Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

RENEWABLES:
ENERGY YOU CAN COUNT ON

How Renewable Electricity Standards Deliver Economic Benefits

May 2013

In Brief

The development of renewable energy resources to meet electricity demand is providing substantial economic benefits to states and communities across the United States. A key driver of this development is the state renewable electricity standard (RES), which requires electric utilities to gradually increase the amount of renewable energy in their power supplies. Twenty-nine states and the District of Columbia have each adopted an RES—for sources such as wind, solar, geothermal, and biopower—to help create reliable markets for renewable energy and reduce dependence on polluting fossil fuels.

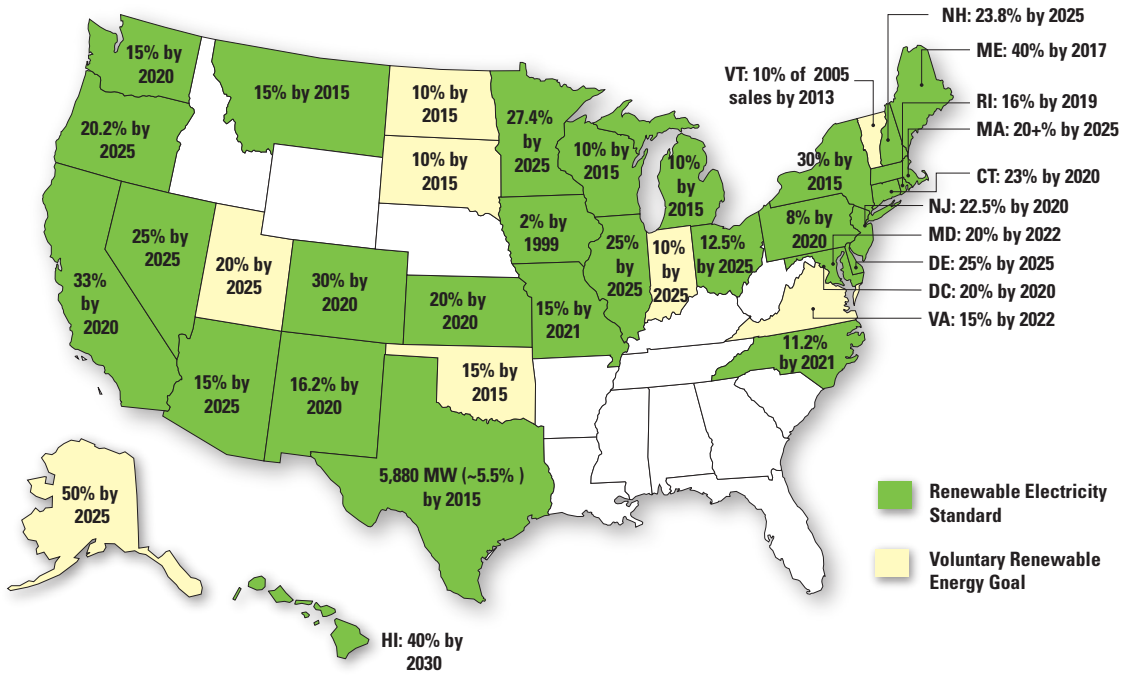
A review of state-level RES policies shows that utilities are successfully meeting their annual renewable energy requirements with little or no additional cost to consumers. In states all across the country, RES policies are also supporting rapidly growing renewable energy industries that provide jobs and bring investments, tax revenues, and other economic benefits to local communities. Manufacturing of renewable energy technologies is also experiencing growth, driven in part by demand from state renewable electricity standards.

State RES policies are poised to continue driving new renewable energy development and the benefits it provides. While infrastructural, market-based, and political challenges remain, proper planning, new investments, smart policies, and strong public support can help maintain the momentum that has been built to date and even accelerate the nation's transition to a cleaner, safer, and more reliable energy future.

The U.S. supply of renewable electricity, having grown at a remarkable pace over the past decade, is substantially reducing our dependence on coal-burning power plants that harm public health and destabilize our climate. Today, renewable energy technologies—such as wind, solar, geothermal, and biopower—are supplying affordable, reliable, and pollution-free power to the equivalent of some 16 million typical American homes. Renewable electricity generation, which grew from less than 2 percent of U.S. capacity in 2007 to more than 5 percent in 2012, was the largest source of new-capacity growth in 2012 (Bloomberg 2013). The nation's growing commitment to renewable energy also means increasing opportunities for economic development. Renewable energy industries now support hundreds of thousands of clean energy jobs, promote billions of dollars in new investment, and constitute an important source of revenue for states and local communities.

Workers install PV modules on an Englewood, CO, home. Jobs are just one of the economic benefits that come from the increased investment in renewable energy spurred by state renewable electricity standards.

Figure 1. State Renewable Electricity Standards



State-level renewable electricity standards are a leading driver of wind, solar, and other renewable development in the United States. Twenty-nine states and the District of Columbia have renewable electricity standards in place, 17 of which have set targets at 20 percent or greater. Another eight states have voluntary targets for renewable electricity.

Essential to this clean energy success story has been the state "renewable electricity standard" (commonly called an RES)[1]—one of the most popular and effective tools for encouraging renewable energy development. This report discusses the central role that state RES policies are playing to help stimulate such development and its economic benefits. Experiences with RES policies in several states are highlighted to illustrate the scale and diversity of these policies and outcomes. We also review some critical challenges that jeopardize the continued success of state RES policies—and the nation's transition to a clean, sustainable, and prosperous energy economy. Finally, we conclude with recommendations for overcoming these challenges.

> Renewable electricity standards are an effective tool for encouraging renewable energy development. Twenty-nine states and the District of Columbia have RES policies in place, 17 of which have targets of 20 percent or greater.

A PRIMARY DRIVER OF RENEWABLE ENERGY

RES policies require electric utilities to gradually increase the amount of renewable energy in their power supplies. This goal is typically accomplished by specifying a percentage that must come from renewable energy resources by a certain year—25 percent

[1] The official name varies from state to state. "Renewable portfolio standard," "alternative energy standard," and "clean energy standard" are common as well. In this report, we refer to all such standards as "renewable electricity standards" (RESs).

by 2025, for example. An RES policy is a market-based policy that stimulates competition among renewable energy developers and creates an ongoing incentive to reduce costs. The RES also represents a way to value the environmental and other important public benefits that are not priced in the energy market. The standard thus provides a more level playing field for renewable energy to compete with fossil fuel resources, which have received decades of subsidies and preferential treatment.

