ALL RISK, NO REWARD FOR TAXPAYERS AND RATEPAYERS

THE ECONOMICS OF SUBSIDIZING THE 'NUCLEAR RENAISSANCE' WITH LOAN GUARANTEES AND CONSTRUCTION WORK IN PROGRESS

Mark Cooper
Senior Fellow for Economic Analysis
Institute for Energy and the Environment
Vermont Law School

November 2009

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ALL RISK, NO REWARD FOR TAXPAYERS AND RATEPAYERS

THE ECONOMICS OF SUBSIDIZING THE 'NUCLEAR RENAISSANCE' WITH LOAN GUARANTEES AND CONSTRUCTION WORK IN PROGRESS

ISSUE BRIEF

The Nuclear Industry's Demands for Direct Subsidies

As the projected costs of nuclear reactor construction have escalated, demand for electricity has declined as result of the recession, and the cost of alternatives has plummeted, the nuclear industry has recognized that new nuclear reactors are simply uneconomic and impossible to fund in the capital markets. Seeking to override the verdict of the marketplace, the industry's lobbying arm has demanded massive increases in subsidies from taxpayers and ratepayers to underwrite the industry.[1] It demands:

- A huge increase in loan guarantees and new rules that would allow the nuclear industry to gobble up all funds earmarked for clean technologies;
- Elimination of conditions that would protect taxpayers in the event of loan defaults;
- Dramatic increases in tax and insurance subsidies; and
- Accelerated and assured recovery of construction costs from ratepayers authorized by state regulators (via "construction work in progress").

These direct subsidies total to hundreds of billions of dollars, but the stakes for consumers could be much higher. Even with subsidies, the cost of nuclear power would be significantly higher than available alternatives. Nuclear subsidies would induce utilities to forego lower-cost alternatives, imposing excessive costs on consumers that could run into the trillions of dollars. This report explains why capital markets will not underwrite nuclear construction at rates that utilities can afford and why taxpayers and ratepayers will bear a heavy burden if they are forced to subsidize the construction of a new generation of nuclear reactors.

Nuclear Reactors are Uneconomic and Highly Risky

Section II builds the framework for analyzing the risks that new nuclear reactors face, as well as the implications for taxpayers and ratepayers. Section III and Appendix B review the concerns of major bond rating agencies (Moody's and Standard & Poor's) and industry consultants (Towers Perrin and NERA). As summarized in Exhibit ES-1, there are over three dozen specific risk factors that fall into six broad categories – technology, policy, regulatory, execution, marketplace, and financial risk – which have led Moody's to conclude that the decision to build a nuclear reactor is a "bet the farm" decision.[2]

---

[1] National Energy Institute, Legislative Proposal to Help Meet Climate Change Goals by Expanding U.S. Nuclear Energy Production Capacity, October 21, 2009, http://www.nei.org/resourcesandstats/documentlibrary/newplants/policybrief/2009-nuclear-policy-initiative.

[2] Moody's Special Comment, *New Nuclear Generation: Ratings Pressure Increasing*, June 2009.

Table IB-1: The Types of Risks Affecting New Nuclear Reactor Projects

Category	Source	Specific Risks
Technology risk stems from the fact that the new generation of nuclear reactors is new and uncertain. Cost estimates have increased dramatically over the past five years, doubling or tripling. At the same time, costs of efficiency and renewable technologies declining and availability is rising.	New technology risk	First-of-a-kind costs Long lead-time
	Alternative technologies	Efficiency potential identified Renewable cost declines
Policy risk stems from the fact that federal policy is in flux. While nuclear advocates have looked to climate policy, which may put a price tag on carbon emissions, as a primary driver of the opportunity to expand the role of nuclear power, they have failed to take account of the equally strong possibility that climate policy will create a very substantial mandate for conservation and renewables, which will dramatically shrink the need for new, nonrenewable generating, large baseload capacity.	Shifting focus	Emphasis on efficiency reduces need Emphasis on renewables reduces need
	Flexible GHG reductions	Lowers carbon cost
Regulatory risk stems from the chance that regulators will move slowly in approving reactors or authorizing their cost recovery. The new designs have proven challenging, with the reference designs going through numerous revisions. Site-specific issues, which cannot be standardized, have proven contentious. While a few states have approved construction work in progress and other measures to ensure cost recovery, the vast majority has not.	NRC regulatory reviews	Lack of experience Change of requirements Design flaws and revisions Site-specific contentions
	Loan guarantee conditions	Taxpayer protections inhibit guarantees
	Rate review	Recovery of costs challenged

Execution risk stems from the fact that reactors have not been built in the U.S. in decades and the industry does not have a great deal of capacity. Of the 19 projects that have applied for licenses at the Nuclear Regulatory Commission, 17 have suffered from one or more of the following problems: delay, cancellation, cost escalation or financial downgrade.	Construction risk Engineering, procurement and construction contract uncertainties	Lack of experience Counterparty risk Cost escalation and volatility Cost overruns
	Size, cost and complexity	Delays
		Rework costs
Marketplace risk on the demand-side flows from the current recession, the worst since the Great Depression, which has not only resulted in the largest drop in electricity demand since the 1970s, but also appears to have caused a fundamental shift in consumption patterns that will dramatically lower the long-term growth rate of electricity demand. On the supply-side of the market, there are a host of alternatives that have lower cost to meet the need for electricity in a carbon-constrained environment and there is growing confidence in the cost and availability of these alternatives.	Uncertain demand growth	Slowing due to recession Shifting due to debt and loss of wealth
	Uncertain fuel costs	Natural gas price decline
	Reactor costs	Long lead time Cost overruns Rate shock reduces demand
Financial risk stems from all of the above risks and are magnified by tight conditions in money markets and the fact that utility balance sheets are weak and too small to support the large size of nuclear reactor projects. The nature of the projects imposes additional financial risks, so much so that, for most utilities, the projects are so large that Moody's has called them "bet the farm" decisions.	General conditions	Tight money New liquidity requirements High-risk premiums
	Utility finance	Increased nuclear operating exposure Existing debt and need to refinance Financial ratio deterioration Rising cost of debt Limited & declining cash & equivalents Weak balance sheets Underfunded pension plans
	Project finance	High hurdle rate for risky projects Impact of large project Debt load and service burden impact Capital structure distortion

Section IV presents empirical evidence at the national level on these risk factors, while Appendix A presents more detailed evidence from Florida in the context of a regulatory proceeding. The simplest way to capture the essence of the empirical evidence is to note that a recent analysis of nuclear reactor economics, based on a 2009 MIT study that was highly favorable to nuclear reactors, could only arrive at the following, tepid conclusion:

> All things considered, the best economic case supporting a significant expansion in nuclear power capacity involves significant CO2 emissions charges, moderate to high fossil fuel prices (including implicit prices reflecting energy security considerations), declining nuclear plant construction costs, and an efficient licensing regulatory framework.[3]

The empirical analysis of Section IV shows that none of the four conditions that might make the economics of nuclear reactors attractive is present. The absence of those conditions is not a mistake or market failure; it reflects fundamental economic conditions and the risks that nuclear reactors face in the real world.

- CO2 emissions charges are projected to be more modest than originally thought because federal policy is contemplating promoting options that are low-cost approaches to carbon reduction (policy risk).
- Fossil fuel prices have moderated, particularly for natural gas, based on dramatic improvements in technologies to exploit the resource base, and confidence has grown in the ability of efficiency and renewables to meet the needs for electricity at much lower cost than nuclear reactors (technological risk creating marketplace risk).
- Nuclear reactor construction cost estimates have risen substantially (technology risk and execution risk).
- The licensing process has proven challenging, not because the licensing authority is inept, but because the designs are not well-conceived and site-specific issues are substantial (regulatory risk).
- The overwhelming majority of states have refused to subsidize nuclear reactors with ratepayer money and special treatment (regulatory risk).

Subsidies for Nuclear Reactor Construction Harms Taxpayers and Ratepayers

Attempting to circumvent the sound judgment of capital markets, advocates of loan guarantees and construction work in progress claim that they lower the financing costs of nuclear reactors and are good for consumers, but shifting risk does not eliminate it and taxpayers and ratepayer will pay the price.

- Because the subsidy induces the utility to choose an option that is not the least-cost option available, ratepayers will bear a higher burden.

[3] Paul L. Joskow and John E Parons, "The Economic Future of Nuclear Power," *Daedalus,* Fall 2009, p. 58.

- Subsidies induce the utility to undertake risky behaviors that they would not otherwise have engaged in. When those undertakings go bad, the costs of the failures will be born by taxpayers and ratepayers in the form of expenditures on facilities that do not produce a flow of goods and services.
- If the pre-approval process for loan guarantees and/or construction work in progress reduces scrutiny over cost escalation and overruns, ratepayers will end up paying a higher price than anticipated.
- Even with subsidies, these projects are so risky and large that they tend to have adverse impacts on the utility's financial rating, which results in substantial increases in the cost of service.
- For cash-strapped consumers, taking after-tax dollars out of their pockets is a severe burden. If taxpayers and ratepayers have a higher discount rate than the utility rate of return, they would be better off having the present use of their money.

There is a high probability that some or all of these factors will impose high costs on taxpayers and ratepayers (as described in Exhibit ES-2).

Table IB-2: Threats to Taxpayers and Ratepayers

Area of Impact	**Threat to Taxpayers and Ratepayers**	**Likelihood of Impact**
Technology choice	Failure to adopt least cost approach	Certain
Project completion	Burden of failed projects	Highly likely
Project oversight	Lax review of project management	Highly likely
Financial ratings	Downgrade or negative	Near certainty
Discount rate	Misallocation of resources	Certain

The Bottom Line on Nuclear Subsidies

From the societal point of view, the push to subsidize dozens, if not hundreds, of reactors in the next couple of decades is not compelling. While it can be argued that a few of the challenges that nuclear reactors face can be seen as "market failures" that might justify government intervention, most of the obstacles are not market failures; they are a reflection of the market's sound judgment about the nature of the technology and the economic conditions new nuclear reactors. The rejection of new reactors by financial markets is not a case of market failure, it is an example of market success, markets properly assessing risk and acting accordingly by refusing to underwrite unacceptable risks. The existence of numerous lower-cost, lower-risk options to meet the need for electricity[4] in a low-carbon environment

[4] See Mark Cooper, *The Economics of Nuclear Reactors: Renaissance or Relapse?* (Institute for Energy and the Environment, June 2009), Chapters V and VI, for a discussion of the available resources and their cost.

undercuts the claim that nuclear reactors are the solution to the externality problem of climate change.

It is difficult to predict in advance how much larger the burden on taxpayers and ratepayers will be if the construction of new nuclear reactors is subsidized. That will depend on a number of factors:

- Above all, the number that are actually ordered, which is uncertain, with numbers running from 45 to 100 as a near-term goal, and as high as 187 for a long-term goal;
- The cost of those reactors, with estimates still rising;
- The number that will be cancelled or abandoned, with a high probability that the number will be substantial;
- When in the development and construction process the projects are terminated; and
- What the alternatives that could have been pursued, but were not, would have cost.

There are clear indications that the risk is high and that the cost will be substantial.

- The reactor projects are far too large to be a prudent investment for utilities – as much as ten times the size of a reasonable investment should be, which will have an impact on their financial ratings.
- The utilities that have proposed projects are having severe difficulties finding neighboring utilities to partner in the project and share the risk.
- Government agencies that have looked at the risk of the loan guarantees have concluded that half the projects could go bad and half the investment in those projects could be lost.
- The risk premium that industry consultants suggest should be demanded by equity owners that fund these projects is about twice the return on equity utilities usually earn.
- Delays and downgrading of financial ratings have already begun, long before concrete has been poured, which is where the construction and rework problems are most severe.

All of these indicators of risk call to mind the previous effort to build nuclear reactors in the U.S., when

- half of the reactors ordered were cancelled or abandoned;
- those that were completed took, on average, twice as long to build as originally planned and cost twice as much as originally estimated;

- four-fifths of the utilities that undertook nuclear construction suffered large financial downgrades and all suffered substantial financial distress; and
- investments in new reactors resulted in spectacular bankruptcies of both investor-owned and publicly-owned utilities.

The last time the nuclear industry circumvented the judgment of the marketplace, it resulted in what Forbes magazine called the "largest managerial failure in American history."[5] The past could be the prologue. A repetition of that history with taxpayers and ratepayers as the underwriters of nuclear reactors would cost not just hundreds of billions in losses for taxpayers on reactors that are cancelled, but also trillions in excess costs for ratepayers when reactors are brought to completion by utilities that fail to pursue the lower-cost, less-risky options that are available.

This is an avoidable error that policymakers can prevent from happening. If policymakers conclude that there is a market failure in the research, development and demonstration phase of the nuclear industry, loan guarantees should

- not be used to fund deployment of mature, expensive, and risky technologies;
- subject to rigorous fiscal, technology and administrative oversight; and
- structured with maximum taxpayer protections and transparency built into the conditions of the loan guarantees.

States should not shift construction risk to ratepayers, but rather should protect ratepayers from those risks by

- rejecting construction work in progress, or other guarantees for nuclear construction costs;
- demanding binding fixed-cost contracts before construction begins; and
- imposing strong incentive/penalty mechanisms to control cost overruns.

By following these principles, the financing of new nuclear reactors would be left to private capital markets, which are fulfilling their function in assessing risk. It is ironic that at a moment when the nation has suffered mightily from the misallocation of the cost of risk in the financial sector, some of the strongest supporters of free markets and critics of government-sponsored enterprises, would urge another massive federal subsidy intended to circumvent the judgment of the capital markets and put another multi-billion dollar program of federal support onto the backs of the American people as taxpayers and ratepayers.

---

[5] Cook, James, 1986 "Nuclear Follies," *Forbes*, February 11, 1985.

I. Introduction

A. Shifting Risks and Costs to Taxpayers and Ratepayers

On the basis of historical and contemporary data, a recent analysis of *The Economics of Nuclear Reactors*[6] concluded that nuclear reactors are uneconomic, in fact vastly more expensive than a wide range of alternatives that are currently available. Recent studies from the National Research Council[7] and the California Energy Commission[8] support that finding. The National Research Council concluded that unsubsidized power from nuclear reactors is between three and four times as costly as reducing the demand for electricity through investments in energy efficiency. The California Energy Commission identified a dozen supply-side options that produce power that is at least 40 percent lower in cost than the power from nuclear reactors.[9]

As the projected cost of nuclear reactor construction has escalated, demand for electricity has declined as result of the recession, and the cost of alternatives has plummeted, the nuclear industry has recognized that nuclear reactors are simply uneconomic and impossible to fund in the capital markets. Seeking to override the verdict of the marketplace, the industry's lobbying arm has demanded massive increases in subsidies from taxpayers to underwrite the industry.[10] It now demands:

- A huge increase in loan guarantees and new rules that would allow the nuclear industry of gobble up all funds earmarked for clean technologies;
- Elimination of conditions that would protect taxpayer in the event of loan defaults;
- Dramatic increases in tax and insurance subsidies; and
- Accelerated and assured recovery of construction costs from ratepayers authorized by state regulators (through payment for "construction work in progress," pre-approval of expenditures, and guarantee of recovery of costs even if nuclear projects are abandoned).

---

6 Mark Cooper, *The Economics of Nuclear Reactors: Renaissance or Relapse?,* Institute for Energy and the Environment, Vermont Law School, June 2009, http://www.vermontlaw.edu/Documents/Cooper%20Report%20on%20Nuclear%20Economics%20FINAL[1].pdf.

7 National Research Council of the National Academies, *America's Energy Future: Technology and Transformation,* August 2009, http://www.nap.edu/catalog.php?record_id=12710.

8 California Energy Commission Draft Staff Report, *Comparative Costs of California Central Station Electricity Generation*, August 2009, http://www.energy.ca.gov/2009publications/CEC-200-2009-017/CEC-200-2009-017-SD.PDF.

9 CEC*, Comparative Costs*, p. 18.

10 National Energy Institute, *Legislative Proposal to Help Meet Climate Change Goals by Expanding U.S. Nuclear Energy Production Capacity,* October 21, 2009, http://www.nei.org/resourcesandstats/documentlibrary/newplants/policybrief/2009-nuclear-policy-initiative.

These direct subsidies total to hundreds of billions of dollars, but the stakes for consumers could be much higher.[11] Even with the subsidies, the cost of power from nuclear reactors would be significantly higher than other alternatives available. If these incentives induce utilities to forego the lower-cost alternatives, the excessive costs imposed on consumers could run into the trillions of dollars.[12]

As the nuclear industry pressures policymakers at the federal and state levels to force taxpayers and ratepayers to provide financial support for these projects, when Wall Street will not, policymakers need some good investment counseling. This paper provides that advice by combining Wall Street analyses with new data on the risks involved in building nuclear reactors.

B. Outline

The paper is organized as follows.

Section II presents the framework for analyzing risk and the assessment of the risks that new nuclear reactors face, as well as the implications for taxpayers and ratepayers. The other three sections provide the conceptual and empirical basis for the conclusions reached in Section II about the risk of nuclear reactors.

Section III and Appendix B review four recent analyses of nuclear reactors, two from Wall Street ratings firms and two from industry economic and management consultants.

Section IV presents national data on the nature of the risks that nuclear projects currently face. Appendix A presents an excerpt from testimony filed in Florida based on the framework developed in this paper.

[11] The Nuclear Energy Institute uses a figure of 45 new reactors at a cost of $6-8 billion per reactor. Under the Title XVII loan guarantee program, the Department of Energy is authorized to cover up to 80% of the cost. Given the lack of restrictions and efforts to relax the terms for guarantees this program could well exceed $200 billion for new reactor projects.

[12] In the first round of applications for loan guarantees, the nuclear industry flooded the Department of Energy with $122 billion of requests, a total amount that is over six times the current authorization of the program. Given these demands and rising costs of new reactors, a program to build 100 reactors would require over $600 billion of loan guarantees. The figure of 100 reactors has received a great deal of political attention because Senator Lamar Alexander has been advocating for that number to be built over the next two decades (Lamar Alexander, “The Real Reason For Fear,” *Washington Times,* October 9, 2009.)

II. ASSESSING THE ECONOMIC RISK OF NUCLEAR REACTORS

A. THE IMPORTANCE OF PROPERLY ALLOCATING RISK

The recent meltdown of the financial sector is a stark reminder of the important role that the [mis]allocation of risk plays in the economy. Financial institutions made loans that were too risky and created products that were so complex they could not properly evaluate or price their risk, while failing to keep adequate assets on their balance sheets to weather the storm when the loans went into default and the obligations could not be paid.[13] The magnitude of the failure to properly allocate and price risk was so great that the federal government felt compelled to bail the banks out, rather than risk a complete collapse of the banking system. Allowing parties to shift risk in this way and thereby avoid responsibility for it, is considered a "moral hazard" that induces irresponsibly risky behavior. That is exactly what the nuclear industry is trying to do with its campaign to secure loan guarantees and payments for construction work in progress.

Consumers generally receive goods and service when they pay for them. Companies invest in the plants and equipment and pay for the materials and labor necessary to produce the goods and services that they then sell to consumers and recover their investment, as well as the cost of production, in the prices they charge. They raise the funds to start the business and keep it going in capital markets by issuing stock to equity owners and bonds to debt holders. Equity owners are paid a rate of return on their investments, which reflects the risk they take, to induce them to buy stock in the company. The bondholders demand to be paid interest in exchange for lending money to the companies and they have the first claim on the assets of the company, should the company fail. The more risky the investment, the higher the rate of return and interest that is demanded by stockholders and bondholders.

The nuclear industry is seeking to alter this process in two ways. First, it wants the federal government to guarantee the loans they need to build the nuclear reactors. If the government guarantees the loans, then the industry will be able to sell the bond at a lower interest rate, since the chance that the government will not make good on the debt obligation, should the project or the company fail, is small. However, the government guarantee means the Treasury, and therefore taxpayers, are on the hook for the value of the loans should they go bad.

Second, the nuclear industry wants consumers to pay for the reactors before they are producing power – to pay construction work in progress – and provide assurance that all costs will be recovered, even if the reactors never come online. The utilities insist that the construction work in progress charged to ratepayers also include the return on equity that the utilities normally earn by taking the risk of building the plant, even though they have shifted the risk to ratepayers. If the plant is not built or suffers cost overruns, the ratepayers will bear the burden.

---

[13] Mark Cooper and Barbara Roper, *Reform Of Financial Markets: The Collapse of Market Fundamentalism and the First Steps in Revitalizing the Economy,* Consumer Federation of America, March 2009, http://www.consumerfed.org/elements/www.consumerfed.org/File/FinancialMarketReformIssueBrief.pdf.

