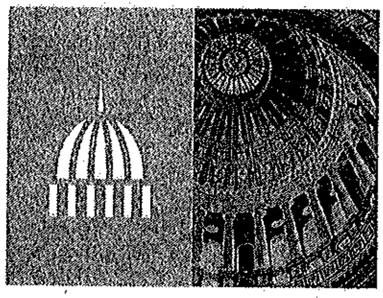
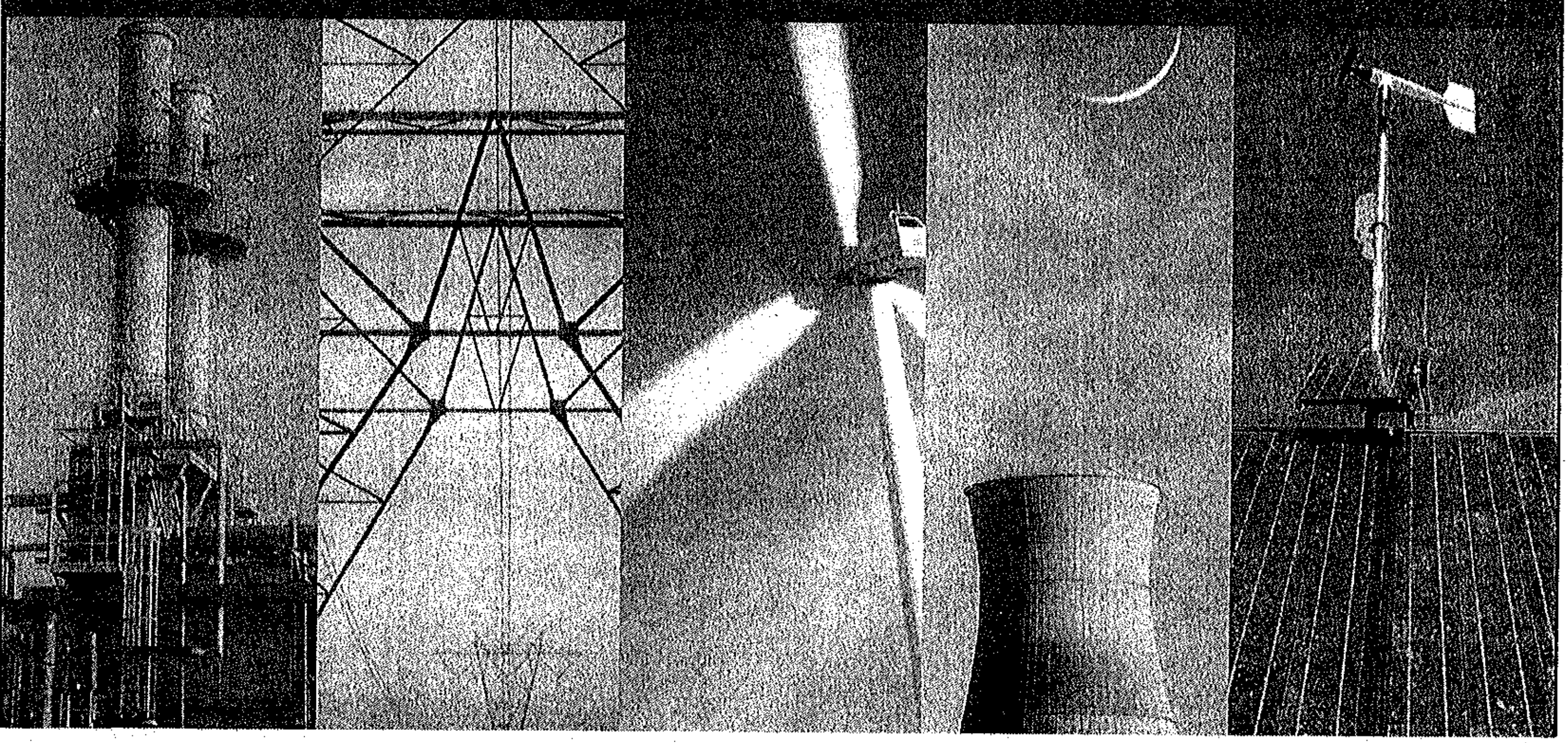


NATIONAL CONFERENCE *of* STATE LEGISLATURES

The Forum for America's Ideas

MEETING THE ENERGY CHALLENGES OF THE FUTURE
A GUIDE FOR POLICYMAKERS



Meeting the Energy Challenges of the Future

A Guide for Policymakers

National Conference
of State Legislatures
The Forum for America's Ideas

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NCSL

The National Conference of State Legislatures is the bipartisan organization that serves the legislators and staffs of the states, commonwealths and territories.

NCSL provides research, technical assistance and opportunities for policymakers to exchange ideas on the most pressing state issues and is an effective and respected advocate for the interests of the states in the American federal system. Its objectives are:

- To improve the quality and effectiveness of state legislatures.
- To promote policy innovation and communication among state legislatures.
- To ensure state legislatures a strong, cohesive voice in the federal system.

The Conference operates from offices in Denver, Colorado, and Washington, D.C.

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The NCSL Task Force on Energy Supply

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April 10-11, 2010, Washington, D.C.
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Executive Summary

Energy issues are paramount in the United States, dominating the news in most cities and states and at the federal level. Whether it is a discussion about rising electricity prices, increasing efficiency or the growth in certain energy sectors, the issues are at the front of many policy discussions nationwide.

Recognizing this increased interest in energy policy and that many good policy ideas are conceived in state legislatures, the NCSL Executive Committee formed the Task Force on Energy Supply in 2009 to look at current energy challenges and create a report. One of the results of their efforts is this document, which provides a background on the current energy situation as it related to electricity production distribution and principles states can use as they work to meet the pressing energy demands of the future.

The task force met four times between December 2009 and May 2010. It heard reports from leading experts on energy topics, including transmission issues, the pros and cons of various fuel sources, and predictions about what the future may hold. During task force meetings, members engaged in discussion with the experts and, using the information gleaned during presentations and outside research, directed NCSL in developing this report and the accompanying policy guide.

The report provides a detailed analysis of the various fuel sources, including nuclear; fossil fuels; renewable sources such as wind, hydropower and solar; energy efficiency; and issues facing the current energy delivery infrastructure, including transmission. This analysis summarizes information on these topics for state legislators, legislative staff and others. It can help facilitate discussions within each state as the legislature works to define energy needs and determine policies that would best achieve a reliable, efficient and cost-effective energy system.

One important challenge identified by task force members was that no single approach will work for every state. Each state or region will face the challenge of striking the right balance, given constraints on financing options, the desire to control possible environmental impacts, and the need to identify reliable fuel sources that are economically viable for their citizens.

The task force recognizes the influence of state legislators in shaping energy policies. Legislators can use this report to help engage their utilities and regulators in meaningful dialogue about developing policies to meet future energy needs of each state and region.

Task force members recognize the significant diversity of each state and region. In many areas of the country, for example, high value is placed on increasing the diversity of the energy supply, decreasing dependence on imports from unfriendly nations, ensuring affordable energy prices and growing the economy. Still, each state and region addresses these issues with a different approach, based on its resources and priorities.

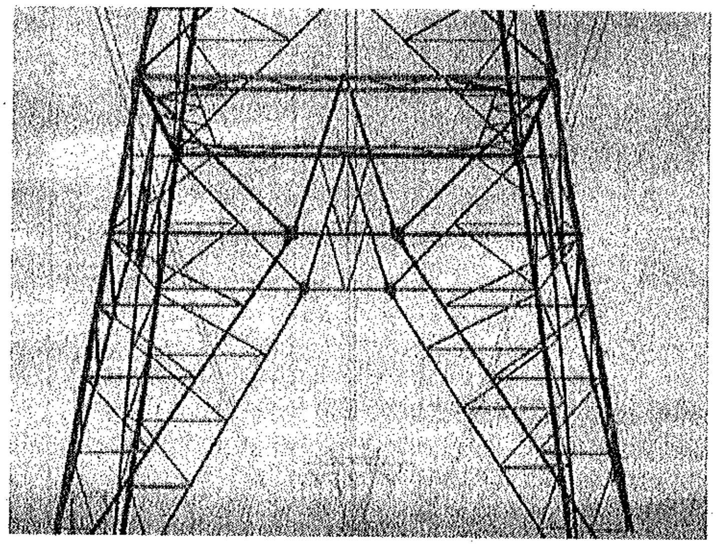
Decisions made today will affect energy reliability, security, economic growth and the environment for decades to come. The importance of a functional and resilient electric grid was highlighted during the Northeast blackout of 2003, which left 50 million people without power due to system failure. To address these and other issues, the task force recognized the need for state legislators to have accurate information about energy supply and demand trends, along with knowledge of what new resources will be needed to ensure that production, distribution and delivery of electricity continues to be affordable and reliable.

Meeting the energy needs of the future, as demonstrated in the report, lies not just in one resource or technology, but in a combination of many technologies and resources, which are likely to include energy efficiency, natural gas, cleaner coal technologies, nuclear energy, smart grid technologies and renewable energy. Since the difference in energy supply resources and energy costs may vary dramatically among states, so may the choice of technologies and policies.

States, utilities and public utility commissions are realizing the benefits of a diverse energy portfolio that includes various sources and technologies. This diversity can help improve reliability, insulate rates against price shocks and improve energy security. The costs, benefits and challenges of implementing these resources and technologies are discussed in detail in this report. Highlights include:

- A discussion of regional variations in electricity prices and resources and how this can affect energy decision making.
- A look at new energy supplies that will be needed in the coming 20 years and the various options available to meet new demands for electricity.
- An overview of the nation's electricity transmission and delivery system and what efforts will be needed to ensure it can meet the demands of the 21st century.
- A review of how the nation's electricity production and supply system functions and the roles of state, local, utility and federal policy in regulating it.
- An exploration of how various energy resources affect the environment and the influence of climate change policies on planning for the future.
- A detailed investigation of various resource options and their costs, including energy efficiency, coal, natural gas, nuclear energy and various forms of renewable energy.
- A summary of policy options available to state legislators to address a broad array of energy issues, including transmission, cleaner coal technologies, renewable energy, natural gas, energy efficiency and nuclear energy.

Introduction



In the past, most U.S. energy decisions have focused on reliability and cost. Today, utilities and policymakers consider many other factors as well, including job creation, economic development, energy security and the environment. This change in decision making is reflected in the growing number of states that are passing clean energy laws, including those related to renewable energy requirements, nuclear energy, energy efficiency, and carbon dioxide capture and sequestration. These policies, along with the potential for federal regulation of greenhouse gas emissions, have changed the decision-making process when it comes to building new power plants. In many instances, utilities are choosing natural gas or renewable energy over new coal plants, since investors and lenders are seeking to avoid the potential costs associated with emissions controls.

As state legislators develop energy policies, they balance costs and benefits associated with various resources. For some states, keeping energy prices low remains paramount, while others pay more to help develop new technologies, grow specific industries, provide energy diversity or reduce emissions. Since cleaner energy options often are more costly than the least expensive alternatives, these decisions depend to a great extent on a state's resources and the cost of electricity.

Energy is a critical issue facing state legislators across the country, and decisions they make today will affect energy reliability, security, economic growth and environmental protection for decades to come. These decisions require the latest information on energy supply and demand trends, electric system functionality and knowledge of the upgrades needed for generation, distribution and transmission systems to ensure an affordable, reliable energy supply. While a number of policy options are available, determining the best approach for any state or region can present a challenge. These decisions depend not only on a state's energy resources and current energy prices, but also on expected long-term cost and availability of resources and economic and environmental goals.

This report discusses how the energy system works, the role of energy prices, growth in electricity demand, and the importance and function of an efficient transmission system. The cost, supply and role of all main U.S. energy sources—energy efficiency, natural gas, nuclear power, coal and renewable energy—also are discussed. A state policy options guide, which outlines various approaches for addressing the energy challenges of the present and future, is available as a companion to this report.

Setting the Stage: Energy in the United States

The nation's electric grid is a complex system connecting thousands of power plants through a web of transmission and distribution lines. This grid brings power to homes, factories and businesses where electricity is needed. Electricity production must meet demand and take into account potential failures and fluctuations based on the season, time of day and variation in renewable power generation. When this balance is disturbed by system failures or severe weather, blackouts can occur. One such blackout left 50 million people in the Northeast without power in 2003. The growing population and an increase in demand for electronic goods are driving much of the U.S. demand for more electricity. Utilities, legislators and state officials will be challenged with meeting this demand while addressing price, energy security, environmental concerns and transmission constraints.

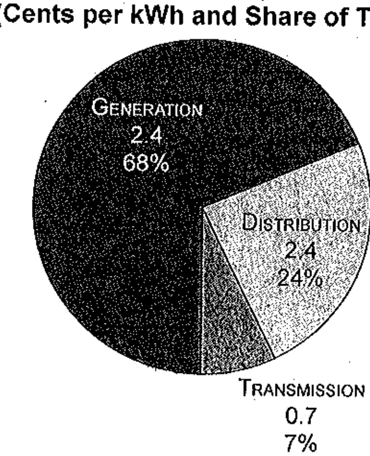
Balancing the System

To effectively meet demand, utilities rely on various types of power plants and system operators that work to balance energy production with energy demand. The need for electricity varies widely based on weather; heating and cooling loads at certain times of the day tend to dominate utility peak demand. Despite advances in demand forecasting, it remains somewhat unpredictable. It also can be difficult to predict production, since power plants and transmission lines can fail unexpectedly due to weather extremes or other problems.

System operators, with the aid of automatic control systems, must account for long-term trends and rapid changes in both supply and demand. Different types of power plants can be used to meet demand. Some, called baseload power plants, run continuously to meet the constant draw of electricity. Peak load power plants adjust to meet the rapid fluctuations in demand that occur throughout the day.

Coal-fired and nuclear power plants are considered baseload plants, and hours or even days of preparation may be needed to start them. Baseload power also can be supplied by natural gas, geothermal plants and hydropower. System operators select which generators will be needed for each day's operation and strive to ensure that adequate generation is available to reliably meet load demand at the lowest cost. To do this, system operators typically keep some power plants ready to go if needed.

Figure 1. Major Components of U.S. Electricity Prices (Cents per kWh and Share of Total)



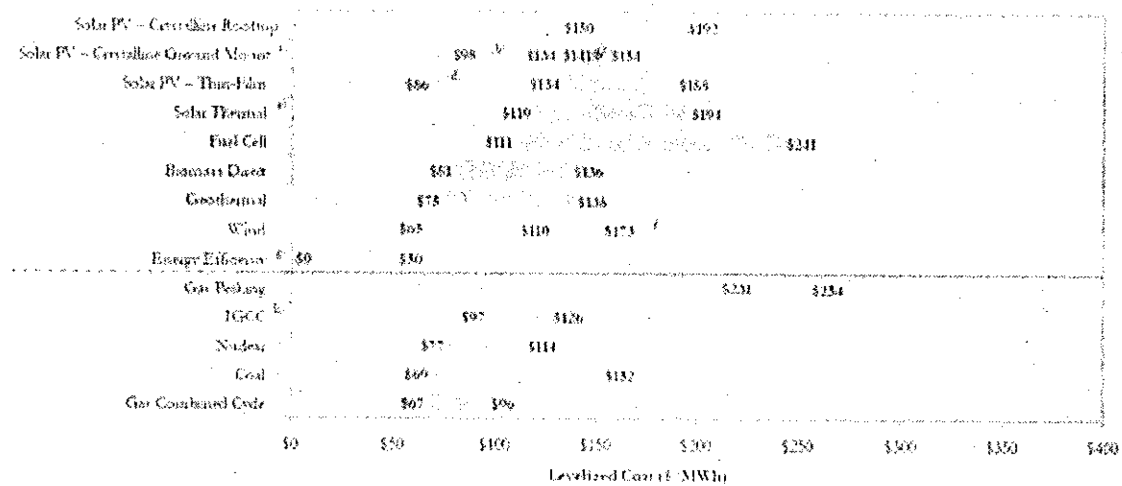
Source: U.S. Energy Information Administration, Annual Energy Outlook 2010, 2009.

