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An Assessment of the Impact of the Energy Bill of 2003 on the U.S. Market for the Nuclear Technologies and Potential New Plant Construction

Technical Report

An Assessment of the Impact of the Energy Bill of 2003 on the U.S. Market for New Nuclear Technologies and Potential New Plant Construction

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PRODUCT DESCRIPTION

The Energy Bill of 2003, still making its way through Congress, will have important implications for the United States nuclear power industry. These implications will depend critically on whether or not the bill passes with tax incentives, liability limits, and research and development provisions favorable to new nuclear power plant construction. This report analyzes the impacts of both scenarios on prospects for new nuclear power plant construction.

Results & Findings

The key incentives for new nuclear power that may be included in the final Energy Bill are extension of the Price-Anderson Act, production tax credits, and research and development authorizations to further nuclear plant designs and supporting technologies. All three of these provisions would impact the prospects of building of new nuclear plants:

- Failure to extend Price-Anderson or pass similar legislation limiting liability for accidents at new nuclear power plants would almost certainly prevent them from being built.
- Tax credits for advanced nuclear power production could have an effect on their financial outlook similar to an increase in the price of competing technologies or an increase in market prices for electricity. The suggested credit of 1.8 cents per kilowatt-hour does not eliminate all of the investment risks for new nuclear power generation, but it would effectively lower the cost of power significantly, thus making advanced nuclear power generation more competitive with other technologies. As structured in current proposals, the tax credit would be especially helpful in reducing the financial risk for the first new advanced nuclear power plants to be built.
- Research and development programs such as those authorized by the Energy Bill have the potential to demonstrate the new process for obtaining a Construction and Operating License (COL) from the NRC, which would eliminate a significant part of the uncertainty surrounding new nuclear plant deployment.

Challenges & Objectives

The main objective of this report is to describe the effect that a change in the current U.S. energy policy might have on the ability to build new nuclear plants in the United States. The factors affecting the ability to build new nuclear power plants in the United States include accident liability (Price-Anderson Act renewal), a new regulatory process (10CFR Part 52) that has not been fully demonstrated, new reactor designs that have never been built, spent fuel and high level waste disposal, high capital and financing costs for construction, and electricity market uncertainties.

Additional concerns for wide scale deployment include the lack of infrastructure in the United States for fabrication of some reactor components; the shrinking pool of educated and experienced individuals prepared to construct, manage, operate, and regulate new nuclear plants; the reliability and availability of the electricity transmission and distribution grid; and public opposition to nuclear technology. Provisions in the Energy Bill are relevant to most of these concerns.

Applications, Values & Use

The nuclear power provisions included in the Energy Bill legislation would significantly improve the market conditions for new nuclear power plants. This is especially true if the production tax credit for advanced nuclear power generation, which is not included as part of the energy tax incentives package that passed the Senate in S.1637, is considered. However, without government loan guarantees to offset the financial risks of investment in the first few new nuclear reactors, the industry may be unwilling to move forward. While the actual funding for the Nuclear Power 2010 Program will be decided through an appropriations process that is separate from the Energy Bill, it should be noted that this program is critical to the future of new nuclear power plant deployment in the United States.

EPRI Perspective

Over and beyond the effects of specific provisions in the Energy Bill, the political environment created by passage of any legislation favorable to new nuclear power plants would represent a significant step in achieving the conditions necessary for new nuclear power plant construction in the United States. It is hoped that the Energy Bill will contain legislation that will help the industry to overcome some key challenges to new nuclear power plant deployment, however, it may not do all that is necessary to mitigate the risks of investing in new nuclear power plants.

Approach

This report evaluates how energy companies in the United States are likely to respond to passage of the Energy Bill of 2003 with or without the inclusion of incentives for new nuclear power plant construction. The report summarizes the relevant sections of the most current versions of the Energy Bill of 2003, with a focus on the provisions that address nuclear power and overviews of the elements of the bill that address competing technologies and electricity market conditions. These elements include production tax credits for renewable generation, research funding for clean coal technologies, credits for producing natural gas from marginal wells, and incentives for conservation and the improvement of the transmission grid. The report analyzes how the nuclear energy industry is likely to respond if the Energy Bill passes with incentives for nuclear power plants. It also discusses policy actions not currently contemplated in any version of the Bill that could further improve the outlook for new construction. Finally, the report analyzes the potential outcomes that might be anticipated if the Bill passes without incentives for nuclear power, including an evaluation of the impact of incentives for competing technologies that would remain in the final bill.

Keywords

Nuclear power
Energy Bill of 2003
Price-Anderson Act
Tax credits
Advanced nuclear plant

ABSTRACT

The phrase, *The Energy Bill of 2003*, actually refers to a bundle of legislation that has been cycling through the United States Congress since April of 2003, current versions of the legislation include the House bill numbered H.R.6 and the Senate bill numbered S.2095. There is also a version of the legislation known as the Conference Energy Bill which is in the form of a conference report numbered 108-375. This report contains an analysis of the impact that passage of this legislation might have on the market for new nuclear power plants in the United States. The analysis details the potential outcomes that might be anticipated for the U.S. nuclear industry for two possible scenarios; 1) the Energy Bill passes with the tax incentives, liability limits, and research and development authorizations favorable to new nuclear power plant construction; and 2) the Energy Bill passes without these incentives for nuclear power. The possible response of energy companies to the passage of the Energy Bill with nuclear power incentives is evaluated. The impact of tax incentives on the cost of new nuclear power plant construction is considered as well as the potential benefits of other measures contained in the Energy Bill that may lower the financial risk of investing in new nuclear power plants. The analysis of the scenario where the Energy Bill is passed without incentives for nuclear power assumes that a version of the Energy Bill including all elements related to non-nuclear generation technologies does pass. This analysis considers whether or not new nuclear power plants can compete under such market conditions.

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INTRODUCTION

The demand for electricity is increasing; the supply of natural gas is limited, the price of natural gas is volatile, and natural gas electric power plants emit greenhouse gases; coal is more plentiful, however, coal-fired electric power plants emit greater amounts of greenhouse gases as well as mercury. Nuclear power is seen by many as one option which would eliminate these concerns. When and how this option will be implemented depends on many factors. The Energy Bill of 2003 is one of those factors. This report will evaluate how energy companies in the United States are likely to respond to passage of the Energy Bill of 2003 with or without the inclusion of incentives for new nuclear power plant construction.

There are three main sections of this report.

- Key Sections of the Energy Bill of 2003 – Provides a summary of the relevant sections of the most current versions of Energy Bill of 2003. This summary is most detailed for provisions in the Energy Bill that specifically address nuclear power such as the production tax credit for advanced nuclear power generation. The Energy Bill provisions that affect the U.S. electricity market, such as incentives for conservation and improvement of the transmission and distribution grid, are described briefly. The summary also includes an overview of elements of the bill that are beneficial to competing generation technologies. Key elements that are included in some versions of the Energy Bill but not others are discussed even though they may not be included when and if the Energy Bill is finally passed.
- Potential Response of Energy Companies to Passage of Energy Bill of 2003 – An analysis of the potential outcomes that might be anticipated for the U.S. nuclear industry if the Energy Bill passes with incentives for nuclear power plants. This section describes the current challenges to new nuclear plant construction in the United States, and evaluates how passage of the Energy Bill may overcome these challenges. A discussion of policy actions that would further improve the outlook for new nuclear power construction but are not included in the Energy Bill is also included.
- U.S. Nuclear Industry Outlook if the Energy Bill of 2003 Passes without Incentives for Nuclear Power – An analysis of the potential outcomes that might be anticipated for the U.S. nuclear industry if the Energy Bill passes without the incentives for nuclear power plants. This analysis assumes a version of the Energy Bill including the elements related to non-nuclear generation technologies does pass. This analysis evaluates the impact of incentives for competing technologies on the outlook for nuclear power plants.

These sections are followed by a summary and conclusions that may be drawn from the analysis, including a brief discussion of the possibility of competing effects if the Energy Bill passes with incentives for nuclear power along with incentives for competing generation technologies.

2
KEY SECTIONS OF THE ENERGY BILL OF 2003

The phrase, *The Energy Bill of 2003*, actually refers to a bundle of legislation that has been cycling through the United States Congress since April of 2003, current versions of the legislation include the House bill numbered H.R.6 and the Senate bill numbered S.2095. There is also a version of the legislation known as the Conference Energy Bill (conference report 108-375). The official title of H.R.6 as introduced to the House of Representatives on April 7, 2003 is, *To enhance energy conservation and research and development, to provide for security and diversity in the energy supply for the American people, and for other purposes*. There was a related bill (S.14) introduced to the Senate on April 30, 2003, however, a newer version (S.2095) has taken its place. This new bill, officially titled *A bill to enhance energy conservation and research and development and to provide for security and diversity in the energy supply for the American people*, was introduced to the Senate on February 12, 2004.[1] In early April 2004, provisions of the energy tax incentives act portion of S.2095 were attached to another pending piece of legislation, the Jumpstart Our Business Strength (JOBS) Act (S.1637), which was passed by the Senate on May 11, 2004.[2]

Energy Bill Status

The likelihood and timing of final passage of the Energy Bill and the format of the reconciled version are uncertain. Senator Jeff Bingaman (Democrat, New Mexico), Chairmen of the Senate Energy and Natural Resources Committee, has stated that "*…both houses of Congress appear to be locked into mutually exclusive positions on a comprehensive energy bill."*[3]

The paragraphs below summarize the actions taken on the key pieces of legislation that may eventually be resolved into one energy bill that could then be signed into law by the President. Figure 2-1 is provided to illustrate these actions.

An important note here, the current President of the United States is a republican who has expressed desire to pass an Energy Bill, however, 2004 is an election year. If a new democratic President is elected before the Energy Bill is passed, there could be a significant delay in passing any sort of comprehensive energy legislation.

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[1] Full Text of Legislation S.2095, Februarys 23, 2004, www.senate.gov

[2] Full Text of Legislation S.1637, May 11, 2004, www.senate.gov

[3] News Release, U.S. Senate Committee on Energy and Natural Resources, *Energy Bill 2004: Downsizing*, March 9, 2004, www.energy.senate.gov

H.R.6

Once it was introduced, this bill was reviewed and discussed in several committees and amended many times in the House. It was passed by the House on April 11, 2003. The measure was received in the Senate on April 29, 2003 and laid before the Senate on May 6, 2003. The Senate amended the bill and then passed it on July 31, 2003. The Senate action was reported to the House on September 4, 2003, at this time, the House rejected the Senate's amended version of the bill and it was sent to conference. The conference report (108-375) was filed on November 18, 2003. The conference report recommended an amendment that replaced much of the bill, this report is also referred to as the Conference Energy Bill. The House accepted the Conference Energy Bill (conference report 108-375). The Senate agreed to consider the Conference Energy Bill (conference report 108-375) on November 19, 2003 and voted on cloture on November 21, 2003. Cloture would limit further consideration and bring the bill to a vote. Cloture was not invoked in the Senate, and thus the Senate did not vote on whether or not to accept the Conference Energy Bill (conference report 108-375).