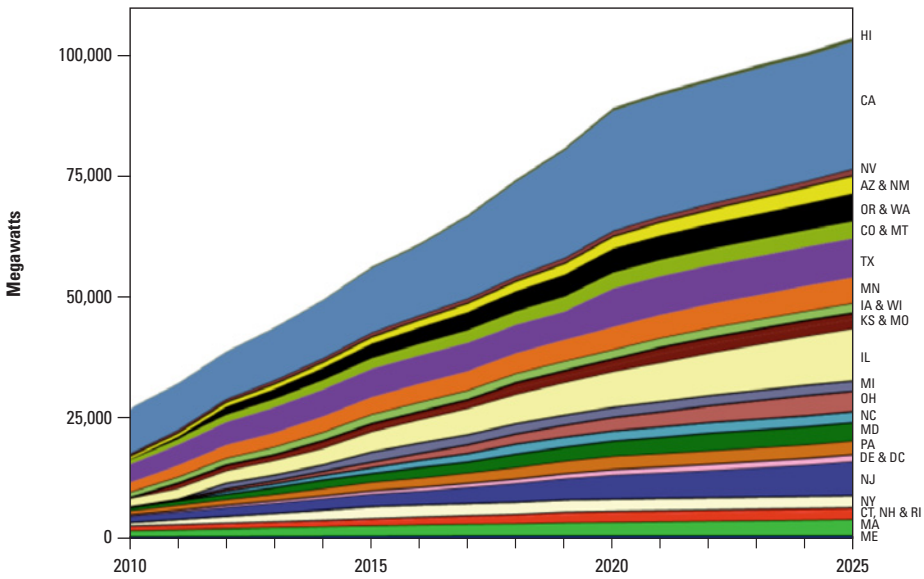
RES polices have been implemented in 29 states and the District of Columbia (Figure 1). Most have been established legislatively, but some—such as New York and Arizona—have been adopted through regulatory action. Voters in three states—Colorado, Washington, and Missouri—passed RES policies through ballot initiatives. Collectively, the renewable energy requirements established by RES policies apply to more than 50 percent of total U.S. electric demand (Barbose 2012).

In states with RES policies in place, at least 33,000 megawatts (MW) of new renewable capacity—equivalent to about 50 average-sized coal plants—were added between 1998 and 2011 (Barbose 2012).[2] Moreover, the required amount of renewable energy will ramp up over time; the Union of Concerned Scientists projects that RES policies will support more than 103,000 MW of renewable energy capacity by 2025 (Figure 2). At least 87,000 MW of this total is expected to come from new renewable energy development[3]—enough new clean power to meet the electricity needs of 50 million typical homes.

As shown in Figure 2, California's 33-percent-by-2020 RES creates the nation's largest market for renewable energy, followed by Illinois, Texas, New Jersey, and Minnesota. Hawaii and Maine have the highest renewable energy targets, requiring 40 percent renewable energy, but because of their small populations and lower electricity demand, their renewable energy markets are smaller than in other states. Seventeen states and the District of Columbia have renewable energy requirements of at least 20 percent.

Besides differing in the percentage of electricity that must come from renewable energy, RES

Figure 2. Projected Renewable Energy Development from State Renewable Electricity Standards*



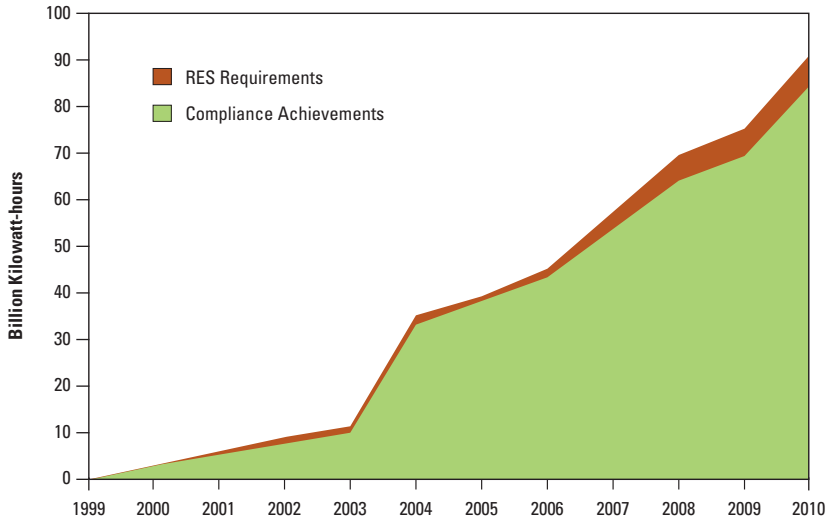
State RES policies are projected to support more than 103,000 MW of renewable energy capacity by 2025, with 87,000 MW of that total coming from new development. The RES policies in California, Illinois, Texas, New Jersey, and Minnesota represent the five largest new renewable energy markets in the United States.

*Includes new and existing renewable energy capacity. Projected development assumes states achieve annual renewable energy targets.

[2] Megawatt (MW) is a basic unit of electrical generating capacity. Typical utility-scale power plants can range from several hundred to 1,500 megawatts or more. The 33,000 MW of renewable energy does not include renewable energy development that has occurred in other states to supply markets in states with RES policies; but that figure does include renewable energy, developed in states with RES policies in place, that is above and beyond what is needed for compliance with a state's RES policy.

[3] Several RES policies allow for certain existing renewable energy resources to count toward compliance. The 87,000 MW of new renewable resources accounts for individual state definitions of "new renewable energy" where applicable, and typically refers to those developed after enactment of relevant RES policies.

Figure 3. Compliance with Annual Renewable Energy Targets



Overall, states with RES policies in place achieved about 96 percent compliance through 2010, with all but three states reporting compliance over 90 percent and most states reporting 100 percent compliance.

Source: LBNL 2013.

policies vary from state to state in several other respects, including: what resources are eligible for compliance; how much renewable energy should come from in-state resources; whether all utilities or just certain ones are covered; and how to track and enforce compliance. Over the past several years, RES policies have also been modified to meet evolving state goals. Eighteen states have increased or accelerated their renewable energy targets since originally adopting them. In addition, many states have amended their RES policies to promote specific renewable energy resources, to support small-scale or community-based systems, or to expand the list of renewable energy resources that qualify.

A STRONG TRACK RECORD OF RES COMPLIANCE

In 2012, for the first time, electricity providers in all 29 RES states and the District of Columbia had a compliance target to meet. And as state-level experience with implementing RES policies grows, utilities are achieving a strong record of compliance. All but six states now have at least three years of experience with RES implementation. According to data from the Lawrence Berkeley National Laboratory, states monitoring compliance through 2010 reported that utilities had met about 96 percent of their renewable energy requirements (Figure 3). Many states—including Colorado, Texas, and Minnesota—are several years *ahead* of schedule.

Despite the strong overall track record of RES compliance, there have been a few examples of states struggling to meet their annual requirements—not from a lack of renewable energy resources but because of market or regulatory barriers that need to be addressed. For example, renewable energy developers in Massachusetts have experienced difficulties in obtaining contracts and financing, as well as delays in siting projects. Recent legislation in that state, requiring utilities to enter into long-term contracts for renewable power, should ease the concerns of financing institutions and help alleviate this problem. In New York, where a state agency is responsible for renewable energy development to meet RES requirements, long lags between agency actions to develop renewable energy have slowed progress. But a major new call for renewable energy project proposals issued in December 2012 should help put the state back on track.

