NUCLEAR POWER PROSPECTS IN THE USA:
THE CONTINUING PROBLEM OF THE WASTE ISSUE

by

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NUCLEAR POWER PROSPECTS IN THE USA: THE CONTINUING PROBLEM OF THE WASTE ISSUE

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ABSTRACT
This paper addresses two questions concerning the economics and prospects for nuclear power in the USA: 1) What is the long term economic future of nuclear energy? 2) Is the inability to solve the nuclear waste issue a factor that will limit new nuclear plant development? With respect to the first question, we find that the long term economic future of nuclear energy is uncertain, at best. Despite recent interest in a "nuclear renaissance," objective, rigorous studies have concluded that, at present, new nuclear power plants are not economically competitive with coal or natural gas for electricity generation and will not be for the foreseeable future. With respect to the second question, we find that the inability to solve the nuclear waste issue will likely limit new nuclear plant development. Nuclear waste disposal poses a serous, seemingly intractable problem for the future of nuclear power, and the waste issue could be a show stopper for new nuclear plants. Thus, while some new nuclear power plants will likely be built in the U.S. over the next two decades, a major "nuclear renaissance" is unlikely.

Key Words: Nuclear waste, nuclear economics, nuclear prospects, nuclear USA, nuclear competitiveness

1. CURRENT STATUS OF THE U.S. NUCLEAR INDUSTRY

1.1 Nuclear Power Production

U.S. nuclear power production has grown steadily and now exceeds electricity generated from oil, natural gas, and hydro plants, and trails only coal, which accounts for more than half of U.S. electricity generation. At present, 103 nuclear reactors are operating. Although no new U.S. reactors have come on line since 1996, U.S. nuclear electricity generation has increased by more than 20% over the past decade (Figure 1), and much of this additional output resulted from reduced downtime. Nuclear plants generated electricity at an average of 90% of their total capacity in 2006, after averaging 75% in the mid-1990s and 65% in the mid-1980s. Reactor modifications to increase capacity have also been a factor.

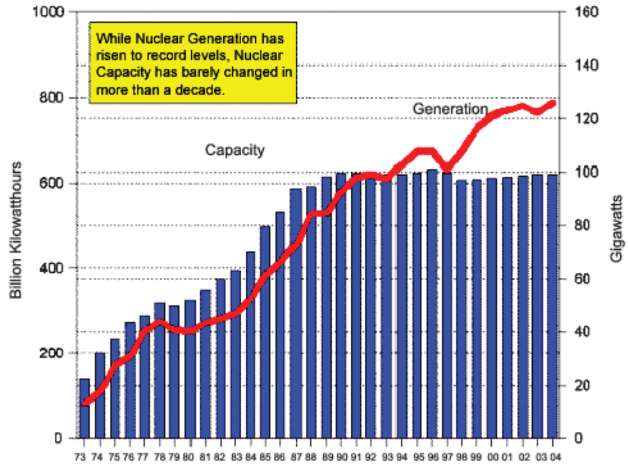

Figure 1. Net Nuclear Generation and Capacity, 1973-2004.
Source: U.S. Energy Information Administration and U.S. Congressional Research Service, 2007.

1.2 Improved Operations and Nuclear Power Forecasts

Improved nuclear plant operations have reduced nuclear power costs, and average O&M costs declined from a high of 4 ¢/kWh in 1987 to below 2.25 ¢/kWh in 2001 (2006 dollars).[1] By 2005, the average operating cost was 1.9 ¢/kWh.[2]

Figure 2 shows the history and forecast of U.S. nuclear power. It illustrates that: 1) Nuclear power increased rapidly to 650 billion kWh in 1980 and 750 billion kWh in 2004; 2) It is forecast to increase to 875 billion kWh by 2030; 3) For the past two decades, nuclear power has generated about 20 percent of U.S. electricity; 4) The share of nuclear power in electrical generation is forecast to decline to about 15 percent by 2030, and EIA projects that only 12 GW of new nuclear plants will be built by 2030.[3]

2. NEW NUCLEAR PLANTS

No new U.S. nuclear plant has been ordered in the U.S. since 1978 and no U.S. reactor has been completed since 1996. However, interest in new U.S. reactors is increasing, and a dozen companies have announced plans to apply for licenses (Table 1), for a total of 34 new nuclear units. The first application to build a new U.S. nuclear plant was filed by NRG Energy in September 2007.

