Chapter 2
Generation Adequacy

The most recent surprise drop in power use, as chronicled by the *Wall Street Journal*, has utility companies worried. Is it the reaction to our current economic downturn or a permanent shift in consumption patterns?[1] While this is a serious question, the larger concern may be the potential impact on new energy investment. If our current economic picture is anything like that of previous years, energy demand will come roaring back as the economy begins to recover. As employment increases, the housing market improves, investment markets stabilize and credit markets remain liquid, energy demand growth is just a matter of when and not if. Even with new industrial and household efficiencies, demand for electricity will continue to escalate. The United States faces a growing challenge to generate the energy needed to reliably meet that demand using the nation's current generation resources. There are short-term solutions to increasing generation availability, including adding transmission infrastructure and increasing energy efficiency and demand response / load management programs; ultimately, however, the United States must invest in substantial, long-term generation construction to meet energy demands of the future.

During the late 1990s and early 2000s, overall baseload generation construction declined as generators were reluctant to commit resources to an unsettled regulatory and developing market-based environment. However, in that same time frame, non-dispatchable or variable land-based wind power and other renewable energy generation resources began to gain a foothold in the United States, where non-dispatchable resources have grown from a 2,013 megawatt (MW) capacity in 1990 to 16,114 MW in 2007.[2] Though geothermal generation has decreased by about 372 MW, solar has increased by 184 MW and wind power by 13,817 MW in this same time frame.[3] A recent windpower report, prepared for the presidential transition team, notes the availability of sufficient wind resources to meet 20% of the nation's energy requirements by 2030[4]. As a clean abundant resource, solar has almost unlimited potential. These resources have the potential to contribute substantially more to the nation's energy supply adequacy.

Encouraging and managing new generation technologies while removing barriers to their development will be crucial to the nation's generation adequacy. Doing so will require bold, decisive action from the U.S. Department of Energy (DOE) and the incoming administration.

2.1 Trends and Drivers

Declining Growth Rates

Ten-year generation growth rates have actually declined from a maximum growth rate of 4.08% in the 1970s to 1.29% during the 2000–2007 timeframe. The net summer capacity 10-year growth rates have declined from a maximum growth rate of 9.22% in

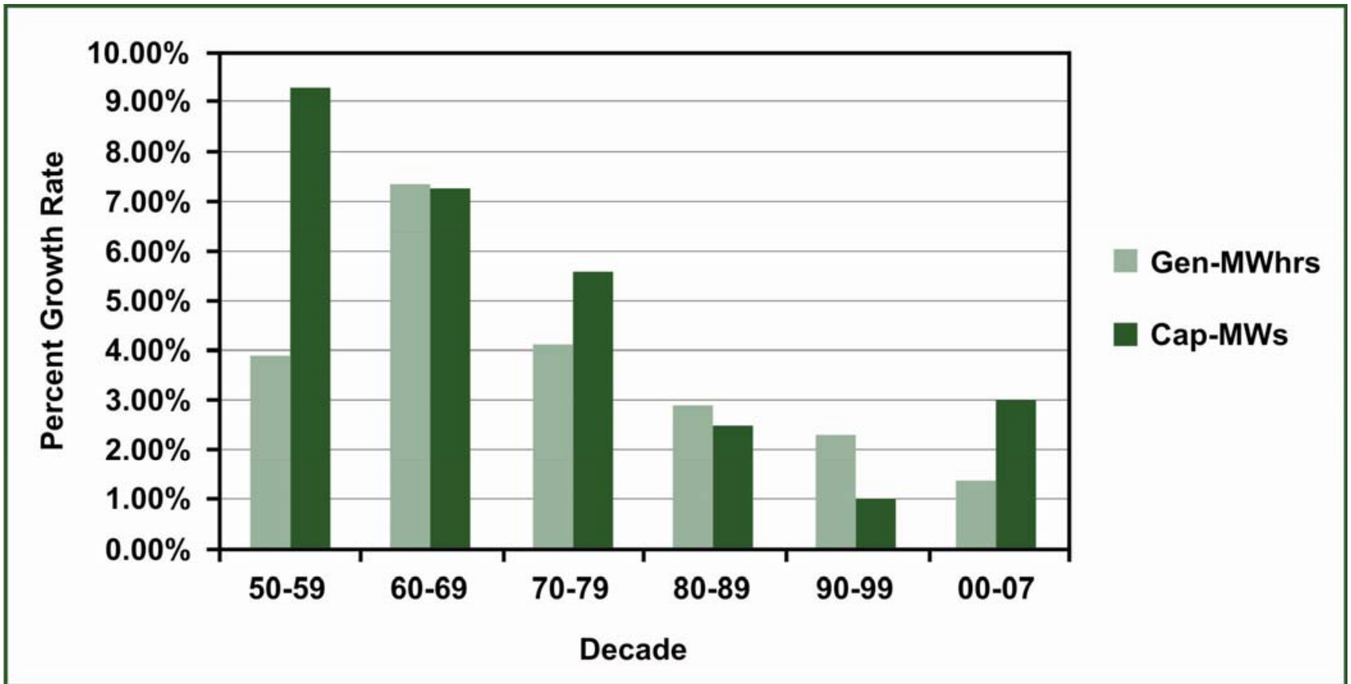
[1] Wall Street Journal, Surprise Drop in Power Use Delivers Jolt to Utilities, Rebecca Smith, November 21,2008

[2]

[3] Energy Information Administration, *Annual Energy Review* (Energy Information Administration, 2007), table 8.11c, http://www.eia.doe.gov/emeu/aer/elect.html.

[4] American Wind Energy Association, Wind Energy for a New Era, (http://www.newwindagenda.org, November 2008)

Figure 2-1. Energy and Capacity Growth Rates



Source: Energy Information Administration 2007 [6]

the 1950s to 3% during 2000–2007 (see figure 2-1). [5] Electricity generation growth rates have fallen significantly, but capacity growth rates have declined almost twice as much. Because generation is being built at far lower than historical growth rates, the nation faces significantly reduced quantities of critical new generation.

Adequacy of Supply

The North American Electric Reliability Corporation (NERC) estimates a peak load growth of 16.6% over the next 10 years and notes in its 2008 *Long Term Reliability Assessment* report that some geographic areas face potentially inadequate generation-resource safety margins to meet growing peak load conditions in the near term. Though the 2007 report cited considerable concern over future inadequate reserve margins, new generation plans and a peak demand reduction of 1% from demand response / load management efforts have moderated those concerns in the 2008 report. It cites an approximate 4.2% improvement in reserve margin over the 2007 level; however resource shortages continue in the Southwest and western Canada. [7]

Forecasting capacity growth over the next 10 years is not an exact science. There may be a level of confidence with new capacity estimates in regulated state jurisdictions that require capacity planning, but in market-based regions, the forecast accuracy is severely limited. Regional Transmission Organizations (RTOs) may review and study all potential generation projects, but only a small percentage may actually be built and interconnected. Additionally, new gas plants can be constructed under shorter time frames, making it unlikely that future plans for these assets extend much beyond a three- to four-year time frame. A forecasted declining reserve margin may be more representative of past events than a realistic picture of the future.

New generation is key to maintaining system reliability, and states play a major role in securing

[5] Energy Information Administration, *Annual Energy Review* (Energy Information Administration, 2007), table 8.2a, http://www.eia.doe.gov/emeu/aer/elect.html; Energy Information Administration, *Annual Energy Review* (Energy Information Administration, 2007), table 8.11a, http://www.eia.doe.gov/emeu/aer/elect.html; Energy Information Administration, *Annual Energy Review* (Energy Information Administration, 2007), table 8.11b, http://www.eia.doe.gov/emeu/aer/elect.html.

