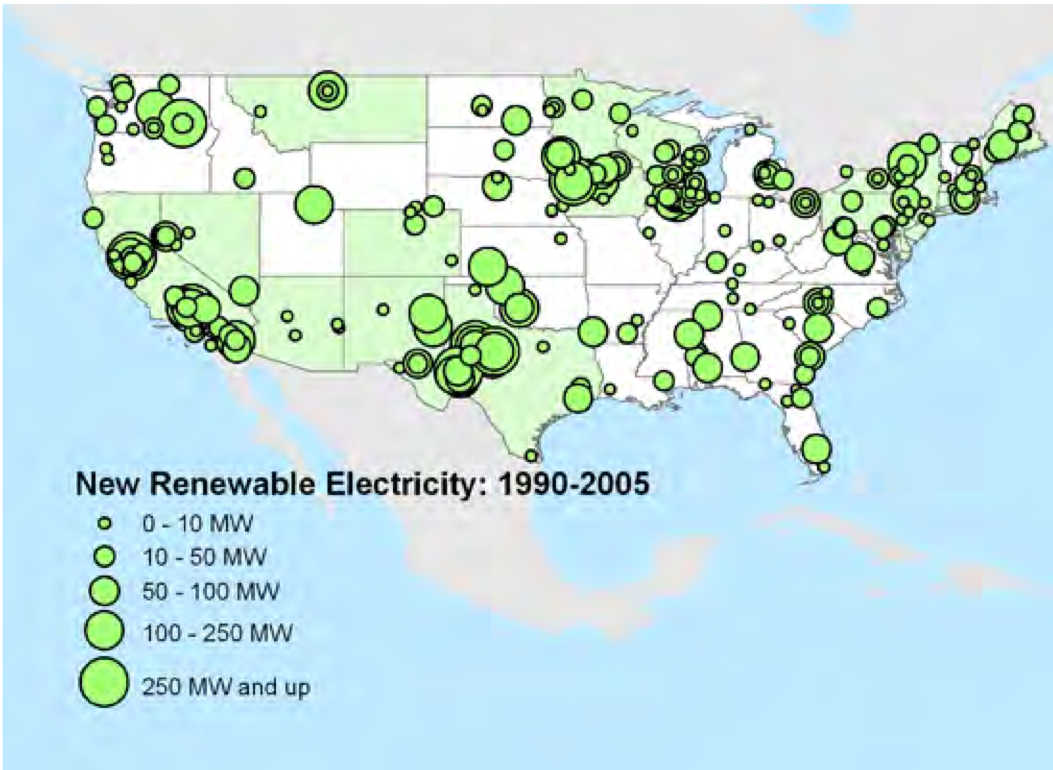
perfect indicator of the impact of RES policies. In some cases, renewable energy development within RES states may be due to factors other than the RES—for example, the desire of utilities to procure low-cost renewable energy or federal production tax credits. In addition, the impact of a state's RES does not stop at the state boundary; in many cases, state RES policies encourage the development of renewable energy in neighboring states without an RES.

Fig. 6 shows additions of renewable electricity generating capacity nationwide between 1990 and 2005. While renewable energy capacity has expanded across the country, the greatest gains have been made in or near states that had adopted an RES by the end of 2005, and particularly in the upper Midwest, the Northeast, California and Texas.

Because many state RESs are of recent vintage, trends in renewable energy development over the last few years are likely to be most instructive in evaluating the benefits of the policy. Looking only at new renewable energy capacity added in 2005 and 2006, along with planned capacity additions in 2007, Texas stands out as the state with the most aggressive renewable energy development, with the addition of more than 2,000 megawatts of new renewable energy capacity. Washington (which adopted an RES by popular referendum in 2006 but experienced most of its renewable energy development as a result of least-cost planning required by state regulators), New York and Colorado followed behind. (See Table 1, page 20.)

In addition to the states with RES policies, states with the largest renewable energy development tended to be the Great Plains and Midwestern states. The plains have excellent wind resources and, in some cases, wind power developed in these states

Fig. 6. Renewable Energy Additions, 1990 through 2005 (Shaded Areas Indicate States with RES Policies at End of 2005)



has been used to meet RES requirements elsewhere. For example, a significant share of the wind energy that has been developed in Iowa—which long ago hit its renewable energy target—supports compliance with the Wisconsin RES.[33]

Because renewable generating capacity built in one state can often be used to comply with another state's RES, one must also look at the renewable energy investments of individual utilities to get a flavor of the influence RES policies have had on renewable energy development. The American Wind Energy Association compiles data on wind power purchased by utilities via long-term contracts. Of the 20 utilities with the largest purchases of wind power, 17 of them are directly affected by an RES (with one of the utilities, Austin Energy, subject to a local rather than a state RES). Two of the three utilities that are not directly affected by an RES are publicly owned utilities in Texas and one of those, City Public Services of San Antonio, has a voluntary renewable energy goal. The remaining utility, the Basin Electric Power Cooperative, sells the renewable energy certificates from its renewable generation in voluntary renewable energy markets.[34] (See Table 2, page 21.)

State RES policies have not always been the primary driver of renewable energy investments. (See "Renewable Energy as a Least-Cost Resource," page 34.) But the presence of 17 utilities subject to RES policies among the top 20 wind power purchasers demonstrates that RES policies have helped to motivate a significant amount of investment in renewable energy in recent years.

Table 1. New and Planned Bulk Renewable Energy Capacity by State (MW)

State	2005	2006	2007 (proposed)	Total	RES Status
TX	554	851	1,089	2,493	in force
WA	150	428	166	744	adopted 2006
NY	139	196	216	551	in force
CO		60	383	443	in force
OR	75	101	227	403	adopted 2007
CA	59	247	40	346	in force
IL	55		282	337	adopted 2007
NM	140	90	90	320	in force
IA	185	99	30	314	in force, target achieved
OK	298	6		304	
MN	104	99	60	262	in force
KS	150	100		250	
ID	11	65	138	213	
SD			150	150	
MT	135			135	in force
NV	28	15	84	127	in force
PA	6	22	80	107	in force
ND	32	69		100	
FL		19	50	69	
NE	59	2	1	63	
ME			49	49	in force
MI			48	48	
HI		41		41	in force
NH			24	24	in force
SC	6	11	3	19	
UT			10	10	
VT			9	9	
NJ		8		8	in force
KY	1	3	3	7	
DE		7		7	in force
IN			6	6	
RI	6			6	in force
WI			4	4	in force
MA			3	3	in force
MO		3		3	
WY	3			3	
TN	2			2	
AK	1	0		2	
AZ	1	0		1	in force

Table 2. Wind Power Purchases via Long-Term Contract by Utility (MW)[102]

Power Company	Power Purchase Agreement for customers	Owned & used for customers	Total for customers	Owned, selling power to 3rd party	RES Utility?
Xcel Energy	1297	26	1323		Yes
Southern California Edison	1026	0	1026		Yes
MidAmerican	268	593	861		Yes (1)
Pacific Gas & Electric	793	0	793		Yes
TXU Energy	705		705		Yes
Puget Sound Energy	0	378	378		Yes
AEP	373	0	373	310	Yes (2)
Alliant	338	0	338		Yes (3)
City Public Services San Antonio	260		260		No (4)
Exelon	259		259		Yes (5)
Austin Energy	215		215		Yes (6)
Public Service New Mexico	204		204		Yes
Reliant	198		198		Yes
Seattle City Light	175		175		Yes
Los Angeles Department of Water & Power	169		169		Yes (7)
Northwestern Energy	135		135		Yes (8)
Basin Electric	131	3	134		No
San Diego Gas & Electric	132		132		Yes
Lower Colorado Municipal Authority	116		116		No
Aquila	112		112		Yes (9)

(1) MidAmerican is subject to the Iowa RES, the goals of which have already been surpassed, and the Illinois RES, which was adopted by the state legislature in mid-2007.

(2) AEP's Texas service territory is subject to an RES; its service territory in other states is not.

(3) Alliant's Iowa service territory is subject to the Iowa RES, the goals of which have already been surpassed. Alliant's Wisconsin, Minnesota and Illinois territories are subject to state RES policies, with the Minnesota and Illinois policies having been adopted in 2007.

(4) City Public Services San Antonio is not subject to the Texas RES, but has adopted a voluntary renewable energy goal.

(5) Exelon's service territory is split between Illinois, whose legislature adopted an RES in mid-2007, and Pennsylvania, which has an RES.

(6) Austin Energy is not subject to Texas' state RES, but is subject to a local RES.

(7) LA DWP has set its own RES targets consistent with the California RES.

(8) Northwestern Energy's Montana service territory is subject to an RES; its South Dakota and Nebraska service territories are not.

(9) Aquila's Colorado service territory is subject to an RES, its Missouri territory is not.

Renewable Energy Is Addressing a Greater Share of New Energy Needs in RES States

RES states are developing more renewable energy than other states. They are also relying on renewable energy for a greater share of their future energy needs.

According to the U.S. Energy Information Administration's list of proposed power plants for 2007, RES states will add an additional 2,293 MW of renewable power capacity, compared to 952 MW in non-RES states. In RES states, renewable electricity generators account for 38 percent of planned capacity additions, compared to 12 percent in non-RES states. This comparison does not provide a perfect picture of the impact of state RES policies, since some renewable electricity generators in non-RES states will be used to comply with state RES policies, while electricity demand in some RES states may be driving the development of non-renewable power sources in non-RES states. Nonetheless, it does suggest that RES states are poised to get more of their power from renewable energy in the years to come.

RES states are clearly moving toward a new energy future in which renewable energy provides for a greater share of our energy needs. While there has been significant renewable energy development in non-RES states, these states continue to rely on fossil fuel-generated power for a large share of their new electricity supply.

The RES Is Supporting a Variety of Clean Energy Technologies

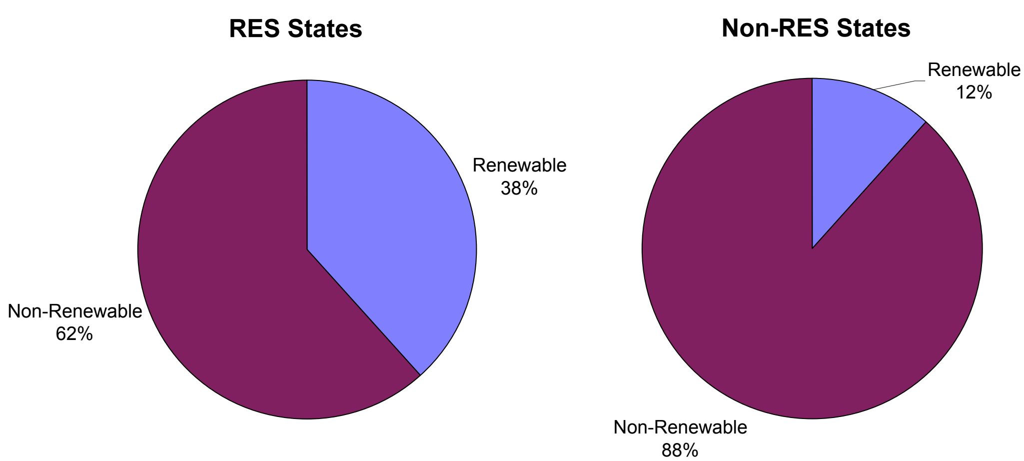
RES policies in the states are encouraging a variety of technologies that can reduce dependence on fossil fuels and reduce emissions from power generation.

Wind Power

Wind power has been by far the largest beneficiary of the RES. As noted above, approximately half of the approximately 9,000 MW of wind capacity that came on line in the United States between 2001 and 2006 was encouraged in some way by state RES policies.[35]

Thanks in part to state RESs, wind power is being demonstrated as an affordable and

Fig. 7. Planned Electric Generating Capacity Additions, 2007



More than 9,000 MW of wind power generating capacity have come on line since 2001. More than half of that growth has been spurred by state renewable electricity standards. (Credit: Patrick Swan)

feasible choice for electric power generation in states across the country. Texas, for example, added 554 MW of wind power in 2005 and 851 MW in 2006, and has proposals on the table to add another 1,089 MW in 2007. The nearly 2,500 MW of wind power capacity that will have been added in Texas between 2005 and 2007 is greater than America's entire wind power generating capacity as recently as 1998.[36]

Other regions of the country are experiencing growth in wind power as well. Colorado, which enacted its RES by voter referendum in 2004, added 60 MW of wind power in 2006 and has another 375 MW proposed for construction in 2007. This figure does not include a 400 MW wind generating facility, which would be the nation's second largest, for which ground was broken in May 2007.[37]

Solar Power

The data above focus exclusively on large-scale renewable power generation and therefore exclude most small-scale renewable energy development, of which solar photovoltaic installations are the most important. Recent state-by-state data for solar PV installations are unavailable, but the track record of the two largest solar power states—California and New Jersey—indicates that policy action, including adoption of an RES, can play a large role in spurring PV installations.[38]