While there are hurdles to the continued success of RES policies (see p.15), renewable energy development is on pace to continue meeting policy requirements. At least 6,000 MW of renewable energy capacity has been brought online in each of the past five years, reaching a peak of more than 16,000 MW in 2012. In comparison, energy experts project approximately 4,000 to 5,000 MW of new renewable energy will need to be developed annually to meet RES policy requirements in coming years (GWEC 2013; Barbose 2012).

A GOOD DEAL FOR CONSUMERS

Nearly all state RES policies include cost-containment measures to protect consumers from higher than expected costs. Nevertheless, meeting RES requirements is proving to be an affordable way for utilities to add power-generating capacity while reducing dependence on fossil fuels. The Lawrence Berkeley National Laboratory, having recently evaluated 2009 and 2010 RES compliance-cost data that were available for 14 states, estimated that all but one state experienced cost impacts of about 1.6 percent or less (Barbose 2012).[4] And there is further compelling evidence—found in more recent data reported by utilities and state agencies charged with RES implementation—that demonstrates the inherent cost-effectiveness of RES policies. Consider the following examples.[5]

- In Michigan, a 2013 Public Service Commission (PSC) report found that: the state's utilities are on track to meet the 10 percent standard at lower costs than anticipated; the costs of all large-scale renewable energy projects are lower than the cost of new coal plants of similar size; and renewable energy contracts continue to show a downward pricing trend (Quackenbush, Isiogu, and White 2013).
- In Minnesota, renewable energy investments lowered electricity prices for customers of Xcel Energy—the state's largest utility—by 0.7 percent from 2008 to 2009. Xcel also estimated that meeting the RES through 2025 would increase costs by just 1.4 percent (Haugen 2011).
- In Oregon, renewable energy investments spurred by the RES in 2011 lowered total annual costs for PacifiCorp by $6.6 million, and increased total costs for Portland General Electric by just $630,000 (or 0.04 percent) (PacifiCorp 2012; PGE 2012).
- In Illinois, the state's two largest utilities, serving the majority of demand in the state, estimated RES compliance costs at 0.04 to 0.08 percent of average retail rates in 2012 (IPA 2012).
- In North Carolina, Duke Energy's residential customers paid just 21 cents per month in 2012 to support the state's RES (down from 27 cents in 2010), while Progress Energy's residential customers now pay 41 cents per month (down from 55 cents in 2011) (Trabish 2013; NCUC 2011).
- In Kansas, RES-driven development by the state's two largest utilities in 2012 and 2013, which will put them more than halfway toward meeting their 20 percent by 2020 target, is resulting in a modest 1.7 percent rate increase for energy consumers (Glass and Ellis 2012).
- In Wisconsin, the PSC estimated that supplying 7.4 percent of the state's total electricity demand from renewable energy resulted in a 1 percent rate increase from 2008 to 2010 (PSC WI 2012).
- In Rhode Island, compliance with the state's RES cost the average household 62 cents per month in 2010 and less than 50 cents per month for each of the three previous years (RI PUC 2012).

Because many of these states are still in the early stages of compliance, cost impacts could change over time as RES requirements increase. Other factors, such as declining costs of renewable energy technologies, changes in fossil fuel prices, and the presence of federal incentives, could also affect the future impact of RES compliance on utilities and consumers. Still,

> Meeting RES requirements is proving to be an affordable way for utilities to add power-generating capacity while reducing dependence on fossil fuels.

[4] That one state, Arizona, had an estimated cost impact of 3 to 4 percent due to incentives for small-scale renewable energy projects that are heavily front-loaded, meaning utilities are paying in advance for renewable energy generation over the life of the projects.

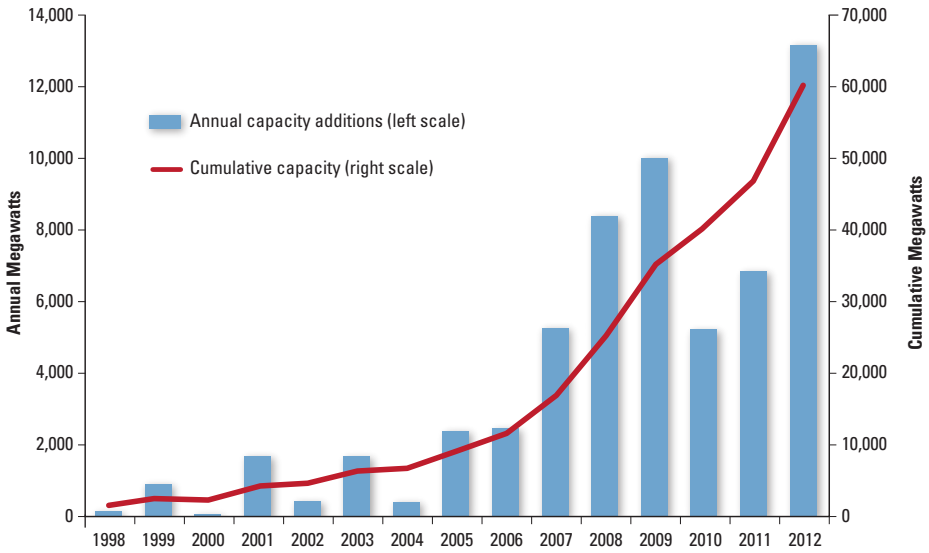
[5] One of the difficulties of comparing compliance costs across states or regions is that they are calculated differently from jurisdiction to jurisdiction. While most of the anecdotal evidence suggests that RES requirements are being met with minimal impact on rates and electricity prices, a standardized nationwide study has not been completed.

the modest cost impacts itemized above are consistent with earlier projections. For example, research by the Lawrence Berkeley National Laboratory in 2007—a comparison of the results from 28 state- or utility-level RES cost studies—found that more than 70 percent of the studies projected either cost savings or retail rate increases of no more than 1 percent (Chen, Wiser, and Bolinger 2007).

Implementing renewable energy, as opposed to relying on potentially volatile coal and natural gas prices, also helps stabilize electricity prices and provide significant long-term savings. That is because most of the costs associated with renewable energy generation are incurred up front, from manufacturing the equipment and constructing the facility. Once installed, the "fuel" (e.g., the sun's rays, the wind) is free, unlike in a coal or natural gas power plant. As a result, longer-term RES cost impacts could be even lower than estimated. For example, Xcel Energy—Colorado's largest utility—reports a small increase in current costs for consumers in meeting that state's RES requirements, but the corresponding investments are projected to decrease annual consumer costs beginning as early as 2014 (Xcel Energy 2012).

> In 2012, wind power made up 42 percent of all new U.S. electric capacity additions, representing a $25 billion investment in the U.S. economy.

Figure 4. U.S. Wind Power Capacity Additions



The U.S. wind power industry experienced record growth in capacity additions in 2012, and cumulative wind capacity now exceeds 60,000 MW.