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[7] North American Electric Reliability Corporation, “2008 Long-Term Reliability Assessment: 2008-2017” (Princeton, NJ: North American Electric Reliability Corporation, October 2008): 8-9, http://www.nerc.com/files/LTRA2008.pdf.

that new generation. In state-regulated environments, state public utility commissions typically charge vertically integrated utilities with maintaining resource adequacy, and may approve cost recovery for generation to satisfy adequate reserve margins. States may impose capacity planning mandates on utilities and typically control the siting process. Some RTOs, recognizing the capacity shortages as reserve margins shrink, have introduced forward capacity markets to provide financial incentive for new capital investments. [8] These markets are intended to stimulate new generation and help maintain reserve margins and adequate reliability but they have not been shown to do so to date.

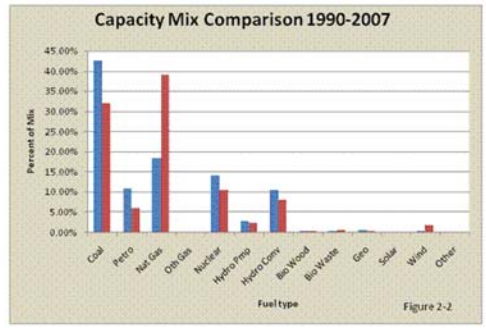
Aging Plants

The generation infrastructure in the United States is aging faster than it is being replaced. Although the recent construction of new gas-fired generation and renewable energy plants has helped to ease that concern, the United States continues to rely on generation capacity built in the 1980s and 1990s. As generation companies retire those older units, the development of new generation resources will be essential. In 1995, the average age of utility generation plants was approximately 40 years. Though that average has fallen to 37 years in 2007, new generation is still required to secure the nation's energy future.

Changing Portfolio Mix

The 2007 profile of generation capacity[9] has changed significantly from that of the 1990s. In 1990, 42.6% of generation capacity came from coal, 18.3% from natural gas, 14% from nuclear, and 10.8% from petroleum. By 2007, coal accounted for 31.9% of capacity, natural gas more than doubled to 39%, nuclear decreased to 10.3%, and petroleum decreased by nearly half to 5.9%. The recent construction of less capital intensive and cleaner gas-fired generation plants has made it the largest new source of generation capacity. During this time, renewable energy sources also increased their role in the capacity mix; though capacity from geothermal decreased slightly, biomass increased, solar increased slightly, and wind power grew by a factor greater than eight (see Figure 2-2).

Figure 2-2



Source: Energy Information Administration 2007 [10]

More Costly Plants

New generation plants are considerably more expensive than their historical counterparts. Driven in part by increasing environmental requirements and rising resource prices, new plant costs have more than doubled in the past 10 years. Construction of a conventional natural gas combustion turbine plant costs about $150 million to $200 million—approximately $500,000 per MW generation capacity. In contrast, a combined cycle gas plant—the more common generation plant constructed today—costs about $700,000 per MW to build. At a 200–400 MW generating capacity, plant construction can total $200 million to $400 million. A new integrated gasification combined cycle (IGCC) plant with carbon sequestration could cost more than 3.5 times as much,

[8] North American Electric Reliability Corporation, "2008 Long-Term Reliability Assessment: 2008-2017" (Princeton, NJ: North American Electric Reliability Corporation, October 2008): 10, http://www.nerc.com/files/LTRA2008.pdf.

[9] Energy Information Administration, website glossary for generation capacity, http://www.eia.doe.gov/glossary/glossary_g.htm. EIA defines generation capacity as "the maximum output, commonly expressed in megawatts (MW), that generating equipment can supply to system load, adjusted for ambient conditions." Capacity represents the level of generation output available from existing plants and is different than the actual energy generated by those plants. While gas may now be the largest capacity resource, it does not run as often as baseload coal or nuclear plants, which currently provide the majority of megawatt-hour energy for consumers.

[10] Energy Information Administration, *Annual Energy Review* (Energy Information Administration, 2007), table 8.2a, http://www.eia.doe.gov/emeu/aer/elect.html; Energy Information Administration, *Annual Energy Review* (Energy Information Administration, 2007), table 8.11a, http://www.eia.doe.gov/emeu/aer/elect.html; Energy Information Administration, *Annual Energy Review* (Energy Information Administration, 2007), table 8.11b, http://www.eia.doe.gov/emeu/aer/elect.html.

or roughly $1.4 billion, a cost similar to offshore wind power costs.[11]

Cost of Fuels, Transport, and Storage

With the majority of energy still generated from baseload coal-fired plants, quality coal must continue to be available and affordable in the future. Newly constructed gas-fired generation capacity has similar concerns with natural gas supply. Though there were no significant fuel disruptions or related generation shortages in 2007, fuel supply has seen volatile periods in past years due to overwhelming storm damage, labor disputes, or storage/transportation issues. An adequate supply of fuel with appropriate reserves is essential to maintain a reliable energy supply in the future.

The Energy Information Administration's (EIA's) *Annual Energy Outlook 2008* projects coal and natural gas prices to 2030. Considering slower economic growth and added environmental concerns, the study predicts coal production will range from stable to a 5% increase.[12] It predicts western mine-mouth coal prices will decrease by approximately 6% to $1.14 per million British thermal unit (BTU) by 2020. However, coupled with higher mining labor and transportation costs, delivered coal prices are expected to remain relatively stable through 2030.

Natural gas supply and use in generation is much more price dependent. Higher gas prices tend to stimulate production but curtail gas-fired generation, unless it is absolutely needed for reliability. Lower gas prices increase the use of gas in electric generation without stimulating new exploration and development. While most residential, commercial, and industrial consumers must rely on gas at market price for heating and process uses, electricity generation can rely on coal, nuclear, oil, and other substitutes when gas prices are high. The EIA predicts a gradual depletion of existing 48-state and shallow-water reserves, to be replaced by new, higher-cost Alaskan gas finds, deep-water finds, and unconventional production (e.g., coalbed methane, tight sandstones, and gas shales). At moderately higher prices and with declining domestic and Canadian production, liquified natural gas (LNG) imports will continue to increase to meet domestic demand requirements. While the annual level of LNG imports may vary due to global market prices, EIA expects a continued gradual increase. Overall, domestic gas production is expected to grow modestly through 2030, dependent on market price variations and supplementation by LNG imports.[13]

Though the storage and transportation of fuels is currently adequate, it remains a key future concern in the fuel industry. With a growing reliance on LNG, it is unclear whether the United States has adequate storage facilities to match its need. Mid-winter deliveries are common in Europe, where there is also a heavy dependence on LNG and storage sites are limited. However, an extremely cold season could make mid-winter LNG deliveries unavailable to U.S. markets, exemplifying the need for adequate storage facilities.

While trucks deliver some coal to nearby power plants, the majority of U.S. coal makes its way from mine to market via rail car. Disruption of rail transport for rail line maintenance or train maintenance can have severe repercussions for the energy industry. In 2005, adverse weather and accumulated coal dust on track beds caused two derailments coming out of the Powder River Basin area, a major western supplier. Rail supply shortages can force users to deplete their own emergency stockpiles and require additional transport to re-establish them. Increased maintenance and diesel fuel costs have made rail transport more expensive. Rail carriers have expressed concern that consolidation savings are no longer available, and they may need to charge higher rates to fund continued growth of the rail infrastructure to meet increasing demand.[14]

Reliability and Cost Challenges for Renewable Energy Resources

The recent growth in wind power generation, while beneficial from a generation standpoint, has also created system planning challenges. Wind power and solar power, often referred to as variable resources, are not controllable as coal, nuclear, and gas-fired

[11] Energy Information Administration, *Assumptions to the Annual Energy Outlook 2008 , June 2008,* table 38, http://www.eia.doe.gov/oiaf/aeo/assumption/pdf/tbl38.pdf

[12] Energy Information Administration, "Coal Forecast," *Annual Energy Outlook 2008 with Projections to 2030 (*Energy Information Administration, 2008), http://www.eia.doe.gov/oiaf/aeo/coal.html.