However, in announcing new reactor applications, utilities have emphasized that they are not committed to actually building the reactors, even if the licenses are approved. Large uncertainties about nuclear plant construction costs and nuclear waste disposal remain, along with concerns about public opposition.

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[1]Uranium Information Centre, *The Economics of Nuclear Power*, Briefing Paper 8, January 2006, p. 3.

[2]*Nucleonics Week*, "U.S. Utility Operating Costs, 2005," September 14, 2006, p. 7.

[3]By contrast, AEO 2007 projects that 140 GW of new coal plants will be built by 2030; see U.S. Energy Information Administration, *Annual Energy Outlook, 2007*, February 2007.

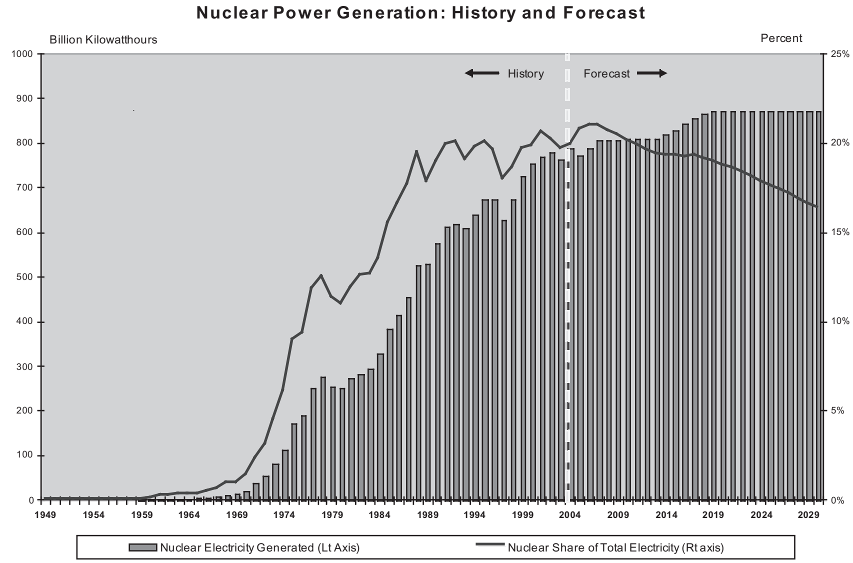

Figure 2. Nuclear Power Generation: History and Forecast
Source: U.S. Energy Information Administration, 2007.

Table 1. Announced U.S. Nuclear Plant License Applications

Announced Applicant	Site	Planned Application Date	Reactor Type	Units
Amarillo Power	Not specified	2007	GE ABWR	2
Constellation Energy (Unistar)	Calvert Cliffs, MD	4Q 2007	Areva EPR	1
	Nine Mine Point, NY	1st half 2008	Areva EPR	1
	Not specified	4Q 2008	Areva EPR	3
Dominion	North Anna, VA	Nov. 2007	GE ESBWR	1
DTE Energy	Fermi, MI	4Q 2008	Not specified	1
Duke Power	Cherokee, SC	2007-2008	West. AP1000	1
Entergy	River Bend, LA	May 2008	GE ESBWR	1
Exelon	Texas	Nov. 2008	Not specified	2
FPL	Not specified	2009	Not specified	1
NRG Energy	South Texas	Project 2007	GE ABWR	2
NuStart	Grand Gulf, MS	Nov. 2007	GE ESBWR	1
	Bellefonte, AL	Oct. 2007	West. AP1000	2
Progress Energy	Harris, NC	Oct. 2007	West. AP1000	2
	Levy County, FL	July 2008	West. AP1000	2
SCE&G	Summer, SC	3Q 2007	West. AP1000	2
Southern Co.	Vogtle, GA	March 2008	West. AP1000	2
TXU	Comanche Peak, TX	4Q 2008	Not specified	2
	Texas	4Q 2008	Not specified	2
	Texas	4Q 2008	Not specified	2
Total Units				34

Source: U.S. Congressional Research Service, Nuclear Regulatory Commission, Nucleonics Week, Nuclear News, Nuclear Energy Institute, and Management Information Services, Inc., 2007.