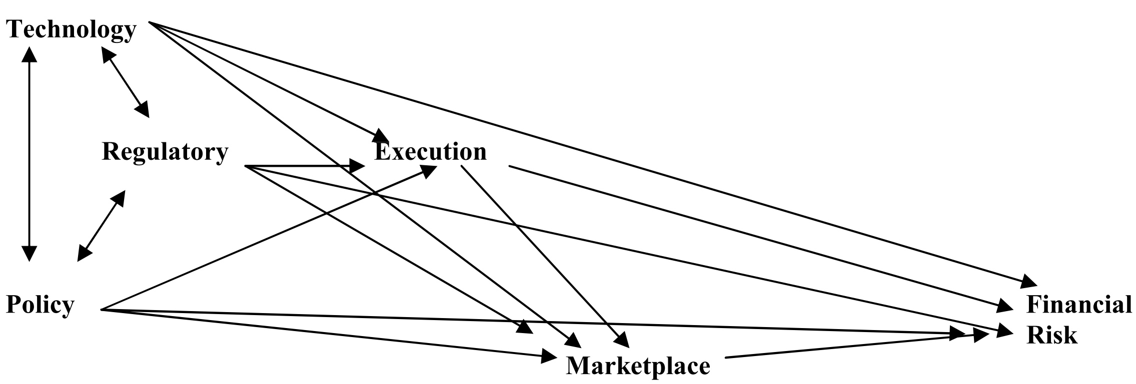
Thus, both of these mechanisms involve the shifting of risk that is normally born by investors and priced in capital markets to others – taxpayers and ratepayers. Therefore, understanding the economic risks that affect nuclear reactors is critical to evaluating the likely impact of forcing taxpayers and ratepayers to subsidize their construction.

B. THE RISK OF NUCLEAR REACTORS IMPOSED ON TAXPAYERS AND RATEPAYERS

The high risk of new nuclear reactors has led Wall Street firms to indicate that it will be difficult, if not impossible, to sell bonds to support these projects in capital markets.[14] Wall Street has also indicated that it will lower the bond ratings of the utilities undertaking these projects.[15] The same factors that have led Wall Street to refuse to finance reactors and to lower the ratings of utilities that are trying to build them are the very reasons that taxpayers and ratepayers may suffer substantial net loses if they are forced to foot the bill for new nuclear reactors.

As shown in Figure II-1, Wall Street and economic analysts identify six basic types of risk that are of concern in the nuclear reactor industry at present: technology risk, policy risk, regulatory risk, marketplace risk, execution risk and financial risk. Technology, policy and regulatory risks tend to be the most basic factors that can affect both the marketplace and the execution risks of the projects. While the risk factors tend to influence one another, they each have distinct causes and consequences. All of the risks feed into the financial risk, which is the ultimate concern of Wall Street analysts in rating the utilities that propose to undertake these projects and industry consultants that advise utilities about investment projects.

Figure II-1: Risks Affecting New Nuclear Reactors



[14] Nicole Gelinas, "Nuclear Power: The Investment Outlook," *Energy Policy & the Environment Report, Manhattan Institute,* No. 1, June 2007, http://www.manhattan-institute.org/html/eper_01.htm:

> So far, Wall Street isn't biting. "The asymmetry of risk is just too large for Wall Street to finance these projects over time horizons that exceed political and economic cycles…. Utilities [are] willing to make this investment, but I don't see [the debt markets] stepping up and funding this program.… The markets aren't going to support it," said one veteran from Wall Street's power-financing industry who came to the discussion. While the financier characterized the 2005 subsidies as "helpful," he said that it's unlikely that the sector will get off the ground without a far more comprehensive "federally based insurance scheme" that, in effect, would eliminate virtually every risk except, perhaps, commercial risk.

[15] See Section IV.

C. THE RISKS FACING NUCLEAR REACTORS

In each of the broad categories of risk, there are a number of specific factors that come into play, bringing the total to about three dozen risks that affect nuclear reactors at present, as described in Table II-1. These are the risks that have led Wall Street to look dimly on funding these projects. These risks are shifted to taxpayers and ratepayers when taxpayers and ratepayers are forced to finance nuclear reactors with loan guarantees and construction work in progress.

Technology risk stems from the fact that the new generation of nuclear reactors are uncertain. Cost estimates have increased dramatically over the past five years, doubling or tripling. At the same time, efficiency and renewable technologies are declining and availability is rising.

Policy risk stems from the fact that federal policy is in flux. It is ironic that nuclear advocates have looked to climate policy, which may put a price tag on carbon emissions, as a primary driver of the opportunity to expand the role of nuclear power, but they have failed to take account of the equally strong possibility that climate policy will create a very substantial mandate for conservation and renewables, which will dramatically shrink the need for new, nonrenewable, large baseload generating capacity. It is not only renewable electricity standards and energy efficiency resource standards that will have this effect, but also building codes, appliance efficiency standards, and increases in funding for weatherization retrofitting of buildings that will have this effect.

Regulatory risk stems from the chance that regulators will move slowly in approving reactors or authorizing their cost recovery. The fact that these are complex designs has made completing them difficult and standardization has proven challenging. Design standardization cannot solve site-specific concerns that arise with these hazardous facilities. The reference designs that were supposed to be the templates to speed the future regulatory approval process have gone through numerous revisions. Site-specific issues, which cannot be standardized, have proven contentious. While a few states have approved construction work in progress and other measures to ensure utility cost recovery, the vast majority has not.

Execution risk stems from the fact that nuclear reactors have not been built in the U.S. in decades and the industry does not have a great deal of capacity. Of the 19 projects that have applied for licenses at the Nuclear Regulatory Commission, 17 have suffered from one or more of the following problems: delay, cancellation, cost escalation or financial downgrade.

Marketplace risk on the demand-side flows from the current recession, the worst since the Great Depression, which has not only resulted in the largest drop in electricity demand since the 1970s, but also appears to have caused a fundamental shift in consumption patterns that will dramatically lower the long-term growth rate of electricity demand. On the supply-side of the market, there are a host of alternatives that have lower cost to meet the need for electricity in a carbon-constrained environment and there is growing confidence in the cost and availability of these alternatives.

Table II-1: The Types of Risks Affecting New Nuclear Reactor Projects

Category	Source	Specific Risks
Technology risk	New technology risk	First-of-a-kind costs Long lead-time
	Alternative technologies	Efficiency potential identified Renewable cost declines
Policy risk	Shifting focus	Emphasis on efficiency reduces need Emphasis on renewables reduces need
	Flexible GHG reductions	Lowers carbon cost
Regulatory risk	NRC regulatory reviews	Lack of experience Change of requirements Design flaws and revisions Site-specific contentions
	Loan guarantee conditions	Taxpayer protections inhibit guarantees
	Rate review	Recovery of costs challenged
Execution risk	Construction risk	Lack of experience Counterparty risk
	Engineering, Production and Construction contract uncertainties	Cost escalation and volatility
	Size, cost and complexity	Cost overruns Delays Rework costs
Marketplace risk	Uncertain demand growth	Slowing due to recession Shifting due to debt and loss of wealth
	Uncertain fuel costs	Natural gas price decline
	Reactor costs	Long lead time Cost overruns Rate shock reduces demand
Financial risk	General conditions	Tight money New liquidity requirements High-risk premiums
	Utility finance	Increased nuclear operating exposure Existing debt and need to refinance Financial ratio deterioration Rising cost of debt Limited & declining cash & equivalents Weak balance sheets Underfunded pension plans
	Project finance	High hurdle rate for risky projects Impact of large project Debt load and service burden impact Capital structure distortion

All of the above risks create a huge **financial risk** for utilities contemplating building reactors. The nature of the projects imposes additional financial risks, so much so that, for most utilities, the projects are so large that Moody's has recently called them "bet the farm" decisions.[16]

The historical experience in the nuclear industry also deserves mention.[17] The industry made similar "bet the farm" decisions in the face of adverse circumstances in the 1970s and 1980s and the results were disastrous for the industry and consumers with half the reactors originally ordered cancelled or abandoned and the remainder suffering severe cost overruns. A combination of risks similar to those we observe today created a financial disaster for utilities and a rate shock for consumers.

D. THE BOTTOM LINE FOR TAXPAYERS AND RATEPAYERS

Nuclear Reactors are High Risk, High Cost Ventures

It is a fundamental principle of investment analysis and regulation of utility decision-making that decisions are constantly evaluated and re-evaluated to ensure that they are prudent and projects are economically viable. The fact that some costs have been sunk in these projects should not matter in the determination of whether to proceed. The project must stand or fall on the merits of going forward costs.[18] It does not make sense to throw good money after bad. Indeed, to date the costs incurred for new reactors are quite small compared to the ultimate costs that will be incurred if construction proceeds.

The Economics of Nuclear Reactors showed that there is no reason to believe the hype about the low-cost, "quick-to-market" claims of nuclear advocates in the early 2000s. As shown in Table II-2, at the height of the "nuclear renaissance" in 2005-2007, when almost two dozen projects seemed to be gaining a head of steam, it took a series of heroic, and entirely unrealistic, assumptions to reach the conclusion that nuclear reactors made economic sense. Most of these assumptions were incorrect when they were made and those that were not incorrect four or five years ago have been undermined by recent developments. Thus, this is the exactly right moment when utilities should cancel or suspend these projects.

---

[16] Moody's Special Comment, *New Nuclear Generation: Ratings Pressure Increasing*, June 2009.

[17] Cooper, *The Economics of Nuclear Reactors,* Chapter IV.

[18] Wikipedia, Sunk Costs: In economics and business decision-making, **sunk costs** are retrospective (past) costs which have already been incurred and cannot be recovered. Sunk costs are sometimes contrasted with prospective costs which are future costs that may be incurred or changed if an action is taken. Both retrospective and prospective costs may be either fixed (that is, they are not dependent on the volume of economic activity, however measured) or variable (dependent on volume). In traditional microeconomic theory, only prospective (future) costs are relevant to an investment decision. Traditional economics proposes that an economic actor does not let sunk costs influence one's decisions, because doing so would not be rationally assessing a decision exclusively on its own merits.

Table II-2: Unrealistic Assumptions Masking the Real Economics of Nuclear Reactors

Technology:

- **Assumption:** New nuclear reactors are economically competitive. The cost characteristics of alternatives are not relevant. The contribution that alternatives (efficiency and renewables in particular) can make to meet the need for electricity is insufficient.
- **Reality:** Nuclear costs are much higher than originally claimed and remain highly uncertain. There is growing confidence in the cost and availability of alternatives that makes them more attractive.

Policy:

- **Assumption:** Public policy would put a high price on carbon and escalate the demand for nuclear because alternatives (especially efficiency and renewables) would not be sufficiently promoted by public policy.
- **Reality:** Efficiency/renewable standards are likely to play a large part in climate policy. This makes alternatives more attractive. Reliance on efficiency, international offsets, and other policies that provide flexibility in meeting greenhouse gas abatement goals lowers the cost of carbon.

Regulatory:

- **Assumption:** The standardized designs would lead to rapid approval of licenses and work authorizations. Loan guarantees would flow with little scrutiny or oversight.
- **Reality:** The standard designs have proven to be complicated. Site-specific issues cannot be standardized and they remain the object of licensing contentions. Efforts to protect taxpayers and ratepayers from the risk of subsidies has slowed the flow of funds.

Execution:

- **Assumption:** Standardized design and accelerated licensing would enable utilities to quickly move into the construction phase. The low cost estimates for reactors would lead to rapid regulatory approval and support at the state level.
- **Reality:** The proposed new designs are complicated. Licensing proceedings remain contentious. Approval of loan guarantees has required more time and information than anticipated. Technological uncertainty raises prospects of cost overruns. First-of-a-kind costs and lack of 1-2 standard designs raises construction risk. Construction has not begun in the U.S., while projects abroad have encountered serious delays and cost overruns. Operating risks of new designs are unknown and foreign experience does not resolve these concerns.

Marketplace:

- **Assumption:** Demand growth and commodity prices for fossil fuels would remain high.
- **Reality:** Declining demand as a result of the "Great Recession" reduces the need for a large quantity of new generation. Falling price of natural gas makes it more attractive. Growing confidence in lower-cost alternatives makes them more attractive.

Finance

- **Assumption:** Financing would be readily available.
- **Reality:** Tight financial markets make financing more difficult generally. The large size of the project relative to the balance sheets of utilities and the increasing concern about delays and cost overruns makes capital market financing more expensive and difficult, if not impossible.

Subsidies Will Impose Severe Financial Harm on Taxpayers and Ratepayers

Advocates of loan guarantees and construction work in progress claim that these subsidies lower the financing costs of nuclear reactors and are good for consumers, but in fact, what they do is shift the risk from shareholders to taxpayers and ratepayers. The risk is not lowered or eliminated. Any benefits from lowering of financing costs are swamped by the costs imposed by shifting risk, as discussed below.

Wall Street responds to risk by raising interest charges or simply refusing to float loans, but when taxpayer and ratepayer money is used by policymakers to subsidize these projects; they are not given this option. The simplistic claim that ratepayers will be better off, if they fund these projects ignores the real-world risks of these projects. Consumers will not be better off if any of a variety of conditions holds.

First, if the subsidy induces the utility to choose an option that is not the least-cost option available, ratepayers will bear the burden. If nuclear reactors are not the least-cost choice to begin with, the accounting treatment can only lower the net losses that choosing the wrong option imposes on consumers. In other words, the correct comparison is not between nuclear reactors with and without subsidies; it is between the least-cost option with subsidies and the nuclear reactor with subsidies (or both options without subsidies). Dozens of studies make it clear that nuclear reactors are far from the least-cost option, even with subsidies, so the bottom line for taxpayers and ratepayers is negative.

Second, if the taxpayer/ratepayer subsidy induces the utility to undertake risky behaviors that they would not have engaged in, but for the subsidy, and those undertakings go bad, the costs of the failures will be born by taxpayers and ratepayers in the form of expenditures that do not produce a flow of goods and services. Beating the odds on high-risk behavior is unlikely and it is taxpayers and ratepayers who bear the burden if projects subsidized with public money fail.[19] Historical experience of failed nuclear projects was very bad and current projects seem to be repeating that pattern with many running into substantial troubles.

Third, if the subsidy approval process reduces scrutiny of cost escalation and overruns, ratepayers will end up paying a higher price than anticipated. These highly complex projects are prone to delay, but their high price tag induces utilities to low ball the initial estimates and claim that they did the best they could to manage the project. Knowing this, utilities are adamantly opposed to price caps or incentive mechanisms that control costs.

Fourth, the analysis must make some heroic and unlikely financial assumptions regarding utilities and consumers for the accounting treatment to result in net gains for consumers. Projects with the subsidies must not have an adverse impact on the utility's financial rating. If the subsidy induces utilities to undertake projects they would not

[19] U.S. Government Accountability Office (GAO), *New loan guarantee program should complete activities necessary for effective and accountable program management.*(Washington, D.C.: 2008); Congressional Budget Office, U.S. Congress, *Cost Estimates: S. 14, Energy Policy Act of 200* (Washington, D.C., 2003).

otherwise have attempted and the utility suffers a rating downgrade by Wall Street as a result of pursuing high-risk ventures, the total cost of electricity will increase by much more than the accounting savings that resulted from the subsidy. Moody's analysis of the nuclear construction boom of the 1970s and 1980s shows that five-sixths of the utilities it rated suffered financial downgrades.[20] The downgrading of utilities proposing new reactors has already begun, long before concrete has even begun to be poured, which is where the execution risk becomes most severe.

Fifth, the financial analysis must assume that taxpayers and ratepayers have nothing better to do with their money than make interest-free loans to utilities to construct reactors. If taxpayers and ratepayers have a higher discount rate than the utility rate of return, they would be better off having the present use of their money. For cash strapped consumers, taking after-tax dollars out of their pockets is a severe burden. Estimates of the discount rate on efficiency investment, for example, run two to three times as high as the utility cost of capital.[21] This is a misallocation of capital that makes consumers worse off.

Because the nuclear projects cannot meet very stringent underlying economic and financial conditions, the claim of consumer benefit is incorrect, as suggested by Table II-3.

Table II-3: Threats to Taxpayers and Ratepayers

Area of Impact	Threat to Taxpayers and Ratepayers	Likelihood of Impact
Technology choice	Failure to adopt least cost approach	Certain
Project completion	Burden of failed projects	Highly likely
Project oversight	Lax review of project management	Highly likely
Financial ratings	Downgrade or negative	Near certainty
Discount rate	Misallocation of resources	Certain

A careful analysis of the risks and challenges facing nuclear reactors makes it abundantly clear why utilities simply cannot fund these projects through capital markets. Without loan guarantees and guaranteed recovery of construction work in progress, these reactors simply will not be built. However, the six inherent risks of new reactors cannot be solved through loan guarantees or construction work in progress; these would only shift the risks from investors to taxpayers and ratepayers. If taxpayer and ratepayer funds are commandeered by policymakers to subsidize new nuclear reactors, it is a virtual certainty that they will suffer severe economic harm.

[20] Moody's Special Comment, *New Nuclear Generation: Ratings Pressure Increasing*, June 2009.

[21] Nick Wilkinson, *An Introduction to Behavioral Economics,* New York: Palgrave 2008, Table 5.1 shows an average discount rate for over two dozen studies of over 75 percent. Raymond S. Hartman and Michael J. Doane, "Household Discount Rates Revisited," *The Energy Journal,* 7:1, 1986, find discount rates for efficiency investment among lower income households of 85 percent and for lower income elderly households of 150 percent.

Environmental Externality Arguments Do Not Justify the Subsidies

From the societal point of view, the arguments to subsidize new reactors in the next couple of decades are not compelling. Nuclear advocates turn to environmental externality concerns as a justification to override the judgment of the capital markets. With a large number of alternatives available to meet the electricity and greenhouse gas reduction needs of the nation at a much lower cost, this argument fails as well. Putting a thumb on the scale to favor nuclear reactors with large subsidies will distort the choice of technology and dramatically raise the cost of meeting the need for electricity in a carbon-constrained environment. It will cost a lot more to buy the reductions in greenhouse gases that society "needs" making it less likely that the policy will be sustained and the goals achieved.

While it can be argued that a few of the challenges that nuclear reactors face can be seen as "market failures" that might justify government intervention, most of the obstacles are not market failures; they are a reflection of market's sound judgment about the nature of the technology and the economic conditions new facing nuclear reactors. The rejection of nuclear reactors by financial markets is not a case of market failure. Rather, it is an example of market success: markets properly assessing risk and acting accordingly by refusing to underwrite unacceptable risks.

E. CONCLUSION

A recent analysis of nuclear reactor economics, based on a 2009 MIT study that was highly favorable to nuclear reactors in a number of ways and openly sought to promote nuclear power, could only arrive at the following, tepid conclusion.

> All things considered, the best economic case supporting a significant expansion in nuclear power capacity involves significant CO_2 emissions charges, moderate to high fossil fuel prices (including implicit prices reflecting energy security considerations), declining nuclear plant construction costs, and an efficient licensing regulatory framework.[22]

As this analysis and *The Economics of Nuclear Reactors* show, none of the four conditions that might make the economics of nuclear reactors attractive is present. The absence of those conditions is not a mistake or market failure; it reflects fundamental economic conditions and the risks that nuclear reactors face in the real world:

- CO_2 emissions charges are projected to be more modest than originally thought because federal policy is contemplating promoting options that are low-cost approaches to carbon reduction (policy risk).

- Fossil fuel prices have moderated, particularly for natural gas, based on dramatic improvements in technologies to exploit the resource base, not to mention growing confidence in efficiency and renewables to meet the needs for electricity at much lower cost than nuclear reactors (technological risk creating marketplace risk).

[22] Paul L. Joskow and John E Parons, "The Economic Future of Nuclear Power," *Daedalus,* Fall 2009, p. 58.

- Nuclear reactor construction costs estimates have risen substantially (technology risk and execution risk).

- The licensing process has proven challenging, not because the licensing authority is inept, but because the designs are not well-conceived and site-specific issues are substantial (regulatory risk).

- The overwhelming majority of states have refused to subsidize nuclear reactors with ratepayer money and special treatment (regulatory risk).

Simply put, the best case scenario has no chance of coming to pass. New nuclear reactors are the worst case for taxpayers and ratepayers if they are forced to subsidize the construction of a new generation of nuclear reactors with loan guarantees and construction work in progress. The last time the nuclear industry circumvented the judgment of the marketplace, it resulted in what Forbes magazine called the "largest managerial disaster in business history."[23] This is a mistake that can be avoided by not forcing taxpayers and ratepayer to subsidize the nuclear renaissance.

[23] Cook, James, 1986 "Nuclear Follies," *Forbes*, February 11, 1985.

III. The Risk of Nuclear Reactors in the Eyes of Industry Analysts

The following discussion demonstrates the basis of the framework for risk analysis laid out in the previous section by reviewing recent analyses of the challenge of constructing new nuclear reactors conducted by Wall Street firms[24] and industry consultants.[25]

A. Moody's

Moody's has issued two special comments on new nuclear generating capacity that underscore the challenges that these huge projects face. In the initial comment in May 2008, after discussing the many challenges to building nuclear reactors, Moody's expressed the hope that utilities contemplating building reactors would take steps to prepare their balance sheets for the impact of these large projects.