Energy Costs

A state's energy portfolio can play a significant role in determining electricity prices. Figure 1 illustrates the three key factors that determine energy prices. These U.S. averages vary by region and market, depending on the age of the infrastructure and the fuel mix.

Some of the least expensive electricity is generated by existing coal and nuclear plants. Nonetheless, the cost of electricity from new power plants of any type is significantly higher until capital costs are recovered. When a state builds new power plants, it is likely to raise rates, regardless of the technology. Figure 2 shows levelized costs of electricity (costs that include the construction and operating costs over the financial life of a plant) for various technologies. These costs represent averages of actual costs of recent and soon-to-be-built projects, which vary based on the electricity market, the type of incentives in place, loan costs, project size, location and environmental regulations. The price range shown demonstrates the large differences that occur based on these factors. The prices for renewable energy include the current federal subsidies; the potential costs of integration, which vary by region, are not included.

Figure 2. Lazard's Levelized Cost of Energy Analysis 4.0

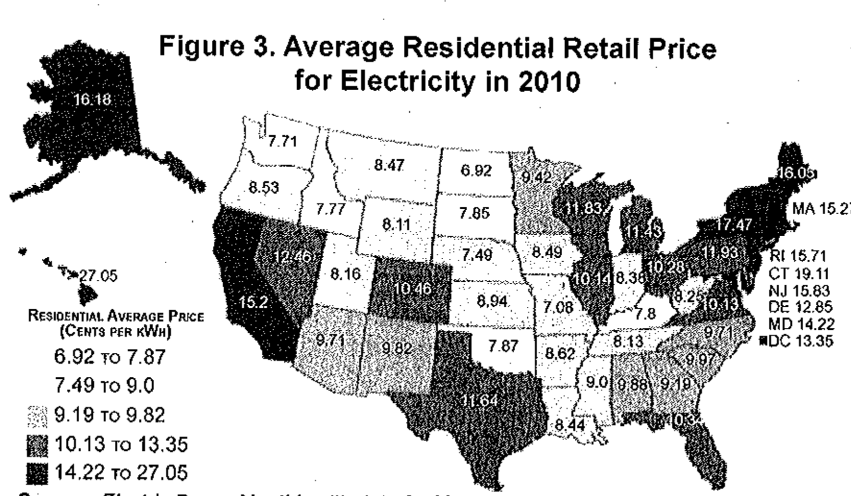


This chart shows the range of levelized costs for building new electricity generation plants of various types. Prices include government subsidies. The range is shown in dollars per megawatt-hour, so the low end for a new coal plant is $69.00 per megawatt-hour, or 6.9 cents per kilowatt-hour. To calculate levelized cost, the total lifetime costs of the plant, including capital, fuel, and finance costs are divided by the amount of energy that will be produced. The high end cost for IGCC (a plant using coal gasification technology) and Coal (based on supercritical pulverized coal plant technology) include the cost of capturing 90 percent of the carbon. The calculations assume that coal costs $2.50 per MMBtu and natural gas costs $6.00 per MMBtu.
Source: Lazard's Levelized Cost of Energy Analysis 4.0, 2010.

Generation represents the largest portion of electricity prices, so states that rely heavily on coal have lower electricity prices than those that rely on more expensive options (Figure 3). Other factors—such as land prices, labor costs and utility regulation—also affect the cost of electricity. Existing prices also strongly influence choices within a state. In states with low rates, all types of new generation will be more expensive and are likely to affect rates, even if the state chooses its least costly options. States with higher electricity rates can choose from many additional options that are more likely to be competitive with existing generation costs. Figure 3 shows state-by-state rates.

Fluctuating fuel prices also affect electricity prices, making long-term budgeting a challenge for homeowners, businesses and state governments. Some consider renewable energy an

Figure 3. Average Residential Retail Price for Electricity in 2010



Source: *Electric Power Monthly* with data for March 2010.

attractive choice because electricity prices for renewable technologies are fixed and predictable over the long term. Renewable energy costs are based on capital and maintenance, since there are no fuel costs.

Prices the utility pays for electricity vary throughout the day, rising during high-demand hours when most expensive power plants must be used to meet demand. During the night when little electricity is used, wholesale prices are much lower. Consumers traditionally have paid one rate, which means there is no incentive to reduce consumption during the hours of high demand. To help the market function more smoothly, utilities are increasing the use of 'time-of-use' rates to better reflect the daily fluctuations in energy prices.
Key factors that affect the price of electricity include the following.

- Fuel Costs. Variable fuel prices are the most significant factor in determining the cost of electricity generated by coal and natural gas. Although coal prices are relatively low, they have been rising. Natural gas prices are currently low but have been volatile in recent history.
- Power Plant Costs. Construction and maintenance costs are greater for some types of power plants than for others.
- Distribution Lines. Growing load and the need to update and maintain distribution lines contribute to the cost of electricity. Distribution constitutes approximately 24 percent of the customer's electric bill.
- Transmission. Maintaining and using the transmission system to deliver electricity represents about 7 percent of electricity cost.
- Weather Conditions. Drought can affect hydropower generation plants that need water for cooling. Hot temperatures increase electrical demand to run air conditioners. Weather conditions also affect the availability of wind and solar power.
- Regulations. In some states, prices are fully regulated by public utility commissions, while in deregulated markets, the public utility only regulates prices for utilities providing transmission and distribution, allowing electricity producers to set their own prices.

Transmission

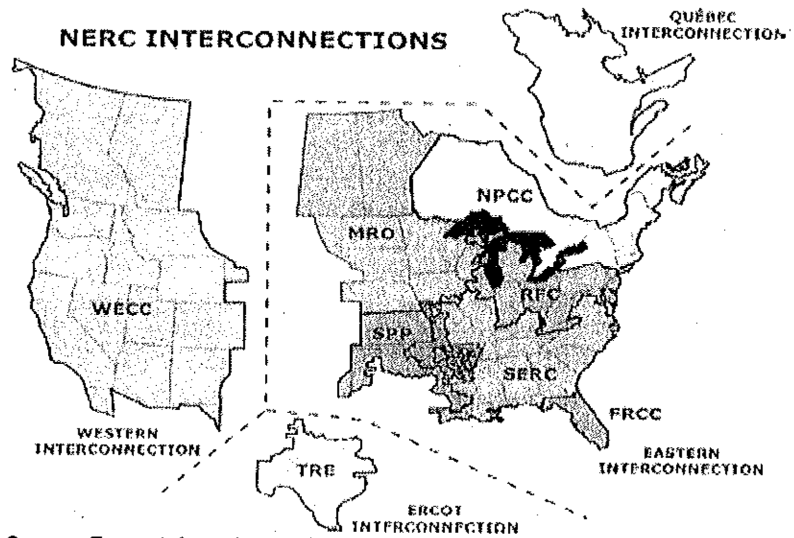
The transmission system is the backbone of the nation's electricity distribution system, carrying energy from power plants to customers. The system is a complex array of electrical lines and substations and meters. Ensuring the reliability and stability of these lines is the critical task of federal and state officials, transmission owners and utilities.

More than 200,000 miles of high-voltage transmission lines and 5.5 million miles of distribution lines connect the nation's 5,400 power plants. Growing energy demand and development of new energy sources are putting pressure on the existing transmission system. Many federal, state and utility representatives feel that the transmission system is outdated and overloaded, which ultimately prevents efficient delivery of electricity, reducing reliability and making energy more costly. New transmission lines and upgrades to many existing lines are needed, although deciding how to pay for them has been a problem. The question of who pays for new transmission lines and how much of the burden should be shared by customers, energy developers and investors is often difficult to resolve. Despite the high cost of transmission projects, transmission averages only about 7 percent of electricity costs.

Transmission Regions. The U.S. transmission infrastructure is divided into three distinct networks, referred to as "interconnections"—the Eastern, Western and Texas (ERCOT) (Figure 4). The Eastern and Western interconnections extend beyond U.S. borders into Canada and Mexico. Within each interconnection, the addition of new electricity supply sources and the development of transmission needed to deliver electricity to consumers require careful coordination to maintain the grid's reliability and limit costs and environmental impacts. Since a significant amount of trade occurs between the United States and Quebec, the Quebec interconnection is important to the Northeastern U.S. electrical grid.

Within the interconnections are independent system operators (ISOs) or regional transmission organizations (RTOs) that coordinate transmission across large regions and ensure a balance between demand and power generation. These entities were created by the Federal Energy Regulatory Commission (FERC) to provide equal opportunities for transmission access, facilitate competition among wholesale suppliers, and provide more accurate electricity prices. The seven ISOs and RTOs in the United States schedule transmission line use; manage the connection of new generation, and ensure fairness and neutrality among market participants. Most RTOs and ISOs are overseen by FERC and coordinate the power grid for two-thirds of the U.S. population.

Figure 4. Transmission Regions

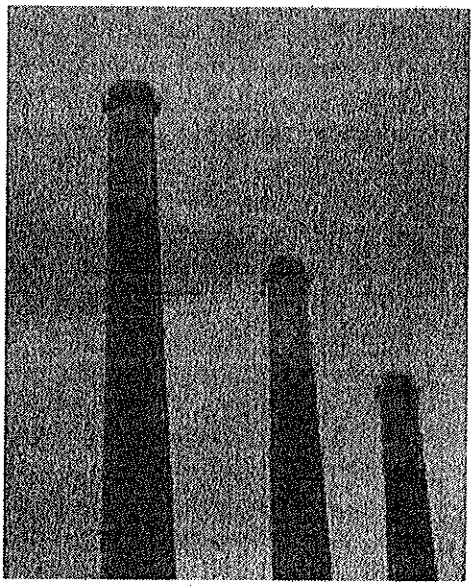


Source: Energy Information Administration.

Siting and Building Transmission Lines. Siting transmission lines also presents challenges. Interconnected transmission development must involve state, regional and federal entities to determine line locations; local governments have a strong influence in the process. The federal government also may play a stronger role, depending on where lines are sited, since nearly 30 percent of U.S. land is federally owned. Although obtaining approval for new projects has always been a challenge, the spread of new residential development in many areas has increased the probability of protests from homeowners. Conservation and preservation concerns also are an issue, since shrinking wildlife habitat areas are receiving stronger protection from advocacy groups and others.

States play a critical role in ensuring that their statutes and policies provide a fair, open process for establishing new transmission lines. Recovering costs, which is especially challenging for projects that cross state lines, can be influenced by state policy. State public utility commissions must determine the details of how retail and wholesale transmission costs are recovered from ratepayers. To help build projects, some states—including Colorado, Idaho, Kansas, New Mexico, North Dakota, South Dakota and Wyoming—have created transmission infrastructure authorities.[1] These authorities facilitate transmission infrastructure development, helping building transmission to state energy resources, which are often in the form of renewable energy. Such authorities, usually governed by a board of directors, are authorized to offer revenue bonds to finance new transmission. Unless guaranteed that generation projects will be built, transmission companies are unlikely to build new lines. On the other hand, energy developers are reluctant to commit to new projects unless they know transmission will be ready. Transmission authorities help bring stakeholders to the table to coordinate and overcome these barriers.

Two organizations have key roles in ensuring the security of the grid and the adequacy of its power supplies. The Federal Energy Regulatory Commission regulates the transmission and wholesale sales of electricity in interstate commerce and sale or leasing of transmission facilities. The North American Electric Reliability Corporation (NERC)—which utilities established in 1968 as a self-regulatory, international nonprofit organization—helps ensure North American electricity supply reliability, planning and coordination.[2] NERC is divided into 10 regional councils (see Figure 4) that oversee coordination of energy supply policies that affect reliability and service in their areas.



The federal government has invested $60 million to plan for the country's three transmission regions. The goal is to help states, utilities and others prepare the grid for future energy demand, renewable energy sources and new energy management technologies. Since siting transmission lines continues to be a challenge, with disagreements regarding where lines should run and who should pay for them, Congress is considering proposals that would give the federal government more power in the process. Under the American Clean Leadership Act, which is being considered in the senate, FERC would have greater authority in siting transmission lines that can benefit a wider region. The goal is to ensure that the broader benefits that regions will see from new lines are not held up by siting or cost-allocation and recovery issues. Although the Energy Policy Act of 2005 already established federal authority to expedite the siting process in some cases, it applied only to areas designated as National Interest Electric Transmission Corridors and areas of extreme congestion.

New Power Plants

As a result of continued demand growth and retirement of existing power plants, electric utilities will need to build new power plants during the coming decades. Because the process of building a new power plant can take years, utilities must begin planning today for plants that will be needed in five to 10 years. New plants, however, can cost billions of dollars. Capital investments in new generation between 2010 and 2030 could range from $455 billion to $951 billion, and much of the capital would come from financing.[3] Uncertainty about future needs and government regulation affect decisions about which plants will be built. These uncertainties can increase the cost of financing, resulting in higher costs to build a plant and, ultimately, higher electricity costs for consumers.

Power plant retirement will be significant in determining how much new generation will be built. The average age of a coal plant in the U.S. is around 40 years, and many are likely to be retired in coming years. By 2035, one-third of nuclear plants will be more than 60 years old, although many are expected to continue operation past that time.[4]

The decision about what type of power plant to build is strongly influenced by the region where it is built, since the price of electricity in the region will determine the profitability of various types of power plants. In regions that rely on coal, where prices often are low, electricity from any new plants will cost more than that from existing ones and so new plants are likely to increase rates. State policies also influence what type of plant can be built. In the 29 states with renewable electricity standards, utilities are more likely to focus on renewable energy before they invest in building new conventional power plants. Four states have greenhouse gas emissions standards for new power plants, so conventional coal plants cannot be built unless they incorporate carbon capture and storage.

Environment

Environmental factors—whether a state is in violation of the U.S. Environmental Protection Agency (EPA) air quality requirements or is under drought stress—also influence energy choices. Since power plants often need large amounts of water for cooling, power plant production may be curtailed in areas experiencing severe water shortages. In arid regions of the United States, water availability plays a major role in determining what type of plant can be built. The National Oceanographic and Atmospheric Administration (NOAA) forecasts that, because water may become scarcer in some regions, water will become even more important for energy and other needs. Water scarcity also effects renewable energy development—a solar thermal power project in the Southwest, which needed a large amount of water for cooling, was canceled because of lack of water. Although power plants can be designed to use far less water, this increases the cost and can lower efficiency.

