Securing a Clean Energy Future

A Governor's Guide to Clean Power Generation and Energy Efficiency

A Report for the National Governors Association as part of the

Securing a Clean Energy Future Initiative

National Governors Association
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Founded in 1908, the National Governors Association (NGA) is the collective voice of the nation's governors and one of Washington, D.C.'s most respected public policy organizations. Its members are the governors of the 50 states, three territories, and two commonwealths. NGA provides governors and their senior staff members with services that range from representing states on Capitol Hill and before the Administration on key federal issues to developing and implementing innovative solutions to public policy challenges through NGA's Center for Best Practices. For more information, visit *www.nga.org*.

Foreword

—Minnesota Governor Tim Pawlenty
NGA Chair,
2007-2008

For the better part of the past century, America has enjoyed the benefits of an energy system that has been relatively inexpensive and easy to use. But our continued reliance on this system—dominated by finite and carbon-intensive resources—has made us increasingly vulnerable to unstable countries that house vast amounts of the world's energy supplies and has jeopardized our relationship with the environment.

Our country is too dependent on foreign sources of energy. By 2030, we will be providing only 65 percent of our own energy needs—35 percent will come from foreign sources, mostly oil. Our total energy-related carbon dioxide (CO_2) emissions are projected to increase more than 25 percent by 2030. Continuing down this dangerous pathway risks our economic well-being, energy security, environmental future, and quality of life.

America is at a tipping point. As has happened at other key moments in our nation's history, the public is ahead of policymakers; citizens are seeking strong leadership for a new direction. As governors, we have a unique opportunity to lead the United States toward a cleaner, more independent, and secure energy future. That's why as 2007-2008 chair of the National Governors Association, I launched a yearlong initiative—*Securing a Clean Energy Future*—to enlist the efforts of all governors to make our nation a global leader in energy efficiency, clean technology, energy research, and the deployment of alternative fuels.

I believe we can and must craft a new comprehensive and multifaceted energy future that does not require sacrificing our prosperity. Our new energy future can increase our national security, improve our environment, and bring economic benefits to our communities.

Record numbers of governors discussed initiatives to develop alternative sources of energy or to promote conservation in their 2007 and 2008 State of the State Addresses. *Securing a Clean Energy Future* draws on these and other efforts to benefit every state-and the nation. The initiative focuses both on what we can do immediately and on what we must do in the future to reduce overall energy demands while keeping our economy strong. A bipartisan task force, comprised of forward-looking governors who share a common desire to advance clean energy ideas and who represent a cross-section of the country, guides the initiative's efforts.

The *Securing a Clean Energy Future* gubernatorial task force will identify and implement approaches that:

- Improve the use of our energy resources through efficiency and conservation;
- Promote nonpetroleum-based fuels, such as ethanol and biodiesel;
- Take reasonable steps to reduce greenhouse gas emissions; and
- Accelerate research and development of advanced clean energy technologies.

Achieving these goals will require a new devotion to conservation, research, new energy technologies, and a clean fuels infrastructure. Changing our current practices—reducing our current dependencies through the development, adoption, and use of new technologies and infrastructure—is a long-term commitment. States have shown they are willing to lead the way. Together, we can find and follow a pathway to a better, cleaner, more independent energy future.

The *Securing a Clean Energy Future* Task Force

Minnesota Governor Tim Pawlenty—Co-Chair
Kansas Governor Kathleen Sebelius—Co-Chair
Connecticut Governor M. Jodi Rell
Florida Governor Charlie Crist
Hawaii Governor Linda Lingle
Montana Governor Brian Schweitzer
Pennsylvania Governor Edward G. Rendell
Washington Governor Chris Gregoire

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Executive Summary

Meeting today's electricity needs calls for addressing two important and seemingly incompatible challenges: satisfying steadily growing demand and mitigating greenhouse gas emissions. The United States' electricity demand totaled more than 3,800 billion kilowatt hours (kWh) in 2006 and is expected to grow approximately 1.1 percent each year in the next two decades. By 2030, electricity consumption will be about 26 percent greater than it is today. Meanwhile, electricity production and distribution accounts for 40 percent of U.S. carbon dioxide (CO_2) emissions. These emissions are projected to grow more than 20 percent by 2030 amid rising concerns about greenhouse gas emissions.

While no single electricity resource will be able to fully meet steadily growing demand, energy efficiency and power generation from renewable energy sources, nuclear, natural gas, and coal (combined with the use of carbon capture and storage) all offer ways to meet electricity demand growth and to manage greenhouse gas emissions at the same time. Cost-effective energy efficiency alone could reduce load growth by half between now and 2025,[1] saving $100 billion in avoided utility costs and reducing greenhouse gas emissions equivalent to taking 90 million vehicles off the road.

States have a substantial role to play in creating a cleaner energy future through enhanced electricity planning efforts and policies that drive greater adoption of efficiency and cleaner power sources. Many states are choosing to focus first on energy efficiency, conservation, and demand-response measures as the quickest, easiest, and least expensive solutions. This focus has many states looking for ways to improve building energy use and reconsidering the regulatory framework and rate structure for utilities.

States also are looking to renewable power generation. States are working to push the market by setting clear targets, eliminating regulatory barriers, and enhancing the transmission infrastructure. In addition, states are examining options for encouraging clean generation from sources such as coal (combined with carbon capture and storage), nuclear, and natural gas that currently provide the vast majority of existing generation.

Governors can help their states increase the use of efficiency and clean energy through a combination of legislative, regulatory, and programmatic actions. First, states can undertake comprehensive electricity planning to accurately forecast demand growth, examine all available resources, and provide a road map for meeting future needs. Through the planning process, states can create well-informed electricity resource plans that seek a diverse resource mix, prioritize cost-effective efficiency and clean generation, and integrate complementary greenhouse gas emission reductions policies that the state may have adopted.

Next, states can reduce demand through robust energy efficiency, conservation, and demand-side programs. Possible actions include:

- Establishing energy efficiency resource standards that set long-term electricity savings goals;
- Implementing state-of-the-art building energy codes and appliance efficiency standards; and
- Restructuring utility rates, regulations, and incentives to remove barriers to utility energy efficiency programs, and make these programs attractive to investors.

After prioritizing energy efficiency and working to reduce demand, the next step in a clean energy strategy is to increase the generation of clean electricity. Promoting renewable energy can be accomplished by taking one or more of the following steps:

- Enacting Renewable Portfolio Standards (RPS) that set long-term goals for renewable power generation;
- Establishing interconnection standards that facilitate transmission capacity for new and remote renewable electricity generation;
- Developing feed-in tariffs, which provide market certainty through pre-established purchase rates per kWh for power from designated sources; and
- Providing incentives for renewable distributed generation, such as direct rebates to end users and net-metering provisions that allow customers to sell excess electricity back to the grid at reasonable rates.

States also can support development of more efficient coal generation with carbon capture and storage by constructing regulatory incentives and frameworks that outline stakeholder rights and liabilities, set long-term monitoring rules, and promote pilot and demonstration programs.

Finally, to sustain these efforts long term, states can provide funding for efficiency and clean energy programs through Public Benefit Funds, performance contracting, and proceeds from greenhouse gas emissions allowances auctions (in states with cap-and-trade markets).

Enhancing efficiency, increasing renewable generation, and generating traditional sources of energy in cleaner ways will require significant investment, new policies and incentives, and leadership from governors working in partnership with utilities and the private sector. Taken together, these efforts will bring America closer to a clean energy future.

States face two pressing electricity challenges: satisfying growing demand and mitigating greenhouse gas emissions.

Introduction

Meeting today's electricity needs depends on resolving these twin challenges: satisfying growing demand while curbing greenhouse gas emissions. Energy efficiency, conservation, and clean energy generation together can help address these challenges simultaneously. This chapter goes into greater detail about the rising demand for electricity and how that impacts greenhouse gas emissions. It then provides an introduction to how states can resolve these competing problems; in particular, how they can engage in enhanced electricity planning efforts and adopt policies that encourage greater investment in and adoption of more efficient and cleaner power. This report focuses on the role of investor-owned utilities. Many of the same challenges and solutions identified also apply to publicly and cooperatively owned utilities (munis and coops).

Electricity Sector Challenges — Rising Demand

U.S. electricity demand totaled more than 3,800 billion kWh in 2006 and is expected to grow approximately 1.1 percent per year throughout the next two decades. While this projected growth is slower than in past decades, by 2030 electricity consumption will be about 26 percent greater than it is today. American homes are currently the leading source of electricity consumption, at 36 percent, compared with commercial buildings, at 34 percent, and industrial plants, at 26 percent. However, commercial building energy consumption is predicted to be the fastest growing sector and, by 2030, to surpass the residential sector as the leading source of demand. Peak demand, while forecast to grow more slowly—by about 18 percent by 2030—would require an estimated 577 new power plants, at an average capacity of 300 megawatts (MW).

In the face of this growing demand, supply has failed to keep up and has led to near-term concerns about electricity availability. Indeed, many states could face serious electricity capacity shortages in the next 3 to 5 years. According to the North American Electric Reliability Corporation's (NERC) 2007 Long Term Reliability Assessment, power system capacity growth is not keeping pace with current regional demand forecasts and, under a business-as-usual scenario, which does not factor in improved energy efficiency or the addition of customer-based distributed generation, capacity margins in some areas of the country could reach critical levels between 2009 and 2013.

The problem of transmission congestion is aggravated by higher demand. NERC's 2007 Survey of Reliability Issues found in its assessment of technical issues, that the top-three concerns, based on likelihood and severity, were aging infrastructure and limited new construction; operating closer to load limits; and transmission system congestion.

Growing demand also puts upward pressure on prices. Major regional wholesale prices for electricity have risen by about 25 to 50 percent since 2001. Average retail rates for all customers rose from 6.64¢ per kWh in 1999 to 9.14¢ in 2007, an increase of some 38 percent. Retail rates in some states have doubled in recent years.

Coal—which supplies roughly half of the nation's electricity and has been a reliably low-cost fuel in the past—has surged in price in the past few years and even doubled in some markets. Experts attribute higher coal prices to rising electricity demand in rapidly developing Asian economies, including China, which is constructing the equivalent of two 500-MW coal-fired plants per week.[2] Prices for natural gas, which supplies nearly 20 percent of the nation's electricity, nearly tripled from $2.19 in 1999 to $6.40 in 2006. Capital costs for all new power plants have also risen along with the price of steel, concrete, and other materials, engineering fees, and environmental equipment. Construction costs for conventional coal plants have more than doubled in recent years.

Electricity Sector Challenges — Growing Greenhouse Gas Emissions

While electricity generation is critical to operating American homes, businesses, and industries, it also is a leading source of greenhouse gas emissions. Electricity use accounts for the largest portion of U.S. emissions—some 40 percent—outpacing the transportation sector. Moreover, U.S. electric power CO_2 emissions are projected to grow more than 20 percent between 2006 and 2030, even as recognition grows that significant greenhouse gas emissions reductions may be needed to address global climate change.

Coal, which generates more than half of U.S. power, has the highest CO_2 emissions rate of any fossil fuel. Compared to natural gas, coal emits approximately 1.7 times more carbon per unit of energy when burned.[3]

The most recent emissions scenarios developed by the scientists on the Intergovernmental Panel on Climate Change (IPCC) indicate that worldwide greenhouse gas emissions need to be cut 50 to 80 percent from 2000 levels by 2050 just to stabilize atmospheric concentrations of greenhouse gases and avoid the most damaging impacts of climate change.

Meeting the Challenges of Rising Demand and Greenhouse Gas Emissions

No single electricity resource will be able to fully meet our steadily growing demand; it will take a combination of generation sources and a greater use of energy efficiency and conservation. However, energy efficiency and cleaner power generation from renewable energy sources, like wind, solar, geothermal, incremental hydro, and biopower, as well as from nuclear, natural gas, and coal plants that incorporate carbon capture and storage technologies, can together help meet electricity demand growth and manage greenhouse gas emissions simultaneously. Transitioning to clean energy also creates economic opportunities by stimulating state and regional economies in novel ways that lead to new jobs. Finally, these multipart strategies for generating electricity can reduce price volatility as well as reliability risks, like blackouts, by diversifying fuel types and balancing supply- and demand-side resources.

As costs for traditional fuels and plant construction materials rise, the demand for newer, more efficient, and cleaner capacities will allow low-carbon electricity generation solutions to compete in the marketplace, particularly one that may become carbon-constrained at both the state and national levels. This dynamic is illustrated by comparing the cost of different types of new generation, as well as energy efficiency, under various potential carbon-price scenarios.

A comparison developed by the ACEEE indicates that energy efficiency provides the lowest leveraged cost of electricity (in this case the cost of reducing demand) at about 3¢ per kWh (data from 2006). This cost, as well as the cost for nuclear power (just over 5¢ per kWh) and certain renewables such as wind (just under 8¢ per kWh), stay at the same price regardless of the price of carbon. If a carbon regulatory policy is put in place that prices carbon, sources that are relatively low-cost today—such as pulverized coal (without carbon capture and storage), which is listed as just over 4¢ per kWh in 2006—become much more expensive at higher carbon prices (doubling in price to 8¢ per kWh at a carbon price around $45). Other sources that emit less carbon dioxide per kWh than pulverized coal, such as combined-cycle natural gas and biomass, also become more expensive with a high carbon price but do not increase in price as much as pulverized coal.[4]

Energy Efficiency

Energy efficiency is widely acknowledged to be the fastest, cleanest, and least expensive way to meet our electricity demands, now and going forward. Often referred to as "low hanging fruit," it is available in every state in the nation. Efficiency steps—if they are part of a concerted policy and combined with investment efforts free from regulatory and market barriers—could meet a significant portion of our electricity needs while reducing greenhouse gas emissions. A recent report released by the National Action Plan For Energy Efficiency estimated that cost-effective energy efficiency could reduce load growth by half through 2025, at a cost that is lower than any source of new generation. A recent Electric Power Research Institute (EPRI) study suggested that, in 2030, U.S. electricity demand could be 7 to 11 percent lower than current forecasts if efficiency steps are taken. In addition, a recent U.S. Department of Energy (DOE)-sponsored survey by the Lawrence Berkeley National Laboratory of five major utility resource plans, done for the Western Governor's Association, shows that these utilities plan to reduce 50 to 70 percent of load growth with energy efficiency.[5]

Renewable Energy

Renewable energy can help fill gaps in electricity resources without adding to greenhouse gas emissions. Renewable energy, including hydroelectric power, currently provides less than 10 percent of the nation's electricity. However, a number of studies indicate that, by 2025, up to 25 percent of power could realistically come from renewable sources, particularly as prices for wind, solar, and other forms of renewable power generation become more cost-competitive with traditional sources.

Cleaner Traditional Fuels

Meanwhile, traditional fuels will continue to play a significant role. However, many experts believe that for coal-generated electricity to remain a viable power source under possible national carbon constraints, its CO_2 emissions will need to be reduced. As a result, states and others are looking at making carbon capture and sequestration (CCS) a viable and cost-effective option. CCS separates CO_2—during the power generation process and stores it underground. CCS technology can capture up to 90 percent of CO_2 in large-scale applications. However, just as for some types of renewables, issues of cost and technology performance as well as legal and regulatory hurdles must be overcome before this approach can be effectively deployed nationwide.