3. THE ECONOMICS OF NUCLEAR POWER

3.1 Major Studies of Nuclear Power Economics

Studies of the nuclear power economics have been conducted by MIT, the University of Chicago (U of C), the Congressional Research Service (CRS), AEI/Brookings, and others.[4] These studies reached similar conclusions: First, new nuclear plants are not competitive with coal or natural gas-fired power plants; second, for nuclear plants to be competitive, substantial cost reductions and federal incentives are required; third, large carbon taxes could increase the costs of fossil fuel plants sufficiently to make nuclear power competitive.

These conclusions are robust despite major differences in assumptions.[5] For example, MIT assumed that construction time for a new nuclear plant will be five years, CRS assumed six years, and U of C assumed seven years.[6] MIT assumed nuclear plant capital costs of $2220/kW, CRS assumed capital costs of $2,030/kW, and U of C assumed costs of $1,960/kW. MIT considered two natural gas cost cases: NG at $4.91/MMbtu and at $7.46/ MMbtu, CRS assumed a NG price of $5.40/MMbtu, and U of C used a range of NG prices between $3.70/MMbtu and $4.90/MMbtu. MIT used two nuclear capacity factors: 75% and 85%, CRS used a capacity factor of 90%, and U of C assumed a capacity factor of 85%. Below we focus primarily on the findings of the MIT study because it was the most comprehensive. However, we also note analogous findings from the CRS, U of C, AEI/Brookings, and other studies.

3.2 Factors Affecting the Competitiveness of New Nuclear Power Plants

New nuclear plants will be built only if they have lower costs than the alternatives, and MIT developed a model to evaluate the cost of nuclear power versus coal plants and natural gas combined cycle plants (NGCC). MIT compared the levelized price of electricity over the lives of different power plants.[7]

[iv]Massachusetts Institute of Technology, *The Future of Nuclear Power, 2003*; University of Chicago, *The Economic Future of Nuclear Power*, August 2004; U.S. Congressional Research Service, *Nuclear Power: Outlook for New U.S. Reactors*, March 2007; Paul L. Joskow, "The Future of Nuclear Power in the United States: Economic and Regulatory Challenges," AEI-Brookings Joint Center for Regulatory Studies, December 2006; the Brattle Group, *The Economics of U.S. Climate Policy: Impact on the Electric Industry*, March 2007; Cambridge Energy Research Associates, *Nuclear Power "Renaissance" Moving Beyond Talk to Real Action*, April 2007. To ensure comparability of the studies' assumption and findings, all costs have been converted here to constant 2006 dollars.

[5]As noted, to ensure comparability of the studies' assumption and findings, all costs have been converted here to constant 2006 dollars.

[6]The Nuclear Energy Institute optimistically estimates that licensing and construction for a new nuclear plant will require about seven years; see Whitford, op. cit.

[7]The levelized cost is the constant real wholesale price of electricity that meets a private investor's financing cost, debt repayment, income tax, and associated cash flow constraints. It is essentially an annualized real life-cycle cost per kWh for each technology or, in a market context, the real life-cycle price per kWh that the plant would have to realize in a competitive market to make it a break-even investment. Different assumptions about the overnight construction cost, financing costs, income tax rates, and associated accounting procedures, capacity factors, fuel price escalation and several other variables can have very significant effect on the results. The model assumed an 85 percent capacity factor and a 40-year economic life for the nuclear plant and considered a range of possible reductions in nuclear costs.

MIT examined how the levelized cost of nuclear generated electricity changes as cost reductions are simulated: First, they assumed that construction costs are reduced by 25% from the base case; second, they examined how costs are further reduced by a one-year reduction in construction time; third, they examined the effects of reducing financing costs to levels comparable to those of gas and coal plants; finally, they examined how the costs of coal and NGCC generation are affected by carbon taxes.

3.3 The Base Case Analysis[8]

The MIT base case estimates the costs of building and operating the three generating alternatives. The nuclear base case capital cost is $2,228/kW – an estimate that is much lower than the costs experienced by U.S. nuclear plants completed during the 1980s and early 1990s but much higher than current vendor cost forecasts.

The base case assumed that non-fuel O&M costs can be reduced by 25% and placed total O&M costs at 18 mills/kWh.[9] We summarize below two MIT cases for the NGCC plants: 1) a case using an NG price of $4.91/MMbtu; 2) a case using an NG price of $7.46/ MMbtu.