Air quality also plays a role in determining energy choices, which is one reason natural gas-fired power plants are often chosen over coal plants. Utilities are finding in some cases that it is less expensive over time to switch to natural gas than to retrofit existing coal plants to meet air quality standards. Colorado legislation, HB 1365, passed in 2010, requires regulated utilities to submit plans that assess the cost of retrofitting 50 percent of their coal fleet with pollution controls or replacing half their existing coal plants with natural gas, energy efficiency or renewable energy. If the plan is accepted by the public utility commission—which bases its decision on cost, emissions reductions and other factors—the utility can recover the cost of the transition through rate adjustments, a significant incentive. One major reason for passing the legislation was the need to improve air quality in order to meet stronger federal clean air standards.

States also are choosing lower emissions energy to address concerns about climate change. Eight states have passed laws that require greenhouse gas emission reductions, often by as much as 80 percent by 2050.[5] These requirements will favor low-carbon electricity sources, such as nuclear power, renewable energy, energy efficiency, and carbon capture and sequestration when it becomes commercially available. Reducing carbon dioxide emissions by 80 percent likely will require a significant change in the energy mix and a new approach to how these states produce and use energy. In response to shareholder and lender concerns, investors and utilities often decide to build power plants that emit lower amounts of greenhouse gases.

Energy Markets

Whether an energy market is regulated can significantly affect electricity prices. Many states saw abrupt changes in electric rates after they deregulated their electricity markets. Several states passed restructuring laws to move from a model where local monopolies provide electric services to one where competitive companies provide electricity on an open market. Instead of setting regulated prices, deregulated states allow prices to be determined by competitive markets. In several states that deregulated their markets, some experienced price spikes and other problems. These were attributed in part to the small number of competitors and rate freezes that had expired. As a result, some deregulated states have moved to increase regulation of the electricity market. The United States does not have a self-contained market for electricity; it also trades electricity with Canada and Mexico, and receives a significant amount of hydroelectric power from Quebec.

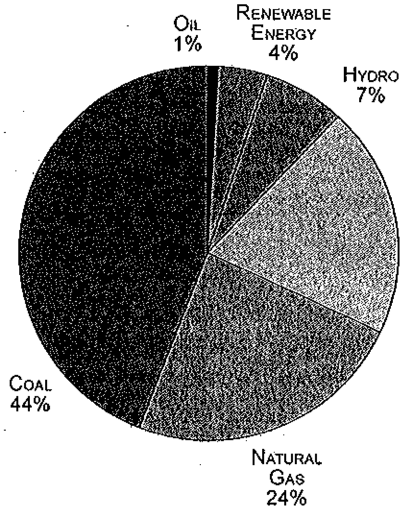
Federal Energy Subsidies

The federal government provides subsidies for research and development and also offers production tax credits. Table 1 highlights Energy Information Administration calculations of monetary subsidies for various fuels. The numbers do not include external factors, such as the health care costs caused by air pollution from fossil fuels, the cost of energy security, environmental costs and federal support to fuel transport infrastructure, among other factors.

Table 1. Subsidy and Support per Unit of Production[6]

Fuel	$/MwH
Coal	0.44
Natural Gas	0.25
Nuclear	1.59
Biomass	0.89
Geothermal	0.92
Hydroelectric	0.67
Solar	24.34
Wind	23.37
Landfill Gas	1.37
Municipal Solid Waste	0.13
Renewables (subtotal)	2.8

Figure 5. Net Generation Shares by Energy Source



Source: U.S. Energy Information Administration, February 2010.

Current and Future Energy Mix

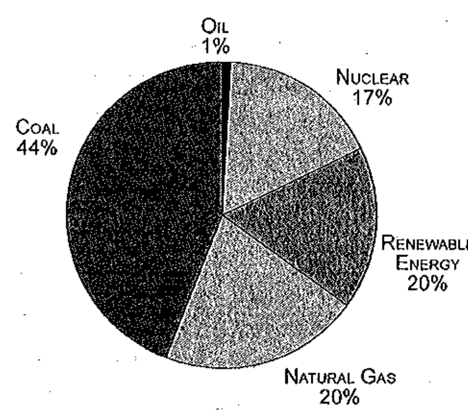
In 2009, coal-fired power plants produced nearly half of the electric power consumed in the United States. Nuclear plants produced 20 percent and natural gas plants produced almost 25 percent. Of the renewable resources, hydroelectric power provided about 7 percent. Other renewable energy sources generated close to 4 percent of the nation's electricity (Figure 5).[7] This mix represents an average for the country as a whole; the energy mix for each state varies significantly from the national average Driving the growth of renewable energy are consumer demand, investors that want to hedge their investments against carbon regulation, renewable portfolios and a shift toward natural gas use. As a result, the percentage of electricity generated from coal has declined slightly. Despite this shift and the growth in renewable energy use, America's energy mix has remained fairly stable over the past few years.

Forecasting America's Energy Needs

Each year, the U.S. Department of Energy (DOE) issues its Energy Outlook report and long-term forecast. The analysis is based on a set of assumptions about factors that are likely to influence energy development: economic growth, past energy trends, future energy prices, and current state and federal policies. The report does not include state and federal policies that might be passed in the future or possible technological breakthroughs.

The latest 2010 report projects that the nation will need 22 percent more electricity in 2035 (Figure 6) than today, an increase of approximately 1 percent per year.[8] This projection is a sharp departure from the forecast presented in the 2007 Energy Outlook, which projected a 43 percent increase in energy consumption between 2005 and 2030,[9] nearly double the 2010 forecast. This revision reflects several changes that have occurred in the past few years—the economic downturn, increasing energy prices, state policy changes, changes to energy efficiency standards and revisions in economic growth forecasts. The variation in forecasts shows that decisions made today will dramatically shape energy demand in the future and that the forecasts are based on 25 years of static.

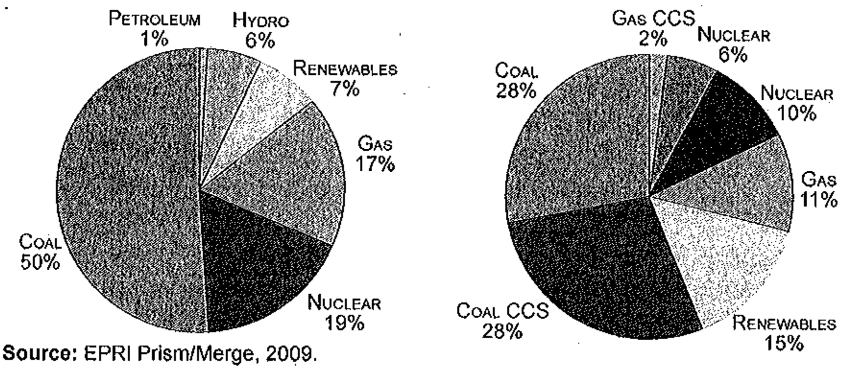
Figure 6. EIA Forecast for Electricity Generation in 2035



Source: Energy Information Administration, Annual Energy Outlook 2010.

The report concludes that nearly half of future capacity growth will be met with natural gas, and 37 percent will be met with renewable energy. It also estimates a 12 percent growth in coal-fired generation. Despite the continuing shift toward gas and renewable energy, DOE's forecast for the 2035 capacity mix does not differ significantly from today.

Figure 7. Comparison of DOE and EPRI Energy Forecasts through 2030



Source: EPRI Prism/Merge, 2009.

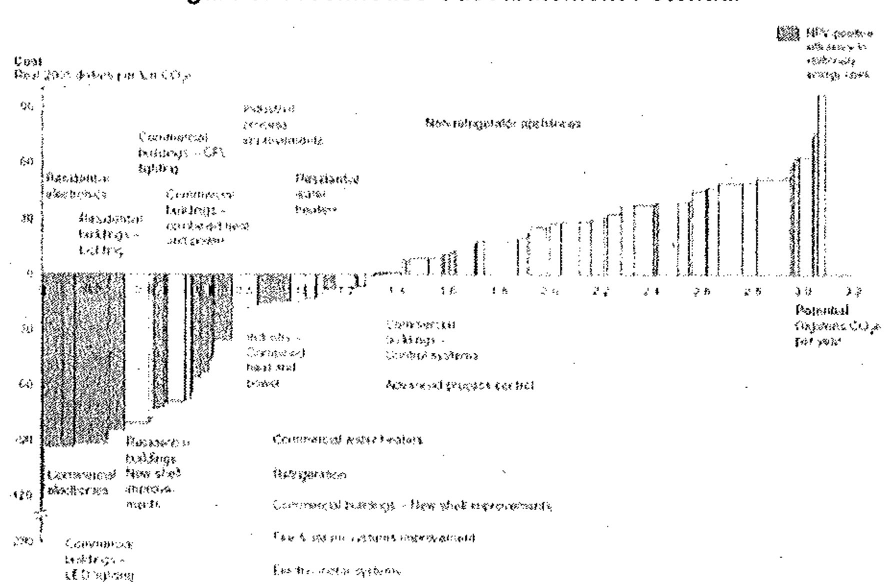
Greenhouse Gas Limits Change the Energy Mix

The Electric Power Research Institute (EPRI), which conducts research and development related to electricity generation, delivery and use, and McKinsey & Company, a global business consulting firm, have considered cost-effective energy mix options if efforts to reduce greenhouse gas emissions are implemented. EPRI's scenario includes a 60 percent reduction in carbon dioxide emissions by 2030; most electricity would come from energy efficiency measures and low carbon resources, including renewable, nuclear and coal with carbon capture. The contrast between the DOE and EPRI scenarios are highlighted in Figure 7. The model predicts that coal with carbon capture would meet 10 percent of demand, nuclear 28 percent and conventional coal without carbon capture 28 percent, a decrease from today's 44 percent. EPRI forecasts that renewable energy generation will increase to 15 percent of total generation, which is similar to the DOE forecast.

The EPRI analysis considered the cost of various emission reduction scenarios by 2050. One scenario included a full portfolio of energy sources, including coal with carbon sequestration. The second would significantly reduce or eliminate coal and nuclear energy use. The report projects that electricity costs under the full portfolio would cost 43 percent less than the one that would eliminate all coal and sharply reduce nuclear energy. Because these projections rely on estimates of economic growth and forecasts of coal, natural gas and renewable energy prices over the next 40 years, however, the possible outcomes do not represent specific assumptions for the many variables involved.

McKinsey focused on the cost of reducing greenhouse gas emissions for various technologies; its assessment was based on least cost to highest cost approaches. Energy efficiency projects—which cost less than building new generation—were found to offset the costs to build most of the more expensive low CO_2 energy technologies needed to reduce the carbon emissions. Figure 8 shows how efficiency technologies can significantly help meet reduction targets at very low cost. Efforts that will produce positive cash flow on investment (denoted as NPV-positive) are shown on the left.

Figure 8. Greenhouse Gas Abatement Potential



Source: McKinsey and Company, *Unlocking Energy Efficiency in the U.S. Economy*, 2009.

Regional Differences Shape the Energy Mix

The national energy picture represents an average of the varied portfolios found among the 50 states. The choices that caused this variation were shaped not only by a region's available resources, but also by state lawmakers, utilities and regulators. In Indiana, for instance, almost all the electricity is generated by coal-fired power plants; California, on the other hand, relies less on coal, and more on imported energy, natural gas, nuclear power and renewable energy. Almost three quarters of Washington's energy is generated by hydropower, while Georgia relies on hydropower for only 3 percent of its energy—of the remaining energy, two-thirds is supplied by coal-fired power plants and nearly 25 percent by nuclear plants. These examples highlight the different choices states have made based on resource availability, environmental impacts, economic development and other factors. Because future state decisions on energy use will depend to a great extent on its existing energy mix, electricity prices and policies, solutions to specific energy challenges will need to be tailored to specific needs.

Energy Sources: Challenges and Opportunities

Decision makers—whether state lawmakers, utilities or public utility commissioners—can consider several energy supply sources, including coal, nuclear, natural gas, energy efficiency, wind, solar, biomass, oil and others. Each combination of supply resource and generation technology has distinct advantages and disadvantages to help states meet energy, economic and environmental interests.

Energy Efficiency

More than half of the energy produced is lost to inefficiencies in power plants, transmission and distribution systems, as well as heating, lighting and cooling of homes and buildings. This leaves a vast resource of energy that can be tapped by making generation, delivery and use more efficient. Energy efficiency has had a significant role in reducing energy demand. Without energy efficiency, the United States would have needed to build twice the number of power plants that were constructed since 1970.[11] Increased efficiency was due in part to federal requirements, including energy efficiency requirements for appliances, higher fuel economy standards for vehicles, and more insulation and weatherization for homes and buildings.

Where Our Energy Goes

- Building operations consumed 72 percent of the nation's electricity in 2006, and this is expected to increase to 75 percent by 2025.[10]
- Lighting homes, offices and streets used 14 percent of U.S. electricity generated in 2007.

Efficiency vs. Conservation

Energy efficiency means getting the same or better service using less energy. Conservation means using less energy—for example by keeping a house warmer in summer and cooler in winter. Energy efficient technologies—more insulation, better windows, a more efficient furnace and air conditioner—maintains a comfortable temperature in a house while using far less energy.

Since implementing energy efficiency costs about one third as much as building new power plants,[12] states and utilities use it to keep ratepayer costs down and meet air quality requirements. It also helps reduce demand during peak hours of the day when the power plants must work harder to supply enough electricity. During hot summer days, for example, better insulated houses use far less electricity for air conditioning, thus lowering peak demand. This also lowers costs to ratepayers and improves reliability, reducing stress on the electricity system and lowering the risk of system failure. Energy efficiency measures also can help the utility defer construction of new generation, and postpone rate increases. Many regions of the country monitor overburdened electric systems on hot summer days. Reducing peaks with efficiency measures increases system reliability and resilience and reduces the chances of large-scale power outages.

The potential for energy efficiency is high. As much as 23 percent of energy demand could be met with energy efficiency by 2020, according to a report by McKinsey and Company.[13] This would result in a 16 percent decline in total electricity use, with a $520 billion of investment yielding $1.2 trillion in savings by 2020 (see figure 8). Although the study assumes that only cost-effective energy efficiency investments would be used, the reported savings could be achieved only with concerted effort by utilities, policymakers, the construction industry and others. One major efficiency investment utilities currently are making uses smart grid technologies to make electricity delivery and use more efficient. These technologies can help provide pricing signals that reflect the true cost of electricity at various times of the day, allow utilities to manage peak loads, offer more efficient deployment of utility resources and increase reliability. They include electronic meters that reflect time-of-use pricing, improved feedback on energy use for consumers and other improvements. The 2009 American Recovery and Reinvestment Act provided $4.5 billion to support smart grid and efficient electricity transmission technologies.

Buildings and homes hold the greatest promise for energy efficiency. Because buildings use about 72 percent of the nation's electricity, they are a vast energy efficiency resource. It is possible to construct buildings and houses that are 30 percent more efficient than standard energy codes require; the added construction costs are paid back in energy savings.[14] Since buildings typically last for 50 years or more and the payback time for increasing energy efficiency may be five years or less, this may seem like a logical choice to increase efficiency. The challenge is that, since building owners often are not the ones who pay the electricity bills, they have little incentive to spend money on energy efficiency improvements. Also, builders are resistant to new energy codes since profit margins are small. Any requirements to increase energy efficiency could lead to higher construction costs, with no assurance that this expense can be recouped in the building sale.