Key State Actions

States are well-positioned to advance efficiency and clean energy solutions. They play a key role in planning for the development and use of electricity generation and are able to direct and encourage investment in efficiency and cleaner sources of generation.[i]

States can take the following action steps:

- Establish and utilize comprehensive electricity resource planning to forecast demand, examine potential of various resources, and develop a sound resource plan to meet state needs;
- Pursue cost-effective energy efficiency and conservation to reduce electric power load growth through policies that set long-term savings goals, establish energy savings standards, create funding sources, and revise the utility regulatory framework to enhance and incentivize utility energy efficiency efforts;

[i] States also can "lead by example" by adopting energy efficiency and clean power solutions within state government and other public buildings and facilities. These efforts are explored in greater detail in the July 2008 NGA Center for Best Practices issue brief titled, *Greening State Government: 'Lead by Example' Initiatives.*

- Prioritize new renewable energy initiatives through policies that establish long-term generation targets for renewable power, help fund new projects, provide consumers with incentives, and create a framework to work with utilities to connect new renewable power to the grid; and
- Promote new clean generation from traditional sources such as advanced coal with carbon capture and storage, natural gas, and nuclear power, and establish a regulatory framework for advanced coal to resolve outstanding issues such as liability and property rights.

Electricity Resource Planning

Energy resource policy and planning establishes a framework around which both demand-side and supply-side electricity resources can be analyzed, planned for, and acquired.

It is important to review how states arrived at their current electricity power situation. As the deregulation of the energy markets took effect, many states stopped or reduced long-term resource planning. However, states in some regions, such as the West and Southeast, have continued mandatory utility resource planning.

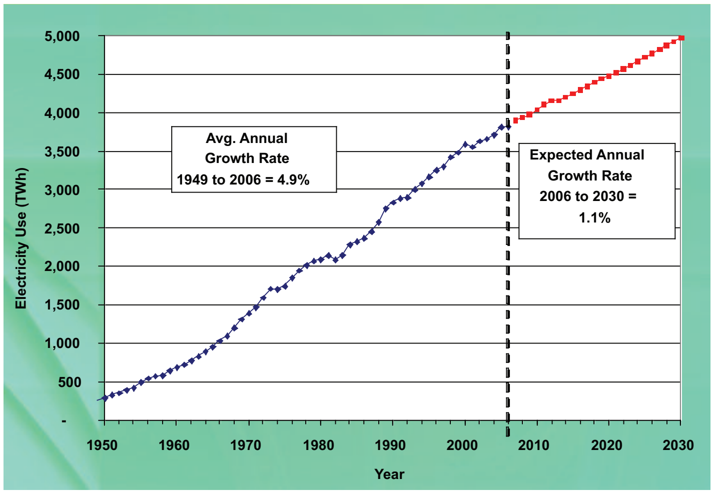
As energy issues moved to the forefront in recent years, many states have revived the utility resource planning processes of years past and even adopted new approaches to account for the role of clean energy. Key practices include acquiring high-quality data on growth rates; developing resource potential studies to inform the selection of resource choices; using cost-benefit or economic analyses to screen resource options; ensuring the equal consideration of supply-and-demand options; and linking to specific or anticipated utility actions, investments, or resource commitments, including efforts stemming from greenhouse gas reduction policies. For instance, some states now require their electric utilities to prioritize energy efficiency and renewable energy in their acquisition of new resources for the power grid. (**Appendix A** offers a fuller account of these topics.)

Forecasting Electricity Usage Patterns

Planning for future electricity needs is largely driven by expected growth compared to existing capacity. Since 1949, electricity use in the United States has grown 15-fold, or by 4.9 percent annually. However, the pace of electricity demand has been slowing. Since 1977, electricity use has grown by an average rate of 2.3 percent per year and electricity demand is forecast to rise at an average rate of 1.1 percent per year through 2030 (**Figure 1**).[6]

Electricity forecasts also vary markedly by region. The U.S. DOE's Energy Information Administration (EIA) estimates in its *Annual Energy Outlook (AEO) 2007 with Projections to 2030* that electricity demand growth ranges from an average of 0.7 percent per year in the New York region to 2.1 percent per year in Florida specifically and in the Southwest generally. The preliminary AEO for 2008 indicates similar trends.

Figure 1. Electric Use in the United States, 1950-2030



Source: U.S. Department of Energy, Energy Information Administration

Past utility forecasts have sometimes overestimated actual demand growth, resulting in capacity overbuilding and associated rate increases. Technology improvements, appliance standards policies or utility efficiency programs, and economic factors can all affect actual energy demand rates and should be carefully accounted for in the development of usage assumptions.

To advance energy efficiency policies in a state or region, it is important demonstrate if the particular resource is readily available, abundant, and cost-effective to deploy. States can conduct an energy efficiency resource potential study to gauge how a resource matches up with these characteristics. This analysis assesses the possible energy efficiency resources in the state or region and estimates the extent to which they could meet the state's future energy needs. This assessment can inform the design of efficiency policies and programs, help set energy savings goals, or determine funding levels for efficiency programs and policies. These studies can be done at varying levels of specificity and expense, offering cost estimates for efficiency, for example, or providing specific recommendations for increasing sector-specific efficiencies. (**Appendix A** provides additional guidance on these studies.)

State Power Planning Initiatives

States are working on comprehensive electricity plans. This is happening, with some distinctions, in both traditionally regulated and restructured states. **California** offers an example of comprehensive electricity planning that incorporates integrated resource planning—discussed in more detail later. The CPUC requires state utilities to submit 10-year procurement plans on a biennial basis and reestablished utility rate incentives to promote demand-side energy efficiency management.[7]

Another example of state electricity planning comes from the Northwest Power and Conservation Council (NPCC), which was established by the U.S. Congress in 1980. NPCC is an interstate coordinating body for **Idaho**, **Montana**, **Oregon**, and **Washington**, guiding the region's utilities. Periodically, NPCC publishes a 20-year plan that outlines policies for reducing and managing the uncertainties and risks that can impact the power system. The most recent plan, released in May 2005, concluded that clean energy options are central to risk and cost reduction, and cited energy conservation and efficiency, demand response, and wind power as central choices. NPCC also encourages the establishment of integrated resource plans to prepare for future adjustments in the energy market and outlines steps to secure and expand newer resources.[8]

The two dozen or so states that restructured their electricity sectors in the 1990s face additional challenges in comprehensive electricity resource planning. This is because electricity in these states is not provided by a handful of highly regulated and integrated companies; instead, utilities are separated into distinct generation, transmission, and distribution entities.

In this context, a concept called "portfolio management" has emerged as an ad hoc policy solution allowing states to engage distribution utilities on behalf of electricity customers. Portfolio management can take many forms, but in essence its aim is to allow a state to reassert a comprehensive resource management role over largely unregulated utilities, thus influencing the demand-side and supply-side acquisitions and resources.[9]

California's power planning initiatives, as well those of other states, are described below.

- The **California** Public Utility Commission's (CPUC's) loading order policy was established in the 2003 joint CPUC/California Energy Commission (CEC) Energy Action Plan. It requires electric utilities to acquire all cost-effective energy efficiency resources before applying for new energy supply projects. Demand-side resources are to be acquired first, up to cost-effectiveness limits. Defined renewable resources are to be pursued next, followed by conventional generation if needed.[10]
- **Wisconsin's** Energy Priority Law establishes a similar set of priorities: To the extent that it is cost-effective and technically feasible to do so, demand should be met first through conservation and efficiency, next through non-combustible renewable energy, then through combustible renewable energy, and, finally, through nonrenewable sources, starting with natural gas and then oil or low-sulfur coal.[8]
- **Connecticut** passed legislation in 2007 requiring that energy efficiency and other demand-side resources be developed first.[12] The bill states that future power needs shall first be met through all available energy efficiency and demand-side resources that are cost-effective, reliable, and feasible. Preliminary estimates indicate that, if fully implemented, this bill could reduce total electricity use in the state below current levels.
- **Maine** has considered requiring distribution utilities that do not own generation to acquire a mix of resources to support "default" service to customers who do not choose unregulated power suppliers for their generation service. Such a mix could include energy efficiency for a portion of default service needs, procurement of renewable supplies, and a mix of conventional supplies, including mixed-length power purchase contracts.[13] This places a major implicit burden on the distribution utility, which is still state-regulated, to make good resource decisions for customers.

Elements of a Sound Resource Plan

When formulating electricity resource plans, states should strive for the following important elements:

- **Adequate time frame**—To allow enough foresight to consider the full range of demand-side management (DSM) and supply options, resource plans should span at least 15 years, and could cover as many as 25 years. Ideally, these plans would be linked to short-term action plans, typically spanning one to three years, to incorporate specific commitments.
- **Transparent forecast**—The forecast should document its methods, assumptions, and data sources as clearly and openly as possible. It should also include sensitivity analyses and alternative forecast scenarios, which account for the most significant sources of possible variance in the forecast.
- **Resource potential studies**—Given the uncertainties around price and availability of traditional fuels, it is important to assess the potential for both demand-side and supply-side resource options. These potential studies can then inform discussion of resource choices in the planning process. A brief discussion of potential studies, with references, can be found in **Appendix A**.
- **Full discussion of resource options**—All reasonable demand-and-supply options should be considered in the plan. Needed transmission and distribution investments should be included. Consistent methods should be used to describe technologies, assess their performance, estimate their costs, and describe their benefits and risks. This element should include realistic resource assessments detailing the amounts of energy and capacity each resource could realistically deliver in specific time frames.

- **Consistent and detailed economic analysis**—All resource options should be screened economically on a consistent basis, including levelized cost per kWh of energy and kilowatts (kW) of capacity, projected impacts on total utility system revenue requirements and rates, and assessment against a standard set of avoided-cost benchmarks.
- **An assessment of alternate plausible scenarios**—Key parameters and assumptions should be varied to examine the effects on resource decisions (e.g., examining high-growth and low-growth alternatives to the baseline load forecast; assessing scenarios with high vs. low carbon costs, etc.). This process can help establish the degree of risk associated with different resource options.
- **Integrated resource strategy**—Pulling together all of the above elements, the plan should present a recommended resource portfolio that presents demand and supply components in a common framework.
- **Action plan**—The plan should also contain detailed information on what the utility proposes for the near and mid terms with respect to specific DSM programs and supply projects. This is one place where states can incorporate related environmental goals.
- **Linkage to specific resource actions**—In some states, resource plans lack a direct connection to utility investment or resource commitments. In others, resource policies specify which resources should be given priority. For example, in some states, there is little or no legal linkage between resource planning and certificate-of-need applications, meaning that power plants or other facilities can be proposed independently of the contents of the resource planning. Other states require that all cost-effective energy efficiency resources be acquired before power plant applications can be submitted.

Integrating Greenhouse Gas Policies into Electricity Planning

Governors and their utility commissions are being asked to extend the planning process beyond their traditional rate-making purview, most notably in the area of climate change mitigation. A majority of states now have climate action plans, a number have set mandatory greenhouse gas emissions reduction targets, several have greenhouse gas emissions performance standards for power plants, and still others are part of regional coalitions that have created or are developing greenhouse gas cap-and-trade markets.

These emerging state policies make climate change issues central to electricity planning. Even in states without mandatory greenhouse gas emissions reduction plans, the potential for a future price cap on greenhouse gases—at either the state or federal level—plays into planning analysis and resource decisions. However, states do not need to overhaul the electricity planning process to develop clean energy policies that meet their greenhouse gas or other environmental goals. Clean energy and climate change policies can complement each other. Sound policies for clean energy can serve to reduce emissions directly, reduce the cost of compliance, or both. To bridge these two efforts, states can launch an action plan within the broader electricity planning process that identifies specific steps to implement its elements. To be effective, the plan should be linked to all resource decisions so that new projects are not pursued unless they are consistent with the plan's goals.

What follows is a discussion of leading greenhouse gas policy efforts that can be integrated into electricity planning.

Climate Action Plans. Thirty-six states have established climate action plans designed to serve as a comprehensive approach to managing greenhouse gas emissions. Given the significant contribution of electricity generation to total greenhouse gas emissions as well as the opportunity for cost-effective reductions, these plans typically contain a menu of options to advance clean electricity generation and energy efficiency. These measures range from appliance efficiency standards to innovative financing for clean energy projects and renewable and efficiency resource standards for utilities. As these action plans go into effect, states should consider their impact on demand forecasts and resource choices. For the most part, the clean energy initiatives undertaken by states are complementary to climate policy goals; this means states can move forward on clean energy policy without having a final climate policy in place.

Greenhouse Gas Emissions Reduction Targets and Regional Coalitions. States are setting mandatory emissions reduction targets, often resulting from recommendations from state climate action plans and advisory groups. **New Jersey** has set mandatory greenhouse gas emissions reduction targets of 1990 levels by 2020 and 80 percent below 1990 levels by 2050.[14] **Hawaii** has set a mandatory GHG emissions reduction target of 1990 levels by 2020, and is developing approaches for reaching this target in conjunction with reducing its dependence on petroleum via the Hawaii Clean Energy Initiative goal of 70% renewable energy sources by 2030. New Jersey is also part of the Regional Greenhouse Gas Initiative (RGGI), along with **Connecticut**, **Delaware**, **Maine, Maryland**, **Massachusetts**, **New Hampshire**, **New York**, **Rhode Island**, and **Vermont**.[15] The RGGI agreement currently affects only the power sector, and the cap-and-trade system it sets up will require a 10 percent reduction from 2009 power sector emissions levels by 2018.[16] Utilities will be required to have allowances to cover their emissions, which will be apportioned to the states. Most states have decided to auction most, if not all of their allowances, rather than distribute them to generators. Proceeds from the auctions will go in part toward energy efficiency projects designed to reduce electricity demand, reduce consumer energy bills, and further reduce emissions.

Power Plant Performance Standards. Power plant performance standards are another area in which greenhouse gas emissions reduction can be integrated into the power planning and resource acquisition process. As noted earlier, **California**, which has set mandatory greenhouse gas emissions reduction targets and is part of several Western regional coalitions to reduce emissions, has required that new long-term contracts for power generation must be for sources that emit no more greenhouse gases per megawatt hour (MWh) than combined-cycle natural gas turbine baseload generation. This is to prevent emissions leakage—also a concern in the RGGI states—whereby utilities would seek to avoid greenhouse gas regulation by buying power from out-of-state sources not subject to the in-state greenhouse gas regulation. **Washington**, like California, requires that new long-term contracts for baseload electric power must be from sources that emit 1,100 pounds of CO_2 or less per MWh (roughly equivalent to combined-cycle natural gas turbine).[17] **Montana**, using a different approach, provides tax incentives to new coal-fired power plants if they capture and sequester at least half of their CO_2 emissions.[18]

Tapping into Energy Efficiency and Other Demand-Side Resources

With a solid framework for resource planning in place, states can start to define the resources and policy options needed to create an actionable resource plan. Demand-side resources, one option, include energy efficiency, conservation, demand response, and distributed generation. Demand-side resources have a number of potential benefits, including lowering overall and peak demand, reducing greenhouse gas emissions, and achieving cost savings and economic development gains. They also face an array of challenges, including the scale of implementation, transaction costs, and market and regulatory disincentives. States are adopting a number of policy approaches to meet these challenges: building codes, appliance standards, energy efficiency resource standards, Public Benefit Funds, DSM programs, and utility rate realignment.