[13] Energy Information Administration, *Annual Energy Outlook 2008 with Projections to 2030,* http://www.eia.doe.gov/oiaf/aeo/gas.html

[14] Energy Information Administration, "Coal Transportation Issues," *Annual Energy Outlook 2007* (Energy Information Administration, 2007), http://www.eia.doe.gov/oiaf/aeo/otheranalysis/cti.html.

generation are. Just as the potential for baseload generation outages must be taken into consideration in system planning, so too does the availability of variable resources. When large areas of Texas, one of the largest wind power producing states, recently experienced high temperatures, low wind power availability and base load generation outages, serious reliability and pricing issues arose. The lack of any generation during peak load periods forces dispatch of higher-cost generation. As renewable variable resources continue to grow in the capacity mix, reserve margins, particularly of controllable plants, become increasingly important.

Renewable energy resources continue to face price competition from baseload generation facilities. As high-voltage transmission grids expand and permit the efficient flow of energy from further distances, this competition is likely to rise. Renewable energy generators will need to find new ways to control costs in larger competitive markets. Technology advances and continued funding for energy research are essential to overcome reliability and cost challenges.

Combined Heat and Power Generation

Combined heat and power (CHP) systems, also known as co-generation, can play a key role in providing new cost-effective and efficient energy systems. While typical generation plants have relatively low efficiencies, CHP generates both electrical and thermal energy with resulting higher efficiencies. The thermal energy is typically used near the generation source, reducing environmental emissions and energy losses.

CHP installations increased significantly during the 1980s and early 1990s; CHP provided 10,000 MW of electric capacity in 1980, which increased to 44,000 MW by 1993.[15] Most of these facilities were installed at large industrial sites where there was also a need for thermal energy. Between 1990 and 2007, overall CHP thermal BTU output actually declined by approximately 4.2%.[16] However, for the electric power sector only, thermal BTU output has increased from 251,635 billion BTUs in 1990 to 363,843 billion BTUs in 2007, an increase of 44.6%.[17]

CHP can be an effective approach to improving energy efficiencies, particularly where there is a productive use of the thermal energy output. Using electric for equipment needs and thermal energy for heating and cooling in close proximity to loads can offer significant efficiencies of operation and reduced environmental impact.

Distributed Generation

Distributed electric generation (DG) will play a growing role in providing generation adequacy in the future. While not necessarily competitive at today's costs for baseload generation, it does offer savings when used to reduce peak demands. The EIA forecasts almost 5,000 MW of this type of capacity by 2010,[18] with assumptions on reduced costs leading to continued growth in this sector of generation.

In addition, distributed generation can offer two large advantages over centralized baseload plants. Having multiple smaller generation units distributed throughout a system enhances system security, making it more difficult to eliminate all generation sources. Second, generation added near the point of consumption offers improved reliability and decreased losses, while potentially freeing up additional line capacity, delaying new infrastructure investment, and helping hold down consumer delivery costs if properly sited, maintained, and coordinated with the utility or system operator. However, challenges remain to sort out what backup power requirements exist for those using distributed generation and how they can be most effectively integrated, while avoiding cross-subsidization issues with other customer classes..

2010 Trends

If current trends continue, there is a general consensus that:

- U.S. reserve margins will continue to decrease.
- Construction of renewable and distributed resources will continue accelerating.

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[15] R. Neal Elliott and Mark Spurr, "Combined Heat and Power: Capturing Wasted Energy," *American Council for an Energy-Efficient Economy,"* May 1999, http://www.aceee.org/pubs/ie983.html.

[16] Energy Information Administration, *Annual Energy Review* (Energy Information Administration, 2007), table 8.3a, http://www.eia.doe.gov/emeu/aer/elect.html.

[17] Energy Information Administration, *Annual Energy Review* (Energy Information Administration, 2007), table 8.3b, http://www.eia.doe.gov/emeu/aer/elect.html.

[18]

- Reliability will become more heavily dependent on transmission infrastructure.
- Gas-fired generation will continue to dominate new power plant growth.
- Nuclear or coal baseload generation, if constructed, will be a much more costly endeavor.

2.2 Barriers

Political, economic, and environmental regulations, as well as basic technological and physical restrictions, can each restrict greater contributions of generation resources to the nation's energy supply. Detailed below, these barriers will be the foremost obstacles to realizing new generation facing the Administration.

Achieving Economic Viability

Project developers must overcome four principal obstacles to demonstrate the economic viability of new generation projects.

Achieving maximum return at minimum risk

The shift in the portfolio mix to cleaner, more costly fuels and more costly renewable energy generation, coupled with recent slower demand growth as noted by utilities[19], creates a new paradigm in both regulated and unregulated areas of the United States—one which favors short-term, low-cost, higher-return investments over high-cost, longer-term, lower-return investments. In dynamic, changing industries without long-term policy direction and commitment, investors, whether public or private, will tend to favor the short-term approach. However, the energy and operating costs, ultimately paid by consumers, may well be higher for low-cost plants and lower for high-cost plants, depending on fuel prices and dispatch times. The challenge in the generation industry is to attract the longer-term baseload commitments and insulate them as much as possible from changing federal policies to reduce investment risk and financial premiums.

Financial risk is a key barrier to new generation development. Both investors and generation companies aim to maximize return and minimize risk.

[19] Wall Street Journal, Surprise Drop in Power Use Delivers Jolt to Utilities, Rebecca Smith, November 21,2008

In today's market, gas-fired facilities and wind power farms are lower-risk investments, particularly where the projects have a guaranteed sale contract or can receive regulated recovery of capital investments. Gas-fired facilities are relatively inexpensive to construct, require shorter lead times, and have fewer environmental implications. Though wind power farms have higher capital costs, the fuel is guaranteed free for the life of the plant. These facilities, however, cannot supply baseload generation like new large-scale coal or nuclear baseload generation facilities. Achieving economic viability for nuclear and coal plants will require a mechanism to reduce business risk factors and increase potential returns.

Overcoming the boom/bust cycle

Given their risk-averse behavior, generators invest in generation projects when prices are sufficiently high to guarantee an acceptable return. Boom/bust investment cycles occur when large generation projects introduce large blocks of capacity after lengthy lead times, satiating the market demand. Increasing shortfalls in generation follow, again raising capacity prices to acceptable investment levels. The quick construction time of smaller gas- or wind power-powered projects allows them to take advantage of capacity shortages with higher return on investment. However, large baseload capacity projects are limited to those times when demand and prices are significantly higher, reinforcing the cyclic investment process. Making new projects economically viable during lower demand growth periods will require policies and actions designed to stabilize investment returns, capacity, and energy prices.

Growing long-term contracts

With rapidly changing markets and regulatory environments, purchasers and suppliers are both reluctant to enter into long-term agreements. Changes to the generation or transmission landscape, new environmental requirements, siting and development hurdles, regulatory review, and a myriad of other variables can reduce a contract to out-of-market pricing very quickly. However, for generation companies seeking external financing to build new capacity, long-term contracts are essential. In addition, long-term contracts can dampen the boom/bust cycle by creating more stable returns not subject to changing demand and supply pricing. Many generation projects require purchase-power agreements and policies that support the negotiation and adoption of long-term contracts.

Assuring asset cost recovery

Whether in an organized market arena or vertically regulated jurisdiction, investors will not commit funds if their ability to recoup capital investment costs is uncertain. In organized markets, the generator typically recovers its costs through capacity and energy payments obtained from the RTO's markets. Even in recently created capacity markets, there are market limits on the level and duration of payments. In regulated markets, cost recovery depends on the regulatory authority and the determination of prudency with respect to the investment. While less risky, the return on investment is also appropriated lowered.

