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The Outlook for Nuclear Energy in the United States

Dark Ages, Renaissance, or Age of Enlightenment ?

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Gouvernance européenne
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Introduction

Renaissance

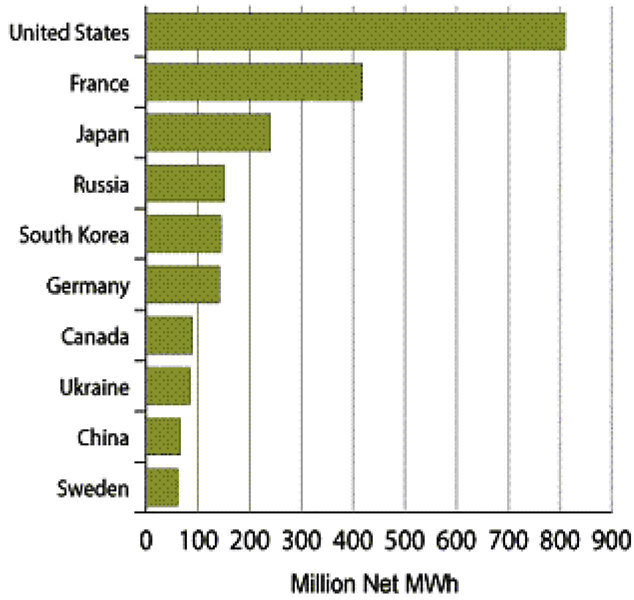
According to the World Nuclear Association (WNA), today there are some 439 nuclear power reactors operating in 31 countries (including Taiwan), with a combined capacity of over 370GWe. These reactors provided about 15% of the world's electricity in 2007. Nuclear energy was responsible for more than 25% of the total electricity supply in 16 countries. In kWh, the US, France, Russia and Korea were the largest producers of nuclear energy in 2008. As of August 2009, some 52 nuclear power units were under construction in 14 countries, and most of these were being built in China (16), Russia (9), India (6), and S. Korea (5). After being suspended in 1985, construction of the Tennessee Valley Authority's (TVA) Watts Bar Unit 2 resumed in 2008, making it the only nuclear unit under construction in the US at this time.

In addition to those under construction, many more reactors (100 +) have been proposed and are in various stages of the preconstruction planning and licensing process. As of September 1, 2009, this includes 18 construction and operating license (COL) applications that have been filed with the Nuclear Regulatory Commission (NRC) for 28 new units in the US alone. Furthermore, according to the International Atomic Energy Agency (IAEA) and the WNA, approximately 30 additional countries are exploring the possibility of starting nuclear energy programs as an option for meeting their future electricity needs. In a global sense, this certainly looks like a "renaissance" to a casual observer or to someone who is inclined to see it that way. However, most of the renaissance is occurring elsewhere, and the US and some other countries are still struggling to launch substantial new nuclear build programs. The renaissance is also a cause of concern to some.

The growing number of reactors in a growing number of countries, many with relatively limited nuclear experience, also increases the risk of a safety-related accident or terrorist incident. While we have seen from the past that experience *per se* does not necessarily reduce the probability of an accident, it is safe to say without much doubt that a serious incident, of any kind, no matter where it occurs, is likely to reset the "renaissance" clock back in time.

Graph 1. Nuclear Generation, 2008

Top 10 Countries – 2,205 Million Net Magawathours (MWh)



Note: Twenty-one other countries account for another 359 million MWh, representing 14% of total world nuclera generation.
Source: International Atomic Energy Agency, Power Reactor Information System File

Nuclear has come a long way in the US

Today's plants produce some of the lowest cost, carbon-free power available. There have been dramatic improvements in nearly every quantifiable aspect of nuclear power plant performance. Public acceptance ratings for nuclear energy are higher than they have been in decades, and there is fairly widespread, bipartisan political support for an expansion of nuclear power. The industry has done an outstanding job positioning itself as a reliable source of clean air energy, one that is capable of contributing to our climate change, energy security and job creation goals.

Many things are now in place to support an expansion of nuclear energy

Regulatory procedures for design certification and licensing of new reactors have been put into place. Financial incentives including government loan guarantees, production tax credits, regulatory risk and limited liability insurance have all been put into place. The NRC has embarked on a multi-year expansion program to train and hire additional employees to deal with new applications and the ongoing inspections that will be required during the construction of new plants. The NRC appears to be up to the task. Many states have also adopted regulations that support new nuclear construction.

The things to resolve…

Nevertheless, many things remain unresolved.

No new plants have been built in the US for decades, and no one knows what to expect as a result. Cost estimates for new nuclear plants have been rising, but are still highly uncertain. The potentially high cost of new nuclear construction and the fear of repeating past mistakes are the largest obstacles. Opponents of nuclear power today base their opposition on the high cost of nuclear generation, proliferation concerns, and the lack of a long-term solution for the waste problem.

Climate legislation

A full-fledged renaissance of nuclear power will require successful cost containment and dilution of the financial risks involved.

It will also require further clarification of the climate legislation now being discussed in congress and nuclear energy's potential role as a carbon-offset technology. The Administration's decision to halt work on the Yucca Mountain high-level waste repository is unlikely to have much impact on nuclear power in the US in the short or medium-terms.

Competition from alternative energy sources

Competition from natural gas, wind, and thin-film solar PV is strong right now.

But, the real question is how long it will last? Natural gas prices will eventually rise. Central station wind and solar are facing growing concerns related to the relatively large size of their "footprints", the need for costly long distance transmission, and relatively low capacity factor that requires more backup. On the other hand, a new nuclear plant, once it is built, will be a reliable source of base load, clean, carbon-free, electric power for 60 to 80 years or more, largely free from the risks of fuel price volatility. Large scale centralized generation projects, be they wind, solar, or nuclear, all face the same financial problems in the US.

Technology cost comparisons

A lot of games are played with alternative generation technology cost comparisons.

The true long-term costs of wind and solar are for the most part unknown. How long does a wind turbine last? Coal is largely discredited today, but it won't go away, and carbon capture and sequestration (CCS) technology has its own problems. More than 100 coal-fired power plants have been canceled since 2001 in the US. Electricity demand is down for two years in a row, and a tug of war is developing between efficiency gains and the need for additional generation capacity. A similar tug of war is developing between large-scale centralized generation and smaller-scale distributed applications.

The 2005 Energy Policy Act

All technologies, including nuclear, are benefiting from the widespread and growing acceptance of the "portfolio" approach to our climate change and energy security challenges.

The portfolio approach accepts as given that we need to use every policy option available to us if we hope to make progress. This approach is also the rational behind the government loan guarantee program established in Title XVII of the Energy Policy Act of 2005 (EPACT). Government loan guarantees to support rapid and widespread deployment of clean energy technologies, while somewhat controversial, are now an accepted part of the US economic landscape, and likely to expand. Government involvement in all aspects of the energy business is on the rise.

Prospect for Nuclear energy

Nuclear energy has a bright future in the US, and it will eventually find its way.

We're not quite there yet, and in the next few years expansion will be slow and deliberate. The first few plants that are lucky enough to qualify for the $18.5 billion currently available in government loan guarantees are set to go forward. Final NRC reviews of the first round of construction and operating license applications could be completed in the 2011-12 time frame. Once a project receives its license, it can finalize its application for a government loan guarantee. Construction could begin soon after and, if everything proceeds smoothly, the first few "test case" new reactors could become operational in the 2018-20 time frame. This is about four to five years after the new reactor construction schedules are due to be completed in Finland, France, and China.

US approach to climate change

Beyond this first round, a major expansion or "renaissance" in the US nuclear power industry will depend largely on the seriousness of the US approach to climate change and an expansion of the government's loan guarantee program.

However, there are many reasons to believe that loan guarantees will eventually be expanded, only the timing remains uncertain.

US support to nuclear technology

The US was and is a leader in nuclear energy technology, and there is a lot of political and economic support for keeping it that way.

The government is committed to working with industry on the next generation of nuclear reactors (GEN IV), on advanced fuel cycle technologies, and on advanced reactors of many possible designs to capture the potential benefits of this evolving technology well into the future. Many challenges remain, but a long-term commitment to the technology is here to stay.

A Brief History of Nuclear Power in the US

More than 25% of current global nuclear capacity is in the United States, and the US is the largest producer of nuclear energy. The history of nuclear energy in the US is well documented and, while it is not the intention to spend much time reviewing it here, it is precisely this history that continues to plague advancements in nuclear energy in the US today. Looked at in its entirety, in the final 50 years of the last century in the United States (and Puerto Rico), more than 250 nuclear units were ordered. More than 230 construction licenses were issued, and more than 180 units actually began the construction process. In spite of this, and in part because of this, 50 units were abandoned before construction was completed, and 28 reactors were closed before the expiration of their 40-year operating licenses expired. Nevertheless, the number of operating reactors in the US reached a peak of 112 in 1990, and it now stands at 104.

The US was a pioneer in the development of commercial nuclear energy. It began in earnest with President Eisenhower's "Atoms for Peace" speech in December 1953, when he said "peaceful power from atomic energy is no dream of the future… that capability, already proved, is here-now-today". Soon after, in September 1954, Lewis Strauss, Chairman of the Atomic Energy Commission (AEC), made the famous remark that "our children will enjoy in their homes electrical energy too cheap to meter".

The Atomic Energy Act of 1954 established a framework for the federal licensing of nuclear plants built by private companies, and the Price-Anderson Act of 1957 allowed the federal government to limit private sector liability in case of a nuclear accident. This Act has been amended and extended many times since, and remains in effect today. The first commercial nuclear reactor started operation in 1957 in Shippingport, Pennsylvania. By 1961, however, only two small reactors were operating and 5 others were under construction, but nuclear reactors were already proving to be more expensive than planned.

In the early 1960s, the primary vendors began offering larger plants on a fixed cost, "turnkey" basis in an attempt to capture economies of scale, minimize financial risks for the investors (including utilities, ratepayers, and public utility commissions), and create a market for commercial nuclear energy. It worked, and utilities ordered 49 plants totaling 40,000 MWe of capacity between 1965 and 1968. Then, after a brief lull, utilities ordered another 145 reactors between 1970 and 1974. The Arab oil embargo of 1973 and

President Nixon's Project Independence added fuel to the fire, prompting the AEC to predict that by the end of the century the US would have 1000 nuclear reactors producing safe, clean, secure, and affordable energy. Nuclear power at the time was already being viewed as a way to displace imported oil, and as a way to deal with air pollution.

By the mid-1970's more than 100 nuclear power plants were planned or built. As many as 15 new reactors received full-power operating licenses in both 1973 and 1974 alone. At the same time, the economic dislocations that hit the US and world economies after the 1973 embargo, sharply raised energy prices, interest rates, labor and commodity prices, and the costs of construction. It also sharply reduced the annual growth rate of electricity demand, from 8% in the 1950s and 60s to 3% in the 1970s and 80s. Electricity demand grew by 2.4% per year in the 1990s and by only 1.2% per year from 2000 to 2007.