What Are "Demand-Side Resources"?

Demand-side resources can be divided into three main categories, each with distinctive traits.

Energy efficiency means providing energy services (comfort, food preservation, clean clothes, lighting, entertainment, etc.) at the same or at a higher quality level, but with fewer units of energy consumed. For example, in the 1970s, the average refrigerator used more than 1,800 kWh per year; today, an average refrigerator uses less than 500 kWh in the same amount of time, while keeping as much or more food fresh. Efficiency typically means substituting a higher performing technology or practice for another in such a way that the relative performance improvement can be measured. Efficiency can reduce customer electricity bills, cut emissions, moderate future electricity prices, and reduce the risk of power blackouts.

Energy conservation refers to energy-use cutbacks that also reduce the energy services that are delivered. For example, setting back thermostats 3 degrees in winter is an act of conservation and could save a consumer $74 per heating season.[19] Conservation is typically achieved through public education or other non-technology approaches that result in changes in energy-consuming behaviors. Conservation can offer the same set of benefits as energy efficiency, but its effects may not be as long lasting because behavior changes are difficult to sustain over long periods.

Demand response refers to reduction of peak electricity loads and may or may not result in a net reduction in total energy usage. For example, a utility may offer customers incentives to allow air conditioning systems to be shut off during the utility's peak demand periods, or a transmission system operator may encourage customers to "sell back" capacity during peak periods by reducing customer electric loads. Demand response can involve direct utility control of customer equipment or a market-based response approach. Demand response can reduce customer bills, though not to the same extent as efficiency; it can be very effective at avoiding blackouts; and it can help moderate wholesale power prices in states where there is a central, organized market for electricity. It may not reduce pollutant emissions, depending on whether there is an actual reduction in electricity consumption. If the reduction at peak load is merely shifted to other times, when power is generated by power sources that emit more pollution than the peak load source, then emissions could actually increase. If the reduction at peak load on the electricity grid means that the end user is switching to a backup generator, which might emit more pollution than the peak load source, this could also increase emissions.

Another category of demand-side resource that can also be considered a supply resource is combined heat and power. This resource will be addressed later in this report.

While each of these three demand-side resources can be effective in reducing demand, policies and programs aimed at coordinating or combining the use of different demand-side resources can help to provide maximum benefits. For example, while a customer could install high-efficiency lighting that saves 75 percent of electricity use compared to a prior lighting system, if the customer also uses conservation techniques such as switching off lights when leaving a room, energy savings will exceed 75 percent.

Benefits of Demand-Side Actions

The benefits of increasing demand-side resources, including reducing demand and lowering greenhouse gases as well as costs savings and economic development gains, are discussed below.

Demand and Greenhouse Gas Reduction Potential. Energy efficiency and conservation measures have the potential to cut demand for electricity, save money, and reduce emissions. According to the *National Action Plan for Energy Efficiency*, demand-side actions could reduce load growth by half between now and 2025.[20] This could save $100 billion in avoided utility costs and produce $500 billion in net savings. Reducing load growth also means avoiding greenhouse gas emissions. If projected load growth between today and 2025 were actually cut in half, it would be equivalent to taking 90 million vehicles off the road in terms of greenhouse gas emissions avoided.[21]

New generation is often needed to help meet peak demand, and demand-side measures that reduce overall demand and also shift demand to off-peak hours can help to eliminate the need for new generation capacity. For example, the **Tennessee** Valley Authority's new efficiency and demand-response plans seek to reduce the growth in peak demand by 1,400 MW by 2012.[22]

Cost Savings and Economic Development Gains. States have shown that efficiency and other demand-side resources can directly and indirectly benefit a state economy. Direct benefits include reduced customer utility bills and increased reliability in the power system.

Some states, including **Washington** and **Oregon,** have been able to decrease annual per-capita retail electricity sales, from about 18,500 and 15,000 kWh, respectively, to 13,000 kWh in both states today. **California** has kept its annual per-capita electricity sales level at about 7,500 kWh since the 1970s, while the overall U.S. average has risen from 7,500 kWh to about 12,000 kWh. The resulting lower electricity bills in California mean households have more income to spend on other goods and services, and help businesses stay profitable and competitive by reducing the flow of energy dollars out of the state to regional, national, or global companies.

Efficiency also generates indirect benefits in the wider economy. Electricity bill savings get spent in the local economy, and efficiency is especially effective as a job-creation investment. Research by the American Council for an Energy-Efficient Economy (ACEEE) shows that energy efficiency investments create an average of three times as many jobs per dollar invested than do conventional energy supply resources.[23]

In addition, efficiency investment flows into sectors that are more labor-intensive (architecture, engineering, contracting, construction, retail sales, etc.) than sectors stimulated by supply investment (primary metals, heavy manufacturing, etc.). Many studies have documented these kinds of economic benefits from clean energy investments. Well-designed policy approaches targeting productive investments in renewables and efficiency can also protect businesses and consumers from the impacts of rising energy prices, generate lower economic costs, and may even yield a small net economic benefit for the local economy.[24] The economic benefits of clean energy technologies have been demonstrated by analyses showing that the economic activity stimulated by efficiency and renewables is typically more labor-intensive and contributes greater value-added returns to the state economy than do conventional energy supply investments.

Many studies break down the benefits of energy efficiency and other clean energy investments by state, showing energy savings, reduced growth in demand, and job creation. An ACEEE analysis of the potential for efficiency in **Maryland** showed that cost-effective energy efficiency resources can reduce about 29 percent of forecast electricity usage by 2025, which would lead to a net gain of 12,000 jobs.[25] A 2007 **Texas** study documented a potential 22 percent electricity savings by 2023 that would lead to a net employment benefit of 38,000 jobs, driven by new efficiency investments that provided a net cumulative energy bill savings of $37.4 billion over the period 2008 to 2023. A 2007 **Michigan** analysis suggested that the state's economy would benefit from cost-effective investments in energy efficiency and renewable energy technologies. This study shows a 24 percent electricity savings potential in 2023, which would support a net gain of 7,500 jobs and a net cumulative energy bill savings of $10.4 billion over the period 2008 to 2023.

Challenges to Deploying Energy Efficiency and Other Demand-Side Resources

Despite the significant potential of energy efficiency, conservation, and demand response to reduce electricity demand growth, challenges remain to rapidly tapping their full potential.

The biggest challenge to efficiency is the sheer size and complexity of implementing changes in the buildings sector, which uses 70 percent of U.S. electricity. The 100-million-plus buildings in the United States account for trillions of dollars worth of capital stock, much larger than the stock of power plants and other electricity infrastructure. The many submarkets comprising the U.S. building stock are complex: There are more than 100,000 companies in the home-building and home servicing business, engaging in millions of transactions every year, from air-conditioner replacements to new home construction. Reaching all of these transactions in their various markets is a huge challenge. The size, diversity, and small-unit nature of our buildings market call for aggregators; that is, institutions that can reach most of these markets effectively.

This overall challenge of large and complex buildings markets points to a more specific barrier to efficiency investment: the fact that most efficiency technologies come in small "bites"—lighting fixtures, appliances, consumer products, and so on that are frequently too small to justify the analysis and other transaction costs that go into supply-side projects. A power generation project typically runs into the hundreds of millions or billions of dollars and, therefore, can support engineering, financial, and legal experts to make the project happen. A $2 light bulb, or even a $1,000 refrigerator, by contrast, are too small to get such attention from capital markets. This "transaction cost" or "information cost" barrier tends to drive capital to the supply side of energy markets.

In addition to the transaction-cost barrier, the other most common and persistent barrier is the "principal-agent" or "split-incentive" problem. This problem occurs when one party (the "agent") makes decisions about, and pays the upfront costs for, a building's energy efficiency performance or an energy-using product, and another party (the "principal") pays the ultimate energy bills. In these situations, the incentives are split: The agent's incentive is to minimize upfront costs, while the principal is concerned more with operating costs, including energy bills. Homebuilders and home buyers are the prototypical principals and agents in U.S. markets, as are residential and commercial landlords and tenants, and even procurement officers and facility managers in large organizations like state government. For common end uses like residential heating and cooling, the principal-agent barrier can affect up to 50 percent of total energy use, severely limiting efficiency investment in these areas.

Barriers can extend beyond structural market characteristics to include policy and regulatory barriers. A key policy barrier in the electricity sector is state rate-making policies. For many reasons, rates have long been designed to recover utilities' costs based on the number of kWh sold; this "volumetric" pricing approach apportions costs fairly based on consumption and also provides an incentive for customers to manage their usage. However, it has a major drawback: It creates a disincentive for utilities to invest in efficiency because, by reducing sales growth in a volumetric pricing system, utilities fail to recover their full costs, and their profit margins can erode rapidly.

Policies to Deploy Demand-Side Resources

To address the challenges above, states are pursuing the following types of policies:

- Creating building energy codes and appliance standards to set basic performance levels for new buildings and key products.
- Engaging utilities and others as aggregators and administrators in delivering efficiency programs to customers through:
  - Energy efficiency resource standards;
  - Public Benefit Funds; and
  - Energy efficiency and demand-side management.
- Aligning utility rate and regulatory policies to encourage utility energy efficiency programs.

Building Energy Codes

Robust building energy codes are key components of a clean energy strategy because new buildings are the largest source of load growth in a typical utility system. The efficiency of a new building is particularly important in fast-growing Southern and Western states, which are also concerned about the availability of adequate energy supplies. Codes help address the principal-agent problem (whereby builders make energy efficiency decisions and pay the associated capital costs, yet do not receive the benefits of lower energy bills, which go to building owners and occupants), which affects about half of the heating and cooling energy used in American homes.[26]

California's state-developed energy code—known as the Title 24 standards—has both stringent rules and high compliance rates, based on field verification studies. It offers flexibility through performance-based specifications and is actively supported through technical assistance.[27] While most codes are prescriptive, California's is performance-based, meaning that it is focused on results. It is credited (along with appliance standards) with saving more than $56 billion in electricity and natural gas costs since 1978, and is projected to save an additional $23 billion by 2013.[28]

Prescriptive building energy efficiency codes, which have specific requirements for such things as wall and ceiling insulation, can be effective as well. In **Washington**, the state building energy code emerged from the Model Conservation Standards (MCS), which were developed in the Northwest in the 1980s and call for specific measures to be adopted in building construction. The Washington State Energy Code has achieved a high level of compliance, with a recent construction practice survey suggesting that 94 percent of homes meet or exceed the code requirements for the building envelope.[29]

Many states also use voluntary programs that go beyond codes, including the U.S. EPA ENERGY STAR program, the U.S. DOE's Building America program, and evolving "green building" programs, such as the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED™) program or the Green Building Initiative's Green Globes program.[27]

Appliance Standards

While many residential, commercial, and industrial energy-using products and equipment are covered by the National Appliance Energy Conservation Act of 1987 and more recent federal laws, states are allowed to regulate products not covered by the federal law. In fact, states have played a key role in driving federal action on appliance and equipment efficiency standards; several times in the past few decades, state action to regulate products has led to federal standards because manufacturers prefer one set of national standards to multiple ones. Standards address the principal-agent problem, but also tackle the transaction-cost problem, especially for small energy-using products like battery chargers, where it is not worth a consumer's time to try to optimize choices for such small energy savings.

During the 1970s, **California** became the first state to adopt appliance standards, paving the way for other states to adopt standards in the 1980s and leading to federal standards legislation. The Golden State has led the nation in appliance standards ever since. The California Energy Commission (CEC), in coordination with Pacific Gas & Electric (PG&E), has done substantial research that has helped other states develop efficiency standards legislation.[31] As mentioned above, these standards, combined with California's building energy code, saved the state more than $56 billion since 1978. California's appliance standards are projected to avoid the need for three large power plants totaling 1,000 Megawatts of generation capacity.[32]

In 2005 and 2006, **Rhode Island** adopted minimum efficiency standards that were based on California's, covering about 15 products. If adopted in all states that have proposed them, appliance and equipment efficiency standards are estimated to save states up to 52 billion kWh in 2020, or the equivalent of about 2 percent of projected electricity consumption.[33]

Utility Efficiency Resource and Program Policies

States have the following three main policy tools to encourage utilities and other key actors to increase efficiency and conservation:

- Energy Efficiency Resource Standards, which require utilities to meet long-term targets to achieve energy savings;
- Public Benefit Funds (PBFs), which create sustained resources for efficiency efforts; and
- Demand-Side Management, which engages utilities to invest in and plan for efficiency.

These tools, outlined below, help states engage utilities and other stakeholders in efficiency promotion in ways they might not have otherwise pursued.

Energy Efficiency Resource Standards (EERS)

Energy Efficiency Resource Standards (EERS) address the hard-to-reach nature of the many and diverse markets that make up the U.S. buildings sector. EERS charge utilities with developing specific levels of demand-side resources by aggregating the end-use markets through efficiency programs. EERS are becoming more commonplace as states continue to set targets for increasing energy savings.

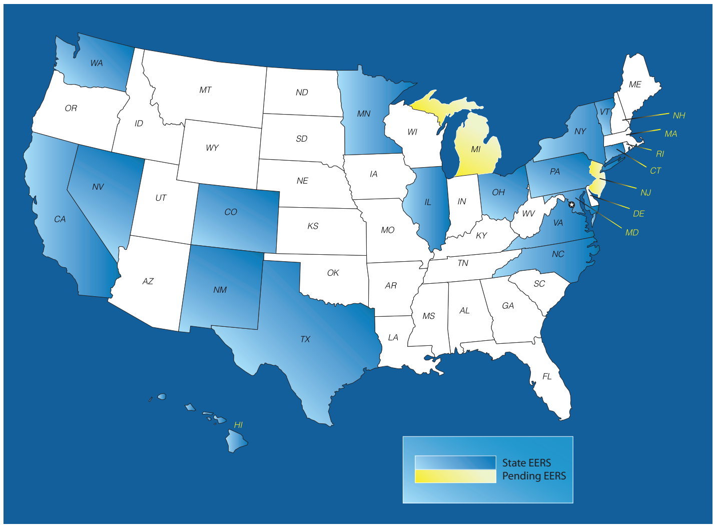
Since the first of these was established in **Texas** in a 1999 restructuring law, EERS have appeared in 17 states and are under development in many others (**Figure 2**). EERS provide a useful framework for achieving state energy savings. By setting a long-term target through an EERS, states have a meaningful goal and organize other policies around reaching the EERS target. EERS also have fundamentally changed the way that states seek energy savings. Whereas many states used to require that utilities spend a certain percentage of revenue on demand-side programs without regard to how much energy was actually saved, EERS require verified energy savings.