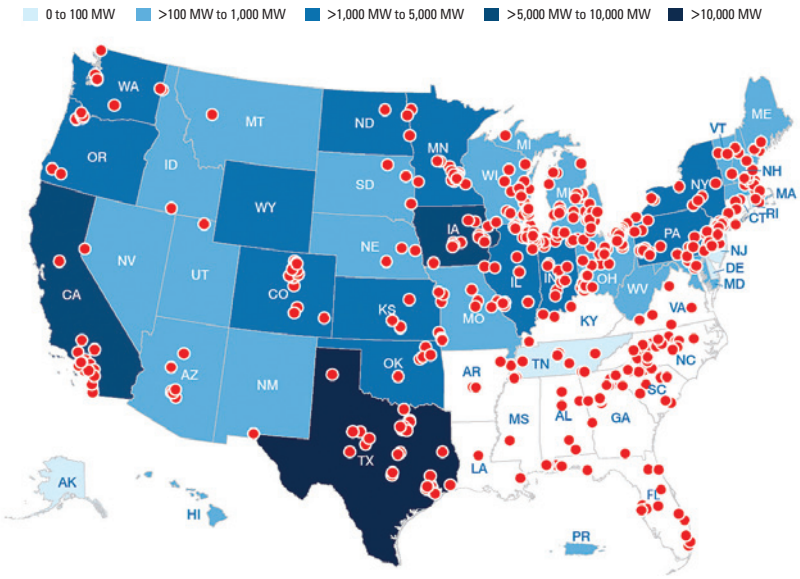
Sources: AWEA 2013; Wiser and Bolinger 2012.

ACCELERATING THE GROWTH OF U.S. WIND AND SOLAR INDUSTRIES

Both the wind and solar industries have experienced rapid growth in the United States over the past several years, thanks in large part to the markets created by state RES policies. Support from various other state policies, as well as from federal policies (see box, "When Federal Policies Complement State Policies," p. 17), also played important roles, especially in the record high levels of new installations that the wind and solar industries each reported in 2012 (Bloomberg New Energy Finance 2013).

Historically, RES policies have promoted the development of wind projects over other renewable energy technologies. Nine of the top 10 states in total installed wind capacity have RES policies, and wind power accounted for an estimated 89 percent of the state RES-driven renewable energy capacity additions from 1998 to 2011 (AWEA 2013; Barbose 2012). In 2012, wind power constituted 42 percent of all new U.S. electric capacity additions, totaling more than

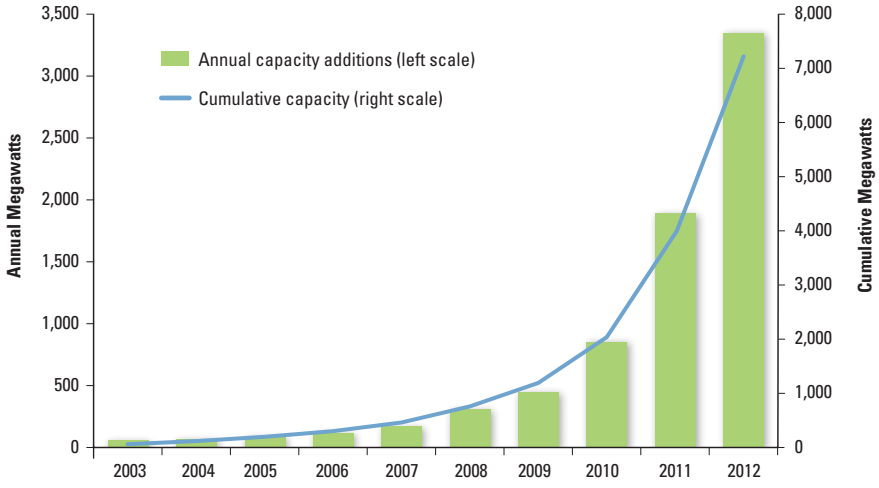
Figure 5. U.S. Major Wind Component Manufacturers



More than 500 wind manufacturing facilities are now located across 42 states. Domestically sourced components made up 67 percent of wind projects in 2011, up from just 35 percent in 2006. The Midwest in particular has experienced strong growth in wind manufacturing investments, due in part to a well-established manufacturing infrastructure, skilled labor force, good wind energy resources, and strong RES policies.

Source: American Wind Energy Association.

Figure 6. U.S. Solar PV Capacity Additions



A record 3,313 MW of solar PV capacity was installed in the United States in 2012—more than 10 percent of all U.S. electric capacity additions—representing a 76 percent increase over 2011 and more than three times the PV capacity installed in 2010. This growth was largely attributable to solar-specific targets within state RES policies as well as rapidly declining costs and federal tax incentives.

Source: SEIA 2012.

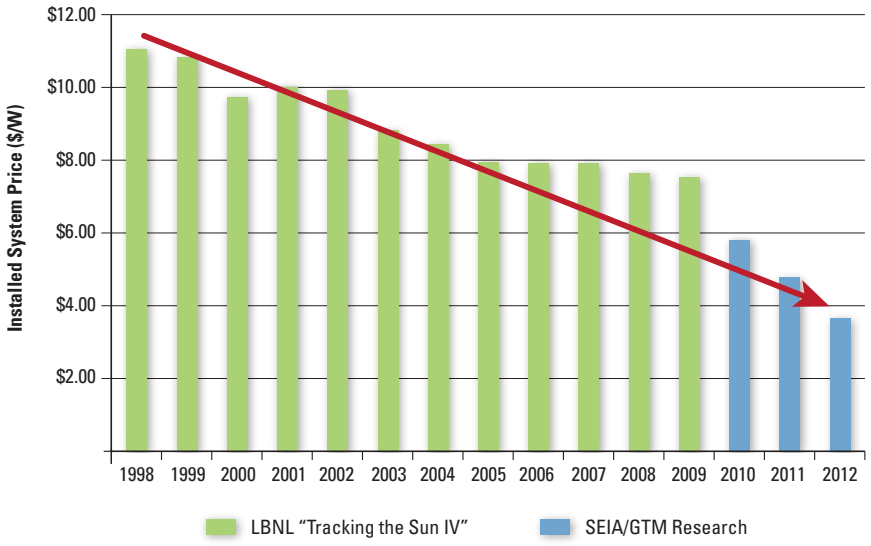
13,000 MW and representing a $25 billion investment in the U.S. economy (Figure 4) (AWEA 2013).

Partly in response to this growth, domestic manufacturing of wind turbine components has also grown significantly. The domestically sourced content of U.S. wind projects installed in 2011 has been estimated at 67 percent, up from 35 percent in 2006, and eight of the world's 10 largest wind turbine manufacturing firms now have facilities in the United States (Wiser and Bolinger 2012). All told, there are now more than 500 facilities in 42 states that manufacture components for the wind industry (Figure 5).

Increased domestic manufacturing, combined with increased efficiencies in manufacturing, installing, and operating wind turbines, have led to significant cost declines for wind power across the United States. Total costs for wind power have dropped 90 percent since 1980; after upticks in 2008 and 2009, wind power costs have again decreased—20 percent since 2010 (Wiser and Bolinger 2012).