Cost Overruns

Many of these first generation plants were site-specific designs and unique. In these days before standardization, many plants began construction before their engineering designs and plans were completed. This gave rise to many construction and regulatory delays and cost overruns. By now, however, most contracts were being undertaken on a "cost-plus" basis that shifted the risk of delays and cost overruns to the utilities and ratepayers. The large capital costs of delayed projects generated capital charges that rapidly accumulated, creating more and more expensive power and "rate shock" when the project went into operation. Construction periods grew to 10 years or more for some plants. As the list of problems grew, the market for new reactors dried up, and the number of new reactor orders collapsed from 38 in 1973 to 2 in 1978. Many plant orders were canceled and many other companies, facing financial ruin, walked away from projects in varying stages of construction.

This led to large increases in electricity rates for the companies that did complete their construction projects, and further slowdowns in the growth of electricity demand. The Shoreham nuclear plant built by the Long Island Lighting Company is the most famous example of what was going wrong at the time. The plant took nearly 25 years to build at a cost of more than 50 times its original estimate, but it never received permission to operate. The whole New York region was affected by the loss and New York ratepayers were stuck with some of the country's highest prices for electricity. In Washington State, the Washington Public Power Supply Company abandoned two unfinished reactors and $2.25 in bonds, resulting in the largest municipal bond default in US history. The Three Mile Island incident in 1979, followed by Chernobyl in 1986, raised many serious safety concerns and fed growing public opposition, which then took over and played a key role in the industry's undoing.

In February 1985, *Forbes Magazine* carried an article about the nuclear energy industry entitled "Nuclear Follies" that stated: "the failure of the US nuclear power program ranks as the largest managerial disaster in business history, a disaster on a monumental scale… and, in little more than a decade (the industry) transformed what elsewhere in the world is a low-cost, reliable, environmentally impeccable energy into a power source that is not only high in cost and unreliable, but perhaps not even safe".

Former NRC Commissioner Peter Bradford writing in the Regulatory Assistance Project's Newsletter places the blame for most of these troubles square on the shoulders of the industry. He writes that "nor were the nuclear plant cost overruns the result of unnecessary rule changes, an ill-conceived nuclear licensing process, erratic state and federal regulation, or the overindulgence of public interventions in the licensing process. Rather, the nuclear industry grew too fast for its own good. In 1968 the average plant under construction was four times larger than the largest plant in operation, and ten times more nuclear capacity was under construction than there was in operation. Immense financial commitments were made to reactor designs for which little or no operating experience existed. When – as happened with some frequency – events showed that safety margins were smaller than regulators believed, modifications were needed to assure that the required levels of safety were being met. The safety goals were consistent, but the regulations necessary to attain them changed in response to the performance of the technology".

In 1986, the Department of Energy came out with a study that concluded that the actual costs of the first 75 nuclear plants entering operation between 1966 and 1977 in the US were 200%, or three times the cost of their original estimates. The DOE also estimated that the cost of nuclear power plants abandoned by their sponsors during construction, cost ratepayers an additional $ 25 billion. A new study by the Union of Concerned Scientists estimates that the combination of cost overruns for the existing generation of completed nuclear units, together with the sunk costs associated with canceled projects, totals in excess of $300 billion (in 2006 dollars). While regulators disallowed some limited portions of these costs as imprudent, ratepayers had to bear most of these cost overruns and sunk costs for canceled projects.

Deregulation/Stranded Costs

The story doesn't end here. Rate shock and high prices gave rise to calls for more competition and less regulation in electricity markets. This led to the Energy Policy Act of 1992, and a spate of rule makings by the Federal Energy Regulatory Commission and state public utility commissions (PUCs). These changes broke utilities' monopolies over the sale and transmission of power in their previously exclusive its service territories. They also gave commercial generators (independent power producers) access to the interstate system for transmitting power and to wholesale power markets for sales. A number of states also experimented with competition in retail markets, but this was mostly limited to very large customers.

As a result of restructuring, many firms were "unbundled" or broken up into separate generation, transmission, and distribution companies. Abundant supplies of low cost natural gas led to a rapid expansion of very low-cost, short lead time combined cycle gas-fired electricity. Competition from cheaper sources of power that came about as a result of deregulation made generation from many expensive nuclear projects too costly to compete, which gave rise to the issue of who should cover the costs of past and now uneconomical investments in nuclear power plants. These "stranded costs" could not be recovered in the new, unregulated competitive markets, and as a result, many companies began to view their nuclear units as liabilities. Many of these plants were sold at unbelievably low prices to get them off the books. PUCs then built some of the difference between what was owed on the nuclear unit and its sales price into the rate base, to allow the utility to recover some of these stranded costs. The accounting is complicated, but estimates of the amount of stranded costs of nuclear plants resulting from restructuring are in the $70 to $85 billion range.

Industry Consolidation

Industry consolidation, achieved through acquisitions and mergers of nuclear plant owners and operators, has been an important factor in strengthening the industry's management skills, finances, and ability to achieve greater efficiencies and economies of scale. This consolidation has left the industry with fewer, large players who are more capable of managing risk, the evolution of technology, the inevitable costs of ongoing government regulation, and the challenges of political change.

At the end of 1991, a total of 101 electric utilities had an ownership interest in operating nuclear power plants. Today, there are 26 operating companies that also own the lion's share of the nuclear generating capacity. Many smaller utility companies also have ownership shares in the rest of the plants, but operation is often left to the larger operating companies.

Recovery

A lot of positive steps have been taken by both industry and government since the industry's nadir in the 1980s, and the US nuclear energy industry today is very much alive and well. There have been dramatic improvements in every quantifiable aspect of nuclear power plant performance over the last 20 years. While overall power generation and electricity prices are down, nuclear energy is on track through the first 5 months of 2009 to set a new generation record with a capacity factor in excess of 90%. The existing fleet of nuclear units produces some of the least expensive power in the US today. They are the proverbial "cash cows" of the generating world, and they stand ready to receive $ billions in windfalls from the eventual imposition of a price on carbon.

The US is on track for a revival of nuclear energy, but the revival is likely to be very slow and very deliberate for most of the next decade. Regulatory procedures have been rationalized and streamlined, but they are new and most of them are just now being tested. Many financial incentives such as loan guarantees, production tax credits, regulatory risk and limited liability insurance programs have all been put into place, but they may not be enough to meet the industry's needs. The high cost of new nuclear power is still a major obstacle, and the industry is united in its push for additional financial support.

The Nuclear Regulatory Commission has embarked on a multi-year program to hire and train 600 new employees to deal with new reactor licensing and design certification applications, and the ongoing inspections that will be required during the actual construction process. While it looks like everything is in place to support and allow for a limited expansion of new nuclear energy plants in the US today, a lot of uncertainties remain, and anything approaching a full-scale "nuclear renaissance" is by no means a sure thing. These uncertainties are examined below.

Investment Risk

Cost is Still the Largest Obstacle

The brief review of the history of nuclear power in the US over last 50 years presented above yields the picture of a largely unsustainable business model. Ratepayers, investors and taxpayers in general paid hundreds of billions of dollars to accommodate construction cost overruns, expensive operating mishaps, plant cancellations, and changes in federal and state policies and regulations. While remedies for many of these problems have now been put into place, for the most part many of the solutions remain untried and untested. The escalating cost estimates for nuclear energy, coupled with in the US very limited recent experience with actual licensing and construction of the current generation of nuclear plants, creates additional uncertainty. In these circumstances, the ultimate, final cost of new units, realized at the time when construction is complete and they are ready to go online, is a highly uncertain estimate at best. These uncertainties create risks that all but make traditional debt/equity financing of new nuclear units impossible in today's market.

No one has started construction of a new nuclear plant in the US for several decades, and the new generation of plants under consideration (Gen III ½) are entirely new designs. Many components now have to be imported from a limited number of experienced suppliers. In addition, nuclear power today can only be deployed in large size increments (1 GW or more), requiring detailed engineering, complicated business planning and long lead times for construction.

Games People Play

A lot of games are played with cost estimates, and many of them can be highly misleading. Cost can refer to "overnight cost" (that excludes financing charges and the time value of money), "all-in cost" (sometimes called "installed cost" that includes "overnight cost" plus finance charges), and "busbar cost" (that includes "all-in cost" plus fuel, operation and maintenance, taxes, insurance, and decommissioning and waste disposal fees).

While nuclear power is a capital intensive, costly proposition, comparisons with alternative technology generation costs can often be misleading. We have relatively little experience with the long-term cost of wind and solar power, and these relatively new technologies have come under pressure lately as a result of land use and other concerns with their large “footprints”. How long does a wind turbine last? Wind and solar require 30 times as much land as nuclear to generate the same amount of power. Also, new large-scale wind and solar projects often require the siting and construction of expensive long distance transmission networks, along with all the problems associated with NIMBY (not in my backyard), BANANA (build absolutely nothing anywhere near anything), and NOPE (not on planet earth). Wind and solar are also intermittent, so they require more redundancies in the form of additional backup generation capacity. A company’s need to minimize risk through fuel diversification often cannot be priced but must be considered, as well as a technology’s suitability for base load vs. distributed power applications.

Without laboring the point, and while acknowledging that it is very difficult, if not impossible, to develop reliable cost estimates for new nuclear plants at this time, (all-in) cost estimates for new nuclear power have escalated very rapidly in recent years. Many of the industry’s own estimates now stand in the range of $8, 000 - $10,000 per kilowatt of capacity, or more, depending on design selection, location, transmission requirements and other factors.

The reasons for the recent cost escalation are not always clear. The costs of all energy projects were escalating rapidly prior to the recession, as were the prices of key commodities like concrete and steel, but they have since come down. Some people believe that the loss of OEM manufacturing capability for nuclear components that has occurred in the US in the past few decades has something to do with it. Like the blacksmiths of old, many nuclear OEMs faded away as new construction wound down in the 1980’s. Today a nuclear renaissance in the US will initially rely on foreign OEMs to supply critical nuclear components needed to build a plant. This creates many chain effects during construction in terms of logistics, quality assurances, verifications and documentation, currency risks, and other uncertainties that give rise to the potential for plant cost escalation.

This, in turn, may be leading many companies to add many more contingencies to their cost estimates. Some nuclear opponents have accused the industry of purposely inflating their cost estimates in order to support their push for additional government loan guarantees. Most nuclear opponents, however, are content with these high and rising cost estimates because, in their view, they show that nuclear power is not economically competitive with other alternatives.

While projects of $10 billion or more are not unique in the energy business, they are often financed by major oil companies like

Shell, BP, or ExxonMobil that have market capitalization values in the neighborhood of $200 to $400 billion. In comparison, the largest US electric power companies (Southern, Duke, Exelon etc.) have market values in the $30 to $40 billion range. Several other companies planning to build new nuclear units (NRG, for example) have market values of $10 billion or less.