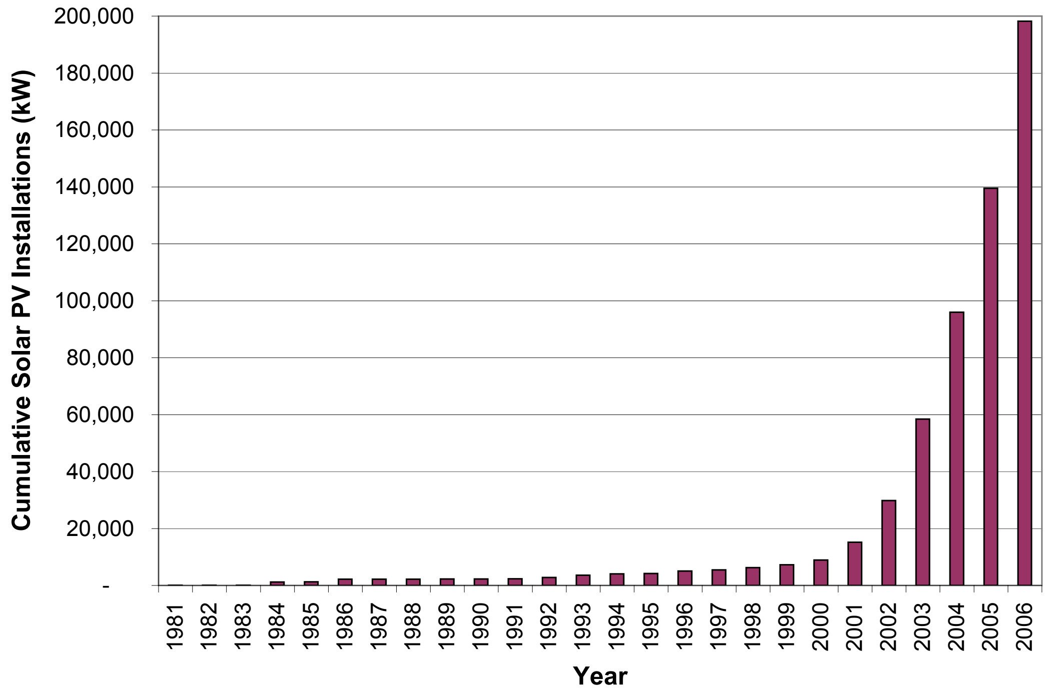
In 2006, more than 58.6 MW of solar PV capacity were installed in California, bringing the state's cumulative PV generating capacity to nearly 200 MW.[39] In New Jersey, more than 17.8 MW of solar PV were installed in 2006, bringing the state's cumulative capacity to at least 27 MW.[40]

Both California and New Jersey have RES policies and New Jersey has taken an extra step by creating a solar "carve-out" within its RES, which will require that 2.1 percent of the state's electricity come from

The market for solar photovoltaic panels has grown rapidly in recent years. (Credit: Robb Williamson, DOE/NREL)

solar power by 2021. However, the boom in solar installations in California is primarily the result of generous incentive programs, while recent growth in New Jersey is the result of both financial incentives and the

Fig. 8. Cumulative Solar PV Capacity, California[41]



state's RES. Several other states—including Arizona, Colorado and Nevada—have also adopted solar carve-outs as part of their RES policies and some of those provisions are beginning to yield dividends. In 2007, for example, Xcel Energy agreed to purchase power from an 8 MW solar PV installation in Colorado to satisfy RES requirements.[42]

In any case, aggressive support for solar photovoltaics will help the industry to achieve technological improvements and economies of scale that will reduce the price of solar photovoltaic systems in the future.

RES policies have also helped spur the resurgence of concentrating solar thermal power plants in the Southwest. These large-scale power plants use mirrors to concentrate and focus sunlight on a receiving liquid or gas, which captures the sun's heat and uses it to power a turbine or an engine, creating electricity. A 64 MW solar thermal plant commenced operation in Nevada in July 2007, the largest built in the world since 1991—and contracts were signed in 2006 to add as much as 2,000 MW in new solar thermal generating capacity in the Southwest in the years to come.[47] In July 2007, California's Pacific Gas & Electric announced that it will buy power from a 553 MW solar thermal power plant in the Mojave Desert, representing the largest solar power agreement in the world.[48]

Geothermal and Biomass

RES policies have also helped encourage modest growth in geothermal and biomass energy. Nevada added 28 MW of geothermal energy capacity in 2005, California added approximately 20 MW in 2006, and about 20 MW of capacity is planned for addition in Nevada in 2007. As noted above, more than 2,400 MW of geothermal energy capacity is in the planning or development stages in the western and Pacific states.[49]

RES policies have helped to drive additions of new biomass capacity. In 2006, Public Service of New Hampshire re-powered a 50 MW coal-fired power plant to operate on wood, generating renewable energy credits that could be sold to support RES policies in other states.[50] (New Hampshire adopted its own RES in 2007.) California generates a significant and growing amount of electricity from biogas collected from manure digesters at dairy farms.[51] And many projects are underway in a variety of states to tap waste gas from landfills as an energy source.

Summary

States that have adopted renewable electricity standards are leading the nation in the development of renewable energy resources. While wind power has been the primary beneficiary of the RES, state policies are encouraging a variety of renewable energy technologies with the ability to make a contribution to America's energy future.

The Southwest: Concentrating Solar Power

America's desert Southwest is an unparalleled resource for solar power. Enough solar energy strikes a 100-mile-square area of Nevada to theoretically provide all of America's electricity.[43] After decades of technological development and demonstration, concentrating solar power (CSP) appears ready to deliver on at least some of that vast potential.

CSP technologies use mirrors to concentrate the sun's energy to produce electric power with conventional turbines or heat engines. CSP was conceived of as a means to harness the sun's energy to provide large-scale, domestically secure, and environmentally friendly electricity. In the aftermath of the energy shortages of the 1970s, federal R&D programs rapidly advanced the technology, leading to early commercial implementation of CSP in the mid-1980s. As energy prices declined during the 1980s, commercial interest in CSP waned, but research and development efforts did not stop – making incremental advances in system performance, reliability and cost over time.[44] As a result, the cost per kilowatt-hour of CSP was cut by two-thirds and the industry has a goal of cutting costs in half again by 2015.[45]

These advances have brought CSP to the brink of wide-scale commercialization. Researchers at Sandia National Laboratory believe that additions of up to 20,000 megawatts of new CSP capacity could come on line by 2020.[46]

The Nevada Solar One power plant, opened in 2007, is the largest solar thermal power plant built anywhere in the world since 1991. (Credit: Desert Vu, used under Creative Commons license, creativecommons.org/licenses/by-nc-nd/2.0/deed.)

Benefits of the RES

Renewable energy provides a host of benefits to the environment and the economy. Even though many state RES policies are in their early stages of implementation, they are already making a positive impact on the environment and local economies.

Environmental Benefits

Global Warming Pollution

Renewable electricity generation installed in RES states averts millions of tons of global warming pollution each year. Global warming emission savings from RES policies depend on the type of power production that is avoided by new renewable energy. For the purposes of this report, we assume that renewable energy in RES states replaces new combined-cycle natural gas-fired power plants, the least polluting fossil fuel power plants.[52] This assumption is likely very conservative and RES policies likely deliver greater global warming emission reduction benefits than are estimated here.

Assuming that renewable energy added in RES states through 2006 replaces combined-cycle natural gas power plants, those additions of renewable energy would avoid an estimated 8.4 million metric tons of carbon dioxide emissions each year, equivalent to taking more than 1.5 million cars off America's roads. Renewable generation planned for addition in RES states in 2007 will save an additional 3 million metric tons per year.

The 11.4 million metric tons of carbon dioxide that will be averted by renewable power in RES states by the end of 2007 represents just a small share of the 2,375 million metric tons of carbon dioxide emitted by electric power plants nationwide in 2005.[53] But it is a significant savings, equivalent to taking more than 2 million cars off the road for a year.[54] And the savings will only increase over time: the Union of Concerned Scientists estimates that state RES policies will avert more than 118 million metric tons of carbon dioxide pollution per year by 2020.[55]

Emissions of Other Harmful Pollutants

By avoiding the need to burn natural gas and other fossil fuels in power plants, renewable energy also reduces emissions of pollutants that contribute to unhealthy air. Fossil fuel-fired power plants emit smog-forming pollutants (such as nitrogen oxides and hydrocarbons) and sulfur oxides, which form dangerous fine soot particles that can become lodged deep in the lungs, contributing to a variety of health problems. Coal-fired power plants also emit mercury, a potent neurotoxin that can affect brain development in young children.

Emissions of nitrogen oxides and sulfur oxides from power plants are regulated by the U.S. Environmental Protection Agency and state agencies. Sulfur dioxide emissions from power plants are governed by a nationwide "cap-and-trade" program. Under cap-and-trade, power plants must own permits called "allowances" for every unit of pollution they emit, with the total number of allowances limited by an overall cap. Power plants that emit less pollution can sell their excess allowances to other power plants. A similar cap-and-trade program governs nitrogen oxide emissions from power plants in the eastern United States.

Because emissions of nitrogen oxides and sulfur oxides from power plants are determined by the level of the emissions cap, expansion of renewable energy would not necessarily reduce emissions of these pollutants in the aggregate. However, expansion of renewable energy could reduce the cost of complying with emission limits and may allow government to contemplate tighter emission standards that are more protective of human health in future years.

Even when compared to natural gas-fired combined cycle power plants—the cleanest fossil fuel power plants—renewable generators produce significantly fewer emissions. Renewable generators built in RES states would reduce more than 2,100 tons per year of nitrogen oxide emissions, 44 tons per year of sulfur oxide emissions, and 220 tons per year of non-methane hydrocarbon emissions compared with natural gas-fired plants. Again, these reductions do not necessarily translate into reductions in aggregate emissions in the short term, but they do help put the United States on a path toward a cleaner electricity system that is more protective of human health.

Table 3. Estimated Annual Emission Reductions from Renewables Built After Adoption of State RESs versus Emissions from Natural Gas Combined Cycle Plants (tons)

	Through 2006	Including Planned 2007 Additions
Nitrogen oxides	2,104	2,854
Sulfur oxides	44	60
Non-methane hydrocarbons	221	300

Water Consumption

Fossil fuel-fired power plants also consume large amounts of water to produce steam to turn turbines. In parts of the country where water is scarce—particularly in the western states—switching from fossil fuels to renewable energy can produce large savings in water consumption.

While some forms of renewable power generation (such as biomass energy plants and solar thermal plants) consume water in much the same way as conventional fossil fuel-fired plants, wind power and solar photovoltaics consume very little water. Assuming the best-case scenario for water consumption in a natural gas combined cycle plant (and assuming that the operation of biomass, landfill gas, geothermal and solar thermal power plants delivers no net water savings), renewable electricity generators built in RES states can be expected to save significant amounts of water.[56]

Renewable generators built in states that had adopted RES policies through 2006 save an estimated 1.2 billion gallons of water per year. Including generators planned for 2007, the savings increase to nearly 1.9 billion gallons per year.

Table 4. Water Savings from Renewables Built After Adoption of State RESs (billion gallons per year)

Through 2006	Including Planned 2007 Additions
1.19	1.87

Economic Development

Renewable energy can play an important role in revitalizing America's economy. A 2006 study by the National Renewable Energy Laboratory of Arizona, Colorado and Michigan found that wind energy development creates greater direct economic benefits than building new natural gas or coal-fired power plants.[57] States with RES policies are already beginning to reap these economic benefits through new jobs in manufacturing and many other areas of the economy as well as accelerated economic development in rural areas.

Job Creation

Only a little more than a decade ago, the United States was the world's leader in renewable energy technology. As late as 1997, for example, the United States was the world's leading producer of solar photovoltaic systems.[58] In the decade since, however, Europe and Japan have moved aggressively to promote renewable energy, sparking the development of strong renewable energy industries and creating thousands of jobs.

As a result, the United States now lags in most categories of renewable energy development. Europe's wind industry employed nearly 50,000 workers in manufacturing, installation and maintenance of wind turbines in 2002, compared to just a few thousand in the United States.[59] And the United States produced less than 10 percent of the world's photovoltaic systems in 2005, trailing far behind Japan and Europe.[60]

But over the last two years, America has begun to close the gap, thanks in large part to the burgeoning domestic market for renewable energy created by state RES policies. Wind and solar equipment manufacturers now see that much of the United States has made a strong, long-term commitment to the development of renewable energy, and investment dollars have started to flow.

RES states have not been the only beneficiaries of the renewable energy boom—indeed, the renewable energy supply chain extends to all 50 states. But the RES states have, in many cases, been the epicenters of renewable energy development, drawing the most significant investments in manufacturing facilities and other infrastructure. The result has been the creation of thousands of new, high-quality jobs.

Wind Turbine Manufacturing

Over just the past two years, several of the world's leading manufacturers of wind turbines have built or announced the construction of manufacturing facilities in the United States, adding hundreds of high-quality jobs. Most of those plants are located in or near states that have adopted RES policies. For example:

- In March 2007, Vestas, the world's largest wind turbine manufacturer, announced that it would build a manufacturing facility in Windsor, Colorado, employing approximately 400 people.[62]

Job Creation Potential of a National RES

In 2007, the Union of Concerned Scientists (UCS) released a study of the economic impacts of a national RES calling for 20 percent renewable electricity by 2020. UCS estimated that the national RES would:

- Create 185,000 new jobs from renewable energy development.
- Produce $66.7 billion in new capital investment; provide $25.6 billion in income to farmers, ranchers and landowners; and add $2 billion in local tax revenues.
- Save consumers more than $10 billion on their electricity and natural gas bills by 2020.[61]

Recent growth in solar energy is creating new jobs—both in manufacturing of solar panels and in installation of solar energy systems. (Credit: Craig Miller Productions/DOE)

- In November 2006, TECO/Westinghouse announced a partnership in which the company will manufacture technology for wind turbines at its Round Rock, Texas facility, adding approximately 100 jobs.[63]

- In August 2006, Siemens announced that it will build a wind turbine manufacturing plant in Fort Madison, Iowa, creating approximately 250 jobs.[64] Siemens joins Clipper Windpower in Iowa, which operates a wind turbine manufacturing facility in Cedar Rapids.