EERS are typically structured as long-term energy and capacity savings goals that are placed on state-regulated utilities. Goals can be expressed as a percentage of forecast load growth (**Texas**), total energy savings (**California**), or total electricity sales (**Connecticut**, **Illinois**, and **Minnesota**). EERS targets are as high as 2 percent of total electricity sales (such as in **Connecticut** in 2008). While 2 percent may not seem like a large number, load growth averages less than 2 percent as a national average, so, depending on the state, a 2 percent EERS can meet all or more than projected load growth.[34, 35]

Vermont and **California** both set EERS goals in the form of total energy savings. In Vermont, an independent "efficiency utility"—Efficiency Vermont (EVT)—delivers efficiency programs for the state and is contractually required to achieve energy and demand goals. EVT cumulatively met more than 5 percent of Vermont's electricity requirements by the end of 2006. In 2007-2008, EVT planned to achieve an additional 214 million kWh of savings and 30 MW of summer peak demand reduction. The projected kWh savings over 2 years amounts to 3.5 percent of 2006 sales.[36] In 2004, California set energy savings goals for investor-owned utilities for the 2004-2013 period, and expects to save more than 1 percent of total forecasted electricity sales per year. In 2013, the savings goals are more than 23,000 gigawatt hours in electricity consumption and 4,885 MW in peak demand.

Connecticut set an EERS target as a percentage of electricity sales. In June 2005, the state legislature modified its Renewable Portfolio

Figure 2. EERS in the United States (May 2008)



Standard (RPS) to include efficiency.[37] Starting in 2007, the state's utilities must procure a minimum 1 percent of electricity sales from resources such as energy efficiency and combined heat and power (CHP), rising to 2 percent in 2008, 3 percent in 2009, and 4 percent in 2010.

Minnesota similarly sets goals as a percent of sales. In December 2006, Governor Tim Pawlenty announced his Next Generation Energy Initiative, calling for 1.5 percent annual energy savings of electric sales (including natural gas), at least 1 percent of which must come from energy efficiency. Previously Minnesota's energy savings program required spending a percentage of utility revenue, but with this plan, enacted in 2007, the state has shifted to an energy savings requirement.[38]

In states without an EERS policy, states may set goals and form voluntary agreements with utilities to reduce energy use. For instance, in **Kansas**, Governor Kathleen Sebelius has called for a 5 percent energy consumption reduction by 2010, and a 10 percent reduction by 2020 and is working with utilities to meet this goal.[39]

Compliance with EERS targets is in its early stages. Some of the targets discussed above are higher than the savings utility programs have attained in the past. Recognizing this, some states are including non-utility policies in their overall strategies for meeting these goals; building codes and appliance standards, for instance, are being wrapped in. Some states, like **Connecticut**, are using market mechanisms like "white certificates,"[ii] which are given to customers or third parties that initiate projects with verifiable energy savings, or are selling compliance credits to utilities.

With electricity prices on the rise in many states, smart meters and other smart-grid technologies are emerging as tools to help utility customers better manage their usage. A smart grid envisions technology innovations that change the relationship between the end user and the power provider in favor of efficiency. By using smart meters, which could offer pricing options more closely related to the actual costs of electricity production, consumers will be better informed about their energy use and its price, particularly during peak-load periods. The end user is empowered to use energy-saving controls on appliances and on other household energy-using devices. These devices will be able to pinpoint stress on the grid and reduce energy use accordingly to avoid blackouts or other supply disruptions. Moreover, end users will be able to remotely control their home or business energy use from a computer.

All of these advances may take years to be fully integrated and may require development of technical standards, but early tests are promising. Pilot studies show that end users respond to the smart-grid information and reduce overall energy use (by as much as 6 percent in one study), and shift demand to non-peak periods (saving customers 3 percent on their energy bill in another study) when time of use rates that encourage off-peak energy use are in place.[40]

While a wide range of options may be needed to meet EERS targets, they represent a focused approach to efficiency goal setting.

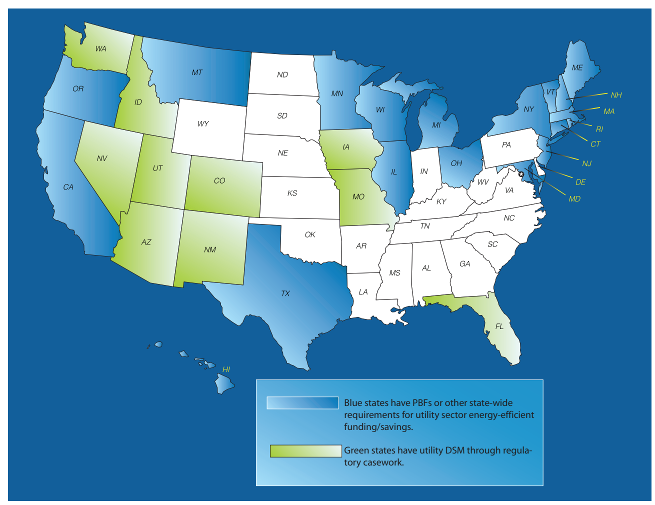
Public Benefits Funds (PBFs)

PBFs are another way to engage utilities and other entities as aggregators in end-use markets to drive wider adoption of efficiency technologies. PBFs originated in the mid-1990s in states seeking new funding mechanisms for energy efficiency and renewable energy as their utility industries were restructured. While EERS set goals in terms of energy savings, and building or appliance standards improve efficiency for particular applications, PBFs take a different approach, acting on their own to increase efficiency or in concert with EERS. They create pools of funds—typically derived from modest charges on customer utility bills—to support efficiency programs or renewable investments.

In **California**, PBFs provide part of the funding that utilities need to reach their EERS goals.

Some 20 states operate PBFs for energy efficiency; other states, primarily ones that did not restructure their electric utilities, administer energy efficiency through a utility-sponsored DSM mechanism (**Figure 3**).

Figure 3. States with PBFs or Demand-Side Management



Another potential avenue for energy efficiency funding comes from the auction of allowances in states that have adopted greenhouse gas cap-and-trade policies, such as the RGGI states. In **Maryland**, Governor Martin O'Malley's Strategic Energy Investment Fund will use revenues from the RGGI to create a new fund for energy efficiency, renewable energy, and related purposes as part of 2008 legislation (House Bill 368/Senate Bill 268).

[ii] These are similar to renewable energy or green certificates that are purchased by utilities to meet renewable energy portfolio standard requirement, except that these verify demand-side actions.

Energy Efficiency and Demand-Side Management Programs (DSM)

DSM was the original approach that states used to task utilities as aggregators to drive efficiency investment in customer markets and is still used effectively today. Several states, especially those without restructured electricity markets, continue planning and administering their utility efficiency programs through the DSM practices that evolved during the 1980s (**Appendix A**). **Iowa** and **Minnesota**, for example, have continued their DSM programs for decades, using traditional resource planning methods; efficiency programs are funded by utilities, with costs recovered through rates.

Some states blend DSM planning and administration methods with PBF funding sources and EERS savings targets. In **Maryland**, the 2008 EmPOWER Maryland legislation sets EERS targets for utilities, which in turn plan, fund, and gain cost recovery under utility commission review. Maryland also established a version of a PBF in 2008, creating the Strategic Energy Investment Fund to utilize proceeds from carbon dioxide allowance auctions under the Regional Greenhouse Gas Initiative. In **New York**, the utility commission is working on setting EERS targets for utilities under a DSM framework that operates in concert with the state's PBF, which is administered by the New York State Energy Research and Development Authority (NYSERDA).

Utility Rate and Regulatory Policies

Even with advanced building codes, strong energy efficiency targets, appliance standards, and a funding mechanism such as a PBF, states still may not tap the full range of cost-effective energy efficiency and conservation measures without examining their utility regulatory structure. If utilities lack incentives, or cannot even recover lost profits due to their energy savings efforts, they are not likely to partner with states to promote efficiency.

States can change the utility regulatory structure to enable utilities to push a full range of energy efficiency and conservation options while still recovering costs and making a profit similar to that from investments in new capacity. State regulation of electricity markets and utilities can be used as a critical lever for encouraging clean energy development, including demand-side resources.

The most comprehensive state utility energy efficiency programs share these key components—cost recovery; decoupling revenues from electricity sold; and share-holder incentive mechanisms—detailed below.

Cost recovery is a longstanding issue affecting energy efficient deployment. Utilities would not be able to effectively pursue efficiency without being able to recover their costs; for regulated entities, cost recovery is subject to formulas set by public policy. Since DSM was first implemented in the 1980s, state utility commissions have established cost recovery mechanisms for utilities. While there are important choices to be made on designing cost recovery methods, this basic practice is not new.

Decoupling, as it is popularly known, has taken center stage recently; it is meant to break the link between a utility's sales and profits and its ability to recover *fixed costs*. While *utility efficiency program costs* can be addressed through well-established recovery mechanisms, there is the larger issue of how utilities' total fixed costs can be recovered and its profit margin maintained when sales decline from expected levels. Poorly designed rate mechanisms can cause utilities to lose opportunities for revenue and profit from efficiency programs, even if direct program costs are recovered. This creates a fundamental disincentive to utility investment in demand-side resources.

Shareholder incentive mechanisms, which states have recently started grappling with, focus on giving utility investors the right financial signals. Beyond cost recovery issues, if efficiency is to become a "big business" for utilities, their shareholders must be able to realize earnings from what utilities spend on the demand side. If shareholders see earnings potential from utility investments in efficiency, they will be more interested in seeing utilities move aggressively in this direction.

Cost-recovery methods for DSM programs. Utility costs for demand-side programs must be recovered from customers. While supply-side investments are typically capitalized and recovered over long periods, demand-side program costs have typically been smaller in absolute size, and thus could be treated as annual expenses or capitalized. If capitalized, recovery periods are typically quite short compared with supply investment amortization periods. States must also decide whether to recover costs across all customer classes, or allocate and recover program costs by customer class.[41] Regardless of what decision a state makes, a key element of partnering with utilities to promote energy efficiency and conservation is ensuring that a mechanism exists to recover costs invested.

In **Arizona**, Arizona Public Service agreed to a cost recovery settlement in 2004. It allows for $10 million each year in base rates for eligible expenses, as well as an adjustment mechanism for program expenses beyond $10 million. It covers the costs of approved "eligible DSM-related items," defined as the planning, implementation, and evaluation of programs that reduce the use of electricity by means of energy efficiency products, services, or practices.[iii]

In **Iowa**, utilities recover energy efficiency program-related costs through an automatic rate pass through reconciled annually to prevent over- or under-recovery (i.e., costs are expensed and recovered concurrently). Program costs are allocated within the rate classes to which the programs are directed. The cost recovery surcharge is recalculated annually based on historical collections and expenses and planned budgets.[iv]

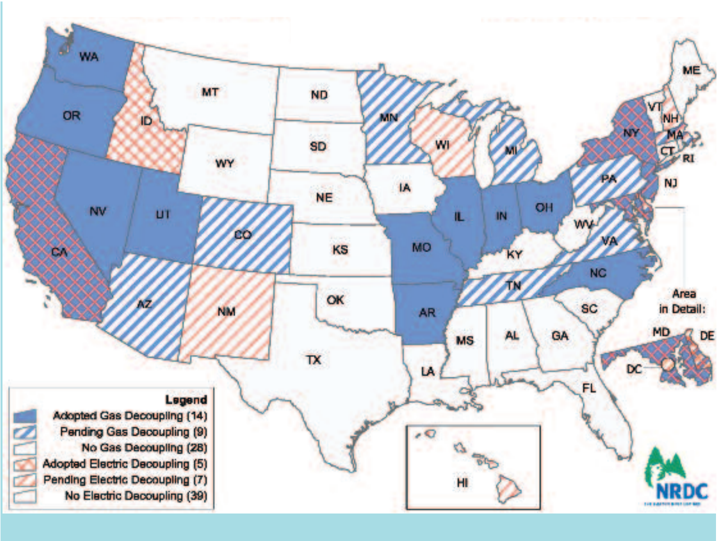
[iii] Refer to Order No. 67744 under Docket No. E01345A-03-0437.

[iv] Refer to 199 Iowa Administrative Code, Chapter 35, pursuant to Iowa Code 2001, Section 476.6.

Decoupling or fixed-cost recovery mechanisms. Historical rate-making practices have linked utility revenues to the amount of electricity sold. While utility revenues and profits are calculated to provide an approved rate of return on assets, the revenue requirement is typically divided by forecast kWh sales. This means that if kWh sales deviate from the forecast, the utility may experience surpluses or deficits in revenues and profits in a given period. In this approach, if efficiency programs reduce kWh sales, utilities typically see revenue shortfalls because they do not fully recover the fixed costs allocated to each kWh of sales. This creates a major disincentive for utility efficiency investment. States have sought to correct this problem largely by separating utility revenues from kWh sales.

This can be done through "decoupling" mechanisms, which adjust revenues each year, accounting for changes in kWh sales so that revenue surpluses or shortfalls are made up the next year through a minor rate adjustment. So, in addition to being able to recover efficiency costs, decoupling allows utilities to be compensated by ratepayers for revenue-losing efficiency efforts. Some utilities have proposed to place a higher portion of per-customer fixed costs in the fixed charge portion of the electric bill so that electricity sales changes only impact the utility's variable costs. However, this approach reduces customer incentives to save energy by reducing the electric bill impact of increasing energy usage, and states have generally not approved this method. Four states use electricity decoupling today and many more use decoupling for natural gas utilities; a number of additional states are exploring this option (**Figure 4**).

Figure 4. Electricity and Gas Decoupling in the United States (February 2008)[42]



Source: Used with permission from the Natural Resources Defense Council, February 2008.

States are working to address all aspects of the utility rate structure to ensure that utilities are able to be effective energy efficiency and conservation partners. For instance, the **Idaho** Public Utilities Commission allowed the Idaho Power Company to enter into a three-year pilot program under which the fixed-cost portion of Idaho Power's revenue was established by a general-rate case, with an alignment mechanism to ensure that the utility would no longer have disincentives to pursue DSM and efficiency programs. In exchange for the removal of the disincentive, Idaho Power agreed to pursue or support a number of energy efficiency and DSM measures, which are reviewed by the commission annually for measurable energy savings.[43]

Shareholder incentive mechanisms. Making efficiency financially attractive to investor-owned utilities is a three-part problem. In addition to providing for utility cost recovery and revenue stability for energy efficiency efforts—so that utilities do not lose money by reducing demand for electricity—utilities will want to be able to earn profit on efficiency investments that are comparable to the ones generated by supply investments.

California was the first state to pursue decoupling, and has now revised its program to provide both penalties and incentives for utility performance.[44] This program goes beyond decoupling and cost recovery by allowing the utility to earn profits on efficiency investments just as they would by selling more electricity. The state sets an energy savings goal, and utilities that meet 85 percent of that goal begin to share in the energy savings at a 9 percent rate, which increases to 12 percent if they meet 100 percent of the goal. For example, if utilities achieve 100 percent of the savings goal and save $2.7 billion, then utility shareholders would receive $323 million, or 12 percent of those savings, with the rest refunded to ratepayers.[45] In turn, if utilities fall below 65 percent of the savings goal, they face financial penalties.