Consensus estimates available today from several sources all show that the US electric power industry will have to spend between $1.5 to $2.0 trillion on new generation capacity, environmental controls, demand side management and transmission and distribution systems between now and 2030. To put that figure into perspective, the estimated “market cap” or book value of the entire US electric supply and delivery system today is only about $800 billion, which reflects all investments made in the last 100 years.

According to the industry, US electric power companies simply do not have the financial strength or capability to finance new nuclear power projects on their own. This is especially true today when the average debt/equity ratio of all investor-owned utilities is close to 60/40, or far from ideal for launching major capacity expansion programs. The lingering effects of the financial crisis only add to the problem. Given our past experience with construction delays and cost overruns, investors remain concerned. In the industry’s view, only the federal government can offset these risks through an expansion of its loan guarantee program.

Additional Risks and Competition

Today, these financial risks are being enhanced by a host of other uncertainties that create even more risks for new nuclear power plants. Of particular note are the uncertainties related to:

The short-term and long-term economic outlook. Most economists expect the recovery to be slow, and that the US may be facing a prolonged period of slower than historical trend economic growth. High and rising public deficits, prospects for inflation, rising interest rates and an expected decline in the value of the dollar could adversely impact nuclear energy, with its long lead times and large capital cost, more than other technologies.

The prospects for energy prices and electricity demand growth. The growth rate of electricity demand has been trending downward in the US for the last three decades. Electricity demand declined two years in a row in 2008-2009. Possible implementation of energy efficiency and renewable portfolio standards, a carbon cap and trade system, and other programs to deploy clean energy sources could raise electricity prices and slow demand even more. A tug of war is developing between the expected growth of efficiency improvements and the need for expansion of generation capacity.

The ongoing evolution of federal and state efficiency and renewable portfolio standards. These can effect prices, GDP, and electricity demand. Successful deployment of new technologies, including nuclear, will require higher electricity rates, which will impact demand and possibly erode the competitiveness of a local utility's service area with other regions that have lower costs.

The nature and timing of the eventual adoption and implementation of carbon mitigation policies. Cap and trade or a tax on carbon; allocation or auction of emission permits; allowances for offsets – all are yet to be decided. The timing and probable effects of these policies are largely unknown at this point, and may be unresolved for some time.

Competition from other new and renewable energy sources. In some parts of the country, wind energy and thin-film solar applications are rapidly coming down in price. Wind is now the fastest growing source of power in the US. On a primary energy equivalent basis, the supply of renewable energy of all types surpassed the contribution of nuclear energy for the first time during the first half of 2009. Unlike nuclear power, wind, solar and other technologies can be deployed in small (less than 1 GW) increments in a shorter time, with less financial risks. Distributed power also raises fewer NIMBY (not in my back yard) related siting concerns.

The costs and feasibility of carbon capture and storage (CCS). Successful deployment of CCS, now a largely untested technology, could dramatically improve the longer-term prospects for coal and natural gas, the US's most abundant fossil fuels.

Advances in technology across the board. Many possibilities open up here, especially if you include the outlook for smart grids and the electrification of transportation. If anything, this probably supports a diverse portfolio approach, which could help the prospects for nuclear.

The availability and cost of natural gas. New discoveries and declining demand have brought about a surplus and a major drop in gas prices. Natural gas is a short lead time technology in the power sector and it is cleaner than coal. It is also being viewed as a bridge technology in the transport sector. Gas will probably have a competitive edge in the short-to-medium-terms, but the question remains "how long will it last"?

The degree of political and public support for nuclear energy. While strong right now, is likely to be affected in the longer-term by the industry's ability to contain costs, reduce investment risks and provide competitive power.

Déjà Vu All Over Again?

Given the US history of massive nuclear cost overruns and construction delays in the 1970s and 1980s and the uncertainties outlined above, many people are questioning whether new nuclear power can help the US electric industry cut its greenhouse gas emissions at a reasonable cost. A recent Moodys report entitled *New Nuclear Generating Capacity: Potential Credit Implications for US Investor Owned Utilities,* contains some interesting conclusions. Moodys concluded that "the complexity and long-term construction horizon associated with building a new nuclear plant expose a utility to "material adverse change" conditions related to political, regulatory, economic and commodity price environments, as well as technology developments associated with supply and demand alternatives". The report went on to say that "these long term risks and potential changes in the landscape could prompt regulators to disallow certain cost recoveries from ratepayers after a plant is built, or lead to possible market interventions or restructuring initiatives by elected officials". That about says it all. Consumers, investors, public utility commissions, and politicians are all worried about the cost of new nuclear and it's impact on electricity rates.

Weighing the Benefits

The nuclear industry has done an admirable job of riding the emerging wave of concerns over greenhouse gas emissions, energy price volatility, energy independence, and economic growth. Public acceptance for new nuclear power is now approaching 70%, the highest in decades. Nuclear power has also been given a new lease on life from the widespread recognition and acceptance of the "portfolio" approach to our energy and climate challenges. This portfolio approach basically accepts as a given fact that "we need to use every weapon in our arsenal", or every option available if we hope to make progress on our climate change and energy security challenges. A new nuclear power plant, once it is built, can be a reliable, baseload source of carbon emissions free power for a lifetime of 60 to 80 years. New nuclear capacity can also provide long term benefits with respect to fuel diversity. An expanding nuclear industry can also help promote high tech job creation in many areas, and new sources of state and local government tax revenues

Industry and government have worked closely together in the last twenty years to overcome many of the earlier problems experienced with nuclear energy. The nuclear industry has done a masterful job positioning itself as a non-carbon-emitting source of reliable, base load, clean air energy. Any price we eventually impose on carbon emissions will work in favor of an expansion of nuclear energy generation. There has been a lot of consolidation in the industry, and the remaining operators/owners have the financial resources, operational experience, and scale economies that allow them to achieve greatly improved efficiencies.

According to the Nuclear Regulatory Commission (NRC), there have been dramatic improvements in nearly every quantifiable aspect of nuclear power plant performance over the last two decades, to the point where it now exceeds expectations. The existing fleet of nuclear power plants produces some of the lowest-cost power available in the US today. The owners of the existing fleet of nuclear generating units are positioned to reap billions of dollars in windfall profits from any policy that puts a price on carbon emissions. The industry has been successful in pointing out nuclear energy's positive contributions to the hot button issues of job creation, energy independence, and carbon reduction.

Regulation and the Learning Curve

Regulatory procedures have been rationalized and streamlined to some degree, but the new procedures are just now being tested for the first time. They are, by necessity, time consuming and expensive. It can cost anywhere from $40 to $80 million and take up to two years to successfully prepare and file an application for a construction and operating license (COL), and the NRC's review of the application can take up to an additional four years to complete. NRC certification of a new reactor design can cost up to $100 million and take five years to complete. The hope and expectation is that, as the NRC and the industry gain experience with the new procedures, the costs and timing of the reviews will come down. In order to handle its growing workload, the NRC embarked several years ago on a multi-year program to hire and train 600 new employees. These new hires will deal with the new wave of reactor licensing and design certification applications, and the inspections, tests, analyses and acceptance criteria (ITAACS) that will form the basis of ongoing inspections during the actual construction process, once it starts.

The industry maintains that the next generation of nuclear plants built in the US will benefit from an industry wide inventory of "lessons learned". Companies building new plants are expected to have all detailed design and construction work completed before construction begins. As construction proceeds, regular inspections and tests (ITAACS) will be performed to ensure that the plant has been built in accord with the approved design. These steps, which can easily number over 800 for a single unit, are worked out in advance and included in the plant's construction and operating license. They are a key management tool. When all the ITAACS are met, the NRC and the public should know that a plant has been built according to design and that it will operate safely.

Financial Incentives

Since the costs and financial risks associated with widespread new nuclear power build remain a formidable obstacle, the US Department of Energy (DOE), working with the industry and the NRC, has come up with a program of financial incentives to help the industry overcome these risks. The incentives include:

Nuclear Power 2010, which is a cost-shared, government industry program to: demonstrate untested regulatory processes; identify sites for new nuclear power plants; develop and bring to market advanced, standardized nuclear plant technologies; and evaluate the business case for building new nuclear power plants.

Energy Policy Act of 2005 (EPACT) financial support for new nuclear generation that includes:

government loan guarantees of $18.5 billion for new nuclear units covering up to 100% of a project's debt, as long as the debt does not exceed 80% of the cost of the project; and $2 billion in loan guarantees for new enrichment plants;

production tax credits of $18 per megawatt-hour for the first 6000 megawatts of new nuclear capacity for the first 8 years of operation;

a form of regulatory insurance called standby support under which the government will cover debt service for the first few plants if commercial operation is delayed. This coverage is capped at $500 million for the first two reactors, and at $250 million for the next four reactors. Covered delays include the NRC's potential failure to meet approval schedules and litigation.

EPACT also rationalized the tax on decommissioning funds, provided for a 20-year extension of the Price Anderson Act for nuclear liability protection, and provided support for advanced nuclear technologies.

In addition, some states have adopted policies that support new nuclear construction, such as tax incentives and regulations that permit some degree of cost recovery for construction work in progress (CWIP), other types of financial support, and assurances of investment recovery.

As a result, in July of 2007, the first application to construct and operate a new nuclear power plant in over three decades was filed with the NRC. By the end of the year, a total of five applications was on file and the number of new applications more than doubled in 2008. To date, the NRC has received 18 applications for 28 units. The very existence of the government financial incentives may be part of the reason behind this wave of recent license applications. The industry's attempts to win an expansion of the government loan guarantee program for new nuclear power plants in the waning days of the Bush Administration could also be a factor behind the current rush.

Submitting an application does not mean that a reactor will be built, however, and many license submittals at this point are aimed at “keeping the nuclear option open”. The time and expense involved in filing so many applications does suggest some degree of commitment. All in all, the DOE received loan guarantee applications for 21 new reactors of five different designs, with a total capacity of 28,800 megawatts. The total amount of loan guarantees requested came to $122 billion versus the $18.5 billion currently authorized. DOE also received loan guarantee applications totaling $4 billion for enrichment plants versus the $2 billion offered.

Rational for Government Support

Not all of these new plants will move forward in the near-term, if at all. At current levels of funding, the incentives in place may be enough to support the licensing, financing, construction and start-up of two to four new units between now and 2020. The rationale for this support is the hope that the experience and lessons learned from the initial round of licensing applications and construction management will be positive enough to dispel many of the uncertainties and risks surrounding costs that plague nuclear power expansion today.

The hope is that support for the first few units will demonstrate the commercial feasibility of the new reactor designs and the new NRC licensing process. It will also give the industry an opportunity to demonstrate and hopefully prove that it can manage large, complex construction projects on time and within budget. While the US appears to be on track for a revival and expansion of nuclear energy, the revival is likely to be very slow and very deliberate for most of the next decade. Where it goes from there will depend in large part on the successes or failures of this first wave of new construction, and on the future availability of capital.