- In July 2006, Suzlon Energy opened a wind rotor blade assembly facility in Pipestone, Minnesota with an annual capacity of 600 MW that employs up to 275 skilled workers. The company had built a wind farm in the area using turbines manufactured elsewhere in 2003.[65]

- In mid-2006, the Spanish wind turbine manufacturer, Gamesa, opened a manufacturing facility Cambria County, Pennsylvania, employing more than 230 workers.[66] The company, whose U.S. headquarters is in Philadelphia, is also building three new manufacturing plants in Bucks County, Pennsylvania on the site of a former steel mill.[67]

Manufacturers of wind turbine blades and other components are expanding their operations in the United States in response to growing demand for wind energy. (Credit: NEG Micon)

Solar Photovoltaics

Solar photovoltaic manufacturing has experienced similar dramatic growth. Between 2000 and 2005, the number of people employed in the solar photovoltaic industry in the United States increased by more than 60 percent, adding more than 1,100 jobs.[68] Employment in the industry will take another large leap with major additions of photovoltaic manufacturing, again centered in states with RES policies.

- In July 2007, BP Solar broke ground on a $97 million expansion of its Frederick, Maryland facility that will nearly double the facility's production capacity to 150 MW.[69]

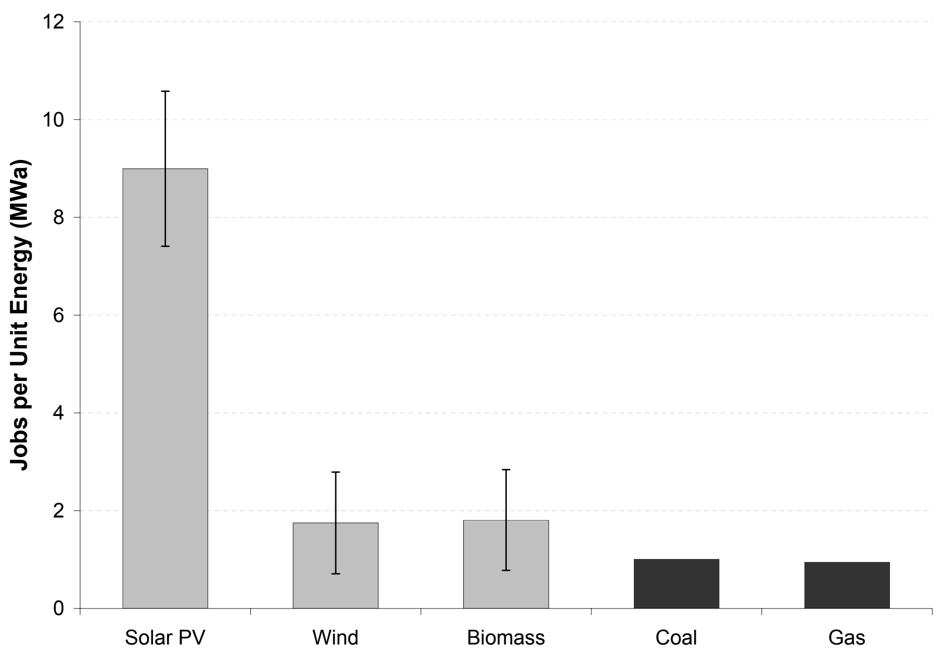
- In April 2007, Evergreen Solar announced that it will add 70 MW of production capacity at its Westborough, Massachusetts facility, doubling the number of employees in the state to more than 600.[70]

Renewable Energy Creates More Jobs than Fossil Fuels

Investment in renewable electricity generation creates more jobs than a similar investment in fossil fuel-fired generation.

A 2004 study by researchers at the University of California-Berkeley estimated that a 20 percent national RES would create twice as many jobs as providing the same amount of electricity via an expansion of coal and natural gas-fired power plants. Photovoltaics generate the greatest employment per unit of energy produced, with wind power and biomass also likely contributing to employment gains versus fossil fuels.[72]

Fig. 9. Jobs Created per Unit Energy[73]



- In March 2007, SolarWorld AG announced that it will build North America's largest solar manufacturing facility in Hillsboro, Oregon, which will produce 500 MW of solar cells per year by 2009.[71] At the same time, the company announced that it will expand its solar module factory in Camarillo, California to integrate the solar cells produced at the Oregon facility into solar modules.

Renewable Energy Supply Chain

For every firm that manufactures wind turbines or solar panels, there are several firms that supply component parts, raw materials or machinery to those companies. The renewable energy supply chain includes many firms—some in RES states and others not—all of which benefit from a greater commitment to renewable energy.

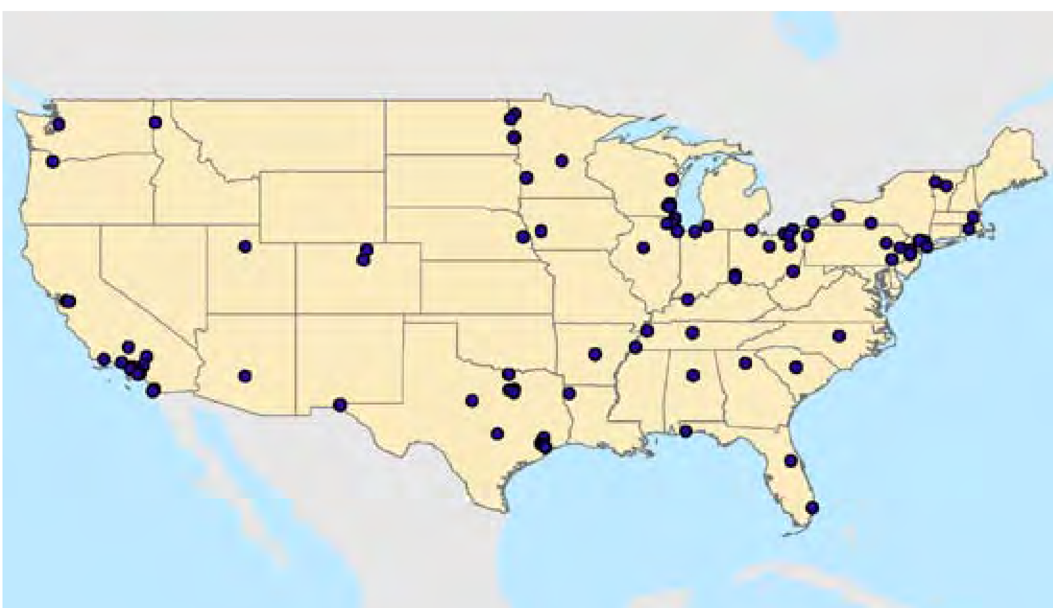
The recent surge in solar photovoltaic manufacturing, for example, has helped spur a similar surge in plans to produce polysilicon, the key ingredient in most solar panels. In 2007, four firms announced plans to increase polysilicon production at existing plants or to build new plants, with the new activity to take place in Idaho, Pennsylvania, Montana and Michigan.[74]

The wind industry casts a similarly long shadow, with a supply chain that includes manufacturers of towers, controls, gearboxes, drive trains, rotors and other components. A 2004 report by the Renewable Energy Policy Project identified companies that supply wind energy components in every region of the country—even those without a strong wind resource or a renewable electricity standard.[75] Thus, while RES states have seen the bulk of renewable energy job creation, reflecting their long-term commitment to renewable energy, the benefits of renewable energy development spread far and wide throughout the United States.

Non-Manufacturing Jobs

Manufacturing is not the only economic sector to benefit from renewable energy development. Construction workers install wind turbines and electricians install solar panels on rooftops. Maintenance workers

Fig. 10. Manufacturers of Wind Turbine Components, 2004[76]



keep wind farms running, while engineers, accountants and project planners identify new opportunities for renewable energy development and transform them into reality. Behind those ranks of renewable energy workers stand many others who owe their jobs at least in part to the increased economic activity generated by renewable energy investment, whether they are truckers, producers of raw materials, service workers or employees at corporate headquarters.

A 2004 analysis of the impact of wind farm development in one rural community—Lamar, Colorado—documented the broad economic impacts of a local wind farm, "from snack bars to rebar." Among the benefits resulting from the project were:

- The employment of more than 400 people working for subcontractors at the height of wind farm construction.
- High occupancy rates for local housing rentals and hotels.
- Dramatic increases in business at local restaurants, movie theaters, hair salons, convenience stores and other establishments.
- Renewed interest in business development in the community.
- The creation of 15-20 permanent, well-paying jobs.[77]

Rural Economic Development

The Colorado example demonstrates how renewable energy can provide an infusion of dollars into often struggling rural economies, helping to sustain local businesses, improve education and other public services, and preserve family farms.

Wind farms can provide an additional source of income to farmers and ranchers while boosting the economic prospects of rural communities. (Credit: Cielo Wind Power, DOE/NREL)

Minnesota: Property Tax Revenue from Wind Power Development

Wind farms are often built in rural areas that have a narrow tax base for local governments, making it a constant struggle to raise money to pay for important public services. A new wind power development can add tens of thousands of dollars to local and county governments' budgets.

Lincoln County, in southwest Minnesota, is home to a shrinking, aging population. Farming provides the most jobs in the county, but earnings vary substantially from year to year as crop prices fluctuate. Twelve percent of county residents live below the poverty level, 25 percent more than the Minnesota average.[82]

In 1998, Enron Wind built the Lake Benton I wind development, a 107 MW facility that produces 327 million kWh of electricity each year.[83] The facility created 19 new operations and maintenance jobs and boosted personal income in the county by $909,000 annually.

Local tax revenues also rose. In 2000, the project increased tax revenues by $611,200, providing 13 percent of tax revenue collected in the county that year.[84] County government received approximately 45 percent of funds, local school districts received another 45 percent, and town governments received 10 percent. In 2002, revenue from the Lake Benton I wind development and a second, older development in the county provided 25 percent of the county's tax revenue.[85]

Tax revenues declined in 2001 and 2002 because the value of the wind farm began to depreciate.[86] Minnesota has since changed its tax on wind farms, shifting away from a property tax-based system to one based on production from the wind farm.[87] This new tax structure creates a more even stream of payments to local governments over the life of the project and allows the wind farm owner to spread out tax costs.

In the words of one Oregon wheat grower, "Renewable energy standards are the best thing for rural communities since the plow."[78]

The Lamar, Colorado wind farm, for example, caused sales tax revenues to spike by approximately 60 percent during construction and resulted in royalty payments to local landowners of $3,000 to $6,000 per turbine. The project is estimated to boost Prowers County's tax base by 29 percent, providing much-needed revenues for local schools, hospitals and other public services.[79]

In Texas, which has seen the largest growth in wind energy development in

> "Renewable energy standards are the best thing for rural communities since the plow."
>
> —Don Coats, Oregon wheat farmer

the United States, the influx of dollars to rural landowners and communities has been large. The American Wind Energy Association estimates that royalty payments to landowners exceed $9.5 million per year, while boosting local property tax revenues.[80]

Increases in property tax revenue can be a boon to local communities. The U.S. Department of Energy reported that Pecos County, Texas added $4.6 million to its property tax revenue from wind energy development in 2002, with rural counties in Minnesota, Wisconsin, Iowa, Oregon, Washington and Wyoming also receiving large infusions of property tax revenue. In the case of Kewaunee County, Wisconsin, the $200,000 in additional property tax revenue from wind energy represented half of the county's total budget.[81]

Cost Savings

It is commonly assumed that renewable energy is more expensive than fossil fuel-fired power. In some places, and by some measures, that is true. However, renewable energy often competes favorably. And when one accounts for the full cost of fossil fuel fired power plants—including such factors as global warming pollution and the risk of future spikes in fossil fuel prices—the economic benefits of renewable energy are magnified.

Renewable Energy as a Least-Cost Resource

In some parts of the country, renewable energy has at times been the least-cost technology to serve electricity demand.

A 2007 study by the energy research firm, Wood MacKenzie, estimated that complying with a federal 15 percent renewable electricity standard would require an additional $134 billion in capital expenditures between 2006 and 2026. However, by reducing demand for natural gas and wholesale gas prices, the RES would reduce power plant operating costs by $240 billion, meaning that a federal RES would reduce the cost of generating electricity by more than $100 billion over that time period.[88]

In Colorado, the state Public Utilities Commission ordered Xcel Energy in 2001 to purchase wind power as a least-cost source of power for Colorado consumers.[89] Wind energy, which is abundant in the plains of eastern Colorado, was judged to be less expensive than a comparable investment in natural gas generation capacity. Those predictions have since been borne out by experience—a 2006 study estimated that wind energy already purchased by Xcel Energy will save Colorado consumers $251 million in fuel and emission costs over a 20-year span.[90]

In Washington state, Puget Sound Energy, which provides electricity to the Seattle area, undertook least-cost planning processes in 2003 and 2005 to determine how to satisfy future energy needs. The process took into account not only the current cost of various resources, but also the anticipated cost of carbon dioxide emissions in the future and the risk of fossil fuel price spikes. Wind power played a key role in both least-cost plans, with Puget Sound Energy committing to the installation of 379 MW of wind power in its 2003 plan and the addition of power from a planned large wind farm in Oregon and a planned geothermal power plant in Idaho in its 2005 plan.[91] The company's 2007 resource plan includes further investments in wind power.[92]

In California, renewable energy has often beaten the price assumed for construction and operation of new natural gas combined-cycle power plants (called the "market price referent" in California's RES). Since 2002, more than 80 percent of the renewable generating capacity for which contracts have been signed by the state's three largest utilities under the

Is Renewable Energy Becoming More Expensive?