S.2095

This bill was read for a second time on February 23, 2003 and placed on the Senate legislative calendar under General Orders. The Senate majority leader can request majority consent to lay the bill before the Senate, if consent is granted, the bill will be debated and the amendment process will begin. The amending process continues until the Senate orders the bill engrossed and read a third time, which precludes further amendment. Then the Senate votes on final passage. It is not clear weather or not the bill will actually go before the Senate in 2004. In early April 2004, provisions of the energy tax incentives act portion of S.2095 were attached to another pending piece of legislation, the Jumpstart Our Business Strength (JOBS) Act (S.1637). This bill was passed by the Senate on May 11, 2004.[4] The House has not yet acted on this piece of legislation.

[4] Full Text of Legislation S.1637, May 11, 2004, www.senate.gov

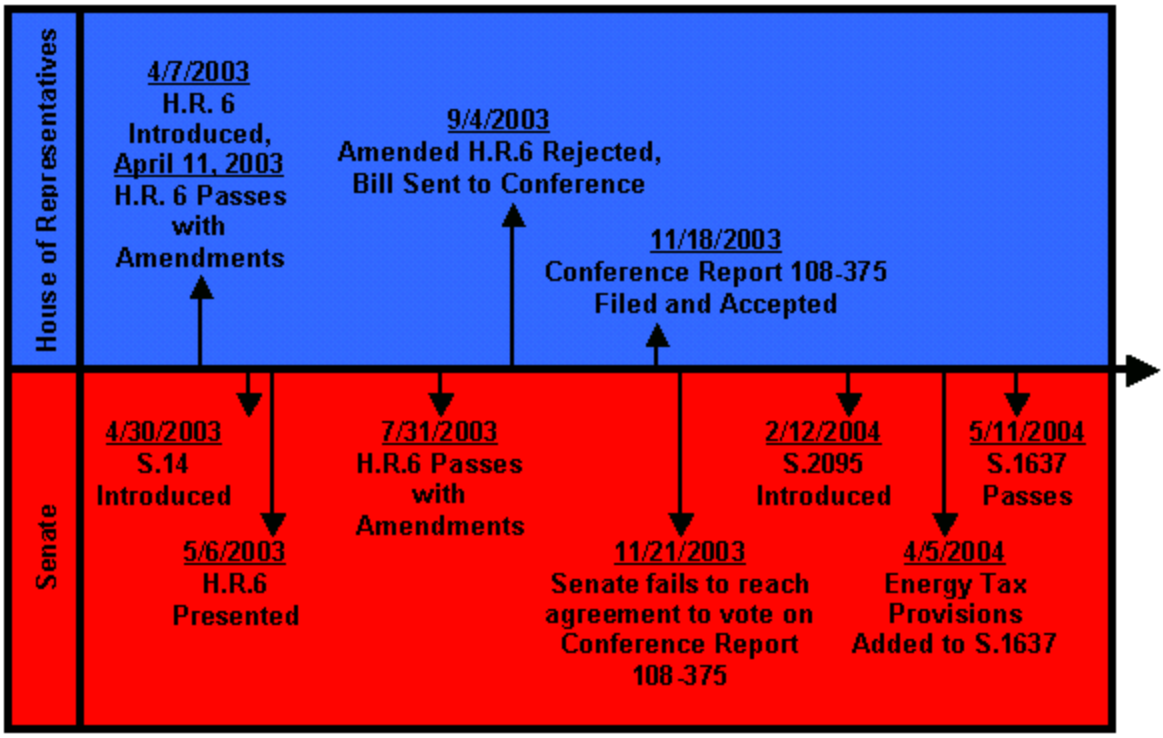

Figure 2-1
Legislative Actions on the Energy Bill of 2003

Key Provisions Relevant to New Nuclear Power Plant Construction

Tax Incentives

The bills S.2095 and H.R.6 do not contain tax incentives for advanced nuclear power facilities. The Conference Energy Bill (conference report 108-375) does include production tax credits for certain advanced nuclear generation facilities. The Senate has passed the tax incentives portion of S.2095, which includes production tax credits for certain sources of natural gas, certain types of coal plants, and several renewable generation technologies but not for advanced nuclear power, as part of a different piece of legislation. The remaining parts of the Energy Bill (with the tax incentives section eliminated) may be considered at a later date. Production tax credits for advanced nuclear generation technologies will not be considered by the Senate unless added by amendment to the remaining sections of the Energy Bill.

The Conference Energy Bill (conference report 108-375), Section 1310, includes a tax credit of 1.8 cents per kilowatt-hour for production from advanced nuclear power facilities. This credit is available to advanced nuclear facilities placed in service before 2021 with a reactor design approved after the date of enactment of the Energy Bill, provided that such design or similar design of comparable energy capacity was not approved on or before such date. This credit would apply for the first eight years of operation of an advanced nuclear power plant. The tax credit does not escalate with inflation. A national cap of 6,000 megawatts of new capacity from advanced reactors would be eligible to receive the credit. If more than 6,000 megawatts of

advanced nuclear power generation capacity is built before 2021, the Secretary of State would be responsible for allocating the 6,000 megawatts of eligibility among these facilities; presumably this would be done on a prorated basis. There is also a prorated annual tax credit limit per facility equivalent to $125 million in tax credits per 1,000 megawatts of generation capacity. This limit is proportional to the plant generation capacity, for example a 1,200 megawatt plant would have an annual tax credit limit of $150 million.

Liability Limitation

The current versions of the Energy Bill include a provision to extend the Price-Anderson Act. The Price-Anderson Act places a limit on the amount the nuclear industry will pay for liability claims from members of the public for personal injury and property damage in the event of a catastrophic nuclear accident. The law requires holders of licenses to operate nuclear power plants to carry the maximum available private insurance, currently $300 million. Should liability claims exceed this coverage, each licensed nuclear reactor would be assessed a prorated share of the excess up to a certain limit.[5] There is also a limit to the amount each reactor will be assessed in a given year. Currently, the Price-Anderson Act covers all U.S. nuclear power plants that began construction prior to December 31, 2003.

There is a provision in S.2095 that extends the protection of the Price-Anderson Act until December 31, 2023. Provisions of this bill also increase the maximum assessment per reactor to reflect inflation, this bill sets the limit at $95.8 million, and increases the annual limit per reactor from $10 million to $15 million. These numbers are in addition to the liability coverage provided by the affected plant's private insurance. The Conference Energy Bill (conference report 108-375) includes the same provisions. There are similar provisions in H.R.6 to revise liability limits, but this bill only extends the protection of the Price-Anderson Act until August 1, 2012.

Research and Development (R&D) Authorizations

There are budget authorizations for nuclear energy research and development programs in S.2095, H.R.6, and the Conference Energy Bill (conference report 108-375). The specific amounts vary and it is difficult to estimate the authorizations that will be included in a final consolidated version of the bill. The authorizations do not actually provide funding, this is done through a separate appropriations process. The specific programs that are likely to receive support are as follows:

- Nuclear Energy Research Initiative (NERI) – Supports general research and development related to nuclear energy.
- Nuclear Energy Plant Optimization Program (NEPO) – Supports research and development activities addressing reliability, availability, productivity, component aging, safety, and security of existing plants.

[5] *Fact Sheet on Nuclear Insurance and Disaster Relief Funds*, September 2003, www.nrc.gov

- Nuclear Power 2010 Program (NP2010) – Provides support for first-of-a-kind engineering design and certification expenses of advanced nuclear power plant designs; encourages domestic energy companies to install new nuclear plant capacity as soon as possible; provides for industry, university, and national laboratory evaluation of advanced nuclear fuel cycles and fuels testing; provides for consideration of proliferation-resistant passively-safe small reactors suitable for long-term production without refueling; allows for participation of international collaborators; supports projects designed to strengthen the competitive position of the domestic nuclear power industrial infrastructure.
- Generation IV Nuclear Energy Systems Initiative – Provides for research and development necessary to identify the most promising advanced proliferation-resistant and passively safe reactor designs for eventual commercial application.
- Advanced Fuel Cycle Initiative – Provides for an advanced fuel recycling technology research and development program to evaluate proliferation-resistant fuel recycling and transmutation technologies that minimize environmental or public health and safety impacts.
- University Nuclear Science and Engineering Support – Supports a program to invest in human resources and infrastructure in the nuclear sciences and engineering and related fields, authorizes fellowship and faculty assistance programs as well as support for research programs and research and training reactors.
- Security of Reactor Designs – Provides for a research and development program on cost-effective technologies for increasing the safety of reactor designs from natural phenomena and the security of reactor designs from deliberate attacks.
- Geological Isolation of Spent Fuel – Supports a study to determine the feasibility of deep borehole disposal of spent nuclear fuel and high-level radioactive waste.

Key Provisions for Competing Generation Technologies

The Energy Bill legislation package {S.2095, H.R.6, and the Conference Energy Bill (conference report 108-375)} includes provisions designed to increase domestic sources of natural gas and encourage clean coal production. There are also provisions for hydropower and other renewable technologies.

General Natural Gas Provisions of Energy Bill Legislation

Construction and operation of an Alaska natural gas transportation project (pipeline) is authorized contingent upon public need, downstream capacity, and evaluation of an environmental impact statement. Incentives for the natural gas pipeline include a loan guarantee and a treatment plant tax credit. Marginal property production and deep water production incentives offer royalty relief for low production and deep wells contingent upon market prices.

General Clean Coal Provisions of Energy Bill Legislation

Funding is provided for projects that advance efficiency, environmental performance, and cost competitiveness of clean coal technologies. Legislation requires that at least 60 percent of the funds are used for projects on coal-based gasification technologies, including gasification combined cycle, gasification fuel cells, gasification co-production, and hybrid gasification/combustion. These projects shall be expected to achieve technical milestones such as sulfur dioxide removal, reduced NOX emissions, reduced mercury emissions, and improved thermal efficiency. The remaining funds will be used for projects using other technologies, these projects will be subject to similar, but less stringent technical milestones.

A loan is authorized for coal technology to support construction of one experimental plant as part of a cooperative agreement with the Department of Energy. There are also provisions for loan guarantees for plants using various gasification technologies.