The U.S. solar power industry has also experienced rapid growth over the past several years, driven in large part by significant cost declines and state RES policies. A record 3,313 MW of solar photovoltaic (PV) capacity was installed in the United States in 2012, an increase of 76 percent over 2011 levels and reflecting more than three times the number of installations in 2010 (Figure 6). Solar PV accounted for more than

Figure 7. Average Installed Solar PV System Prices



The declining costs of solar PV systems are driving an increase in the use of solar energy to meet RES requirements. Total installed cost for solar PV dropped 33 percent from 2011 to 2012 alone and continued price declines are expected as efficiencies in manufacturing and installation continue to improve.

Source: SEIA 2013.

10 percent of all new U.S. electric capacity additions in 2012, and total installed PV capacity surpassed 7,700 MW (SEIA 2013). Seventeen of the 20 states with the highest total installed PV capacity in 2012 had RES policies in place (SEIA 2013). The majority of current U.S. solar investments are concentrated in the northeast and western regions of the country, where solar resources are particularly strong or where RES policies have solar-specific targets or other incentives.

Along with RES policies, a recent sharp decline in solar PV system costs is helping to spur the industry's record growth. Total installed costs dropped 33 percent from 2011 to 2012 alone, and PV module prices have declined by 75 percent since 2008 (Figure 7) (SEIA 2013; McCrone 2012). This cost decline is attracting more attention from large businesses and utilities seeking to take advantage of the improved economics by investing in major projects (IREC 2012a). As a result, the average system size has grown considerably.

Half of the nation's 10 largest solar PV installations were installed in 2011, and the share of all U.S. grid-connected PV installations that were utility-scale (greater than two megawatts) grew from virtually zero in 2006 to nearly 40 percent in 2011 (IREC 2012b).[6]

RES POLICIES DELIVER ECONOMIC BENEFITS

Investments in renewable energy are providing a host of economic benefits across the country in the form of jobs, income streams for state and local economies, and stabilized electricity costs.

Job creation. Renewable energy industries are a proven job creator, even in challenging economic times. For example, the solar PV installation industry added nearly 14,000 jobs in 2012 and now employs more than 57,000 people nationally (Solar Foundation 2012).

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Painters put the finishing touches on a wind turbine blade, just a few of the nearly 30,000 jobs at almost 500 wind turbine and component manufacturing facilities in the United States. As demand for wind power has grown, so has the percentage of domestically manufactured components used in U.S. wind facilities—67 percent in 2011, compared with 35 percent in 2006.

[6] For solar installations, a typical household might have a capacity of between two and eight kilowatts, commercial-scale facilities typically range from 50 kilowatts to two megawatts, and utility-scale projects can range from a few megawatts to several hundred megawatts.

Manufacturing, sales, and distribution of solar PV systems supported another 45,000 jobs in 2012. In all, more than 119,000 people worked in solar-related industries in 2012, representing a 13.2 percent increase over 2011 levels (SEIA 2013).

Likewise, wind energy development is generating good jobs, with 75,000 full-time workers employed in the United States today (AWEA 2012b). These jobs employ workers—such as civil and electrical engineers, machinists, metal workers, construction laborers, and electricians—who were particularly hard hit by the 2008 recession and housing market collapse. The total wind energy workforce also includes 30,000 jobs at nearly 500 wind turbine and component manufacturing facilities across the country (AWEA 2012b; Figure 5, p. 7).

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Wind projects provide additional revenue streams for rural communities, including tax payments to local governments and lease payments to farmers and other landowners. This wind power facility in Lincoln County, MN, supports more than 30 jobs and accounts for more than $900,000 in personal income annually. Landowners also receive more than $500,000 annually in lease payments, and the project provides more than $600,000 in annual property tax payments to Lincoln County (NEA 2003).

Investing in renewable energy resources typically offers two economic advantages over traditional fossil fuels as a driver of job growth: (1) they are relatively labor intensive, so they create more jobs per dollar invested than fossil fuel resources; and (2) their installation uses primarily local workers, so investment dollars are kept in local communities, leading to greater indirect and induced economic benefits.[7]

Local economic stimulation. Developing renewable energy resources also makes good economic sense in communities where projects are sited. The National Renewable Energy Laboratory recently found that wind projects have a county-level annual earnings impact of $5,000 to $43,000 per megawatt of installed wind capacity, depending largely on whether the project has a local ownership component (DOE 2012). This impact—typically in the form of lease, royalty, or right-of-way payments to local landowners—is becoming an increasingly important revenue stream in the agricultural communities where many wind projects are sited.

State and local governments also collect property and income taxes and other payments from renewable energy project owners. These payments are particularly important to communities that struggle to maintain funding levels for such things as schools and infrastructure. For example, wind projects in Iowa, which now generates more than 20 percent of its electricity with wind, provided more than $19.5 million in annual property tax payments to state and local governments in 2011 (AWEA 2011).

> Renewable energy creates more jobs per dollar invested than fossil fuel resources, and its development keeps investment dollars in local communities.

[7] Indirect benefits include the activities involved in supplying goods and services to the renewable energy industries. Induced benefits are a result of the spending of wages earned by those directly and indirectly employed in the industries.

Renewable energy projects also help reduce the costs that consumers pay to import coal or natural gas for electricity generation. In 2008, 38 states were net importers of coal from other states and countries. Eleven of those states spent more than $1 billion each on net coal imports (Deyette and Freese 2010). This is money that could otherwise be spent on in-state clean energy resources to improve local economies.

More stable electricity rates. Among the key advantages of most renewable energy resources are the absence of ongoing fuel costs and liberation from volatile domestic and global fossil fuel markets. The up-front costs of renewable energy are typically higher than those of fossil fuels, but the blowing winds and shining sun serve as free "fuel." Therefore the cost of producing electricity remains relatively low and stable for the life of the facility.

By contrast, natural gas and coal are subject to rapidly changing markets, which make overreliance on these fuels to meet electricity needs a risky proposition. Natural gas, while currently at low prices, has experienced significant price volatility over the past decade. Coal prices have historically been relatively low and stable, but they have increased significantly in recent years as a result of reduced mining productivity, expanding foreign markets, and increased transport costs.

The price-stability benefits offered by homegrown renewable energy provide a clear long-term advantage for utilities and their customers over the uncertainties associated with natural gas and coal.

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This New Jersey water treatment plant obtains nearly 15 percent of its power needs from the adjacent ground-mounted solar PV system. Because of an aggressive RES and state incentives, New Jersey's solar PV sector has enjoyed consistent growth over the past several years. In 2013, the state is expected to reach a total of 1,000 MW of grid-connected solar PV.

New Jersey: Solar power grows in the Garden State. New Jersey's RES policy was first adopted in 1999, but it has since been strengthened several times by the state Board of Public Utilities and now stands at 22.5 percent by 2021. One of the key features of New Jersey's standard is its requirement that 2.12 percent be met with solar energy—a policy element often referred to as a "solar carve-out." As a result of the state's RES policy and other supporting policies, New Jersey has become a national leader in solar energy development.

The state ranks second among all states in solar PV installations, behind California. New Jersey now

Among the key advantages of most renewable energy resources are the absence of ongoing fuel costs and liberation from volatile domestic and global fossil fuel markets.