The industry points out the progress that has been achieved in Japan and Korea as evidence that it can learn from past mistakes and bring projects to completion on time and on budget. The new plant designs under consideration in the US today will all be built overseas prior to US construction, and they should benefit from the learning curve. The industry, along with the vendors, the NRC, and engineering firms, has also established a number of working groups to improve quality assurances, learn from past mistakes, take corrective actions, and utilize new construction management tools. Nevertheless, every new nuclear “build” is being watched very closely. Any instances of poor performance, mismanagement, construction delays or cost overruns are likely to have an impact on the conviction to move ahead with new builds, and on the progress of the other units in the planning, licensing, and construction pipeline.

The Promise of Standardization

Albert Einstein once said, "technological progress is like an ax in the hands of a pathological criminal". The experiences gained from building new designs usually lead to improvements, modifications, delays, and higher costs for similar plants that follow. The hoped for "standardization" of plant designs almost always gives way to the relentless march of technological advancement. All the advanced reactor designs face first-of-a-kind engineering costs. In addition, global OEM manufacturing capabilities for key nuclear components are likely to be stretched to the limit in the near future, and need to be developed to support further build. The French and Chinese governments are subsidizing the design finalization, construction and testing of the first EPR and AP-1000 reactors, respectively, in Finland and on their own home ground in France and China. Since most of the reactors being licensed in the US (including the EPR and AP-1000) will be built overseas before construction takes place in the US, the US nuclear industry is watching overseas progress very closely, and hoping to benefit from the learning curve.

A Government-Dependant Nuclear Industry. Even if these "first mover" projects enjoy success, financing may continue to be a problem. The industry appears to be strongly united in its support for additional government loan guarantees as a necessary prerequisite for large-scale expansion. Many nuclear CEO's have stated emphatically that new nuclear capacity will not go forward without government loan guarantees. Several license applications have been suspended pending the availability of new funding for loan guarantees.

It remains to be seen whether the industry's position is a negotiating tool supporting an attempt to shift additional risks to the taxpayers, or if it is a real prerequisite for expansion. Some observers believe that, for historical reasons (that we explore below), the industry's entire existence has evolved to the point where it now depends on the continued development and maintenance of a very close, symbiotic relationship with government in all aspects of the business.

The industry today is unwilling, and some say unable, to take on a lot of new financial risks associated with a major capacity expansion program unless it does so hand-in-hand with government, every step of the way. Regarding this point, it is important to recognize that governments have a sizeable direct financial (ownership) stake in their nuclear industries in most of the other countries with civilian nuclear energy programs today. In the US, the government supports nuclear energy in a variety of ways, but outside of the government involvement in TVA and the other regional power marketing authorities, the US government has no direct or indirect ownership interests in commercial nuclear energy generation today.

The industry points out that the US electric power sector consists of a relatively large number of small companies that do not have the size or financial strength to finance new nuclear power projects on their own. They are very small compared to large international oil and gas companies or large, consolidated government-owned electric utility companies. This fact is often cited as an additional reason for government financial support.

Government Loan Guarantees

The Political Economy of Nuclear Power: A Controversial Matter of Philosophy

While there appears to be growing bipartisan support for government loan guarantee programs to support the deployment of nuclear and renewable energy technologies, the whole concept is controversial, and has its equal share of bipartisan detractors as well. Both the House and Senate versions of the cap and trade legislation under discussion contain language establishing a Clean Energy Deployment Administration (CEDA) to support the deployment of clean (carbon-free) energy technologies through an expansion of government loan guarantees. While details about the structure, management and functioning of CEDA remain to be determined; the devil is clearly in the details.

Opponents argue that government loan guarantee programs distort capital markets, raise the cost of capital for everyone outside the guarantee program, stifle innovation, and squeeze out small business. They also argue that the political nature of the program will inevitably put the government in charge of technology selection. Others fear that support for nuclear power will come at the expense of smaller scale technologies like renewable energy (wind and solar) and energy efficiency. Opponents claim that government loan guarantees support the accumulation of private profits at the cost of public (taxpayers') financial risk. The federal government manages a loan guarantee program of close to $1.2 trillion today to insure necessary investment in critical national needs like housing and transportation infrastructure.

Most environmental organizations do not support an expansion of government loan guarantees for nuclear power beyond what has already been allocated, and their web sites openly express concerns that nuclear power will "hijack" the climate issue at the expense of renewables. For this reason, the House Bill (Waxman-Markey: H.R. 2454, The American Clean Energy and Security Act) imposes a limit of 30% on the amount of government loan guarantees that can support the deployment of any single technology. The Senate Energy and Natural Resources Committee Bill does not include this limit.

Like the US Export-Import Bank and other federal loan guarantee programs, the loan guarantees are scored at zero in the annual budget process, and would not impact the government deficit unless a recipient were to default. While the industry places a low probability on the chance of default, critics of the program point out the potential for the taxpayer to be saddled with large potential debts. The industry maintains that the program is structured to be self-financing, so that the companies receiving the loan guarantees pay the cost to the government of providing the guarantee, and all administrative costs. They maintain that in a well-managed program, projects will be selected based on credit worthiness, due diligence and strong credit metrics that will minimize the chance of default and risk to the taxpayer. Critics point out the nuclear industry's historical track record, and the likelihood that taxpayers are being set up to pay another huge bailout.

Proponents argue that the social benefits (achievement of our climate and security goals) far outweigh the costs and distortions of the program. They also argue that our capital markets aren't functioning as they should, that increased government involvement in energy markets is both necessary and inevitable to fix what is broken. The lack of financing is retarding the hoped for expansion of the green revolution and green job creation, leading many others to believe that taxpayers should bear some of the risks associated with rapid deployment of new energy technologies. The loan guarantees for nuclear power as they are currently structured are to be paid for by the recipients of the guarantees.

Economists, on the other hand, argue that if the purpose of an expanded loan guarantee program was to correct for a market imperfection, in this case the external costs of global warming, the most efficient mechanism is either a carbon tax or a cap-and-trade system. Increasing the price of carbon will allow the market to favor, and ultimately choose lower cost, cleaner, non-carbon technologies. Other, more pragmatic voices say that it is politically difficult, if not impossible, to raise energy (carbon) prices in the US in such an open and transparent manner. Therefore, they tend to view government incentives (subsidies) that support the deployment of clean energy technologies, while hiding the real costs to the consumer (taxpayer), as the only solution.

The current loan guarantee program created by Title XVII of EPACT 2005 is viewed by many and by the nuclear industry as an appropriate way to finance widespread deployment of clean and secure energy technologies. The loan guarantee program covers 10 technologies that are eligible for loan guarantees. These include renewable energy systems, advanced fossil energy technologies, hydrogen fuel cell technologies for various applications, advanced nuclear facilities, efficient electrical generation, transmission and distribution technologies (smart grids), end use efficiencies, fuel efficient vehicles, and pollution control equipment (like carbon capture and storage).

Climate Legislation

The current climate bills in the both the House and Senate attempt to cushion the initial impact of a cap-and-trade system on the price of energy. Both bills delay the phase-in of implementation, allocate rather than auction early CO2 emission permits, and add renewable portfolio standards, grants, subsidies and government loan guarantees to the mix. In the US political system, our elected representatives feel the need to please and appease their constituents, and, as a result, they will go to great lengths to disguise any policy actions that might raise the price of energy. How this all plays out is difficult to determine at this point in time. If past is prologue, however, it looks likely that any climate legislation that eventually passes congress will probably be very complicated, very inefficient, very expensive, and possibly very ineffective.

We have no choice but to accept this reality, however, because that is now the US political system works. What is clear is that the degree of government involvement in energy markets and many other aspects of US society and business is clearly on the rise. While this fact alone adds to the uncertain outlook for nuclear energy, it also supports the industry's call for more loan guarantees and an even greater dependence on close government-industry cooperation in the future.

Is the Window Closing? Health care reform has grabbed the spotlight and pushed energy into the background for the time being, raising doubts about the ability of Congress to successfully debate and pass new energy (climate) legislation in 2009. On Tuesday September 15, 2009, Senate Majority Leader Harry Reid told reporters that the Senate might not act on climate legislation until next year. High unemployment, growing deficits, and a declining ability to finance major structural changes are also likely to have an impact. Next year is an election year, and that may delay progress on these issues even further. Meanwhile, the Environmental Protection Agency (EPA) has classified carbon emissions as a harmful pollutant. Failure of congress to act on the climate bills could prompt the EPA to use its powers under the Clean Air Act to begin regulating CO2 emissions.

Many people now expect energy, climate, the degree of direct government involvement in energy markets, and support for the deployment of clean, renewable, and nuclear energy technologies to be the main issues in the 2010 mid-term elections, and in the 2012 Presidential political campaign. Congress could act before that time, but resolution of the industry's hoped for expansion of the federal government's loan guarantee program for new nuclear builds in the US might have to wait.

2012 is also a realistic time frame for the NRC to finish its reviews, and rule on at least some of the first round of construction and operating license (COL) applications for new nuclear units that it has received since 2007. Once a project receives its COL from the

NRC, then (and only then) can DOE move forward to finalize the already authorized ($18.5 billion), first round of government loan guarantees. Construction could begin soon after, but bear in mind that a COL, once it is issued, is good for 20 years. If construction proceeds, the first few, "test case" new reactors in the US could become operational by 2018-2019. This is about four or five years after the new reactor construction completion schedules underway in China, Finland, and France.

A real "renaissance" in the US nuclear industry may not happen without a large expansion of the government's loan guarantee program. A lot will depend on the seriousness of the US effort to deal with climate change. Government involvement in all aspects of the energy industry is growing, and support for the job creation possibilities of the clean energy revolution make it more likely than not that loan guarantees will eventually be expanded.

Other Issues

Yucca Mountain and Spent Fuel

Impact of the Yucca Decision

The Obama Administration's decision to halt work on the development of a high level nuclear waste repository for spent nuclear fuel in Nevada, while controversial, is unlikely to have much impact on the advancement of nuclear energy in the short or medium-terms. Only a few states have policies that link the construction of new nuclear generation to the establishment of a clear policy and program for managing spent nuclear fuel, and none of these currently have credible proposals for new units on their books. According to the Nuclear Waste Policy Act (NWPA), which was first passed in 1982 and subsequently amended several times, the DOE was to identify a site and then construct and operate a permanent geological repository. The companies were obligated to pay one mill ($.001) per kwh of nuclear generated electricity into a Nuclear Waste Fund to pay for this service, and DOE was to begin accepting spent fuel from the companies by 1998.