Fossil Energy Tax Incentives

All three pieces of legislation {S.2095, H.R.6, and the Conference Energy Bill (conference report 108-375)} include tax incentives for certain types of fossil generation technologies. The following types of incentives are included:

- Credit for Producing Oil and Gas from Marginal Wells – Provides a $3 per barrel credit for qualified crude oil production from marginal wells and a 50 cents per 1,000 cubic feet credit for qualified natural gas production from marginal wells. A marginal well has average daily production of not more than 25 barrel-of-oil equivalents and produces water at a rate not less than 95 percent of total well effluent.
- Credit for Clean Coal Technology – Provides credit for production from coal-based generation units that have become clean coal technology units via retrofitting, re-powering, or replacement. The credit is calculated based on the plants allocation from the national capacity limitation, the credit is adjusted for inflation. The national limit is 4,000 megawatts of eligible generation capacity placed in service in the10 year period following enactment of the legislation. Provides credit for investing in qualified advanced clean coal technologies and credit for production from qualified advanced clean coal technology units. An advanced clean coal technology unit is defined as a new, retrofit, or re-powering unit which is an eligible advanced pulverized coal or atmospheric fluidized bed combustion technology unit or an eligible pressurized fluidized bed combustion unit or an eligible integrated gasification combined cycle technology unit, or an eligible other technology unit, and meets certain carbon emission rate requirements.

Fossil Energy Research and Development (R&D)

There are budget authorizations for fossil energy research and development programs in S.2095, H.R.6, and the Conference Energy Bill (conference report 108-375). The fossil research and development authorizations are pretty much consistent between the different versions of the bill, however, these authorizations are no guarantee of the actual amounts that will be made available

through the appropriations process. The specific programs that are likely to receive authorization are as follows:

- Oil and Gas Research – Provides for a program of research, development, demonstration, and commercial application on oil and gas. Elements of the program include exploration and production, gas hydrates, reservoir life and extension, transportation and distribution infrastructure, ultra-clean fuels, heavy oil and oil shale, related environmental research, and compressed natural gas marine transport.
- Fuel Cells – Supports a program of research, development, demonstration, and commercial application on fuel cells for low-cost, high-efficiency, fuel-flexible, modular power systems. The demonstrations shall include fuel cell technology for commercial, residential, and transportation applications along with distributed generation systems.
- Natural Gas and Oil Deposits Report – Requires a bi-annual report to Congress on the latest estimates of natural gas and oil reserves, reserves growth, and undiscovered resources in Federal and State waters off the coast of Louisiana and Texas.
- Integrated Clean Power and Energy Research – Provides for a center or consortium to conduct research, development, demonstration and commercial application on areas such as efficiency and reliability of gas turbines for power generation, reduction in emissions from power generation, promotion of energy conservation issues, effectively utilizing alternative fuels and renewable energy, development of advanced materials technology for oil and gas exploration and utilization in harsh environments, and education on energy and power generation issues.
- Research and Development for Coal Mining Technologies – Provides for a program of research and development on coal mining technologies requiring cooperation of Federal agencies, coal producers, trade associations, equipment manufacturers, institutions of higher education and other relevant entities.
- Coal and Related Technologies Program – Provides for additional research and development programs to facilitate production and generation of coal-based power through innovations for existing plants, integrated gasification combined cycle, advanced combustion systems, turbines for synthesis gas derived from coal, carbon capture and sequestration research and development, coal-derived transportation fuels and chemicals, solid fuels and feedstocks, advanced coal-related research, advanced separation technologies, and a joint project for permeability enhancement in coals for natural gas production and carbon dioxide sequestration.
- Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources – Provides for a program of research, development, demonstration, and commercial application of technologies for ultra-deepwater and unconventional natural gas and other petroleum resource exploration and production.

Renewable Energy Provisions

The legislation contains provisions designed to increase development and use of clean and renewable energy. Currently these energy sources provide less than half as much electric power

in the United States as nuclear power plants, the majority of it hydroelectric power.[6] Specific provisions for renewable energy that are included in at least one version of the Energy Bill are listed below. Renewable energy resources include solar, wind, ocean, geothermal, biomass, landfill gas, and incremental hydropower.

- Credit for Electricity Produced from Certain Renewable Resources – Extends existing production credits for certain renewable generation technologies and expands these credits to apply to additional technologies. Under this provision, the production tax credit applies to wind, closed-loop biomass, open-loop biomass, geothermal energy, solar energy, small irrigation power, and municipal solid waste. The credit will apply to facilities placed in service prior to December 31, 2007.
- Assessment of Renewable Energy Resources - Mandates a federal renewable energy resources assessment to assist in the long-term planning for the expansion of renewable energy production.
- Renewable Energy Production Incentive - Reauthorizes the Renewable Energy Production Incentive Program which provides incentive payments to qualified renewable energy facilities.
- Federal Purchase Requirement - Sets requirements for federal government consumption of renewable energy as a percentage of total energy consumed.
- Geothermal Energy Incentive - Encourages exploration and development of geothermal energy, including a call for a rulemaking on a new royalty structure that encourages new production.
- Hydroelectric – Provides production incentives and streamlines the re-licensing of hydroelectric facilities to ensure continued availability of clean and reliable energy.

Key Provisions for Supporting Transmission Infrastructure

There are requirements for electric reliability standards, transmission infrastructure modernization, transmission operation improvements and transmission rate reform in all three pieces of legislation [S.2095, H.R.6, and the Conference Energy Bill (conference report 108-375)]. Key provisions are described in the list below.

- Reliability Standards - Amends the Federal Power Act to grant Federal Energy Regulatory Commission (FERC) regulatory jurisdiction over an Electric Reliability Organization. Prescribes guidelines for electric reliability standards, including electric transmission infrastructure, operation and transmission rates.
- Transmission Infrastructure Modernization – Allows for designation of national interest electric transmission corridors. Requires the Secretary of Energy and the Federal Energy Regulatory Commission to submit a report on the steps necessary to establish a system to provide real-time functional status of all transmission lines to transmission system owners and organizations. Provides for a comprehensive research, development, demonstration and

[6] Energy Information Administration, Monthly Energy Review, Electricity Net Generation (All Sectors), March 26 2004 http://www.eia.doe.gov

commercial application program to promote improved reliability and efficiency of electrical transmission and distributions systems. Establishes an Office of Electric Transmission and Distribution within the Department of Energy responsible for developing and implementing a comprehensive strategy to improve the nation's electricity transmission and distribution.

- Transmission Operation Improvements – Sets forth requirements to improve access to transmission services and promote competitive markets.
- Transmission Rate Reform – Requires FERC to establish by rule within one year transmission pricing policies and policies for the allocation of costs associated with interconnection of new transmission facilities not located within regional transmission organizations. This provision encourages the construction of new transmission infrastructure to update America's outdated and inadequate transmission grid.

Key Provisions for Energy Efficiency

There are provisions in the Energy Bill designed to reduce energy consumption and encourage conservation.

- Residential Energy Efficiency Provisions – Provides incentives for solar, wind, fuel cells, lower wattage light bulbs, energy efficient homes, and weatherization.
- Commercial Energy Efficiency Provisions – Sets new appliance standards for illuminated signs and traffic signals, provides funding to commercialize photovoltaic generation, and provides an investment tax credit for fuel cells.

3
POTENTIAL RESPONSE OF ENERGY COMPANIES TO PASSAGE OF THE ENERGY BILL OF 2003 WITH INCENTIVES FOR NEW NUCLEAR POWER PLANTS

The main objective of this report is to describe the effect that a change in the current US energy policy might have on the ability to build new nuclear plants in the United States. The factors currently affecting the ability to build new nuclear plants in the United States are discussed in this section in order to put the changes associated with the Energy Bill into context. There are some challenges to building new nuclear power plants that could be overcome with final passage of the Energy Bill. The key incentives for new nuclear power that may be included in the final Energy Bill are extension of the Price-Anderson Act, production tax credits, and research and development authorizations to further nuclear plant designs and supporting technologies. This section provides an analysis of the impacts each of these provisions will have on the current challenges to new nuclear power plant production. A brief summary of challenges that are not affected by the Energy Bill is also included. The probable outcome of passage of an Energy Bill including the key incentives for new nuclear power is discussed at the conclusion of this section.

Challenges Associated with New Nuclear Power Deployment

The factors affecting the ability to build new nuclear power plants in the United States include accident liability (Price-Anderson Act renewal), a new regulatory process (10CRF Part 52) that has not been fully demonstrated, new reactor designs that have never been built, spent fuel and high level waste disposal, high capital and financing costs for construction, and electricity market uncertainties.[7] Additional concerns for wide scale deployment include the lack of infrastructure in the United States for fabrication of some reactor components; the shrinking pool of educated and experienced individuals prepared to construct, manage, operate, and regulate new nuclear plants; the reliability and availability of the electricity transmission and distribution grid; and public opposition to nuclear technology.

The Nuclear Waste Policy Act which was passed in 1983 and amended in 1987 authorized and required the U.S. Department of Energy (DOE) to locate and build a permanent repository and

[7] Experts from U.S. financial and nuclear industries completed a Business Case Study for Early Orders of New Nuclear Reactors that identified the existence of three key barriers to commercial operation by 2010. The key barriers identified were waste disposal, accident indemnification, and commissioning. The study also listed critical risks associated with the design, licensing, and construction of new reactors. These include regulatory risk resulting in delays that increase financing costs, first-of-a-kind engineering costs, high capital costs and cost overruns, forecasting demand, and transmission availability and congestion. - available at http://www.ne.doe.gov/home/bc/businesscase.html

interim storage facility and develop a transportation system to safely link nuclear plants to the facilities. The legislation required DOE to begin disposal of high-level radioactive waste by January 31, 1998. The nuclear industry is still waiting for an interim storage facility, and for licensing and opening of the selected permanent facility.[8] Yucca Mountain was recommend by the President of the United States as the site for a spent fuel and high level radioactive waste repository and Congress approved this recommendation in 2002.[9] The DOE is in the process of preparing a license application for the Yucca Mountain high level waste repository which is expected to be submitted this year. The Nuclear Regulatory Commission (NRC) review process is estimated to be complete sometime before 2008, with construction beginning in 2008 if a license is granted. If all goes as planned, Yucca Mountain will be available for permanent waste storage beginning in 2010.[10] Yucca Mountain has a statutory limit of 63,000 metric tones of commercial spent nuclear fuel. The amount of accumulated spent nuclear fuel from currently operating reactors is expected to reach that limit by 2015, thus disposing of spent fuel from all nuclear reactors operating after that time will require additional repository capacity.[11] The lack of storage capacity for spent nuclear fuel from future reactors represents a key challenge to new plant construction, given that the first spent fuel repository has been over twenty years in the making and still is not open for business.