Tapping into Renewable Energy Supply

Many states are looking to increase the use of renewable energy resources, for reasons including diversifying supply, lowering price volatility, and reducing greenhouse gases. Clean energy resources for electricity generation are not spread evenly across the states, and are often concentrated in certain regions of the country. However, most states have access to several sources of renewable energy, including biomass, wind, ocean energy, hydropower, solar, geothermal, and combined heat and power (CHP).

Renewable energy relies on fuels that are abundant and low or no cost, limiting generation expenses after accounting for upfront capital. Renewable energy can diversify an electricity portfolio and provide economic development opportunities. It also produces little or no emissions. However, there are challenges to expanding renewable energy use, including the need for new transmission infrastructure to reach remote sources and the need to resolve intermittency problems associated with certain resources, such as solar and wind.

States can enact various policies to increase the use of renewable energy, including Renewable Portfolio Standards, Public Benefit Funds for clean energy, feed-in tariffs, and distributed generation incentives and policies. These policies provide incentives and requirements to increase renewable energy generation and encourage investment in new renewable energy projects.

What is Renewable Power?

Renewable power includes a number of sources, such as biomass, solar, wind, hydro, ocean energy, geothermal, and CHP. Many renewable power sources can be used as central-generation power, such as utility-scale wind farms, hydro-electric plants, or solar thermal plants. In addition, several renewable energy sources are well-suited to perform as distributed generation sources, including photovoltaic solar power (which can be sited on a consumer's roof) and community-scale wind projects.

Renewable Resources

Biomass. "Biomass" refers to plant matter grown for biofuels and biodegradable plant or animal wastes burned to produce energy. Biomass has much lower heat content than fossil fuels—typically one-half to one-quarter the heat content of fossil fuels on a volumetric basis. This low energy density raises biomass transportation costs, which can limit biomass power generation to sites near biomass sources or preexisting biomass collection points for other commercial uses. The U.S. DOE's *Billion Ton* study[46] conservatively estimates that the United States can sustainably produce 1.3 billion tons of biomass per year while still meeting food, feed, and export requirements. It estimates that by 2020 biomass could supply 5 percent of the nation's power requirement and 10 percent of its transportation needs, based on current projected demand.[47] While air pollution emissions controls are often required for biomass combustion, overall greenhouse gas emissions are greatly reduced[48] relative to burning fossil fuels or allowing the biomass to decay. Another use of biomass is in co-firing at existing coal power plants.

Solar. Photovoltaic (PV) power systems convert sunlight into electricity through an electronic process. They work without moving parts, external fuels, noise, or emissions. PV generation is growing: U.S. DOE estimates that solar PV could provide as much as 10 percent of U.S. electricity by 2030. Solar power is clean, abundant, and sustainable; but because of high initial costs, it typically requires policy support and/or incentives to gain wide market acceptance. PV power is generally more expensive than conventional grid power, but prices are dropping as a result of private capital investments together with public and private R&D to drive increased production and system efficiency improvements.[49] Solar technology, however, has been helped by net-metering standards so that PV systems can fairly and safely feed power into the grid.[50] The National Renewable Energy Laboratory's PVWATTS program provides site-specific resource availability of solar energy anywhere in the United States.[51]

Solar thermal power. Solar thermal power is another option for turning the sun's energy into electricity. Mirror-based "power tower" technologies, where hundreds of mirrors reflect solar radiation to a central boiler-generator system, are giving way to concentrating-trough technologies, where long arrays of pipes holding heat-transfer fluid sit in reflective, parabolic-shaped troughs, generating high temperatures for turbine generators that produce power. One study indicated that solar thermal has potential to meet 90 percent of U.S. electricity demand, even accounting for significant increases in the use of electricity for plug-in hybrids and other electric vehicles.[52] The ease of energy storage provides a tremendous advantage for solar thermal, which operates at about 60 percent efficiency compared with PV, at around 10 percent efficiency. The typical application is for hot water for normal direct use, or central generation demonstrated by the recent 64-MW installation in Nevada.[53]

Wind, Ocean, and Hydro. Wind energy turbines transform the wind's kinetic energy into electrical energy; hydroelectric power does the same with moving water. Both wind and water-power technologies can be developed at small scale as distributed energy resources, generating a few kWh, or as utility-scale projects, generating many MW of capacity. Economies of scale tend to favor larger projects; however, there are often environmental concerns with large dams. The large regional variations in availability of wind and hydro resources[54] mean that the scale and cost of projects will be site-specific. A U.S. DOE study found that wind could provide 20 percent of the nation's electricity by 2030.[55] While there is already substantial generation from hydropower resources, there is growing interest in developing wave and tidal energy (hydrokinetic) technologies for electricity,[56] and in increasing capacity at existing hydropower installations around the nation. It is possible for the nation to bring on more than 23,000 MW of new hydro capacity by 2025 through improvements in traditional hydropower and with advanced technologies for hydrokinetic and ocean/wave electricity generation.[57] The Federal Energy Regulatory Commission (FERC) in 2008 noted that hydrokinetic energy, if technology progress continues, could alone increase water power from about 8 percent to almost 20 percent of the nation's electricity generation.

Geothermal Power. Geothermal power production—harvesting the thermal energy emanating from within the earth's crust to make electricity, which powers large portions of countries like Iceland—has recently experienced a burst of interest in the western U.S., where suitable sites exist. Distinct from generating electricity from high-temperature sources, there is growing use of geothermal—or "ground-source" or "ground-coupled"—heat pump (GHPs) systems for individual buildings or campuses. These technologies use the moderate ambient ground temperatures as a heat source in the heating season and as heat sinks in the cooling season. While they still use grid-supplied electricity, GHPs show much higher efficiencies than conventional electric or fuel-based heating and cooling systems. Their capital costs are higher, however, because of the need to install in-ground heat-exchange loops. Using heat-mining technology to tap engineered geothermal systems (EGS), which are reservoirs designed to produce heat for baseload generation, one recent Massachusetts Institute of Technology study indicated geothermal energy could produce 100,000 MW of electricity by 2050.[58]

Combined Heat Power (CHP). CHP is a specific form of DG, which usually places electric power generating units at or near customer facilities to supply on-site energy needs. CHP enhances the advantages of DG by the simultaneous production of useful thermal and power output, thereby increasing overall efficiency. In **Connecticut** and **North Carolina**, which have implemented policy changes targeting CHP, new market segments are developing around CHP applications, which are producing "green collar" jobs. At the same time, overall energy efficiency and reliability are improving as power generation emissions are reduced.

U.S. DOE has evaluated an integrated CHP application where a gas-fired five-MW turbine recycles waste exhaust heat to produce steam to supply process heating. It found a 153 percent improvement in total efficiency, a 36 percent reduction in nitrogen oxide (Nox) emissions, and a 47 percent reduction in CO_2 emissions when compared with conventional energy. By using landfill gas, anaerobic digester gas, or biomass gasification instead of natural gas to fire the CHP plant, the CO_2 emissions are reduced to zero.[v]

Benefits of Renewable Energy Supplies

The use of clean energy reduces air pollution and greenhouse gas emissions, improves the reliability of electricity through a diversified portfolio, and improves the economy as new technologies are developed and brought to scale. Clean energy investments can mitigate the impacts of rising energy prices, generate lower economic costs, and may even yield a small net economic benefit for the local economy.[59]

A number of sources of renewable energy are abundant in regions across the country and are increasingly cost competitive. For example, a report that examined a scenario under which wind power would provide 20 percent of U.S. electricity supply by 2030 found that although capital costs for new wind generation would be slightly higher than a business as usual scenario, using wind as fuel would result in $155 billion less in fuel expenditures.[60] Solar photovoltaic systems have declined in price every year since they were introduced into the market.[61] Many states are energy importers and send billions of dollars out of state to fuel producers. Increased use of clean energy produced in state could keep more money in-state and provide economic development and jobs.[62]

While the nation's energy supply for electricity is, for the most part, delivered from central station power plants through the electricity grid to the end user, there has been renewed interest in promoting distributed generation. Distributed generation technologies, such as solar photovoltaic, small-scale or community wind projects, and CHP, do not rely on the transmission infrastructure to deliver power. The advantages of distributed generation include improved reliability and greater consumer control over power production. Distributed generation also enhances reliability for the conventional power distributors because the excess power dispersed by these small-scale projects can be tied back into the electricity grid.[63]

Distributed generation technologies offer ways to improve system efficiency as well as reliability. CHP systems, one of the most common forms, can achieve thermal efficiencies of 70 percent or higher by using both the electrical and thermal output. It can also reduce transmission and distribution losses by siting the generation source at or near customer locations. And if distributed generation is sited in areas where transmission or generation capacity is limited, these facilities can support system reliability by relieving transmission congestion and reducing the outage risks. Distributed resources also can reduce wholesale power prices by helping meet peak demand.

Challenges for Renewable Power

While renewable power offers many benefits, there are challenges to bringing it to utility scale and using it for baseload power. From a financial standpoint, renewables provide a different business model where the primary expense is upfront capital, with little to no fuel cost compared with fossil-fueled plants, although they are still not conventionally economic except in niche applications. Renewables provide a fixed investment not affected by fuel price fluctuations, greenhouse gas outputs, or other environmental impacts. Nevertheless, transmission issues and intermittency are the leading challenges to wider use of these power sources.

[v] A useful overview of power technology selections for CHP specifically, and DG in general, is provided by U.S. EPA's *Catalog of CHP Technologies*, http://www.epa.gov/chp/documents/catalog_of_ percent20chp_tech_entire.pdf, and its Biomass Combined Heat and Power Catalog of Technologies, http://www.epa.gov/chp/documents/biomass_chp_catalog.pdf. See more about the wide application of boilers in Oak Ridge National Laboratory's *Guide to Combined Heat and Power Systems for Boiler Owners and Operators,* http://cibo.org/pubs/ornl-tm-2004-144.pdf. The use of DG technologies in the utility grid is covered in the Interstate Renewable Energy Council's *Interconnection Guide*, http://www.irecusa.org/fileadmin/user_upload/ConnectDocs/IC_Guide.pdf, and in its monthly newsletter. These technology-focused documents provide "how to" details on the advantages of CHP, renewable fuels, and energy efficiency. The publications provide solid "best practice" guidance on the financial and technical requirements for implementing CHP.

Transmission

While the current electricity transmission grid was set up to move power from coal, nuclear, and natural gas plants to end users, renewable sources such as wind and solar are often captured in more remote areas distant from major load centers. This means new transmission capacity will be needed to bring power to the major load centers and, ultimately, to end users.

Getting new renewable projects sited, permitted, and interconnected to the grid can be challenging, involving a complex set of federal, regional, state, and sometimes even local jurisdictions. Getting consensus on how the costs of new transmission are allocated, especially on large multi-state transmission lines, can be difficult. Before construction or installation can begin, most clean energy projects need approval and permits for the desired site. For larger power facilities, this can involve a myriad of environmental and other permits from federal and state agencies, as well as local approvals. The siting process for large power plants is typically time-consuming and expensive. State or federal permitting processes are typically more predictable than local ones. However, state/federal permitting may also require extensive impact studies, lengthy reports, and time-consuming review and public consultation processes.

Local siting approval may engender a different set of problems. Projects often require a zoning variance, or the development of a special ordinance that then calls for a conditional- or special-use permit. This latter situation can lead to unpredictable outcomes: In some cases, local stakeholders may be supportive, based on the promise of new tax revenue and economic development; in other cases, vocal opponents may slow progress or enact an ordinance that effectively prohibits the project. The American Wind Energy Association's *Siting Handbook*[64] provides a state-by-state guide to siting and permitting issues. While focused on wind projects, it represents the kinds of issues many clean energy projects typically face.

Distributed generation may require fewer and less involved permit processes compared with siting larger, centralized electricity generation. A home or small business solar PV system, for instance, often requires only a local building permit to begin installation and an inspection to start operation. In some instances, a zoning variance or conditional-use permit is a prerequisite to obtaining a permit. However, residential systems may also run afoul of local covenants and ordinances that prevent homeowners from making certain alterations to their property. In response to this, 16 states currently have renewable energy access laws that prevent such restrictions, and 20 other states allow easement agreements to remove impediments to system operation. Many of these laws specifically refer to solar energy systems, but a few protect wind energy systems as well. For more information, see the Database of State Incentives for Renewables and Energy[65] and (NREL's) Renewable Energy *Consumer Guides*.[66]

Gaining affordable and timely access to the power grid is key to the viability of clean power projects. The particulars of connecting to the grid, however, differ based on the size and type of project. FERC handles interconnections to transmission lines at the wholesale level, which typically affects larger power plants at higher voltage levels, while distribution-level interconnections are handled at the state level. FERC has adopted interconnection standards for generators smaller than 20 MW, but these only apply when a facility must connect to the transmission system.

Intermittency

Another challenge is using certain renewables for baseload electricity, which has to be predictably available to meet demand. While hydropower, biomass, ocean power and geothermal are capable of being used as dispatchable baseload electricity, solar and wind—though renewable, fast growing, and of great potential—are only as predictable, or dispatchable, as tomorrow's weather report. That does not mean that these substantial resources cannot produce baseload electricity, it means that baseload dispatch is predicated on future weather patterns and the availability of generation resources. NREL and others[67] have studied the dispatch issue and modeled coordinating direct dispatch as well as shifting solar and wind production to energy storage, such as compressed air and pumped storage systems that can be tapped during peak demand periods.

Policies to Deploy Renewable Energy Resources

States have several policies to consider to directly promote clean and renewable electricity generation, including the following:

- Renewable/clean energy standards;
- PBFs for clean energy;
- Feed-in tariffs; and
- Distributed generation incentives and policies.

Additional policies involving transmission and distributed generation to support clean electricity generation will be discussed later in this chapter.

Renewable/Clean Energy Standards. Renewable/Clean Energy Standards, more commonly known as Renewable Portfolio Standards (RPS), require that a certain percentage of a utility's new generating capacity or energy sales derive from renewable resources. RPS are typically set in percentage terms with target dates; for example, 20 percent of electricity sales must come from renewable energy by the year 2020. Currently, 26 states have an RPS. An additional six states have nonbinding Renewable Portfolio Goals (RPG).[68] Most states include provisions for RPS-compliant power to either be produced directly by the utility, or to be purchased in the form of Renewable Energy Certificates (RECs). Some states require that the RECs be produced within the state, while others allow out-of-state RECs to count toward the goal, as long as they are generated within the regional power market.

To ensure that an RPS promotes renewable energy development as early as possible, most states include interim-year goals before the final compliance year. Since regulatory commissions usually require utilities to acquire energy resources on a least-cost basis, utilities may try to satisfy their full requirements through contracts with a few large-scale wind farms. To encourage a more diverse set of resources, 13 states have now adopted separate "carve outs," or set asides within their RPS policies, specifically for solar or other forms of distributed generation that may otherwise be left out.