For a variety of reasons this didn't happen. The Nevada project was regularly underfunded in the annual congressional budget appropriations process. Nevertheless, and four years late, the DOE and the National Academies finished all their studies and reviews in 2002, and reaffirmed that the Yucca Mountain site was a safe and scientifically sound option. The President and Congress agreed with this recommendation, and Yucca Mountain was designated as the site where DOE would build the repository. Legal challenges and funding shortfalls continued to plague the project and DOE didn't submit a license application to the NRC to construct and operate the Yucca Mountain site until 2008, 10 years after it was to have begun accepting spent fuel. The NRC could take up to four years to review DOE's application, and under the current timetable, even if the Obama Administration changed its mind (doubtful), the DOE probably couldn't finish construction and open the facility before 2020, at the earliest.

The Obama Administration's decision to take the Yucca Mountain project off the table was initially met with skepticism by many and as a clear sign that the President was antinuclear. Like most things in Washington, however, it is much more complicated than that. The Obama Administration by itself cannot actually close the project, since it is mandated under the terms of the Nuclear Waste policy Act (NWPA). In the absence of legislation that alters the NWPA or specifically terminates the project, it must continue. There is no law that says the project has to be funded, however, and cutting the funding for the project to the minimum necessary to support the NRC's ongoing review of DOE's license application is the route the current administration has taken.

The NRC is continuing to review DOE's application for a construction and operating permit for the Yucca Mountain repository, but it is not expected to rule on this application for several years, if at all. Funding that allows the NRC and DOE to continue with the license application process is included in the budget, as are funds that support the State of Nevada's Agency or Nuclear Projects, Nuclear Waste Project Office. The Mission of this state office, which is funded through DOE's budget, is to make sure the health, safety and welfare interests of the State of Nevada are adequately protected with regard to any federal high-level nuclear waste activities in the state. Surprising as it might be, the US DOE actually pays the cost of funding a state office whose sole mission is to oppose the opening of the Yucca Mountain repository. Harry Reid, the Senate Majority Leader and Senator from Nevada, has vowed to reduce the funding that supports the NRC's ongoing review of DOE's license application in future budgets, but he may not have the support he needs to carry this out. Senator Reid is up for re-election in 2010, and while his popularity has waned, and unemployment and the rate of home foreclosures in Nevada are well above the national average, no strong opponent has emerged.

Obama's decision on Yucca Mountain was more political than technical in the sense that it fulfills his campaign promise to the people of Nevada. No Democratic presidential candidate supported the Yucca project during the campaign. It was also an important opening to Senate Majority Leader Harry Reid, who Obama was courting to gain support for his Supreme Court and other appointments, and his economic, health care, and climate agendas. The decision was technical in the sense that many people believe that the Nuclear Waste Policy Act (NWPA) was fatally flawed from the beginning, and in need of a major overhaul. Given the political opposition to the project, the very concept of a permanent repository became scientifically, economically, and legally indefensible to many observers. Many others also believe that a review of current US policy on fuel cycle management and waste disposal issues is long overdue.

Advanced Fuel Cycle Technology

Most of the same people welcome the administration's call for the establishment of a "blue ribbon" panel to formulate recommendations on waste, and believe that the US will eventually embrace and adopt recycling and reprocessing. Developing and utilizing advanced fuel cycle technologies that compliment the next generation of advanced reactors, will allow us to extract more energy out of spent fuel, burn some of the more harmful elements, and minimize the waste stream. However, reprocessing and advanced reactors will not completely eliminate the eventual need for a permanent geological repository for the by-products of spent nuclear fuel. For this reason many people believe that we have not heard the last of Yucca Mountain yet, and that it may resurface once again as a possible repository option at some time in the future, four, eight, or even more years down the road.

Catch-22: Expensive Campaign Promises

The Nuclear Waste Policy Act (NWPA) will eventually need to be changed but the already-crowded congressional agenda probably means that changes are unlikely anytime soon. In the meantime, the NWPA prohibits DOE from searching for other sites and sponsoring the development of centralized or interim spent fuel storage facilities, anywhere outside of Nevada, until the NRC grants the DOE the authority to construct a repository at Yucca Mountain. Gregory Jaczko, the Chairman of the NRC, and Stephen Chu, The Secretary of Energy, have both stated that the current practice of keeping spent nuclear fuel at reactor sites in water pools or in dry steel and concrete casks does not pose significant risks to the public. The NRC is in the process of reviewing its Waste Confidence Rule, and is soon expected to adopt the staff recommendation that affirms the viability of storing spent nuclear fuel above ground, on existing and new reactor sites, for 60 years after the expiration of a plant's operating license. This will buy a lot of time for the DOE and industry to put additional resources into their work and eventual decisions on advanced fuel cycle technologies.

Some 60,000 metric tons of spent nuclear fuel from commercial reactors have been accumulated in the US over the last 50 years, and the amount is increasing by 2000 metric tons a year. Many commercial reactors, especially those that have received life extensions, have spent fuel accumulations that now exceed their original pool storage capacity, and they have been forced to purchase dry cask storage systems to store additional waste. By 2010, most reactors in the US will have exhausted their existing pool storage capacity and will be forced to begin dry cask storage. These dry casks cost about $1 million each, hold about 10 tons of waste, and are stored above ground on the secured site of the reactor. There are now about 950 dry casks in use around the country. The NRC has determined that used nuclear fuel can be safely stored in these casks for years, and that the spent fuel being stored on site around the country is safe for the public and secure from damage or theft. It is expensive, however, and more centralized storage options would provide economies of scale for storing, monitoring and securing the used fuel. This used fuel is now viewed by many as a "strategic national energy reserve" that can eventually supply our nuclear fuel requirements for hundreds of years.

In the meantime, a growing number of lawsuits have been filed against DOE for non-performance of its legal and contractual obligation to begin removing spent fuel from reactor sites in 1998. Since 1998, 71 lawsuits have been filed by the nuclear reactor owners to recover damages and storage costs resulting from DOE's failure to begin removing fuel. Ten of the lawsuits have been settled, four judgements were affirmed, and six cases have been dismissed. The other 51 cases are still pending. Since the damages in each lawsuit are limited to the costs incurred prior to the beginning of the lawsuit, additional lawsuits can be filed to recover subsequent costs and additional damages accruing each year from on-site storage, until DOE catches up with its obligation to remove spent fuel. Without changes to the NWPA, this could go on and on.

The DOE estimates that its liabilities under existing law resulting from its failure could amount to $12 billion between 1998 and 2020. Other estimates, premised on the assumption that the Yucca Mountain project is scrapped entirely, go as high $30 to $100 billion. Since DOE is prohibited from searching for alternative sites to Yucca Mountain by the NWPA, it cannot fulfill its obligation by taking the fuel and storing it somewhere else, and these lawsuits will continue to pile up. These settlements are paid directly by the Treasury.

The owners and operators of the existing commercial nuclear plants (and test reactors) have been paying a fee of $0.001 (one mill) per kWh into the Nuclear Waste Fund (NWF) since 1983. Over the years, about $32 billion in fees and interest have been paid into the fund. DOE has spent about $10 billion on analyzing, characterizing, and developing the Yucca Mountain project, making the site the most thoroughly and extensively studied piece of real estate in the US, if not the world. The Fund has a current balance of approximately $23 billion. Each year it takes in an additional $750 million in fees and it earns about $1 billion in interest.

Since the Obama Administration's announcement to shelve work on the project, many state governors, state legislatures, consumer groups, and the nuclear industry have all begun asking congress and the federal government to suspend payments into the NWF. They have also asked the Administration to refund to consumers the $23 billion currently in the fund account. The NWF, like Social Security, is really just an account commingled with the general revenue fund at Treasury, so paying the money back to ratepayers would have a direct impact on the budget deficit. If this happens, the Administration's decision to suspend work on Yucca

Mountain could turn out to be one of the most expensive campaign promises in history.

The Nuclear Regulatory Commission

Deliberate, Firm, and Efficient

The NRC by design is a very conservative and deliberate agency, and in many ways it has to be. In a recent interview published by *Nuclear Street*, Dr. James Mahaffey says: "there is nothing particularly safe about releasing thermal energy at the rate of a billion watts (per hour) in a moderately sized concrete building… as long as you treat nuclear power like it wants to kill you, an excellent safety record can be achieved". In the US government, the DOE is responsible for promoting the use of nuclear technology, and the NRC is responsible for regulating the safe and secure civilian use of nuclear technology and materials. Promotion of nuclear power is not part of the NRC's mandate, and it is probably best that it isn't. The NRC licenses and regulates nuclear power plants, fuel cycle facilities such as uranium recovery, enrichment, and processing, and the transport and storage of nuclear waste. It also licenses the use of nuclear materials for medical, industrial, and other purposes during construction. This meant that it actually had to hire close to 1200 extra staff to compensate for attrition and the retirement of "baby-boomers".

Prior to 2007, when the current round of new reactor construction and operating license applications began to arrive, the NRC hasn't had to deal with a reactor license application for decades. Beginning in 2006, the NRC launched a program to hire 600 additional staff over a three-year period, in order to deal with the new round of COL license applications, reactor design certifications, and inspections It takes approximately two years to train and certify a NRC license examiner. At the present time, the NRC is devoting a tremendous amount of time, attention, and resources to training and transferring knowledge to a new generation of regulators.

The NRC has close to 4000 employees today. It has an annual budget of just over $1 billion, most of which is recovered from license applicants in fees. Surprisingly, and given the politics involved, no one in Washington seems to view this as a potential conflict of interest. Congress does have oversight responsibility, and the NRC is not independent in that regard. The NRC is governed by a five-member Board of Commissioners who are nominated by the President and confirmed by the Senate, for a term of five years. The President chooses one of the Commissioners to act as Chairman, and this appointment to the Chair does not require Senate confirmation. There are currently two vacant positions on the five-member Board to be filled by President Obama. While there is no official word on possible nominees, the inside rumor is that William Magwood, a former Director of DOE's Office of Nuclear Energy, and George Apostolakis, a professor at MIT, may be the next candidates.

The New Chairman

The current Chairman, Gregory Jaczko, was appointed to the NRC in 2005, and elevated to the position of Chair by President Obama in May of 2009. His appointment was initially met with considerable skepticism by the industry. Prior to the NRC, Jaczko, who has a Doctorate in Physics, worked as appropriations director and science advisor to Nevada Senator Harry Reid, who is widely known as a devoted antinuclear activist and for his opposition to Yucca Mountain. Jaczko also worked as a congressional science fellow for Representative Edward Markey of Massachusetts, who is another nuclear power opponent. Jaczko has been the sole dissenter on several issues brought before the Commission in recent years. On the positive side, as a scientist and physicist, he does not seem to be against the technology per se, but he clearly takes his job as a regulator seriously.

Jaczko has been outspoken about his regulatory agenda. It is clear from his speeches thus far that he wants to be known as an effective, decisive, firm and efficient regulator, and as someone who takes his mission of protecting the public's health and safety very seriously. Jaczko has worked hard to reduce the threat posed by a potential commercial airline crash on new reactor designs, and he has made improvement in fire protection regulations - safety issues related to fire protection and emergency core cooling systems – one of the top priorities for his tenure as Chairman. He has also said he would like to give final approval to "at least one new reactor license application by 2012". He seems well aware of the challenges facing the Commission as they move forward with the certification of new reactor designs, new license applications, the construction and vendor inspection programs, and the complicated endeavor of inspections, tests, analyses, and acceptance criteria reviews for new reactors during the construction process. He wants the NRC to be fully invested in guiding these complicated procedures.