> Given these long-term risks, a utility's approach to its overall corporate finance policies becomes a critical factor in the overall credit profile assessment during the construction period. In general, Moody's incorporates a view that a utility company would prepare for the higher risk profile associated with construction by maintaining, or strengthening further, its strong balance sheet as well as maintaining robust levels of available liquidity capacity. This is a critical assumption since our preliminary analysis leads us to conclude that financial credit metrics will deteriorate meaningfully without the introduction of significant mitigating factors and/or other structural provisions.[26]

A year later, in June 2009, Moody's took a much dimmer view of the prospects for building nuclear reactors. While Moody's identifies the developments in the project and regulatory areas that are positives for nuclear reactor construction, it still concludes that the negatives are a great concern and declares that it "is considering taking a more negative view for those issuers seeking to build new nuclear power plants"[27] because "we view nuclear generation plans as a "bet the farm" endeavor for most companies, due to the size of the investment and length of time needed to build a nuclear power facility."[28] The change in

---

[24] Moody's *Nuclear Generating Capacity: Potential Credit Implications for U.S. Investor Owned Utilities,* May 2008; Moody's June 2009; Dimitri Mikas, "Financing New Nuclear Construction & Implications for Credit Quality," *Is there a Nuclear Renaissance,* p. 20; Standard & Poor's, May 28, 2009; Standard & Poor's, *Utilities Make Some Progress on New Nuclear Power, But Hurdles Still Linger,* March 9, 2009; Standard & Poor's, *For New U.S. Nuclear Power Plants, Liquidity Requirement Could be Substantial,* October 21, 2008; Standard & Poor's, *As Nuclear Power Renaissance Gains a Foothold in U.S., A Host of Details Needs Sorting Out,* March 7, 2008.

[25] Stephen Maloney, *Financial Issues Confronting Nuclear Construction,* Carnegie Endowment for International Peace, November 13, 2008; Stephen Maloney, *Nuclear Power Economics and Risk*, Council on Foreign Relations, July 10, 2009; Edward Kee, *First Wave or Second Wave? It is time for US nuclear power plant projects with a first wave build strategy to consider moving to the second wave,* NERA, July 24, 2009.

[26] Moody's, May 2008, p. 3.

[27] Moody's, June 2009, p. 1.

[28] Moody's, June 2009, p. 4.

attitude stemmed in part from deteriorating financial market conditions and the failure of the utilities contemplating building reactors to strengthen their financial positions.

> Credit conditions are yet another question. Few, if any of the issuers aspiring to build new nuclear power have meaningfully strengthened their balance sheets, and for several companies, key financial credit ratios have actually declined. Moreover, recent broad market turmoil calls into question whether new liquidity is even available to support such capital-intensive projects.[29]

In both documents, Moody's identifies the cause and implications of these risks. The May 2008 document identified several sources of risk. The financial risks of the project are sharply increased by the execution risk, which is compounded by technology, marketplace and regulatory risks.

> The complexity and long-term construction horizon associated with building new nuclear plant expose a utility to "material adverse change" conditions related to political, regulatory, economic and commodity price environments, as well as technology developments associated with supply and demand alternatives. These long-term risks expose a utility to back-end regulatory disallowance risk or other potential market intervention or restructuring initiatives by elected officials.[30]

The June 2009 Moody's document reiterated these concerns.[31] The inherent nature of these projects continues to be a challenge and creates marketplace and technological risk. Notwithstanding the fact that public policy has created favorable conditions for reactor construction in some aspects of regulation, there are other aspects that pose continued risk in both execution risk and regulatory risk.[32] Policy risk has increased due to the orientation of climate change policy toward promoting alternatives.

> Less clear today is the effect that energy efficiency programs and national renewable standards might have on the demand for new nuclear generation. National energy policy has also begun eyeing lower carbon emissions as a key desire for energy production—theoretically a huge benefit for new nuclear generation—but the price tags associated with these development efforts are daunting, especially in light of today's economic turmoil. It isn't clear what

---

[29] Moody's June 2009, p. 2.
[30] Moody's May 2008, p. 5.
[31] Moody's June 2009, p. 5.
[32] Moody's June 2009, p. 7.

> The sheer size, cost and complexity of new nuclear construction projects will increase a utility's or power company's business and operating risk profile, leading to downward rating pressure. The length of a nuclear construction effort also entails lengthy regulatory reviews and potential delays in recovering investments, changing market conditions, shifting political and policy agendas, and technological developments on both the supply and demand side.

> effect such shifts, or changes in technology, will have for new nuclear power facilities.[33]

Moody's continues to see execution risk in these projects and points to the history of the financial difficulties that utilities building reactors had in the 1970s and 1980s as instructive for evaluating current projects.

> Moody's is considering applying a more negative view for issuers that are actively pursuing new nuclear generation. History gives us reason to be concerned about possible significant balance-sheet challenges, the lack of tangible efforts today to defend the existing ratings, and the substantial execution risk involved in building new nuclear power facilities.[34]

One of the sources of this concern about the execution risk is the failure of those proposing to build new reactors to provide the detailed information that would be associated with a well-thought out investment of this size.

> We remain concerned over the absence of details regarding key elements associated with the decision process to proceed with a project of this scale. Information is needed regarding the all-in construction costs and break-down of those costs; the construction timeline and schedule; the Engineering, Procurement and Construction (EPC) contractual arrangements and the allocation of fixed versus variable costs within those arrangements; the financing structure, expected sources of financing and pro-forma capitalization; and, the ultimate impact on consumer rates.[35]

The result of these market, regulatory and technological uncertainties and risks is to create financial pressure on projects, pressures that are reflected by project specific concerns and the general turmoil in the credit markets.

> Given these long-term risks, a company's financial policy becomes especially critical to its overall credit profile during construction. In general, we believe a company should prepare for the higher risk associated with construction by maintaining, if not strengthening, its balance sheet, and by maintaining robust levels of available liquidity capacity.[36]

---

[33] Moody's June 2009, p. 2.

> While a constructive regulatory relationship will help mitigate near-term credit pressures, we will remain on guard for potential construction delays and cost overruns that could lead to future rate shock and/or disallowances of cost recovery. Given the lengthy construction time needed for nuclear projects, there is no guarantee that tomorrow's regulatory, political, or fuel environments will be as supportive to nuclear power as today's.

[34] Moody's June 2009, p. 2.
[35] Moody's May 2008, p. 2.
[36] Moody's June 2009, p. 5.

B. STANDARD & POOR'S

Moody's is not the only credit rating agency to recognize the challenges facing nuclear reactors. Even at a promotional conference, a Standard & Poor's executive noted that "challenges for the industry participants abound."[37] While recognizing that there are positive aspects of the current environment, as Moody's did, Standard & Poor's identifies more aspects of the current situation that are negative. Interestingly, even with a loan guarantee, Standard & Poor's sees significant financial issues as described in Figure III-1.

Figure III-1: Standard & Poor's Credit Profile Considerations

Business risk profile	
New Technology Risk	↑
Construction Risk	↑
How much risk is mitigated by EPC contract?	↑↓
Nuclear operating exposure will increase	↑
Regulatory framework for recovery of investment	↑
Financial risk Profile	
Debt imputation: 25% for projects vs. 50% for regulated utilities	↑
Even with DOE guarantee, debt loads can increase significantly	↑
80/20 vs. 60/40 capital structure	↑
Despite DOE guarantee, debt service will be fully accounted for	↑
Ability to recover cash return on work in progress	↓

Source: Dimitri Mikas, "Financing New Nuclear Construction & Implications for Credit Quality," *Is there a Nuclear Renaissance,* p. 20, Standard & Poor's, May 28, 2009. Arrows point in the direction of the impact on risk.

Standard & Poor's remains more positive on nuclear reactors than Moody's, although it is quite clear that the subsidies from taxpayers and ratepayers are the key to the financing of these projects. In a March 2009 analysis entitled *Utilities Make Some Progress on New Nuclear Power, But Hurdles Still Linger,* the table of contents tells the story:

Support for New Construction Varies from State to State

The Licensing Process and Framework Remain Untested

[37] Dimitri Mikas, "Financing New Nuclear Construction & Implications for Credit Quality," *Is there a Nuclear Renaissance,* p. 20, Standard & Poor's, May 28, 2009.

The DOE's Loan Guarantees Figure in Several Financing Approaches

For Credit Risk, Balance-Sheet Size is Important

Recession and Falling Energy Prices Can Alter Perspectives

The Need for Construction Contracts that Can Help Limit Exposure[38]

This list includes two positive factors, which relate to the taxpayer (Department of Energy loan guarantees) and ratepayer (construction work in progress) funding of the reactors. Four of the six factors listed are sources of concern: regulatory risk (uncertain licensing), financial risk (credit and balance sheet), marketplace risk (recession and energy prices) and execution risk (construction contracts).

Standard & Poor's points out that the approach taken to support projects in the southeastern U.S. goes well beyond turning ratepayers into investors; it takes all of the risk off of the utilities by

- Allowing utilities to receive pre-approval for construction costs and schedules;
- Providing for periodic review to ensure compliance with schedules and budgets;
- Allowing for recovery of a cash return on "construction work in progress" costs for both equity and debt components;
- Preventing future regulatory commissions from reviewing the prudence of previously approved capital spending; and
- Allowing for recovery of abandoned investment and providing for inclusion of the completed plant in the "rate base" (the value of property on which a utility can earn a regulatory-specified rate of return) without a major rate case filing with the regulator.[39]

Ironically, the efforts of the Department of Energy (DOE) to impose conditions on guaranteed loans that would help to mitigate the risk to the Treasury and protect the taxpayer in the event of defaults on the loan – i.e. a first lien for the Treasury and cross collateralization – are seen as creating "complications" and "challenges" for the financing of nuclear projects. That these conditions were imposed by the Bush administration, which had been very supportive of and helped to invent the term "nuclear renaissance," and the fact that the nuclear industry has lobbied hard to eliminate them underscore the risk that the loan guarantee program poses to taxpayers.

> From a purely technical perspective, the loan guarantee program would work naturally with a transaction that is project-financed in the traditional sense. In such a case, if the project falters, the sponsor can walk away and lose its

[38] Standard & Poor's, Hurdles Remain, p. 1.
[39] Standard & Poor's, Hurdles Remain, pp. 2-3.

equity, while the DOE takes control of the project assets and makes the lenders whole. Because of the DOE's requirement to have a priority lien over the project assets, regulated electric utilities applying under the program that lack a first mortgage bond indenture can facilitate a loan guarantee request, while the existence of a first mortgage bond indenture can introduce complications. Therefore, regulated utilities with first mortgage bond indentures will likely have to implement funding structures that satisfy the DOE's need while at the same time preserving compliance with their mortgage indentures.

Another challenge that has come up for companies pursuing new construction through a partnership arrangement under the DOE's program deals with the issue of how the department requires all participants to cross-collateralize each other's obligations. This essentially creates a situation where the project participants are jointly and severally liable. This arrangement differs from past projects that incorporated an undivided interest approach in which each participant was responsible only for its own portion of the project.[40]

The large size of the reactors figures into the loan guarantees. Utilities are attempting to find approaches that can fit into the loan guarantee program that let them share the reactors.

The traditional framework in which regulated utilities use on-balance-sheet financing to build generation plants while merchant generation companies use a project finance approach still holds largely true. However, companies are experimenting with various structures, including partnerships, and they are trying to take advantage of the DOE's loan guarantee program, whether they are regulated or merchant. Partnerships can be very appealing because they not only moderate or spread the construction and financing risk, but they can also help tailor an investment's size to a company's projected load in the time frame in which the plant will enter commercial operation. The loan guarantee program appeals to all participants – whether regulated or merchant, public or investor owned – because it can lower borrowing costs.[41]

These highly technical financial discussions can be boiled down to a simple proposition. With the guaranteed loans equal to as much as 80 percent of the value of very risky projects, the DOE imposes two conditions on the loans that help to protect the taxpayer's investment should the project falter. The DOE holds the first lien and all of the partners are liable for the entire project. Private sector lenders also want the first lien, which creates a conflict. The nuclear industry is pressing hard to eliminate these taxpayer protections.

The problem that the large size of these projects poses to their financing is a major component of the Standard & Poor's analysis.

[40] Standard & Poor's, Hurdles Remain, pp. 4-5.
[41] Standard & Poor's, Hurdles Remain, p. 3.

> Given the new plant's large projected cost, how big the companies' balance sheets are can be a significant factor in terms of how much credit risk we recognize. A new project that materially affects a company's size can introduce significantly more risk and necessitate that every other aspect of the company's business perform flawlessly to provide the necessary support to its credit profile, especially during the period when capital spending peaks and the financial profile becomes stressed. For a company whose nuclear project investment is small compared with its balance sheet, these same concerns apply but, in our view, are moderated to some extent. Balance-sheet size is also an important consideration in adjusting rates during the construction period (assuming regulators allow the company to get a cash return on its construction work in progress during construction), as well as in the final rate adjustment necessary to include the plant in rate base.
>
> Finally, balance–sheet size relative to the size of the investment in the nuclear project can become an important factor if the company needs to abandon the project. While many regulated jurisdictions provide for recovery of the prudently incurred investment, the time for recovery of the investment remains fairly open. Thus for a company with a small asset base, recovering its abandoned investment in a nuclear plant over a long period of time can adversely affects it financial risk profile.[42]

The Standard & Poor's analyst pointed out that "even with DOE guarantee debt loads can increase significantly."[43] The Standard and Poor's analysis provided estimates of the balance-sheet impact for three companies, showing that the nuclear project equaled 28 percent of total assets for Georgia Power, 76 percent for South Carolina Gas and Electric and 146 percent of Progress Energy.[44] Interestingly, Moody's has downgraded South Carolina Electric and Gas and issued negative advice on the Southern Company, the parent of Georgia Power.[45]

C. CONSULTING FIRMS

A November 2008 presentation by an analyst at Towers Perrin provided an early warning about the risk of nuclear reactor projects in the emerging economic environment.[46] An updated version of that analysis from July 2009 reinforces the initial observations.[47] The two areas where the analyst was well ahead of the curve in raising concerns were in the recognition of marketplace and financial risk.

The slowing of load growth and the decline of the cost of alternatives, particularly natural gas, were identified as undermining the case for nuclear reactor projects. The decline

---

[42] Standard & Poor's, Hurdles Remain, p. 4.
[43] Mikas, *Financing*, p. 20.
[44] Standard & Poor's, Hurdles Remain, p. 5.
[45] Moody's, *Changes Outlook of Southern and Three Subs to Negative*, September 1, 2009.
[46] Stephen Maloney, *Financial Issues Confronting Nuclear Construction,* Carnegie Endowment for International Peace, November 13, 2008.
[47] Stephen Maloney, *Nuclear Power Economics and Risk*, Council on Foreign Relations, July 10, 2009.

in demand reduces the need for new reactors. "With falling demand for power, current market conditions generally provide no compelling need or reason for many utilities to immediately take on any more risk than they already face…. The recession is showing no signs of the Government-promised abatement or any response to "stimulus" – demand is low."[48] Weakened balance sheets resulting from declining sales reduce the ability of the utilities to undertake large projects. "In fact, utilities have very significant balance sheet and liquidity challenges in this market with no immediate or obvious resolution…. Therefore, many utilities have no basis [at this time] to count on organic growth to strengthen cash flows, balance sheets, or [offset] pension losses."[49]

The analysis identifies two forms of regulatory risk – uncertainty about project approval by an inexperienced, understaffed Nuclear Regulatory Commission and uncertainties about the allowance of cost recovery by state regulators. Specifically, the untested Combined Construction and Operation License process does not address issues not submitted for review, nor does it preclude subsequent ratchets arising from rulemakings. The gap from the former leaves open restatement of standards applied to such things as field engineering, which typically represent more than half of the overrun potential in any project.

Even with set regulatory requirements, projects face a host of execution risk problems, including the lack of current utility experience constructing reactors, the ability of management to oversee these projects, and the likelihood of the need to rework projects. Particularly notable here is the concern about the vendors and contracts to which many turn to look for help to reduce risk exposure.

The Towers Perrin analysis devotes the greatest attention to the worsening financial conditions, both in the broader financial market in general and for the utility sector in particular. Tightening credit and high-risk premiums, as well as federal credit policies are seen as raising the cost of long-term capital. At the same time, market dynamics lower the market capitalization of utilities, limiting their ability to invest. The balance sheets of utilities are weak and becoming weaker, a trend that caused Moody's to change its view in 2009. The analysis offers "some energy sector planning thumb rules":

- Always hedge your risk within your risk capital limits.
- Don't invest in projects claiming more than 10% of your assets.
- Risky issues call for higher returns… indicated returns for nuclear projects should be ~ 18-25% or more.[50]
- Uncertainty (i.e., risk) in initial estimates will grow over the course of a project at rates proportional to the square root of time.
- Since DCF [discounted cash flow] systematically underestimates compound risk and new construction faces significant irreversibilities,

[48] Maloney, *Economics and Risk*, 2009, pp. 4-5.
[49] Maloney, *Economics and Risk*, 2009, pp. 4-5.
[50] Maloney, *Economics and Risk*, 2009, p. 10.

> never base a risky or uncertain project's success solely on the NPV [net present value] or a DCF calculation.[51]

The analysis focuses on the situation in which construction work in progress is not available and concludes that the long construction period creates a heavy burden on the financial risk profile of the utility. Finally, the analysis expressed concern about federal loan guarantees. It argues that the federal government is not a reliable counterparty and that credit conditions should raise concern about its ability to perform as counterparty.

> Federal loan "guarantees" are risky. Remember: the Federal Government is not a reliable business partner. It is a serial breacher of agreements and its policies systematically fail to perform to forecast while always costing more than promised.
>
> If a utility proceeds with the Federal Government as a guarantor, it would be prudent and responsible to apply risk management protocols normally reserved for high-risk counterparties.[52]
>
> Bottom line: Federal Government has proven itself an unreliable counterparty:
>
> - Policies systematically fail to fulfill promises or hit their forecasts,
> - A serial breacher of agreements,
> - Paper thin Balance Sheets: Federal Government and FRB [Federal Reserve Board] both fail to meet IMF standards,
> - Bond auctions show diminishing enthusiasm for more UST [U.S. Treasury] paper,
> - Growing international sentiment to diversify off USD [U.S. Dollar] as reserve currency,
> - Market concerns over UST "credit card balance."[53]

The weight of these risks and uncertainties led a Vice President of NERA Economic Consulting, a leading utility consulting firm, to recommend that utilities consider pushing off the decision to build nuclear reactors because

> a first-wave project may face higher risks and costs, including scarce nuclear industry resources; uncertainties about carbon control and electricity demand; organized anti-nuclear efforts; some degree of first-of-a-kind (FOAK) risks and higher costs; and difficult markets for nuclear financing and funding.[54]

Appendix B summarizes the reasons given in the NERA analysis, organized according to the framework used in this analysis. Those concerns parallel the discussion in this section.

---

[51] Maloney, *Economics and Risk*, 2009, pp. 10-11, 12, 24.
[52] Maloney, Economics and Risk, pp. 5, 23.
[53] Maloney, Economics and Risk, p. 5… 23.
[54] Kee, p. 2.

IV. EMPIRICAL EVIDENCE OF THE INCREASING RISK OF NUCLEAR REACTORS AT THE NATIONAL LEVEL

This section briefly reviews empirical evidence at the national level underlying the pattern of risks associated with new nuclear reactors. It emphasizes the dramatic increase in risk that has occurred in recent years and new evidence since the publication of *The Economics of Nuclear Reactors.*

A. TECHNOLOGY RISK

The lower-cost, low-carbon technologies available today and the cost trajectory of several others indicate that the combination of efficiency and renewable technologies can meet the need for electricity while hitting the aggressive carbon reduction targets contained in the House climate bill (American Clean Energy and Security Act of 2009, H.R. 2454) for over a quarter of a century.[55]

Figure IV-1 shows the range of estimates of costs, including recently updated analyses from the California Energy Commission and Lazard, in addition to the National Research Council estimates. It shows the average of the eight studies cited, as well as the high and low estimates. It includes only studies that examined both traditional sources of generation (e.g. nuclear, coal and natural gas) and at least one alternative option (efficiency or a renewable option). Two characteristics of this analysis stand out. First, there are numerous alternatives that are lower in cost than nuclear power. Second, the spread of estimates for the lower cost technologies is smaller.

A recent study from the National Research Council estimates that nuclear reactors without subsidies cost three or four times as much as efficiency.[56] The most recent cost analysis by the California Energy Commission finds fifteen supply-side options to be less costly than nuclear, a dozen of which have costs that are 40 percent below nuclear costs.[57]

Price is only half of the technology story. Quantity is the other half. *The Economics of Nuclear Reactors* concluded that efficiency and low-cost renewables, if fully exploited, would be adequate to meet the 2030 targets for carbon reductions contained in the climate legislation passed by the House. Exhibit IV-2 shows three estimates of the potential contribution of efficiency and renewables to meeting the need for electricity in 2030. The exhibit shows the strong similarities between estimates presented in *The Economics of Nuclear Reactors* and the recent analysis presented by the National Research Council.