INDIVIDUAL STATES' ECONOMIC BENEFITS: FOUR CASE STUDIES

We highlight the experiences of four states—New Jersey, Michigan, Colorado, and Texas—to illustrate how RES policies help deliver diverse economic benefits.

boasts some 19,330 installations, with a total capacity of more than 950 MW (NJCEP 2012). Another 4,860 projects, totaling almost 750 MW, were in the pipeline as of December 31, 2012 (NJCEP 2012). New Jersey's largest solar project, a 20 MW facility located in Pilesgrove, came online in late 2011; this project alone represented a $90 million investment and created some 200 construction jobs during its development (ACORE 2012).

Overall, the renewable energy investment dollars flowing into New Jersey are translating into thousands of clean energy jobs. Between 2006 and 2010, New Jersey attracted more than $500 million in venture capital investments related to renewable energy (ACORE 2012). Asset financing provided another $227 million between 2010 and 2011 (NJBPU 2009). As of 2009, there were an estimated 2,180 New Jersey firms operating in renewable energy industries, with an annual employment of 64,380 (NJDOL 2009). Businesses such as Sunlit Systems in Edison and Sonali Solar, an international PV-module manufacturing company with corporate headquarters in Closter, are bringing jobs and investment to New Jersey to support its growing renewable energy markets. Investments in research and development are also occurring in the state; for example, Honeywell in Morris Township recently unveiled its Power Shield Cool Black, a laminate film designed to increase the efficiency of solar panels (Honeywell 2012).

As solar energy technologies continue to advance, New Jersey appears to be well positioned to take advantage of growing state, national, and global markets.

Michigan: Manufacturing a renewable energy economy. Michigan's RES, enacted in 2008, requires both investor-owned and public utilities to meet 10 percent of their retail electricity sales with renewable energy resources by 2015. The standard also includes incentives to use Michigan-made components and Michigan-based workers when developing renewable energy projects. The state's utilities are well on their way to meeting the 10 percent requirement, with significant benefits going to local economies. In addition, Michigan is capitalizing on its traditional assets—a skilled labor force, an existing manufacturing infrastructure, access to transportation, and proximity to major energy markets in nearby states—to attract renewable energy companies and compete in the growing clean energy industries.

Investments by DTE Energy, Michigan's largest utility, in three wind projects are contributing $150 million in economic benefits to the state. Michigan is also capitalizing on its skilled labor force and existing manufacturing infrastructure to attract renewable energy companies and compete in the growing clean energy industries.

Meanwhile, Michigan is rapidly developing the renewable resources it needs to meet its 10-percent-by-2015 target. The state's utilities are projected to generate some 9 percent of their power from renewable energy by the end of 2013, up from about 4 percent in 2011 (Quackenbush, Isiogu, and White 2013). The vast majority of development to date has occurred in Michigan's wind industry, which has nearly 1,200 MW of installed or approved projects—accounting for almost 94 percent of total RES-driven installed capacity (Quackenbush, Isiogu, and White 2012).

This wind development translates into real economic benefits in Michigan. For example, investments by DTE Energy, Michigan's largest utility, in three wind projects are contributing $150 million in economic benefits to the state. DTE's Gratiot Wind Park, built in 2011, provided over $30 million in direct payments to Michigan construction contractors and materials/equipment providers (Quakenbush, Isiogu, and White 2013). An additional sum, estimated at $750,000, was paid directly to local suppliers for things such as food and lodging. All told,

> Since Colorado's RES was passed in 2004, more than $550 million in asset financing and more than $1 billion in venture capital have been invested in the state.

the development of Michigan's wind energy resources has resulted in more than $1.79 billion invested in the state (Quakenbush, Isiogu, and White 2013).

Michigan's RES and the corresponding investments in renewable energy are helping to revitalize the state's manufacturing sector as well. Michigan is now home to nearly 200 companies that operate in the solar or wind supply chains, supporting more than 10,000 jobs. Clean technology was the state's fastest-growing sector in 2010 and 2011, with more than $10 billion in announced investments (Craig, Learner, and Gray 2011).

One of the anchors of Michigan's renewable energy manufacturing base is Hemlock Semiconductor. Hemlock produces polycrystalline silicon (a basic raw material in the manufacture of solar PV cells) at its plant near Midland, supporting 300 jobs and representing a $1 billion investment. Also in Midland, Dow Chemical is investing $249 million in a PV plant to make residential solar shingles. And in Detroit, Clairvoyant Energy has partnered with Ford Motor Company to install a solar manufacturing facility in a shuttered automobile assembly plant (Craig, Learner, and Gray 2011).

The wind industry is also taking advantage of Michigan's long tradition of manufacturing by investing in new facilities that make parts for wind facilities. For example, Danotek Motion Technologies near Detroit is building high-efficiency generators for use with wind turbines (Danotek 2013). Global Wind Systems, a turbine manufacturer, has also invested more than $32 million in Michigan, building its first facility in Novi in 2009 and supporting more than 800 jobs (Wolffe 2008).

Officials in Oakland County, near Detroit, recently estimated that alternative energy industries had made 23 separate investments in the county through February 2013, totaling almost $506 million, supporting 3,600 jobs, and adding $12.8 million to the annual tax base (OCM 2013). This story is repeating itself in communities across the state, with major cities and small towns reaping economic benefits from continued investments in renewable energy.

Colorado: A promising future for a renewable energy economy. Colorado's RES was first passed by ballot initiative in 2004, but the legislature has since increased it twice. The state now requires 30 percent renewable energy by 2020 for investor-owned utilities and 10 percent by 2020 for publicly owned utilities. As in several other states, the Colorado RES provides additional incentives for renewable energy projects located within the state. Since the RES was adopted, Colorado has benefited from more than $550 million in asset financing and more than a billion dollars in

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This 300 kW solar PV system atop the Colorado Convention Center in Denver is one of the largest rooftop solar systems in the state. Smaller residential rooftop PV systems have also become popular as costs have declined and innovative financing mechanisms have been developed to help meet the demand created by Colorado's RES.

venture capital support for renewable energy (EDF 2012; ACORE 2011).

Wind power is currently the largest contributor to Colorado's annual RES requirements, with more than 2,300 MW of installed capacity providing enough electricity to power some 500,000 homes (AWEA 2013). In 2011, Colorado's wind industry supported 4,000 to 5,000 jobs, made property tax payments totaling more than $10 million, and paid about $5.4 million in land lease payments (AWEA 2012c).

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These wind turbines, on a West Texas farm near McAdoo, are part of the tremendous effort to develop the state's vast wind resource. As of the end of 2012, more than 12,000 MW of wind capacity had been installed in Texas, making it the leader in wind development in the United States.

The development of Colorado's solar energy resources is also creating significant economic benefits. Colorado currently has 239 MW of installed solar PV capacity, and the state's more than 1,000 solar businesses support almost 6,200 employees (Solar Foundation 2011). This puts Colorado first in the nation in solar jobs per capita and second only to California in total solar jobs.