After decades of price declines, the price of renewable energy technologies, including wind turbines and solar panels, has been on the rise. So too, however, have prices for competing electricity generation technologies. Puget Sound Energy, in its 2007 Integrated Resource Plan, estimated that the cost of wind generation had increased by 76 percent from four years earlier, but that the cost of natural gas combined cycle plants had increased by 44 percent and the cost of natural gas to fuel those plants had increased by about 85 percent.[94] Similar cost increases have been documented for new coal and nuclear power plants in the United States and around the world.[95]

The recent price spike for solar panels has been driven in part by rapid growth in demand outstripping supply of raw materials, such as the polysilicon used in most solar panels. For wind turbines, prices have risen due to a variety of factors including the declining value of the U.S. dollar, higher prices for materials such as steel, and shortages of key wind turbine components.[96]

However, recent boosts in manufacturing capacity for solar panels and wind turbines in the United States could enable the industries to achieve greater economies of scale that could reduce prices in the long term, improving the competitiveness of renewable energy even further versus other forms of power generation.

California RES has been obtained at costs below the market price referent.[93]

Not every state requires utilities to evaluate and purchase generation resources on a long-term, least-cost basis, and some states that do require resource planning fail to include the environmental costs of various alternatives (including the very real costs that could arise from limits on global warming pollution from power plants). The examples of Washington, Colorado and California, however, suggest that renewable energy can often compete head-to-head with fossil fuels and, in many cases, save consumers money outright.

Solar Power: Avoiding Utility Expenses

Solar photovoltaic power is more expensive than wind power, but it has unique attributes that make it more cost-competitive than it appears to be on the surface. Solar panels provide energy at times when it is in the greatest demand, and consequently most expensive—during hot summer days when air conditioning demand is at its peak. One recent study suggests that the value of utility-installed PV can exceed $6,000 per kilowatt in avoided investments in peak generation capacity, natural gas, transmission congestion charges, distribution system expansion, and other utility expenses.[97] Including these avoided costs improves the economics of solar power.

Reduced Natural Gas Prices

Renewable energy development also reduces demand for fossil fuels, particularly natural gas, which is limited in supply and has experienced dramatic price volatility over the last several years. Reducing demand for natural gas eases the pressure on natural gas prices, such that a 1 percent reduction in natural gas demand results in a reduction in wholesale natural gas prices of 0.8 percent to 2.0 percent.[98] A 2005 study estimated that the 18 state RES policies then in effect would produce savings of approximately $10 billion in lower natural gas bills as a result of reduced demand for natural gas.[99] Reductions in natural gas prices benefit individuals and businesses throughout the economy—from families keeping their homes warm during the winter to industries that use natural gas as a raw material.

The Cost of RES Compliance

Overall, renewable electricity standards have not led to significant rate increases in most of the states where they have been adopted. A 2007 review of state RES policies by analysts at the Lawrence Berkeley National Laboratory and the Energy Information Administration estimated that the rate impact of RES policies in six of seven states studied was likely less than 0.5 percent. (The six states were Maine, Maryland, New Jersey, New York, Connecticut and Arizona. The seventh state, Massachusetts, has experienced higher costs due to poor program design, but the program still has an estimated rate impact of only 1 percent.)[100] The analysis held out the possibility that RES policies in other states could result in lower electricity costs and concluded that, to date, "there is little evidence of a sizable impact on average retail electricity rate in most instances" from RES policies.[101]

Conclusion and Recommendations

States that have adopted renewable electricity standards are in the forefront of renewable energy development in the United States. Those states are now reaping the benefits of that development in reduced emissions of global warming pollutants and other dangerous air pollutants, economic development, and, in some places, lower costs for energy.

Some of the benefits of state renewable electricity standards are being enjoyed by residents of states that have not adopted the standards. Renewable energy manufacturing activities are creating jobs and economic development up and down the supply chain, boosting businesses in every corner of the United States. And all Americans benefit when we reduce pollution and conserve fossil fuels.

To expand the benefits of renewable energy development, the United States should adopt a renewable electricity standard requiring at least 25 percent of the nation's electricity to come from new renewable resources by 2025. States that have not yet adopted renewable electricity standards should consider doing so. And states that have adopted renewable electricity standards should consider setting more aggressive goals for clean renewable energy and ensuring that their existing policies are designed to maximize renewable energy development by requiring a significant share of renewable energy to be obtained through long-term contracts and allowing only truly clean, renewable sources of energy to qualify under the RES.

Similarly, state and federal governments should ensure that other public policies are aligned with the goals set forth in renewable electricity standards. For example, the federal government should shift subsidies away from dangerous and polluting sources of energy—such as nuclear and coal-fired power plants—and direct that funding toward research, development and deployment of clean, renewable sources of energy. Both state and federal governments should also work to maximize the amount of energy we save through improvements in energy efficiency, which is often the cleanest, cheapest way to address America's energy needs.

America is on the cusp of a revolution in the way we generate and use electricity, moving away from the dirty and polluting energy sources of the past and toward a new energy future that relies on clean, renewable energy to satisfy a greater share of our electricity needs. States that have adopted renewable electricity standards are leading the way, in the process demonstrating how renewable energy can protect our environment while boosting America's economy.

Methodology

Definition of Renewable Energy

Throughout this report, renewable energy is considered to include electricity generated from the following sources: agriculture crop byproducts, black liquor, geothermal energy, landfill gas, solar power, wood and wood waste, wood waste liquids, wind power, and other biomass solids, liquids and gases. Hydroelectric power, while renewable, may have significant environmental impacts and is not included in this analysis. Similarly, municipal solid waste is not included as a renewable source of energy.

The definition of renewable energy used in this report does not necessarily match the definitions of renewable energy in the various state RES policies. Some sources defined as renewable here may be excluded from state RES policies, while other sources of energy may be defined as "renewable" under state RES policies, but are not included in this analysis.

Source of Generating Capacity Data

Estimates of renewable energy capacity are based on bulk electric generating capacity through 2005 as reported to U.S. Department of Energy, Energy Information Administration, *Form 860 Database: Annual Electric Generator Report*, downloaded from www.eia.doe.gov, 27 June 2007. Generating units listed as retired in the Form 860 database were excluded from this analysis.

Data on new renewable energy additions in 2006 were obtained from U.S. Department of Energy, Energy Information Administration, *Generating Unit Additions in the United States by State, Company and Plant, 2006*, downloaded from www.eia.doe.gov, 27 June 2007. Proposed 2007 capacity additions were obtained from U.S. Department of Energy, Energy Information Administration, *Proposed U. S. Electric Generating Units by Year, Month, Company and Plant, January 2007 - December 2007*, downloaded from www.eia.doe.gov, 27 June 2007.

U.S. Energy Information Administration data include only generators that provide electricity to the nation's bulk electricity system and do not include smaller, distributed renewable generators (such as solar panels installed on homes and businesses).

Attribution of Renewable Generating Capacity to "RES States"

Renewable generating capacity was attributed to an "RES state" if that state had adopted an RES by the end of the year prior to the year the generator went into service.

Calculation of Renewable Energy Benefits

In calculating the emission reductions from new renewable energy, we assumed that new renewable energy would supplant natural gas-fired combined-cycle power plants, the cleanest form of fossil fuel generation. This assumption is very conservative, as renewable energy will sometimes displace forms of generation with greater carbon dioxide emissions per unit of energy produced. (For example, relatively inefficient "peaking" generators that operate only at times of highest demand for electricity.)

Annual electricity production from renewable energy technologies was calculated using estimated annual capacity factors for renewable generators built in 2006 from U.S. Department of Energy, Energy Information Administration, *Assumptions to the Annual Energy Outlook 2007*, April 2007.

To estimate averted carbon dioxide emission reductions from renewable energy, we assumed a heat rate for natural gas combined cycle power plants of 7,163 BTU/kilowatt-hour from U.S. Department of Energy, Energy Information Administration, *Assumptions to the Annual Energy Outlook 2007*, April 2007. Carbon dioxide emissions per BTU of natural gas consumed were based on carbon coefficients from U.S. Department of Energy, Energy Information Administration, *Documentation for Emissions of Greenhouse Gases in the United States 2004*, December 2006.

We assumed that all renewable energy technologies (except geothermal energy) produce zero net carbon dioxide emissions. Biomass combustion produces carbon dioxide, but produces zero net carbon dioxide because biomass absorbs carbon dioxide from the atmosphere as it grows. For geothermal energy, carbon dioxide emission rates were obtained from U.S. Department of Energy, Energy Information Administration, *Documentation for Emissions of Greenhouse Gases in the United States 2004*, December 2006. Landfill gas and manure digesters produce additional global warming emission reductions by reducing emissions of methane, which is a potent greenhouse gas. Those additional benefits are not reflected in this report.

For emissions of nitrogen oxides, sulfur oxides and non-methane hydrocarbons, we assumed emission rates from a natural gas combined cycle power plant based on Pamela L. Spath and Margaret K. Mann, National Renewable Energy Laboratory, *Life-Cycle Assessment of a Natural Gas Combined-Cycle Power Generation System*, September 2000. We did not assume any emission benefits from biomass or biogas combustion. Biomass power plants produce air pollutants at varying rates and emission reductions from these technologies cannot be assumed.

Water savings were based on assumed water consumption of approximately 0.1 gallon per kilowatt-hour for a natural gas combined cycle plant from Clean Air Task Force and Land and Water Fund of the Rockies, *The Last Straw: Water Use by Power Plants in the Arid West*, April 2003. We assumed no water consumption benefits from biomass technologies and solar thermal power plants. We also assumed no water consumption benefits from geothermal power plants, which "consume" significant amounts of water from deep underground sources that are typically unsuitable for other uses. Finally, we assume that wind and solar photovoltaic power consume no water in their operation.

Notes

1. "25 states" includes Illinois, where the state legislature had adopted an RES which was pending the governor's signature as of this writing.

2. Based on U.S. Department of Energy, Energy Information Administration, *Retail Sales of Electricity by State by Sector by Provider* [Excel worksheet], downloaded from www.eia.doe.gov/cneaf/electricity/epa/sales_state.xls, 15 August 2007.

3. Does not include hydroelectric power additions. Includes renewable generating capacity added prior to the end of 2006.

4. U.S. Department of Energy, Energy Information Administration, *Petroleum Navigator: United States Spot Price FOB Weighted by Estimated Import Volume*, downloaded from tonto.eia.doe.gov/dnav/pet/hist/wtotusaw.htm, 23 July 2007.

5. U.S. Department of Energy, Energy Information Administration, *Natural Gas Navigator: U.S. Natural Gas Wellhead Price*, downloaded from tonto.eia.doe.gov/dnav/ng/hist/n9190us3m.htm, 23 July 2007.

6. American Wind Energy Association, *Annual and Cumulative Capacity Chart* [Excel workbook], downloaded from www.awea.org/projects/, 22 July 2007.

7. While the cost for solar and wind power has increased in recent years, both technologies have experienced significant, long-term declines in price.

8. See note 1.

9. American Wind Energy Association, *Annual and Cumulative Capacity Chart* [Excel workbook], downloaded from www.awea.org/projects/, 22 July 2007.

10. Ibid.

11. Based on nameplate capacity, from Ryan Wiser and Mark Bolinger, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, May 2007.

12. Ryan Wiser and Mark Bolinger, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, May 2007. Note: wind turbine prices have increased in the last few years, along with the cost of other forms of electricity generation, as a result of higher prices for raw materials and other factors.

13. Ibid.

14. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Wind Powering America: Clean Energy for the 21st Century*, September 2004.

15. BP, *BP Statistical Review of World Energy 2007*, June 2007.

16. Ibid.

17. Charles F. Kutscher, ed., American Solar Energy Society, *Tackling Climate Change in the U.S.: Potential Carbon Emissions Reductions from Energy Efficiency and Renewable Energy by 2030*, January 2007, estimate in constant 2004 dollars.

18. "Historically" from U.S. Department of

Energy, Energy Information Administration, *Renewable Energy Annual 2004*, June 2006.

19. "Landfill gas" from U.S. Environmental Protection Agency, *Landfill Methane Outreach Program: Accomplishments*, downloaded from www.epa.gov/lmop/accomplish.htm, 25 July 2007.

20. Geothermal Energy Association, *Update on US Geothermal Power Production and Development*, 10 May 2007.

21. U.S. Department of Energy, Energy Information Administration, *State Electricity Profiles 2005*, March 2007.

22. Thomas Petersik, U.S. Department of Energy, Energy Information Administration, *State Renewable Energy Requirements and Goals: Status Through 2003*, downloaded from www.eia.doe.gov/oiaf/analysispaper/rps/index.html, 22 July 2007.

23. See note 1.

24. Percentages shown reflect requirements for large investor-owned utilities. Requirements for small utilities, municipal utilities and rural cooperatives are often less stringent. Some percentages include only new renewable resources while others include new and existing resources. Sources: NC Solar Center and Interstate Renewable Energy Council, *DSIRE: Database of State Incentives for Renewable Energy*, accessed at dsireusa.org, 31 July 2007; Union of Concerned Scientists, *Renewable Electricity Standards at Work in the States*, downloaded from www.ucsusa.org/clean_energy/clean_energy_policies/res-at-work-in-the-states.html, 31 July 2007.