Jaczko is committed to an open, transparent regulatory process that gives outside stakeholders and the public at large every opportunity to make their views known. He clearly wants diverse opinions to be heard, so that the Commission can understand the public interest and as much about a complicated issue as possible before making decisions. He says that he wants to make informed decisions based on open debate. His outreach efforts, openness, and the seriousness with which he has approached the regulatory tasks confronting him have won him a certain amount of (faint) praise from environmental groups.

Even some outspoken antinuclear opponents don't think he will be just another rubber stamp for the industry. They hope that he will regulate an industry that needs to be regulated, and that he will seriously review the standards and regulations that are in place to make sure they are the best rules for the job. For the most part, the industry is taking a wait-and-see attitude towards the new Chairman, and in my view this is probably the right stance. In the end, it is probably futile to speculate about the new Chairman's real agenda or hidden sympathies, if there are any, as only time and his record of performance will tell.

Up to the Task

The new licensing and reactor certification processes have been plagued by some delays, but this was to be expected. The NRC attributes these delays to the industry's inexperience with the new application and review processes. This in turn has led to the filing of incomplete applications, with insufficient data and sometimes multiple modifications to applications after they have been filed. Those who know the NRC say that the agency is not resource constrained, and that the Commission is staggering the review process so as to assure that the most likely candidates are moving forward as quickly as possible. In fact, many believe that the NRC is on a relatively fast track today, compared to the former license process.

Public and Political Support for Nuclear Power

Strong and Growing

Bipartisan support for nuclear power appears to be growing across a broad spectrum of very diverse interest groups. The nuclear industry and its many proponents in government, academia, and professional nuclear associations have been very focussed in getting their message out. According to some estimates, the nuclear industry has spent upwards of $1 billion in the last 10 years in the US alone on its campaign to position nuclear energy as a clean, reliable, secure and safe source of carbon free energy. The industry has many champions in both parties. After all, nuclear power is produced in 31 states, and many other states are host to DOE nuclear programs and component supply and fuel cycle service industries.

The 2008 Elections

The Presidential campaign of 2008 took place in one of the most volatile energy markets in recent memory, and the candidates often took positions on issues that were not clearly thought out. For example, Senator McCain called for the temporary suspension of federal excise taxes on motor gasoline and diesel fuel during the peak-driving summer season, a proposal that would have subsidized oil consumption in a tight market. Hillary Clinton also called for the suspension of taxes to help consumers with this pocketbook issue. Candidate Obama, on the other hand, called for use of the Strategic Petroleum Reserve (SPR) and the imposition of a “windfall profits tax” on major oil companies that would then be reinvested in new and renewable energy technologies to promote his vision of the new green economy.

During the long campaign, Senator McCain in response tried repeatedly to show that Obama was antinuclear, forcing Obama to reaffirm over and over again his support for nuclear power as part of our energy mix. By doing so, McCain hoped to raise the ire of the Democratic political left, and put Obama at odds with members of his own party. In retrospect, this campaign posturing isn’t all that surprising. If we examine the facts, however, it appears that Obama was sincere. Obama’s home state of Illinois has more operating commercial nuclear reactors (11) than any other state in the country. David Axelrod, Obama’s political advisor, had previously been a consultant to Exelon, an Illinois company that is the nation’s largest operator of (17) nuclear plants. It has been reported that Exelon and its employees contributed in excess of $250,000 to candidate Obama’s Senate and Presidential campaigns. Exelon supports the President’s carbon cap and trade agenda, and it could reap an estimated $ 1 billion per year in windfall profits from the imposition of a $15 per ton price on carbon emissions. Senator Obama, along with 40% of the Democratic Senators, voted in favor of the Energy Policy Act of 2005, which provided billions of dollars in new incentives for the nuclear industry.

Obama on Nuclear

In a television interview on *Meet the Press* during the campaign, host Tim Russert asked Senator Obama about his position on nuclear energy. Russert asked: “In terms of climate change, global warming, you’ve talked about wind and solar and biofuels. What about nuclear? All-in-all realistic assessment, don’t we need more nuclear power to wean ourselves off those same fuels that are contaminating the world?” Obama replied: “I think we do have to look at nuclear, and what we’ve got to figure out is can we store the materials properly? Can we make sure that they’re secure? Can we deal with the expense? Because the problem is, is that a lot of our nuclear industry, it reinvents the wheel. Each power plant that is proposed has a new design, has – it, it has all kinds of changes, there are all sorts of cost overruns. So it has not been an effective option. That doesn’t mean that it can’t be an effective option, but we’re going to have to figure out storage and safety issues. And my attitude when it comes to energy is there’s no silver bullet. We’ve got to be… we’ve got to look at every possible option.”

From this interview, it is clear that candidate Obama was relatively well informed and that he gave his position some thought.

On the other hand, Senator McCain at one point in the campaign called for the construction of 700 new nuclear units and four more Yucca Mountain repositories, at a cost of $4 trillion, to solve our climate problem.

Last year, in response to high oil prices Republicans in general called for the opening of the US Outer Continental Shelf (OCS) and Alaska to increased exploration and development drilling for oil and gas. “Drill baby drill” became their motto. Republicans also favored an expansion of nuclear energy as another tried and true way to reduce our dependence on imported energy and simultaneously reduce our carbon emissions. When he signed the Energy Policy Act of 2005 into law, President Bush declared that “of all our nation’s energy sources, only nuclear power plants can generate massive amounts of electricity without emitting an ounce of air pollution or greenhouse gases”. Republicans are generally viewed as having a bias in favor of “big” energy, with big being defined as oil and gas, coal, and nuclear power. Democrats in general are seen as favoring “small” energy, meaning energy efficiency, biomass, wind, solar and other more-distributed renewable technologies.

In day-to-day life for most politicians, however, the distinctions are far subtler. For example, even though candidate Obama supported nuclear power, he was running on an “anti-Bush” platform. He chose not to highlight his support for nuclear power at every occasion for partisan reasons. As we say, he didn’t wear his support for nuclear power on his jacket lapel, in the same way as those who supported “drill-baby-drill”. Political support for nuclear energy, however, is increasingly bipartisan, and even some long time foes of nuclear energy, like House Speaker Nancy Pelosi, now argue that nuclear energy has to be “on the table”. President Obama’s issue paper on energy and the environment on the White House web site has a clear statement of support for nuclear energy as an important tool for reducing our carbon emissions and our dependence on imported energy.

Portfolio Approach

There is also a growing recognition that our concerns with atmospheric chemistry and greenhouse gas emissions will require the deployment of a portfolio of technologies if we hope to meet our climate and energy security objectives. These approaches will require energy efficiency improvements along with aggressive expansion of renewable energy, nuclear power, advanced coal and gas-based technologies with carbon capture and sequestration, distributed resources, smart grids, plug in hybrid electric vehicles (PHEVs) and other transportation technologies. In fact, nearly everyone, and especially politicians, have bought into this portfolio approach to energy policy that says in effect, “we need every tool in our kit” if we hope to make progress. The beauty of this approach is that it gives politicians the opportunity to shade their emphasis and support for any given technology to suit their purposes or their audience at any given point in time

A considerable trade-off and compromise has been steadily emerging in the past few years between competing energy and environmental interests. This compromise implicitly recognizes each competing fuel's potential contribution to our climate and security problem and, therefore, its right to exist. It has environmentalists recognizing that nuclear can make a contribution and nuclear proponents recognizing that wind and solar may have merit. It is also based in part on the notion contained in just about every academic study done in the recent past that concludes "removing any one of these technology options from the portfolio approach is likely to place unsustainable pressures on the remaining options". Therefore, everything (including nuclear, renewables, efficiency, clean coal, biofuels, PHEVs, smart grids, CCS and everything else) has to be "on the table". This is the new mantra, and it enjoys wide political support. Fortunately for us, this may just turn out to be the right policy approach.

Role of the Labor Unions

Labor unions have also gotten in on the act, often in ways that create strange bedfellows and cut across partisan lines. In California, for example, one proposal to build a large new solar power installation ran into severe environmental opposition by a coalition of union and environmentalist groups. The project backers did not promise to utilize only union labor in the construction and operation of the plant. A similar proposal by a different group that promised to pay "prevailing wages", which is Davis-Bacon Act code for using only union labor, sailed through the environmental review process without any opposition or delays. Labor supported Obama in the campaign, and Obama now supports labor.

This is happening in nuclear power as well. The nuclear industry is united in its call for an expansion of the government loan guarantee program for new nuclear plants, and it has encouraged big labor to support this expansion. Both the House and Senate Energy Committee bills contain provisions for the establishment of a Clean Energy Deployment Administration (CEDA). CEDA would provide additional government financial loan guarantees for the deployment of clean energy technologies, as long as the recipients of the loan guarantees respect the Davis-Bacon Act and pay "prevailing wages".

The nuclear industry's talking points on this issue are as follows:

It is in the constituents' and the nation's best interests to support the highly trained work force that is committed to the safety, construction, operation and maintenance of nuclear facilities.

The loan guarantee program and Davis-Bacon are important components to supporting the nation's nuclear renaissance.

Without congressional support for nuclear construction projects, the nation looses opportunities to benefit from thousands of American jobs that realize critical economic gains for the entire country and move the United States towards energy independence.

Together, labor unions and the nuclear power industry can make our nation's future brighter.

Key Administration Supporters

Dr. Stephen Chu, the current Secretary of Energy and Nobel Prize winning physicist, just last August signed onto a paper written by the Directors of the Department of Energy's National Laboratories entitled "A Sustainable Energy Future: The Essential Role of Nuclear Energy", which argues that "nuclear energy must play a significant and growing role in our nation's - and the world's – energy portfolio if we are to stave off catastrophic climate change". During his Senate confirmation hearing, Dr. Chu said, "nuclear power is going to be an important part of our energy mix. It is 20% of our electricity generation mix today, but it is 70% of the carbon-free portion of electricity today. And it is baseload. So I think it is very important that we push ahead".

The administration nominated and the Senate has confirmed Dr. Warren F. Miller to the dual post of Assistant Secretary for Nuclear Energy and Director of the Office of Civilian Nuclear Waste Management. Dr. Miller, a Ph. D. in Nuclear Engineering, is a long-time member of the American Nuclear Society, a former research engineer at Los Alamos National Laboratory, and a faculty member of the Nuclear Engineering Department at Texas A&M. In his confirmation hearing he strongly stated his support for moving ahead with the deployment of new nuclear power in the US. John Holdren, the White House Science Advisor, is a Physicist, and a proponent of nuclear energy.