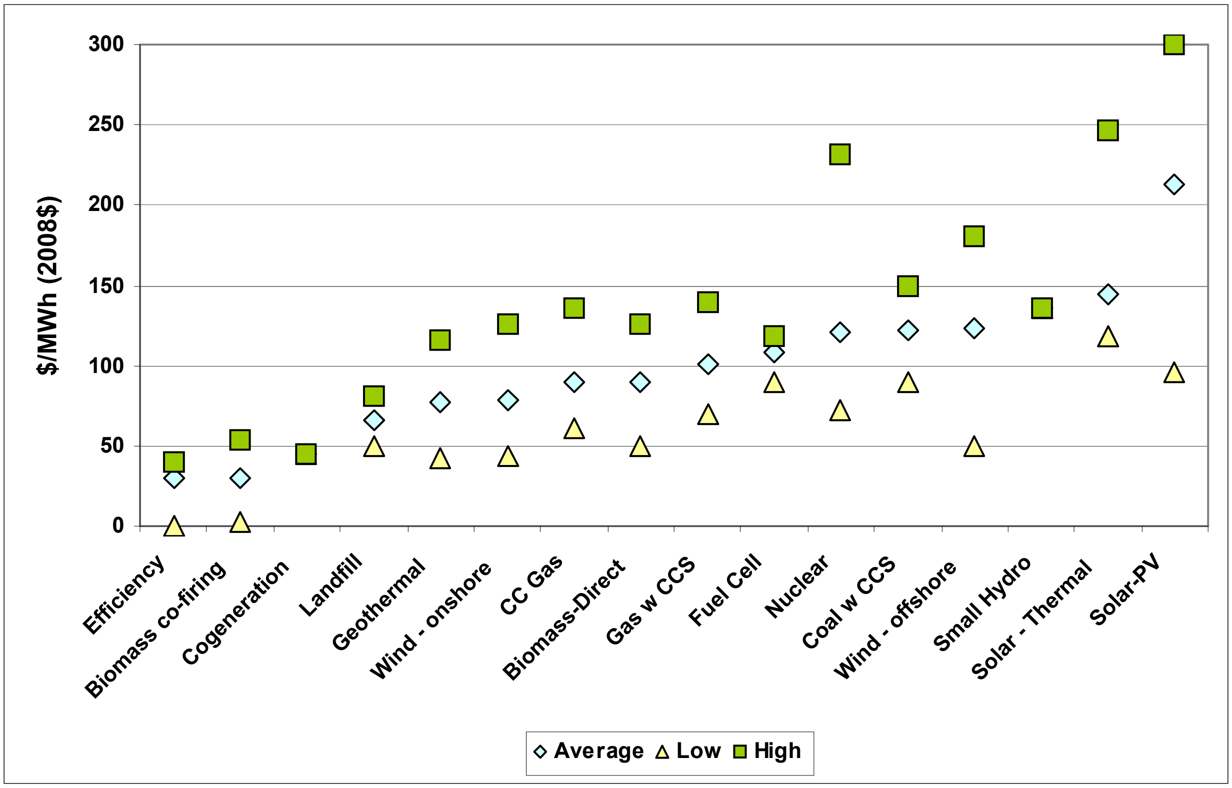
---

[55] Cooper, *Economics of Nuclear,* p. 51.

[56] National Research Council of the National Academies, *America's Energy Future: Technology and Transformation, Summary Edition*, 2009, http://www.nap.edu/catalog.php?record_id=12710.

[57] California Energy Commission Draft Staff Report, *Comparative Costs of California Central Station Electricity Generation*, August 2009, http://www.energy.ca.gov/2009publications/CEC-200-2009-017/CEC-200-2009-017-SD.PDF.

Figure IV-1: Levelized Cost of Low Carbon Options to Meet Electricity Needs



Sources: Congressional Budget Office, *Nuclear Power's Role in Generating Electricity*, May 2008, p.13; Stan Kaplan, *Power Plants: Characteristics and Costs,* Congressional Research Service, November 13, 2008, Appendix B; Staff draft, *Comparative Costs of California Central Station Electricity Generation Technologies Cost of Generation Model*, August 2009, p. 18; Lazard, *Levelized Cost of Energy Analysis—Version 2.0*, June 2008, p. 10; *Levelized Cost of Energy Analysis – Version 3.0,* for efficiency, onshore wind, biomass, natural gas, coal and nuclear and solar PV, as reported in World Resources Institute, *Renewable Energy Opportunities in Florida,* April 2009; Amory Lovins, and Imran Shiekh, and Alex Markevich, *Nuclear Power: Climate Fix or Folly?,* December 31, 2008, Draft, p. 2; Moody's, *New Nuclear Generating Capacity: Potential Credit Implications for U.S. Investor Owned Utilities*, May 2008, p. 15; National Research Council of the National Academies, *America's Energy Future: Technology and Transformation, Summary Edition*, 2009, p. 58; Renewable Energy Policy Network for the 21st Century, *Renewables 2007: Global Status Report*, 2008; Standard & Poor's, *Assessing the Credit Risk of Competing Technologies for New U.S. Nuclear Power Plants*, August 13, 2008, p. 11.

The National Research Council relied on a study by Lawrence Berkeley Laboratories on the potential for efficiency technologies to reduce consumption in the residential and commercial sectors only by 2030.[58] A recent study by McKinsey and Company has estimated

[58] Richard Brown, Sam Borgeson, Jon Koomey and Peter Biermayer, *U.S. Building-Sector Energy Efficiency Potential,* Lawrence Berkeley National Laboratory, September 2008, http://enduse.lbl.gov/info/LBNL-1096E.pdf.

a substantial potential to reduce demand for electricity in the industrial sector by 2020 as well.[59]

In Figure IV-2, the McKinsey estimate for the industrial sector reduction has been added to the National Research Council estimates for residential and commercial sectors. The renewable estimates are those that are expected to be in the market by 2030. In the case of the National Research Council, the estimates for 2020 and 2035 are used to interpolate the 2030 potential. The UCS estimate includes all the renewables projected to be in the supply mix by 2030. The estimate from *The Economics of Nuclear Reactors* is based on the low-cost renewables (i.e. it does not include offshore wind or high cost biomass), because the sector is in compliance without those technologies being deployed in large quantities.

It should also be noted that promoting efficiency saves substantial quantities of natural gas. Combining the Lawrence Berkeley Laboratories estimate for the residential and commercial sectors with the McKinsey estimate for the industrial sector, the potential savings of natural gas is 4.1 quadrillion Btu of natural gas.[60] This large savings would help keep downward pressure on natural gas prices. Natural gas would also be available and attractive for cogeneration and generation of electricity. The 4.1 quads are equal to 18 percent of base case projections for natural gas consumption in 2030. It is equal to 80 percent of base case natural gas consumption in the electricity sector.[61] As pointed out in *The Economics of Nuclear Reactors,* since natural gas emits about half the carbon that coal does, is economically attractive in cogeneration applications, and is an ideal resource to balance low-load factor renewables, natural gas could play a significant role in meeting the targets for reduction in greenhouse gas emissions, particularly if policies to achieve the efficiency based reductions in consumption are implemented.

B. Policy Risk

Climate change policy that puts a price on carbon can make fossil fuel plants more costly, which helps all low carbon alternatives. Climate change policy has not stopped with putting a price on carbon, however. Policy has moved on to include many complementary policies that directly encourage the development and deployment of low-carbon technologies. Most prominent among these policies being added are efficiency and renewable mandates. The energy efficiency policies include many new initiatives – an energy efficiency resource standard, building energy performance standards – as well as major increases in existing policies – such as appliance efficiency standards and major increases in funding for the retrofit of existing buildings. Taken together, these can also lower the demand for nonrenewable large baseload generation significantly.

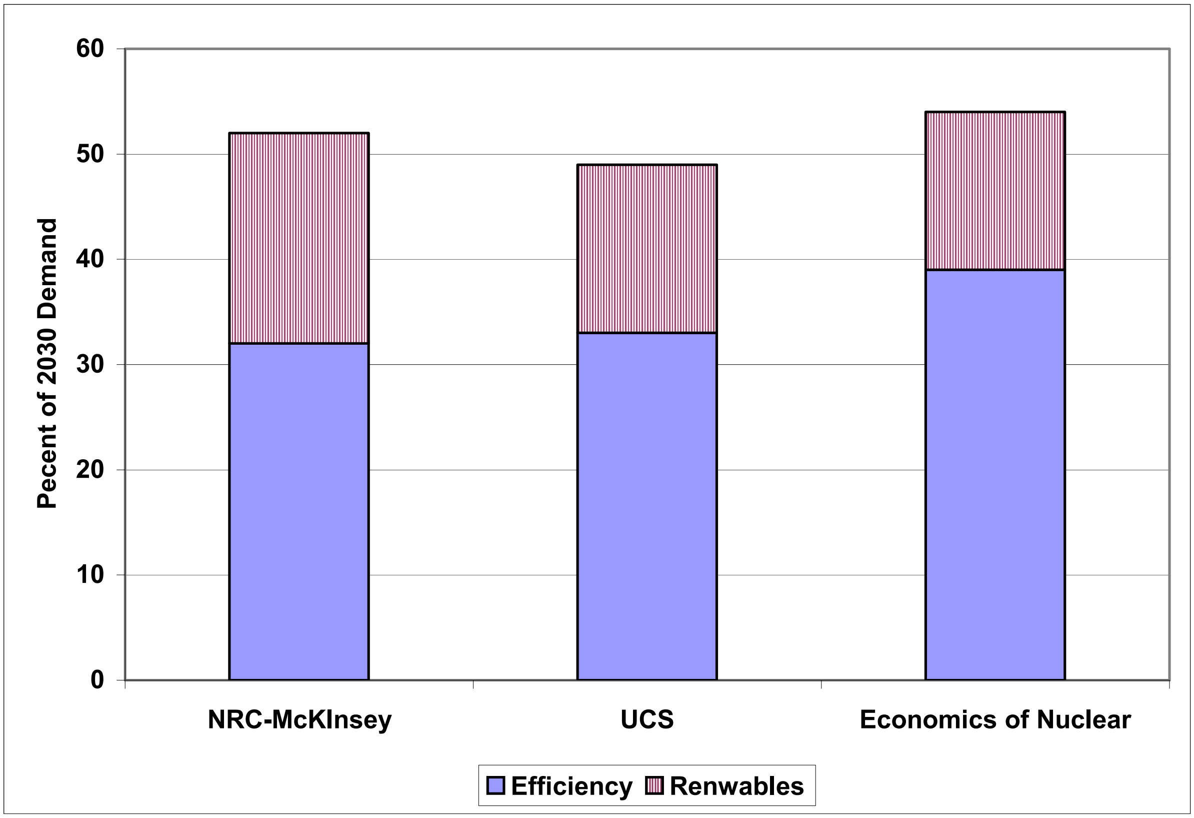
---

[59] McKinsey Global Energy and Materials, *Unlocking Energy Efficiency in the U.S. Economy,* McKinsey & Company, July 2009, http://www.mckinsey.com/clientservice/electricpowernaturalgas/downloads/us_energy_efficiency_full_report.pdf.

[60] Lawrence Berkeley Laboratory, *U.S. Building-Sector Energy Efficiency Potential,* Tables 1 and 2; McKinsey, *Unlocking Energy Efficiency*, p. 75.

[61] National Research Council*, America's Energy Future*, Table 2.1.2.

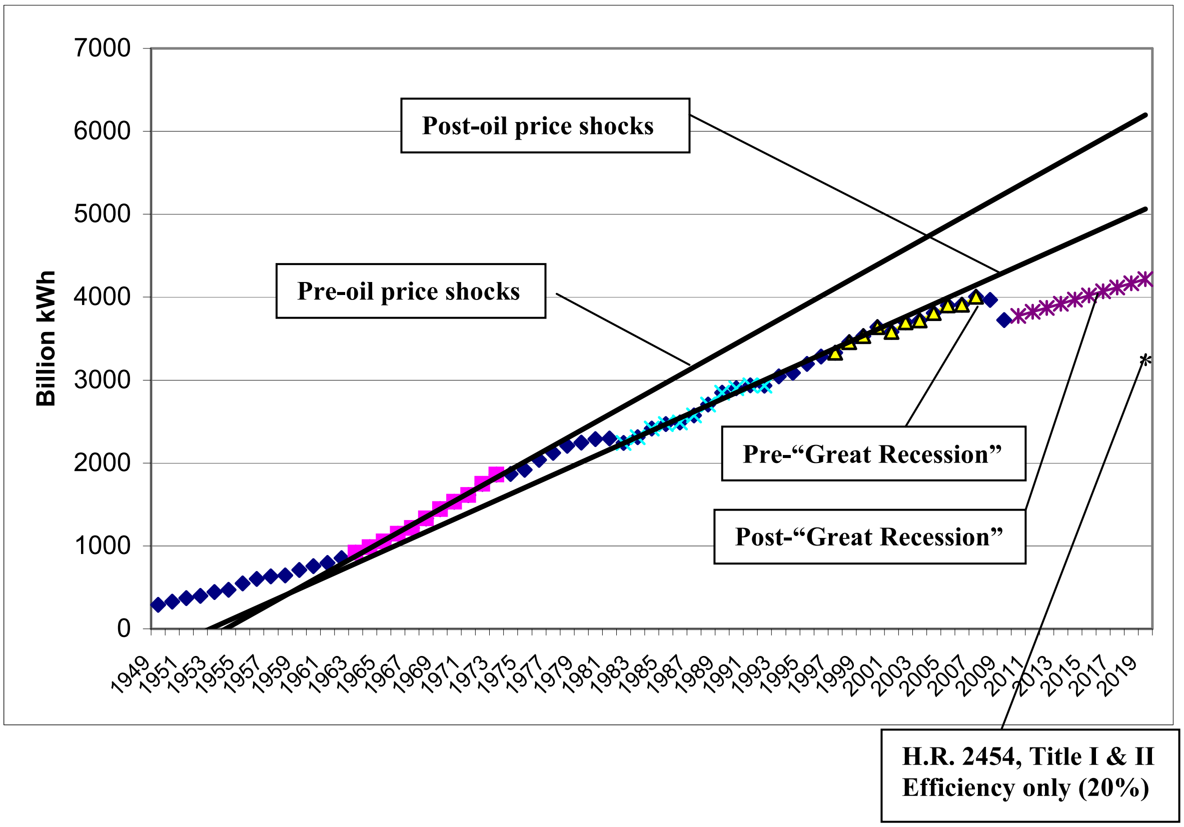
Figure IV-2: Sources of Low Carbon "Supply" of Electricity



Sources: National Research Council of the National Academies, *America's Energy Future,* August 2009. The National Research Council relies on a study from Lawrence Berkeley Laboratory (Brown, Richard, Sam Borgeson, Jon Koomey and Peter Biermayer, *U.S. Building-Sector Energy Efficiency Potential*, September 2008); McKinsey & Company, *Unlocking Energy Efficiency in the U.S. Economy,* July 2009; Rachel Cleetus, Steven Clemmer and David Friedman, 2009, *Climate 2030: A National Blueprint of a Clean Energy Economy*, Union of Concerned Scientists, May 2009; Mark Cooper, *The Economics of Nuclear Reactors: Renaissance or Relapse*, Institute for Energy and the Environment, Vermont Law School, June 2009.

Figure IV-3 shows a number of factors that affect the demand of electricity. The shifting growth trends will be discussed below in the section on marketplace risk. Here attention is focused on the impact of a 20 percent reduction in demand that could result from the efficiency requirements in the House climate bill (American Clean Energy and Security Act, H.R. 2454). The 20 percent is a soft, mid-term mandate for efficiency and renewables that has some flexibility, but it becomes firm before the 2030 target date. Moreover, efficiency grows larger as the building code, appliance efficiency, and retrofit initiatives proceed independently of the energy efficiency resource standard. The combined effect of moderating growth and continual ratcheting up of efficiency sharply reduces demand below the trend lines. The need for new generation is eliminated and substantial reduction of high carbon generation is possible. By 2020, a 20 percent reduction results in the lowered projection of demand growth is equal to the output of more than 100 reactors. Given that the full potential for energy efficiency gains in the next two decades was estimated at 30 percent by the National Research Council and that does not exhaust the technical potential, efficiency improvement could reduce demand even farther.

Figure IV-3: External Shocks and Public Policy Shift the Level and Growth Rate of Demand



Sources: U.S. Energy Information Administration, *Monthly Energy Review,* various issues, author calculation.

Policies such as these that reduce the demand for emission allowances, as well as number of other approaches that allow flexibility to make the early years of the climate change abatement regime more manageable, have dramatically lowered the projected cost of allowances. The utilities had assumed a much higher carbon cost in the proceedings to justify new reactors than is currently expected.

C. Regulatory Risk

The effort to standardize designs has foundered, as one of the leading candidate reference designs, chosen by six of the license applicants and the most active projects [AP-1000], is in its seventeenth revision in a few short years and a smaller number to other designs. The AP-1000, which accounts for the largest number of units that are seeking licenses (14 of 25), has recently been flagged for a major design flaw -- the inability of the containment building to withstand the impact of hurricanes and tornados. Given that the AP-1000 reactors are proposed for the Gulf Coast and Southeast, where these weather events are common, this would appear to be a serious concern. As stated in a recent NRC letter:

> The Nuclear Regulatory Commission staff has informed Westinghouse that the company has not demonstrated that certain structural components of the revised AP 1000 shield building can withstand design basis loads…
>
> "We've been talking to Westinghouse regularly about the shield building since October 2008, and we consistently laid out our questions to the company," said Michael Johnson, director of the NRC's Office of New Reactors. "This is a situation where fundamental engineering standards will have to be met before we can begin determining whether the shield building meets the agency's requirements."[62]

The EPR design, one of the front-runners for a federal loan guarantee at the Calvert Cliffs site in Maryland, has also been delayed by design problems. EPRs are under construction in Finland and France, and an application for a new reactor has been submitted to the UK government. Earlier this year, Finnish regulators threatened to halt construction of the EPR, because they were not satisfied that key safety systems will work. French and British regulators have also expressed dissatisfaction with the EPR design. In response, the French government-owned EPR vendor Areva recently agreed to modify the design of the EPR's safety system, which is likely to cause further delays.

The vast majority of new reactor designs, including Revision 17 of the AP-1000 design, have not yet gone through the NRC certification process. That process, which includes review by the NRC technical staff and a notice-and-comment rulemaking, has been completed for only one design: the ABWR. For the AP-1000 Revision 17, the EPR, the EBWR, and the USAPWR, the NRC has set open-ended schedules for completion of the certification process. Even the ABWR's certification must be renewed when it expires in 2012.

The effort to standardize designs has also been hampered by the NRC's decision to accept individual license applications before the designs on which they are based have been reviewed and certified. The NRC has created great uncertainty in the licensing process by commencing individual application reviews before fundamental design issues are resolved. For example, NRC had to suspend its review of several applications after the applicants got cold feet about the problem-plagued ESBWR design on which they had relied. In the case of North Anna Units 3 and 4, the licensing process was well underway when the applicant, Dominion, asked the NRC to suspend its review.

[62] "NRC Informs Westinghouse of Safety Issues with AP1000 Shield Building," *NRC News Release*, No. 09-173, October 15, 2009.

Restrictions placed by the NRC on the hearing process have also created uncertainty regarding the licensing of new reactors. The NRC limits the issues that can be raised in reactor licensing hearings to siting and environmental issues. Design questions are shunted to future rulemakings that may not conclude until the individual licensing cases are over. In a number of individual reactor licensing cases, hearing requesters have attacked the adequacy of the reactor's underlying design, only to have their "contentions" (i.e., disputes with the adequacy of the license application) dismissed on the ground that design challenges may only be raised in design certification rulemakings. Because these rulemakings may not begin until the hearing is well under way or even completed, the postponement of fundamental criticisms casts a cloud over the viability of the individual license applications.

Finally, even to the limited extent that members of the public are permitted to challenge individual license applications based on siting and environmental issues, the opposition put up by neighbors of new reactors is significant. In the 19 licensing cases pending before the NRC, the Atomic Safety and Licensing Board (ALSB) has admitted almost two dozen contentions out of well over one-hundred. that were submitted in requests for adjudicatory hearings. All of the issues admitted for litigation are substantive in nature, covering problems such as the inadequacy low level radioactive waste storage measures, concerns about radioactive contamination of water, the need to consider alternative energy sources, thermal and other impacts to aquatic organisms, and concerns about the impact of accidents. The bottom line for this review of risk is that the regulatory process is vigorous and the projects face significant regulatory risk.

D. EXECUTION RISKS

Historically, the industry has been plagued by the inability to build reactors on time and on budget and that problem continues today. Industry projections of overnight costs of reactors have more than doubled since 2001-2002, when the idea of a "nuclear renaissance" first gained currency, from about $2000/kW to about $4,000/kW. By 2008, some Wall Street analysts put the cost as high as $6,000/kW. These estimates were examined in detail in *The Economics of Nuclear Reactors.* Recent developments affirm the cost uncertainty. As noted above, the National Research Council continues to report a wide range of costs and utility costs estimates continue to have wide ranges. The range of costs for conventional projects is generally ± 10%. In an analysis that compared capital costs of two proposed reactors at the South Texas site in Texas, the range was –6% to +50%, meaning that the costs really are not well-known and are likely to be much higher than initial estimates.[63] As utilities move through the development process, they continue to offer nonbinding cost estimates and resist efforts to be held to fixed prices or even incentive schemes.

Table IV-1 shows the difficulties that the projects that have sought licenses have encountered in chronological order. About half of the projects that have been put forward as the start of the next generation or reactors have been delayed or canceled. Those that have moved forward have suffered substantial cost escalation and several have received negative

[63] CPS Energy, *Assumptions for 2009 Resource Plan Analaysis*, Public Version, June 29, 2009, p. 29.

financial reviews. Of the 19 applications at the NRC, 15 have had some type of delay, cost increase, utility downgrade and/or cancellation.