Generation companies are spending increasing amounts of time and money to meet planning, permitting, siting, and interconnection requirements when building new generation, especially with new technologies. The recovery of significant development costs can be more problematic than the recovery of hard asset costs and subject to higher levels of scrutiny. To secure cost recovery for both hard asset and development costs, regulatory approaches that minimize uncertainty and market rules that provide longer-term certainty are needed.

Political and Regulatory Uncertainty

Continued uncertainty in the energy sector about expected political or regulatory actions has negatively impacted potential new generation projects. Federal legislators have been unable to produce a comprehensive energy plan or establish long-term energy policies. Production tax credits, investment tax credits, and grant programs have typically been renewed in short-term increments. The expectation of stricter federal regulations on carbon emissions or air quality have stalled generation projects. The challenge here is not building new generation, but establishing policies and regulations that will ensure the economic viability of generation projects. Three areas of uncertainty are detailed below:

Grants and tax incentives

As part of the Energy Improvement and Extension Act of 2008, Congress extended the production tax credit (PTC) for wind energy, set to expire December 31, 2008, through 2009 to stimulate renewable energy generation. Established in 1992, the PTC has created uncertainty in the renewable energy industry since its first lapse for wind power generation in 1999, followed by additional lapses in 2001 and 2003. According to the American Wind Energy Association (AWEA), new installed wind power capacity declined by 93%, 73%, and 77% respectively during those years.[20]

Investment tax credits for renewable energy facilities were also scheduled to expire in December 2008, but were extended for eight years in the same legislation. This was critical for higher-cost renewable ventures such as solar power. However, Congress must begin thinking—and legislating—in terms of 20–30 years for generation resources.

Loan guarantees for energy projects are another federal policy plagued by uncertainty. The Energy Policy Act of 2005 authorized DOE to issue loan guarantees to eligible projects that avoid, reduce, or sequester air pollutants or anthropogenic emissions of greenhouse gases and employ new or significantly improved technologies. However, annual Congressional funding approvals limit DOE's authority. In 2008, Congress authorized $38.5 billion in loan guarantee authority for innovative energy projects: $18.5 billion was allocated for nuclear power facilities; $2 billion for advanced nuclear facilities for the front end of the nuclear fuel cycle; $10 billion for renewable and/or energy-efficient systems and manufacturing and distributed energy generation/transmission and distribution; $6 billion for coal-based power generation and industrial gasification at retrofitted and new facilities that incorporate carbon capture and sequestration or other beneficial uses of carbon; and $2 billion for advanced coal gasification.[21] By October 2008, DOE had received 19 Part I applications from 17 electric power companies for federal loan guarantees to support the construction of 14 nuclear power plants in response to DOE's June 30, 2008 solicitation. The applications reflect the intentions of those companies to build 21 new reactors, with some applications covering two reactors at the same site. The nuclear industry is now asking for $122 billion in loan guarantees, significantly exceeding the $18.5 billion currently allocated.[22] The energy sector's dependence on congressional funding introduces short-term uncertainty into long-term construction projects.

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[20] Anita Huslin, "Energy Boost," *Washington Post*, sec D-1, April 14, 2008.
[21] Department of Energy, Loan Guarantee Program, October 29, 2008, http://www.lgprogram.energy.gov/
[22] Department of Energy, Office of Nuclear Energy, "DOE Announces Loan Guarantee Applications for Nuclear Power Plant Construction," October 2, 2008, http://www.ne.doe.gov/newsroom/2008PRs/nePR100208.html.

Though funds may be available in one year, projects applying for loans in future years are uncertain what may be available.

Climate and Environmental Issues

Impending carbon-reduction and climate-change mitigation regulations introduce numerous uncertainties. Ten northeastern and mid-Atlantic states and several western states have already enacted mandatory carbon reduction plans. The northeast states' Regional Greenhouse Gas Initiative (RGGI) establishes a cap and trade program to reduce carbon emissions 10% by 2019. The price of carbon emissions, established in the September 25, 2008 RGGI auction, was $3.07 per ton.[23] The Western Climate Initiative (WCI), which includes seven western states and several Canadian provinces, aims to reduce carbon emissions 15% below 2005 levels by 2020 by employing a cap and trade program. The question appears no longer if, but when and how carbon reductions will become mandatory throughout the United States. Congress most recently considered the carbon issue with proposals for a carbon tax or national cap and trade program. There is no national regulation at the time of this report's publication, but the uncertainty of a looming program's size, goals, and implementation continues to affect the construction of carbon-emitting plants. Building any type of carbon emitting plant in today's environment automatically adds more cost with uncertainty of how much it may ultimately cost.

Along with carbon reductions, there is the potential for changing regulation on air pollutants, chiefly sulfur oxide (SO_x), nitrogen oxide (NO_x), and mercury, in the near future. On March 10, 2005, the Environmental Protection Agency (EPA) issued the Clean Air Interstate Rule (CAIR), designed to achieve the largest reduction in air pollution in more than a decade. CAIR established caps for sulfur dioxide (SO_2) and NO_x emissions across 28 eastern states and the District of Columbia. In a closely related action, the EPA also formulated a Clean Air Mercury Rule (CAMR) to further reduce pollution throughout the United States.[24] While some utilities committed to major investments for compliance, others challenged the rule in court. On July 11, 2008, the District of Columbia Court of Appeals issued an opinion that overturned the CAIR and placed other state environmental regulations in question. The EPA filed a petition for rehearing on September 24, 2008.[25] With federal clean air requirements in question and an administration in transition, regulations will remain unclear pending court action on the rehearing appeal.

The EPA's Clean Water Act (CWA) provided 2004 regulations for managing thermal discharges to surface water in the U.S. Based on a January 2007 decision by the Second U.S. Circuit Court of Appeals, EPA suspended its Phase II implementation and is considering a new rulemaking.[26] Under new regulations, , generators may be required to replace once-through cooling cycles with closed-loop cooling towers.[27] The uncertainty on this issue can pose significant costs for new and existing generators and, if passed, would reduce the capacity of existing resources through added parasitic loads and unit retirements. A 2008 NERC special assessment projects a 2015 decline in reserve margins from 14.7% to 10.4% when both retirements and cooling system parasitic loads are considered. That represents an approximate 49,000 MW loss of U.S. capacity by 2015.[28]

Market or Regulatory Changes

While many states continue to regulate vertically integrated utility companies and plan for new generation, deregulation and the establishment of RTOs have brought a host of uncertainties to the industry. Market rules continue to change and can be significantly different between RTOs. While the advent of central capacity markets, and particularly forward markets, helped to create some capacity price certainty, it was only for relatively short periods of time. The introduction of energy efficiency programs in capacity markets has created another competitive challenge to generation companies. RTOs such as the California Independent System Operator (CAISO) and the Midwest Independent System Operator

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[24] Environmental Protection Agency, "Clean Air Interstate Rule," http://www.epa.gov/cair/

[25] *State of North Carolina v. U.S. Environmental Protection Agency*, Docket No. 05-1244, Environmental Protection Agency, http://www.epa.gov/airmarkets/progsregs/cair/docs/CAIR_Rehearing_Petition_as_Filed.pdf.

[26] North American Electric Reliability Corporation, 2008 Long-Term Reliability Assessment Report, October 2008, pages 29.

[27] North American Electric Reliability Corporation, "2008 Long-Term Reliability Assessment: 2008-2017" (Princeton, NJ: North American Electric Reliability Corporation, October 2008): 29-30, http://www.nerc.com/files/LTRA2008.pdf.

[28] North American Electric Reliability Corporation, "2008-2017 NERC Capacity Margins: Retrofit of Once-Through Cooling Systems at Existing Generation facilities" (Princeton, NJ: North American Electric Reliability Corporation, October 2008): 4, http://www.nerc.com/files/NERC_SRA-Retrofit_of_Once-Through_Generation_090908.pdf.