The newest plant in the United states has been operating for nearly a decade, the oldest plant has been operating for over 30 years.[12] The nuclear workforce is aging, and the fact that new plants have not been ordered has discouraged students from entering the nuclear field. The infrastructure for constructing nuclear plant components in the United States is no longer in place, the jobs and factories have moved to other countries. Initial construction of new nuclear power plants will have to rely on foreign suppliers, large scale deployment would require renewed infrastructure in the United States.

Nuclear power plants provide large scale baseload generation, generating enough power for hundreds of thousands of homes. A reliable grid is critical for distributing this power and recent events have highlighted weaknesses in the United State's electricity transmission and distribution system. These weaknesses represent a challenge to the construction of new nuclear power plants.

The biggest challenge to building new nuclear power plants in the United States is the uncertainty of the return on the investment. Nuclear power plants involve high capital costs for construction. These costs are recovered over a very long period with an asset that earns revenue

[8] Nuclear Energy Institute, History, http://www.nei.org

[9] Office of Civilian Radioactive Waste Management, Yucca Mountain Project Fact Sheet on License Application, http://www.ocrwm.doe.gov

[10] Office of Civilian Radioactive Waste Management, Yucca Mountain Project Fact Sheet on License Application, http://www.ocrwm.doe.gov

[11] Program Overview, Advanced Fuel Cycle Initiative, Office of Nuclear Energy, Science and Technology U.S. Department of Energy, February 2004, http://www.ne.doe.gov

[12] Nuclear Energy Institute, U.S. Nuclear Power Plants, General/Statistical Information, http://www.nei.org

for forty to sixty years. There are often unexpected costs and delays involved with first-of-a-kind construction. Regulatory delays due to the new process may also occur. These delays increase the cost of financing. Private banks may be unwilling to finance such a project, or may charge very high rates in order to assume these risks. The competitive market with changes in price and demand levels for electricity adds another level of uncertainty in terms of the investment value for nuclear power. The limited availability of qualified operators and staff, lack of a permanent waste repository, and the potential for problems with the transmission grid are also concerns for investors. The greatest investment risk is that without indemnification, the liability associated with an accident at a nuclear power plant would mean certain financial ruin.

Price-Anderson Extension Impact

The Price-Anderson Act accident indemnification expired December 31, 2003, unless it is extended, plants that begin construction in the future will not be covered by this act, all currently licensed plants are still covered. The Price-Anderson Act puts a limitation on the financial liability of existing nuclear reactors in the event of an accident. Each nuclear power plant carries the maximum available private liability insurance, the Price-Anderson Act sets a limit on the additional financial liability in the event of an accident and spreads this financial liability among all operating nuclear reactors. While extension of the Price-Anderson Act is not going to guarantee that new nuclear power plants will be built in the United States, it is an important step toward that goal. Failure to extend Price-Anderson or pass similar legislation limiting liability for accidents at new nuclear power plants would almost certainly prevent them from being built.

Impact of Production Tax Credits

There are many factors affecting the financial outlook for new nuclear power plants in the United States. These include the initial capital plus financing cost of construction, the operations and maintenance cost, the price of competing technologies (affected by natural gas prices and cost of environmental compliance for coal plants), market prices for electricity, and the availability of reliable transmission systems to distribute the large scale base load electricity generated by a nuclear plant. Tax credits for advanced nuclear power production could have an effect on the financial outlook similar to an increase in the price of competing technologies or an increase in market prices for electricity.

The suggested credit of 1.8 cents per kilowatt-hour does not eliminate all of the investment risks for new nuclear power generation, but it would effectively lower the cost of power significantly, thus making advanced nuclear power generation more competitive with other technologies. This is not to say that advanced nuclear power generation could not be economically competitive with other technologies in the absence of a production tax credit. As stated many times throughout this report, the construction costs for new nuclear power plants are highly uncertain. Estimates of capital costs for advanced nuclear plants range from $1250 per kilowatt to about $2000 per kilowatt of plant capacity. The Electric Power Research Institute (EPRI) completed an analyses using the National Energy Modeling System (NEMS) that assumed the lower value for capital costs and no production tax credit, this analysis predicted that advanced nuclear power plants

will become economically competitive and could begin deployment in the 2009/2010 timeframe.[13]

A tax credit is direct dollar-for-dollar reduction of tax liability (not just a tax deduction which reduces tax liability only in proportion to the applicable tax rate).[14] An energy company or consortium would have to have annual tax liability greater than the annual maximum credit ($125 million per 1,000 megawatts of advanced nuclear generation capacity) in order to receive full benefit from the credit. The analyses described and referenced in this section assume that the energy companies or consortia operating new nuclear power plants have annual tax liability greater than the annual maximum credit for the total advanced nuclear power generation capacity that they build. This tax liability would be based on profit either from the advanced nuclear power generation facility/facilities or from other assets owned by the energy company or consortia.

Table 3-1 shows an analysis of this benefit for two possible scenarios. In the first scenario, an energy company or consortium constructs the first advanced nuclear plant which is placed into service at the beginning of 2012 and operates smoothly for eight years during which five or fewer additional plants are placed in service, thus the national 6000 megawatts cap is not exceeded and the plant receives the maximum tax credit. The text of the provision for tax credits on electricity produced from advanced nuclear power facilities states that the national limitation of 6,000 megawatts shall be allocated in such a manner as the Secretary may prescribe, thus the credit could be divided among multiple facilities with a total capacity beyond 6,000 megawatts. The second scenario predicts that after construction and a few months of successful operation of the first advanced nuclear plant, several new plants are ordered and construction of these plants takes around five years. A specific example for this scenario is described in Table 3-1, it is assumed that 11 additional 1,000 megawatt plants are placed in service at the beginning of 2019. In this example, the total advanced nuclear generation capacity in the United States becomes 12,000 megawatts (twice the national cap for tax credits) in 2019. It is assumed that in 2019 the cap would be allocated equally among the operating plants because all of the plants have the same capacity, thus the first plant operating since 2012 is assumed to receive a reduction from its original allocation. In this scenario all twelve operating plants receive the tax credit for only 500 megawatts (half of their generation capacity) in the years 2019 and 2020.

[13] *Nuclear Power's Role in Meeting Environmental Requirements: Evaluation of E-EPIC Economic Analyses*, EPRI, Palo Alto, CA: 2003. 1007618

[14] definition from investorwords.com, http://www.investorwords.com

Table 3-1
Analysis of Tax Benefit for the First Advanced Nuclear Power Plant Built in the United States

Scenario	First plant placed in service on 1/1/2012, five or fewer additional advanced plants placed in service before 2021	First plant placed in service on 1/1/2012, eleven additional advanced plants placed in service on 1/1/2019, equal allocation of national cap	
		2012 – 2018	2019 – 2020
Tax Credit ($ per kilowatt-hour)	0.018	0.018	0.018
Plant Size (1,000 megawatt converted to kilowatt)	1,000,000	1,000,000	1,000,000
Capacity Factor (%)	90	90	90
Total Annual Production (kilowatt-hours)	7,884,000,000	7,884,000,000	7,884,000,000
Available for Tax Credit ($)	141,912,000	141,912,000	70,956,000
Annual Tax Credit Limit ($)	125,000,000	125,000,000	125,000,000
Actual Annual Tax Credit ($)	125,000,000	125,000,000	70,956,000
Period Eligible (years)	8	6	2
Total Benefit ($)	1,000,000,000	891,912,000	

The tax credit would be especially helpful in reducing the financial risk for the first new advanced nuclear power plants to be built. The energy companies or consortia that build the first few new plants could be rewarded with as much as a billion dollars in tax credits during the first eight years of operation. This money could be used to reduce the construction loan debt and associated financing costs significantly, thus reducing the lifecycle cost of the plant and the resulting cost of power production.

There has been a lot of work by the industry to estimate construction and operation costs for an advanced nuclear power plant, however, until the first plant is built there is significant uncertainty around these figures. The Department of Energy sponsored a business case study for early orders of new nuclear reactors. This study was completed by experts from U.S. financial and nuclear industries. They estimated the cost of power to be in the range of 3.8 to 4.2 cents per kilowatt-hour for a first-of-a-kind plant, with second and third plants being near 3.7 cents per kilowatt-hour, and standardized plants possibly achieving 3.4 cents per kilowatt-hour. This study used plant capital costs in the range of $1500 to $1700 per kilowatt[15], debt financing cost of 8%, debt:equity profile of 50:50, and internal rate of return of 10 to 12 percent. Although the design life of the plant used is 60 years, the study relied only on the initial 40 year licensed

[15] This is a conservative assumption. EPRI's EPIC study (*Nuclear Power's Role in Meeting Environmental Requirements: Evaluation of E-EPIC Economic Analyses*, January, 2003) assumes capital costs of only $1250 per kilowatt-hour.

period of operation. This study was completed in July of 2002, over the prior year wholesale spot prices of electricity had ranged from 1.5 to 25 cents per kilowatt-hour depending on the season and the region, with most prices in the 2 to 4 cents per kilowatt-hour range. The results of this business case study show that the cost of power from a first-of-a-kind plant may be higher than the market price of the electricity.[16] At $1500 per kilowatt, construction of a 1000 megawatt plant would cost $1.5 billion, the tax credit of around $1 billion spread over the first eight years of operation would be enough to turn the financial picture around for the first few advanced nuclear power plants built in the United States. The business case study predicted that the experience gained in building the first few advanced nuclear plants would result in a lower cost of power for the standardized plants built later.

The Energy Information Administration (EIA) used the National Energy Modeling System (NEMS) to quantitatively analyze the impact of nuclear production tax credits. This analysis assumed base plant capital costs of $1,669 per kilowatt, and applied contingency factors that brought the total capital costs up to $1,928 per kilowatt for advanced nuclear power plants.[17] The EIA's projection was that production tax credits for advanced nuclear power plants would stimulate the development of 6,000 megawatts of new nuclear capacity, with the first 2,000 megawatts being added in 2013, another 2,000 megawatts added in 2014, and the final 2,000 additional megawatts being added in 2015. Their analysis assumed that each 1,000 megawatt plant would ramp up to full production over a 3 year period, with the production during the first 2 years being lower than the roughly 7 billion kilowatt-hours required to reach the tax credit limit of $125 million per year for a 1000 megawatt advanced nuclear plant. The total impact on tax revenue for the 6000 megawatts of new nuclear capacity was projected to be about $5.7 billion, or about $950,000,000 in tax credits per 1,000 megawatt plant. The development of 6,000 megawatts of new nuclear capacity would demonstrate regulatory and construction processes and eliminate first-of-a-kind costs, providing a better financial outlook for additional new nuclear power capacity. The EIA analysis projected that the cost reductions for these Nth of a kind plants would not be enough to make them economical once the national cap on new capacity eligible for tax credits had been reached.[18] The EIA report included future year projections for total generation by sector for the modeled provisions of Conference Energy Bill (conference report 108-375) and for a reference case. The difference between these two values is included in Table 3-2, the projection for nuclear power production was greater where the provisions of the Conference Energy Bill (conference report 108-375) were modeled.