Another barrier is the utility disincentive. Utilities promote consumer-driven energy efficiency to a point, since it can help lower peak demand and operation costs. Efficiency programs also can be preferred investments for customers, since efficiency costs much less than building new power plants and does not require new transmission lines. Utilities may not be enthusiastic about aggressive energy efficiency programs, however, since most make money based on how much electricity they sell. Reducing energy sales through energy efficiency may reduce utility profits. Some states have addressed this issue by creating a market model that allows utilities to profit as much from investment in energy efficiency as in new generation. One approach, called decoupling, separates profit from electricity sales so that increasing or declining sales do not affect a utility's profit.

State Policy

Several states have recognized energy efficiency as a critical resource and are implementing policies that will increase efficiency and reduce consumer electricity bills and business operating costs. These policies can include stronger energy codes, requirements for utilities to meet yearly energy efficiency targets, decoupling utility profits from electricity sales, and creating programs that reinvest ratepayer fees in energy efficiency programs. Many states are also looking at energy efficiency as the least expensive approach to reducing greenhouse gas emissions. Twenty-four states require utilities to meet a certain amount of annual energy demand via energy efficiency. Massachusetts will require 2.4 percent per year starting in 2012, and Ohio will require 2 percent beginning in 2019.

The federal government is providing more that $11 billion for state energy efficiency efforts through the American Recovery and Reinvestment Act. Under the act, $3.1 billion is available to state energy programs and $5 billion to state weatherization programs. Another $3.2 billion is being distributed through energy efficiency and conservation block grants. Some of the money is only available to states that adopt efficient commercial and residential building energy codes and plans to achieve code compliance.

Cost

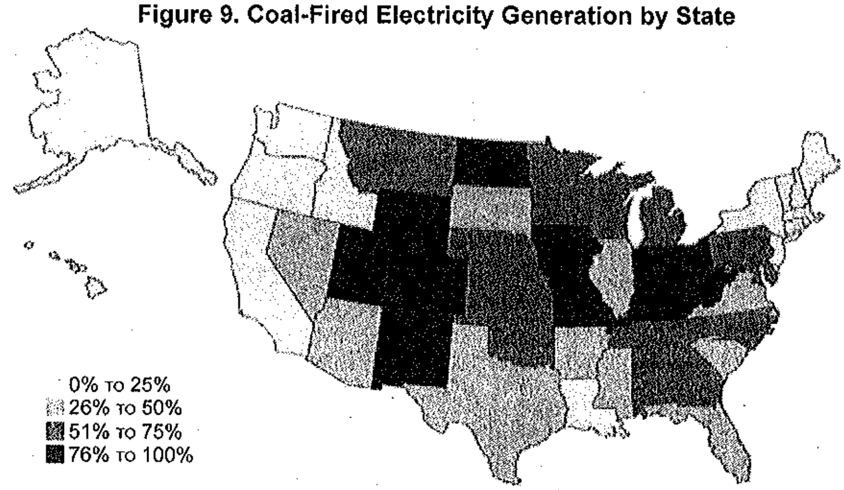
The initial costs of energy efficiency upgrades represent one of the most significant barriers, even though the investment can pay back fairly quickly. To help consumers deal with this initial cost, states have implemented revolving loan funds, grants and other financing mechanisms. Connecticut's Clean Energy Fund, for example, comes from a small ratepayer fee and helps utilities pay for programs that reduce natural gas and electricity consumption. Program analysis estimated that lifetime savings for these investments are $4 for every $1 spent. Many other state programs also have seen 2 to 1 or 3 to 1 investment returns for energy efficiency.

Another approach allows building and homeowners to repay loans for energy efficiency upgrades with energy savings. This can be implemented through on-bill financing—a utility program that finances the costs of energy efficiency improvements and collects loan payments on the customer's monthly bill—or property-assessed financing using special improvement districts. (See www.ncsl.org/default.aspx?tabid=19561 for more information.)

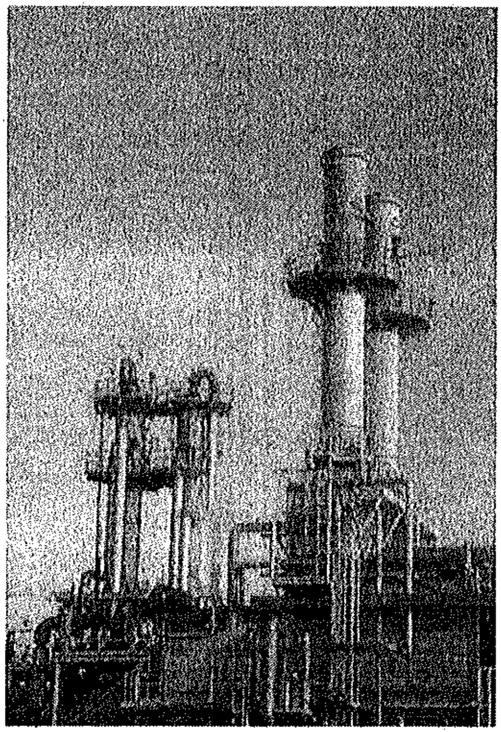
Coal

The nation relies on coal for nearly half its electricity needs and the large domestic supply is enough to power the country for 140 years at current consumption rates.[15] Most of the country's coal reserves are located in 10 states, although coal is actively mined in 25. The importance of this resource varies significantly by state and region. New England and the Pacific states rely on coal-generated electricity for less than 20 percent of their needs, while in the southeastern United States and mountain regions, coal meets more than 50 percent of electricity needs. Many states, including Indiana, Ohio and West Virginia, generate more than 75 percent of their electricity from coal. Others, such as California, Idaho, New York and Washington use coal for less than 15 percent of their electricity needs. Figure 9 shows electricity generation by state, although consumption percentages may differ because electricity from power plants often is exported or imported.

Figure 9. Coal-Fired Electricity Generation by State



Source: U.S. DOE, Energy Information Administration, 2009.



The Future of Coal

As of January 2010, 22 coal plants were under construction and eight more were permitted.[16] Construction costs for the new plants are significantly higher than for their older counterparts, so electricity generated from new plants also will cost more. Many new and proposed plants implement state-of-the-art technologies that make coal burn cleaner but also increase costs. Many proposed plants will use supercritical or ultra supercritical pulverized coal technology, which improves efficiency and lowers emissions by using a high pressure combustion chamber. Six of the proposed plants will use Integrated Gasification Combined Cycle (IGCC) technology, which turns coal into a gas before burning. This process allows more effective carbon dioxide capture and sequestration and removal of other emissions.

Closures of existing coal plants or cancellations of planned coal plants have increased in the past few years, driven by uncertainty about the greenhouse gas regulations and the cost of compliance with air quality requirements. Coal plants usually operate for at least 40 years; with retrofits, they have an expected lifetime of 50 to 60 years. Many coal plants have outlived their predicted lifespan, and many utilities, when assessing the cost of upgrading versus replacement, have chosen to close older plants. The other factor driving closures and cancellations is state and federal policy. The cost of building cleaner coal plants that meet air quality regulations and uncertainty about carbon regulations have persuaded many utilities to consider other alternatives. In 2009, 12 plants were being closed, and 15 new plant closures were announced.[17]

New technologies are being researched to remove CO_2 from coal fired and natural gas-fired plants, reducing their greenhouse gas emissions. CO_2 capture technologies that can be retrofitted to existing plants are under development in the United States and worldwide. The CO_2 then can be stored deep underground in saline aquifers or used for oil recovery.

Environmental Considerations

Air quality is the primary environmental concern for coal-fired power plants, which emit a significant amount of air pollutants. In 2010, the U.S. Environmental Protection Agency began implementing new rules that will significantly reduce coal plant emissions. The first, the Clean Air Interstate Rule, requires a reduction from 2003 levels of more than 60 percent for nitrogen oxides (NOx) and over 70 percent for sulfur dioxide (SO2) emissions, both of which contribute to smog and respiratory illnesses. The second, the Clean Air Mercury Rule, requires a 70 percent reduction in mercury emissions. The U.S. EPA also is developing air toxics emission standards for power plants under the Clean Air Act in regard to the Clean Air Mercury Rule, which should be finalized by November, 2011. These efforts come at a cost, however, and will increase the price of electricity generated by coal plants. The federal government is likely to implement additional regulations, such as those to tighten coal ash disposal methods or improve coal mining safety.

Since coal plants are responsible for one-third of America's greenhouse gas emissions—80 percent within the electric power industry—they are a growing concern for states and the federal government. The EPA now requires reporting of greenhouse gas emissions, and it soon may limit emissions unless Congress passes federal climate change legislation or limits EPA's regulatory authority over greenhouse gas emissions.

Coal mining also can significantly affect the environment by polluting water and destroying wildlife habitats. The health effects from coal mining include death from cave-ins, coal dust explosions, methane explosions and methane inhalation. Many coal miners also have suffered lung ailments and other disabilities.

Cost

The Energy Information Administration forecasts that coal will supply about 44 percent of the nation's electricity needs in 2035, as it does today. This forecast does not take into account the effect that greenhouse gas regulations could have on the energy mix.

The costs for a new coal plant ranges widely, depending on the type of coal used, type of financing available, technology used, and location. Costs for conventional coal-fired plants start at about 6.9 cents per kilowatt-hour (kWh) while the costs for a modern supercritical plant range from 8.5 cents to 10.5 cents per kWh and higher. For Integrated Gasification Combined Cycle (IGCC), costs are estimated at 9.7 cents to 13 cents per kWh. Adding carbon capture and sequestration increases the price by at least 3 cents per kWh.[18]

State Action

States have addressed energy issues through legislation during the past few years; some legislation has reduced the viability of coal as a fuel source. Legislation includes the renewable electricity requirement passed by 29 states and the District of Columbia and greenhouse gas reduction requirements adopted by eight. In addition, power plant carbon emission standards in five states require some degree of carbon capture and storage for coal plants. Other states are directly targeting coal plants through other measures. A 2010 Colorado law requires utilities to analyze the cost of upgrading their coal plants to meet new EPA air quality standards and compare it to the cost of replacing 50 percent of their coal plants with natural gas, renewable energy or energy efficiency. If the analysis is accepted, utilities can recover conversion costs from ratepayers. Colorado utilities are likely to pursue conversion and replacement if cost-recovery is included, since a move toward cleaner fuels will protect utilities and ratepayers from future carbon regulations and reduce EPA air quality compliance costs.

States also have created regulatory frameworks to allow carbon capture and sequestration from coal plants, addressing long-term liability, ownership, permitting and safety regarding injection and long-term storage of carbon dioxide. Kansas, Louisiana, Montana, North Dakota, Oklahoma, Texas, West Virginia and Wyoming have passed comprehensive legislation on this issue, and others are considering it.

Federal Action

The federal government has supported research and development into carbon capture and sequestration (CCS) technologies by contributing $3.4 billion toward research and development through the American Recovery and Reinvestment Act. This includes $334 million to the first active CCS project in the United States, American Electric Power's Mountaineer Power Plant in West Virginia. The U.S. EPA also is supporting CCS by developing a regulatory framework that will ensure the long-term safety and efficacy of underground carbon dioxide storage sites.

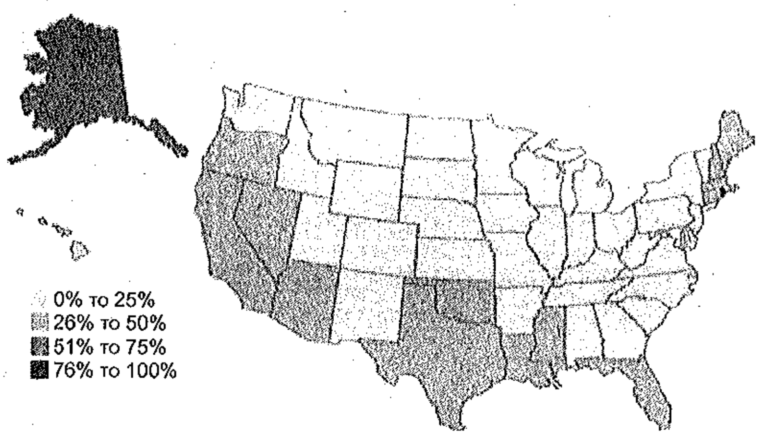
Natural Gas

Natural gas-fired power plants produce 24 percent of the electricity in the U.S. Like coal, the role of natural gas varies among states. In the West, natural gas competes with coal as the leading resource for electricity generation, while in the Southeast it supplies only about 15 percent. Figure 10 demonstrates the variation in natural gas generated electricity among the states. In the past decade, use of natural gas as a baseload power resource has grown. It often is favored over coal because it emits far fewer pollutants. Historically, dramatic fluctuations in natural gas prices and consistently higher prices than coal have been major drawbacks to heavy reliance on this resource. New advances in drilling technologies and the process of hydraulic fracturing, however, have opened previously unavailable deposits of natural gas in shale formations, significantly expanding U.S. gas reserves. At current production levels, many now predict that the United States has 100 or more years of natural gas supplies remaining.[19] Figure 11 shows the location of natural gas-rich shale formations across the country.

U.S. Natural Gas Supplies and Production

- Natural gas supplies 24 percent of U.S. electricity.
- The United States has enough natural gas to last about 100 years at current levels of use.
- Of the natural gas consumed in the United States, 97 percent comes from North America, and 84 percent was extracted in the United States.

Figure 10. Gas-fired Electricity Production by State



Source: U.S. DOE, Energy Information Administration, 2009.

As with coal, reliance on natural gas varies across the nation. The highest reliance is generally around 50 percent, although most states obtain less than 10 percent of their electricity from natural gas. Natural gas plants can be started and stopped more quickly than coal plants, so regions that have gas-fired plants often can more easily integrate renewable energy at lower cost.

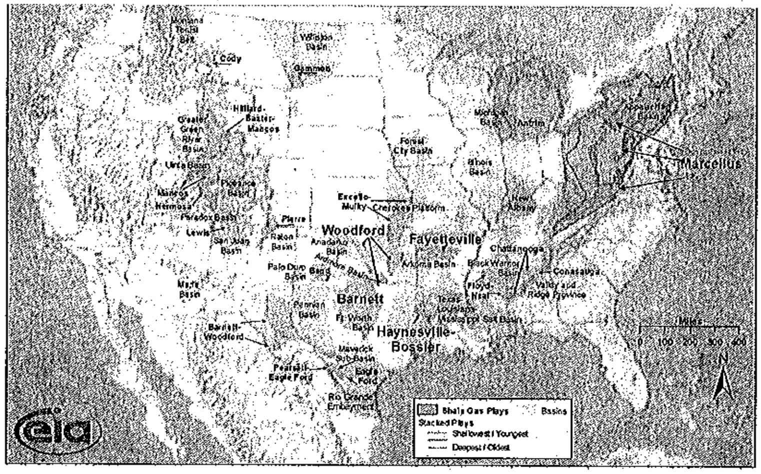
The United States imported nearly 16 percent of the natural gas it consumed in 2007; 99.8 percent originated in Canada.[20]

The Future of Natural Gas

The extensive natural gas distribution system and large domestic supplies have made it an easy choice to help many utilities meet energy demand. The U.S. reliance on natural gas for electricity generation is expected to continue to increase, since gas-fired power plants tend to be easier to finance, cheaper to build, and easier to permit than coal plants. They also emit less smog-forming pollutants and carbon dioxide, so utilities in areas with air quality concerns and greenhouse gas emission limits prefer natural gas to coal. Since gas plant carbon dioxide emissions are nearly half that of coal plants, banks and investors consider natural gas plant investments to be less risky than coal and are more likely to provide project financing for them.