Base case results indicate that nuclear power is much more costly than the coal and natural gas alternatives even in the high NG price cases – Table 2. In the low NG price case, NGCC is about equivalent in price to coal, but with higher NG prices NGCC is not competitive with coal. This indicates that high natural gas prices will lead investors to switch to coal rather than to nuclear.

Table 2 shows that, at present, nuclear power is not economically competitive with coal or natural gas, and that on a levelized cost basis is: Nearly 60% more expensive than coal, about 60% more expensive than NG at $4.91/MMbtu, and 20% more expensive than NG at $7.46/MMbtu. This table also shows that coal is competitive with natural gas at prices in the range of $5/MMbtu and is less expensive than NG at prices higher than $5/MMbtu. Finally, this table also shows that even with significant cost reductions nuclear power is not competitive with coal, although it is competitive with natural gas at $7.46/MMbtu. Thus, with current expectations about nuclear plant construction costs, O&M costs, and regulatory uncertainties, it is unlikely that nuclear power can compete with natural gas or coal.

3.4 Hypothesized Reductions in Nuclear Costs

MIT examined the impact of reduced nuclear costs, and first simulated the case where nuclear construction costs could be reduced by 25 percent (Table 2). While this reduces the levelized cost of nuclear electricity, it is still not competitive with gas or coal in any of the base cases. MIT simulated reducing construction time for a nuclear plant from five to four years and this further deceased costs, but not enough to make

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[8]To ensure comparability of the studies' assumption and findings, all costs have been converted here to constant 2006 dollars.

[9]The authors included this reduction in O&M costs in the base case because they expected that operators of new nuclear plants in a competitive wholesale electricity market environment will have to demonstrate better than average performance to investors. The 18 mills/kWh O&M cost value is consistent with the performance of existing plants that fall in the second lowest cost quartile of operating nuclear plants.

nuclear competitive. MIT simulated the case where the nuclear plant could be financed at the same cost of capital as a coal or gas plant. It found that nuclear power would be competitive with NGCCs in a high gas price world, but would still be more expensive than coal plants and NGCCs in a low gas price world — assuming that comparable improvements in the costs of building coal and NGCCs plants are not also achieved.[10]

This suggests that with significant cost reductions and continued excellent operating performance, nuclear could compete with natural gas if gas prices are much higher than what EIA is forecasting. However, nuclear would still be more costly than coal. Further, the cost improvements required to make nuclear competitive with coal are significant, including a 25% reduction in construction costs, a greater than 25% reduction in O&M costs, reducing construction time from five to four years,[11] and financing nuclear plants at the same costs as coal plants. Even so, nuclear is never less costly than coal.

Table 2. Estimated Costs of Electric Generation Alternatives

	Real Levelized Cents/kWh (2006 dollars)
Base Case	
Nuclear	7.4
Coal	4.7
Natural Gas ($4.91/MMbtu)	4.6
Natural Gas ($7.46/MMbtu)	6.2
Reduced Nuclear	
Costs Cases Construction costs reduced 25 percent	6.1
Construction time reduced by 12 months	5.9
Cost of capital reduced 20 percent	4.9

Source: Management Information Services, Inc., and Massachusetts Institute of Technology, 2007.

3.5 Potential Impact of Carbon Taxes

MIT estimated the costs of the fossil-fueled generation alternatives to reflect carbon taxes of $50/tC, $100/tC, and $200/tC – Table 3.[12] The study found: 1) with taxes in the $50/tC ($13.50/t CO_2) range, nuclear power is not competitive; 2) with taxes in the

[10]MIT also estimated that if nuclear plant operators could reduce O&M costs by another two to 14 mills/kWh, consistent with the best performers in the industry, nuclear's total cost would match the cost of coal and the cost of CCGT in the high gas price case, but not the low gas price cases. However, this reduction does not provide nuclear plants with a meaningful economic advantage over coal.

[11]As noted, CRS assumed that it would take six years to build a new nuclear plant and U of C assumed that it would take seven years.