[16] *Business Case for New Nuclear Power Plants Bringing Public and Private Resources Together for Nuclear Energy*, Final Draft, Office of Nuclear Energy, Science, and Technology, July 2002, www.ne.doe.gov/home/bc/businesscase.html

[17] This is a very conservative assumption compared to EPRI's $1250 per kilowatt and the business case study assumption of $1500 to $1700 per kilowatt.

[18] Energy Information Administration, Office of Analysis and Forecasting, *Analysis of Five Selected Provisions of the Conference Energy Bill of 2003*, February 2004, SR/OIAF/2004-01

Table 3-2
EIA Analysis Resulting Impact of Advanced Nuclear Power Production Tax Credits

Year	Increase of Nuclear Generation for Conference Energy Bill Case Over Reference Case Generation in Billion Kilowatt-Hours
2010	5
2015	42
2020	48
2025	48

Construction and financing costs are the key challenges when it comes to the ability of advanced nuclear plants to be cost competitive with other generation technologies. The tax credit would offset a significant part of these costs and would most likely stimulate the development of new nuclear capacity prior to 2021, contingent upon passage of the provision to extend the Price-Anderson Act. The business case study described earlier in this section concluded that once the first few advanced nuclear plants have been built and operated, the key uncertainties will be eliminated and nuclear power can be fully competitive in the electricity marketplace.[19] The EIA completed a quantitative analysis of the several provisions of the Energy Bill, including the production tax credits for advanced nuclear power generation. The assumption this analysis used for advanced nuclear plant capital cost was conservative compared to figures used by the nuclear power industry, this assumption led to a very conservative estimate for the amount of advanced nuclear generation capacity that will be added if production tax credits for advanced nuclear power plants become law. The EIA's optimistic projections for future natural gas prices[20] could also contribute to an underestimate of added advanced nuclear generation capacity. The EIA's projection that only 6,000 megawatts will be built as a result of the production tax credit goes against the industry consensus that once new nuclear power plant construction and operation has been successfully demonstrated in the United States, additional new nuclear power plants will be very economically competitive with other technologies.

Impact of Research and Development Activities

Research and development (R&D) programs such as those authorized by the Energy Bill have the potential to demonstrate the new process for obtaining a Construction and Operating License (COL) from the NRC, which would eliminate a significant part of the uncertainty surrounding new nuclear plant deployment. Some of the research programs that are authorized in the Energy Bill are already underway and have resulted in significant progress toward developing new designs (particularly the AP-1000 and ESBWR) and demonstrating the new regulatory process in

[19] *Business Case for New Nuclear Power Plants Bringing Public and Private Resources Together for Nuclear Energy*, Final Draft, Office of Nuclear Energy, Science, and Technology, July 2002, www.ne.doe.gov/home/bc/businesscase.html

[20] This is detailed in section 4.

the United States. There are also authorizations for developing more advanced reactor designs and addressing nuclear waste management concerns.

It is not possible to quantitatively analyze the impact of the R&D authorizations in the Energy Bill for several reasons.

- Authorizations for R&D programs do not guarantee that funding will be provided for authorized programs, the funding is determined separately by passage of the Energy and Water Appropriations Bill.
- Appropriations for the R&D programs authorized in the Energy Bill can occur based on prior generic R&D authorizations, thus many of the programs discussed in this section are on-going and will continue despite the fact that the Energy Bill has been tied up in Congress. These programs are able to receive appropriations even if the specific authorizations listed in the Energy Bill do not pass.
- Privately funded R&D programs may emerge to advance technologies in the absence of government funding.
- The relationship between funding of R&D and the resulting availability of new technologies and improvement of existing technologies is extremely variable.

This section will provide a qualitative analysis of the benefits of the R&D programs authorized in the Energy Bill.

One of the main objectives of the Nuclear Energy Research Initiative (NERI) is to develop advanced concepts and scientific breakthroughs in nuclear fission and reactor technology to address and overcome the principal technical obstacles to the expanded use of nuclear energy: economics, proliferation, and waste management. The other main objectives are to advance the state of nuclear technology in the United States in order to maintain a competitive position in overseas markets and a future domestic market, and to promote and maintain nuclear science and engineering infrastructure to meet future technical challenges. NERI uses a competitive process to selectively fund researcher-initiated R&D proposals from universities, national laboratories, and industry. Past projects have been in the areas of new reactor designs and technologies, advanced nuclear fuel, nuclear waste management, and fundamental nuclear science. The work sponsored by NERI addresses some of the long term challenges to deploying new nuclear power plants in the United States. The simple act of financing research in the nuclear field is key to training and recruiting staff for new nuclear power plants in the United States.

The Nuclear Energy Plant Optimization (NEPO) program is focused on existing plants and does not have a significant impact on the outlook for new nuclear power plant construction in the United States.

The Nuclear Power 2010 Program, which began in February 2002, is a joint government/industry cost-sharing effort to develop advanced nuclear plant technologies and demonstrate new regulatory processes leading to new nuclear power plant deployment.[21] The first product of this

[21] Program Overview, *Nuclear Energy Research Initiative*, Office of Nuclear Energy, Science and Technology U.S. Department of Energy, March 2003, http://www.ne.doe.gov

program was a near-term deployment roadmap recommending actions to be taken by government and industry to enable new commercial nuclear power plant deployment by 2010. Additional work in 2002 included Early Site Permit (ESP) scoping studies to evaluate site suitability and to develop schedule and resource estimates for siting new nuclear plants, a nuclear business case study to identify the necessary conditions under which energy companies would add new nuclear capacity[22], and the initiation of cost-shared regulatory demonstration projects with industry to obtain Nuclear Regulatory Commission Early Site Permits (ESP) for specific commercial nuclear plant sites. These efforts paid off in 2003 when three energy companies, Exelon Generation Company, Dominion Energy, and Entergy, submitted applications to the Nuclear Regulatory Commission for Early Site Permits. Each company selected an existing power plant site as the potential location for a new nuclear power plant. It is expected to take two years for the NRC to review and act on these applications.[23]

In late spring of 2004, three different utility led consortia submitted proposals in response to the DOE funding opportunity titled, *Nuclear Power 2010 Program: New Nuclear Plant Licensing Demonstration Projects*. Each project will be cost shared 50/50 between the consortium and the DOE. The largest consortium includes Constellation Generation Group (a subsidiary of Constellation Energy), EDF International North America (a subsidiary of Electricite de France), Entergy Nuclear, Exelon Generation, Southern Company, Duke Energy, the Tennessee Valley Authority, Florida Power & Light, Westinghouse Electric Company, and GE Energy's nuclear operations. If the proposal is accepted, the project will involve more detailed engineering work on the Westinghouse AP-1000 and the General Electric ESBWR. The plan is to complete one or more COL applications in time to submit to the NRC in 2008. It is anticipated that the NRC would make a decision on this application in 2010, if approval is granted, any combination of the consortium's members would have the option to use the COL. Another consortium submitted their proposal seeking DOE funds from the Nuclear Power 2010 Program on March 17, 2004. This group is led by Dominion Generation, with the participation of AECL Technology {(a subsidiary of Atomic Energy Canada Ltd. (AECL)}, Bechtel Power Corporation, and Hitachi America. They plan to prepare a COL application using AECL's advanced Candu reactor design, the ACR 700. A separate consortium requested DOE matching funds to examine building a reactor in northern Alabama at TVA's Bellefonte nuclear site. The DOE has agreed to co-sponsor this project.[24] TVA began construction of two units at this site and stopped work before they were complete. This TVA consortium also includes General Electric, Toshiba, USEC Incorporated, Global Fuel-Americas, and Bechtel Power Corporation. They will evaluate only the GE Advanced Boiling Water Reactor (ABWR) marketed under a joint agreement with Toshiba.

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[22] *Business Case for New Nuclear Power Plants Bringing Public and Private Resources Together for Nuclear Energy*, Final Draft, Office of Nuclear Energy, Science, and Technology, July 2002, www.ne.doe.gov/home/bc/businesscase.html

[23] News Release, *Entergy is Third Company to File for Early Site Permit with NRC*, October 24, 2003, www.nei.org

[24] News Release, *DOE and TVA Enter Collaborative Study on Advanced New Nuclear Power Plants*, May 28, 2004, www.nei.org

The companies in all three consortia have not made any commitments to build new nuclear power plants even if their applications are successful.[25]

The Generation IV Nuclear Energy Systems Initiative provides research and development funding for advanced proliferation-resistant, fuel recycling, and transmutation technologies. The goals for Generation IV nuclear energy systems are safe, reliable, sustainable energy generation that meets clean air objectives and minimizes nuclear waste. The objective of the initiative is to develop and demonstrate these systems. The program supports research on six advanced concepts, with emphasis on the Next Generation Nuclear Plant (NGNP), Very High Temperature gas Reactor (VHTR) technology with advanced hydrogen and electricity generation capabilities. This initiative will advance technologies that may become commercially available around 2020 or later, it does not impact the outlook for new nuclear power generation in the nearer term.[26]

The Advanced Fuel Cycle Initiative complements the Generation IV Nuclear Energy Systems Initiative with its mission to develop reactor fuel and fuel cycle technologies to support Generation IV nuclear energy systems. This initiative seeks to enable a transition from the current once-through nuclear fuel cycle to a sustainable, closed nuclear fuel cycle. Another objective of this program is to develop technologies that will reduce the cost of geologic disposal of high-level waste from spent nuclear fuel thereby enhancing the repository performance. Management of spent nuclear fuel is one of the key challenges to new nuclear power plant deployment in the United States, this initiative could be key to meeting that challenge in the long term.[27]

The authorization for university nuclear science and engineering support would help to meet the long term challenge of limited availability of qualified operators and staff.

The authorization related to the security of reactor designs provides research and development on cost-effective technologies for increasing the safety of reactor designs from natural phenomena and the security of reactor designs from deliberate attacks. Safety is the number one concern of the nuclear industry. Existing plants have an excellent record that is tough to improve upon. New technologies that continue to provide excellent safety and offer cost savings would be of benefit to new nuclear plants, and could be key to meeting the challenge of public support for new nuclear power plants.

The Energy Bill authorizes a study to determine the feasibility of deep borehole disposal of spent nuclear fuel and high-level radioactive waste. This method of geological isolation of spent fuel could offer a solution for spent fuel storage once Yucca Mountain if full, thus addressing one of the key challenges to new nuclear power plant construction.