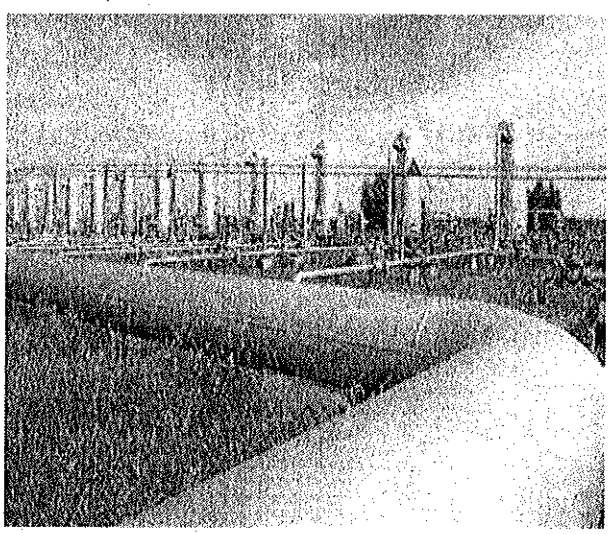
Environmental Issues

Figure 11. Shale Deposit of Natural Gas in the United States



Source: Energy Information Administration, 2009.

With respect to air quality, natural gas is the cleanest of the fossil fuels. It does not produce mercury, emits only a minimal amount of particulates and very small amounts of smog-forming pollutants. Carbon dioxide emissions are about half that of coal plants. As with any natural resource extraction, some disturbance of the environment occurs when heavy machinery is used to drill and access natural gas resources. New horizontal drilling techniques require less land to access gas reservoirs than vertical drilling. Still, concern about ground water pollution from the hydraulic fracturing process and on-site emissions need to be addressed through monitoring and adherence to environmental protocols. New York no longer permits natural gas drilling from shales until more data can be collected on the potential effects on water quality.



Cost

The levelized cost, which includes the costs of construction and operation over the life of the plant, for electricity from new gas plants is 6.7 cents to 9.6 cents per kilowatt-hour. Costs vary depending on where the plant is built, financing and other factors. Since fuel costs are a major factor in electricity prices, natural gas has not always been the fuel of choice for electricity generation. Rapid price fluctuations have made it difficult to forecast natural gas costs. Because power plants may last 50 years or longer, it is necessary to have some idea about future prices when deciding the type of plant to build. Since 2005, gas prices have fluctuated from around $13 per MMBtu (1,000 cubic feet of natural gas) to $3 per MMBtu; the low occurred late in 2009. As the economy recovers and shale gas becomes available, natural gas prices are expected to rise slightly and remain at between $5.5 and $7.5 per MMBtu until the year 2030.[21]

State Action

Since the rules and regulations for natural gas depend on the ownership of the surface or mineral below, federal, tribal, state or county governments may have jurisdiction, depending on the issue and location. States can provide oversight of natural gas drilling through various administrative bodies and can create policies that protect natural resources and wildlife.

In the 2010 legislative sessions, at least 36 states considered 145 bills related to natural gas. Several bills focused on research, drilling and development of natural gas resources—especially those in the recently discovered shale formation areas around the country. Other bills focused on the role gas will play in meeting state energy needs, including electricity generation or heating.

Performance standards that require power plant emissions to be equal to or better than natural gas have been implemented in California, Oregon and Washington. Colorado's HB 1365, the "Clean Air-Clean Jobs Act," promotes shifting half of the state's utilities' coal plants to natural gas and other electricity sources. This may change Colorado's energy mix, which is nearly 70 percent coal.

Although federal law governs some natural gas drilling and development, states have a significant role in implementing those regulations and what, if any, additional requirements will be placed on gas development. Under existing laws, states can regulate or permit drilling and fracture of wells; spacing of drilling pads and other surface disturbances, disposal of wastes, and plugging completed or abandoned wells.

Nuclear Power

Nuclear power plays a large role in the nation's energy supply; 104 reactors at 65 nuclear power plants deliver 20 percent of the nation's electricity. Although it is one of the most reliable, secure and low-emission sources of electricity, concerns about nuclear reactor safety and waste disposal have reduced the push for new nuclear power plants. The last U.S. nuclear power plant to be completed went online in 1996. States and the federal government have begun to consider nuclear power as a reliable source of electricity that addresses growing concerns about greenhouse gas emissions. The safety record of nuclear plants during the past few decades, along with new plant designs that increase safety, are reassuring investors and energy decision makers.

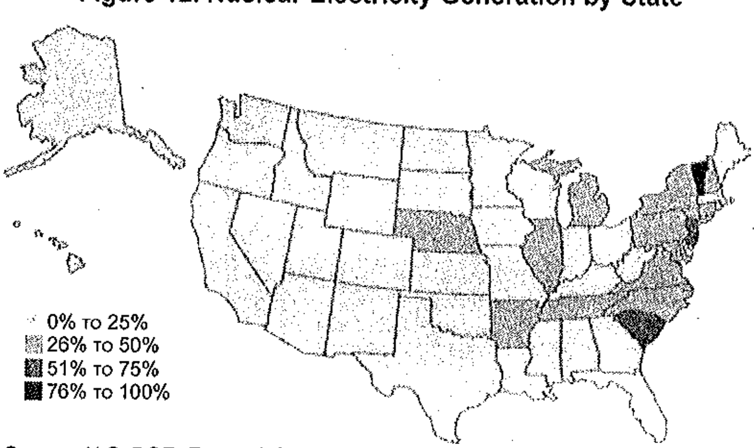
Nuclear Power in the United States

- Nuclear power provides 20 percent of U.S. energy.
- Fourteen percent of uranium used for nuclear power is mined in the United States.
- One-fourth of the world's uranium reserves are in the United States.

Source: Energy Information Administration, 2008.

Nuclear power's role in state and regional energy portfolios varies—19 states have no nuclear generation, while just a few rely on nuclear power for more than 50 percent of their energy Most reactors are located in the East, near readily available water supplies (see figures 12 and 13).

Figure 12. Nuclear Electricity Generation by State



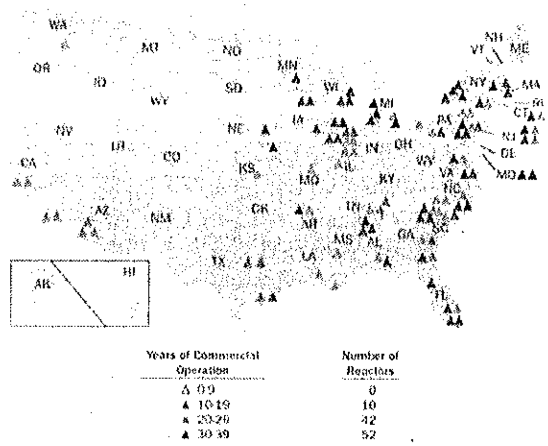
Source: U.S. DOE, Energy Information Administration, 2009.

Uranium, which powers nuclear reactors, is relatively inexpensive. Although one-quarter of the world's uranium reserves are located in the United States, most is found in sandstone deposits and is of lower grade. Due to the sharp price decline of uranium in the 1980s, U.S. uranium mining became unprofitable; most is now imported from Canada and Australia. Efforts currently are under way to revitalize U.S. uranium mining, however.

The Future of Nuclear Power

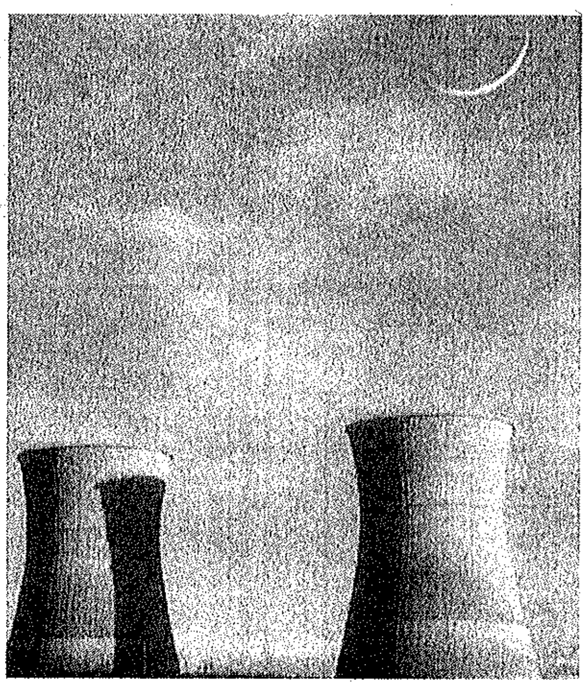
Since nuclear energy produces carbon-free electricity with a relatively abundant fuel, the prospect for new plants is higher than at any time since the 1970s. The U.S. Nuclear Regulatory Commission (NRC) expected 22 license applications between 2007 and 2012 and currently has applications from Alabama, Florida, Georgia, Louisiana, Maryland, Missouri, Mississippi, North Carolina, New York, South Carolina, Tennessee, Texas and Virginia. Since the average plant is licensed for 40 years and its lifetime can be extended to 60 years or more, the long-term energy production potential for these plants is significant.

Figure 13. Location of U.S. Nuclear Reactors



Source: U.S. Nuclear Regulatory Commission, 2010.

Some remain concerned about overall nuclear plant safety, accidents, nuclear waste storage and waste transportation. Long-term storage of used nuclear fuel remains an issue after plans were abandoned for a permanent storage facility in Yucca Mountain, Nev. Some are hesitant to build more plants until a permanent waste disposal solution has been found.



California, Connecticut, Illinois, Kentucky, Maine, Oregon, West Virginia and Wisconsin have placed moratoriums on building new nuclear power plants until a federal nuclear waste repository is built. Hawaii and Minnesota also prohibit new nuclear plants, although not due to lack of a federal storage facility. Although the Department of Energy is responsible for developing a way to dispose of spent nuclear fuel and high-level waste, the political realities of doing so present significant challenges. A new federal blue-ribbon commission is studying the issues and will make recommendations to solve the problems associated with used fuel. The potential recommendations are to include on-site storage, interim off-site storage, recycling of used fuel, a permanent disposal repository and approaches to transportation.

Cost

The levelized cost (includes the cost of construction and operation over the life of the plant) for electricity from new nuclear plants ranges from 7.7 cents to 11.4 cents per kWh. Unlike coal and gas-fired power, fuel costs play only a minor role in determining electricity costs from nuclear plants. Much of the cost for nuclear power is related to construction. Because cost estimates for new plants range from $10 billion to $17 billion, financing these projects can be a major barrier. For this reason, the federal government is often involved in securing loans to finance nuclear plant construction. President Obama announced in early 2010 that the federal government is offering loan guarantees for up to $8.3 billion for construction of two nuclear plants in Georgia, the first new nuclear power plants to be built in the last 30 years. The administration's fiscal 2011 budget request asks Congress to add $36 billion to the nuclear loan guarantee program. Loan guarantees significantly reduce nuclear plant financing costs by shifting investment risk to the federal government. Some believe the guarantees are necessary to ensure that regulatory changes do not stop completion of a plant. Although nuclear power plants are more expensive, they usually generate much more electricity than coal or gas plants.

Environmental Considerations

Although nuclear energy essentially produces no greenhouse gases or pollutants, the environmental issues include disposal of used fuel, waste storage and potential releases of radioactivity at nuclear power plants. Environmental impacts associated with uranium mining are similar to those of mining other metals.

State Action

In the 2009 and 2010 legislative sessions, 16 states considered legislation related to permitting, building or financing new nuclear facilities. Alaska, Hawaii, Illinois, Kentucky, Minnesota, Virginia, West Virginia and Wisconsin considered overturning their bans on building new nuclear power plants. Only Alaska successfully overturned its moratorium with passage of Senate Bill 220 in April 2010.

In 2009, Georgia acted to reduce financing costs for new nuclear power by passing Senate Bill 31, the Georgia Nuclear Energy Financing Act. Under the act, the Georgia Public Service Commission can permit utilities to charge customers for financing costs associated with new nuclear reactors while construction is underway. Traditionally, utilities do not start charging for such costs until the plant has been placed in service. Allowing ratepayer contributions to start during work-in-progress lowers financing costs which helps lower the long-term cost of a plant and reduce the amount of the rate increase due to the plant's construction. Several states—including Florida, Idaho, Iowa, Kansas, Louisiana, Mississippi, North Carolina, and Virginia—have enacted similar legislation.

Other states also are including nuclear power as a part of their clean energy portfolios. Ohio passed an alternative energy portfolio standard in 2008 requiring that 25 percent of electricity generation be obtained from alternative energy sources by 2025. Half the alternative energy can come from sources such as third-generation nuclear power plants or clean coal technologies. In 2010, South Carolina enacted legislation requiring its State Energy Office to include nuclear energy in promoting carbon-free energy.

States also have been actively involved in regulating nuclear waste transportation; many require permits and fees to transport it within state lines.

Federal Action

The federal government is involved in finding a long-term storage site for nuclear waste and offering loan guarantees for nuclear power plant construction. The Department of Energy actively supports nuclear energy in other areas. Its efforts include supporting research into next generation nuclear energy technologies; working with industry to identify new sites for nuclear power plants; working to ensure fuel supply for nuclear plants; and working to solve nuclear waste generation issues.

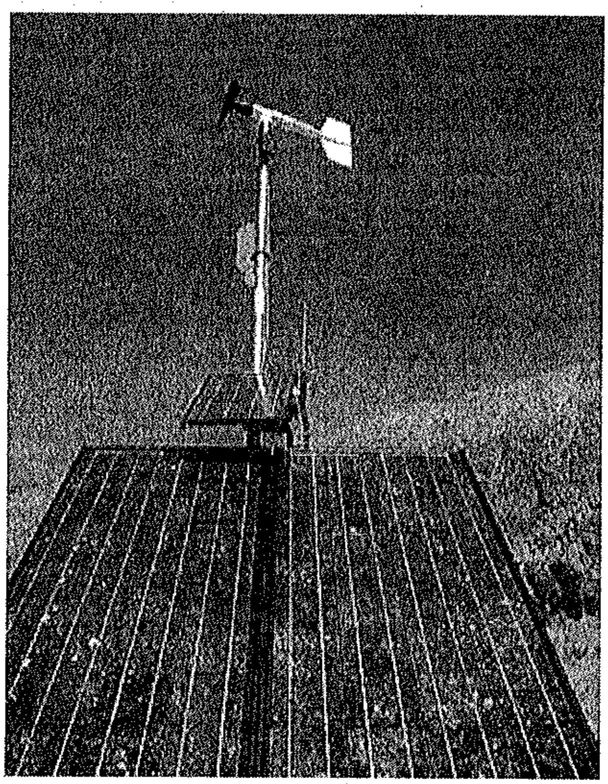
Renewable Energy

The United States produces 10 percent of its electricity from renewable energy, two-thirds of that from hydropower. While the amount of renewable energy seems low compared to other sources, its importance is increasing. The U.S. Department of Energy reports renewable energy will provide nearly 40 percent electricity growth through 2035, assuming existing state and federal incentives and state renewable electricity mandates continue. The United States has vast resources of wind, solar, geothermal, biomass and wave energy.