Table 2-1: September 2007–September 2008 Commodity Price Increases

Sept 2007–Sept 2008 Commodity Price Increases	
Steel Mill Products	38.2%
Concrete Products	4.3%
Copper	4.2%
Turbines-Gens	8.6%
Private Industry Labor	3.3%
Electric Power Generation	12.9%

Source: Bureau of Labor Statistics 2008.[29]

(MISO), while trying to mitigate interconnection barriers, are modifying interconnection cost allocations and creating financial uncertainty. RTOs on both coasts are considering environmental concerns and potential ways to help facilitate the entry of variable renewable energy into the marketplace.

At state levels, the regulation landscape also continues to change. States that fully supported deregulation in the late 1990s and have participated in market dynamics are looking at ways to change energy procurement practices and considering long-term commitments outside of existing markets, even where a competitive market may exist.

Construction, Operating, and Workforce Issues

New generation is expensive. In today's economic environment, the cost to plan, construct, own, and operate a generation station is becoming a much larger obstacle to all companies. Although the current economic downturn has softened commodity prices, the permanence remains unclear. Typically, the costs of raw materials that construct a power plant have seen significant increases in the past three years. Steel prices have seen the largest increase, followed by copper, generating equipment, and concrete. According to the U.S. Bureau of Labor Statistics, the end price of electric power generation (including capacity, energy, and ancillary services) has risen by 12.9% from September 2007 to September 2008 (see Table 2-1 above). General labor costs have increased by approximately 3.3% since September 2007. When taken together, a $1 billion generation project started in today's environment may well cost and additional $2 billion when completed eight years later.

The generation industry is also facing a new global demand for electrical equipment and skilled craftsmen. With new fast-paced generation construction in developing countries, demand for generators, steam turbines, boilers, and related equipment has accelerated, driving up prices and extending order lead times from 6–12 months into 2–3 years. The number of skilled craftsmen trained to work on generation systems continues to decline as more of the workforce retires. Those that continue to work and move into the generation arena must be more flexible and able to move beyond domestic borders to command higher financial returns.

In 2007, NERC reported that about 40% of senior electrical engineers and shift supervisors in the electric power industry will be eligible to retire in 2009.[30] An informal NERC survey of the industry found that 67% of participants thought there was a high likelihood there would be a reliability risk due to the aging workforce and growing lack of skilled workers.[31] Both electric and water utilities face the prospect of losing up to 60% of their top management and other key workers by 2010.[32] However, NERC's *2008 Long-Term Reliability Assessment Report*[33] noted the industry is making progress in addressing the issue.

Changing fuel costs add to the growing expenses of generation plants. Central Appalachian coal rose from $45.00 per ton in October 2007 to $119.00 per ton on October 24, 2008. Henry Hub natural gas spot prices rose from $7.80 per million BTU (MMBTU) in June 2007 to $12.70 per MMBTU in June 2008, and then dropped to $6.50 per MMBTU in October 2008 with the economic downturn. New York Mercantile Exchange (NYMEX) heating oil futures rose from $2

[29] U.S. Bureau of Labor Statistics; "Producer Price Index" (Washington, D.C.: U.S. Bureau of Labor Statistics, 2008), table 2, http://www.bls.gov/news.release/ppi.t02.htm; and http://www.bls.gov/ppi/ppitable05.pdf.

[30] North American Electric Reliability Corporation, "Key Issues: Aging Workforce," http://www.nerc.com/page.php?cid=4|53|55

[31] North American Electric Reliability Corporation, "Results of the 2007 Survey of Reliability Issues" (North American Electric Reliability Corporation, October 24, 2007): 6, http://www.nerc.com/files/Reliability_Issue_Survey_Final_Report_Rev.1.pdf

[32] "Black & Veatch Launches New Management Succession Planning Service to Address the Aging Workforce," *Business Wire*, June 18, 2007, http://www.allbusiness.com/services/business-services/4513937-1.html

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per gallon in June 2007 to $3.80 per gallon in June 2008, but also declined to $1.91 per gallon in October 2008. Crude oil futures have seen similar price swings, moving from $65.00 per barrel in June 2007 to $131.00 per barrel in June 2008 and falling back to $65.00 per barrel in October 2008. Higher coal prices and volatile petroleum and natural gas prices, all subject to changing worldwide demand, create a high level of uncertainty for generation projects.[34]

Greening the Industry

Twenty-nine states and the District of Columbia have e mandated some level of renewable energy for state energy supplies by enacting Renewable Portfolio Standards (RPS). These can vary from set megawatt load levels to various percentages by certain timeframes and have provided added incentive for much of the nation's new renewable energy resources.[35] While this may increase energy and capacity prices, it can also help to insulate domestic energy supplies from potential disruptions of international fuel sources. Adding more renewable energy resources increases the diversity and security of domestic energy supplies while providing economic development benefit in those states with renewable resources. Most recently, California's Governor has issued an executive order accelerating the use of renewable energy and proposing legislation for one-third of utility supply to be from renewable energy by 2020.

In similar fashion to renewable standards, some states have adopted energy efficiency standards to help offset the need for new expensive generation. Both Texas and North Carolina have requirements for a portion of energy supply to be provided by energy efficiency.[36] As these requirements continue to grow, generation providers will have to adapt to the changing regulatory circumstances and the need for new clean energy resources.

While 58% of states have adopted some form of RPS, the adoption and implementation of a national RPS standard offers several advantages. Most importantly, it provides incentive to develop new, clean domestic supply resources to help achieve energy independence goals. In addition, it enhances energy security, may improve system reliability and can be more cost effective and efficient than individual state models by providing regional flexibility and shifting resource development to regions that have higher levels of needed resource drivers such as wind power, solar, or biomass. A potential drawback is that certain regions could also be economically and financially disadvantaged as regional planning took advantage of more efficient regions. This concern needs careful consideration in a national program design.

Climate change and environmental concerns continue to gain popular support in regulatory bodies. Air quality rules may soon require minimizing particulate, pollutant gases, and metal compounds, a process that requires expensive and highly technical chemistry.

Traditional generation creates process waste, whether it is coal ash, spent nuclear fuel rods, cooling water, or flue gas particulate. Containing these wastes is more expensive for some fuel types, and it is difficult to plan for unknown costs of future waste requirements.

Environmental permitting for new generation also hinders new generation. Existing state and federal laws can require multiple agency applications to secure the necessary permits to build new generation. Cities, counties, and various state agencies typically each have a process mandated by charter or state law. The permitting process in all states is becoming more transparent with active participation by state; federal; local agencies; and environmental, political, and consumer groups. Planned site use, environmental mitigation (including the use of brownfield sites), and infrastructure security all require negotiation during the development permitting process.

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[34] Energy Information Administration, "Coal News and Markets," http://www.eia.doe.gov/cneaf/coal/page/coalnews/coalmar.html#spot; Energy Information Administration, *Petroleum Navigator* "Daily Cushing OK WTI Spot Price FOB" http://tonto.eia.doe.gov/dnav/pet/hist/rwtcd.htm; Energy Information Administration, "Daily New York Harbor No.2 Heating Oil Spot Price FOB" "http://tonto.eia.doe.gov/dnav/pet/hist/rhonyhd.htm. The American Transmission Company LLC has refunded 100% of generator interconnection costs since it began operations in 2001.

[35] Energy Efficiency and Renewable Energy, "States with Renewable Portfolio Standards," *EERE State Activities and Partnerships* (Washington D.C.: Energy Efficiency and Renewable Energy, 2008) http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm, (accessed November 2008).

[36] Energy Efficiency and Renewable Energy, : "Portfolio Standards," *EERE State Activities and Partnerships* (Washington D.C.: Energy Efficiency and Renewable Energy, 2008) http://apps1.eere.energy.gov/states/alternatives/portfolio_standards.cfm.