[12]The lower value is consistent with EPA estimates of the cost of reducing U.S. CO_2 emissions by about one billion metric tons per year. The $100/tC and $200/tC values bracket the range of values that appear in the literature regarding the costs of carbon sequestration, recognizing that there is enormous uncertainty about the costs of deploying CO_2 capture, transport, and storage on a large scale.

\$100/tC (\$27/t CO_2) range, nuclear would be marginally competitive with coal and with natural gas in the high NG price case; 3) with taxes in the \$200/tC (\$54/t CO_2) range, nuclear is cheaper than coal and natural gas in the high NG price case, but is still not be competitive with natural gas in the low NG price case.

However, there is a caveat: With high carbon taxes, it could become economic to deploy IGCC and CO_2 sequestration. Depending on IGCC economics, coal could play a larger competitive role in a world with high carbon taxes than suggested by Tables 2 and 3.

Table 3. Impact of Carbon Taxes on Estimated Costs of Electric Generation Alternatives

	Real Levelized Cents/kWh (2006 dollars)		
	\$50/tC (\$13.50/t CO_2)	\$100/tC (\$27/t CO_2)	\$200/tC (\$54/t CO_2)
Coal	6.0	7.3	10.0
Natural Gas (\$4.91/MMbtu)	5.2	5.8	6.9
Natural Gas (\$7.46/MMbtu)	6.8	7.4	8.5

Source: Management Information Services, Inc., and Massachusetts Institute of Technology, 2007.

4. ENERGY POLICY ACT OF 2005

Substantial federal nuclear incentives were included in the Energy Policy Act of 2005 (EPACT). These include \$3 billion in R&D, more than \$3 billion in construction subsidies for new nuclear plants, \$6 billion in operating tax credits, a 20-year extension of liability caps for nuclear accidents, and federal loan guarantees for nuclear plant construction.

4.1 Nuclear Production Tax Credit

EPACT provides a 1.8 cents/kWh tax credit for up to 6,000 MW of new nuclear capacity for the first eight years of operation, up to \$125 million annually per 1,000 MW.[13] A major factor in the impact of the tax credit is its allocation among reactors. The 6,000 MW of capacity eligible for the tax credit is to be allocated to reactors that apply for an NRC license by 12-31-08 and begin construction by 01-01-14. If applications with more than 6,000 MW of nuclear capacity are received by 12-31-08, the 6,000 MW cap will be allocated proportionally among the plants.[14] However, if most of those reactors were to become eligible for the credit, the credit's effect could be diluted to the point where it would no longer provide a sufficient incentive.

[13]An eligible reactor must be placed into service before 01-01-21.

[14]For example, if 12,000 MW of new nuclear capacity met the application deadline and eventually went into operation, then only half the electrical output of each reactor would receive the tax credit. If license applications by 12-31-08 totaled less than 6,000 MW, then additional reactors would become eligible until the limit is reached.

The credit would most effective if 100% of a reactor's output was eligible; however, if each new nuclear unit receives the credit, then only four or five reactors could be covered within the 6,000 MW limit. Because three reactor designs are currently under consideration, only one or two units of each design would likely be constructed under this scenario. That may not be sufficient to reduce costs sufficiently through series production.

4.2 Regulatory Risk Insurance

Regulatory delay insurance, "Standby Support," covers the costs of replacement power due to licensing delays. The first two new reactors licensed by NRC could be reimbursed up to $500 million each; the next four reactors could receive 50% reimbursement up to $250 million.

The Standby Support program is designed to reduce uncertainty about the Combined Construction Permit and Operating License (COL) process that poses an obstacle to nuclear plant orders. Because the first two reactors face the most uncertainty, they would receive the most coverage. The program anticipates that the the first two reactors will provide sufficient experience for the next four to proceed with half the coverage, and then for additional reactors to be built with no insurance.

4.3 Loan Guarantees

New nuclear plants are eligible for EPACT loan guarantees of up to 80% of a plant's cost.[15]

4.4 Effects of EPACT Incentives on Nuclear Power

The rationale for EPACT incentives is that there are "first mover costs" that inhibit construction of new nuclear plants and prevent nuclear designs from moving down a learning curve. By subsidizing the first 6,000 MW of new capacity, construction costs and regulatory uncertainty will be reduced.

Since EPACT, industry has "announced" intentions to pursue about two-dozen new nuclear plants. The first application for a COL was made in September 2007, but there have been no firm contracts consummated. Additional COL applications are forecast for 2008, and this indicates that it is unlikely that any new nuclear capacity will enter service much before 2015.