Public Acceptance

According to several recent polls, public acceptance of nuclear energy has been improving, and is now higher than it has been in years. A large majority now thinks that nuclear energy is important for our energy and economic future. Furthermore, most people surveyed said that building a new nuclear unit at an existing site nearest where they live would be acceptable. The G8 Leaders meeting in L'Aquilla, Italy in July endorsed nuclear power as "a means to address climate change and energy security, with an essential role in meeting the dual challenge of reducing greenhouse emissions and lowering fossil fuel consumption". Contrary to popular opinion, the perceptions of many people in the US are influenced by what is happening with nuclear energy in other countries.

Opposition to Nuclear

Opposition to nuclear energy is still very strong, multilayered, and highly charged and emotional. The debate has been elevated somewhat from the days of “radiophobia” and the “China Syndrome”, but it still sometimes looks like a clash of religions. Opponents today are more likely to point out the high cost of nuclear power, proliferation concerns, and the lack of any long-term solution to the waste problem as reasons for their opposition. Likewise, they have worked hard to keep nuclear power out of federal and state renewable portfolio standards, and to make sure nuclear isn’t counted as a carbon offset technology in any cap and trade scheme. Nuclear opponents tend to favor “green and renewable” approaches with a strict definition that excludes nuclear power, while nuclear proponents tend to favor “clean” energy solutions that are more encompassing.

The real test of the strength of this opposition, however, is political. Both renewable and nuclear energy today enjoy widespread bipartisan political support. The underlying tension between pro and antinuclear groups in Washington is currently focussed on attempts to define new legislation, financial incentives, appropriations and government stimulus support for one technology at the expense of the other. Outside of the radical fringe on both sides, most members of congress do not want to be put into a position where they have to choose. It is reasonable to assume that the portfolio approach will once again carry the day, and congress will provide equal (or nearly equal) support for both views.

Electricity Demand

Trends

Electricity demand is expected to decline by 3.3% this year, after declining by 1.6% in 2008. Electricity demand is now expected to recover only slowly, along with the economy in 2010. The outlook for electricity demand in the US has gradually come down. According to the Energy Information Administration’s (EIA) 2008 Annual Energy Outlook, electricity demand in the reference case forecast was expected to grow by 1.5% per year to 2030. In the 2009 Outlook, published in February of this year, EIA lowered this forecast to 1.1% per year. In April they published a revised Outlook that takes into account the energy provisions of the American Recovery and Reinvestment Act (ARRA…the stimulus plan) enacted in February 2009, that lowered the expected growth of US electricity demand further to 0.9% per year between now and 2030.

The EIA recently (August) published an assessment of the Waxman-Markey Climate Bill that passed the House on June 26, 2009. That Bill, otherwise known as H.R. 2454, The American Clean

Energy and Security Act of 2009 (ACESA), seeks to regulate emissions of greenhouse gases through a complicated mix of market-based programs (cap and trade), efficiency programs, mandates and economic incentives. The EIA examined 5 cases under varying assumptions, and in these cases the growth of electricity demand ranged from 0.2 to 0.7% per year from 2007 to 2030. Other recent studies (EPRI, McKinsey) expect US electricity demand to grow at rates of less than 1.0% per year from here on out.

A utilities capital expansion plan is based on the expected load requirements of its' own market or service area, and not on these "macro" projections for the country as a whole. It also has to take into account the need to replace old, worn out, non-performing and non-conforming generation and transmission infrastructure. There can be major differences in the choice of technologies between regions as well. Solar energy is growing faster in the West and Southwest. Wind is growing in both the North and South Central Plains states. Nuclear appears to be a favored option for the South and Southeastern parts of the country.

Overview. Status of the US Nuclear Industry

Reactors in Operation

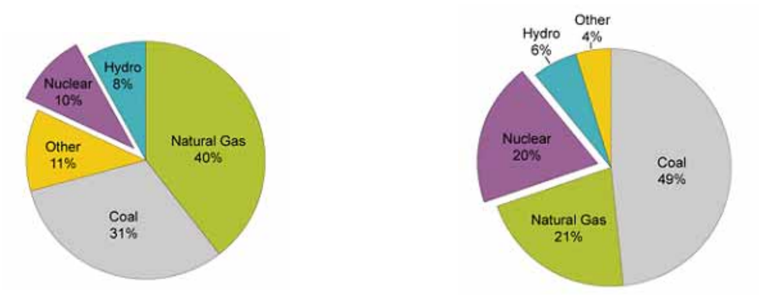
The United States currently has 104 commercial nuclear generating units in operation at 65 power plant sites in 31 states. At the end of 2008, these nuclear units had a total net summer generating capacity of just about 100 GWe. They generated some 806 million MWh of electricity, or some 20% of the 2008 US total generation of 4115 million MWh. Nuclear power today represents only 10% of total US electricity generation capacity of all types, but accounts for more than 20% of all US net electricity generation.

All US plants are generically light water reactors of the pressurized water (PWR-69 units) or boiling water (BWR-35 units) types.

Commercial nuclear reactors are operating at 65 sites in 31 states, and nuclear power was the largest source of electric power in 6 states in 2008. President Obama's home state of Illinois, with 11 units, has the most nuclear generating capacity of any state, followed by Pennsylvania, South Carolina, New York, Alabama, North Carolina and Texas, in that order. Palo Verde (Arizona) is the largest nuclear plant in the US, with 3 reactors of 1311, 1314, and 1247 MW each, for a total of 3872 MW. Ft. Calhoun (Nebraska) is the smallest nuclear plant with one reactor of 478 MW. Most of the US nuclear plants are located east of the Mississippi River.

Graph 2. Capacity and Generation, 2008

Capacity, 2008	Generation, 2008
Total: 994,888 MW	Total: 4,115 MWh



Source: Energy Information Administration

Map 1. 2008 Commercial Nuclear Plants

Source: Energy Information Administration; data are trhough December 31, 2008.

Three more reactors are partly built and have valid construction licenses. All three of these are TVA units. In 2007 TVA decided to complete construction of its Watts Bar unit 2 in Tennessee. Construction was suspended in 1985, and then resumed under a still-valid construction permit in October 2007. There are currently 2000 people working on construction at the site, and the 1180 MWe unit is expected to come on line in 2013, making it the first new reactor to come on line in the US since its twin Watts Bar unit 1 began operation in 1996. The Watts Bar 2 unit will also be one of the last plants to seek an operating license from the NRC using the now outmoded two-step process (10CFR50).

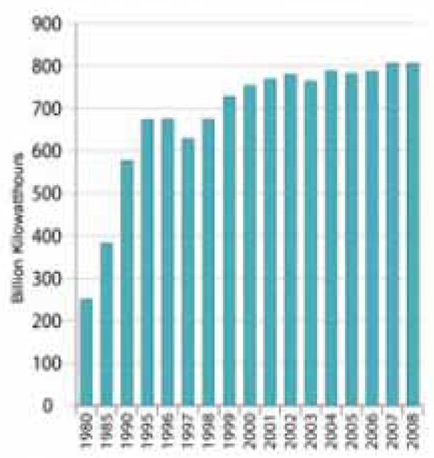
TVA also abandoned construction of its 1200 MWe Bellafonte units 1 and 2 in 1988, after $2.5 billion had been spent and unit 1 was substantially completed. The NRC reinstated the construction permits for these units in February 2009, but TVA has not yet committed to restarting construction, or possibly using the site for a new, more modern unit.

In addition to the 104 unit commercial fleet of nuclear reactors, there are currently 33 research and test reactors licensed by the Nuclear Regulatory Commission (NRC) and operating in the US. Most, but not all of these research and test reactors are at colleges and universities in the US with the rest operated by private research enterprises. In addition, the Department of Energy owns and regulates its own research and test reactors.

Generation and Capacity Factor

The US generated 4156.7 gigawatt hours of electricity in 2008, down slightly from the recent peak in 2007.

Graph 3. Nuclear Generation, 1980-2008



Source : Energy Information Administration

Net electricity generation is expected to fall again in 2009 by about 2.8 percent as a result of the economic recession, and to recover slowly along with the economy in 2010. Coal-fired generation has suffered the largest decline in the past two years, leaving slightly greater shares of the market to natural gas, conventional hydro, renewables and nuclear power. In the 12 months ended in May 2009, 46% of US electricity generation came from coal, 21% came from natural gas, 21% came from nuclear, 7.5% came from conventional hydro, and 4.1% came from renewables.

Nuclear power has demonstrated an average capacity factor greater than 90 percent in the past five years, which represents an outstanding improvement in operating efficiency over time, and it achieved a capacity factor of nearly 92 percent in the last three years 2006-08. This compares favorably with the 70% capacity factor achieved by coal, 42% for combined-cycle natural gas, 36% for conventional hydro, and 40% for other renewable sources. Nuclear electricity generation in the US accounts for more than 70% of all non-carbon-based sources of electricity generation.

Reactor Shutdowns

A total of 132 commercial nuclear units were issued full-power operating licenses in the US between 1957 and 1996, which was the last year that a new unit began full operation. The number of commercial reactors in operation reached a peak of 112 units in 1990. A total of 28 reactor units have been permanently shutdown in the United States (and Puerto Rico) between 1963, the date of the first shutdown, and 1998, the date of the last closure. In addition, there are a total of 13 research and test reactors that have been permanently shutdown or are in various stages of decommissioning. The adequacy of funds available to pay for decommissioning and dismantlement are reviewed periodically by the NRC.

Power Uprates

Between 1977 and May 2009, the Nuclear Regulatory Commission (NRC) approved a total of 124 applications for power uprates at existing nuclear units totaling 5640 MWe. The NRC currently has six applications for power uprates under review, totaling 595 MWe. According to a recent survey, it expects to receive 42 additional applications for power uprates totaling 2894 MWe between now and 2013. Over the whole period from 1977 to 2013, power uprates at existing plants, when completed, will have added the equivalent of nearly 9 new (1000 MW) nuclear power plants to US nuclear capacity.

Furthermore, it is not expected to stop there. World Nuclear News (WNN) reported that Exelon, the largest nuclear operator in the US, has announced plans to uprate much of its reactor fleet to provide the equivalent of one new power plant, more than 1300 MWe, by 2017. A 38 MWe increase at Exelon's Quad-Cities plant launched the program, and uprates are underway at the company's Limerick and Peach Bottom nuclear stations in Pennsylvania, and at the Dresden, LaSalle, and Quad-Cities plants in Illinois. In addition to increasing power, many of the uprates involve component upgrades, and these improve the reliability of the units and support operating license extensions, which require extensive review of plant equipment condition. Exelon has already added 1100MWe in uprates to the capacity of its nuclear fleet in the last decade.

License Renewals and Life Extension

The Nuclear Regulatory Commission issues licenses for commercial power reactors to operate for up to 40 years, and allows these licenses to be renewed for an additional 20 years. According to the NRC, the initial 40-year license term was chosen on the basis of economic and antitrust considerations, not technical limitations. The NRC has established over time a rigorous license-renewal process, complete with public hearings and thorough safety reviews that can nevertheless be completed in a reasonable period of time, with clear safety requirements to assure safe plant operation.