Connecting to the Transmission Grid

Connection with the transmission grid in a safe and reliable manner is of utmost importance for new generation. To ensure that the new generation can meet these requirements, the transmission owner or RTO typically requires a series of studies that identifies necessary upgrades and equipment requirements. The studies determine deliverability and potential costs for interconnection. While these are necessary, studies can take more than six months to complete, and are further complicated by the continuously changing study profile. The multiplicity of requests and the level of technical detail required in each study can create a significant time lag in the process and can at times be an obstacle to moving forward on a project.

Following the facility study is the formal interconnection agreement. At this point, the project must make a more significant capital commitment to move forward. Once an interconnection agreement is executed, most projects are considered viable and are included in future reliability studies. Again, the key concern is the uncertain time it can take to complete and execute the agreement.

While FERC has continued to ensure open access to the transmission grid, the entity responsible for the cost of interconnection varies across the nation. Generators pay 100% in the Pennsylvania, New Jersey, Maryland Interconnection (PJM), MISO uses a 50/50 split,[37] and a more recent recently approved pricing policy provides generators with a potential 100% refund of network upgrade costs necessary for interconnection.[38]

Interconnection cost allocation can be a significant issue for new generation projects, particularly renewable energy plants. These types of plants are typically sited close to fuel sources or in open rural areas. Wind power farms need areas where there are consistent wind power flows, and commercial solar installations need significant open space. Transmission for interconnection may be located nowhere near these locations. In Texas, recognizing renewable energy generation interconnection constraints, Senate Bill 20 laid the groundwork for large transmission lines to accommodate wind power industry needs and to further accelerate the use of wind power in the state. The Texas Public Utilities Commission approved an approximate $5 billion transmission investment to move 18,456 MW of wind power from western Texas and the Panhandle to metropolitan areas of the state. The cost for this transmission was estimated at $4 per month for every Texas ratepayer but helped to eliminate the interconnection barriers for wind power and solar in Texas while reducing overall energy prices.

2.3 Key Considerations

While U.S. electric energy demand has often fluctuated from year to year, it has continued a generally increasing trend of 2.6% per year between 1995 and 2006.[39] Meeting this growing demand will require an increasingly diverse generation mix and new generation construction. The following nine fuel types can each play a part in increasing the nation's generation capacity, but they also currently face specific challenges to the development of projects, in addition to those outlined above.

Biomass

Biomass generation facilities tend to be smaller size plants to minimize the difficulties with storing, handling, and transporting large quantities of the necessary fuels. While coal has a heat value of 8,000–14,000 BTU per pound, wood and even dried switch grass have a heat value of around 6,500–7,500 BTU per pound, meaning larger quantities of the fuel are needed to achieve the same BTU heat input to a generation process. Conversely, landfill gas has a 12,000–13,000 BTU per pound heat content, making it a renewable fuel of choice where available. While biomass fuels may be cost competitive, the quantity needed can impose difficulties. Additionally,

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[38] FERC Docket ER08-796, See ITC Midwest, LLC, 124 FERC 61, 150 (2008), and cases cited therein. FERC has approved a pricing policy filed by International Transmission Company, Michigan Electric Transmission Company and ITC Midwest under which a generator may receive 100% refund of Network Upgrade costs when a generator has at least a one year contract to serve the ISO's network consumers or is designated as a network resource at time of commercial operation. In approving this policy, FERC indicated that a 100% reimbursement for Network Upgrades is just and reasonable, and that different rate proposals can be just and reasonable. The American Transmission Company LLC has refunded 100% of generator interconnection costs since it began operation in 2001.

[39] Energy Information Administration, December 2008, http://www.eia.doe.gov/cneaf/electricity/epa/epat3p2.html

generators must manage a complex biomass fuel cycle from start to finish to ensure consistent availability of fuel and to minimize price instability.

Principally thought of as wood-burning plants or landfill-gas plants, biomass generation plants are not considered a utility-scale enterprise. As such, biomass projects typically suffer from higher investment costs and a lack of venture capital for new projects. When and where biomass projects have been successful, there have generally been public policies designed to offer project incentives.

As with other renewable fuels, interconnection costs and the allocation of such costs can be a barrier to new projects. Since many of the projects are smaller, they often must interface with local utilities at retail-level distribution voltages. Unless biomass plants are willing or can sell energy to the local utility, there can be additional energy wheeling costs for handling the energy injection on the distribution system.

Clean Coal Technologies and/or Integrated Gasification Combined Cycle (IGCC) Plants

Clean coal and IGCC plants, while more environmentally friendly, face many of the same challenges as traditional coal plants: they require coal delivery and storage, produce a flue gas with carbon dioxide (CO_2), and have resulting wastes for disposal. Requirements for carbon capture, land-use mitigation, emission control/disposal, and internal energy use required to maintain the gasification and emission processes rapidly increase the costs of such ventures. IGCC plants are estimated to use up to 30% of the power generated for support processes.[40] Higher costs and lower outputs will require additional federal support if new IGCC or clean-coal ventures are to be viable.

Carbon capture and sequestration will add both cost and technological difficulties to generation plants. When deciding the location of new plants, generators must consider the transport of fuels to the site and transport of captured carbon to a sequestration location. Mine-mouth coal plants may be replaced by coal plants located near subterranean ground formations that can store carbon, depending on which part of the energy cycle is more costly: fuel procurement or carbon sequestration. The availability of appropriate sites may well be a significant barrier to new coal generation, depending on the type of underground formations that can accept and hold carbon emissions. Such sites may also have transmission interconnection barriers where they are far from existing facilities.

Coal generation also continues to have issues with waste storage and disposal. While there are efforts to recycle ash into useful processes, much of it wind powers up as landfill in carefully prepared dump sites to limit heavy metal ground water contamination. According to the American Coal Ash Association (ACAA), the United States produced 125 million tons of coal combustion products in 2006. Of that amount, 43% was used beneficially, leaving approximately 70 million tons for disposal.[41]

Although new coal technologies offer significant improvement, public perception has not reduced barriers for these new plants. With the recent rise in coal prices and continued environmental concerns, renewable energy generation appears to be the public's preferred solution, which places new coal technologies at a competitive disadvantage in the quest for new project financing. Coal may need new policy incentives to maintain its share of baseload capability in the United States.

Combined Heat and Power and Distributed Generation

Site-by-site environmental and regulatory permitting requirements for CHP and DG plants can be costly and time consuming. Many states still require onerous and expensive interconnection studies, and current policies do not always recognize or reward the avoided emissions from the inherent high-process efficiency for CHP or reduced losses from DG. Additionally, some utilities charge backup or standby rates that can increase the cost of interconnecting to the distribution grid. While there is tremendous opportunity for CHP and DG, it will take a concentrated effort, much like that put forth for renewable energy, to realize the efficiency and environmental benefits this type of generation offers.

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[41] American Coal Ash Association, "Advancing the Management and Use of Coal Combustion Products," http://www.acaa-usa.org/index.cfm (accessed November 12, 2008).

Geothermal

The principal barrier to geothermal generation is finding locations for economical energy production with minimal interconnection costs.[42] Accessing readily available heat sources in the earth often requires access to rugged and difficult terrain. Once an access point is identified, generators must consider water table concerns, sustainability of heat flows, protected wilderness issues, and transmission interconnection availability. Of all the renewable energy generation technologies, geothermal provides the most challenging siting concerns.

Other barriers include relatively lower efficiencies of operation, in comparison to typical coal-fired base load units, due to lower temperature steam and the environmental requirements to deal with a corrosive fuel containing some heavy metals. While geothermal plants are relatively clean in comparison to coal plants, they can produce some harmful emissions and wastewater that require special disposal processes. Additionally, geothermal plant sizes may be limited by the availability of steam and the geological heat transfer rates at the site.