25. Colorado Renewable Energy Society, "Despite Strong Opposition We Won!" *CRES News*, November 2004.

26. Some technologies and energy sources labeled as "biomass" can be toxic or unsustainable and should be avoided. State RES policies should only provide credit to the following biomass resources: 1) Any plant-derived organic matter available on a renewable basis; 2) Non-hazardous plant matter waste material that is segregated from other waste materials and is derived from: a) an agricultural crop, crop by-product or residue resource; b) waste such as landscape or right-of-way tree trimmings or small diameter forest thinnings but not including municipal solid waste, recyclable post-consumer waste paper, painted, treated or pressurized wood, wood contaminated with plastic or metals, or tires; 3) gasified animal waste; 4) digester gas; 5) biogases and biofuels derived, converted or processed from plant or animal waste or other organic materials; 6) landfill methane. Any biomass combustion must use the best available control technologies for emissions. Preference should be given for gasified biomass technologies.

27. North Carolina State University, NC Solar Center, *DSIRE: Database of State Incentives for Renewable Energy*, downloaded from dsireusa.org/library/includes/incentivesearch.cfm?Incentive_Code=CO24R&Search=Technology&techno=Biomass&currentpageid=2&EE=1&RE=1, 22 July 2007.

28. See note 2.

29. Does not include hydroelectric power additions. Includes renewable generating capacity added prior to the end of 2006.

30. Ryan Wiser, et al., Lawrence Berkeley National Laboratory, *Renewables Portfolio Standards: A Factual Introduction to Experience from the United States*, April 2007.

31. See note 12.

32. "RES states" include all states that had adopted an RES by the end of the previous year. Figures through 2006 based on U.S. Department of Energy, Energy Information Administration, *Form EIA-860 Database: Annual Electric Generator Report*, downloaded from www.eia.doe.gov/cneaf/electricity/page/eia860.html, 28 June 2007. Figures from 2006 based on U.S. Department of Energy, Energy Information Administration, *Generating Unit Additions in the United States by State, Company and Plant, 2006* [Excel workbook], downloaded from www.eia.doe.gov/cneaf/electricity/page/capacity/newunits2006.xls, 27 June 2006. Data for 2007 based on U.S. Department of Energy, Energy Information Administration, *Proposed U.S. Electric Generating Units by Year, Month, Company and Plant, January 2007-December 2007*, downloaded from www.eia.doe.gov/cneaf/electricity/page/capacity/proposedunits.xls, 17 July 2007.

33. Lori A. Bird, et al., *Factors Driving Wind Power Development in the United States*, paper presented to Windpower 2003 conference, 21 May 2003.

34. Basin Electric Power Cooperative, *Basin Electric Ranks 6th in Renewable Energy Sales* [press release], 17 May 2007.

35. See note 12.

36. Based on comparison of actual and proposed wind power additions from the U.S. Energy Information Administration (see Methodology for more details) with American Wind Energy Association, *Annual and Cumulative Capacity Chart* [Excel workbook], downloaded from www.awea.org/projects/, 22 July 2007.

37. FPL Energy, *Colorado Gov. Ritter and FPL Energy Break Ground at the Nation's Second-Largest Wind Farm* [press release], 16 May 2007.

38. California (with 63.5 MW in new photovoltaic capacity) and New Jersey (11.6 MW) were projected to be the largest states for new solar photovoltaic installations in 2006. New Jersey was expected to exceed the third-place state, New York, by a factor of five. Based on Prometheus Institute and Solar Energy Industries Association, *U.S. Solar Industry Year in Review: 2006*, undated.

39. California Energy Commission, *Grid-Connected PV Capacity (kW) Installed in California*, updated 15 February 2007.

40. New Jersey Board of Public Utilities, New Jersey Clean Energy Program, *Renewable Energy Systems Completed*, downloaded from www.njcep.com/html/res-installed/solar-install.html#s1, 22 July 2007.

41. California Energy Commission, *Grid-Connected PV Capacity (kW) Installed in California*, updated 15 February 2007.

42. Colorado Public Utilities Commission, *PUC Approves First-of-a-Kind Solar Energy Contract* [press release], 7 February 2007.

43. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Learning About PV: The Myths of Solar Electricity*, downloaded from www1.eere.energy.gov/solar/myths.html, 24 July 2007.

44. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Research and Development Advances in Concentrating Solar Power*, downloaded from www.energylan.sandia.gov/sunlab/research.htm, 10 October 2006.

45. Ibid.

46. Ibid.

47. "Nevada" based on U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Largest Solar Thermal Plant in 16 Years Now Online*, 13 June 2007; "contracts" based on Prometheus Institute and Solar Energy Industries Association, *U.S. Solar Industry Year in Review: 2006*, undated.

48. Pacific Gas and Electric Company, *PG&E Signs Agreement with Solel for 553 Megawatts of Solar Power* [press release], 25 July 2007.

49. See note 20.

50. Public Service of New Hampshire, *PSNH Wood-Fired Power Plant in Service* [press release], 4 December 2006.

51. Judith Ikle, California Public Utilities Commission, *Biogas Energy: Progress and Potential*, 19 April 2007.

52. The type of generating capacity that is averted by renewable energy depends in large part on the characteristics of the renewable energy itself and the mix of generators supplying energy to the grid. Because of the low marginal cost of generating power from the wind, wind power tends to displace the most expensive form of generation from the grid – often natural gas, but sometimes oil or even coal. Customer-sited solar photovoltaic power is experienced by the grid as a reduction in demand, again resulting in the highest-cost resource being replaced. Some forms of renewable energy – such as biomass and geothermal energy and concentrating solar power with thermal storage – can be used as baseload resources and, in theory at least, replace coal or nuclear power. The assumption that renewable energy replaces combined cycle natural gas-fired plants is, therefore, a conservative one and it is likely that global warming emission reductions from renewable energy development are greater than estimated here.

53. U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2005*, November 2006.

54. Based on 12,000 miles driven per year, average on-road fuel economy of 19.98 miles per gallon for 2005 from U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 2007*, February 2007, and carbon dioxide emissions of 19.6 pounds per gallon of gasoline.

55. Jeff Deyette, Union of Concerned Scientists, personal communication, 22 August 2007. Estimate does not include North Carolina or Illinois.

56. Geothermal power plants consume large amounts of water, but the water is saline water from deep underground and generally unfit for other uses.

57. S. Tegen, National Renewable Energy Laboratory, *Comparing Statewide Economic Impacts of New Generation from Wind, Coal, and Natural Gas in Arizona, Colorado, and Michigan*, May 2006.

58. National Association of State PIRGs, *Achieving a New Energy Future: How States Can Lead America to a Clean, Sustainable Economy*, August 2005.

59. "50,000" from European Wind Energy Association, Wind *Energy – The Facts, Volume 3: Industry & Employment*, 2004; "a few thousand" based on 2,000 from American Wind Energy Association, *Wind Energy Tutorial: Wind Energy and the Economy*, downloaded from www.awea.org/faq/wwt_economy.html#How%20many%20people%20work%20in%20the%20U.S.%20wind%20industry, 22 July 2007.

60. Solar Energy Industries Association, *The Solar Photovoltaic Industry in 2006*, downloaded from

ap.stop.dupont.com/Photovoltaics/en_US/assets/downloads/pdf/SEIA_StateofSolarIndustry2006.pdf, 23 July 2007.

61. Union of Concerned Scientists, *Cashing in on Clean Energy* [fact sheet], July 2007.

62. Vestas, *Vestas to Establish Blade Factory in Colorado, USA* [press release], 20 March 2007.

63. Austin Chamber of Commerce, *First Clean Energy Announcement for Central Texas*, November 2006.

64. Siemens USA, *Siemens Selects Iowa Site for Its First Wind Turbine Blade Manufacturing Facility in the U.S.* [press release], 17 August 2006.

65. Suzlon Energy, *Suzlon Announces Production of its First Wind Turbine Blade in the USA* [press release], 29 November 2006.

66. Commonwealth of Pennsylvania, *Governor Rendell Inaugurates Gamesa's Cambria County Manufacturing Facility* [press release], 12 June 2006.

67. Commonwealth of Pennsylvania, *Governor Rendell Announces Bucks County as Site of Gamesa's Three New Manufacturing Facilities* [press release], 7 March 2006.

68. U.S. Department of Energy, Energy Information Administration, *Renewable Energy Annual 2005 Edition*, July 2007.

69. Renewable Energy Access.com, *BP Solar Expands Solar Manufacturing Capacity in Maryland*, 17 July 2007.

70. Solarbuzz, *Evergreen Solar Expands Manufacturing Capacity; DC Chemical Takes Equity Interest in Company*, 17 April 2007.

71. SolarWorld AG, *SolarWorld Group to Build America's Largest Solar Factory in the USA* [press release], 1 March 2007.

72. Daniel M. Kammen, Kamal Kapadia and Matthias Fripp, University of California-Berkeley Renewable and Appropriate Energy Laboratory, *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?*, 13 April 2004.

73. Ibid.

74. U.S. Department of Energy, Office of Renewable Energy and Energy Efficiency, "Solar Manufacturing Takes Flight in the United States," *EERE Network News*, 9 May 2007.

75. George Sterzinger and Matt Svrcek, Renewable Energy Policy Project, *Wind Turbine Development: Location of Manufacturing Activity*, September 2004.

76. Ibid.

77. Craig Cox, *From Snack Bars to Rebar: How Project Development Boosted Local Businesses Up and Down the Wind Energy "Supply Chain" in Lamar, Colorado* [PowerPoint presentation], March 2004.

78. Quote from Oregon wheat farmer Don Coats. Environment Oregon, *New Oregon Energy Law Means State Requirements Deliver Enough Renewable Energy for 30 Million Households* [press release], 6 June 2007.

79. See note 77.

80. American Wind Energy Association, *Wind Power: Economic Development for Texas* [fact sheet], undated.

81. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Wind Energy for Rural Economic Development*, August 2004.

82. Northwest Economic Associates, *Assessing the Economic Development Impacts of Wind Power, Final Report*, prepared for National Wind Coordinating Committee, 12 February 2003.

83. Ibid.

84. Ibid.

85. Southwest Regional Development Commission, The Minnesota Project, and Windustry, *The Facts on Wind: A Proven Economic Development Tool*, March 2003.

86. Northwest Economic Associates, *Assessing the Economic Development Impacts of Wind Power, Final Report*, prepared for National Wind Coordinating Committee, 12 February 2003; and Leslie Kaas Pollock and Troy Gagliano, "Tax and Landowner Revenue from Wind Projects," *Legisbrief*, National Conference of State Legislatures, January 2004.

87. See note 82.

88. Wood MacKenzie, *North American Power Service Insight: The Impact of a Federal Renewable Portfolio Standard*, February 2007.

89. See note 77.

90. Jane E. Pater, et al., Interwest Energy Alliance, *Wind on the Public Service Company of Colorado System: Cost Comparison to Natural Gas*, August 2006.

91. Puget Sound Energy, *Least Cost Plan*, April 2005; Puget Sound Energy, *Puget Sound Energy Selects Seven Projects to Increase Power Supplies by 25 Percent to Meet Customers' Growing Need* [press release], 22 August 2006.

92. Puget Sound Energy, *Conservation, Wind Power, Natural Gas Drive 20-Year Resource Plan for Puget Sound Energy* [press release], 31 May 2007.

93. California Energy Commission, *Database of Investor-Owned Utilities' Contracts for Renewable*

Generation, Contracts Signed Toward Meeting the California Renewables Portfolio Standard Target, downloaded from www.energy.ca.gov/portfolio/contracts_database.html, 21 August 2007.

94. Puget Sound Energy, *Least Cost Plan 2007*, downloaded from www.pse.com/energyEnvironment/pse2007irpView.aspx, 24 July 2007.

95. Matthew L. Wald, "Costs Surge for Building Power Plants," *New York Times*, 10 July 2007.

96. See note 12.

97. Chris Robertson and Jill K. Cliburn, *Utility-Driven Solar Energy as a Least-Cost Strategy to Meet RPS Policy Goals and Open New Markets*, paper presented to the ASES Solar 2006 conference, 7-13 July 2006.

98. Ryan Wiser, Mark Bolinger and Matt St. Clair, Lawrence Berkeley National Laboratory, *Easing the Natural Gas Crisis: Reducing Natural Gas Prices Through Increased Deployment of Renewable Energy and Energy Efficiency*, January 2005.

99. Ibid.

100. Massachusetts has a too-low price cap and also does not permit long-term contracts for renewable energy, which has stifled development of new renewable energy to satisfy the requirement.

101. See note 30.

102. American Wind Energy Association, *AWEA Wind Power Projects Database: Utility/Power Companies Purchasing Wind Through Long-Term Contract (At Least 100 MW)*, downloaded from www.awea.org/projects/, 28 August 2007.

Appendix: Renewable Energy Development and Benefits in RES States

Understanding These Tables

The following tables show the bulk renewable electric generating capacity added in each state since the adoption of the state's first mandatory requirement for renewable energy development (renewable electricity standard), along with estimated pollution reductions and water savings from those facilities.

- These tables reflect the definition of renewable energy described in the "Methodology" section of this report and **not** renewable energy as it is defined in state RES policies. Some plants included in the following lists may not be eligible for credit under state RES policies, while others that are not included in these lists may be eligible for credit.
- The tables reflect all renewable energy additions since the *first* mandatory renewable energy requirement in each state, not necessarily the most significant or meaningful one. In some cases, such as Pennsylvania, states had required renewable energy additions for individual utilities or for particular technologies. The tables include all renewable energy additions in each state, even if they were for utilities or used technologies that were not covered by the initial requirement.
- The tables do not include renewable energy additions in non-RES states, even if they were driven by power or renewable energy credit sales to RES states.
- The tables do not include additions of small-scale renewable electricity generators such as residential solar photovoltaic panels.
- Proposed 2007 generation additions are shown in *italics*.
- Estimated pollution reductions and water savings benefits are based on general, national assumptions explained in "Methodology." The performance and benefits of individual plants will vary.