License renewals cost between \$10 to \$15 million each to prepare the necessary regulatory filings, and to support the NRC's license renewal process. License renewals are expected to take about 22 to 30 months to review and approve, but a current plant license holder may apply for a license renewal as early as 20 years before the expiration of its current license. License renewals are often pursued in conjunction with power uprates, and often involve additional investments and replacement of major plant components.

Nevertheless, even with additional capital expenditures, license renewals at existing nuclear power plants are probably the least expensive source of future electricity supply. While license renewals are important for the near and medium-terms, new nuclear plants will eventually have to be built if nuclear is to hold on to its 20% share of the electricity generation market.

To date, the NRC has issued license renewals for 54 of the 104 existing commercial nuclear units in the US. The Oyster Creek nuclear power plant, which was the oldest reactor in operation in the US, was recently granted a 20-year license extension (to 2029) in what the NRC called the "most extensive license renewal to date". The operating licenses of Southern Company's Vogtle units 1 and 2 were also recently extended for 20 years, taking them to 2047 and 2049.

As of June 2009, the NRC was considering 13 additional applications for license renewal covering an additional 16 units. The NRC has also received letters of intent to apply for license renewals between now and 2015 covering an additional 20 units. Many people expect that all or nearly all of the 104 existing plants will eventually apply for and receive license extensions. Most forecasts of future generation capacity also assume license extensions for all the existing plants.

Meanwhile, research on nuclear power plant aging (conducted by DOE, EPRI, and the NRC) continues unabated. It now seems possible that the life span of a nuclear generating unit may eventually be extended from 60 to 80 years and maybe even beyond that with proper maintenance, and replacements and upgrades of key reactor components. However, decisions about granting further extensions to operating licenses beyond the current 60-year limit really don't have to be made anytime soon, as the first 20-year license extension (or 60 year license) isn't due to expire until 2029. If the life span of the existing plants isn't extended beyond 60 years, however, nuclear generation could level off and possibly decline after 2029, if there are not enough new plants coming on line to offset the closures.

Groundwork for Expansion

In addition to industry consolidation and improvements in efficiency, there have been a number of policy and regulatory changes over the past 15 years that have helped to create a firm foundation for future nuclear capacity expansion. These policy changes have included the development and deployment of a new, streamlined construction and operation license procedure, a new reactor certification process, joint government-industry cooperative efforts to promote new builds, and government sponsored financial incentives for new plants.

New Reactors

To date, the NRC has received 18 license applications covering 28 new nuclear units at 21 different sites. Fifteen of the sites selected already have operating reactors, and the remainder is new “grassroots” projects, most of which are located in the South and Southeastern US. The license submissions for 5 units have been suspended by the applicants, pending reactor design selection and availability of federal financial assistance. The NRC has received notification that several additional applications are likely to be filed later this year and in 2010. These will bring the total number of license applications and reactor units to 23 and 34 respectively.

Design Certification

The NRC has issued design certifications for the Westinghouse AP 1000, and the General Electric (Toshiba) ABWR. Four reactor designs are undergoing NRC review. These include the GE (Hitachi) ESBWR, Areva US-EPR, Mitsubishi US-APWR, and the AP-1000 amendment.

Front Runners for Loan Guarantees

Based on the Part I and Part II loan guarantee applications received so far, DOE has informally selected five reference license applications as short-listed potential candidates for the $18.5 billion currently available in federal loan guarantees. These include Unistar’s Calvert Cliffs unit 3, NRG’s South Texas Project units 3 & 4, Southern’s Vogtle units 3 & 4, SCG&E’s Summer units 2 & 3. Luminant’s Comanche Peak units 3 & 4 were selected as first alternative should any of the others drop out. In total, four different reactor designs are involved in very different locations serving both regulated and unregulated markets.

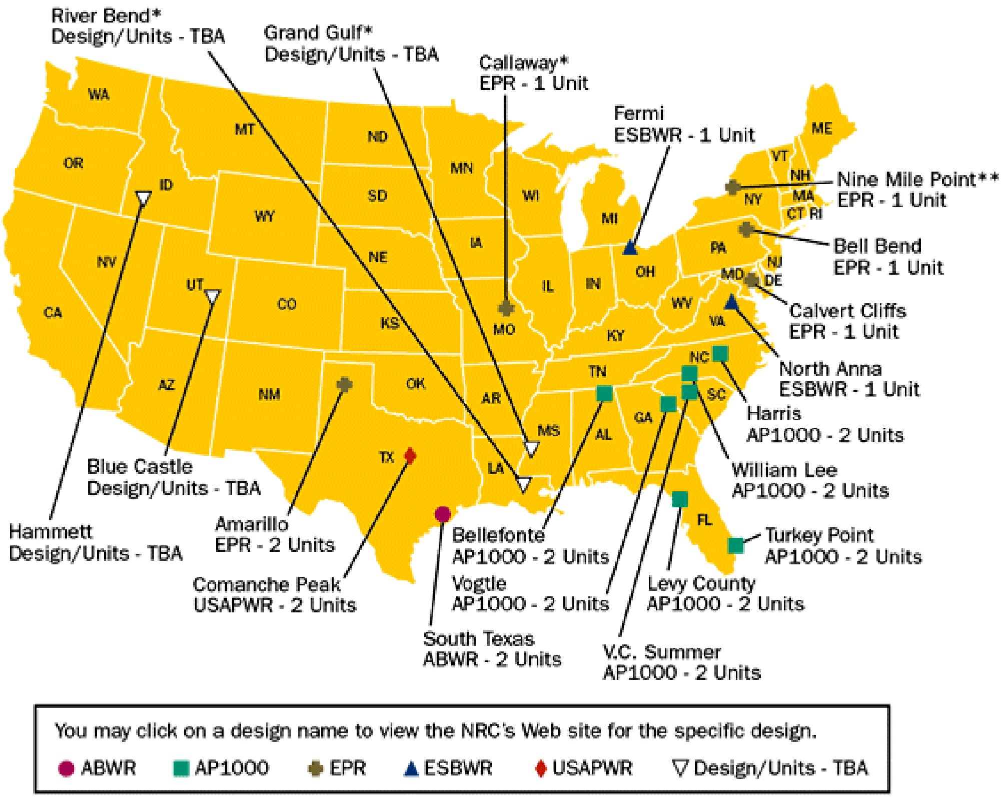
Appendix 1: US Nuclear Statistics

See US Energy Information Administration; (available at http://www.eia.doe.gov/cneaf/nuclear/page/operation/statoperation.html):

Table 1. Nuclear Reactor, State, Type, Net Capacity, Generation, and Capacity Factor
Table 2. US Reactor Ownership/Operator Data
Table 3. Nuclear Reactor Characteristics and Operational History

Appendix 2: Proposed New Reactors in the US

MAP of Proposed New Reactors



*Review Suspended
**Review Partially Suspended

Source: <http://www.nrc.gov/reactors/new-reactors/col/new-reactor-map.html>

Expected New Nuclear Power Plant Applications Updated July 2, 2009						
Company*	**Date of Application**	**Design**	**Date Accepted**	**Site Under Consideration**	**State**	**Existing Operating Plant**
Calendar Year (CY) 2007 Applications						
NRG Energy (52-012/013)***	09/20/2007	ABWR	11/29/2007	South Texas Project (2 units)	TX	Y
NuStart Energy (52-014/015)***	10/30/2007	AP1000	01/18/2008	Bellefonte (2 units)	AL	N
UNISTAR (52-016)***	07/13/2007 (Envir.) 03/13/2008 (Safety)	EPR	01/25/2008 06/03/2008	Calvert Cliffs (1 unit)	MD	Y
Dominion (52-017)***	11/27/2007	ESBWR	01/28/2008	North Anna (1 unit)	VA	Y
Duke (52-018/019)***	12/13/2007	AP1000	02/25/2008	William Lee Nuclear Station (2 units)	SC	N
2007 TOTAL NUMBER OF APPLICATIONS = 5 TOTAL NUMBER OF UNITS = 8						
Calendar Year (CY) 2008 Applications						
Progress Energy (52-022/023)***	02/19/2008	AP1000	04/17/2008	Harris (2 units)	NC	Y
NuStart Energy (52-024)***	02/27/2008	ESBWR	04/17/2008	Grand Gulf (1 units)	MS	Y
Southern Nuclear Operating Co. (52-025/026)***	03/31/2008	AP1000	05/30/2008	Vogtle (2 units)	GA	Y
South Carolina Electric & Gas (52-027/028)***	03/31/2008	AP1000	07/31/2008	Summer (2 units)	SC	Y
Progress Energy (52-029/030) ***	07/30/2008	AP1000	10/06/2008	Levy County (2 units)	FL	N
Exelon (52-031/032)***	09/03/2008	ESWBR	10/30/2008	Victoria County (2 units)	TX	N
Detroit Edison (52-033)***	09/18/2008	ESBWR	11/25/2008	Fermi (1 unit)	MI	Y
Luminant Power (52-034/035)***	09/19/2008	USAPWR	12/2/2008	Comanche Peak (2 units)	TX	Y
Entergy (52-036)***	09/25/2008	ESBWR	12/4/2008	River Bend (1 unit)	LA	Y
AmerenUE (52-037)***	07/24/2008	EPR	12/12/2008	Callaway (1 unit)	MO	Y
UNISTAR (52-038)***	09/30/2008	EPR	12/12/2008	Nine Mile Point (1 unit)	NY	Y
PPL Generation (52-039)***	10/10/2008	EPR	12/19/2008	Bell Bend (1 unit)	PA	Y
2008 TOTAL NUMBER OF APPLICATIONS = 12 TOTAL NUMBER OF UNITS = 18						
Calendar Year (CY) 2009 Applications						
Florida Power and Light (763)	6/30/2009	AP1000		Turkey Point (2 units)	FL	Y
Amarillo Power (752)		EPR		Vicinity of Amarillo (2 units)	TX	UNK
Alternate Energy Holdings (765)		EPR		Hammett (1 unit)	ID	N
2009 TOTAL NUMBER OF APPLICATIONS = 3 TOTAL NUMBER OF UNITS = 5						
Calendar Year (CY) 2010 Applications						
Blue Castle Project		TBD		Utah	UT	N
Unannounced		TBD		TBD	TBD	UNK
2010 TOTAL NUMBER OF APPLICATIONS = 2 TOTAL NUMBER OF UNITS = 2						
Calendar Year (CY) 2011 Applications						
No Letters of Intent have been received from applicants expressing their plans to submit new COL applications in CY 2011.						
2007 – 2011 Total Number of Applications = 22 Total Number of Units = 33						

*Project Numbers/Docket Numbers **Yellow – Acceptance Review Ongoing ***Blue – Accepted/Docketed

Source: <www.nrc.gov/reactors/new-reactors/col.html>