Minnesota's RPS, enacted in February 2007, classifies the following energy sources as renewable: solar thermal electric, PV, landfill gas, wind, biomass, hydroelectric, municipal solid waste, hydrogen, co-firing, and anaerobic digestion. The RPS requires that 30 percent of energy produced by Xcel Energy, a major state energy provider, must be from renewable sources by the end of 2020. Wind power must make up at least 25 percent of the 30 percent mandate. Other Minnesota utilities have an RPS goal of 25 percent renewable energy by 2025. The Minnesota Public Utilities Commission (PUC) regulates the utilities, making sure they are meeting the RPS goals. Utilities must make a "good-faith" effort to achieve their set RPS goals. The PUC can impose a financial penalty for noncompliance of an amount not to exceed the cost of complying with a prescribed action. State law also requires the PUC to create a system of tradable renewable energy credits to be used by utilities.[69]

In 2004, **Pennsylvania** created its Alternative Energy Portfolio Standard (AEPS), which requires that electric distribution companies and generation suppliers provide in-state customers with energy supplied by 18 percent alternative energy sources by 2020. The AEPS also requires that an additional 0.5 percent of the state's electricity demand come from solar photovoltaic sources. The legislation creates a two-tiered system for categorizing the sources of renewable and alternative energy such that 8 percent must come from Tier I and 10 percent must come from Tier II. Tier I-eligible resources include solar thermal, wind, low-impact hydro, anaerobic digester gas, landfill methane, qualifying biomass, fuel cells, and coal mine methane. Tier II-eligible resources include waste coal, qualifying distributed generation, demand-side management (including energy efficiency), hydropower that doesn't qualify as low-impact, municipal solid waste, biomass, and IGCC. The legislation also sets two alternative compliance payment (ACP) standards of $45 per MWh for non-solar photovoltaic and 200 percent of average market value for solar.[70]

New Jersey has established a RPS that requires electricity suppliers and providers to get 22.5 percent of their energy from certified renewable sources by 2021. Solar electricity must make up 2.12 percent of the 22.5 percent. New Jersey's RPS has two categories of renewable sources: Class I and Class II. **Maryland's** RPS also is two tiered. By 2022, 22 percent of the state's energy must come from Tier 1 renewable sources, 2 percent of which must be solar. Tier 1 renewable sources include solar; wind; geothermal; energy from waves, tides, currents, and thermal differences; qualifying biomass; and methane from the anaerobic decomposition of organic materials in landfill or wastewater treatment plants.[71]

Public Benefit Funds. PBFs are currently used to support renewable energy in 16 states.[72] These funds are frequently the most significant source of financial assistance for renewable and other distributed energy projects. Fund specifics vary, but typically a PBF generates income from a small, universal charge per kWh or per account on electricity bills. Sometimes this is also extended to natural gas utilities, such as in **Wisconsin** and **Michigan**, although this is not as common. The surcharge is typically quite small—a few "mills" or tenths of a cent per kWh but annual fund revenues can total in the hundreds of millions in the aggregate.

For clean energy projects, PBF funds are most often used for direct rebates and other incentives. States have, however, used PBF dollars to support production payments, loan programs, research and development (R&D) grants, demonstrations, industrial recruitment incentives, technical assistance, and training. **California's** PBF, for example, funds several incentive programs for renewable energy and energy efficiency, in addition to R&D. Because a primary goal for a PBF is often to develop an industry capable of sustaining itself without subsidies, an effective renewable PBF sets total funding levels high enough to transform the market.

Clean energy markets require development on many fronts, not just funding for individual projects. Supporting technical education, professional certification, manufacturing capacity development, and other facets of a developing market are essential. Ideally, states use the fund to support a diverse portfolio of initiatives in a variety of sectors and technologies, but maintain the flexibility to act on market conditions and emerging opportunities. The **New York** State Energy Research and Development Authority (NYSERDA), for example, regularly issues program opportunity notices (PONs) targeting specific energy applications within certain industries. NYSERDA also provides technical assistance on some projects and supports the development of renewable energy equipment manufacturers within the state.

Effective PBFs also offer consistent incentives over the long term, thus avoiding "boom-and-bust" cycles. Market experience shows that clean energy industries develop best when governments provide clear market signals over an extended period. Many states authorize PBFs for five- to 10-year periods to accommodate this reality. Programs funded by PBFs should also maintain continuity. Potential participants should not fear an abrupt halt to the program and be able to trust that the funding will remain. For instance, the **California** Energy Commission's Emerging Renewables Program, which is funded through the state PBF, has been in operation since 1998.

Early experiences with PBFs demonstrated the risk of budgetary transfers that expropriate funds for other purposes. When state budgets get tight, officials are tempted to divert clean energy funds for emergency relief. Some states have avoided this by contracting out PBF administration. Vermont's funds for energy efficiency, for example, are held by the **Vermont** Energy Investment Corporation (VEIC), an independent nonprofit organization that administers the state's efficiency programs. Other states have looked to establishing legislative language that prohibits such transfers.

Feed-In Tariffs. These mechanisms set pre-established purchase rates per kWh for power from designated sources, which can be higher than other sources of electricity. They require electric utilities to purchase electricity from these sources at the stipulated rates, and typically set an extended time period for the rate. The rate usually varies by resource type, depending on the price needed to make a clean energy resource competitive with traditional resources. The concept behind feed-in tariffs drove the development of power purchase rates for nonutility generators under the Public Utility Regulatory Policies Act (PURPA) of 1978. States used various methodologies to develop rates that were then binding on utilities to pay qualifying facilities and were based on the "avoided cost" of new incremental generation. In this decade, feed-in tariffs are widely used in Europe, but are just beginning to reemerge in the United States. The methods used to develop these newer tariffs are typically less strictly linked to the avoided-cost methods used under PURPA, but in the larger sense have the same intent—to support the development of clean energy resources.

States are beginning to experiment with feed-in tariffs of various sorts—there is as yet no comprehensive compendium of these efforts. **Georgia** Power Company offers a special tariff for residential solar PV systems. **California** adopted a new feed-in tariff in 2008, though it was a measured approach with a limit set on the total power capacity.

Washington provides tax incentives for renewable energy production by consumers at a base rate of $0.15 per kWh, which is then adjusted at a rate based on the mode of electricity production, which includes solar, wind, and anaerobic digesters. The incentives are limited to $2,000 per year per customer. The state's utilities earn credits by paying the incentives. The total credits earned by a utility are limited to .25 percent of the utility's taxable power sales, or $25,000, whichever is greater. The payment of incentives to customers ends June 30, 2014.[73]

The feed-in tariffs used in Europe, and in Germany in particular, have shown great success in advancing the solar industry through their simple design and especially the use of high incentive rates. Consumers know exactly how much the utility will pay them for the electricity they produce, and those prices are guaranteed for a set amount of time. This simplifies economic calculations and provides predictability while improving project financial profiles.

Distributed Generation Incentives. States also have a role to play in providing incentives for clean distributed generation. This can include offering financial incentives, such as in **California**, which has developed the Million Solar Roof Initiative, which aims to install PV solar panels for 1 million homes and businesses by 2018. Through the initiative, homeowners and businesses are provided financial incentives—in the form of rebates over time—to install distributed solar energy generation capacity.[74] State programs can also help promote distributed generation, as in **Minnesota**, which has a Community-Based Energy Development (C-BED) program to encourage the development of community-scale wind power generation. Utilities required to meet the state's RPS also must make a good-faith effort to incorporate C-BED projects.[75] The utilities must also offer C-BED projects front-loaded tariffs to assist with the upfront costs of wind power generation.

Aside from financial and program support, two other key state policies that enable wider use of distributed generation are net-metering and interconnection standards. Net-metering programs serve as an important incentive for consumer investment in renewable energy distributed generation. Net-metering allows customers who generate their own electricity to get credit for any excess over their immediate needs. This allows electricity customers to offset the cost of utility-supplied electricity by selling the power generated at their homes or businesses back to the utility.

Despite the fact that 42 states plus the District of Columbia[72] now offer varying degrees of net-metering, several policy challenges continue to hinder the effectiveness of these policies. To begin with, eligible customers and renewable technologies are narrowly defined. There are additional requirements and fees for customer-generators. In some areas, financial incentives to overcome the high first cost of renewable technologies do not exist. Such programs are often not advertised to potential customer-generators.

States could take a number of steps to encourage customers to exercise net-metering options where they exist; particularly, allowing all customer classes to net-meter using a wide variety of renewable technologies.

California and other states have prohibited utilities from tacking on demand charges, standby charges, customer charges, minimum monthly charges, interconnection charges, or other charges that would increase an eligible customer-generator's cost beyond those of other customers.

Another potential hindrance to widespread net-metering is a lack of promotion. Potential customer-generators simply do not know of this option. States should be sure their utilities' net-metering programs are well publicized and that additional information and program materials are readily available.

State governments are also taking the following other steps to advance the effectiveness of net-metering:

- **Simplify Interconnection Standards**—Reduce unnecessary (redundant) safety requirements such as external disconnect switches and additional liability insurance.
- **Streamline Application Processes**—Require utilities to respond promptly to customer applications. Disallow excessive customer application fees, special charges, or tariff change fees.
- **Allow Banking of Excess Generation**—Allow periodic banking and reconciliation of net-excess generation.
- **Allow Customers to Own Renewable Energy Certificates (RECs) and Carbon Credits**—This allows customers to retain the value of these credits and trade them separately from the power sold back to the utility.
- **Define Eligible Technologies Inclusively**—Allow all renewables (and CHP) to be eligible for net-metering.
- **Require Broad Participation**—Create statewide rules that require all utilities to adopt net-metering and allow all customer classes to participate.

States that have not yet explored net-metering policies should also consider tax incentives, utility rebates, and other financial incentives to complement net-metering policies.

New Jersey legislation extends net-metering to large commercial and industrial electricity customers, as well as to residential customers. Customers must use a Class I renewable energy source (e.g., wind or solar photovoltaic energy) as defined by the New Jersey Board of Public Utilities (BPU) to be eligible for net-metering. The electric energy provider credits the customer-generator for any energy produced in excess of the amount used by the customer-generator in a given billing period. The customer-generator is afforded several options to collect energy credits at the end of an annualized period. The customer-generator can receive the avoided wholesale cost of power, the real-time locational marginal pricing rate, or enter into a bilateral energy purchasing agreement with the energy provider. The new legislation gives the BPU the authority to allow the power providers to cease net-metering once customer-generated power equals 2.5 percent of the state's peak energy demand.[77]

Many states have adopted separate interconnection standards for small generators that are not subject to FERC oversight (i.e., those connecting to the distribution system, typically at lower voltages). States frequently set limits on individual systems and/or aggregate capacity that may apply under the standardized rules, while also providing simplified rules and reviewing requirements for small systems (although definitions vary). Therefore, in some states, a home PV or wind system may be subject to a less complicated process than a system that has a larger potential to impact grid operation and safety.[78]

States can expedite these processes by taking the following actions:

- Consolidate and streamline state permitting and siting processes through a single agency.
- Prioritize designated clean energy technologies in siting and permitting processes, including committing to fixed time periods for state review.
- Streamline state interconnection standards and procedures that require reasonable and fair time frames and costs for utility interconnection procedures. For example,
  - Limit interconnection fees to reasonable levels proportional to the project's size;
  - Set simple "plug-and-play" rules for residential-scale systems;
  - Set expedited procedures for larger systems.
- Set fair and reasonable standby and supplemental electricity rates for distributed generation.
- Enact legislation and/or regulations that standardize and limit local processes that can be used to unreasonably obstruct clean energy project development.

Ohio's interconnection standards incorporate many of these principles. The standards have three levels of review for distributed generation systems: up to 10 kWh, up to 2 MW, and up to 20 MW. Utilities must provide applicants with a standard agreement and may not require additional liability beyond proof of insurance. The excess electricity produced by a customer is credited by the utility at that utility's unbundled generation rate. The customer-generator can request a refund of the collected credits over a 12-month period.[79] **Massachusetts** offers fast-track permitting for new clean and renewable energy project proposals, including expedited environmental reviews and permitting, and negotiated alternative permitting fees and timelines.[80]

Advanced Clean Generation from Coal, Natural Gas, and Nuclear

While states are working with utilities and others to deploy energy efficiency and renewable power to meet growing consumer and industry demand, the United States still relies on coal, natural gas, and nuclear power to meet the majority of its electricity needs and will continue to do so for the foreseeable future.

Each of these traditional electricity sources comes with a set of advantages and challenges. Coal is low cost and domestically plentiful but emits significant quantities of greenhouse gas. Natural gas plants can be brought on- and offline quickly, making them ideal for peak power generation, but natural gas prices have been rising as supplies tighten, and it is still a significant source of greenhouse gas emissions. While nuclear power generation does not emit any greenhouse gases, it faces persistent cost and waste disposal concerns.[81] States and others are actively engaged in technology and policy efforts that are directed toward producing traditional energy supplies in cleaner ways.

Advanced Clean Coal

America relies on coal to meet half of its electricity needs. While future coal's abundance in the United States has long afforded Americans a low-cost source of electricity, current and possible climate change regulations mean that continued reliance on coal will likely require advanced technologies. These technologies hold promise—but pose new challenges—for the future of coal-fired power generation. States are addressing policy and technical issues related to advanced clean coal, especially carbon capture and storage (CCS) that separates the CO_2 from power plant emissions and stores it safely underground.

Benefits of Coal-Generated Electricity

Coal is an abundant resource in the United States and has played a key role in meeting the nation's energy needs—the estimated recoverable coal reserves in the United States can supply 250 years of electricity at current consumption levels.[82] Nearly two-thirds of these reserves are located in the western states of **Colorado**, **Montana**, **North Dakota**, **Texas**, **Utah**, and **Wyoming**; large deposits also exist in **Ohio**, **Pennsylvania**, **West Virginia**, **Indiana**, **Kentucky**, and **Illinois**.

Because of its abundance, coal prices are relatively stable and provide electricity at a cost of between $1 and $2 per British thermal unit (BTU) compared with $12 per BTU for natural gas. Even with costly air pollution control systems, coal prices remain competitive with other traditional energy sources and, in most cases, are less expensive than renewable energy or natural gas. Energy security concerns have also contributed to a renewed interest in coal, both for power generation as well as for liquid fuels.

Challenges Facing Coal-Generated Electricity

While coal supplies are abundant, relatively low cost and secure, coal also produces considerably more greenhouse gas per kWh compared to other fossil fuels. In 2004, coal-fired power plants emitted almost 2 billion tons of CO_2, which was nearly one-third of all U.S. CO_2 emissions. A single coal plant can emit 5 to 6 million tons of CO_2 into the atmosphere on an annual basis.

Recognizing the increased risks for new coal plants given the uncertain regulatory environment, a group of investment and banking entities have established a set of carbon principles. These are voluntary criteria to add to the due diligence of building traditional coal-fired plants and to illustrate the impact potential future carbon dioxide emissions regulations are having on current electric power sector investments.[83]

Plans to build new coal plants have come under increased scrutiny in a number of states due to expected future costs, regulatory risks or environmental impacts. In October 2007, a **Texas** utility entered into an agreement not to build eight of the 11 planned coal-fired power plants. The **Kansas** Department of Health and Environment denied the permit for two coal-fired power plants. In June 2007, the **Florida** Public Service Commission denied a petition for approval of two coal-fired power plants. In February 2007, the **North Carolina** Utilities Commission rejected one of two proposed coal-fired power plants to be built.