State Utility Name	Plant Name	Generating Capacity (MW, summer)	Year in Service	Energy Source	Est. Water Savings (million gallons)	Est. Carbon Dioxide Reductions (metric tons CO_2 / year)
Arizona						
Arizona Public Service Co	Ocotillo	0.1	1998	Solar PV	0.0	70
Arizona Public Service Co	Ocotillo	0.1	1999	Solar PV	0.0	70
Salt River Proj Ag I & P Dist	Tri Cities	0.8	2001	Landfill gas	0.0	2,397
Salt River Proj Ag I & P Dist	Tri Cities	0.8	2001	Landfill gas	0.0	2,397
Salt River Proj Ag I & P Dist	Tri Cities	0.8	2001	Landfill gas	0.0	2,397
Salt River Proj Ag I & P Dist	Tri Cities	0.8	2001	Landfill gas	0.0	2,397
Salt River Proj Ag I & P Dist	Tri Cities	0.8	2001	Landfill gas	0.0	2,397
Salt River Proj Ag I & P Dist	Agua Fria	0.2	2001	Solar PV	0.0	140
Tucson Electric Power Co	Springerville	5.1	2001	Solar PV	0.9	3,566
Arizona Public Service Co	Prescott Airport	2.1	2002	Solar PV	0.4	1,468
Western Renewable Energy LLC	Western Renewable	2.5	2004	Wood & wood waste	1.8	6,908
Arizona Public Service Co	Saguaro	1.0	2005	Solar PV	0.2	699
		AZ Total 15.1			**3.4**	**24,906**
California						
Algonquin-Cambrian Pacific GenLLC	Colton Landfill	1.3	2003	Landfill gas	0.0	3,805
Algonquin-mbrian Pacific GenLLC	Mid Valley Landfill	1.3	2003	Landfill gas	0.0	3,805
Algonquin-mbrian Pacific GenLLC	Mid Valley Landfill	1.3	2003	Landfill gas	0.0	3,805
Algonquin-mbrian Pacific GenLLC	Milliken Landfill	1.1	2003	Landfill gas	0.0	3,206
Algonquin-mbrian Pacific GenLLC	Milliken Landfill	1.1	2003	Landfill gas	0.0	3,206
Los Angeles County Sanitation	Total Energy Facilities	8.0	2003	Other biomass gas	0.0	22,106
FPLE High Winds, LLC	High Winds LLC	145.8	2003	Wind	47.3	179,597
FPLE High Winds, LLC	High Winds LLC	16.2	2003	Wind	5.3	19,955
P P M Energy Inc	Mountain View III	22.4	2003	Wind	7.3	27,592
Landfill Generating Partners	Symore San Diego	2.8	2004	Landfill gas	0.0	8,390
County of Sonoma Dept of Trnsp	Sonoma Central Landfill Phase III	0.7	2004	Landfill gas	0.0	2,097
County of Sonoma Dept of Trnsp	Sonoma Central Landfill Phase III	0.7	2004	Landfill gas	0.0	2,097
Sierra Pacific Industries Inc	Sierra Pacific Lincoln Facility	11.3	2004	Wood & wood waste	8.2	31,169
Coram Energy, LLC	CTV Power Purchase Contract Trust	4.5	2004	Wind	1.5	5,543

State Utility Name	Plant Name	Generating Capacity (MW, summer)	Year in Service	Energy Source	Est. Water Savings (million gallons)	Est. Carbon Dioxide Reductions (metric tons CO_2 / year)
California (cont'd)						
Enxco Service Corporation	Oasis Wind	60.0	2004	Wind	19.4	73,908
Diablo Wind LLC	Diablo Wind LLC	18.0	2004	Wind	5.8	22,172
Coram Energy, LLC	Coram Energy LLC (ECT)	6.0	2005	Wind	1.9	7,391
Coram Energy, LLC	Coram Energy LLC	3.0	2005	Wind	1.0	3,695
Babcock & Brown Power Op Partners LLC	Kumeyaay Wind	50.0	2005	Wind	16.2	61,590
ORL Geothermal, Inc	Second Imperial Geothermal	16.0	2006	Geothermal	0.0	47,172
ORL Geothermal, Inc	Heber Geothermal	5.0	2006	Geothermal	0.0	14,741
ORL Geothermal, Inc	Heber Geothermal	1.0	2006	Geothermal	0.0	2,948
Los Angeles County Sanitation	Puente Hills Energy Recovery	3.2	2006	Landfill gas	0.0	9,588
Los Angeles County Sanitation	Puente Hills Energy Recovery	3.3	2006	Landfill gas	0.0	9,888
Los Angeles County Sanitation	Puente Hills Energy Recovery	3.3	2006	Landfill gas	0.0	9,888
AMERESCO Santa Cruz Energy LLC	AMERESCO Santa Cruz Energy	1.0	2006	Landfill gas	0.0	2,996
AMERESCO Santa Cruz Energy LLC	AMERESCO Santa Cruz Energy	1.0	2006	Landfill gas	0.0	2,996
AMERESCO Santa Cruz Energy LLC	AMERESCO Santa Cruz Energy	1.0	2006	Landfill gas	0.0	2,996
P P M Energy Inc	Shiloh I Wind Project	150.0	2006	Wind	48.6	184,770
Sacramento Municipal Util Dist	Solano Wind	24.0	2006	Wind	7.8	29,563
Babcock & Brown Power Op Partners LLC	Buena Vista Energy LLC	38.0	2006	Wind	12.3	46,808
Mark Technologies Corp	*Alta Mesa Project Phase IV*	*40.0*	*2007*	*Wind*	*13.0*	*49,272*
	CA Total	**642.1**			**195.5**	**898,759**
Colorado						
Invenergy Services LLC	Spring Canyon	60.0	2006	Wind	19.4	73,908
SunE Alamosa1 LLC	*SunE Alamosa1*	*1.2*	*2007*	*Solar PV*	*0.2*	*839*
SunE Alamosa1 LLC	*SunE Alamosa1*	*6.3*	*2007*	*Solar PV*	*0.0*	*6,523*
P P M Energy Inc	*Twin Buttes Wind Project*	*75.0*	*2007*	*Wind*	*24.3*	*92,385*
Babcock & Brown Power Op Partners LLC	*Cedar Creek Wind*	*300.0*	*2007*	*Wind*	*97.2*	*369,540*
	CO Total	**442.5**			**141.2**	**543,195**

State Utility Name	Plant Name	Generating Capacity (MW, summer)	Year in Service	Energy Source	Est. Water Savings (million gallons)	Est. Carbon Dioxide Reductions (metric tons CO_2 / year)
Delaware						
AMERESCO Delaware South	AMERESCO Delaware South	1.0	2006	Landfill gas	0.0	2,996
AMERESCO Delaware South	AMERESCO Delaware South	1.0	2006	Landfill gas	0.0	2,996
AMERESCO Delaware South	AMERESCO Delaware South	1.0	2006	Landfill gas	0.0	2,996
AMERESCO Delaware South	AMERESCO Delaware South	1.0	2006	Landfill gas	0.0	2,996
AMERESCO Delaware Central	AMERESCO Delaware Central	1.0	2006	Landfill gas	0.0	2,996
AMERESCO Delaware Central	AMERESCO Delaware Central	1.0	2006	Landfill gas	0.0	2,996
AMERESCO Delaware Central	AMERESCO Delaware Central	1.0	2006	Landfill gas	0.0	2,996
	DE Total	**7.0**			**0.0**	**20,974**
Hawaii						
Hawi Renewable Development LLC	Hawi Wind Farm	10.6	2006	Wind	3.4	13,057
Kaheawa Wind Power LLC	Kaheawa Pastures Wind Farm	30.0	2006	Wind	9.7	36,954
	HI Total	**40.6**			**13.2**	**50,011**
Iowa						
Des Moines Metro WRF	Des Moines Wastewater Reclamation Fac	0.6	1991	Other biomass gas	0.0	1,547
Des Moines Metro WRF	Des Moines Wastewater Reclamation Fac	0.5	1991	Other biomass gas	0.0	1,492
Des Moines Metro WRF	Des Moines Wastewater Reclamation Fac	0.6	1991	Other biomass gas	0.0	1,520
Davenport City of	Davenport Water Pollution Control Plant	0.8	1995	Other biomass gas	0.0	2,211
Davenport City of	Davenport Water Pollution Control Plant	0.8	1995	Other biomass gas	0.0	2,211
Bio-Energy Partners	Metro Methane Recovery Facility	0.8	1998	Landfill gas	0.0	2,397
Bio-Energy Partners	Metro Methane Recovery Facility	0.8	1998	Landfill gas	0.0	2,397
Bio-Energy Partners	Metro Methane Recovery Facility	0.8	1998	Landfill gas	0.0	2,397
Bio-Energy Partners	Metro Methane Recovery Facility	0.8	1998	Landfill gas	0.0	2,397
Bio-Energy Partners	Metro Methane Recovery Facility	0.8	1998	Landfill gas	0.0	2,397
Bio-Energy Partners	Metro Methane Recovery Facility	0.8	1998	Landfill gas	0.0	2,397
Bio-Energy Partners	Metro Methane Recovery Facility	0.8	1998	Landfill gas	0.0	2,397
Bio-Energy Partners	Metro Methane Recovery Facility	0.8	1998	Landfill gas	0.0	2,397
Hawkeye Power Partners LLC	Hawkeye Power Partners LLC	42.0	1999	Wind	13.6	51,736

State Utility Name	Plant Name	Generating Capacity (MW, summer)	Year in Service	Energy Source	Est. Water Savings (million gallons)	Est. Carbon Dioxide Reductions (metric tons CO_2 / year)
Iowa (cont'd)						
Mission Iowa Wind	Storm Lake 1	112.5	1999	Wind	36.5	138,578
RP Operations Company LLC	Storm Lake II	80.2	1999	Wind	26.0	98,790
Storm Lake Power Partners I LLC	Northwest Wind	0.7	1999	Wind	0.2	862
Storm Lake Power Partners I LLC	Northwest Wind	0.7	1999	Wind	0.2	862
Algona City of	Iowa Distributed Wind Generation Project	2.3	2000	Wind	0.7	2,833
Northern Iowa Windpower LLC	Top of Iowa Windfarm	80.0	2001	Wind	25.9	98,544
FPL Energy Hancock County Wind, LLC	Hancock County Wind Energy Cen	98.0	2002	Wind	31.8	120,717
P P M Energy Inc	Flying Cloud Power Partners LLC	43.5	2003	Wind	14.1	53,583
MidAmerican Energy Co	Intrepid	175.5	2004	Wind	56.9	216,181
MidAmerican Energy Co	Century	185.0	2005	Wind	60.0	227,883
MidAmerican Energy Co	Victory Wind Farm	99.0	2006	Wind	32.1	121,948
Madison Gas & Electric Co	*Top of Iowa Windfarm III*	*29.7*	*2007*	*Wind*	*9.6*	*36,585*
	IA Total	**958.8**			**307.6**	**1,197,259**
Massachusetts						
Massachusetts Wtr RAuth-Deer I	Deer Island Treatment Plant	9.0	1998	Other biomass gas	0.0	24,869
Gas Recovery Systems Inc	Randolph Electric	0.9	2000	Landfill gas	0.0	2,697
Gas Recovery Systems Inc	Randolph Electric	0.9	2000	Landfill gas	0.0	2,697
Gas Recovery Systems Inc	Randolph Electric	0.9	2000	Landfill gas	0.0	2,697
Gas Recovery Systems Inc	Fall River Electric	0.9	2000	Landfill gas	0.0	2,697
Gas Recovery Systems Inc	Fall River Electric	0.9	2000	Landfill gas	0.0	2,697
Gas Recovery Systems Inc	Fall River Electric	4.4	2000	Landfill gas	0.0	13,184
AMERESCO Chicopee Energy LLC	AMERESCO Chicopee Energy	1.9	2004	Landfill gas	0.0	5,693
AMERESCO Chicopee Energy LLC	AMERESCO Chicopee Energy	1.9	2004	Landfill gas	0.0	5,693
AMERESCO Chicopee Energy LLC	AMERESCO Chicopee Energy	1.9	2004	Landfill gas	0.0	5,693
Princeton Town of	*Richard F Wheeler*	*3.2*	*2007*	*Wind*	*1.0*	*3,942*
		MA Total 26.8			**1.0**	**72,556**
Maine						
Lincoln Paper and Tissue, LLC	*Lincoln Paper & Tissue*	*7.4*	*2007*	*Black liquor*	*0.0*	*20,558*
Evergreen Wind Power LLC	*Mars Hill Wind Farm Project*	*42.0*	*2007*	*Wind*	*13.6*	*51,736*
		ME Total 49.4			**13.6**	**72,294**