Table IV-1 Chronology of Execution Problems for New Nuclear Reactors

Month	Year	Reactor and Action	Type of Event
January	2008	MidAmerican cancels propose Idaho reactor	Cancellation
February		NRC Suspends South Texas application	Delay
March		Progress triples cost estimate Levy reactors to $17 billion	Cost Increase
August		Constellation's estimate for the cost of Calvert Cliff increased from $2 billion in 2005 to $9.6 billion	Cost Increase
October		Progress Energy's estimate for two reactors at Shearon Harris in NC increased	Cost Increase
November		Duke increases cost estimate for Lee Reactors from $5 billion to $10 billion	Cost Increase
December		TVA increases cost estimate for Bellefonte from $6.4 to $10.4 billion	Cost Increase
January	2009	Dominion in Virginia abandoned ESBWR design and suspended application for reactor at North Anna	Cancellation
March		Entergy in Mississippi suspended application for reactor at Grand Gulf	Delay
		Entergy in Louisiana suspended application for reactor at River Bend	Delay
April		AmerenUE in Missouri cancelled Callaway 2 reactor	Cancellation
May		PPL's estimate for one reactor at Bell Bend in PA increased from $4 billion to $13-$15 billion	Cost Increase
		South Carolina Electric & Gas cost increase by $1 billion	Cost Increase
		Progress in Florida announced 20-month delay of Levy County reactors	Delay
		Entergy in Texas cancelled two Victoria reactors	Cancellation
		Exelon Cancels 2 Victoria Reactors in Texas	Cancellation
		Moody's downgrades PPL	Negative Financial
July		Moody's and Fitch downgraded South Carolina Electric & Gas due to proposed Lee reactors	Negative Financial
		Ontario Scraps nuclear plant deal	Cancellation
August		TVA in Alabama cancelled three Bellefonte reactors	Cancellation
		NRC delayed the scheduled publication of the final environmental review for Constellation's	Delay
		Calvert Cliffs in Maryland to February 2011, a delay of 13 months	
		Constellation delayed NRC's review of its Nine Mile Point application	Delay
		in New York to September 2010, a one year delay	
		TVA in Alabama delayed remaining Bellefonte reactor from 2016 to 2020-2222	Delay
		Duke Energy in South Carolina: Lee reactors delayed from 2016 to 2021	Delay
September		AP-1000 design in 17th revision; NRC announced additional problems that	Delay
		will likely cause further delay	
		Moody's gives negative advice on Georgia Power due to Vogtle	Negative Financial

Sources: Press accounts

Moving to the contract phase of a project does not ensure smooth development either. Progress Energy in Florida may have set a record for "quick to delay." Although the NRC gave the company a strong indication that it would not receive a limited work authorization because of site-specific concerns, Progress signed an engineering, procurement and construction (EPC) contract. When the limited work authorization was denied, Progress was forced to delay its agreed-upon schedule and renegotiate the contract. It took a mere 23 days for the project to fall at least 20 months behind schedule.

E. Marketplace Risks

Demand

Demand-side risks flow from the current recession, the worst since the Great Depression, which has not only resulted in the largest drop in electricity demand since the 1970s, but also appears to have caused a fundamental shift in consumption patterns that will lower the long terms growth rate of electricity demand dramatically.

As shown in Figure IV-3 above, the oil price shocks of the 1970s and the nuclear rate shock of the 1980s destroyed the demand that the reactors were intended to fulfill. Utility management was slow to recognize the change in demand and unwilling to admit that the projects they had bet their companies on were simply not needed. They poured billions into projects that were not economically viable.

The oil price shocks of the 1970s did two things. First, they shifted demand lower. By 1982, demand was 13 percent lower than it would have been if growth had continued at the same rate as in the previous 10 years (i.e., 1962-1972). Ten years is a useful frame of reference since that is the planning horizon used by many utilities. Second, demand grew more slowly from the lower base. By 1992, demand was 17 percent lower than it would have been if there had been neither a shift nor a reduction in the growth rate. Given the capacity and the capacity factors of the period, this was equal to the generation one could expect from 99 reactors, almost exactly the number that were cancelled as the "Great Bandwagon Market" for nuclear power ground to a halt.

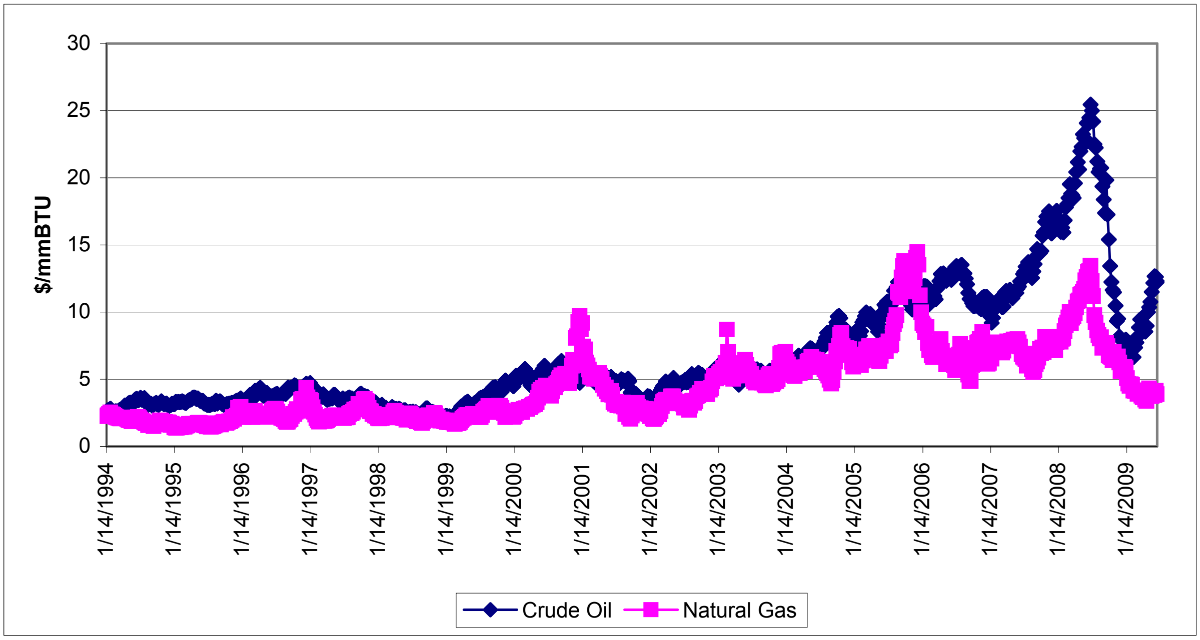
Today, the "great recession" has again dramatically reduced load growth projections. While management cannot be blamed for a shift in demand, it is responsible to adapt quickly to the changing economic environment. The initial drop in demand through the first quarter of 2008 has been larger than either of the oil price shocks. Assuming that the great recession is over (so the shift ends in 2009) but that the rate of growth slows by the same amount as it did after the oil price shocks, the future growth path would be much lower than previously anticipated. This would not be the result of higher prices (although climate policy may cause prices to rise), but because the consumption bubble has burst – growth in housing, housing size, new appliances, etc. will slow.

Natural Gas Prices

The marketplace risk that nuclear reactors face exists on the supply-side, as well. As we have seen, nuclear reactors are more costly than many alternative supply-side options. A factor that played a critical role in the effort to convince public service commissions to certify the need for nuclear in 2018 was a spike in natural gas prices. Recent estimates of the natural gas resources have increased dramatically and the price has tumbled and separated from the price of oil, as shown in Figure IV-4.[64]

Predicting future prices is uncertain, but it just as likely that the speculative bubble in natural gas was the aberration, not the rule. Commodity markets seem to be taking this view. The NYMEX price for natural gas for the end of 2021 is more than $4 below the peak hit in June 2008.

Figure IV-4: Natural Gas Wellhead, Henry Hub Futures Prices



Source: Energy Information Administration, Petroleum Spot Prices, http://tonto.eia.doe.gov/dnav/pet/xls/PET_PRI_SPT_S1_M.xls, Natural Gas Future Prices, Contract 1: http://tonto.eia.doe.gov/dnav/ng/xls/NG_PRI_FUT_S1_M.xls

F. Financial Risk

The key indicator of the financial risk for utilities is the size of the project relative to the capital base of the company. The cautious rule of thumb would keep projects small, i.e., 10% of market capitalization. Table IV-2 updates the examples provided by Standard & Poor's and includes all of the utilities undertaking single projects that Moody's considered to have at least a medium level of activity. Two of the projects have public power partners, so the capital requirement is only the amount for which the investor-owned utility is responsible. It is clear that these projects are huge by traditional financial standards and

[64] Clifford Krause, "New Way to Tap Gas May Expand Global Supplies," *New York Times,* October 10, 2009: "gas reserves in many countries could increase over the next two decades, comparable with the 40 percent increases in the United States in recent years."

justifies the concern expressed by the Wall Street analysts and major industry-consulting firms previously cited.

Three of the projects on this list have suffered negative financial treatment (PPL, Southern and SCANA) and a fourth has a low rating (NRG). The case of SCANA is striking. The project has a public power partner, has been authorized construction work in progress, and is on the short list for federal loan guarantees, which means that as little as 10 percent of the capital would have to be raised in corporate financial markets (i.e. assuming a federal guarantee of 80 percent, only 20 percent of half of the project would have to be raised); yet the utility was downgraded. For the Southern Company, the reactor is the smallest compared to the capitalization, but it recently received a negative treatment from Moody's.

Table IV-2: Reactor Costs Compared to Market Capitalization of Active Projects

Utility	Proposed Reactor	Market Capitalization (Billion)	Reactor Capital Requirement (Billion)	Reactor, as % of Market Capitalization
Duke	Lee	19.8	17	86
Florida Power & Light	Turkey Point	21.4	14	65
Progress	Levy	17	9.8	173
SCANA	Summer	5.8	4.1*	140
Southern	Vogtle	14	24.5	57
NRG	South Texas	6.5	6.5*	100
Unistar	Calvert	5.9	4.2*	71
	Nine Mile Pt.		4.2*	71
PPL	Bell Bend	11.2	14	125

* 50% share of total project

Sources and Notes: Investor Information, various companies. Market capitalization is year-end stock outstanding multiplied by stock price on 10/10/2009. Capital requirement is all in costs taken from Exhibit JJR-3: Cost estimates of for New AP1000 Reactors, Florida Public Service Commission, Docket No. 090009-EI. Company estimates for non AP-1000 reactors, i.e. NRG's ABWR and PPL's EPR.

Table IV-3 places the adverse events in the context of key characteristics of nuclear reactor projects that should affect their economics and financial prospects. The trade and regulatory literature suggests the following attractive characteristics:

- Brownfield sites are very attractive because they lower the risk of regulatory approval and site development costs.
- Two unit sites are attractive because cost sharing between the units lowers the average cost substantially. However, this benefit is mitigated by the fact that the two units must come on line close together (less than 18 months apart) to capture that benefit. This creates the possibility of creating significant excess capacity and the need for partners to absorb that excess.

- Given the large size of these projects, companies pursuing more than one project are likely to suffer financial stress.
- Given the declining demand, the total number of projects that are in the state (or reliability region) will also play a part, since partners may be harder to find where a large number of units are being proposed.

The first two projects listed have all of those characteristics. One has been cancelled; the other has suffered negative financial advice. The next four projects have the first three characteristics, but have multiple projects in the state/reliability region. They have all suffered difficulties – been suspended, downgraded or are struggling to find partners. The other projects have only two of the desirable characteristics and they are generally encountering difficulties. The fact projects with the most desirable economic characteristics are having difficulties is particularly telling.

Table IV-3: Key Nuclear Reactor Project Characteristics and Adverse Events

Company	Project Name	Company # of Project	Design Type	Reference Design	Units at site	State	Units in State	Power Pool	Brownfield (1 = yes)	Moody's Level of Activity	Capital as % of Market Cap	Advese Events
Ameren	Callaway	1	EPR	0	2	MO	2	SPP	1	1		Cancelled because of no CWIP
Southern	Vogtle	1	AP1000	1	2	GA	2	SERC	1	3	57	Negative financail advice
SCEG	Summer	1	AP1000	0	2	SC	4	SERC	1	3	140	Downgrade
FPL	Turkey Pt.	1	AP1000	0	2	FL	4	FRCC	1	1	65	Application not filed, Struggling to find partne
NRG	STP	1	ABWR	1	2	TX	6	ERCOT	1	3	100	Struggling to find partners
Luminant	Comanche	1	USAPWR	1	2	TX	6	ERCOT	1	0		Suspended
Progress	Harris	2	AP1000	0	2	NC	2	SERC	1	1		
Dominion	N. Anna	1	ESBWR	1	1	VA	1	SERC	1	1		Suspended
Detroit Ed	Fermi	1	ESBWR	0	1	MI	1	MAIN	1	1		
Entergy	River Bend	2	ESBWR	0	1	LA	1	SERC	1	1		Delayed, Changed design
PPL	Bell Bend	1	EPR	0	1	PA	1	ECAR	1	2	125	Cancelled because of no CWIP
Unistar	Calvert	2	EPR	1	1	MD	1	MAAC	1	3	70*	
Unistar	Nine Mile	2	EPR	0	1	NY	1	NPCC	1	3	70*	Suspended
Entergy	Grand Gulf	2	ESBWR	0	1	MS	1	SERC	1	1		Delayed, Changed Design
Duke	Lee	1	AP1000	0	2	SC	4	SERC	0	2	86	Delayed due to lack of demand
Exelon	Victoria	1	ESBWR	0	2	TX	6	ERCOT	0	1		Delayed, Changed design
Nustar	Bellefonte	1	AP1000	0	2	AL	2	SERC	0	1		Cancelled due to lack of need
Progress	Levy	2	AP1000	0	2	FL	4	FRCC	0	2	173*	Delayed due lack of work Authorization
	* These percentages are for each project in a 2 project company, Unistar claculation puts ownerhsip a 50%											

Sources: http://www.nuclear.gov/np2010/neScorecard/neScorecard.html, Company web sites for stock price, Annual Reports for shares outstanding, Exhibit JJR-3 Comparison of Cost Estimates for New AP-1000 Reactors, Docket No. 0900009-EI, for AP-1000 costs; Mark Cooper, *The Economics of Nuclear Reactors: Renaissance or Relapse?,* Institute for Energy and the Environment, Vermont Law School, June 2009, p. 24.

G. THE BOTTOM LINE ON DIRECT SUBSIDIES FOR NUCLEAR REACTORS

It is difficult to predict in advance how much larger the burden on taxpayers and ratepayers will be if the construction of new nuclear reactors is subsidized. That will depend on a number of factors:

- Above all, the number that are actually ordered, which is uncertain, with numbers running from 45 to 100 as a near term goal, and as high as 187 for a long term goal;
- The cost of those reactors, with estimates still rising;
- The number that will be cancelled or abandoned, with a high probability that the number will be substantial;
- When in the development and construction process the projects are terminated; and
- What the alternatives that could have been pursued, but were not, would have cost.

There are clear indications that the risk is high and that the cost will be substantial.

- The reactor projects are far too large to be a prudent investment for utilities, as much as ten times the size of a reasonable investment should be, which will have an impact on their financial ratings.
- The utilities that have proposed projects are having severe difficulties finding neighboring utilities to partner in the project and share the risk.
- Government agencies that have looked at the risk of the loan guarantees have concluded that half the projects could go bad and half the investment in those projects could be lost.
- The risk premium that industry consultants suggest should be demanded by equity owners that fund these projects is about twice the return on equity utilities usually earn.
- Delays and downgrading of financial ratings have already begun, long before concrete has been poured, which is where the construction and rework problems are most severe.

All of these indicators of risk call to mind the previous effort to build nuclear reactors in the U.S., when

- half of the reactors ordered were cancelled or abandoned;
- those that were completed took, on average, twice as long to build as originally planned and cost twice as much as originally estimated;
- four-fifths of the utilities that undertook nuclear construction suffered large financial downgrades and all suffered substantial financial distress; and
- investment in nuclear reactors led to spectacular bankruptcies of both investor owned and publicly owned utilities.

The past could be the prologue. A repetition of that history with taxpayers and ratepayers as the underwriters of nuclear reactors would cost not just hundreds of billions in losses for taxpayers on reactors that are cancelled, but also trillions in excess costs for ratepayers when reactors are brought to completion by utilities that fail to pursue the lower-cost, less-risky options that are available.

This is an avoidable error that policymakers can prevent from happening. If policy makers conclude that there is a market failure in the research, development and demonstration phase of the nuclear industry, loan guarantees should

- not be used to fund deployment of mature, expensive, and risky technologies;
- be subject to rigorous fiscal, technology and administrative oversight; and
- be structured with maximum taxpayer protections and transparency built into the conditions of the loan guarantees.

States should not shift construction risk to ratepayers, but rather should protect ratepayers from those risks by

- rejecting construction work in progress, or other guarantees for nuclear construction costs;
- demanding binding fixed cost contracts before construction begins, and
- imposing strong incentive/penalty mechanisms to control cost overruns.

By following these principles, the financing of new nuclear reactors would be left to private capital markets, which are fulfilling their function in assessing risk. It is ironic that at a moment when the nation has suffered mightily from the misallocation of the cost of risk in the financial sector, some of the strongest supporters of free markets and critics of government-sponsored enterprises, would urge another massive federal subsidy intended to circumvent the judgment of the capital markets and put another multi-billion dollar program of federal support onto the backs of the American people as taxpayers and ratepayers.

APPENDIX A:
ECONOMIC AND RISK ANALYSIS OF THE PROPOSED NUCLEAR REACTORS IN FLORIDA

The decision to build nuclear reactors is ultimately a local decision. It is the ratepayers of an individual utility that will bear the bulk of the costs and the public utility commissions of most states who will certify the need for the reactor and allow its costs to be recovered in rates. This appendix presents an excerpt from testimony prepared in the Florida Power and Light case, which applies the framework to a state proceeding and develops data specific to the state and utility.

ANALYZING THE RISK FACTORS

Approach

Q. How do you approach the analysis of the long-term feasibility of the nuclear reactors?

A. The rule adopted by the Commission requires an assessment of the long-term feasibility of the projects. I believe a thorough review of the projects is vital to protect the public interest. In a competitive marketplace firms must constantly review whether their investment decisions continue to be economically viable and justified in light of the changing market, technological, financial and regulatory conditions. For utility services that are offered under franchise monopoly conditions subject to regulatory oversight, the commission is charged with protecting the public from imprudent actions by the utility. It must ensure that utilities exercise the same vigilance with respect to the prudence of their actions as firms in a competitive market.

This regular review of the long-term feasibility of a project is particularly important in the case of nuclear reactors, which are, by their nature, extremely vulnerable to these four types of risk. As very large investments that take a long time to construct, and produce large quantities of electricity, they represent a huge quantity of inflexible, sunk costs. These investments are incapable of responding to change. They are inherently "go-no-go" decisions that should be made before costs are incurred. Because of their size and nature, the Commission needs to address the long-term feasibility of the projects before additional, substantial costs have been incurred.

Q. Please summarize your findings.

A. I have identified dramatically changed circumstances since affirmative determinations of need were made by this Commission for these reactors and present in my testimony evidence on the current marketplace, regulatory, technological, and financial risks of these reactors proposed for construction in Florida by Progress and FPL. These changed circumstances and resulting risks lead me to conclude that completion of the Turkey Point and

Levy reactors is no longer feasible in the long term and that incurring additional costs on these reactors would not be prudent.

The decisions by Progress and FPL to build these nuclear reactors were based on four important assumptions that have been called into question in the time since the evidence was filed in their petitions for determination of need ("Need Docket").

(1) They assumed a high rate of demand growth.

(2) They downplayed the contribution that efficiency and renewables can make to meet the need for electricity.

(3) They assumed high prices for fossil fuels based on both commodity prices and the belief that public policy would put a high price on carbon.

(4) They used a low estimate of the cost of nuclear reactors.

The impact of the changed factors on these assumptions that have developed since the Need Docket can be summarized as follows:

<u>Market Factors</u>	
Declining Demand	Eliminates need for large quantity of new generation
Falling price of natural gas	Makes natural gas more attractive
<u>Regulatory Factors</u>	
Efficiency/renewable stds.	Reduces need for non-renewable generation
Carbon cost reduction	Makes low carbon resources less attractive
<u>Technological Factors</u>	
Nuclear cost uncertainties	Raises prospects of cost overruns
Growing confidence in cost and availability of alternatives	Makes alternatives more attractive
<u>Financial Factors</u>	
Tight Financial markets	Makes finance more difficult
Increasing concerns on Wall Street about nuclear reactors	Makes finance more expensive

Any of these changed factors alone could demonstrate that completion of these reactors is not feasible in the long term Taken together, these factors thoroughly undermine the case that the companies have tried to make to demonstrate the long-term feasibility of these nuclear reactors at this time. The evidence presented by the companies to the Commission does not take these changed factors fully into account and does not reflect the highly uncertain future that nuclear reactors face.

If the Commission were to merely conclude that the changes in conditions make the future highly uncertain, that conclusion alone would argue strongly against continuing with these reactors. In an uncertain environment, the assets a prudent person acquires should be flexible, have short lead times, come in small increments and not involve the sinking of large capital costs. The characteristics of nuclear reactors are the antithesis of those best suited to an uncertain environment. They are large, “lumpy” investments that require extremely long lead times and sink massive amounts of capital. Therefore, it would be imprudent to allow the companies to incur any more expenses or recover those costs from ratepayers at this time because the companies have failed to demonstrate the long-term feasibility of completing the reactors.