A subsidy of $20/Mwh and insurance against regulatory delays are important. However, since the subsidies are available for only the first 6,000 MW of new nuclear capacity, the long term effects will depend on reducing plant construction costs significantly below $2,300/kW ($2006), limiting plant construction time to five years or less, and a carbon tax of at least $25/ton of CO_2.

These conclusions are consistent with EIA's forecasts.[16] The EIA reference case reflects the EPACT subsidies and projects 9,000 MW of new nuclear capacity by 2030,

[15]If a borrower defaults, DOE must pay off the loan and can either take over the project or reach an agreement with the borrower to continue the project. To prevent default, DOE can make loan payments on behalf of the borrower, subject to appropriations and an agreement by the borrower for future reimbursement.

[16]U.S. Energy Information Administration, *AEO 2007*, pp. 82-85.

all built prior to 2020 and which receive the EPACT production tax credit. This indicates that these nuclear subsidies make the plants they apply to economic investments, but that nuclear plant construction costs do not decline enough to make further post-subsidy nuclear plant investment economic.

5. THE NUCLEAR WASTE ISSUE

5.1 Waste Disposal Problems

Radioactive spent fuel produced by nuclear reactors poses a disposal problem that could limit new nuclear plant construction. The Nuclear Waste Policy Act of 1982 commits the federal government to providing for permanent disposal of spent fuel in return for a fee on nuclear power generation. However, the schedule for opening the planned national nuclear waste repository at Yucca Mountain, Nevada, has slipped two decades past NWPA's deadline of 01-01-98. DOE currently hopes to begin receiving waste at Yucca Mountain by 2017.[17] In the meantime, more than 50,000 tons of spent fuel are being stored nuclear facility sites.

NWPA limits the Yucca Mountain repository to the equivalent of 70,000 tons of spent fuel and, since U.S. nuclear power plants discharge an average of 2,000 tons of spent fuel per year, the Yucca Mountain storage limit is likely to be reached before any new reactors come on line. Thus, even if Yucca Mountain eventually begins operating, it could not accommodate the spent fuel from new nuclear power plants, and continued storage at reactor sites and interim storage at central locations may be necessary.[18]

The extent to which the nuclear waste issue could inhibit nuclear power expansion is unclear. NRC contends that onsite storage of spent fuel would be safe for at least 30 years after expiration of a reactor's operating license,[19] and NRC does not consider the lack of a permanent waste site to be an insurmountable obstacle.[20] Seven states have laws that link approval of new nuclear power plants to adequate waste disposal

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[17]U.S. Department of Energy, "DOE Announces Yucca Mountain License Application Schedule," news release, July 19, 2006.

[18]The primary long-term options include lifting the statutory cap on Yucca Mountain disposal, developing additional repositories, and reprocessing spent fuel for reuse of plutonium and uranium. The Bush Administration's Global Nuclear Energy Partnership proposal, unveiled in February 2006, envisions reprocessing as a way to reduce the amount of long-lived plutonium and highly radioactive cesium and strontium that would need to be placed in Yucca Mountain, thereby expanding its disposal capacity.

[19]As a result, the Commission concluded that "adequate regulatory authority is available to require any measures necessary to assure safe storage of the spent fuel until a repository is available."NRC, "Waste Confidence Decision Review," 55 Federal Register 38472, Sept. 18, 1990. The 1990 decision was reaffirmed by NRC on November 30, 1999, and on August 10, 2005 NRC denied a petition to amend the decision.

[20]However, the Bush Administration was concerned enough about repository delays to include a provision in its recent nuclear waste bill to require NRC, when considering nuclear power plant license applications, to assume that sufficient waste disposal capacity will be available in a timely manner; see. "Nuclear Fuel Management and Disposal Act," transmitted to House Speaker Nancy Pelosi and Vice President Richard Cheney March 6, 2007, by Energy Secretary Samuel Bodman.

capacity,[21] although the U.S. Supreme Court has limited state authority here.[22] No nuclear plants have been ordered since the various state restrictions were enacted, so their ability to meet the Supreme Court's criteria has yet to be tested. Finally, the nuclear waste issue has historically been a focal point for public opposition to nuclear power. Proposed new reactors that have no clear path for removing waste from their sites could face intense opposition.[23]