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[25] News Release, *Consortia Apply to DOE to Test Licensing Process for New Nuclear Plants*, April 30, 2004, www.nei.org

[26] Program Overview, *Generation IV Nuclear Energy Systems Initiative*, Office of Nuclear Energy, Science and Technology U.S. Department of Energy, February 2004, http://www.ne.doe.gov

[27] Program Overview, *Advanced Fuel Cycle Initiative*, Office of Nuclear Energy, Science and Technology U.S. Department of Energy, February 2004, http://www.ne.doe.gov

Again it should be noted that the Energy Bill provides authorization for certain levels of funding for these R&D programs and the actual budget appropriations are carried out separately. Passage of the Energy Bill with these R&D authorizations would not guarantee a certain level of appropriations, but it would indicate congressional support for this work. Also, failure to pass the Energy Bill with these authorizations would not necessarily mean these programs have to come to a halt, the funding could still be made available through the appropriations process.

Impact of Provisions for Supporting Transmission Infrastructure

While reliability of the electricity transmission grid is essential to the success of the electricity industry as a whole, nuclear power plants are more sensitive to grid failures than other generation facilities for two reasons. First, the loss of offsite power impacts nuclear power plant operations and safety. All nuclear power plants in the United States are powered from a minimum of two offsite transmission lines and maintain redundant onsite emergency power supplies. The loss of power from all offsite transmission lines is considered to be a precursor to the station blackout event, in which the onsite emergency power supplies also fail. The station blackout event can be a large contributor to the core damage frequency, thus an increase in the frequency or duration of loss of offsite power events increases the risk of core damage. Second, nuclear power plants have a larger capacity than most other generation facilities, and are usually run as base load, while some competing technologies are only used for peak loads, or in the case of wind, only used when available. Nuclear plants generate more power on a per plant basis and by design, these plants are located farther from population centers than most other generation facilities.

Recent events have shown that the electricity grid in the United States will need improvements in order to operate efficiently and reliably. Following the widespread power outage of August 14, 2003, the NRC began to focus added attention on the operational readiness of offsite power systems at nuclear power plants.[28]

The Energy Bill provision for guidelines for electric reliability standards, including electric transmission infrastructure, operation and transmission rates would help reduce the risk of loss of offsite power at nuclear power plants. This provision would also help ensure that the base load capacity generated by new nuclear plants could be distributed efficiently at a reasonable cost. The provisions for transmission infrastructure modernization, operation improvements, and rate reform would have similar effects.

Impact of Provisions for Electricity Conservation

The EIA's analysis[29] of the impacts of the Conference Energy Bill (conference report 108-375) found that of the incentives for residential energy conservation, only the provision for lower wattage light bulbs would have a direct and measurable effect on residential energy demand.

[28] NRC Inspection Manual, Temporary Instruction 2512/156, *Offsite Power System Operational Readiness*, 4/29/2004 www.nrc.gov

[29] Energy Information Administration, Office of Analysis and Forecasting, *Summary Impacts of Modeled Provisions of the 2003 Conference Energy Bill*, February 2004, SR/OIAF/2004-02

This provision was projected to save 2 to 3 percent annually on electricity demand for residential lighting. The effects on energy consumption are partially offset by reductions in energy price resulting from generation incentives in the Energy Bill that increase demand. The EIA projected a net savings of about 0.15 percent on total delivered energy consumption and a drop in energy prices of close to 1 percent for the residential sector relative to the reference case. The reference case projections are business-as-usual trend forecasts based on known technology, demographics, and associated trends, and current laws and regulations, including scheduled regulatory changes.

The EIA's analysis projected that supply-driven energy price effects of the Energy Bill would level out the effects of conservation incentives, resulting in delivered energy consumption for the commercial sector being approximately the same as for the reference case. The projected energy price decrease is also around 1 percent for the commercial sector.

Challenges that are not Impacted by the Energy Bill

Construction loan guarantees for new nuclear power plants are currently not a part of S.2095, H.R.6, or the Conference Energy Bill (conference report 108-375) and it doesn't appear likely that they will be added to the final legislation. Financing is a key challenge to new nuclear power plant deployment because of the high capital costs for construction and the uncertainty on return. Even if the tax credit for advanced nuclear power generation were to pass, the risk of delays in commencing operation of a new plant may be too great for investors. The EIA analysis found that the tax credit is not expected to encourage construction of nuclear capacity beyond an additional 6000 megawatts because without the credit, their analysis found advanced nuclear plants are not economical compared to other generation sources. The EIA assumptions for high capital costs and contingencies, along with an optimistic projection for natural gas prices contributes to this result. An analysis performed by EPRI found that advanced nuclear power plants could be economically competitive in the near future without production tax credits. There is a lot of uncertainty in the capital costs for advanced nuclear plant construction in the United States and this means it may be difficult to finance construction loans. Government assistance in the form of loan guarantees would overcome this key challenge.

Another way to address this challenge of competitive cost of power would be enacting cap and trade legislation that would place financial value on emissions avoided by nuclear power generation, or implementing a tax on greenhouse gas emissions from fossil plants. Monetizing the harm of greenhouse gas emissions could open the market to new nuclear power plants. No such provisions are included in the Energy Bill legislation.

The nuclear industry faces opposition in the form of concerned citizens who do not recognize the value of nuclear power as a source of non-emitting generation, and who fear nuclear accidents due to operator error, mechanical failure, or terrorist attack. Some of the research and development projects that are funded by the Energy Bill could alleviate public concerns by providing more advanced technical solutions to limit nuclear waste proliferation and improve nuclear reactor safety. These further improvements in technology may not be enough to change the public perception of nuclear technology. The nuclear power plants currently operating in the United States have an outstanding safety record, and yet much of the public is still opposed to

nuclear power. Provisions for public education on nuclear reactor operations and safety, and legislative recognition of the benefits of nuclear power as a non-emitting generation technology could be very successful at changing the public's perception, but such provisions are not included in the Energy Bill.

Resulting Outcomes of Energy Bill Passage

The political environment created by passage of any legislation favorable to new nuclear power plants would represent a significant step in achieving the conditions necessary for new nuclear power plant construction in the United States. It is hoped that the Energy Bill will contain legislation that will help the industry to overcome some key challenges to new nuclear power plant deployment, however, it may not do all that is necessary to mitigate the risks of investing in new nuclear power plants.

Passage of the Price-Anderson Act extension would open the door for advanced plant construction, a door that was shut when the Act was allowed to expire on December 31, 2003. This provision is included in all versions of the legislation, and even if a comprehensive Energy Bill is not approved by the 108th Congress, the Act has been extended several times in the past, and it is likely to be extended again.

Passage of production tax credits for advanced nuclear power plants would provide the financial leverage needed to make the first few new nuclear power plants economically competitive. Once these first few plants are built and begin operation, the uncertainties that have held off investors will be eliminated. The option for additional advanced nuclear power plants will be available to meet growth in electricity demand. The production tax credit is included only in the Conference Energy Bill (conference report 108-375), it was not part of the original text of H.R.6 and was left out of S.2095. The energy tax incentives portion of S.2095 has been attached to a different piece of pending legislation. Advanced nuclear power production credits would have to be added by amendment in order to pass with this legislation. The remainder of the Energy Bill may or may not be considered in this Congress and it may not include production tax credits for advanced nuclear power plants. The provision as it stands excludes designs that have already been certified, and similar designs of similar size that have not yet been certified. The certified AP-600, System 80+, and Advanced Boiling Water Reactor (ABWR) designs would not be eligible for the tax credit. The EIA's analysis of the advanced nuclear power production tax credit estimated that it would stimulate construction of only 6,000 megawatts of new nuclear generation capacity. Experts from U.S. financial and nuclear industries completed a Business Case Study for Early Orders of New Nuclear Reactors, this group concluded that once the first several plants have been built and operated, the key uncertainties will be eliminated and nuclear power can be fully competitive in the electricity marketplace. If production tax credits for advanced nuclear power plants become law, it is highly probable that one or more new nuclear plants will be built in the United States sometime in the early 2010's. If the first few new nuclear plants meet expectations for construction cost and schedule, and operate with generation costs at or below current estimates, it is possible that several additional new nuclear power plants will be built shortly there after.

Many of the authorizations for nuclear power research and development activities are related to Generation IV technologies that will not be commercially available until a decade or two from now. One exception is the DOE Nuclear Power 2010 Program which is focused on demonstration of advanced reactor designs and the new regulatory process. Under this program, utility led groups including reactor and fuel vendors and others have formed with the intent of participating with the DOE in cost-shared efforts to demonstrate the ESP and COL processes. The success of these efforts is critical to the future of new nuclear power plant deployment in the United States.

4

U.S. NUCLEAR INDUSTRY OUTLOOK IF THE ENERGY BILL OF 2003 PASSES WITHOUT INCENTIVES FOR NUCLEAR POWER

The Energy Bill contains several provisions to benefit generation technologies aside from nuclear power production. This section analyzes how these provisions may affect the electricity market, thus impacting the nuclear industry. The potential outcome of passage of the Energy Bill with incentives for most other generation technologies but not for nuclear power production is described in the conclusion of this section. The Energy Information Administration (EIA) provides analyses of legislative provisions at the request of members of Congress. These analyses are publicly available. This section draws significantly from three such reports, as listed below.

- Energy Information Administration, Office of Analysis and Forecasting, *Analyses of Selected Provisions of Proposed Energy Legislation: 2003*, September 2003, SR/OIAF/2003-04 – This report provides analysis of the types of provisions for energy consumption and fuel savings that were included in the original version of H.R.6.
- Energy Information Administration, Office of Analysis and Forecasting, *Analysis of Five Selected Provisions of the Conference Energy Bill of 2003*, February 2004, SR/OIAF/2004-01 – This analysis is limited to five selected provisions that were included in the revised version of H.R.6 published in the Conference Energy Bill (conference report 108-375), and does not describe the combined effects of all provisions of the bill.
- Energy Information Administration, Office of Analysis and Forecasting, *Summary Impacts of Modeled Provisions of the 2003 Conference Energy Bill*, February 2004, SR/OIAF/2004-02 - This analysis covers most of the provisions that were included in the revised version of H.R.6 published in conference report (108-375), and models the combined effects of these provisions of the bill. Provisions that authorize R&D funding which may or may not be made available through appropriations were not modeled.

These reports compare energy and fuel prices and generation mix resulting from passage of the Energy Bill provisions to a reference case. The reference case projections are business-as-usual trend forecasts based on known technology, demographics, and associated trends, and current laws and regulations, including scheduled regulatory changes. These quantitative analyses were performed using the National Energy Modeling System (NEMS).