There are other factors that will be documented by other witnesses that reinforce the conclusion that the reactors are no longer feasible in the long-term, including the failure of some of the projects to obtain regulatory approvals, which were being counted on to stay on schedule and uncertainties and delays in the Nuclear Regulatory Commission (“NRC”) licensing process. While one can point to some positive developments in the policy space, such as the possibility of the creation by the U.S. Congress of a Clean Energy Development Authority, these are vastly outweighed by the negative developments.

MARKETPLACE CONDITIONS

Demand

Q. Have there been changes in the marketplace that affect the long-term feasibility of these nuclear reactors?

A. Yes. There has been a dramatic change in the marketplace since the companies prepared their need analyses in the respective need dockets. The nation has plunged into the worst recession since the Great Depression. Some even call it a depression. Moreover, there is a growing recognition that this change is not simply a severe dip in the business cycle, but rather a major shift in the economy. The spending binge on which the U.S. embarked for a decade, in which households and business became highly leveraged, is likely over. A massive amount of household wealth was destroyed when the housing market bubble burst. Retirement accounts have been devastated by the collapse of the stock market.

Ironically, the decade on which the projections were based in the need docket coincided almost exactly with the decade in which the housing and consumption bubbles were pumped up by excessive leverage. That level of growth was unsustainable. It is my opinion that the shift in consumption is permanent and signals slower growth in the future. However, even if this were just a severe downturn in the business cycle, it would affect the demand for electricity sufficiently to raise questions about the long-term feasibility of these new nuclear reactors.

Q. Is there evidence that load growth has changed in the FPL service territory?

A. Yes there is strong evidence of a dramatic reduction in consumption that should sharply reduce projected load growth. FPL provides sufficient detail to examine closely the problem of excess capacity created by the nuclear reactors, as shown in Exhibit

MNC-1, page 1. The reduction in peak demand between the 2008 and 2009 feasibility analysis is striking. In 2017, which is a crucial year in the 2008 analysis because that was the year the reserve margin hit the limit of 20 percent, the 2009-projected peak is 11 percent lower than the peak projected in 2008. Under the 2009 projection, the FPL does not reach the 2017 peak projected in 2008 until 2022, five years later. By 2040, the projected peak is 20 percent lower.

Q. Is this dramatic shift in demand fully reflected in the 2009 Economic Analysis?

A. With a dramatic decline in demand, averaging between 10 and 11 percent in the decade between 2010 and 2020, all else equal, one would expect to see an equally dramatic increase in FPL's reserve margins. That is not the case. With a drop in the summer peak of more than 10 percent in 2017, FPL shows only a 1 percent increase in reserve margin. In order to achieve that level, it must use the flexibility of natural gas plants to react to the decline of projected peak demand. Comparing Schedule 8 in the 2008 and 2009 10-year plans, we can see natural gas plants moved back a year or two, reduction of inactive reserves and elimination of some additions altogether, while making room for the Turkey Point reactors. Thus in contrast to the ten year time horizon needed for nuclear reactors, the short time frame for deploying gas alternatives is much more flexible for dealing with the uncertainties in demand.

To put these declines in demand into perspective, I note that taken together, the reduction in projected peak summer demand between the 2008 and 2009 10-year plans is almost 3500 MW, which exceeds the combined capacity of three of the four reactors. Since these utilities represent just under three quarters of the total statewide peak summer demand, and assuming the other utilities in the state have suffered similar reductions in demand, the lowering of the peak statewide in the past year would exceed the capacity of all four plants being considered in this docket.

There are two important implications from this change in demand. First, a lack of demand can undermine the long-term feasibility of the reactor. This played a critical role in the cancellation and abandonment of nuclear reactors in the 1970s and 1980s. Back then, it was oil price shocks and rate shock that undermined demand. Today it is the great recession and, as I describe below, climate policy, that can undermine demand, but the historical experience teaches us that inadequate demand can definitely render nuclear reactors infeasible in the long term. Second, hoping to sell pieces of the plant – either with off system sales at wholesale or equity stakes – in an attempt to salvage failing economics brought on by declining demand may not be feasible with a state-wide reduction in demand.

NATURAL GAS PRICES

Q. Are there other market changes that the Commission should consider?

A. Yes, the price of gas, which plays a central role in Florida, bears close scrutiny. Natural gas was the best alternative to nuclear in the economic analysis of the FPL Need Docket, and FPL has focused on gas in this proceeding. In that Need Docket analysis, the variable cost of gas accounts for 90 percent of the difference between the nuclear scenario and the gas scenario, and the cost of natural gas is the single largest determinant of the variable cost by far.

In this proceeding, FPL concludes that the prospects for nuclear reactors have actually brightened because of rising fossil prices – both commodity prices and carbon compliance costs. "The primary reasons for the projected general increase in the economic advantage of the Turkey Point 6 & 7 project, compared to the 2007 Need Determination filing, are: (i) currently projected higher natural gas costs, particularly in the early years; and (ii) higher projected environmental compliance costs." (Florida Power & Light Company, Docket No. 0900009-EI, Responses to Staff's Second Set of Interrogatories, Interrogatory No. 45, page 1 of 1).

This conclusion does not comport with the emerging reality. The price of natural gas has not only tumbled, but it has separated from the price of oil. There are a number of reasons that natural gas might not continue to track oil as closely in the future as it has in the past. It is much more of a regional market than oil. There is increasing optimism about natural gas resources. There are efficiency programs targeted at natural gas consumption in the climate change legislation moving through Congress, which may free up supply and put downward pressures on price. Finally, there is considerable evidence that a significant part of the volatility in the natural gas market over the past decade was caused by excessive speculation brought on by excessive deregulation. The rise in prices and volatility was coincident with the creation of what is known as the Enron loophole and the entry of index traders into the market. There are strong regulatory and legislative measures being put into place to prevent excessive speculation from again afflicting energy markets. In short, the past decade should be the exception, rather than the rule in natural gas markets.

Q. Please provide empirical evidence to support your concerns about the natural gas projections employed by FPL.

A. The evidence relies on futures prices. As shown in Exhibit MNC-2, page 2, the Henry Hub futures price, which is the standard base for natural gas pricing, is a near perfect predictor of natural gas wellhead prices. As shown in Exhibit MNC-2, page 3, the Henry Hub price is a near perfect predictor of Florida prices for gas for electric utilities.

Exhibit MNC-2, page 1shows that the dramatic change in natural gas prices is not reflected in the FPL's analysis. The price of natural gas shown in FPL's "Key Assumption" analysis, is a cross between the mid and the high estimates from the Need Docket. These very high price projections stand in sharp contrast to the prices that prevail in the natural gas futures market. Exhibit MNC-3-page 1 shows the August futures price for Nymex Henry Hub natural gas, in years matching those used in the need docket. On average, the natural gas price in the "Key Assumption" page is about 50 percent higher than the Nymex price.

Needless to say, overestimating the single most important factor in the economic analysis can have a huge impact on the economic calculation made by the company. The Nymex futures prices are a lot closer to the low gas cost scenario from the FPL 2007 Need

Docket than they are to the "Key Assumptions" prices used by the company in this feasibility assessment. In the Need Docket, two of the three nuclear cost scenarios had higher overnight costs than the break even capital cost point in the low gas case.

REGULATORY CONDITIONS

Q. Should regulatory conditions enter into the Commission's evaluation of the long-term feasibility of these reactors?

A. Yes. The companies' Need Docket analyses were driven by assumptions about federal regulatory policy. The companies have put a high price on carbon in their economic analyses. Without the high price on carbon, the economics of nuclear reactors would look very different. To my knowledge, the state of Florida has not put a price on carbon, nor is it contemplating doing so. Thus, the companies have decided to pursue these projects and the Commission has allowed cost recovery based, in part, on assumptions about federal climate change policy.

Q. Are you suggesting that the Commission should not take future climate change policy into account when considering the long-term feasibility of these reactors?

A. Quite the contrary. I believe the Commission should take federal policy into account when considering the long-term feasibility of these reactors, since that is a major source of regulatory risk to state decisions. However, I believe the Commission must take the **<u>entirety</u>** of federal policy into account. The prospect of federal climate change legislation is growing. The idea of putting a price on carbon is only a part of the legislation that is moving through the Congress. H.R. 2454, the American Clean Energy and Security Act, the first piece of climate change policy legislation to pass a house of Congress, does not simply put a price on carbon directly. Rather, it establishes an elaborate scheme of allowances to emit carbon, which will indirectly set a price on carbon. Moreover, policies other than putting a price on carbon, particularly policies to promote efficiency and renewables, play a large role as well.

Q. Please describe the full suite of federal policies that affect the long-term feasibility of these nuclear reactors.

A. On the supply-side, the legislation has a renewable energy standard that would require utilities to meet an increasing part of their load with renewables. Within a decade, they would be required to get 20 percent of their generation from renewables, with as much as 8 percent of that total coming from efficiency. At the same time, the legislation includes a number of provisions that have sharply lowered projections of the cost of carbon credits, such as efficiency and renewable mandates, subsidies for carbon control technologies and domestic and international offsets. All of these lower the demand for allowances and therefore the price. This means that the assumed compliance costs of fossil fuels are lower than projected by the companies in prior proceedings and this proceeding.

On the demand side, there is a substantial mandate for energy efficiency. This is embodied, in part, in the ability to meet 40 percent of the renewable resource standard with efficiency and, in part, in dramatic improvements in building codes and appliance standards. Mandates to improve the energy efficiency of new buildings by 30 percent in the near term and 50 percent in the longer term will have a substantial impact on energy demand over the life of the reactors being considered in this proceeding. Funds from certain allowances are set-aside to improved efficiency, particularly for natural gas. Similarly, the American Recovery and Reinvestment Act of 2009 includes a huge increase in funding to improve the energy efficiency of existing buildings. As the efficiency of buildings and appliances improves, the demand for electricity and natural gas declines.

These regulatory factors – increased renewables, lower demand through efficiency, and a lower price on carbon – must be considered in the evaluation of alternative scenarios for future supply of electricity. Extracting only the price of carbon from the policy landscape and inserting it in the economic analysis, while ignoring the other aspects of policy, distorts the picture being presented to the Commission. These other policies would further undercut the claim that nuclear reactors are feasible in the long-term. Many of these other aspects have been part of the climate change policy debate for quite some time. Taken together, these changes on the demand side, as well as the renewable standard, will have a substantial impact on the need for new non-renewable generation and undermine the long-term feasibility of building these reactors.

Q. Would the cost of compliance of fossil fuels be affected as a result of these policies?

A. One would expect that it would. Decreasing demand for allowances due to the efficiency and renewable policies and access to low cost offsets would depress the price. In its “Key Assumptions” FPL has increased the price of carbon compliance above the highest level from the 2007 analysis. As Exhibit MNC–4, page 1 shows, the long run price under all the environmental scenarios has more than doubled. As Exhibit MNC-4, page 2 shows, the “Key Assumption price” is roughly equal to the Env II price. In 2040 the price is almost 50 percent higher than the EPA estimate of carbon costs in the wake of HR 2454. Over the 25-year period, the key assumption price on carbon is over 35 percent higher than the EPA price. In fact, the EPA prices are close to the Env I price.

TECHNOLOGICAL CONDITIONS

Efficiency and Renewables

Q. Should changing technological conditions factor into the analysis of the long-term feasibility of these reactors?

A. Yes. While climate policy is seen as giving a direct advantage to reactors by putting a price on carbon, that policy does much the same for other technologies. In fact, there are ways in which the alternative technologies are likely to receive an even larger boost. There are also many programs targeted at various technologies that are in earlier stages of development that may enjoy larger cost reductions as the science advances and the scale of production ramps up.

I believe there are three technological developments that are shifting the terrain in ways that disfavor nuclear reactors – the availability and cost of conserved energy, the availability and cost of renewables, and the availability and cost of nuclear reactors.

Q. Please describe the emerging terrain for efficiency technologies.

A. There is a growing consensus that the cost of many alternatives is lower than that of nuclear reactors. For efficiency, the change in the terrain is largely a matter of increasing confidence that substantial increases in efficiency are achievable at relatively low cost. The detailed analysis of potential measures and the success of some states at reducing demand through energy policies have increased the confidence that efficiency is a reliable option for meeting future needs for electricity by lowering demand, as shown in Exhibit MNC-5.

I believe that the technology of efficiency has come into much sharper focus in the past year. Numerous studies of the potential for and cost of improvements in efficiency in the residential, commercial and industrial sectors have shown that large quantities of energy can be saved at relatively low cost, as summarized in Exhibit MNC-5. One study was done specifically for Florida, which found that aggressive policies to reduce energy consumption could lower demand by 20 percent at a cost of less than 3.5 cents per kWh.

Thus, independently of any regulatory mandate, as the technology of efficiency is proven out, the Commission should consider greater reliance on it as part of the least cost approach to meeting the need for electricity. The combination of regulatory and technological changes will drive efficiency into the electricity sector, undermining the long-term feasibility of the reactors.

Q. Please describe the emerging terrain of renewables.

A. The concern with climate change has sharpened the focus on the cost and availability of renewable technologies. For renewables, the change is in strong cost reductions that are expected as new technologies ramp up production. In half a dozen studies the cost of alternatives that included renewables and/or efficiency, every analyst found several non-fossil resources less costly than nuclear.

The only two technologies on which there is a wide difference of opinion about cost are solar photovoltaics and nuclear. The other technologies included in recent studies there is much better agreement. The combination of regulatory and technological changes will drive renewables into the electricity sector, undermining the long-term feasibility of the reactors.

Q. How do the regulatory and technology changes alter the context for assessing the long-term feasibility of these reactors?

A. They dramatically alter the context. HR 2454 intends to lower demand for nonrenewable generation resources. It could do so significantly. The renewable energy standard ("RES") builds to 20 percent by 2022. Improvements in the building codes start quickly with a 30 percent reduction in consumption from new buildings by 2010 and build to a 50 percent reduction by 2014 for residential building and 2015 for commercial buildings. Additional improvements of 5 percent are called for every three years after 2017/2018. Revenue for retrofitting of existing buildings would begin when the allowances go into force. Appliance efficiency standards will unfold over time. Studies by the American Council for an Energy Efficient Economy suggest that the building codes, appliance standards and retrofitting of existing buildings could lower demand by as much as 7 percent. The renewable energy standard would be on top of the building code, appliance standards and retrofit impacts, pushing the theoretical total reduction of demand for nonrenewable generation past 25 percent, but there are a number of mechanisms that would lower that impact. In particular, states that cannot or choose not to expand renewables can make alternative compliance payments of $25 per MWh to states that exceed the combined efficiency renewable energy standard.

On a national average basis, the EPA projects a 10 percent reduction in demand and growth in renewables equal to 1.1 percent of demand.[65] An earlier analysis suggests the weatherization program in the American Recovery and Reinvestment Act would lower demand by 1.4 percent.[66] The impact varies from state-to-state, however. The American Council for an Energy Efficient Economy estimated the impact of the improvement in building codes and appliance standards in Florida would be 20 percent above the national average.[67] In a state where so much efficiency is available at less than 2.5 cents per KWh, it would make sense to petition for the maximum efficiency contribution to the RES (8 percent) and develop as much renewable energy as is economic, before sending money to California, Washington, Minnesota and Massachusetts. Combining these factors, a reasonable range for the impact on Florida would be a 10 to 20 percent reduction in the demand for non-renewable generation.[68]

---

[65] EPA Analysis of toe American Clean Energy and Security Act of 2009 H.R. 2454 in the 111th Congress, 6/23/09, p. 26

[66] Contrast EPA Analysis of toe American Clean Energy and Security Act of 2009 H.R. 2454 in the 111th Congress, 6/23/09, p. 26, with EPA Preliminary Analysis of toe Waxman Markey Discussion Draft: American Clean Energy and Security Act of 2009 H.R. 2454 in the 111th Congress, 4/20/09, p. 23. the former includes the effect of the ARRA in the reference case, the latter does not. I attribute the difference to the ARRA

[67] Energy Savings from Codes and Standards Count Towards EERS Savings Goals, available at http://www.aceee.org/energy/national/EERScssavings.pdf

[68] The American Council for and Energy Efficient Economy puts the savings from Title I and Title II of HR2454 at 5.4 quds in 2020 and 12.2 quads in 2030. These savings work out to 12.2 percent of the energy consumed in the electricity sector and in 2020 and 25.6 percent of the energy consumed in 2030 (see HR. 2454 Addresses Climate Change Through a Wide Variety of Energy Efficiency Measures, available at http://www.aceee.org/energy/national/HR2454_Estimate06-01.pdf)

Q. What impact does including the efficiency and renewable policies in HR 2454 have on FPL's projections for load growth and demand for nonrenewable resources such as nuclear reactors?

A. They would have a major impact. The 20 percent scenario is described in Exhibit MNC-6, page 1. Under this scenario, FPL does not reach the peak for 2017 projected in the Need Docket until 2036. Exhibit MNC-6, page 2 presents the 10 percent scenario, and under this scenario, FPL does not reach the peak projected in the Need docket for 2017 until 2028. The combination of the great recession and H.R 2454 climate policy extends the decision horizon by one to two decades. In an uncertain environment, that is a lot of breathing room. Utilities should be managing their resources to accommodate this shift and the first thing they should do is take the least flexible projects out of the queue, such as new nuclear reactors.

NUCLEAR REACTOR COSTS

Q. Pleases describe the uncertainties about the cost of nuclear reactors.

A. For nuclear reactor costs, the evidence on technology points in the opposite direction. Early in this decade vendors and contractors at the Department of Energy produced very low estimates of the cost of nuclear reactors, claiming that things have changed since the first generation of reactors. In the eight years since those initial, promotional studies were released, the estimate of the cost of nuclear reactors has increased dramatically, especially among Wall Street and independent analysts. As long as the costs placed before the Commission are "non-binding," the Commission must be aware of the growing uncertainty about the cost of nuclear reactors. As long as they are "non-binding," the prospect of cost escalation places ratepayers at risk, especially where costs for construction work in progress is being granted.

In fact, the extreme uncertainty about nuclear reactor costs has caused FPL to create a whole new framework for evaluating options. As FPL put it in the Need Docket:

> The second difference in the economic analysis approach step that developed the CPVRR costs for the resource plans is that no generation or transmission capital costs associated with Turkey Point 6 & 7 were included in the analysis. The reason for this is that *FPL does not believe it is currently possible to develop a precise projection of the capital cost associated with new nuclear units with in-service dates of 2018-on.* Consequently, FPL's economic analysis approach normally used to evaluate generation options has been modified to include a second economic analysis step." ("Need Study for Electrical Power, Docket No. 07-0650-EI, Florida Power and Light Company, October 16, 2007, pp. 104-105, emphasis added).

In the 21 months since that statement was made, there have been dozens of studies of the projected costs of nuclear reactors. The cost in 2008 $ have ranged from a low of just under $2400/kW to a high of just over $10,000/kW.

As described in the FPL need study, FPL's cost estimate was derived from an early low estimate for a different type of reactor and its current estimates remain in the low range of projections. Each of FPL's estimates (low, middle and high) is in the bottom quarter of the comparable estimates. The wide range of cost scenarios considered within each of the studies attests to the uncertainty that afflicts all of the studies and to which FPL has testified.

The two conclusions I would draw from this analysis are (1) the range of costs considered by FPL is narrow and too low and (2) the uncertainty is huge. This only reinforces my opinion that the prudent course would be to avoid rigid, expensive choices, especially if there is time to let the uncertainties diminish before decisions must be made.

FINANCIAL CONDITIONS

Q. What financial factors are affecting the long-term feasibility of these reactors?

A. There are two categories of factors – the general financial environment and the specific plant finance. The general environment for raising large sums of money has clearly deteriorated. Money is tight. How long that will last and the nature of the long-term environment remains to be seen.

In a sense, the marketplace, regulatory and technological risks combine with the nature of nuclear reactors to create the severe financial risk that nuclear reactors face. The financing of the construction of large nuclear reactors has also come under greater scrutiny by Wall Street.

Thus, the Commission needs to be sensitive to the potential financial risks of these plants. Credit downgrades raise the cost of capital and can have a significant impact on the cost of electricity and undermine not only the long-term feasibility of the reactors, but also the viability of the utility.

Let me stress again that the importance of uncertainty is a key fact for the Commission to take into account and the importance of demand projections. One of the key factors contributing to the bust of the nuclear boom of the 1970s was the inability or unwillingness of utilities that had become committed to nuclear construction to cope with reduced demand growth. The oil price shocks of the 1970s and the rate shock of the 1980s destroyed the demand that the nuclear reactors were intended to supply.

Today we have a similar demand shock created by the great recession and the pending climate change policy. It is highly unlikely that demand will reach the levels predicted in the Need Dockets for decades. Between the two utilities, FPL and Progress have lowered their projection of peak demand for 2017 by almost 3700 MW. That is equivalent to the capacity of three of the four units they are planning to build. Climate change policy could reduce the need for nonrenewable capacity by another 3300 to 6600 MW in their service territories in the next two decades. The chance that Florida will actually need these four reactors should climate change legislation be enacted along the line of HR 2454 is virtually zero. If climate change legislation were not enacted now or in the future, the carbon compliance prices assumed by the companies would not come to pass. In that case, the reactors could not be justified on economic grounds. Either way, these reactors are not feasible in the long-term.