One immediate approach to cut coal's CO_2 footprint is to improve efficiencies at current coal facilities. Although plant modifications can be expensive, the World Energy Council and others have shown that there is significant opportunity to reduce emissions by improving plant operation and transmission efficiencies. Emissions benefits can be achieved from greater plant performance monitoring; improved heat-rate optimization for coal-fired generation; and the addition of advanced controls, new turbines, and other capital modifications.

For these reasons, a diverse set of environmental, industry, and other stakeholders are supporting efforts to retrofit coal-fired power plants with CO_2 emissions separation and sequestration technology. Several new combustion technologies are being explored that can support CCS technologies, including critical and supercritical pulverized (SPC) coal and Integrated Gasification Combined Cycle (IGCC); hybrid concepts that utilize fuel cells and combustion turbines to achieve greater efficiencies are also being looked at.

Carbon Capture and Storage. Due to existing state and potential future federal carbon regulations, many experts believe that CO_2 emissions from coal must be reduced significantly for it to remain a viable future source of electricity. This will likely require some form of CCS.

Carbon Capture and Storage: Technology Options for Coal-Fired Power Plants

As noted above, CCS is an industrial process that separates CO_2 from power plant emissions through the subsequent recovery of a concentrated stream of CO_2 that is safely stored away from the atmosphere. There are two main methods of carbon capture. The first, CO_2 capture from flue gases, begins with conventional pulverized coal plants burning coal with air to produce steam. CO_2 is exhausted in the flue gas at a concentration of 10 to 15 percent by volume. The post-combustion capture of CO_2 is challenging due to low pressure and diluted concentrations, which require treating high volumes of gas and greatly increase the size and cost of the equipment.

Aqueous amines are the state-of-the-art technology for CO_2 captured from pulverized coal power plants. Research shows that CO_2 capture and compression using amines raises the cost of electricity from a newly built supercritical pulverized coal power plant by 84 percent. Since the goal for advanced capture technology is to increase the levelized cost of electricity by no more than 20 percent, amines technology is not yet competitive.

Oxygen-rich combustion ("oxy-combustion") of coal uses pure oxygen diluted with recycled CO_2. Oxy-combustion not only produces a concentrated stream of CO_2 for capture, it can also reduce NOx and mercury emissions. Oxy-combustion's key process principles have been demonstrated commercially, including air separation and flue gas recycling. Producing the pure oxygen for this process is expensive, but novel oxygen separation techniques, such as ion transport membranes and chemical looping systems, could reduce costs to the point that oxy-combustion could become competitive.[84]

The second technology in use today is CO_2 separation from coal-derived gas. IGCC offers the potential both for higher power plant efficiency and reduced costs of CO_2 emissions control. IGCC starts with the raw fuel, converts it to gas through a chemical refining process, and separates the CO_2 and other pollutants from the energy-containing gaseous fuel. The gasified fuel is then burned in turbine systems similar to those used in combined-cycle gas turbines today. The CO_2 produced in IGCC processes is concentrated and at high pressure; these conditions permit lower-cost CO_2 capture using a glycol-based sorbent.

Benefits of CCS. A 2005 IPCC *Special Report on Carbon Dioxide Capture and Storage* concluded that CCS technology can capture up to 90 percent of CO_2 in large-scale applications and that effective storage of CO_2 can contribute to 55 percent of the total emissions reductions scientists say are necessary to achieve climate stabilization.

An MIT study,[85] *The Future of Coal*, reports that without carbon capture, capital costs are higher for IGCC than pulverized coal (PC) plants. However, while incorporating CCS into either an IGCC plant or a PC plant increases construction costs, it is estimated to be less costly to include CCS technology with an IGCC plant than with a PC plant. In addition, the cost of electricity generation from an IGCC plant with CCS is estimated to be less than from a PC plant with CCS, in part because the capture requires less energy when the carbon is already in a concentrated form, as it is with IGCC. Furthermore, the MIT report estimates that with a carbon price of $30 per ton, CCS equipped plants would be cost-competitive compared to plants without CCS.

Challenges of CCS. While industry has experience with capturing CO_2 and injecting it underground for enhanced oil recovery, there is not long-term experience with sequestration. To fully address greenhouse gas concerns, CCS will need to demonstrate the ability to permanently and safely store CO_2 underground. There is not currently a large-scale demonstration of permanent CO_2 sequestration, and concerns remain over legal liability if the CO_2 should escape storage and cause harm to human health or the environment. In this situation, there is a regulatory vacuum. The permitting, monitoring, liability, and property rights issues associated with CCS can be complex.[86] How governments and competitive markets manage the expense and liabilities of handling large quantities of CO_2 gases has yet to be determined on a large scale. [87]

State Action on Advanced Coal with CCS

While effective CCS can help to reduce carbon footprint, it comes with a series of interwoven technical, regulatory, and legal challenges. Research shows that CO_2 capture and compression raises the cost of electricity from an IGCC plant by about 25 percent. Moreover, the recent cancellation of the U.S. DOE FutureGen project—a demonstration-scale IGCC plant with CCS that was to be built in **Illinois** —has created a need for states to explore pilot and demonstration opportunities using clean advanced coal technologies on their own. While CO_2 has been captured and sequestered at oil production facilities, only one near-commercial demonstration of CCS at a coal power plant is planned in **Texas**. However, several federal programs, overseen by U.S. DOE and U.S. EPA, are funding laboratory-to-pilot-scale research projects. U.S. DOE recently awarded six sequestration partnership grants, including more than $126 million for CCS tests in **California** and **Ohio**.

Efforts are also underway in other places to address the regulatory and policy challenges of CCS. **Indiana**,* **Illinois**, **Iowa**, **Kansas**, **Michigan**, **Minnesota**, **Ohio**,* **South Dakota**,* **Wisconsin**, and Manitoba have agreed a regional regulatory framework for liability issues relating to CO_2 storage by 2010 as part of the Energy Security and Climate Stewardship effort.[vi] **North Dakota** has statutes in place that permit transport of CO_2 and has one large commercial pipeline in place to support the Dakota Gasification project that transports CO_2 for use in enhanced oil recovery.

States such as **Montana** and **Wyoming** are also developing regulatory frameworks and regional partnerships to address carbon capture, transport, and storage from coal plants, and are pursuing technological developments that will aid in cleaner energy production.[88] **Wyoming** has created a framework to advance the use of CCS by establishing a subsurface pore space that is used for the sequestration of CO_2 and belongs to surface owners. The state has also established the conditions under which the property rights of the subsurface strata can be transferred to another entity.[89] It also addresses oversight authority and permit-issuing guidelines for CCS. The Wyoming Department of Environmental Quality (DEQ) sets regulation standards for long-term geological storage of CO_2 and issues permits for pilot CCS programs. The DEQ director is required to recommend changes to Wyoming's law to promote equivalency and consistency with federal regulations, once they are established.[90] Additionally, Wyoming has identified several large-scale sequestration sites that have proper receiving geology as well as demonstrable caps and seals. The largest of these is the Rock Springs Uplift, which appears capable of sequestering 10 to 20 billion tons of CO_2.[91]

CCS holds considerable promise for achieving the necessary balance between the need to reduce CO_2 emissions and the importance of having affordable, secure energy supplies. According to the International Energy Agency, CCS is second only to energy efficiency in the potential to reduce CO_2 in a cost-effective manner.[92] However, given the uncertainly, states should still consider a broad portfolio of energy resources when addressing their future energy needs.

Natural Gas

Most natural gas is extracted from gas and oil wells. In the 1990s, around 90 percent of newly installed electricity capacity came in the form of natural gas plants. Of this, about one-third is for residential and commercial use, one-third is for industrial use, and one-third is for electric power production.

Benefits

Gas turbines have the advantage of being scalable; turbines can be built in sizes ranging from 25 kW to 100 MW or more. At times of high energy demand, these plants can also be brought online and into production rapidly, making natural gas a good option during times of peak power demand. Natural gas is also an attractive fuel for electricity generation because it produces the least amount of greenhouse gas emissions of any fossil fuel.

Challenges

Despite its flexibility and emissions benefits, natural gas faces price and supply constraints because it is used for heating and other applications aside from electricity generation. Volatile and rising natural gas prices have posed challenges to industry and consumers and led many experts reconsider the use of natural gas for electricity generation. U.S. natural gas reserves are only approximately 8 percent of the world's supply, and while the United States already imports natural gas, increasing consumption of natural gas could lead to greater reliance on imported natural gas.

Policy

In states examining climate policies, increased generation from gas may be an attractive option. **California's** climate change legislation requires that in all new long-term contracts for generation, the power source must be at least as clean as a new combined-cycle natural gas plant.[93] **Vermont's** State Climate Change Action Plan recommends the expanded use of natural gas where it is cost effective and can replace other fossil fuels as an energy option in the transition to cleaner and renewable resources.

In **New York**, natural gas plays a critical role in meeting peak winter heating requirements and is a cleaner alternative to oil heating for homes and business.

Nuclear Power

Like natural gas, nuclear power provides approximately 20 percent of the U.S. electricity demand. Although the United States has the most nuclear capacity of any nation, no new commercial reactor has come online since 1996.

Benefits

Nuclear energy production emits no carbon emissions at the plant site, although studies show that CO_2 is emitted from mining and processing uranium, and in the transportation and storage of spent fuel.[94] Also, there is ample available domestic fuel; U.S. uranium ore reserves were estimated at about 890 million pounds, and are located primarily in **Wyoming** and **New Mexico**. Partially because of the inexpensive fuel, once built, a nuclear power plant is among the cheapest sources of electricity. Since 1987, the cost of producing electricity from nuclear plants has decreased from 3.63¢ per kWh to 1.68¢ per kWh in 2004.

The current generation of light-water reactors, known as Gen II systems, use traditional "active" safety features requiring electrical or mechanical systems to be available on command. However, industry leaders believe that new advanced systems will expedite reactor certi-

[vi]*Indiana, Ohio, and South Dakota are observers in the process of forming a regional cap and trade agreement.

fication review processes and shorten construction schedules. The new generation of reactor designs, know as Gen III and Gen III+, typically use "passive" safety features that do not require systems to engage or operators to intervene, relying on gravity or natural convection or other forces to sustain reactor safety. Other improvements include removing water circulation pipes that could rupture and accidentally drain water from the reactor, exposing the fuel rods to a potential meltdown, as well as fewer pumps to move the water through the system.

Gen III and Gen III+ reactors are also designed to achieve higher fuel burn-up, reducing spent fuel waste and increasing plant lifetimes to as many as 60 years.[95] This new generation of reactors has been under development since the 1990s, drawing on the operating experience of American, Japanese, and Western European reactor fleets.

Challenges

The largest question with nuclear power is the still-unresolved issue of disposal of spent fuel and contaminated waste, especially long-lived radioactive waste now stored on site at each of 31 states with nuclear power capacity. The Yucca Mountain Repository, located in **Nevada**, is the U.S. DOE's proposed repository for spent nuclear reactor fuel and other high-level radioactive waste. It has remained closed due to regulatory, geological, and cost uncertainties.

Nuclear power plants are also expensive to license and build due to costly reactor technologies, construction and siting considerations, and growing security costs. New plants may cost as much as $5,000 to $8,000 per kW.[96] Future siting and licensing decisions for new nuclear projects may be affected by new reactor technologies' success in passing federal and state safety reviews, the availability of stable financing for new plant construction, and other criteria. States must also address the future decommissioning costs of nuclear reactors. These uncertainties create both real and perceived risks in financial markets and for investor-owned power companies, which can limit the pool of willing investors and increase the cost of capital for nuclear projects.

Policy

Despite cost and waste issues, the new generation reactors, along with growing demand for clean power, have sparked a renewed interest in nuclear power at the state level. According to the Nuclear Regulatory Commission, 29 new reactors are now under consideration and application licensing and re-licensing permit have been filed for nuclear plants in several states.

While states have a limited role in new reactor design, those with reactors are addressing policy and regulatory barriers to plant development. **Mississippi**, which receives one-quarter of its power from nuclear energy, is one of the candidates for a new nuclear power plant. Mississippi Governor Haley Barbour discussed the importance of new, advanced nuclear energy development in his 2008 State of the State address.

New laws in **Florida**, **Georgia**, and other states allow utilities to recover plant pre-construction costs from ratepayers. In Florida, both state utilities, Progress Energy and Florida Power and Light, have plants under development. Progress Energy projects that its new plants will cost at least $14 billion. Progress Energy expects its customers' bills to increase no more than 4 percent annually during construction and calculates that the new nuclear plants will save ratepayers more than $1 billion a year when they come online in 2016.

Steps to Clean and Efficient Electricity

This guide reviewed a number of policies and programs that states can consider to make their electricity mix more diverse and their economies more energy efficient. A summary of legislative, regulatory, or programmatic actions that governors can employ to move their states toward cleaner and more efficient electricity use follows.

- Support thorough and well-informed electricity planning that seeks a diverse resource mix, prioritizes cost-effective efficiency and clean generation, and integrates complementary greenhouse gas emission reductions policies that the state may have adopted.
- Promote efficiency and conservation through—
  - Energy efficiency resource standards that set long-term goals for electricity savings;
  - State-of-the-art building energy codes and appliance efficiency standards; and
  - Utility rates, regulations, and incentives to remove barriers to utility energy efficiency programs and to attract investors.
- Promote renewable energy through—
  - Renewable Portfolio Standards that set long-term goals for renewable power generation;
  - Incentives for renewable distributed generation, such as direct rebates to end users and net-metering provisions allowing customers to sell excess electricity back to the grid at reasonable rates;
  - Interconnection standards that facilitate transmission capacity for new and remote renewable electricity generation; and
  - Feed-in tariffs, which provide market certainty through pre-established purchase rates per kWh for power from designated sources.
- Develop regulatory frameworks and incentives for advanced coal with carbon capture and storage that offer clear guidelines concerning stakeholder rights and liabilities and long-term monitoring rules and promote necessary pilot and demonstration programs.
- Set up long-term funding sources for efficiency and clean energy programs through Public Benefit Funds, performance contracting, and proceeds from greenhouse gas emissions allowance auctions in states with cap-and-trade markets.

Tapping efficiency, increasing renewable generation, and working to expand cleaner traditional energy sources will require significant investments, new policies and incentives, and leadership from governors in partnership with utilities and the private sector. Through these efforts, we can achieve a clean energy future.

Appendix A. History and Evolution of State Energy Resource Planning

Since the establishment of state utility commissions in the late 19th and early 20th centuries, state-franchised utilities typically conducted resource planning in a straightforward process of forecasting electricity demand and building generation, transmission, and distribution capacity to meet forecast power needs. Prior to the 1970s, fossil-fueled power plants were the primary supply option, operating under few environmental constraints and in relatively low-priced fuel markets. Developing electricity demand helped bring power grids to maturity by increasing economies of scale. With the aid of engineering advances in generation and grid technology, during the first two-thirds of the 20th century, load growth and grid expansion served to reduce electricity rates while supporting economic modernization and improved quality of life for most Americans.