Nearly 7 percent of renewable energy comes from hydropower and 3.4 percent comes from other sources such as wind and solar. Wind is one of the fastest growing renewable technologies because it is often cheaper than new natural gas plants in some states. Wind power now produces about 2 percent of the nation's electricity, five times more than in 2005. Solar also is growing quickly. The nation generates eight times more solar energy than it did five years ago. Hydropower, currently the only renewable that provides large amounts of baseload power, is increasingly being used to offset the variability of wind power.

U.S. Renewable Supply

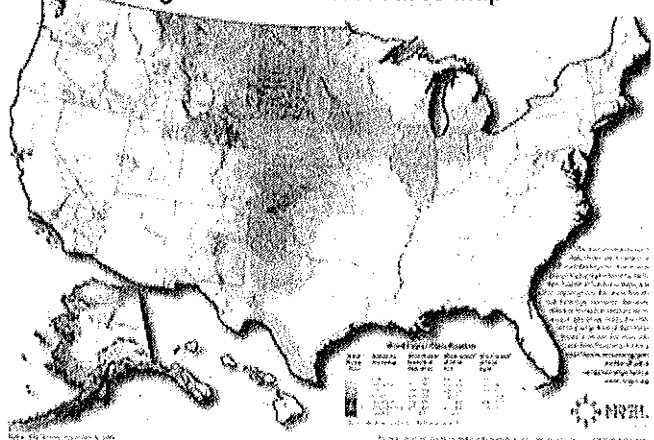
- The United States obtains 10 percent of its electricity from renewable energy
- Based on existing state and federal policies, nearly 40 percent of all new electric generation capacity added in the next 25 years is likely to be renewable.[22]
- The United States has a vast amount of untapped solar, wind, geothermal and biomass energy resources.



Renewable energy is as an attractive resource because it uses a domestic energy supply, allows states to produce their own energy, helps grow new technologies, promotes economic development and increases energy security. Although some types of renewable energy currently are more expensive than conventional electricity sources, states see its benefits as a reason to support its development. U.S. companies also are concerned about gaining a place in the global market. China, which views renewable energy as critical to its economic future, enacted policies that helped it become the world's largest producer of wind turbines and solar panels. The United States, once a leader in development of these technologies, now imports many wind turbines and solar products from China and Europe. As the global market for these technologies grows, some states fear that the United States may lose its place in the expanding global energy technology market.

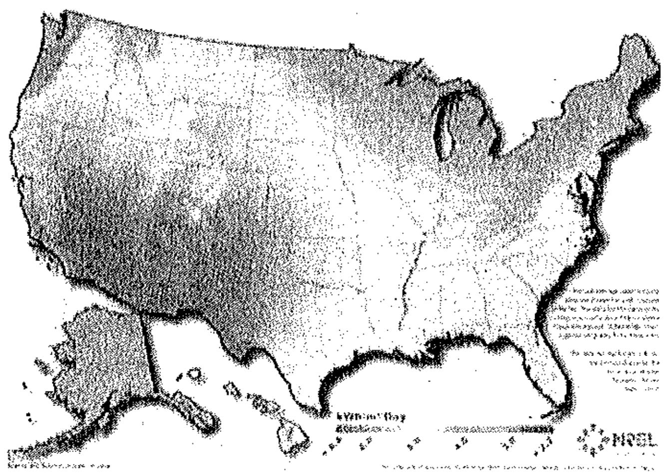
Some renewable energy—such as biomass (includes wood, municipal solid waste, agricultural waste), geothermal, and hydropower—provides a steady source of energy that can be used as baseload power. Sources such as wind and solar are intermittent, however, so other energy sources are needed when the sun is not shining or the wind is not blowing. In areas that use natural gas or where electricity markets cover a large area, there may be little challenge to integrating these intermittent sources. In regions where the energy grid is

Figure 14. Wind Resource Map



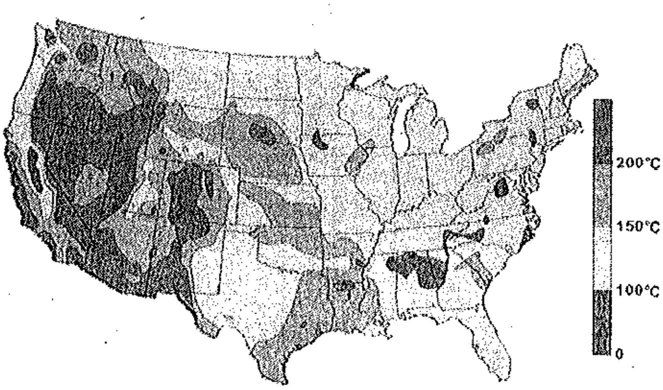
Source: National Renewable Energy Laboratories, 2009.

Figure 15. Solar Resource Map



Source: National Renewable Energy Laboratories, 2009.

Figure 16. Geothermal Resource Map



Source: U.S. Department of Energy, 2008.

not supplied with natural gas power and in smaller energy markets adapting to intermittent sources can be challenging and more costly. Thus, while wind and solar energy can play a role in the energy supply, they cannot be relied upon as the sole generation source unless large quantities of energy can be stored at low cost. Adding more renewable energy to the grid usually does not require that new gas power plants be built as backup, though it may be necessary depending on the size and energy mix of the electricity market.

Renewable energy is not distributed evenly throughout the country—much of the best wind is located from the Texas Panhandle northward through North Dakota, and tremendous wind resources are available off the East and West coasts of the United States (Figure 14) The southwest and to some extent the south is rich in solar (Figure 15). Biomass is plentiful in the South (Figure 16).

The Future of Renewable Energy

Many states have renewable energy incentives, and 29 require utilities to meet targets for acquiring power from renewable sources. These policies, along with federal production incentives, are likely to drive significant growth in the coming years—according to the DOE nearly 40 percent of all new electricity generation will come from renewable sources between now and 2035.

Compared to fossil and nuclear energy, renewable energy is in its infancy. As with all new technologies, it is expected to become less expensive as technologies mature and become mass produced. Although many types of renewable energy—such a solar, for example—command a premium, prices have been dropping. Falling prices are likely to accelerate adoption of renewable energy and reduce the need for incentives. Many states have been able to decrease their solar rebates due to the lower prices for solar panels. If federal climate legislation is enacted, the growth in renewable energy is likely to accelerate as fossil fuel generation becomes more expensive, according to DOE analysis.[23]

Cost

Producing electricity from renewable energy sources often is more expensive than obtaining it from coal or natural gas plants, although wind can be competitive in some regions. One consideration separating many renewables from conventional energy is that, since they have no fuel costs, they can provide stable and predictable long-term electricity costs. The barrier for many renewables, however, is the up front capital cost. The levelized cost of wind energy, ranging from about 6.5 cents per kWh to 11 cents per kWh, explains its tremendous growth in many states. Solar power, depending on the technology or location, may cost between 12 cents per kWh and 19 cents per kWh. Unlike less expensive wind energy, solar energy is produced during daytime peaks in energy consumption, which increases its value significantly. Some renewables—wind energy, biomass and geothermal energy—are competitive with energy prices in many parts of the nation. Some industry experts expect solar energy to compete with conventional power by 2015, particularly in the sunnier regions of the country. These costs include current federal subsidies. Table 2 illustrates cost summaries of various renewable technologies.

Table 2. Range of Levelized Costs of Renewable Energy in Cents/kWh (Includes government subsidies)

Wind	Biomass	Geothermal	Solar Thermal	Solar Photovoltaic
6.5 - 11¢	6.5 - 11.3¢	7.5 - 13.8¢	11.9 – 19.4¢	13.4 – 19.2¢

Source: Lazard 4.0, Levelized Cost of Energy Analysis, 2010.

Electricity prices play a significant role in the regional outlook for renewable energy. In coal-reliant states with low electricity prices, renewable energy technologies are more expensive than current energy prices, so it may be more challenging to implement them.

Environmental Factors

Most types of renewable energy create little or no air pollution or greenhouse gases. In addition, solar photovoltaic and wind energy need little or no water to operate, so they may be a good choice for regions where water supply is an issue. The exception is solar thermal power plants, which may use water in the cooling process, depending on the design.

Both wind and large-scale solar facilities can require significant land area. For example, a solar thermal plan uses between five and 10 acres of land per megawatt of electricity generated. Water also can be a concern for certain solar thermal electric plants that, like conventional power plants, need water to generate electricity. Installing both solar and wind can disturb the natural environment, so wildlife studies are often conducted before projects proceed. Bird and bat migration and flight patterns are important considerations for wind turbines since poorly located turbines can cause excessive deaths.

State Action

All states provide incentives to support renewable energy development. These efforts are motivated by the desire to promote economic development, address air quality and greenhouse gas concerns, hedge against fluctuations in fuel costs and expand the diversity of the energy mix.

State legislatures are actively engaged in energy policy, as the 29 states with renewable electricity mandates clearly show. States are adopting policies to create the demand that will push development of renewable energy technologies and make them more competitive. To date, 29 states and the District of Colombia have adopted these standards, which range up to 33 percent, although most are between 20 percent and 25 percent. Target dates also vary, but most fall between 2015 and 2025. States also provide a variety of other renewable energy support policies, including tax incentives, rebates, grants, revolving loan funds and expedited siting.
So far, the rate increases due to the policies have been less than 1 percent for most states with these standards, according a report by the Lawrence Berkeley Laboratory.[24]

Federal Action

The federal government provides a significant amount of assistance for all forms of renewable energy, including grants, research and development, technical support and tax credits. Wind and geothermal energy receive extra tax credit of 2.1 cents per kWh generated. Solar, fuel cells, small wind and geothermal also receive a 30 percent investment tax credit, which can make a large dent in purchasing costs. The American Recovery and Reinvestment Act (ARRA) is providing $4 billion in loan guarantees for renewable energy projects.[25] The current federal production tax credit for renewable energy is set to expire on Dec. 31, 2013.

Energy Demand and Supply — State Policy Options

Coal Technology

1. Coal Gasification

Coal gasification generates fewer pollutants than pulverized coal plants although it emits carbon dioxide (CO2) at rates equivalent to a modern supercritical pulverized coal plant. Coal gasification plants are 30 to 50 percent more expensive to build than pulverized coal plants. To encourage use of this new technology, 17 states offer incentives for coal gasification. Incentives include property tax exemptions and bond issuance support for coal gasification equipment and facilities. Alabama, Connecticut and Virginia also have considered adding gasification to their state energy plans. For more information on gasification technology, see www.fossil.energy.gov/programs/powersystems/gasification/index.html.

2. Carbon Capture and Sequestration for Coal Plants

Tax Incentives

Fourteen states use incentives to encourage carbon capture and sequestration (CCS) to reduce greenhouse gas emissions. New Mexico established an advanced energy tax credit worth up to $60 million for electric power plants that capture and sequester their CO2, and monitor the CO2 sequestration sites. Texas offers a sales tax exemption for components used in CCS.

Liability

A major barrier to long-term CO2 storage is ownership and liability, so states that wish to encourage carbon sequestration will need to resolve these issues. Laws in eight states concern liability of pore space owners and long-term management of sequestration sites. The pore space is the place deep underground where CO2 is injected and stored. States could assign long-term liability to the state, the site operator or the landowner or can create joint liability for sites. Illinois has assumed liability associated with the FutureGen project's sequestered CO2, as well as any current or future environmental benefits, marketing claims, tradable credits, emissions allocations or offsets. In Wyoming, the sequestration site operator owns the CO2 and is liable during site operation. The owner of the pore space where CO2 is deposited is not liable for any effects of geologic sequestration.

Transportation of Carbon Dioxide

Transporting CO2 from the point of capture to an appropriate storage formation will require additional pipeline construction in order for CCS to become more widely deployed in the coming years. The U.S. already has approximately 3900 miles of CO2 pipeline, which is used primarily by the oil and gas industry for enhanced hydrocarbon recovery. Jurisdiction for pipeline safety currently resides with the Office of Pipeline Safety (OPS) under the Department of Transportation (DOT) and the jurisdiction over siting is with the states. Rates for CO2 pipelines generally are set by contract. Expansion of the interstate CO2 pipeline system may require modifications to existing state regulations and creation of new regulations in states without such regulations.

Natural Gas

1. Interstate Collaboration on Pipeline Permitting and Siting

Two-thirds of the lower 48 states depend on the interstate pipeline system for their natural gas, so collaboration between states on pipeline development is important. Legislation pending in Pennsylvania, the "Mid-Atlantic Area Natural Gas Corridor Compact Act," would authorize the state to join the Mid-Atlantic Natural Gas Corridor Compact. The compact promotes cooperation regarding approval and construction of interstate natural gas pipelines in the Mid-Atlantic region. Development of a regional pipeline siting council will facilitate the siting interstate natural gas pipelines within the compact.

2. Performance Standards for New Power Plants

Several states who want to reduce air pollution and greenhouse gas emissions have passed performance standards that require in-state power plants to meet CO2 emissions standards equal or better than natural gas power plants. These standards have been implemented in California, Oregon and Washington.

3. Ensuring Adequate Capacity

Possible reasons for gas pipeline outages include maintenance, temporary decreases in market demand and weather-related limitations to operations. Oklahoma recently enacted SB 2169, creating the Task Force on Tax Incentives to Increase Natural Gas Pipeline Capacity. The task force is studying relevant tax incentives available to the natural gas pipeline transmission industry to determine the extent to which such incentives are used and whether incentives affect pipeline capacity.

Transmission

1. Consider Non-transmission Alternative

A range of options are available that can help extend the life of existing transmission lines and reduce congestion on overburdened lines. Some approaches include energy demand management programs, better energy efficiency and the development of distributed generation. The National Council on Electricity Policy publication, *Updating the Electric Grid: an Introduction to Non-Transmission Alternatives for Policymakers*, provides an overview of these options. See www.ncouncil.org/Documents/National%20Council%20Non%20Transmission%20Alternatives%20FINAL_web%20version.pdf.

2. Create Transmission Infrastructure Authorities to Facilitate Transmission Infrastructure Development

Transmission infrastructure authorities facilitate the necessary planning and coordination to build transmission lines. In some states, they are authorized to offer revenue bonds to finance new transmission and coordinate interstate planning. The Wyoming Infrastructure Authority has received significant support from the Wyoming Legislature. A $1.6 million operating budget was approved for 2007-2008, and $10 million was available for project development support. The Wyoming authority can issue up to $1 billion of revenue bonds to finance transmission projects. For a summary of infrastructure authority activity, see the transmission update at www.nationalwind.org/assets/publications/NWCCtransmissionupdateOct07FINAL.pdf. Also see wyia.org/projects/ for more information about Wyoming's program.