State Utility Name	Plant Name	Generating Capacity (MW, summer)	Year in Service	Energy Source	Est. Water Savings (million gallons)	Est. Carbon Dioxide Reductions (metric tons CO_2 / year)
Minnesota						
Gas Recovery Systems Inc	Pine Bend	3.8	1996	Landfill gas	0.0	11,386
Gas Recovery Systems Inc	Pine Bend	3.8	1996	Landfill gas	0.0	11,386
Gas Recovery Systems Inc	Pine Bend	6.0	1996	Landfill gas	0.0	17,978
Sappi Cloquet LLC	Sappi Cloquet Mill	20.5	1997	Wood & wood waste	14.9	56,646
Northern Alternative Energy	Allendorf	1.2	1998	Wind	0.4	1,478
RP Operations Company LLC	Lake Benton I	107.2	1998	Wind	34.7	132,049
Edison Capital	Lakota Ridge LLC	11.2	1999	Wind	3.6	13,796
Edison Capital	Shaokatan Hills LLC	11.8	1999	Wind	3.8	14,535
Moorhead City of	Wind Turbine	0.7	1999	Wind	0.2	862
Woodstock Hills LLC	Woodstock Windfarm	10.2	1999	Wind	3.3	12,564
Lake Benton Power Part II LLC	Lake Benton II	103.5	1999	Wind	33.5	127,491
CHI Operations Inc	Twin Lake Hills LLC	1.9	2000	Wind	0.6	2,340
CHI Operations Inc	Hadley Ridge LLC	1.9	2000	Wind	0.6	2,340
Sappi Cloquet LLC	Sappi Cloquet Mill	14.0	2001	Black liquor	0.0	38,685
Enxco Service Corporation	Champepaden Wind Power	2.0	2001	Wind	0.6	2,464
Enxco Service Corporation	Moulton Wind Power	2.0	2001	Wind	0.6	2,464
Kas Brothers Windfarm LLC	Kas Brothers Windfarm	1.5	2001	Wind	0.5	1,848
Moorhead City of	Wind Turbine	0.7	2001	Wind	0.2	862
Northern Alternative Energy	Wilmont Hills LLC	1.5	2001	Wind	0.5	1,848
CHI Operations Inc	Tsar Nicholas LLC	1.9	2001	Wind	0.6	2,340
CHI Operations Inc	Sun River LLC	1.9	2001	Wind	0.6	2,340
CHI Operations Inc	Julia Hills LLC	1.9	2001	Wind	0.6	2,340
CHI Operations Inc	Jessica Mills LLC	1.9	2001	Wind	0.6	2,340
CHI Operations Inc	Jack River LLC	1.9	2001	Wind	0.6	2,340
CHI Operations Inc	Autumn Hills LLC	1.9	2001	Wind	0.6	2,340
CHI Operations Inc	Winters Spawn LLC	1.9	2001	Wind	0.6	2,340
CHI Operations Inc	Spartan Hills LLC	1.9	2001	Wind	0.6	2,340
CHI Operations Inc	Soliloquoy Ridge LLC	1.9	2001	Wind	0.6	2,340
CHI Operations Inc	Ruthton Ridge LLC	1.9	2001	Wind	0.6	2,340

State Utility Name	Plant Name	Generating Capacity (MW, summer)	Year in Service	Energy Source	Est. Water Savings (million gallons)	Est. Carbon Dioxide Reductions (metric tons CO_2 / year)
Minnesota (cont'd)						
CHI Operations Inc	Hope Creek LLC	1.9	2001	Wind	0.6	2,340
CHI Operations Inc	Florence Hills LLC	1.9	2001	Wind	0.6	2,340
CHI Operations Inc	Agassiz Beach LLC	1.9	2001	Wind	0.6	2,340
Garwin McNeilus	G.McNeilus Windfarm -Dodge Center	32.0	2002	Wind	10.4	39,418
Minwind Energy LLC	Minwind	3.8	2002	Wind	1.2	4,681
Worthington Public Utilities	Worthington	0.9	2002	Wind	0.3	1,109
Worthington Public Utilities	Worthington	0.9	2002	Wind	0.3	1,109
Worthington Public Utilities	Worthington	0.9	2002	Wind	0.3	1,109
Worthington Public Utilities	Worthington	0.9	2002	Wind	0.3	1,109
Garwin McNeilus	G.McNeilus Windfarm -Dodge Center	8.0	2003	Wind	2.6	9,854
Garwin McNeilus	Adams Wind Farm	14.0	2003	Wind	4.5	17,245
Northern Alternative Energy	L J Trust	1.8	2003	Wind	0.6	2,217
Northern Alternative Energy	NAE Shaokatan Power	1.6	2003	Wind	0.5	1,971
Northern Alternative Energy	Zachary Ridge LLC	1.8	2003	Wind	0.6	2,217
P P M Energy Inc	Moraine Wind LLC	51.0	2003	Wind	16.5	62,822
Viking Wind Projects	Viking Wind Partners	12.0	2003	Wind	3.9	14,782
Worthington Public Utilities	Worthington	1.0	2003	Wind	0.3	1,170
Worthington Public Utilities	Worthington	1.0	2003	Wind	0.3	1,170
Southern Minnesota Mun P Agny	Fairmont Wind	0.9	2003	Wind	0.3	1,109
Southern Minnesota Mun P Agny	Fairmont Wind	0.9	2003	Wind	0.3	1,109
Chanarambie Power Partners, LLC	Chanarambie Power Partners, LLC	85.5	2003	Wind	27.7	105,319
TG Windfarm LLC	TG Windfarm LLC	2.0	2003	Wind	0.6	2,464
CG Windfarm LLC	CG Windfarm LLC	2.0	2003	Wind	0.6	2,464
Bisson Windfarm LLC	Bisson Windfarm LLC	2.0	2003	Wind	0.6	2,464
Tofteland Windfarm LLC	Tofteland Windfarm LLC	2.0	2003	Wind	0.6	2,464
Westridge Windfarm LLC	Westridge Windfarm LLC	2.0	2003	Wind	0.6	2,464
Fey Windfarm LLC	Fey Windfarm LLC	2.0	2003	Wind	0.6	2,464
Windcurrent Farms LLC	Windcurrent Farms LLC	2.0	2003	Wind	0.6	2,464
K-Brink Windfarm LLC	K-Brink Windfarm LLC	2.0	2003	Wind	0.6	2,464

State Utility Name	Plant Name	Generating Capacity (MW, summer)	Year in Service	Energy Source	Est. Water Savings (million gallons)	Est. Carbon Dioxide Reductions (metric tons CO_2 / year)
DL Windy Acres LLC	DL Windy Acres LLC	2.0	2003	Wind	0.6	2,464
S&P Windfarm LLC	S&P Windfarm LLC	2.0	2003	Wind	0.6	2,464
Boeve Windfarm LLC	Boeve Windfarm LLC	2.0	2003	Wind	0.6	2,464
B&K Energy Systems LLC	B&K Energy Systems LLC	2.0	2003	Wind	0.6	2,464
Garwin McNeilus	G.McNeilus Windfarm -Dodge Center	3.0	2004	Wind	1.0	3,695
Garwin McNeilus	Adams Wind Farm	10.0	2004	Wind	3.2	12,318
Minwind Energy LLC	Minwind 3-9	11.6	2004	Wind	3.7	14,227
Southern Minnesota Mun P Agny	Redwood Falls Wind	1.7	2004	Wind	0.5	2,032
Southern Minnesota Mun P Agny	Fairmont Wind	1.7	2004	Wind	0.5	2,032
Stahl Wind Energy LLC	Stahl Wind Energy	1.7	2004	Wind	0.5	2,032
Carstensen Wind LLC	Carstensen Wind	1.7	2004	Wind	0.5	2,032
Northern Lights Wind LLC	Northern Lights Wind	1.7	2004	Wind	0.5	2,032
Lucky Wind LLC	Lucky Wind	1.7	2004	Wind	0.5	2,032
Greenback Energy LLC	Greenback Energy	1.7	2004	Wind	0.5	2,032
P P M Energy Inc	Trimont Area Wind Farm	100.5	2005	Wind	32.6	123,796
Southern Minnesota Mun P Agny	Redwood Falls Wind	1.7	2005	Wind	0.5	2,032
Southern Minnesota Mun P Agny	Fairmont Wind	1.7	2005	Wind	0.5	2,032
FPL Energy Mower County LLC	Mower County Wind Energy Center	98.9	2006	Wind	32.1	121,825
Fibrominn LLC	*Fibrominn Biomass Power Plant*	*59.5*	*2007*	*Agricultural byproduct*	*0.0*	*164,467*
	MN Total	**871.2**			**262.4**	**1,241,152**
New Jersey						
Middlesex Generating Company LLC	Middlesex Generating Facility	4.1	2001	Other biomass gas	0.0	11,329
Middlesex Generating Company LLC	Middlesex Generating Facility	4.1	2001	Other biomass gas	0.0	11,329
Algonquin-Cambrian Pacific GenLLC	HMDC Kingsland Landfill	0.9	2002	Landfill gas	0.0	2,697
Babcock & Brown Power Op Partners LLC	Jersey-Atlantic Wind Farm	7.5	2006	Wind	2.4	9,239
	NJ Total	**16.6**			**2.4**	**34,594**

State Utility Name	Plant Name	Generating Capacity (MW, summer)	Year in Service	Energy Source	Est. Water Savings (million gallons)	Est. Carbon Dioxide Reductions (metric tons CO_2 / year)
New Mexico						
Albuquerque City of	Southside Water Reclamation Plant	2.1	2002	Other biomass gas	0.0	5,803
Albuquerque City of	Southside Water Reclamation Plant	2.1	2002	Other biomass gas	0.0	5,803
FPL Energy New Mexico Wind LLC	New Mexico Wind Energy Center	204.0	2003	Wind	66.1	251,288
Babcock & Brown Power Op Partners LLC	Caprock Wind Farm	60.0	2004	Wind	19.4	73,908
Babcock & Brown Power Op Partners LLC	Caprock Wind Farm	20.0	2005	Wind	6.5	24,636
Edison Mission Op & Maintenance Inc	San Juan Mesa	120.0	2005	Wind	38.9	147,816
Babcock & Brown Power Op Partners LLC	Aragonne Wind LLC	90.0	2006	Wind	29.2	110,862
Babcock & Brown Power Op Partners LLC	*Aragonne Wind LLC*	*90.0*	*2007*	*Wind*	*29.2*	*110,862*
	NM Total	**588.2**			**189.3**	**730,978**
Nevada						
Caithness Operating Co	Caithness Dixie Valley	58.0	1998	Geothermal	0.0	170,999
Homestretch Geothermal LLC	Wabuska	0.1	2002	Geothermal	0.0	147
Ormat Nevada Inc	Brady	6.5	2002	Geothermal	0.0	19,164
Ormat Nevada Inc	Richard Burdette Geothermal	20.0	2005	Geothermal	0.0	58,965
Ormat Nevada Inc	Richard Burdette Geothermal	8.0	2005	Geothermal	0.0	23,586
Ormat Nevada Inc	Desert Peak Power Plant	15.0	2006	Geothermal	0.0	44,224
Fish Lake Power Co	*Fish Lake Geothermal Project*	*20.5*	*2007*	*Geothermal*	*0.0*	*60,321*
Solargenix Energy Inc	*Nevada Solar One*	*64.0*	*2007*	*Solar thermal*	*0.0*	*66,051*
	NV Total	**192.0**			**0.0**	**443,457**
New York						
Seneca Energy II	Ontario LFGTE	0.8	2005	Landfill gas	0.0	2,397
Seneca Energy II	Ontario LFGTE	0.8	2005	Landfill gas	0.0	2,397
Seneca Energy II	Ontario LFGTE	0.8	2005	Landfill gas	0.0	2,397
Flat Rock Windpower, LLC	Maple Ridge Wind Farm	137.0	2005	Wind	44.4	168,757
Innovative Energy Systems Inc	Modern Innovative Energy LLC	1.6	2006	Landfill gas	0.0	4,794
Innovative Energy Systems Inc	Modern Innovative Energy LLC	1.6	2006	Landfill gas	0.0	4,794

State Utility Name	Plant Name	Generating Capacity (MW, summer)	Year in Service	Energy Source	Est. Water Savings (million gallons)	Est. Carbon Dioxide Reductions (metric tons CO_2 / year)
New York (cont'd)						
Innovative Energy Systems Inc	Modern Innovative Energy LLC	1.6	2006	Landfill gas	0.0	4,794
Innovative Energy Systems Inc	Modern Innovative Energy LLC	1.6	2006	Landfill gas	0.0	4,794
Innovative Energy Systems Inc	Colonie LFGTE Facility	1.6	2006	Landfill gas	0.0	4,794
Innovative Energy Systems Inc	Colonie LFGTE Facility	1.6	2006	Landfill gas	0.0	4,794
Innovative Energy Systems Inc	Colonie LFGTE Facility	1.6	2006	Landfill gas	0.0	4,794
Flat Rock Windpower, LLC	Maple Ridge Wind Farm	33.0	2006	Wind	10.7	40,649
Flat Rock Windpower, LLC	Maple Ridge Wind Farm	91.0	2006	Wind	29.5	112,094
Flat Rock Windpower, LLC	Maple Ridge Wind Farm	61.0	2006	Wind	19.8	75,140
Seneca Energy II	*Seneca Energy*	*1.6*	*2007*	*Landfill gas*	*0.0*	*4,674*
Seneca Energy II	*Seneca Energy*	*1.6*	*2007*	*Landfill gas*	*0.0*	*4,674*
Seneca Energy II	*Seneca Energy*	*1.6*	*2007*	*Landfill gas*	*0.0*	*4,674*
Seneca Energy II	*Seneca Energy*	*1.6*	*2007*	*Landfill gas*	*0.0*	*4,674*
Babcock & Brown Power Op Partners LLC	*Ecogen Wind*	*79.5*	*2007*	*Wind*	*25.8*	*97,928*
Community Energy Inc	*Jordanville*	*130.0*	*2007*	*Wind*	*42.1*	*160,134*
	NY Total	**551.3**			**172.3**	**714,149**
Pennsylvania						
FPL Energy Pennsylvania Wind LLC	Green Mountain Wind Farm	10.4	2000	Wind	3.4	12,811
Waste Management Inc	Green Knight Energy Center	2.4	2001	Landfill gas	0.0	7,191
Waste Management Inc	Green Knight Energy Center	2.4	2001	Landfill gas	0.0	7,191
Waste Management Inc	Green Knight Energy Center	2.4	2001	Landfill gas	0.0	7,191
FPL Energy FPL E Mill Run WIndpower LLC	Mill Run Windpower	15.0	2001	Wind	4.9	18,477
Somerset Windpower LLC	FPL E Somerset Windpower LLC	9.0	2001	Wind	2.9	11,086
FPL Energy Meyersdale Windpower LLC	Meyersdale Windpower	33.0	2003	Wind	10.7	40,649
Waymart Wind LP	Waymart Wind	64.5	2003	Wind	20.9	79,451
Rollling Hills Landfill LLC	Rolling Hills	5.5	2005	Landfill gas	0.0	16,480
Babcock & Brown Power Op Partners LLC	Wind Park Bear Creek	21.5	2006	Wind	7.0	26,484
Babcock & Brown Power Op Partners LLC	*Allegheny Ridge Wind Farm*	*80.0*	*2007*	*Wind*	*25.9*	*98,544*
	PA Total	**246.1**			**75.6**	**325,555**