5.2 The Nuclear Fuel Cycle and Nuclear Waste Disposal

The U of C study analyzed the costs of nuclear power generated by the nuclear fuel cycle, and considered two options for spent fuel disposition: On-site storage followed by centralized disposal; and on-site storage and reprocessing followed by centralized disposal.[24] The front-end costs of nuclear fuel are relevant regardless of which alternative is used. As shown in Table 4, these costs amount to $3.50 to $5.50 per MWh, or about 5% to 12% of the cost of nuclear power generation. In the U.S., the direct method of spent fuel disposal has been used, without reprocessing. Disposal costs consist of on-site storage costs plus a charge to pay for eventual permanent storage. The back-end costs are about $1.20 per MWh, as shown in Table 5, which is about 2% of the overall LCOE. Thus, plausible differences in fuel cycle costs are not likely to be a major factor in the economic competitiveness of nuclear power.

Table 4. Components of Front-End Nuclear Fuel Costs, $ per kg U (2006 dollars)

Process Step	Direct Outlays	Interest Cost	Total Cost
Ore Purchase	$242 to $385	$102 to $164	$344 to $548
Conversion	$44 to $102	$16 to $38	$60 to $141
Enrichment (per kg SWU)	$661 to $1,037	$215 to $334	$876 to $1,372
Fabrication	$210 to $273	$215 to $75	$268 to $348
Total		$1,548 to $2,408	
$ per MWh		$3.88 to $5.81	

Source: University of Chicago and Management Information Services, Inc., 2007.

[21]The six states are California, Connecticut, Kansas, Kentucky, New Jersey, West Virginia, and Wisconsin; Wisconsin Legislative Council Staff, "State Statutes Limiting the Construction of Nuclear Power Plants," October 5, 2006.

[22]Steven M. Wiese, "State Regulation of Nuclear Power," CRS Report prepared for the House Committee on Interior and Insular Affairs, December 14, 1992, p. 18.

[23]Nearly 300 environmental groups have reiterated their opposition to construction of new nuclear power plants; see "Nearly 300 Groups Reject Nuclear Energy as a Global Warming Solution," Washington, D.C., Nuclear Information and Resource Service, June 2005. Harvey Wasserman, a leader of the Clamshell Alliance that prevented construction of the Seabrook 2 nuclear plant, has stated that "I do intend to make it as difficult for them as possible. The antinuclear network is very much intact." Whitford, op. cit., p. 49.

[24]University of Chicago, op. cit. The study did not consider recycling of mixed-oxide fuel.

Table 5. Disposal Costs, $ per MWh (2006 dollars)

Fuel Cycle Component	No Reprocessing
Temporary on-site storage	$0.10
Permanent disposal at Yucca Mountain	$1.09
Total	$1.19

Source: University of Chicago and Management Information Services, Inc., 2007.

6. CONCLUSIONS

First, we find that the long term economic future of nuclear energy is uncertain, at best. Despite recent interest in a "nuclear renaissance," objective, rigorous studies have concluded that, at present, new nuclear power plants are not economically competitive with coal or natural gas for electricity generation and will not be for the foreseeable future. Even using the EIA NG price forecasts, coal plants are the cheapest, followed by NG plants, and then nuclear plants. If EIA seriously underestimates future NG prices, as many analysts contend, then nuclear plants may eventually be able to compete with NG plants. However, in this case the cost advantage of coal plants is even more pronounced.

Second, we find that the inability to solve the nuclear waste issue will likely limit new nuclear plant development. Nuclear waste disposal poses a serous, seemingly intractable problem for the future of nuclear power, and the waste issue could be a show stopper for new nuclear plants: Seven states have specific laws that link approval for new nuclear power plants to adequate waste disposal capacity, and other states have a variety of similar restrictions. Further, the waste issue has historically been a flash point for public opposition to nuclear power.

Thus, while some new nuclear power plants will likely be built in the U.S. over the next two decades, a major "nuclear renaissance" is unlikely. EIA's most recent estimate is that about 12 GW of new nuclear plants will be built by 2030, and that by 2030 nuclear energy will be providing only about 15% of U.S. electricity – compared to its current share of about 20%.