3. Create Renewable Energy Zones

Several states are developing transmission plans to coordinate development of high-value renewable areas with new transmission lines. These plans identify the regions richest in renewable energy resources and suggest the most cost-effective transmission options to use these resources. Development of these regional zones harmonizes transmission and renewable development. Some states, including Colorado and New Mexico, have created transmission authorities to coordinate new transmission investment, much of it focused on supporting renewable energy. For a description of California's plan, see the Transmission Update at www.nationalwind.org/assets/publications/NWCCTransmissionUpdateAug08.pdf. A description of the Texas effort is available at www.wind-coalition.org/policy/transmission. Texas was able to finance its lines based on net consumer savings. The cost for wind and transmission development were repaid by savings from lower natural gas demand and prices.

4. Right-Sizing Transmission Lines

It is important to plan for future growth by building lines with enough capacity to handle the growth that may occur in the future. This can prevent the need for future upgrades, which are far more costly than building large enough lines the first time. Ensuring that future growth is incorporated into current transmission projects will make the best use of available corridors and reduce environmental disturbance. The incremental cost of building larger lines is much less than the cost of obtaining new permits and coordinating with landowners to increase line capacity in the future.

5. Address Cost Allocation and Cost Recovery

The Federal Energy Regulatory Commission (FERC), regional transmission organizations (RTOs) and public utility commissions (PUCs) have jurisdiction over transmission lines, depending on various factors. An overview of the process and how policymakers can address cost allocation and recovery challenges is available at www.eesi.org/electric-transmission-201-cost-allocation-09-mar-2010. Another resource is Lawrence Berkeley Laboratories' publication, *Transmission Benefit Quantification, Cost Allocation, and Cost Recovery* available at certs.lbl.gov/pdf/cost-allocation.pdf. The Federal Energy Regulatory Commission is proposing new cost-allocation rules to "ensure that transmission services are provided on a basis that is just, reasonable and not unduly discriminatory or preferential." Information about the new rules is available at www.ferc.gov/news/news-releases/2010/2010-2/06-17-10-E-9-factsheet.pdf.

6. Expedite Transmission Siting

Siting authority varies by state, but some have considered fast-tracking transmission line siting for various reasons. Kansas created an expedited siting policy that allows a 120-day maximum time within which the Public Utility Commission must decide on a transmission siting application. Kansas does not require siting permission for line upgrades in existing rights of way. An NCSL planning and siting publication is available at www.ncsl.org/Portals/1/documents/energy/transbrochure.pdf. Lawrence Berkeley Laboratories' publication on transmission line siting and permitting is available at certs.lbl.gov/ntgs/issue-5.pdf.

Nuclear Energy

1. Expedited Permitting Laws

State laws to simplify the permitting process by creating a lead agency can allow construction within a shorter time frame and reduce financing costs. Due process for safety and security still are recommended. Florida's Electrical Power Plant Siting Act is widely referred to in the electricity sector (see www.leg.state.fl.us/Statutes/index.cfm?App_mode=Display_Statute&URL=Ch0403/part02.htm&StatuteYear=2008&Title=->2008->Chapter 403->Part II).

2. State-Level Financing Support Mechanisms

Some states allow utilities to recover financing costs and return on equity during new plant construction through timely rate increases. This practice can dramatically reduce project interest costs. A 2009 Georgia law (SB 31) allows utilities to recover financing costs from ratepayers during construction of a nuclear power plant in the state. Georgia Power estimates this will save ratepayers around $2 billion in total financing costs for their 46 percent share of the new two-reactor Vogtle nuclear plant project under construction. Similar legislation has been enacted in Florida, Kansas, Mississippi, South Carolina, and Virginia to encourage new power plant development. FERC also offers similar financial support for construction of new transmission lines.

In states where electricity markets are deregulated, long-term power purchase agreements (PPAs) can help reduce financing costs for new power plants by guaranteeing cash flow and cost recovery. State-based loan guarantees or bonding authorities also can help lower financing costs for nuclear power or other energy technology projects.

3. Tax Incentives

States are using various tax policies to create incentives for nuclear plant development. Kansas (House Bill 2038, enacted in 2007), Texas and Utah tax policies include property tax abatement.

4. Education and Training

Twenty-eight states have developed state energy consortia to develop skilled craft worker and professional energy workforce programs; 18 are in states that have nuclear plants and nuclear-specific goals. These energy consortia have supported two-year and four-year education and advanced degree programs to meet workforce needs. In working with utilities, legislators can create opportunities for aligning workforce education programs with utility needs, thus ensuring that local training leads to job opportunities.

5. Incentives for Domestic Production of Power Plant Technology

Tax incentives and other policies that encourage nuclear power development can support the technologies and promote domestic production of components necessary to build, operate and maintain nuclear plants. The emerging U.S. nuclear supply chain can serve existing and new nuclear plants both here and abroad, presenting export opportunities for American products.

6. Revise or Repeal Nuclear Moratoria

Changing or repealing nuclear moratoria is the first step to promoting nuclear energy in states that have such prohibitions. With enactment of its "Alaska Sustainable Energy Act," (SB 220), the state repealed its nuclear ban and provided incentives for small-scale nuclear projects by making them eligible for funding from the state's Power Project Loan Fund (see www.legis.state.ak.us/basis/get_bill.asp?bill=SB%20220&session=26).

7. Site Suitability Studies

States are promoting research to find suitable sites for new nuclear power plants. Iowa's newly enacted House File 2399 will expedite the nuclear permitting process by completing part of the initial environmental scoping to let utilities know that nuclear sites are welcome within a given community. For more information about Iowa's effort, see coolice.legis.state.ia.us/Cool-ICE/default.asp?Category=billinfo&Service=Billbook&menu=false&hbill=HF2399.

8. Defining Nuclear as Clean Energy

Ohio's Advanced Energy Portfolio Standard (SB 221, enacted in 2008) allows half its standard to be met with low carbon, non-renewable sources such as clean coal or nuclear energy. In 2009, Utah enacted amendments (HB 430) to its Renewable Energy Development Act to provide incentives to nuclear and other clean energy facilities.

9. Decommissioning Trust Fund Support

To encourage construction of new nuclear plants in Texas, the state provides a financial guarantee to allow use of sinking funds for nuclear decommissioning trust funds. This provides a significant cost savings for plant developers in merchant markets because it allows the utility to provide funding over a much longer time. This mechanism usually is available only in rate-regulated jurisdictions. The Texas bill (H.B. 1386) gives the Public Utility Commission of Texas (PUCT) authority to regulate decommissioning trust funds. It includes a state guarantee to support a sinking fund mechanism for up to six new nuclear power plants under construction before 2015. (Bill text is available at www.legis.state.tx.us/tlodocs/80R/analysis/html/HB01386E.htm).

Energy Efficiency

1. System Benefit Funds

Twenty states have implemented these programs, which are funded by fees added to consumer utility bills. The funds are used by the utility or other entity to implement energy efficiency efforts such as rebates, energy audits and weatherization.

2. Energy Efficiency Resource Standards

Fifteen states have implemented these standards, which require utilities to meet a percentage of annual demand with energy efficiency measures. States have chosen various targets—Illinois will require up to 2 percent per year by 2015, and Massachusetts will require utilities to hit 2.4 percent per year from 2012 onward. Some states allow combined heat and power systems to count toward the standard. These systems use waste heat from natural gas or coal plants to generate power or to heat buildings.

3. On-Bill Financing, Property-Assessed Clean Energy Financing

These policies allow consumers to finance their energy efficiency or renewable energy upgrades through property tax assessments or payments on their monthly energy bill. They offer low-cost financing that removes the large upfront costs that often prevent energy efficiency upgrades. Energy savings usually are more than the increased assessment. (For more information, see NCSL's publication on the issue at www.ncsl.org/default.aspx?tabid=19561).

4. Energy Service Contracting (Performance Contracting)

States have set up programs that allow schools, government buildings and private building owners to finance energy efficiency improvements with energy savings gained through improvements. At least 20 states support energy services contracting by providing technical or monetary support through grants and loans.

5. Preferred Resource Requirements

Some states require utilities and the public utilities commission give energy efficiency priority in meeting energy demand, considering new power sources only after energy efficiency measures are implemented.

6. Smart Grid Technologies

Laws in at least eight states authorize utilities to install smart grid technologies, such as smart meters at homes and buildings. Some of these policies encourage use of this technology to reduce energy consumption. (See www.ncsl.org/documents/energy/Windpermit0406.pdf for more information about state efforts to promote smart grid technology.)

7. Decoupling

Decoupling involves removing a major utility disincentive for promoting energy efficiency, which lowers electricity consumption, which can result in lower sales and lower profits. By weakening or breaking the link between revenue and sales, decoupling allows utilities to recover fixed costs and earn authorized revenue even if sales fall, which can make energy efficiency programs more appealing. California, Connecticut, Idaho, Maryland, New York and Vermont have all created market structures that decouple profits for one or more electric utilities.

8. Energy Code Improvements

Since most of U.S. electricity is used in buildings, addressing building and energy codes can help to increase efficiency. Laws in several states require commercial and residential housing to meet or surpass national energy code standards or their equivalent. Many states with standards do not have the necessary training and enforcement to ensure compliance, however. The Building Code Assistance Project provides information on both residential and commercial energy codes nationwide and ranks code energy efficiency at bcap-ocean.org/code-status-map-commercial. A DOE map of state energy codes and their status, along with other energy code information, is available at www.energycodes.gov/states/.

9. Energy Standards for Public Buildings

At least half the states have some energy efficiency requirement for new construction or renovation of publicly funded buildings. Although most of these requirements do not pertain to existing buildings—which represent the bulk of energy consumption—some states also require or set goals for energy reduction in existing state buildings. (See http://www.ncsl.org/default.aspx?tabid=12987 for a description of state mandates and goals.)

10. Educational Training

To ensure that the workforce is prepared for energy efficiency and renewable energy jobs, states are investigating ways to create educational and training programs to train prospective workers. New Mexico, for example, passed the Green Jobs Bonding Act (HB. 622) in 2009, which creates a fund for green jobs training programs, authorizes issuance of green jobs revenue bonds, and sets procedures to implement grants for green jobs training programs to higher education. (See http://www.ncsl.org/?tabid=20739 for 2010 green jobs legislation.)

Renewable Energy

1. Renewable Electricity Standards

Renewable electricity standards, also called renewable portfolio standards, require utilities to produce a percentage of the electricity they sell from renewable sources. Twenty-nine states and the District of Columbia have such requirements, under which electricity providers generally must meet targets for obtaining from 10 percent to 33 percent of power for retail sales from renewable generation. States often require that part of the standard be met with solar or other types of renewable energy. For more information about these standards, visit NCSL's online summary of state efforts at /www.ncsl.org/default.aspx?tabid=17571 and the NCSL article exploring state efforts to meet renewable electricity standards at www.ncsl.org/default.aspx?tabid=16661. Several National

Renewable Energy Laboratory reports are available that examine best practices and lessons learned from existing renewable electricity standards: www.nrel.gov/analysis/scepa_rps.html.

2. Economic Impacts

As states decide which type of energy to add to meet growing demand, some emphasized the long-term economic impact of their energy choices. Colorado requires its public utilities commission to evaluate the effects of energy resource choices on employment and long-term economic viability in local communities.

3. Net Metering

Net metering allows ratepayers with on-site renewable energy generators—such as small windmills or rooftop solar panels—to count their energy production against their energy consumption, basically allowing the meter to turn backward when energy is produced. Forty-three states offer net metering, although the approaches vary dramatically. Variations include system size, whether customers can carry excess generation over from month to month, and whether customers can receive money from the utility for excess generation. For more information, see *Connecting to the Grid: A Guide to Distributed Generation Interconnection Issues* at irecusa.org/wp-content/uploads/2009/11/Connecting-to-the-Grid-Guide-6th-edition.pdf.

4. Interconnection Standards

Many states have interconnection standards that set procedures for how the utility connects a renewable energy system—such as a house or building with solar panels—to the electric grid. Without standards, utilities may be less willing to install renewable energy. For more information, see *Connecting to the Grid: A Guide to Distributed Generation Interconnection Issues* at irecusa.org/wp-content/uploads/2009/11/Connecting-to-the-Grid-Guide-6th-edition.pdf.

5. Production Incentives

To address the difference in cost between renewable and conventional energy, several states provide production incentives to renewable energy producers. Iowa, for example, offers large wind producers a production tax credit of 1 cent per kilowatt-hour; owners of smaller turbines, such as farms, receive 1.5 cents per kilowatt-hour.

6. Feed-in Tariffs

The feed-in tariff, a type of production incentive, has been widely used in other countries as a renewable energy incentive, particularly for solar energy. A feed-in tariff sets a long-term above-market payment for renewable electricity produced by commercial, residential customers or other providers of renewable energy. Under a 2009 law (HB 445), Vermont was among the first states to implement this policy, which allows renewable energy providers to receive a guaranteed rate for 10 to 20 years. Under the Vermont feed-in tariff, for example, owners of wind turbines receive 21.4 cents/kWh; landfill gas providers receive 9 cents/kWh; farm methane providers get 14.1 cents/kWh; hydropower receives 12.2 cents/kWh; biomass producers get 12.5 cents/kWh and solar producers get 24 cents/kWh. Other examples of feed-in tariff policies can be found in Oregon, which passed a law mandating a pilot program, and Hawaii, where the PUC approved use of the feed-in tariff, although the implementation details are still being finalized. Utilities in Indiana, Florida, Michigan, Texas, and Wisconsin offer tariff payments for renewable energy. The National Renewable Energy Laboratory explores feed-in tariffs in An Analysis of Renewable Energy Feed-in Tariffs in the United States, available at www.nrel.gov/analysis/pdfs/45551.pdf.

7. Tax Incentives

Many states provide a range of tax incentives for renewable energy, including sales tax, income tax and property tax reductions.

8. Standardized Permitting Requirements

States have implemented streamlined and standardized permitting requirements for renewable energy development. These requirements are intended to reduce overly restrictive local siting policies for renewable energy and harmonize renewable energy permitting and siting rules statewide. Many states have also created laws that restrict homeowner association bans on renewable energy systems siting on homeowner property.

9. System Benefit Funds

These funds are collected through small fees added to consumer utility bills. In 20 states, utilities or other entities use these funds, for renewable energy. Various states use the funds for rebates on renewable energy equipment, grants for demonstration projects, and grants for research and development.

10. Grants, Rebates, Revolving Loan Funds

States have used a variety of funding sources, including grants for research and demonstration projects; rebates to defray consumer costs for various technologies; and low-interest loan programs for more affordable financing.

11. Educational Training

To ensure that a workforce is prepared for energy efficiency and renewable energy jobs, states are investigating ways to create worker educational and training programs. New Mexico, for example, enacted the Green Jobs Bonding Act (HB 622) in 2009, which creates a fund for green jobs training, issues green jobs revenue bonds, and provides grants for green jobs training programs to higher education.

Solar

1. Solar Set-Aside in Renewable Electricity Standard

One of the strongest solar power incentives is the solar set-aside, which requires that a specific amount of a renewable electricity standard be met with solar. Sixteen states have solar or distributed generation set-asides, ranging from 0.2 percent for solar in North Carolina to 4 percent in New Mexico. This approach can support technologies that offer benefits not provided by a less expensive renewable energy alternative. Solar, for example, is well-suited to placement on buildings and houses, closest to where electricity is used. This reduces the cost of building and maintaining transmission lines and avoids some energy development siting. Set-asides support new technologies such as solar until they can achieve the cost benefits of mass production.