State Utility Name	Plant Name	Generating Capacity (MW, summer)	Year in Service	Energy Source	Est. Water Savings (million gallons)	Est. Carbon Dioxide Reductions (metric tons CO_2 / year)
Rhode Island						
Ridgewood Power Management LLC	Ridgewood Providence Power	1.5	2005	Landfill gas	0.0	4,494
Ridgewood Power Management LLC	Ridgewood Providence Power	1.5	2005	Landfill gas	0.0	4,494
Ridgewood Power Management LLC	Ridgewood Providence Power	1.5	2005	Landfill gas	0.0	4,494
Ridgewood Power Management LLC	Ridgewood Providence Power	1.5	2005	Landfill gas	0.0	4,494
	RI Total	**6.0**			**0.0**	**17,978**
Texas						
Ft Worth City of	Village Creek Wastewater Treatment Plant	4.2	2001	Other biomass gas	0.0	11,606
Ft Worth City of	Village Creek Wastewater Treatment Plant	4.2	2001	Other biomass gas	0.0	11,606
El Paso Electric Co	Hueco Mountain Wind Ranch	1.3	2001	Wind	0.4	1,601
FPL Energy Upton Wind LP	King Mountain Wind Ranch 1	278.0	2001	Wind	90.1	342,441
NWP Indian Mesa Wind Farm LP	NWP Indian Mesa Wind Farm	82.5	2001	Wind	26.7	101,624
Pecos Wind I LP	Woodward Mountain I	82.0	2001	Wind	26.6	101,008
Pecos Wind II LP	Woodward Mountain II	78.0	2001	Wind	25.3	96,081
Shell Wind Energy Inc.	Llano Estacado Wind Ranch	80.0	2001	Wind	25.9	98,544
Trent Wind Farm LP	Trent Wind Farm, L.P.	150.0	2001	Wind	48.6	184,770
Desert Sky Wind Farm LP	Desert Sky	160.5	2002	Wind	52.0	197,704
Viridis Energy	Atascosita	1.7	2003	Landfill gas	0.0	5,094
Viridis Energy	Atascosita	1.7	2003	Landfill gas	0.0	5,094
Viridis Energy	Atascosita	1.7	2003	Landfill gas	0.0	5,094
Viridis Energy	Atascosita	1.7	2003	Landfill gas	0.0	5,094
Viridis Energy	Atascosita	1.7	2003	Landfill gas	0.0	5,094
Viridis Energy	Baytown	1.0	2003	Landfill gas	0.0	2,996
Viridis Energy	Baytown	1.0	2003	Landfill gas	0.0	2,996
Viridis Energy	Baytown	1.0	2003	Landfill gas	0.0	2,996
Viridis Energy	Baytown	1.0	2003	Landfill gas	0.0	2,996
Viridis Energy	Bluebonnet	1.0	2003	Landfill gas	0.0	2,996
Viridis Energy	Bluebonnet	1.0	2003	Landfill gas	0.0	2,996
Viridis Energy	Bluebonnet	1.0	2003	Landfill gas	0.0	2,996
Viridis Energy	Bluebonnet	1.0	2003	Landfill gas	0.0	2,996

State Utility Name	Plant Name	Generating Capacity (MW, summer)	Year in Service	Energy Source	Est. Water Savings (million gallons)	Est. Carbon Dioxide Reductions (metric tons CO_2 / year)
Texas (cont'd)						
Viridis Energy	Coastal Plains	1.7	2003	Landfill gas	0.0	5,094
Viridis Energy	Coastal Plains	1.7	2003	Landfill gas	0.0	5,094
Viridis Energy	Coastal Plains	1.7	2003	Landfill gas	0.0	5,094
Viridis Energy	Coastal Plains	1.7	2003	Landfill gas	0.0	5,094
Viridis Energy	Conroe	1.0	2003	Landfill gas	0.0	2,996
Viridis Energy	Conroe	1.0	2003	Landfill gas	0.0	2,996
Viridis Energy	Conroe	1.0	2003	Landfill gas	0.0	2,996
Viridis Energy	Security	1.7	2003	Landfill gas	0.0	5,094
Viridis Energy	Security	1.7	2003	Landfill gas	0.0	5,094
Viridis Energy	Security	1.7	2003	Landfill gas	0.0	5,094
Shell Wind Energy Inc.	Brazos Wind Farm	160.0	2003	Wind	51.9	197,088
Aelous Wind, LLC	Acolus Wind Facility	3.0	2003	Wind	1.0	3,695
Babcock & Brown Power Op Partners LLC	Sweetwater Wind 1 LLC	37.5	2003	Wind	12.2	46,193
Gas Recovery Systems Inc	Sunset Farms	0.9	2004	Landfill gas	0.0	2,697
FPL Energy Callahan Wind, LLC	Callahan Divide Wind Energy Center	114.0	2005	Wind	36.9	140,425
FPL Energy Horse Hollow LLC	Horse Hollow Wind Energy Center	213.0	2005	Wind	69.0	262,374
Babcock & Brown Power Op Partners LLC	Sweetwater Wind 2 LLC	91.5	2005	Wind	29.7	112,710
Babcock & Brown Power Op Partners LLC	Sweetwater Wind 3 LLC	135.0	2005	Wind	43.8	166,293
AES SeaWest Inc	Buffalo Gap Wind Farm	120.6	2006	Wind	39.1	148,555
FPL Energy Horse Hollow LLC	Horse Hollow Wind Energy Center	223.5	2006	Wind	72.4	275,308
FPL Energy Horse Hollow LLC	Horse Hollow Wind Energy Center	299.0	2006	Wind	96.9	368,309
Airtricity Inc	Forest Creek Wind Farm LLC	124.2	2006	Wind	40.3	152,990
FPL Energy Red Canyon LLC	Post Wind Farm LP	84.0	2006	Wind	27.2	103,471
Mesquite Wind Power LLC	*Lone Star Wind Farm*	*200.0*	*2007*	*Wind*	*64.8*	*246,360*
Edison Mission Op & Maintenance Inc	*Wildorado Wind Ranch*	*161.0*	*2007*	*Wind*	*52.2*	*198,320*
Babcock & Brown Power Op Partners LLC	*Sweetwater Wind 4 LLC*	*135.0*	*2007*	*Wind*	*43.8*	*166,293*
AES Sea West	*Buffalo Gap II*	*232.5*	*2007*	*Wind*	*75.4*	*286,394*
Babcock & Brown Power Op Partners LLC	*Sweetwater Wind 5*	*160.0*	*2007*	*Wind*	*51.9*	*197,088*
Mesquite Wind Power LLC	*Post Oak*	*200.0*	*2007*	*Wind*	*64.8*	*246,360*
	TX Total	**3646.8**			**1,168.8**	**4,561,990**

State Utility Name	Plant Name	Generating Capacity (MW, summer)	Year in Service	Energy Source	Est. Water Savings (million gallons)	Est. Carbon Dioxide Reductions (metric tons CO_2 / year)
Washington						
Sierra Pacific Industries Inc	*Sierra Pacific Burlington Facility*	*26.0*	*2007*	*Wood & wood waste*	*0.0*	*71,955*
PacifiCorp	*Marengo Wind Plant*	*140.4*	*2007*	*Wind*	*45.5*	*172,945*
	WA Total	**166.4**			**45.5**	**244,899**
Wisconsin						
Madison Gas & Electric Co	Wind Turbine	11.0	1999	Wind	3.6	13,550
Wisconsin Electric Power Co	Byron	0.6	1999	Wind	0.2	739
Wisconsin Electric Power Co	Byron	0.6	1999	Wind	0.2	739
Wisconsin Public Service Corp	Lincoln Turbines	1.8	1999	Wind	0.6	2,217
Winnebago County	Winnebago County Landfill Gas	0.9	2000	Landfill gas	0.0	2,697
Winnebago County	Winnebago County Landfill Gas	0.9	2000	Landfill gas	0.0	2,697
Winnebago County	Winnebago County Landfill Gas	0.9	2000	Landfill gas	0.0	2,697
WM Renewable Energy LLC	Metro Gas Recovery	0.8	2000	Landfill gas	0.0	2,397
WM Renewable Energy LLC	Metro Gas Recovery	0.8	2000	Landfill gas	0.0	2,397
WM Renewable Energy LLC	Metro Gas Recovery	0.8	2000	Landfill gas	0.0	2,397
WM Renewable Energy LLC	Metro Gas Recovery	0.8	2000	Landfill gas	0.0	2,397
WM Renewable Energy LLC	Pheasant Run Landfill Gas Recovery	0.8	2000	Landfill gas	0.0	2,397
WM Renewable Energy LLC	Pheasant Run Landfill Gas Recovery	0.8	2000	Landfill gas	0.0	2,397
WM Renewable Energy LLC	Pheasant Run Landfill Gas Recovery	0.8	2000	Landfill gas	0.0	2,397
WM Renewable Energy LLC	Pheasant Run Landfill Gas Recovery	0.8	2000	Landfill gas	0.0	2,397
Milwaukee Metro Sewerage Dist	MMSD South Shore Wastewater	1.4	2000	Other biomass gas	0.0	3,869
Bio-Energy Partners	Omega Hills Gas Recovery	3.0	2001	Landfill gas	0.0	8,989
Onyx Glacier Ridge Landfill LLC	Onyx Glacier Ridge Landfill	0.9	2001	Landfill gas	0.0	2,697
Onyx Glacier Ridge Landfill LLC	Onyx Glacier Ridge Landfill	0.9	2001	Landfill gas	0.0	2,697
Wisconsin Power & Light Co	Berlin	0.8	2001	Landfill gas	0.0	2,397
Wisconsin Power & Light Co	Berlin	0.8	2001	Landfill gas	0.0	2,427
Wisconsin Power & Light Co	Berlin	0.8	2001	Landfill gas	0.0	2,427
Bio-Energy Partners	Ridgeview	0.8	2002	Landfill gas	0.0	2,397

State Utility Name	Plant Name	Generating Capacity (MW, summer)	Year in Service	Energy Source	Est. Water Savings (million gallons)	Est. Carbon Dioxide Reductions (metric tons CO_2 / year)
Wisconsin (cont'd)						
Bio-Energy Partners	Ridgeview	0.8	2002	Landfill gas	0.0	2,397
Bio-Energy Partners	Ridgeview	0.8	2002	Landfill gas	0.0	2,397
WM Renewable Energy LLC	Pheasant Run Landfill Gas Recovery	0.8	2002	Landfill gas	0.0	2,397
WM Renewable Energy LLC	Pheasant Run Landfill Gas Recovery	0.8	2002	Landfill gas	0.0	2,397
WM Renewable Energy LLC	Pheasant Run Landfill Gas Recovery	0.8	2002	Landfill gas	0.0	2,397
WM Renewable Energy LLC	Pheasant Run Landfill Gas Recovery	0.8	2002	Landfill gas	0.0	2,397
Badger Windpower LLC	Badger Wind Farm	30.0	2002	Wind	9.7	36,954
Bio-Energy Partners	Ridgeview	0.8	2003	Landfill gas	0.0	2,397
Dairyland Power Coop	Seven Mile Creek LFG	0.6	2004	Landfill gas	0.0	1,798
Dairyland Power Coop	Seven Mile Creek LFG	0.6	2004	Landfill gas	0.0	1,798
Dairyland Power Coop	Seven Mile Creek LFG	0.6	2004	Landfill gas	0.0	1,798
Dane County Public Works	Dane County Landfill #2 Rodefeld	0.8	2004	Landfill gas	0.0	2,397
Dane County Public Works	Dane County Landfill #2 Rodefeld	1.6	2004	Landfill gas	0.0	4,794
AMERESCO Janesville LLC	AMERESCO Janesville	1.0	2004	Landfill gas	0.0	2,996
AMERESCO Janesville LLC	AMERESCO Janesville	1.0	2004	Landfill gas	0.0	2,996
AMERESCO Janesville LLC	AMERESCO Janesville	1.0	2004	Landfill gas	0.0	2,996
Dairyland Power Coop	*Sarona Land Fill*	*1.0*	*2007*	*Landfill gas*	*0.0*	*2,936*
Dairyland Power Coop	*Sarona Land Fill*	*1.0*	*2007*	*Landfill gas*	*0.0*	*2,936*
Dairyland Power Coop	*Sarona Land Fill*	*1.0*	*2007*	*Landfill gas*	*0.0*	*2,936*
Dairyland Power Coop	*Seven Mile Creek LFG*	*1.0*	*2007*	*Landfill gas*	*0.0*	*2,936*
	WI Total	**79.2**			**14.3**	**159,462**