The current market share of nuclear power and competing technologies is shown in Figure 4-1. Energy Bill provisions supporting technologies that do not hold a significant share of the current electricity market are not expected to have a significant impact on the market conditions for new nuclear power plants.

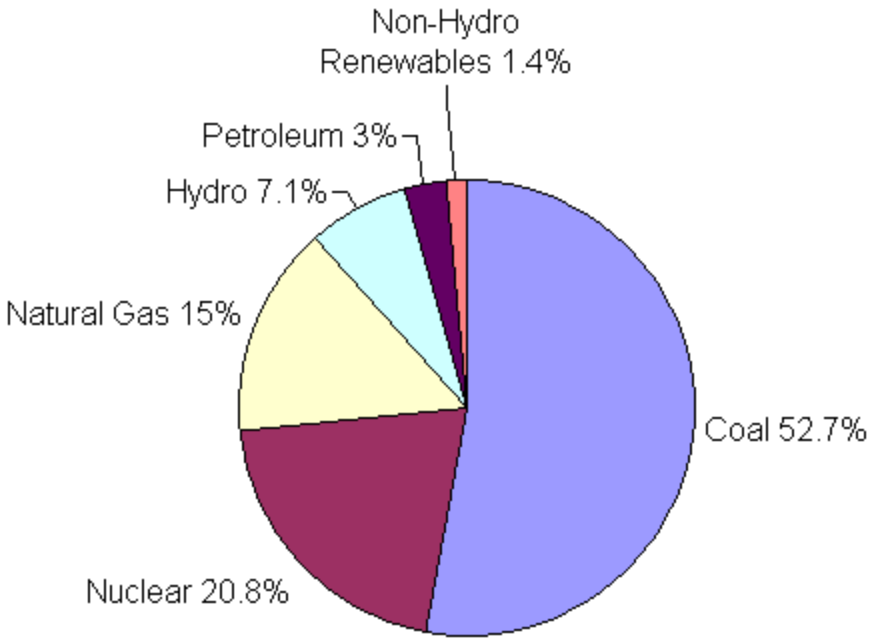

Figure 4-1
Breakdown of Total Electric Power Production by Sector for 2003, Data from the Energy Information Administration[30]

Impact of Natural Gas Provisions

The predicted price range for natural gas in 2005 and beyond is very wide. The National Petroleum Council's (NPC) report from September 2003, *Balancing Natural Gas Policy – Fueling the Demands of a Growing Economy: Volume I – Summary of Findings and Recommendations*, predicted average annual Henry Hub prices (in 2002 dollars) to range from just under $4 to around $5.75 per million BTU in 2005, with the range widening each year after that. The predicted price range for 2025 is from about $3 to over $7 per million BTU (one million BTU is equal to 1000 standard cubic feet of natural gas). This wide range has two bands of assumptions, both requiring significant initiative by policy makers and industry stakeholders to implement recommendations made by the NPC in their report. The mid-point of the predicted price range, where the two bands meet, is just under $5 per million BTU. The NPC recommendations required just to meet the higher band of the predicted price range include improvements in energy efficiency and conservation, enabling legislation for the Alaskan pipeline, new liquid natural gas terminals, and drilling and development activity in the Rocky Mountains. In order for natural gas prices to fall in the lower band of the predicted range, the NPC also recommends improving demand flexibility and efficiency, increasing supply diversity, sustaining and enhancing infrastructure, and promoting efficiency of markets. The NPC recommendations are beyond the current status quo, some of these recommendations would be achieved by provisions of the Energy Bill. The NPC reported that a status quo approach to

[30] Energy Information Administration, Monthly Energy Review, Electricity Net Generation (All Sectors), March 26 2004, http://www.eia.doe.gov, Data for 2003.

natural gas policy yields undesirable outcomes.[31] This may be interpreted as a prediction of prices at the high end of their estimate or even greater, and natural gas supply not meeting demand.

The Energy Information Administration's analysis of the Energy Bill provisions for natural gas paints a somewhat different picture than the National Petroleum Council's report, despite some commonalities in the Energy Bill provisions and the NPC recommendations.

The EIA's Energy Bill analysis predicts lower natural gas prices relative to the reference case over the short term based on the combined effect of the various provisions, with prices coming back up to match the reference case in 2025. The EIA prediction of a natural gas price of a reference case price of $4.40 per thousand cubic feet in 2025 is somewhat optimistic compared to the National Petroleum Council's findings. The NPC's status quo is comparable to the EIA's reference case, and yet the NPC reports that a status quo approach yields undesirable results and recommends significant actions by policy makers and industry just to keep prices in the range of about $5 to $7 per thousand cubic feet by 2025 (2002 dollars).

The EIA report, *Summary Impacts of Modeled Provisions of the 2003 Conference Energy Bill,* predicts that the construction incentives for the Alaska Natural Gas Pipeline would advance construction and entry-into-service of the pipeline by one year in comparison to the reference case, entry-into-service of the pipeline is predicted in 2017 with passage of the Energy Bill. This report predicts lower natural gas prices relative to the reference at this time based on the combined effects of the various Energy Bill provisions. The lower prices are predicted to slow the development of deepwater resources, while offshore production remains steady due to the royalty relief for low production and deep wells in the shallow waters of the Gulf of Mexico.

Tax credits for non-conventional natural gas production were modeled by the EIA, based on a $3 per barrel Btu equivalent, the EIA allowed a credit of 53 cents per thousand cubic feet, the credit applies for 4 years of gas production prior to 2010 for wells placed into service up until 2006. This credit would increase the profitability of non-conventional fuels, resulting in drilling increases, higher reserve levels, and increased production. The tax credit is expected to stimulate the addition of new non-conventional reserves and production from them as long as they are economical. The tax incentives allow marginal supplies to be profitable sooner than in the base case, increasing the expected ultimate recovery per well. The EIA report on provisions of the Conference Energy Bill (conference report 108-375) projects that passage of this bill would result in a 3 percent increase in cumulative non-conventional production for the period from 2004 to 2009 compared to the reference case. The EIA report from September 2003, which covered several provisions for energy consumption and fuel savings but did not include production tax credits for advanced nuclear generation, found a similar result for increases in natural gas production. This study predicted a 2.8 percent decrease in wellhead prices versus the reference case for the time period from 2003 to 2010.

The EIA's analysis specific to the Conference Energy Bill (conference report 108-375) predicts that the provisions for natural gas supply will increase domestic production from non-

[31] National Petroleum Council, *Balancing Natural gas Policy – Fueling the Demands of a Growing Economy: Volume I – Summary of Findings and Recommendations*, September 25, 2003, www.npc.org

conventional and offshore sources, placing downward pressure on wellhead prices in the short term, mainly between 2005 and 2010. These lower prices are expected to delay some liquefied natural gas projects resulting in higher gas prices in 2010 continuing for a short time until the provisions for renewable and nuclear production tax credits moderate the demand for natural gas electricity generation and thus lower the price. The affect of these provisions is also limited in duration. The EIA model shows that the periods of lower prices and the incentives for increased production prior to 2010 result in lower available resources by 2020 and predicts that by 2025 the effects of passage of the Energy Bill even out such that the price of natural gas will be the same as in the reference case, $4.40 per thousand cubic feet in 2025 (2002 dollars). The EIA's prediction for changes in total natural gas electricity generation due to passage of the Conference Energy Bill (conference report 108-375) is shown in Table 4-1 below, the net effect of the Conference Energy Bill (conference report 108-375) provisions is expected to reduce natural gas electricity generation in most years, when compared to the reference case. In both cases, electricity generation from natural gas is expected to increase over time.

Table 4-1
EIA Analysis Resulting Impact of Energy Bill Provisions on Electricity Generation from Natural Gas

Year	Change in Natural Gas Generation for Conference Energy Bill Case vs. Reference Case Generation in Billion Kilowatt-Hours
2010	-36
2015	-36
2020	-28
2025	8

It is not possible to meaningfully analyze the R&D authorizations related to exploration and production of natural gas. The authorizations for these activities do not ensure that appropriations of funding will actually occur. The outcome of R&D activities if they are funded, particularly exploration, is highly uncertain. Qualitatively, it can be estimated that passage of the Energy Bill with the provisions for R&D activities related to natural gas exploration and production could increase supply and lower prices. The magnitude of these effects is highly uncertain.

The EIA's analyses suggest that the impacts of Energy Bill provisions offering incentives for natural gas production and construction of the natural gas pipeline are minimal and short lived. Although the outlook for new nuclear power plant construction is not very good without passage of at least some of the nuclear provisions in the Energy Bill, separate passage of the Energy Bill's natural gas provisions is not predicted to make it worse.

In recent years, natural gas plants have been the main source of new generation capacity in the United States because these plants have low capital costs for construction. However, high natural gas prices have prompted energy companies to plan for the construction of new coal-fired plants for the first time in more than a decade. This section has shown that the Energy Bill

provisions do little to curb high natural gas prices. The next section will examine the impacts of the clean coal provisions in the Energy Bill. Coal currently fuels the majority of power production in the United States. Environmental groups are strongly opposed to additional coal plants based on current technologies because they emit carbon dioxide, sulfur dioxide, nitrogen oxide, and mercury.[32]

Impact of Clean Coal Provisions

Coal is not as costly or as limited in supply as natural gas, and could be the biggest competitor to nuclear power if the environmental effects are either accepted by society or substantially reduced by technology.

The Conference Energy Bill(conference report 108-375) includes investment tax credits for up to 6,000 megawatts of advanced clean coal power plants, broken into 3,000 megawatts of advanced integrated gasification combined cycle plants (IGCC), and 3,000 megawatts of other advanced coal technologies, such as advanced pulverized coal plants. The EIA's analysis of this bill predicts that this will accelerate the construction of IGCC plants resulting in additional capacity. The provision for other advanced coal technologies is not expected to result in increased capacity relative to the reference case due to the combined effects of the other Energy Bill incentives. Overall, total generation from coal is expected to be reduced slightly by the passage of the Conference Energy Bill (conference report 108-375), while the amount of advanced coal generation capacity is about four times greater than in the reference case. The EIA also performed an analysis of similar provisions included in H.R.6, which did not include production tax credits for nuclear generation. This analysis projected that the total generation from coal would not be changed, and that the contribution for advanced coal plants would be approximately doubled compared to the reference case used in this study. This analysis projected an additional 77,000 megawatts of new coal capacity between 2005 and 2025, including approximately 8,000 megawatts of advanced clean coal technologies. Table 4-2 details the EIA's estimates for reduction in coal power generation resulting from passage of the Conference Energy Bill (conference report 108-375), percentage-wise, these reductions range from 1 to 2 percent when compared to the reference case.