2. Property Assessed Clean Energy Financing, On-Bill Financing

These policies allow consumers to finance solar energy systems through property tax assessments or payments on monthly energy bills. Laws in 20 states allow local governments to set up such programs to help consumers finance renewable energy equipment purchases at low rates. In many cases, the payments are equal to or less than the amount the new solar panels save the consumer on energy. (For more information, see NCSL's publication on the issue at www.ncsl.org/default.aspx?tabid=19561.)

Note: The Federal Housing Finance Agency in July 2010, announced that they support the mortgage companies Fannie Mae's and Freddie Mac's negative view of these programs, which has led to the suspension of all state programs for property assessed renewable energy financing. This is despite the federal government's support, sometimes financial for these programs. California attorney general is planning a major action against Fannie and Freddie regarding their blockage of this state financing program.

3. Third-Party Ownership Legislation

Some companies allow consumers to lease solar panels or set up power purchase agreements. These programs allow a third party to install and maintain the system and to receive compensation through lease payments or payments for the electricity produced from the rooftop solar. This means a homeowner—or nonprofit or school—can take advantage of solar with little or no up-front cost, sometimes for the same price as the normal electricity bill. Since the company that owns the solar equipment takes advantage of the tax credits to lower its costs, non-taxed entities such as nonprofit organizations and schools can use the technology. Because companies that offer this service may be classified as a utility, they cannot operate in many states. A 2009 Colorado law (SB 51) allows such companies to operate without being designated as utilities.

Wind

1. Expedited Permitting and Siting

The time needed to permit a wind project varies by state, and long permit times can not jeopardize a developer's ability to coordinate financing but also can increase costs. To address both this issue and the challenge posed by disparate township and county siting regulations, some states have expedited permitting requirements for renewable energy proposals; state agencies must respond more quickly to proposals and permits. Some, like Wisconsin (see http://irecusa.org/2010/06/wisconsin-psc-seeks-public-comment-on-proposed-wind-siting-rules/), also are considering uniform wind siting standards. These standards often address tower height and setback from the property line to prevent overly burdensome city and county regulations. The rules are being established in consultation with the Wisconsin's Wind Siting Council, which was created by the Legislature to develop uniform state siting rules. (NCSL's siting publication, *State Permitting and Siting of Wind Energy Facilities*, produced in collaboration with the National Wind Coordinating Collaborative, is available at www.ncsl.org/default.aspx?TabId=19630.)

Biomass

Many biomass incentives fall under state renewable electricity standards. The types of biomass eligible under the standards vary by state. In some states, municipal solid waste combustion and waste-to-energy programs are eligible, while in others use of this biomass resource is limited. Many states also use various policies listed under the general renewable heading— such as grants, tax breaks and production incentives—to encourage biomass energy production.

Geothermal

States have numerous incentives for geothermal energy, many of which fall under renewable electricity requirements, grants, tax incentives and other policies.

Small Hydropower

Many states support small hydropower projects through renewable electricity requirements, tax credits and grants.

Like most power projects, small hydropower faces permitting application delays. Streamlining the permitting process and accelerating permitting agencies' response times can reduce the costs and uncertainty connected to development of these projects.

Zoning changes also can affect these projects. Classifying small hydropower as a beneficial use for zoning purposes could increase the incentive to build these projects.

Producing a report on the best resource areas with lowest environmental impact and developing best practices for these resources is an important first step in determining which state policies can best promote small hydropower.

Glossary

Baseload Energy The amount of electric power a utility must supply constantly to meet the demand for energy.

Baseload Power Plant Power plants that provide consistent power in order to meet the continuous energy demand on the electric grid. These are often coal or nuclear power plants, though natural gas baseload power plants are becoming more common. Some forms of renewable energy—including hydroelectric, geothermal, biogas, biomass and solar thermal with storage—also can provide baseload power.

Carbon Dioxide (CO_2) Carbon dioxide is a product of fossil-fuel combustion, as well as many natural biological processes. Atmospheric CO_2 traps heat in the Earth's atmosphere and is considered a greenhouse gas.

Carbon Capture and Storage (Sequestration) A process of capturing carbon dioxide (CO_2) from large point sources such as power plants, and storing it for long periods of time. Geologic formations such as oil fields, gas fields, saline formations, coal seams, and saline-filled basalt formations have been suggested as possible storage sites.

Clean Coal Technologies A term to describe technologies being developed that aim to reduce the environmental impact of coal-fired power plants. These technologies— such as integrated gasification combines cycle (IGCC) and carbon capture and storage—allow coal to generate energy while releasing far fewer pollutants.

Coal Gasification The heating and partial combustion of coal to release volatile gases, such as methane and carbon monoxide; after pollutants are washed out, these gases become efficient, clean-burning fuel.

Decoupling A technique that separates or 'decouples' the connection between sales and profits for utilities. For the typical utility, a decline in sales often leads to a decline in earnings, which means that reductions in consumption due to energy efficiency, or rooftop solar, can result in declining profits. If decoupling is put in place, the rate of a utilities profit is not based on the amount of electricity sold, removing a major utility disincentive for energy efficiency.

Deregulated Energy (Electricity) Market Instead of setting regulated prices for wholesale electricity, state with deregulated electricity allow wholesale prices to be determined by competitive markets. Deregulated states may also allow full consumer choice when it comes to electricity retail sales companies.

Distributed Generation Generating resources, such as rooftop solar or small wind on a farm, which are located close to or on the same site as the facility using the power.

Distribution Lines After transmission lines bring the power from generating facilities to substations and the voltage is reduced, distribution lines carry this lower voltage electricity to homes, farms and businesses.

Energy Code Relates to energy usage conservation requirements and standards in building and homes, often covering insulation, windows, heating and cooling.

Energy Efficiency Energy efficiency refers to getting the same amount of service (heating and air conditioning, refrigeration, lighting etc) while using less energy.

Energy Efficiency (Resource) Standard A standard which requires electric or gas utility companies to increase energy efficiency, usually by a specified percentage each year.

Energy Information Administration (EIA) A statistical and analytical agency within the U.S. Department of Energy. EIA collects, analyzes, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets and public understanding.

Federal Energy Regulatory Committee (FERC) An independent agency that regulates the interstate transmission of natural gas, oil, and electricity. FERC also monitors and investigates energy markets and it highly involved in electricity transmission line development.

Independent System Operator (ISO) An organization formed with the direction or recommendation of the Federal Energy Regulatory Committee (FERC). ISO's coordinate, control and monitor the operation of electrical power systems in a specific state or region.

Integrated Gasification Combined Cycle (IGCC) Technology A clean-coal technology that combines coal gasification with combined cycle power generation. Coal, water and oxygen are fed to a gasifier, which produces syngas. This medium-Btu gas is cleaned (particulates and sulfur compounds removed) and is fed to a gas turbine. The hot exhaust of the gas turbine and heat recovered from the gasification process are routed through a heat-recovery generator to produce steam that drives a steam turbine to produce electricity

Levelized Energy Cost An economic assessment of the cost of the energy-generating system. Levelized costs include lifetime operating costs, such as initial investment, operations and maintenance, fuel costs, and the costs of financing.

Long-Term Power Purchase Agreement An agreement between an electricity generator and a power purchaser, where the purchaser agrees to purchase electricity for a long period of time, often 20 years, for a fixed price. Such agreements play a key role in the financing of independently-owned electricity generation.

North American Electric Reliability Corporation (NERC) A nonprofit organization that oversees eight regional reliability entities and encompasses all of the interconnected power systems of the contiguous United States, Canada and a portion of Baja California in Mexico.

Nuclear Regulatory Commission (NRC) An independent federal agency created in 1974 to license and regulate nuclear power plants.

On-Bill Financing An approach that can be used by utilities, in which customers are allowed to finance the cost of energy efficiency improvements through the utility which then collects the loan payments on the monthly utility bill.

Peak Demand The point at which demand for electricity reaches its highest level, usually occur in the morning hours from 6 a.m. to 9 a.m. and during the afternoons from 4 p.m. to about 9 p.m. Afternoon peak demand periods are usually higher, particularly during summer months.

Pore Space The open spaces or voids in rock or soil. This is the space where CO_2 is injected during sequestration.

Public Utility Commission A governing body that regulates the rates and services of a public utility.

Regional Transmission Organization (RTO) An organization that is responsible for moving electricity over large interstate areas. RTOs coordinate, control and monitor an electricity transmission grid that has higher voltages than a typical power company's distribution grid.

Regulated Energy (Electricity) Market Utilities are primarily responsible for their own generation, transmission and distribution of power to all of the retail customers in the service territory.

Smart Grid Delivers electricity from suppliers to consumers using two-way communications technology to improve the way electricity is transmitted and consumed. May help increase efficiency, reduce cost and increase reliability.

Solar Thermal Power A technology for harnessing solar energy for thermal energy (heat). High temperature collectors concentrate sunlight using mirrors or lenses to concentrate heat, generate steam and generate electricity.

Supercritical or Ultra Supercritical Pulverized Coal An advanced technique using coal for the generation of electricity. It uses a high pressure and high temperature combustion system to burn coal more efficiently, producing fewer emissions than traditional coal fired power plants.

Third Generation Nuclear Power Plants Generation III nuclear reactors were certified by the Nuclear Regulatory Commission in the 1990s, and offer extended service life, improved fuel technology, superior thermal efficiency, passive safety systems and standardized designs for reduced maintenance and capital costs.

Notes

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LINKS AND RESOURCES

Agency/Department Directives, Orders, Policies and Guidance

- DOE Directives, Orders and Policies: www.energy.gov/about/guidance_documents.htm
- EPA Rulemaking Gateway: yosemite.epa.gov/opei/RuleGate.nsf/
- EPA Significant Guidance Documents: www.epa.gov/lawsregs/guidance/index.html
- FERC Documents and Filings: www.ferc.gov/docs-filing/dec-not.asp
- NRC Commission Documents: www.nrc.gov/reading-rm/doc-collections/commission/

American Recovery and Reinvestment Act of 2009 - Recovery.gov is the U.S. government's official website that provides easy access to data related to Recovery Act spending (http://www.recovery.gov/Pages/home.aspx)

- U.S. Department of Energy: www.energy.gov/recovery/index.htm
- Summary of ARRA Spending for Energy: www.energy.gov/recovery/breakdown.htm
- U.S. Environmental Protection Agency: www.epa.gov/recovery/
- U.S. Department of the Interior: recovery.doi.gov/

NCSL Energy Policy Resources

- NCSL resources on most energy policy issues are available online and upon request. These include publications, reports, presentations and legislative summaries on energy efficiency, energy security, electricity transmission, renewable electricity standards, carbon sequestration, climate change, smart grid, green jobs and many others.
- Recent energy-related publications are available at www.ncsl.org/?tabid=19630.
- Bill summaries and information about recent legislative activity on a variety of energy topics are available in the NCSL Energy Legislation Database at www.ncsl.org/?tabid=13011.
- Contact the NCSL energy program at (303) 364-7700.

Meeting the Energy Challenges of the Future
A Guide for Policymakers

Meeting the Energy Challenges of the Future: A Guide for Policymakers provides an overview of the challenges facing states as they attempt to meet the electricity demands of the 21st century. It investigates regional diversity, fuel sources, and the economic and environmental effects of energy choices. This guide also explores the long-term supply outlook, options for meeting growing energy demand, the challenges of building and updating the electricity transmission and distribution system, and options for improving efficiency. It includes a detailed analysis of the various fuel sources, including nuclear energy; fossil fuels; renewable sources such as wind, hydropower and solar; and energy efficiency. Policy options are included for each of the critical energy issues discussed in this report.

The report was developed under direction of the NCSL Task Force on Energy Supply, which was formed in 2009 to consider potential solutions to the nation's energy challenges. The goal of this report is to facilitate discussions within each state to define energy needs and determine policies that will best achieve reliable, efficient and cost-effective electricity production, transmission and distribution.

National Conference of State Legislatures
The Forum for America's Ideas

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NCSL NEWS

July 25, 2010

How Will States Meet the Energy Challenges of the Future?

A new guide for state policymakers highlights various resource, technology and policy solutions.

- Energy Supply Task Force
- Legislative Summit
- Energy Task Force Report
- Legislative Summit Multimedia
- Press Room
- Press Release Archives

The cost of cooling and heating a home, rising fuel prices and the availability of finding alternative energy sources are all issues capturing headlines in newspapers and at state capitols across the country.

Recognizing this increased interest in energy policy among state legislatures, the National Conference of State Legislatures' (NCSL) Executive Committee formed the Task Force on Energy Supply in 2009.

After a year of studying resources, technology and policy solutions from across the country, the Energy Task Force has released a new publication, "Meeting the Energy Challenges of the Future: A Guide for Policymakers" at NCSL's 36th annual Legislative Summit in Louisville, Ky. It contains principles that state legislators could employ when trying to determine how they will keep the lights on in the future.

- Meagan Dorsch
Media Manager
Denver
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"This task force recognizes the influence state legislators can have in shaping energy policies," said Representative Tom Holbrook of Illinois. "Lawmakers across the country can use this report to help engage their utilities and regulators in meaningful dialogue about how to meet the future energy needs of each state and region."

"Meeting the Energy Challenges of the Future: A Guide for Policymakers" provides analysis of various fuel sources, energy efficiency, development and issues facing the current energy delivery infrastructure, including transmission. Highlights include:

- A look at what new energy supplies will be needed in the next 20 years and the various options available to meet new demand for electricity.
- A review of how the nation's electricity production and supply systems function and the role of state, local, utility and federal policy in regulation.
- An exploration of various energy resource impacts on the environment and the influence of climate change policies on planning for the future.
- A summary of policy options available to state legislators to address a broad array of energy issues, including transmission, cleaner coal technologies, renewable energy, natural gas, energy efficiency and nuclear energy.

One important challenge we found is that there is no "one-size fits all" approach that will work for every state. Given the current financial constraints, each state or region will have to make decisions that make economic sense for their constituents," said Representative Al Carlson of North Dakota.

Meeting future energy needs, as demonstrated in this report, lies not just in one source or technology, but in the combination of many technologies and resources, which are likely to include energy efficiency, natural gas, cleaner coal technologies, nuclear energy, smart grid technologies and renewable energy. Since the difference in resources and costs can vary dramatically among states, the choice of technologies and policies may also vary. The costs, benefits and challenges of all the different resources and technologies are discussed in detail within the NCSL Energy Supply Task Force report.

The chairs of the NCSL energy supply task force will be available for interviews at the Kentucky International Convention Center (KICC) at 10:30 - 11:30 a.m. in the NCSL press conference room, 114 of the convention center.

Registered members of the media are welcome to attend. Local media who are interesting must register at the NCSL press office, room 113 of the convention center. Reporters who would like to schedule an interview with one of the task force chairs may call the NCSL press room at 502-815-6870 to set up a time.

NCSL is a bipartisan organization that serves the legislators and staffs of the states, commonwealths and territories. It provides research, technical assistance and opportunities for policymakers to exchange ideas on the most pressing state issues and is an effective and respected advocate for the interests of the states in the American federal system.

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