Geothermal plants, while environmentally cleaner than fossil-fuel baseload units, are an expensive proposition. Financing for geothermal plants, given the higher cost of facilities and the risk of steam resource losses, is an ongoing challenge.

Hydroelectric

U.S. hydroelectric generation capacity has declined in recent years. Hydroelectric capacity has decreased from 75.3 gigawatts (GW) in 1990 to 71.8 GW in 2006.[43] In addition to lost capacity, it has also experienced lower energy outputs due to dryer weather conditions. Hydroelectric generation dropped to 8% of the nation's supply capacity in 2006.[44]

In terms of barriers to more hydroelectric, it is essential to remember an earlier distinction between run-of-the-river hydropower and dam hydropower. Run-of-the-river installations are typically much smaller and have a significantly lower impact, while large dams flood large strips of the landscape and disturb fish migration routes, among other impacts. While most hydroelectric plants have environmental and societal costs associated with location and transmission, those requiring dams can have considerable impact on marine animals and forested habitats, and in some instances, can displace homes and communities.

Hydropower is also beginning to face new competition. New technologies such as tidal, wave, and river generation facilities are being explored. Competition for financing may become a significant barrier in the face of new developing technologies.

Natural Gas

One of the least expensive types of new generation and the quickest to build, natural gas generation, has had relatively few barriers to its development, as evidenced by the recent increases in gas-fired capacity. Natural gas is limited mostly by siting issues and availability of gas. However, there are carbon emission issues that may well slow the development of gas plants. Although a combined-cycle gas plant can produce up to 70% less carbon emissions than a conventional coal plant, it still must contend with the cost of the remaining 30%.

Fuel availability has recently been called into question; there may be insufficient gas supplies to support the level of plants currently being planned and constructed. Future gas plants may well be dependent on the development of domestic shale gas reserves, additional LNG supplies, and infrastructure to meet generation demand.

Another potential barrier to new entry may be the ability of gas-fired plants to secure enough capacity and energy revenues to recover investment costs. Gas-fired generation has historically been relatively

[42] California Energy Commission, "Energy Quest," http://www.energyquest.ca.gov/story/chapter11.html. Geothermal energy is often referred to as any energy producing approach that uses the earth's heat or coolness to improve energy efficiency; for example, ground water heat pumps can be a geothermal energy product. However, for purposes of this paper, geothermal energy will be a generation system that uses the earth's heat to produce electric energy. There are many examples of geothermal plants, particularly in California, where there are currently 14 plants in operation.

[43] Energy Information Administration, http://www.eia.doe.gov/cneaf/electricity/epa/epat2p2.html, Existing Net Summer Capacity, October 22, 2007

[44] Energy Information Administration, http://www.eia.doe.gov/cneaf/electricity/epa/epat2p2.html, Existing Net Summer Capacity, October 22, 2007

high on the economic dispatch curve and run for shorter periods of time to meet peak loads.

Nuclear

Nuclear energy planning, if not actual construction, is experiencing a profound upswing, with many generation companies proposing projects. In 2007, the Nuclear Regulatory Commission (NRC) received five applications for new plants. In 2008, the NRC expects to have 13 new applications.[45] While financing this level of construction may be a barrier for some companies, applications do not indicate this concern. One applicant noted that it expects to seek DOE loan guarantees, with specific financing likely to come from the Federal Financing Bank (FFB), a government entity managed by the U.S. Treasury Department.[46] The nuclear energy industry may offer long-term stability for U.S. energy resources, but Congress-mandated loan guarantees of $18 billion will be far oversubscribed with these applications.

A more serious barrier for new nuclear generation is the potential for significant cost growth. With continually escalating material and labor costs, a long-term, eight- to nine-year construction project faces significant final cost uncertainty. This increases financial risk and produces higher premiums for secured loans. Where previous nuclear construction projects suffered major cost overruns and left developers in serious financial straits, new nuclear generation projects will face extremely cautious financial commitments.

The sheer size and capacity of new nuclear facilities also present challenges for the delivery of energy on the existing transmission grid. New 1600 MW nuclear plants will require significant transmission capacity to move energy to markets which will add costs additional costs to an already costly effort.

Other barriers to new nuclear plants include the high cost of planning, development, siting, permitting, and litigation where necessary. Worldwide demand of raw materials such as steel, concrete, and uranium fuel is creating highly volatile prices. In addition, although somewhat diminished at this time, there is remaining public perception and fear of danger from a potentially catastrophic and hazardous event at a nuclear facility.

Finally, waste disposal and an appropriate mechanism for the long-term storage of spent nuclear fuel await resolution.

Oil

Oil-fired generation continues to decline in the United States. With environmental concerns, rising fuel prices, and concerns of foreign dependency, it is no longer used in generation except in special circumstances. The principal barriers to new oil-fired generation are the price for fuel, the uncertainty over fuel availability, the cost of carbon emissions, and the fact that all of these variables at highest prices would leave these projects noncompetitive.

Solar

Solar generation, both photovoltaic (PV) and thermal, have significant cost barriers to overcome as a new energy source. PV installations can cost up to 20–50¢ per kilowatt-hour (kWh) before incentives, while concentrated thermal installation could cost 15–17¢ per kWh.[47] These costs are currently keeping solar generation limited to those locations where subsidies are available and public policy requires use of renewable energy resources. Costs for both PV and thermal generation have only been decreasing gradually.

A substantial barrier for solar power is finding appropriate locations where economies of scale can offer pricing benefits to the developer and where interconnection costs are still manageable. Solar projects need access to transmission with the capacity to take maximum output; however, there are many times during day and night when that transmission is not utilized. This is true for all variable resources that must plan for maximum output but realistically have lower outputs because the sun does not shine and the wind power does not blow all the time. Underutilized transmission capacity can add cost to this type of project.

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[45] Nuclear Regulatory Commission, "Expected New Nuclear Power Plant Applications," August 2008, http://www.nrc.gov/reactors/new-licensing/new-licensing-files/expected-new-rx-applications.pdf.

[46] Kevin James Shay, Nuclear Plant Financing Scarce, *Gazette.Net*, August 1, 2008, http://www.gazette.net/stories/080108/businew180449_32355.shtml.

[47] Solarbuzz, "Solar Energy Costs/Prices," Photovoltaic Industry Statistics: Costs," http://www.solarbuzz.com/statsCosts.htm (Accessed November 12, 2008); Michael Kanellos, "Shrinking the cost for solar power," *CNET News*, May 11, 2007, http://news.cnet.com/Shrinking-the-cost-for-solar-power/2100-11392_3-6182947.html .

Wind

As of September 3, 2008, U.S. wind generation capacity totaled 20,152 MWs.[48] A key barrier to continuing wind power development, as previously discussed, is the uncertainty of the PTC. Long-term extension of this credit and higher prices for renewable energy credits are necessary to secure financing for new projects.[49]

Several wind power-generation expenses create barriers for new projects. Wind power is a variable generation that must pay for high-capacity interconnection resources, but typically only uses about 20–30% in daily generation output. Heavy new demand in the industry has caused temporary shortages and higher prices for turbines, blades, and other construction materials. Finding locations appropriate for facilities with manageable interconnection costs is also a challenge for new wind power generation efforts. However, states such as Texas are beginning to address this issue by installing new transmission to prime wind power generation sites.

Offshore wind power generation faces similar challenges. Delaware recently announced a contract for its first offshore wind power farm; however, to provide the necessary financial viability, the project required a 20-year purchase arrangement and authorization for the company to earn three renewable energy credits for every one MW of renewable energy generation.[50] Rhode Island and New Jersey have also announced the approval of $2 billion and $1 billion offshore wind power farms, respectively, with state financial support.