Q. Please summarize your conclusions.

A. The small cost advantages claimed for these nuclear units in the future underscores how important all of the changing conditions I have identified are. The Florida legislature has created an environment that provides incentives for nuclear reactors, but it has not written a blank check nor created a blindfold. The utilities and the Commission must act prudently within the confines of the incentive structure the legislature has established. In this prudence review the utilities ask for cost recovery for these proposed nuclear reactors by constructing an economic analysis that gives nuclear a slight, or 4-5 percent, cost advantage. However, that analysis rests on a series of assumptions that are no longer consistent with reality, if they ever were – high demand growth, very little contribution from efficiency and renewables, high fossil fuel costs, and low nuclear reactor costs.

My testimony has identified seven factors that are moving strongly against nuclear reactors. Any one of the seven could reverse the conclusion reached by the utilities that nuclear reactors are less expensive.

Slowing demand growth due to a major shift in the economy

Moderating natural gas prices

Federal policies to require a growing role of efficiency and renewables

Moderating CO2 compliance costs

Improving technology and cost of efficiency

Improving technology and cost of renewables

Escalating nuclear reactor costs.

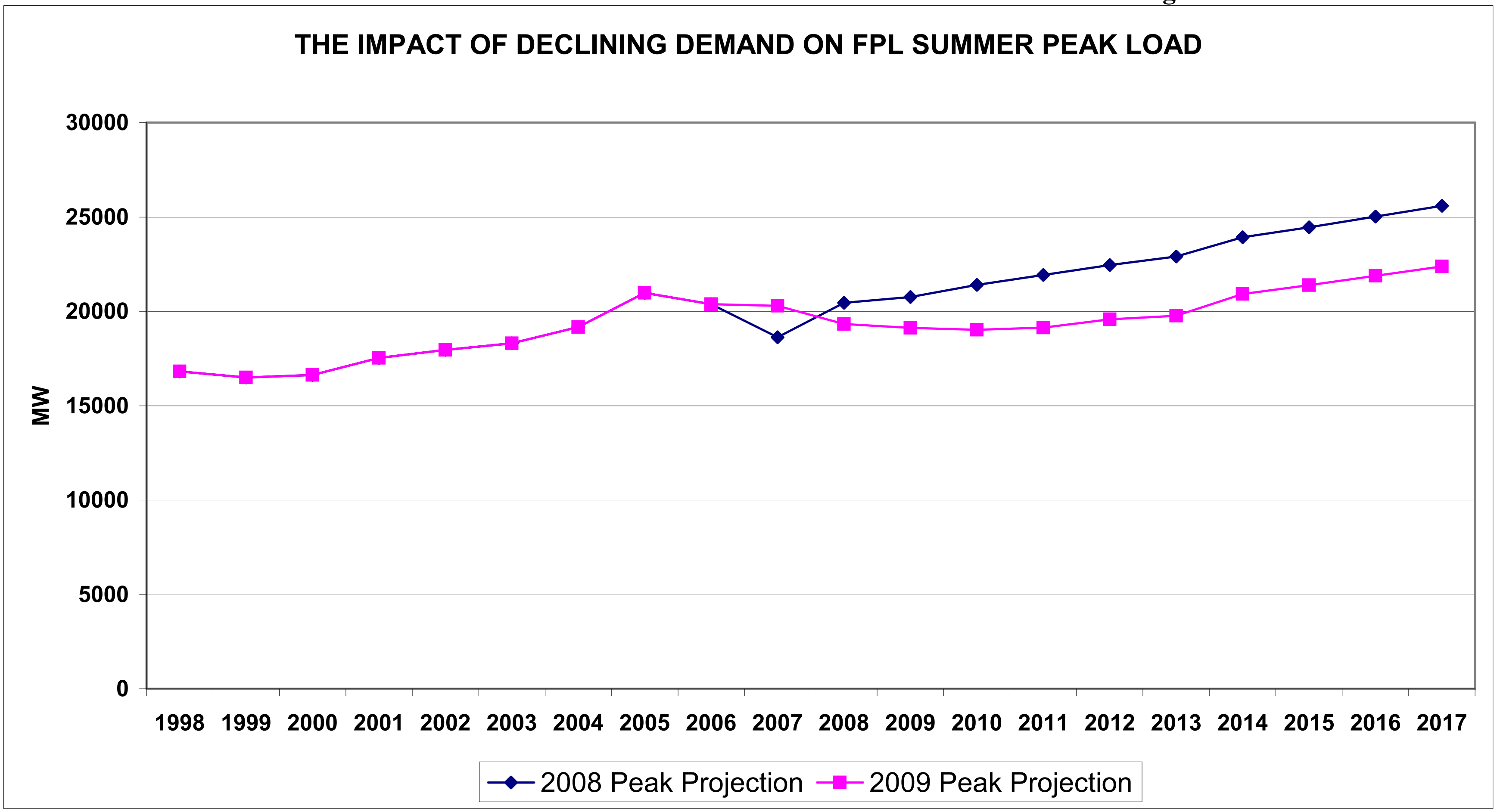
Given that all seven of these factors are moving strongly against nuclear reactors, it is highly likely that the reactors will cost consumers much more than the alternatives. And, given that relatively little has been spent on the proposed reactors now, this is the moment for the Commission to take the required hard look at the long-term feasibility of the completion of these reactors. Spending more on nuclear reactors and allowing the utilities to recover those costs from ratepayers would be imprudent.

Q. Does this conclude your testimony?

A. Yes it does.

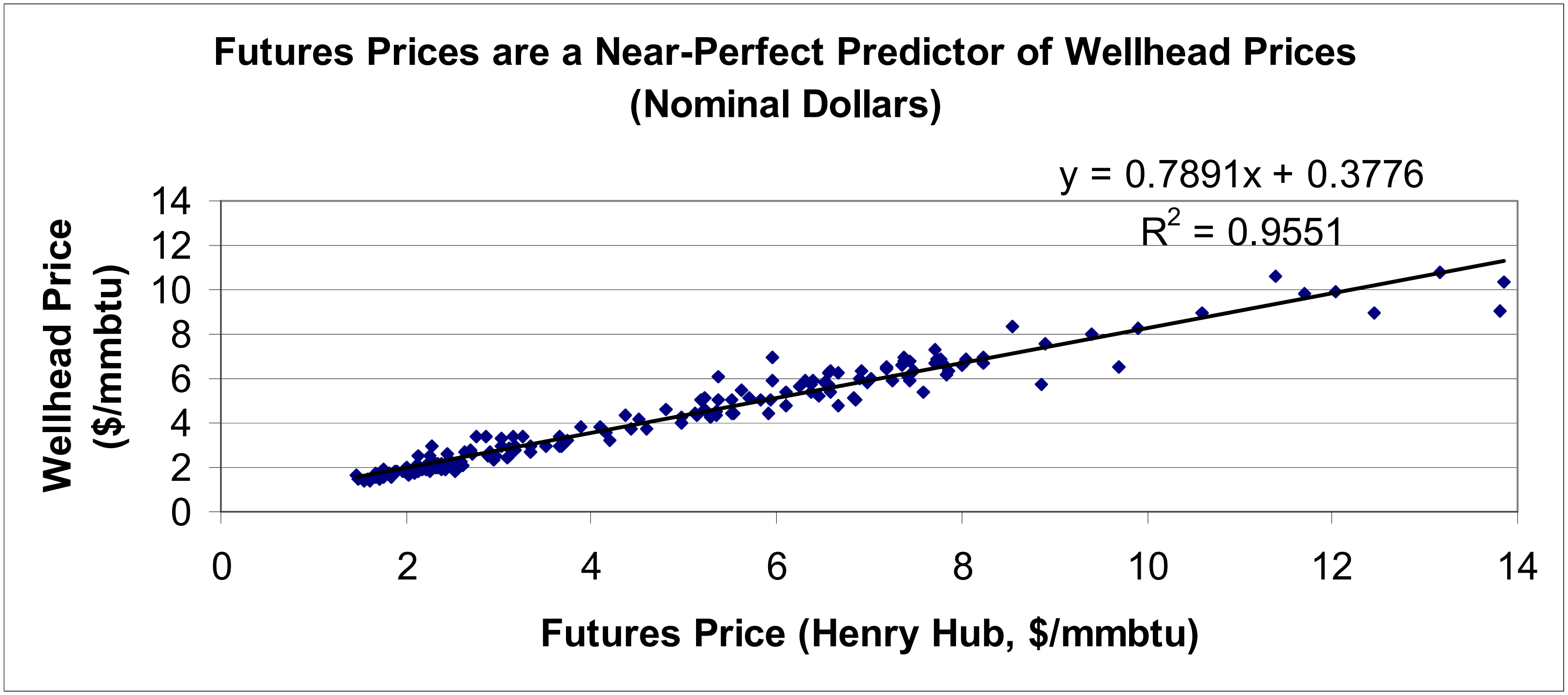
EXHIBITS ACCOMPANYING DIRECT TESTMONY OF MARK N. COOPER

Docket No. 090009-EI
Exhibit MNC-1
Page 1



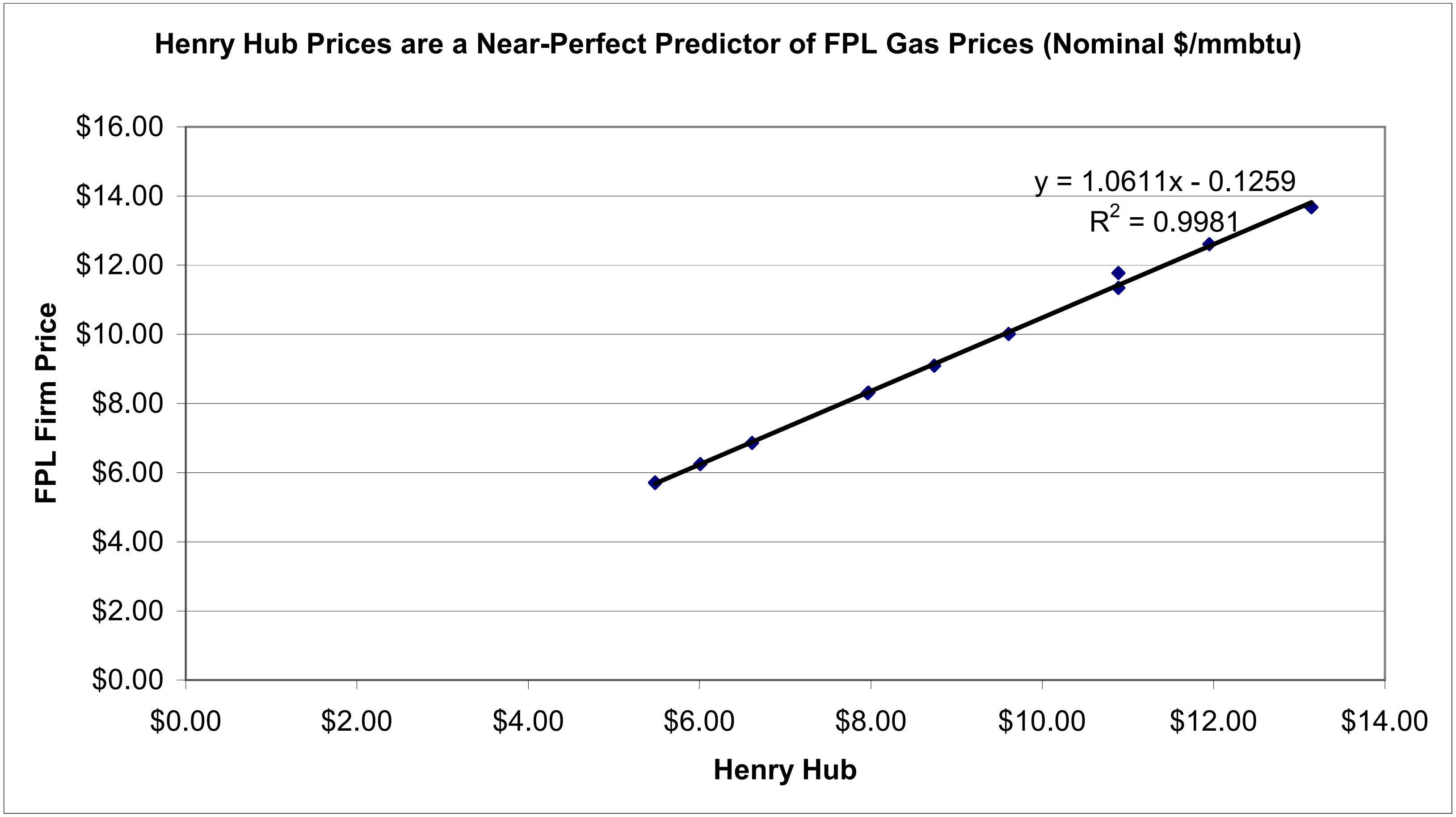
Source: 2008 10-year plan, p. 40; 2009 10-year plan, p. 45.

NATURAL GAS WELLHEAD, HENRY HUB AND FUTURES PRICES



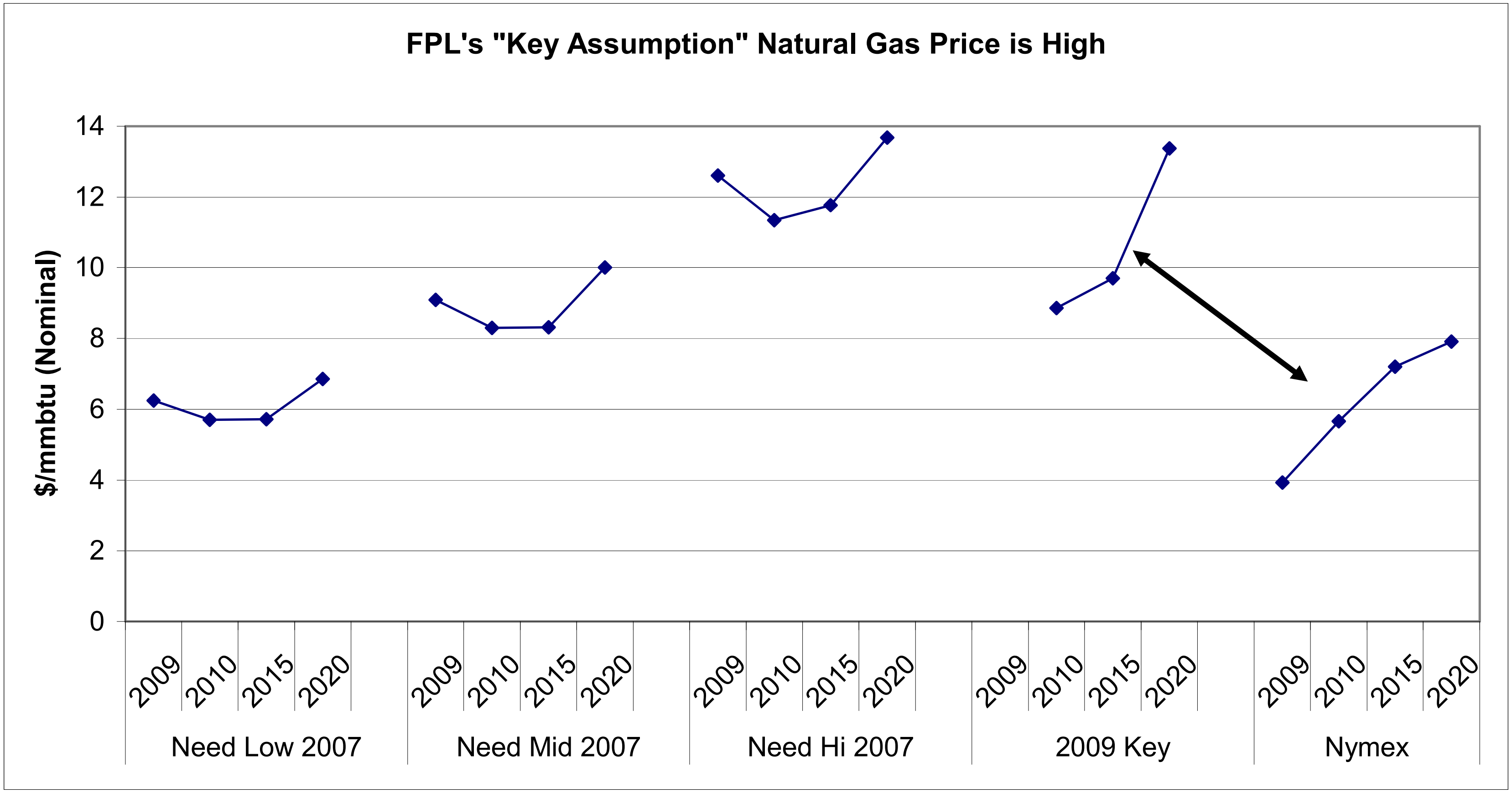
Source: Energy Information Administration: http://tonto.eia.doe.gov/dnav/ng/ng_pri_fut_s1_m.htm, http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm, visited 7/11/2009

NATURAL GAS WELLHEAD, HENRY HUB AND FUTURES PRICES



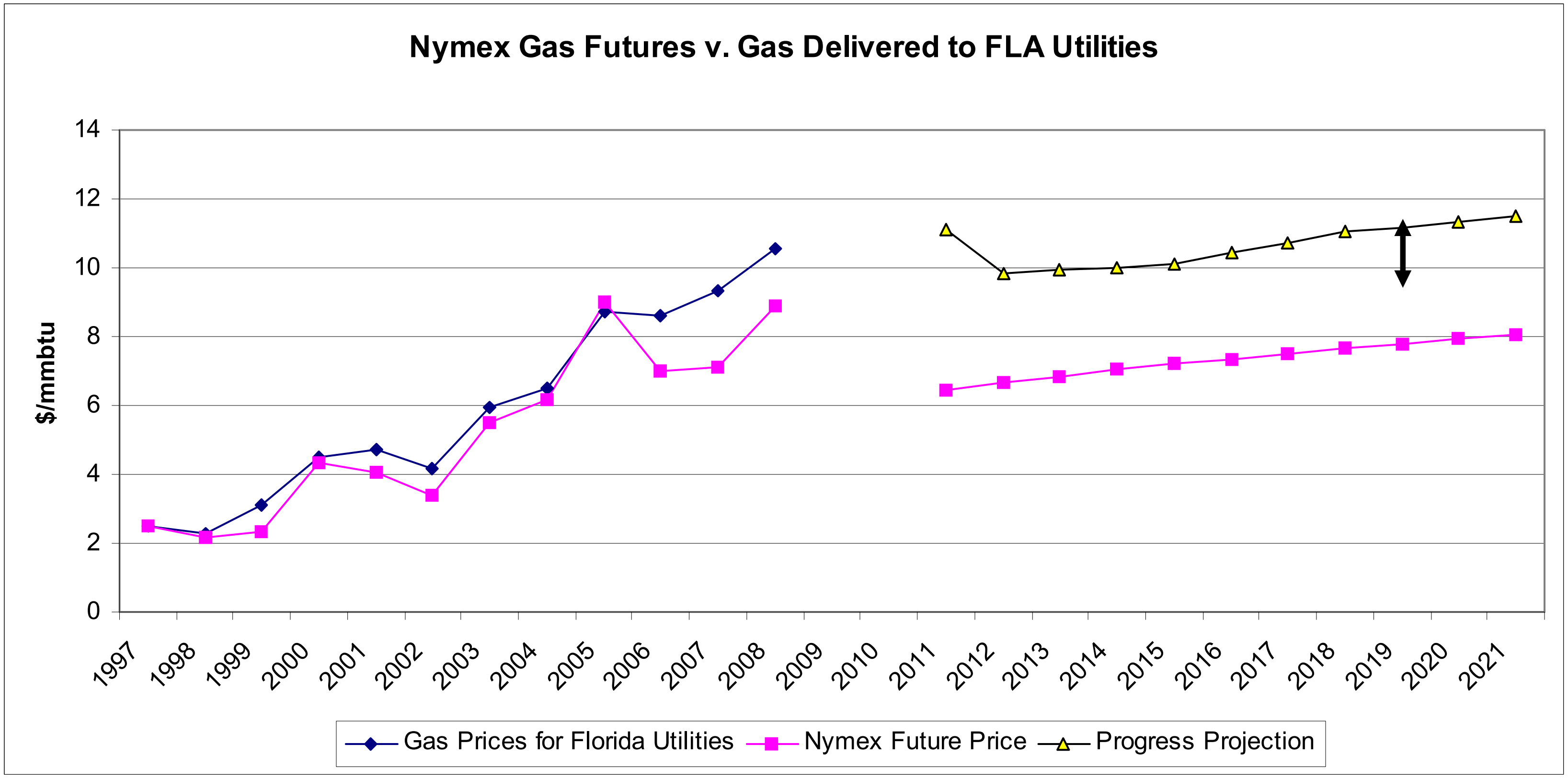
Source: FPL Need Study for electrical Power Docket No. 07-0650, Appendix E