Today there are more than 1,500 clean energy companies in Colorado, with the sector having experienced an annual growth rate of 18 percent between 2004 and 2010 (Ritter 2010). Renewable energy manufacturing has played a key role in the expansion, with wind and solar companies investing heavily. For example, Vestas, a Danish wind turbine maker, has established a manufacturing hub in Colorado that employs a total of about 1,000 people in facilities in Windsor, Brighton, and Pueblo. This investment by Vestas has also led six other companies that supply Vestas with component parts to expand in Colorado (Ritter 2010). In addition, SMA Solar Technology employs 260 people at its solar inverter manufacturing plant in Denver and Ascent Solar Technologies makes thin-film solar PV on multiple production lines at its facility in Thornton.

Colorado's decision to focus on developing its renewable energy resources is proving to be a smart choice. And with enormous potential still untapped, the state appears well positioned to continue its leadership role in transitioning to a clean energy economy.

Texas: Wind and solar resources create economic boon. Signed into law in 1999, Texas's original RES required 2,000 MW of new renewable energy capacity to be developed by 2009.[8] The state

> With more than 12,000 MW of wind capacity installed in Texas, the state has exceeded its renewable energy target well ahead of schedule. Texas now has more wind capacity installed than the second- and third-leading states combined.

[8] Unlike most states, the Texas legislature established a capacity-based RES requirement rather than one based on generation as a percent of electricity consumption. However, for implementation purposes the Public Utilities Commission of Texas, through its regulatory authority, has converted the capacity requirements into generation-based targets.

RES policies face several challenges to their continued success. Clear and consistent policies, long-term planning, and strong public engagement are needed to overcome these obstacles and continue the transition to a clean energy economy.

exceeded this target nearly four years earlier than the deadline, and—as a result of this success—the legislature increased the new-capacity requirement in 2005 to 5,000 MW by 2015 (with a voluntary goal of 10,000 MW by 2025). With more than 12,000 MW of wind capacity installed as of the end of 2012—up from just 184 MW in 1999—Texas has once again exceeded its target well ahead of schedule (AWEA 2012a).

Installed wind capacity in Texas is greater than that of the second- and third-leading states combined, and this capacity includes several of the largest wind projects in the world (AWEA 2013). Even though the RES target has been achieved, low cost and enormous resource potential have continued to drive Texas's investments in wind. In 2012, the state accounted for almost 14 percent of the nation's new capacity installations—more than 1,800 MW (AWEA 2013).

The solar industry is also starting to thrive in Texas. In 2011, 86 MW of grid-connected solar PV capacity was installed in the state, a more than 300 percent increase over 2010 but still a small fraction of the resource's potential (Sherwood 2011). However, significant growth is expected in the coming years, with 459 MW of utility-scale solar capacity being considered in West Texas's Presidio, Pecos, and Tom Green counties and a 400 MW solar project under development in San Antonio (SEIA 2012; Office of the Governor 2010).

This growth means thousands of jobs in Texas: each megawatt of wind and solar employs an estimated six to 43 people, respectively, during project construction (Billy Hamilton Consulting 2010). As a result, the development of Texas's wind and solar resources has already supported more than 60,000 jobs in construction, manufacturing, operations, and transportation (of wind and solar components). More than 4,800 companies now operate in Texas's renewable energy sectors, which attracted almost a billion dollars in venture capital funds from 2006 to 2010 (Office of the Governor 2010).

These industries also benefit local economies through a variety of income streams and ancillary benefits. For example, Nolan County, TX, home to more than 3,000 MW of wind facilities—including the 782 MW Roscoe Wind Farm—has seen local economic benefits totaling nearly $400 million. This sum includes more than $17 million annually in royalty payments to landowners, over $30 million in property taxes, and the employment of some 1,300 people—with a payroll of $56 million (Office of the Governor 2010).

The state's growth in renewable energy manufacturing has been particularly notable. State factories produce a variety of components for the international wind industry, including carbon fiber in Abilene, steel parts in Brownwood, tower steel in Ft. Worth and El Paso, tower assembly in Coleman, turbine blades in Gainesville, bolts and clamps in Nacogdoches, and blade repair in Sweetwater. The Texas solar industry is also making significant contributions to the state economy. Approximately 11.5 percent of the world's silicon processing is located in Texas, and industry leaders such as Freescale Semiconductor, Applied Materials, and Samsung all have facilities located there (Office of the Governor 2010).

All in all, Texas's RES has driven significant job creation, attracted billions in investment, and helped strengthen the state's manufacturing sector, while producing emissions-free, low-impact renewable electricity to power homes and businesses. Texas is an excellent example of how effective policy can create transformative change in the energy industry and provide substantial economic and environmental benefits.

CHALLENGES TO THE CONTINUED SUCCESS OF RES POLICIES

Despite their strong record in driving renewable energy development, RES policies face several important challenges to their continued success: physical constraints to building renewable power plants and connecting them to the power grid; short-term oversupplies of renewable energy in local markets and other economic considerations that may slow new development; and political challenges from opponents of renewable energy. Clear, consistent policies, long-term planning, and strong public engagement are needed to overcome these obstacles and continue the transition to a clean energy economy.

Transmission and siting challenges. One of the most significant physical challenges to the fulfillment of RES requirements is the ability of the nation's transmission system to keep pace with renewable energy development. Some of the best renewable resources are located far from the cities and industrial facilities where electricity is most needed. For example, the nation's best onshore wind resources lie in the north-south corridor stretching from North Dakota to Texas, one of the least populated areas of the United States (NREL 2012a). Similarly, the nation's best solar resources are located in the desert Southwest, also an area of light population (NREL 2012b). Significant investments in transmission infrastructure are needed to move electricity generated by wind turbines or solar facilities to the country's more heavily populated and industrialized areas.

Thus, as we look beyond current RES targets and consider the country's ability to meet larger shares of its electricity demand with renewable energy, adequate transmission infrastructure becomes a significant concern. The National Renewable Energy Laboratory confirms that while the resources are available, a large-scale and coordinated effort must be undertaken to improve and expand the nation's electricity grid system (NREL 2012c). Transmission projects can take years to plan, site, and construct, however, thereby posing a major challenge to states and utilities seeking to meet an increasing amount of electricity demand with renewable energy (Tawney, Bell, and Ziegler 2011).

Fortunately, state governments are beginning to address this problem. In Texas, for example, the legislature directed the Public Utilities Commission to identify "competitive renewable energy zones," where there are high-quality renewable energy resources without adequate transmission. The commission then set a budget for developing transmission infrastructure in these zones and awarded funds for more than 30 projects to bring remote renewable energy onto the grid (Trabish 2010).

Siting of renewable energy facilities (and of transmission lines, for that matter) is also a growing challenge to supporting the transition to more renewable energy. Environmental concerns and, when renewable energy facilities are proposed in more populated areas, NIMBYism (not-in-my-backyard attitudes) can both

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One of the challenges to the continued expansion of renewable energy development is the transmission infrastructure for bringing electricity from where the renewable resources are plentiful to where the electricity is needed. Several states are making progress in overcoming this barrier.