In the 1970s, several factors combined to change the utility regulatory climate. Engineering advances and economies of scale in most power grids plateaued, so adding new resources to the supply system no longer automatically reduced electric rates. Fossil-fuel prices rose with the oil crisis, driving up the cost of utility fuels. Cost overruns at several nuclear power plants also served to raise electricity rates. The advent of air quality and other environmental laws began to constrain power plant emissions, further raising costs. And the rise of renewable energy technology, combined with early attempts at opening power markets to competition, created the awareness of alternatives to conventional power generation.

States grappled with these suddenly changed circumstances by reevaluating the resource planning process. The concept of "least-cost planning" was developed as a framework to determine the lowest-cost way to meet future electricity needs. In the 1980s, this idea was formalized as integrated resource planning (IRP), based on work led by the U.S. Department of Energy, the Electric Power Research Institute, and many state utility commissions. IRP's main tenets included the examination of a wide range of resource options, including both demand-side and supply-side technologies, and the use of a common economic cost-effectiveness methodology to evaluate these resource options. By using an objective and consistent economic approach, it was possible to identify the lowest-cost mix of resources available to meet future electricity needs.

Demand-side management, or DSM, also evolved in the 1980s as an approach to categorizing, evaluating, and deploying demand-side resources like energy efficiency, load management, and distributed generation. In concert with IRP processes, DSM programs became commonplace in the late 1980s and early 1990s. By 1993, DSM program spending rose to about $2.4 billion annually, of which about $1.6 billion was for energy efficiency and the remainder for load management.[97]

In the mid-1990s, states began to restructure their electricity markets. Between 1996 and 2001, about half the states opened their retail electricity markets to competition. In this wave of restructuring, states pursuing this path typically cut back their IRP processes on the theory that competitive markets would replace the need for some parts of the traditional regulated resource planning process. Typically, power plant ownership in restructured markets would pass to nonregulated companies; in such cases, state utility commissions typically gave up their generation planning powers.

As "restructured" states backed away from key aspects of IRP, many also backed away from their commitments to energy efficiency. In some cases, it was asserted that competitive market forces would replace utility-run DSM program functions. In other cases, utilities simply felt the need to reduce expenses in a competitive marketplace and saw a diminished role for themselves in customer energy efficiency. As a result, energy efficiency expenditures in state utility-sector programs fell 50 percent between 1993 and 1998, from $1.6 billion to $800 million.[98]

Among other provisions, the *Public Utility Regulatory Policies Act of 1978* (PURPA), enacted in 1998, established the right for nonutility generation, including renewable energy generation, to sell power to regulated utilities. PURPA rules resulted in many states establishing rates based on avoided costs, which utilities were required to offer independent power producers. Many such contracts were established in the 1980s and 1990s. As restructuring emerged in the 1990s, many states sought to restructure, buy out, or otherwise move away from this method of procuring renewable energy.

To address the loss of energy efficiency and renewable energy investment that occurred in restructured states, as described above, several states shifted to new resource policies. Some 20 states established public benefits funds (PBFs), in which small fees were collected for each kWh sold and the proceeds used to support efficiency and renewable investment. A like number of states established Renewable Portfolio Standards (RPS), which set specific targets that regulated utilities must meet in terms of renewable power as a percentage of total kWh sales. Some 15 states created Energy Efficiency Resource Standards (EERS), which set long-term, quantitative targets for energy efficiency program savings for utilities. Several states have RPS and EERS combined in a single policy framework. These and other policies are described in more detail in the Tapping Demand-Side Resources section.

Today, states' electricity resource planning approaches are more diverse than ever. Some states, which never restructured their electricity markets, have maintained traditional IRP processes all along. Others have revived IRP processes that had been reduced in scope. Others have continued IRPs while adding policies like RPS or EERS. And still others use their own unique approaches.

More and more states are exploring linkages between their energy and environmental policies and between the agencies that manage these policies. Clean energy resources are a growing focus in this nexus because they can provide measurable cost-effective benefits in terms of reduced air pollution, water pollution, and greenhouse gas emissions. Some states, for example, have developed specific ways to apply the pollution-reduction benefits of clean energy policies toward their compliance requirements under federal environmental laws. State Implementation Plans for nitrogen oxides, for example, have increasingly included energy efficiency and renewable energy policies as specific compliance measures.[99] And as state and regional climate policies emerge, utility commissions and air quality agencies are finding new avenues of cooperation to design and administer the regulatory structures needed to attain CO_2 emissions targets.[100]

Fundamentals of Electricity Resource Planning

Resource planning in the power sector relies on some basic practices, analytical methods, and data sources, although its forms are increasingly diverse among states today. First among these is the availability, level of detail, and quality of data on the resources states want to develop. Data issues include:

- **Availability, quality, and detail.** Determining the amount of energy available from specific resource types, and the years by which they can delivered to markets, is not a simple analytical challenge. Renewable energy resources can be estimated in rough terms; for example, average wind speeds for suitable geographical locations such as ridgelines can be calculated. But it is more challenging to predict the total MW of capacity that can be developed within a realistic time frame, given the issues involved with site permitting, transmission access, component delivery, available financing, and other factors. For energy efficiency, resource assessment involves detailed analysis of current and projected building stock and industrial facilities plus projections of efficiency technology performance and cost. In most states, detailed information on the building stock can be quite limited, such as details on the saturation, type, and performance of existing air conditioning equipment. And, as with renewable resources, projecting the total energy efficiency impacts that can be realized from specific policies in a given time frame can be inexact. Fortunately, a number of states have evolved methods to make reasonable projections based on limited data, so these issues can be managed. Nonetheless, states planning to undertake serious resource analysis should not underestimate the challenges entailed in this process.

- **Energy and demand forecasting.** Often referred to as "load forecasting," the foundation of resource planning is developing an accurate projection of energy use and peak demand. Gauging the need for new generation, transmission, and distribution capacity in future years depends on a reasonably accurate estimate of these needs. Typical forecasting methods include econometric modeling, population growth estimates, and end-use saturation estimates in various combinations. Most forecasting software models used by investor-owned utilities are proprietary and thus limited in transparency, so it can be difficult to understand assumptions and calculations that could cause forecasts to vary from actual load growth.

Utility forecasts have overestimated actual demand growth in the past. Because most software models rely heavily on past growth factors and project them into the future with only minor adjustments, there is a tendency for forecasts to simply extrapolate historical trends without fully capturing effects that can modify demand growth. Federal Energy Information Administration data show that electricity demand grew 10 to 15 percent annually from the late 1940s into the 1960s. By the 1970s, load growth was typically in the range of 3 to 4 percent annually.[101] In this decade, EIA forecasts have fallen further: In the *2006 Annual Energy Outlook* (AEO), load growth through 2030 was estimated at 1.7 percent annually. By the 2008 AEO, the forecast had fallen to 1.3 percent per year.[102]

What can cause forecasts to exceed actual load growth? Key factors include:

- **Technology improvements.** Efficiencies in many end uses improve over time. For example, new refrigerators use as little as one-quarter the electricity of those they replace, new central air conditioners can use as little as half the power of older models, and new windows can cut heat loss and heat gain by up to half. Some forecasts do not accurately estimate the load-reducing effects of replacing these devices as normal market cycles proceed.
- **Policy effects.** Technology improvements can be driven by policy actions. For example, federal and state appliance efficiency standards can dramatically shift the load impacts of new devices within a few years. The federal energy legislation passed in 2005 and 2007 contained new standards for 25 products affecting residential, commercial, and industrial loads. One factor in the reduction in EIA forecasts from 2006 to 2008 may have been that the new forecast accounted for the load-reducing impacts of such standards.
- **Macroeconomic factors.** While most forecasting methods use best-available econometric techniques, these do not always fully capture dynamics in the wider economy, especially when economic factors are changing rapidly. One such factor is the price of fossil fuel, which has multiple effects. Rising gasoline prices create a consumer perception of rising energy costs, which can lead to a broad energy conservation effect in some customer segments. Fuel prices also affect electricity rates through utility fuel-adjustment clauses and wholesale market prices, leading to higher average bills. One factor thus driving the AEO forecasts lower is the likelihood of

increased electricity prices. Rising motor fuel prices also have indirect effects on customer electricity loads in that they tend to devalue homes that are more distant from urban centers. These homes tend to be larger, on average, than homes closer to urban centers, and thus tend to consume more energy. Rising fuel prices can drive a trend.

- **Economic assessment methods for resource technology options.** Most states use one or more economic screening or benefit-cost calculation methods when comparing resource choices in an IRP process. Because it is important to estimate the cost-effectiveness of different resource choices, states have tended to use a standardized set of economic tests in their IRP processes. The most widely used text in this regard is the *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects.*[103] This manual details four principal cost-effectiveness tests:
  - **The Participant Test.** Retail rates are used to value energy savings, and the customer's net cost of installation is used to value the cost of demand-side investments.
  - **The Total Resource Cost (TRC) Test.** Avoided costs of new supply resources are used to value energy savings, and the total cost of installing measures, including utility program costs, is used to value the costs of demand-side investments. TRC can be expanded into a Societal Test by including elements like environment costs associated with power generation.
  - **The Rate Impact Measure (RIM).** Measures the effect of DSM programs on electricity rates.
  - **The Program Administrator Cost Test.** Also known as the Utility Cost Test. Uses the DSM program costs, rather than the total resource cost of DSM measures, as the cost basis, and uses avoided costs as the basis for valuing energy savings.

While these tests are used most often to assess DSM resource options, they can also be used to compare a full range of demand-side and supply-side resource choices. While these tests are most commonly expressed in terms of benefit-cost ratios, or net benefits, they can also be expressed as the lifetime levelized cost per unit of saved energy or capacity. Levelized cost is a useful expression because it allows comparison of demand-side and supply-side options. For example, if the levelized cost of saved energy from a DSM program is 3¢ per kWh and the projected cost of power from new generation is 6¢ per kWh, it is easy to see that the DSM option is half the cost of the supply option.

- Elements of a sound resource plan. States should seek to include the following elements in an electricity resource plan:
  - **Adequate time frame.** To allow enough foresight to consider the full range of DSM and supply options, resource plans should span at least 15 years, and could cover as many as 25 years. It is also advisable to link these plans to short-term action plans, typically spanning 1 to 3 years, to incorporate specific commitments.
  - **Transparent forecast.** The forecast should document its methods, assumptions, and data sources as clearly and openly as possible. It should also include sensitivity analyses and alternative forecast scenarios, which account for the most significant sources of possible variance in the forecast.
  - **Full discussion of resource options.** All reasonable demand and supply options should be considered in the plan. Consistent methods should be used to describe technologies, assess their performance, estimate their costs, and describe their benefits and risks. This element should include realistic resource assessments detailing the amounts of energy and capacity each resource could realistically deliver in specific time frames.
  - **Consistent and detailed economic analysis.** All resource options should be screened economically on a consistent basis, including levelized cost per kWh of energy and kW of capacity, projected impacts on total utility system revenue requirements and rates, and assessment against a standard set of avoided-cost benchmarks.
  - **Assessment of alternate plausible scenarios.** Key parameters and assumptions should be varied to examine the effects on resource decisions (e.g., examining high-growth and low-growth alternatives to the baseline load forecast; assessing scenarios with high vs. low carbon costs, etc.) This process can help establish the degree of risk associated with different resource options.
  - **Integrated resource strategy.** Pulling together all of the above elements, the plan should present a recommended resource portfolio that presents demand and supply components in a common framework.
  - **Action plan.** The plan should also contain detailed information on what the utility proposes for the near and mid-terms with respect to specific DSM programs and supply projects.

- **Linkage to specific resource actions.** In some states, resource plans seem to be viewed as an exercise in themselves, with little connection to actual utility investment or resource commitments. In others, resource policy is very specific in terms of which kinds of resources should be given priority. For example, in some states, there is little or no legal linkage between the IRP and certificate-of-need applications, meaning that power plants or other facilities can be proposed independently of the contents of the IRP. Other states require that all cost-effective DSM resources be acquired before power plant applications can be submitted.

Energy resource potential studies

To advance energy efficiency policies in a state or region, it is important to make the case for efficiency as a readily available, abundant, cost-effective energy resource. One of the first steps toward making this case is to determine whether an energy efficiency resource potential study already exists for the state in question. A potential study is a tool that assesses the possible energy efficiency resources in the state or region and estimates the extent to which that efficiency could contribute to meeting the state's future energy needs. This assessment can inform the design of efficiency policies and programs, help set energy savings goals, or determine funding levels for efficiency programs and policies.

If a study has not been done recently in a state or region, the state should consider commissioning one. The National Action Plan on Energy Efficiency (NAPEE) has issued a primer on energy efficiency potential studies: *Guide for Conducting Energy Efficiency Potential Studies*.[104] This resource will help a state identify the ultimate goal of a state-level potential study, the level of analysis or amount of detail required, and the time and funding needed to complete such a study.

These analyses fall into three general levels, each intended to address a specific policy need:

- **Policy scoping studies.** These studies can be done fairly quickly; they provide a first-order estimate of the magnitude of energy efficiency resources available in a state. They are typically based on similar studies in other states, with adjustments for state-specific market and other key characteristics.
- **Policy and planning analyses.** These analyses provide greater detail on in-state energy efficiency resources and the policies and programs that could be implemented to realize the efficiency potential. They require much more intensive development of in-state data and can take 4 to 6 months to complete.
- **Detailed program planning and targeting studies.** These studies provide additional specificity in order to design and implement individual energy efficiency programs. Designed for program administrators, this type of study assesses key sector and measure opportunities and makes detailed recommendations on specific program designs, impacts, and evaluation methods. These assessments may take more than 6 months to complete and can be cost-intensive depending upon the scope and level of detail.

In addition to defining the appropriate level of analysis in this way, the state must decide on the specific fuel and energy sectors to be evaluated for their efficiency potential. For example, if a state is interested in setting targets for both electricity and natural gas savings, this implies additional data needs, analysis time, and calendar time.

Recent American Council for an Energy-Efficient Economy (ACEEE) efficiency potential analyses for **Florida**, **Maryland**, and **Texas** fall within the second level of analysis described above. These studies provide overall estimates of cost-effective efficiency resource potential and also translate the findings into specific actionable policies and their estimated impacts in the state. These studies suggest that energy efficiency offers the potential to meet most, if not all, of a typical state's electricity consumption growth while at the same time contributing to economic growth in the state and creating new "green collar" jobs.

Appendix B. Distributed Generation Resources

- DOE Distributed Energy Program Publications, http://www.eere.energy.gov/de/publications.html.
- EPA Combined Heat and Power Partnership, http://www.epa.gov/CHP/index.html.
- EPA AgSTAR Program, http://www.epa.gov/agstar.
- EPA Landfill Methane Outreach Program, http://www.epa.gov/landfill.
- USDA Rural Development Energy Initiatives, http://www.rurdev.usda.gov/rd/energy.
- EERE Biomass Program, http://www1.eere.energy.gov/biomass.
- U.S. Clean Heat and Power Association, http://www.uschpa.org.
- World Alliance for Decentralized Energy (WADE), http://www.localpower.org.
- International District Energy Association, http://www.districtenergy.org.

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