Offshore wind power projects are typically twice as expensive as land-based ones but offer the opportunity to serve high-priced electricity markets in coastal areas. The need to construct higher foundations in a marine environment that withstand both wind power and wave turbulence adds to the cost of construction. Due to the harsh environment, these facilities require additional maintenance to ensure full lifecycle operation. Permitting for offshore facilities generally requires compliance with both state and federal requirements due to environmental and marine transit issues. The U.S. Minerals Management Service (MMS), charged with permit authority, recently issued its draft permit requirements for offshore wind farms in federal waters. However, with offshore wind farm facilities extending from turbine location to substation landfall, the permitting process will involve almost every interested agency, both federal and state.

The increasing availability of wind power and other variable resources is rapidly changing the system planning environment for transmission systems. Whereas baseload and on-call conventionally fueled peaking plants have typically been used to meet system planning requirements, a much larger portion of today's generation resources are not dispatchable. The variability of wind power as a resource makes this a challenge. As generation increasingly comes from variable resources, reliability organizations will need to plan for enough flexible supply and/or demand resources to allow for system balancing. Developers who wish to cluster units for economic advantage may begin to see new siting barriers created by reliability concerns.

2.4 RECOMMENDATIONS

Encouraging and managing new generation technologies while removing barriers to their development will require bold new actions by the new administration that significantly differ from historical efforts. Leaving the generation adequacy problem solely up to the generation industry will likely result in market inefficiencies that lead to reliability concerns, higher energy prices, and a portfolio of facilities that serves only generator interests. DOE must undertake aggressive and timely efforts to address market failures and promote an optimum mix of generation resources.

DOE has already recognized the need for bold, new action to make large and lasting changes in the energy industry. In its *20% Wind Energy by 2030* report, DOE notes that "the 20% Wind Power Scenario is not likely to be realized in a business-as-usual future. Achieving this scenario would involve a major national commitment to clean, domestic energy sources with minimal emissions of GHGs

[48] American Wind Power Energy Association, News Releases and Statements, U.S. Wind Energy Installations Surpass 20,000 Megawatts, September 3, 2008,
[49] American Wind power Energy Association, "Wind Power Outlook 2008" (Washington, D.C.: American Wind power Energy Association, 2008), http://www.awea.org/pubs/documents/Outlook_2008.pdf.Wind power
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[greenhouse gases] and other environmental pollutants."[51]

The EAC has identified seven recommendations to DOE to enhance generation development.

1. Reduce the financial risk faced by new generation developers.

The most significant barrier to new generation is establishing the financial viability of proposed projects. DOE must support policies, programs, and legislation that minimize the risk of cost recovery and maximize available returns. Consider the following potential tactics:

Create cost-recovery insurance pools for generation developers, whereby new projects may apply and qualify for partial cost-recovery insurance. Such pools would be limited to generation projects that employ new or enhanced technologies and have substantial planning and development costs.

Continue to provide financial grants for new and enhanced technologies, and expand grant programs to support planning and development of new generation projects that demonstrate clean and/or renewable and environmental benefits.

Ensure continued funding for and availability of federal loan guarantees for new energy technologies.

2. Promote policies, processes, and legislation that increases investor certainty over 30 years.

In the generation industry, long term is considered the 30–40 year life of a plant. Yet, federal and state governments discuss and produce legislative changes for energy almost annually. The need for longer-term legislative consistency conflicts with the need for short-term reactions, creating detrimental uncertainty for new generation and new technology development. The recent extension of the production tax credit (PTC) for one year and an impending carbon emissions program, for example, make it impossible for generation developers to predict and plan for requirements. The 2008 National Governors Association Policy Position, NR-18, Section 18.1.3, echoes the need for long-term legislative thinking in the energy sector and is a good source for additional recommendations.[52] More specific suggestions for DOE's consideration include:

- Advocate the continuation and establishment of production tax credits, the expansion of investment tax credits and the provision of comparable incentives for not-for-profit generators, for a much longer term to provide additional financial certainty for new generation projects.
- Promote the use of long-term investment contracts through preferential grants and loans for new technologies that seek long-term generation output contracts.

3. Advocate policies, processes, and legislation that promote new transmission, support development of a high-capacity transmission system, and fairly allocate transmission interconnection costs.

The cost of building transmission facilities, particularly for renewable energy generation plants located in rural or remote areas, can be a significant cost barrier for most new generation projects. Adequate investment in the nation's transmission system is essential so that the electricity generated throughout the United States can be delivered to urban centers that need the increased supply. DOE should:

- Support the development of new transmission facilities that enhance the bulk energy flows and provide for major resource interconnections across the United States.
- Advocate a fair and equitable interconnection cost allocation process that balances costs and

[51] U.S. Department of Energy, *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply* (Washington, D.C.: U.S. Department of Energy, 2008), http://www.20percentwind.org/20percent_wind energy_report_revOct08.pdf.Windr

[52] National Governors Association, "NR-18: Comprehensive National Energy and Electricity," *Policy Position* (Washington, DC: National Governors Association, July 2008), http://www.nga.org/portal/site/nga/menuitem.8358ec82f5b198d18a278110501010a0/?vgnextoid=2a2b9e2f1b091010VgnVCM1000001a01010aRCRD.

benefits for both transmission owners and generators.

4. Promote improved planning processes that expedite generation facility studies and interconnection agreements, and consider generation solutions for reliability.

RTOs have a significant number of generation projects awaiting the facility studies that identify preliminary interconnection requirements and costs. Delays in the review process make time projections uncertain and impact project viability. Recommended DOE actions to enhance and improve that process include:

- Advocate for more accurate and timely interconnection study processes for generation and transmission developers.
- Consider a national review of generation planning processes in cooperation with NERC and other interested agencies.

Promote a planning and review process that examines whether bulk power system reliability is maintained in compliance with mandatory NERC/ERO reliability standards related to the existing diversity of generation sources, including variable generation.

- Consider providing transmission owners and RTOs, in market based deregulated regions, the ability to secure new cost-based generation to maintain system reliability when it becomes the most cost-effective solution to help mitigate congestion and maintain reliability.
- Promote greater regional coordination and planning; to do so, consider re-establishing regional coordination offices and providing grants to support regional energy planning efforts.

5. Advocate improved and longer-term certainty for air quality, water quality, and carbon emission requirements.

- Advocate the adoption of long-term national policies for carbon restrictions, air quality rules, and waste disposal that support the development of new generation technologies and add longer-term environmental compliance certainty for all generation companies.
- Adopt policies that coordinate the environmental limitations imposed by legislation or regulatory actions with the types of new generation needed to comply.
- Support the adoption of new air and water quality standards that maintain environmental quality while creating long-term certainty.

6. Continue supporting new technology development, and maintain or improve DOE grant and loan guarantee programs.

Innovation drives the development of new and efficient generation technologies. DOE must continue and enhance its support for generation research and development.

- Adopt a long-term funding plan that provides a stable level of support for new generation programs and technologies and guides direction and purpose.
- Support efforts to make efficient, cost-effective technology advancements and improved manufacturing processes in generation equipment.

7. Support the development and expansion of distributed and renewable energy generation.

Distributed and renewable generation have the ability to play a much larger role in securing adequate generation and need to be considered in state and RTO planning processes.

- Support revisions to regional and interregional planning processes that permit RTOs to solicit and incorporate both cost effective generation and energy efficiency resources in long term supply plans.
- Explore and promote the potential for distributed, renewable energy generation and high-efficiency CHP to help meet supply requirements.
- Assess the potential for a national renewable portfolio standard to encourage efficient clean energy development, increased energy independence, and security.
- Support the development of reasonable and fair interconnection standards and tariffs for distributed generation.
- Support distributed generation emission requirements that are based on power output as opposed to fuel input to encourage more efficient use of fuels.