> The deployment of wind, solar, and other renewable resources is attracting investments from manufacturers, creating jobs, and producing revenue streams for landowners and local communities, all while providing clean energy that reduces air pollution and helps stabilize our climate.

slow or stop development.[9] To overcome siting challenges, developers must research sites carefully and engage local residents early and often in the development process; these steps ensure that residents understand the benefits of renewable energy and the tradeoffs associated with continued reliance on fossil fuels. In addition, facilities must be located and managed properly to minimize impacts on sensitive habitats or species.[10]

Market challenges. As project costs have declined and development has accelerated to take advantage of federal incentives, there has been significant construction of renewable energy facilities in recent years at rates that are outpacing the markets created by RES policies. This has led to local "oversupplies" of renewable energy to meet RES targets. To continue experiencing rates of growth comparable to those achieved over the past five years, states may have to increase the size of the near-term compliance market by expanding or accelerating their annual renewable energy requirements—a practice that many have done in the past (Bloomberg 2013).

Historically low natural gas prices also pose a market challenge for renewable energy. Natural gas prices have declined dramatically as advances in hydraulic fracturing significantly increase domestic supplies from shale and other natural gas deposits. Lower natural gas prices have led to reductions in electricity prices, which makes it more difficult for renewable energy to be cost-competitive. However, renewable energy technologies offer more stable prices over the long term while natural gas has been subject to periods of dramatic price volatility, which are projected to recur as global export markets and our economy grow. By diversifying the electricity mix, continued investments in renewable energy can provide a hedge against high natural gas prices in the future.

Political challenges. RES polices have a history of bipartisan support and demonstrated success, yet now they face challenges from political opponents of renewable energy. Of the 30 RES policies in place, 14 were enacted with Republican governors in office and half had either Republican control of both houses of the state legislature or two houses that were split between Democrats and Republicans. Recently, however, renewable energy has become more politically divisive. Attacks on RES policies are now being led by organizations such as the American Legislative Exchange Council, Beacon Hill Institute, and Heritage Foundation, which often receive funding from fossil fuel interests and use biased analysis to advocate for the repeal or scaling back of RES policies.

Other attempts to weaken RES policies come from the legislative and regulatory domains. Their proposals are not to repeal, but to allow economically mature resources (such as large-scale hydropower) or nonrenewable resources (such as natural gas or nuclear power) to be counted toward meeting RES requirements. These proposals erode one of the primary goals of the RES, which is to diversify the power supply by promoting the development of new renewable energy resources.

To date, most of the attacks on RES policies have been unsuccessful, largely because policy makers generally recognize the diverse and significant benefits that renewable energy development confers on their state economies and local communities. However, efforts to roll back or repeal RES policies are expected to continue.

[9] See, for example, Hsu 2011.

[10] See, for example, Lee 2013.

When Federal Policies Complement State Policies

Federal tax incentives have been a strong complement to state RES policies in promoting renewable energy development. The Federal Renewable Electricity Production Tax Credit (PTC), used primarily by wind developers, is a per-kilowatt-hour tax credit for electricity generated by qualified renewable energy sources. Solar developers have access to the Federal Investment Tax Credit (ITC), which offers a tax credit of 30 percent of the installed cost of a renewable energy system. Both incentives have successfully driven renewable energy development by reducing its cost—thereby leveling the playing field so that renewable energy can compete with fossil fuels, which have benefited from large federal subsidies for decades.

The PTC and ITC have been key elements of renewable energy's success over the past 20 years, particularly in states with RES policies in place. In fact, state RES policies and these federal tax incentives are natural partners in supporting the United States' transition to a clean energy economy. State RES policies create a long-term market for renewable energy, and the PTC and ITC help bring down the up-front costs. In effect, federal incentives make compliance with state RESs even more affordable.

The ITC was initially authorized in 2005 and then reauthorized in 2008 to be available for projects commissioned through 2016. This multiyear extension has promoted the solar industry's growth by providing policy certainty—and thus the confidence to make long-term investments, such as in building new manufacturing facilities.

Unfortunately, the PTC has suffered from inconsistent and short-term support over the past decade. Since July 1999, the PTC has needed reauthorization five times, sometimes leaving gaps in availability and creating significant uncertainty in the wind industry. This has made it difficult for wind developers and their supply chain partners to project future demand for their products and make the long-term investments that could stabilize and grow the industry further. The PTC is set to expire again at the end of 2013.

Nevertheless, given the environmental, economic, and public health benefits of developing renewable energy, the PTC and ITC are inherently smart policies that, in combination with state RES policies, help set the nation on a path toward a clean energy future.

CONCLUSIONS AND RECOMMENDATIONS

State RES policies are powerful tools for affordably driving significant levels of renewable energy development. In turn, the deployment of wind, solar, and other renewable resources is attracting investments from manufacturers, creating jobs, and producing revenue streams for landowners and local communities, all while providing clean energy that reduces air pollution and helps stabilize our climate. Together with smart complementary policies, state RES policies can help maintain the nation's momentum toward a clean and prosperous renewable energy economy. To increase the likelihood of such a future, we offer the following recommendations:

- **Adopt strong renewable electricity standards and expand existing ones.** The success of RES policies so far makes a strong case for enhancing them. State governments and Congress should establish RES policies that require electric utilities to procure at least 25 percent of their power from renewable energy sources by 2025. A national RES that sets a minimum level of renewable energy use for all states would ensure that the entire nation contributes to—and reaps benefits from—the clean energy transition.
- **Track RES progress and benefits.** Reporting on utility progress in meeting RES requirements should be done regularly, accurately, and consistently.

This information gives policy makers and the public much-needed information for understanding the economic impacts—benefits as well as costs—of investing in renewable energy, and it can give them the confidence to continue supporting RES polices.

- **Invest in new transmission capacity for renewable energy.** Modernizing the U.S. electric grid and the rules that govern it is critical to the continued success of state RES policies and the clean energy transition. Federal, regional, and state authorities should identify transmission projects that have the greatest economic benefits in delivering renewable electricity from where it can be most effectively generated to where it is most needed. New mechanisms for financing and recovering costs, and more efficient processes for the responsible siting of transmission lines, are also needed to ensure a level playing field for renewable energy's competition with fossil fuel and nuclear technologies.
- **Develop responsible and consistent siting regulations for renewable energy projects.** State and local governments should coordinate their plans to develop harmonious, transparent, and science-based siting regulations for renewable energy projects. Such collaboration allows project developers to create efficient protocols for meeting regulatory requirements, thereby reducing transaction costs while protecting environmentally sensitive or valuable natural areas.
- **Extend tax advantages and establish other financial benefits for renewable energy.** Federal tax incentives have been a key driver of renewable energy in the United States (see box, "When Federal Policies Complement State Policies"). Congress should extend these tax credits for wind and other renewable resources, especially the production tax credit, by at least four years. Government should also explore a range of other incentives for developing renewable energy.

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