[32] Press Release, Senate Committee on Energy & Natural Resources, U. S. Senator Pete V. Domenici, NM, Chairman, *Natural Gas Prices Result in More Coal Plants – Amid Complaints from Enviros Worried about Air Quality*, March 22, 2004 www.energy.senate.gov

Table 4-2
EIA Analysis Resulting Impact of Energy Bill Provisions on Electricity Generation from Coal

Year	Change in Coal Generation for Conference Energy Bill Case Over Reference Case Generation in Billion Kilowatt-Hours
2010	-34
2015	-21
2020	-26
2025	-66

Passage of an Energy Bill that does not include incentives for advanced nuclear power, particularly production tax credits, would result in slightly more new coal generation capacity being added between 2005 and 2025 than if the nuclear incentives were passed. Passage of Energy Bill provisions supporting clean coal technologies would have an effect on the make up of that additional coal generation capacity, increasing the use of advanced clean coal technologies. The EIA projection for the case where the Conference Energy Bill(conference report 108-375) passes includes a significant increase in advanced clean coal technologies, yet still expects these plants to make up less than 10 percent of the total coal generation capacity.

The R&D provisions of the Energy Bill related to coal technologies cannot be analyzed quantitatively because the authorization for these activities does not ensure that appropriations of funding will actually occur. Also, the outcome of R&D activities if they are funded is highly uncertain. Qualitatively, it can be estimated that passage of the Energy Bill with the provisions for R&D activities related to coal mining technologies and innovation of coal power systems could lower the cost of coal generation and/or reduce the emissions. These activities would likely increase market share for coal generation, which is already quite large.

With or without passage of the Energy Bill in its various forms, the EIA projections show that the United States will rely heavily on existing coal generation technologies through 2025. Since the overall impact of clean coal provisions in the Energy Bill is minimal, it is expected that these provisions would have little effect on the outlook for new nuclear plant construction.

Overall Impact of Fossil Generation Provisions

The analyses discussed above found that the provisions of the Energy Bill will not significantly impact natural gas supply and prices and that the United States is expected to continue to rely heavily on coal for electricity generation for decades to come. The EIA's analyses of the impact of production tax credits for natural gas from unconventional sources and support for the Alaska natural gas pipeline found that the impact on supply would be a small and short term increase. When the production tax credits for natural gas from unconventional sources were considered apart from power production credits for advanced nuclear plants and renewables, the expected price decrease was less than 3 percent and lasted for just a few years.

Impact of Renewable Energy Provisions

The EIA applied the NEMS model to study the effects of the renewable energy production tax credits for wind and biomass generation. The results anticipated significant growth in generation from wind and biomass co-firing while the tax credits are in effect, but by 2025 the level of generation from the these technologies is projected to be only 14 percent above the reference case. The EIA analysis compared projections for total renewable generation with production tax credits to a reference case. The differences between the two cases are shown in Table 4-3 below.

Table 4-3
EIA Analysis Resulting Impact of Non-Hydroelectric Renewable Generation Production Tax Credits

Year	Increase of Non-Hydroelectric Renewable Generation for Conference Energy Bill Case Over Reference Case in Billion Kilowatt-hours
2008	88.19
2010	67.21
2015	27.82
2025	8.14

The total electricity generated in 2003 from non-hydroelectric renewables was estimated by the EIA to be 73.12 billion kilowatt-hours, thus the increases due to production tax credits are considerable in the peak years. However, non-hydro renewable energy production accounted for only about 1.4 percent of total production in 2003. The EIA's analysis predicted a very slight reduction in electricity and natural gas prices due to the increases in non-hydroelectric renewable and nuclear power production related to production tax credits. The overall electricity price impact of increased renewable generation would be much smaller in the absence of production tax credits for advanced nuclear power, and would be almost non-existent after 2015. The provisions for non-hydroelectric renewable production tax credits would not significantly change the outlook for new nuclear power plant construction in the United States in the scenario where the Energy Bill passes with these provisions and does not include provisions for nuclear generation.

Hydroelectric power is the main source of renewable energy. The Senate version of the Energy Bill authorizes incentive payments for qualified additional hydroelectric facilities and for increasing efficiency and production from existing hydroelectric facilities. The funding for these incentive payments is subject to appropriations and thus uncertain. These incentives apply to new turbines and generating devices installed at existing dams or conduits and to improvements to existing hydroelectric production facilities. The additional capacity that can be developed from these resources will be limited, thus the resulting impact of these provisions is not expected to be significant.

Resulting Outcomes of Energy Bill Passage without Nuclear Power Incentives

The effects of Energy Bill provisions for competing generation technologies on the outlook for new nuclear power plants in the United States are very minimal. The provisions for natural gas, coal, and renewable generation technologies are not expected to provide long term solutions to the issues of energy supply diversity, environmental quality, and fuel cost. However, if the Energy Bill is passed without any of the provisions for new nuclear power plants included, the challenges to building new nuclear power plants in the United States may not be overcome. The previous section of this document explained that extension of the Price-Anderson Act is not just beneficial for new nuclear power plant construction, it is essential. If the Energy Bill is passed without this provision, it will have to be passed as part of some other legislation in order for any company to even consider investing in a new nuclear power plant in the United States. Once the Price-Anderson Act is extended, nuclear power plants may be constructed only if they can be expected to be economically competitive with other forms of generation. Analyses and estimates from EPRI, the EIA, and the industry group that completed the business case study for the DOE differ on whether or not this is possible without some government assistance (i.e. production tax credits, construction loan guarantees, or credit for avoided emissions) to cover construction and financing costs. Despite this challenge, the nuclear industry has been working with the DOE to advance nuclear reactor designs and demonstrate the new reactor licensing process. Although the authorizations for these on-going R&D projects do not have to pass in order for Congress to appropriate the funding, it should be noted that failure to maintain the DOE funding that has contributed to these efforts could slow the progress.

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SUMMARY AND CONCLUSIONS

The Energy Bill legislation, including H.R.6, S.2095, and the Conference Energy Bill (conference report 108-375), contains several provisions that could improve the outlook for new nuclear power plant construction in the United States. There are measures for advanced nuclear power production tax credits, extension of the Price-Andersen Act liability limitation, and authorization of nuclear R&D. Measures to improve the reliability and efficiency of the electricity transmission and distribution system are also included.

There are also provisions in the Energy Bill for increasing natural gas production, increasing electricity production from renewable generation facilities, and improving coal technologies. These competing technologies will also benefit from transmission grid improvements.

The Energy Bill also contains incentives to improve energy efficiency and conservation. These are designed to reduce the demand for electricity.

Limitations of the Energy Bill

Utilities and investors that consider building a new nuclear plant in the United States are faced with extreme uncertainty in construction costs and high risk of delays during the construction process and operation start up due to regulatory matters and/or public opposition. The current versions of the Energy Bill may not do enough to address this issue. The analyses of the Energy Bill discussed in Section 3 found that the production tax credit for advanced nuclear power generation would most likely result in construction of some advanced nuclear power plants in the United States. The production tax credit is not included in all versions of the Energy Bill, and may not become part of any final Energy Bill legislation that passes into law. The EIA expected the impact of this provision to be limited to the national cap on new generation capacity eligible for credits, which is 6000 megawatts. The actual impact could be more significant, because the experience and knowledge gained during construction of the first few nuclear power plants should result in lower costs for future plants. Alternatively, the production tax credits may not actually be enough to offset the investment risk for the first new nuclear plant. The other provisions for nuclear energy included in the Energy Bill would support new plant construction efforts, but do not offer specific financial incentives for new nuclear power plants. Section 3 also discussed some other policy initiatives, not currently included in the Energy Bill, that could go a lot further toward ensuring that new nuclear power plants are built in the U.S., these include financial recognition of avoided emissions and construction loan guarantees.

The analyses discussed in Section 4 found that the provisions of the Energy Bill will not significantly impact natural gas supply and prices. Natural gas supplies are limited and recently

high prices have prompted energy companies to consider building more coal plants instead of natural gas plants. As the electricity demand grows even more, the price of natural gas will likely soar even higher. In the near future, energy companies and their customers will likely find themselves choosing between adding more coal generation capacity or adding more nuclear generation capacity.

Coal electricity generation has a very negative impact on air quality, and, based on the EIA analysis, the Energy Bill provisions are only expected to reduce the amount of electricity generated from coal plants by about 1 or 2 percent compared to the reference case. The EIA projects increasing generation from coal plants in both the reference case and with passage of the Energy Bill. Even with passage of the Energy Bill, only about 10 percent of the added coal generation capacity is projected to come from advanced clean coal technologies.

Combined Impacts of Energy Bill Provisions

Earlier sections of this report touched on the combined effects of various provisions of the Energy Bill Legislation. Section 3 discussed the significant implications of the production tax credit for advanced nuclear power generation. This provision would provide a favorable economic picture for the first few advanced nuclear plants built in the United States. Construction and operation of these first few plants would eliminate the uncertainties that have held off investment in new nuclear power plants in the U.S. The other nuclear power incentives discussed in section 3 improve the outlook for new nuclear power plants by ensuring limited liability in the event of an accident, and providing for R&D projects needed to support design and construction of new U.S. nuclear power plants.

Much of the analysis discussed in section 4 included the combined effects of the various Energy Bill provisions. Where the provisions for fossil fuel generation technologies were considered independently, the impacts on supply and price were quite minimal. The Energy Bill provisions for renewable technologies were expected to result in a considerable increase in use of these technologies for a few years, with effects tapering off by 2025. When the Energy Bill provisions were considered in combination, increases in generation for advanced nuclear power and renewable technologies were expected to stabilize natural gas prices in the period from 2010 to about 2020 and to reduce the demand for generation from coal power plants from the time the Energy Bill passes through 2025. Quantitative analysis performed by the EIA found that the combined effects of the Energy Bill provisions, including production tax credits for both advanced nuclear power and competing technologies, as well as incentives for conservation resulted in an electricity price reduction of around one percent when compared to a status-quo reference case, for the period from the time the Energy Bill passes to 2025.

The nuclear power measures included in the Energy Bill legislation would significantly improve the market conditions for new nuclear power plants. This is especially true if the production tax credit for advanced nuclear power generation, which is not included as part of the energy tax incentives package that passed the Senate in S.1637, is considered. However, without government loan guarantees to offset the financial risks of investment in the first few new nuclear reactors, the industry may be unwilling to move forward. While the actual funding for the Nuclear Power 2010 Program will be decided through an appropriations process that is

separate from the Energy Bill, it should be noted that this program critical to the future of new nuclear power plant deployment in the United States. The Energy Bill provisions for competing technologies and for energy conservation are not expected to have a significant impact on electricity market conditions and would not reduce the benefits provided by the nuclear energy provisions.

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