PROJECTED NATURAL GAS PRICES COMPARED TO NYMEX FUTURES PRICES



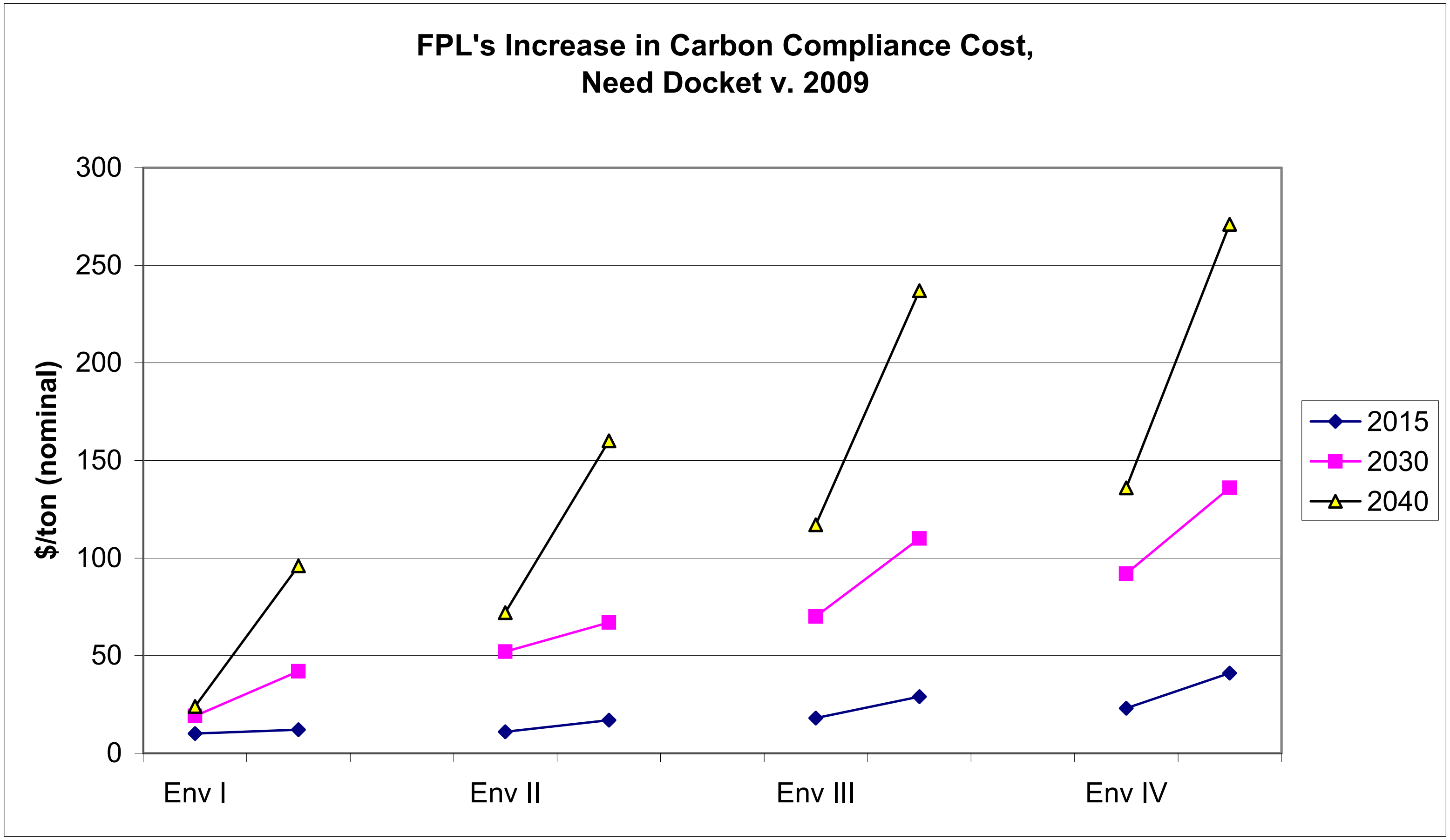
Source: FPL Need Study for Electrical Power Docket No. 07-0650, Appendix E;
Nymex Futures Contract, http://www.nymex.com/ng_fut_csf.aspx, visited 7/11/2009

PROJECTED NATURAL GAS PRICES COMPARED TO NYMEX FUTURES PRICES



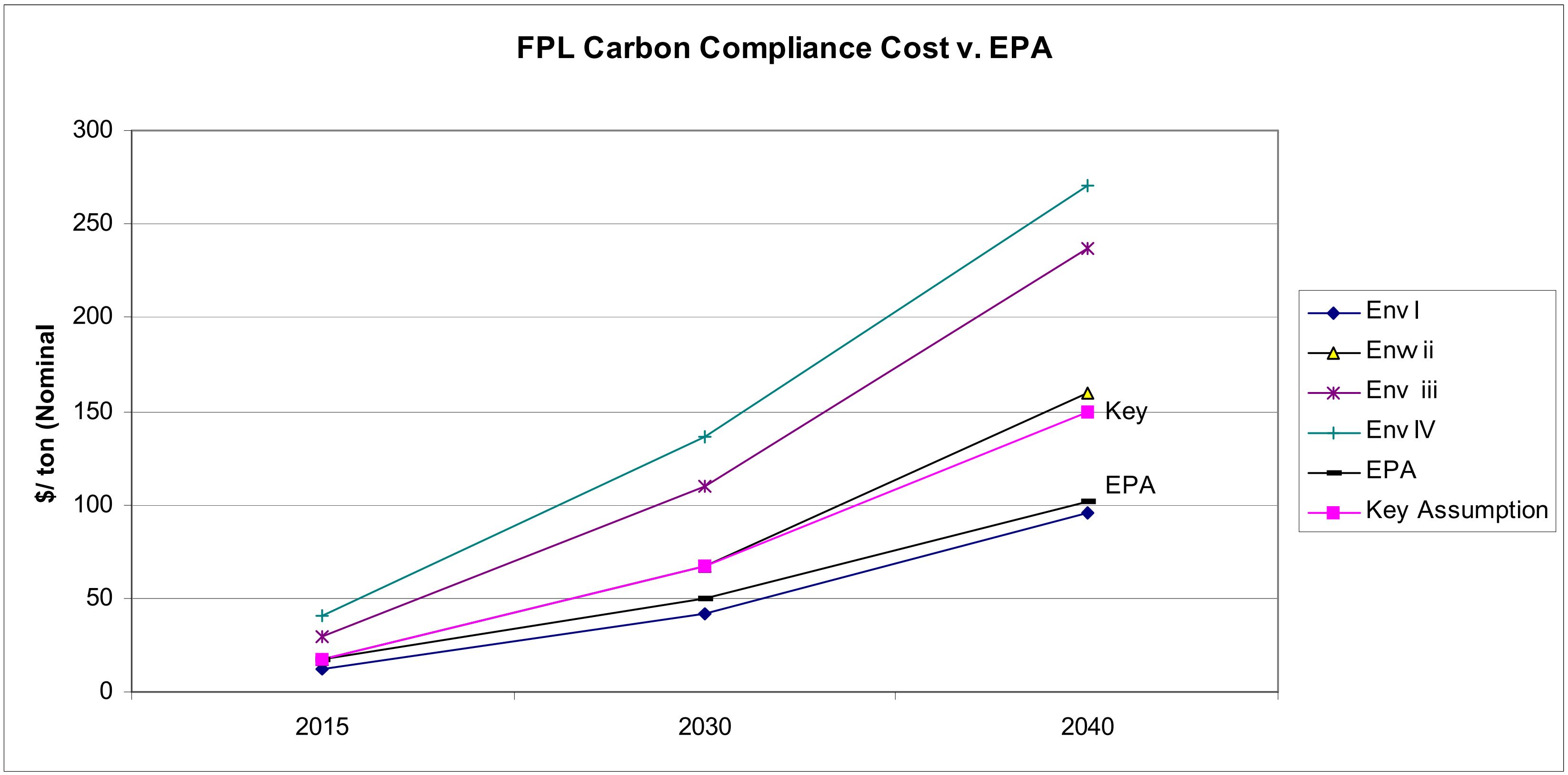
Source: Testimony of Garry Miller, Docket No. 090009, May 1, 2009, Exhibit GM-1, page 2of 2; Energy Information Administration, Annual Natural Gas Futures Contract 1, http://tonto.eia.doe.gov/dnav/ng/xls/NG_PRI_FUT_S1_M.xls
Annual Florida Gas Price Sold to Electric Power Companies; **http://tonto.eia.doe.gov/dnav/ng/hist/n3045fl3a.htm;**
FPL Need Study for electrical Power Docket No. 07-0650, Appendix E;
Nymex Futures Contract, http://www.nymex.com/ng_fut_csf.aspx, visited 7/11/2009

PROJECTIONS OF CARBON COMPLIANCE COSTS



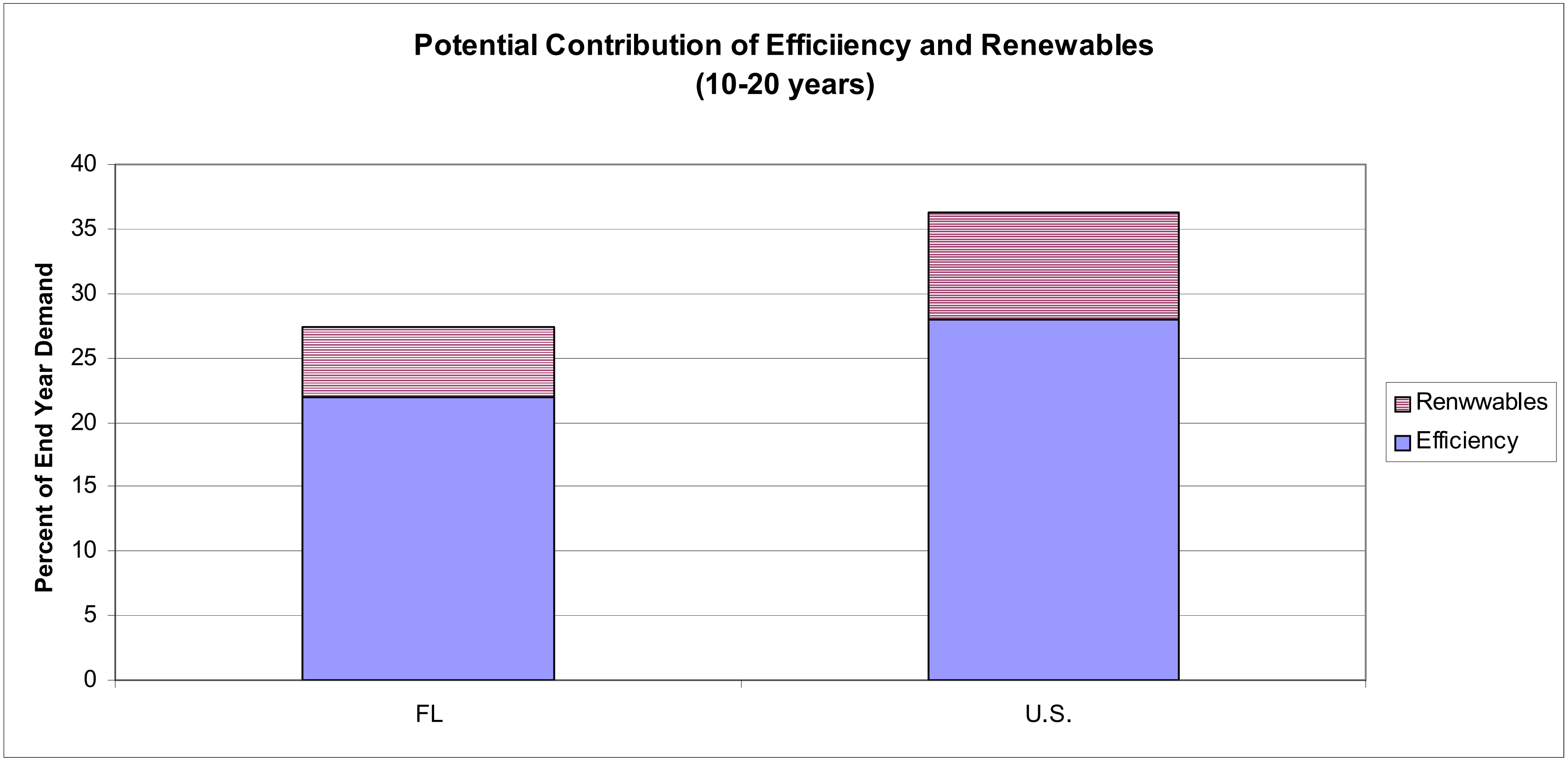
Source: Florida Power and Light, Need Study for Electrical Power, Docket No. 070650-EI, Appendix F, page 3 of 4; Florida Power and Light Docket No. 090009 EI, OPC's Third Set of Interrogatories, Question No. 47, p 1 of 2.

PROJECTIONS OF CARBON COMPLIANCE COSTS



Source: Florida Power and Light, Docket No. 090009 EI, OPC's Third Set of Interrogatories, Question No. 47, p 1 of 2; EPA Analysis of toe American Clean Energy and Security Act of 2009 H.R. 2454 in the 111th Congress, 6/23/09, p. 14, using the highest price and converting real to nominal dollars at the 2.5% rate of inflation assumed by FPL

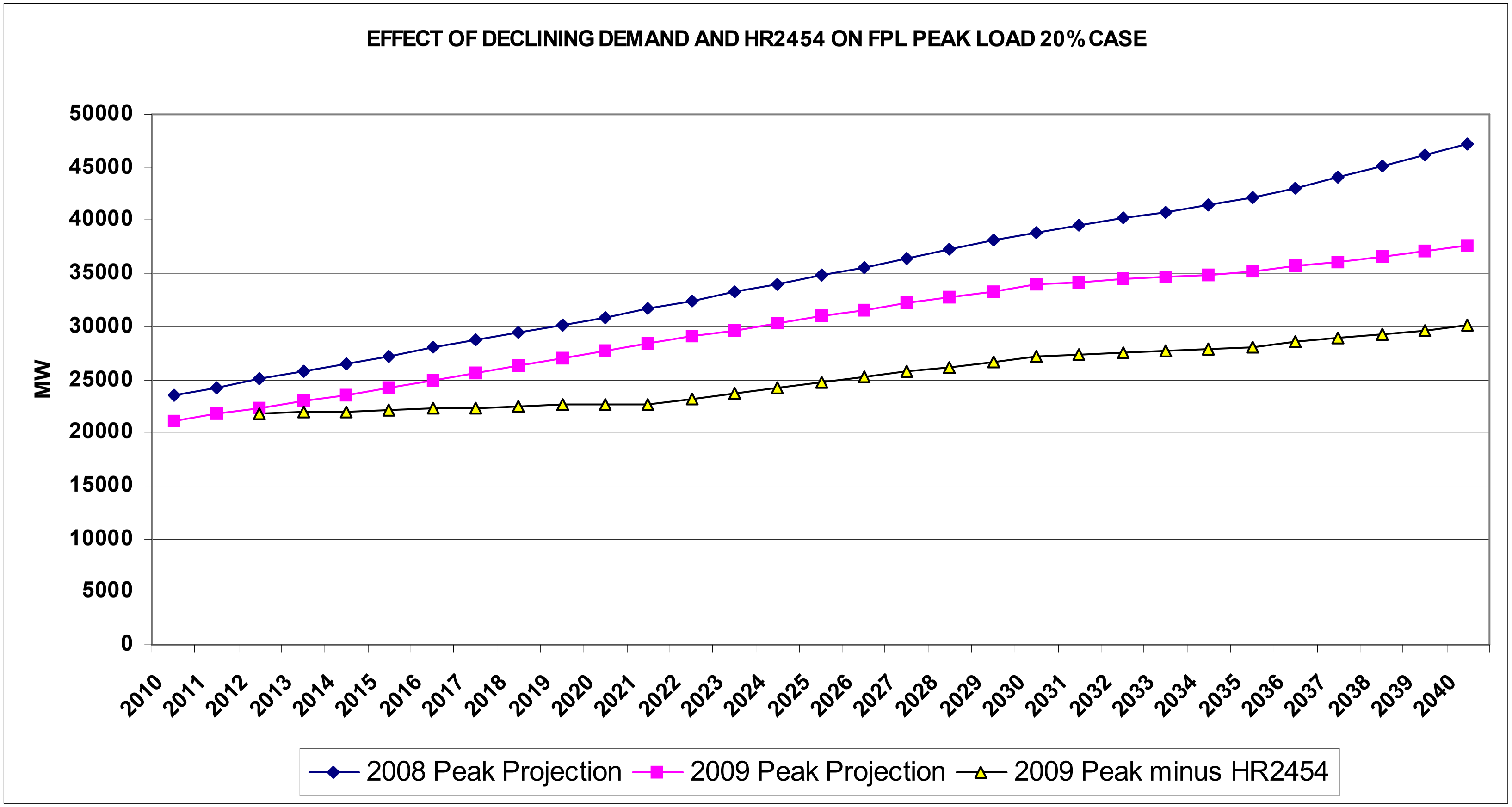
ESTIMATES OF POTENTIAL MID-TERM EFFICIENCY SAVINGS



ESTIMATES OF POTENTIAL MID-TERM EFFICIENCY SAVINGS (Sources)

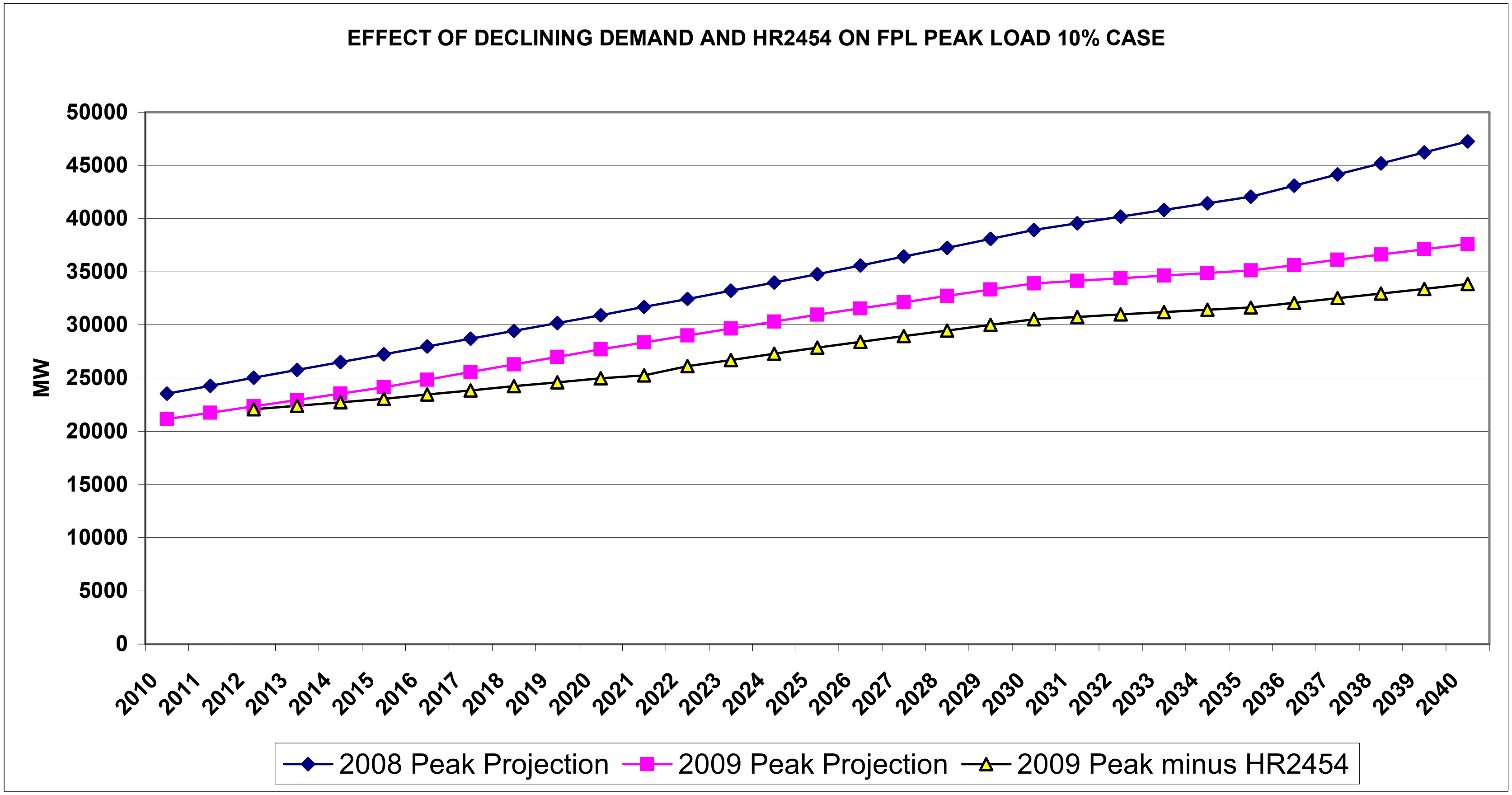
Source: **Florida is from Elliott, R. Neal, et al.** ***Potential for Energy Efficiency and Renewable Energy to Meet Florida's Growing Energy Demands,*** **American Council for an Energy Efficient Economy, June 2007, p. 9, 12. The national average is the simple average individual state studies in the following. American Council of an Energy- Efficient Economy, et al., 2009,** ***Shaping Ohio's Energy Future,*** **March 2009, p.13, 15, 17. American Council of an Energy-Efficient Economy, et al., 2008,** ***Energizing Virginia: Efficiency First,*** **September 2008, p. 14, 16, 18. American Council for an Energy-Efficient Economy, 2007, Howard Geller, et al.,** ***Utah Energy Efficiency Strategy: Policy Options,*** **November 2007. American Council for an Energy- Efficient Economy, 2007,** ***Energizing Virginia: Efficiency First,"*** **September 2008. Beck, Frederic, et al. 2002,** ***Powering the South: A Clean & Affordable Energy Plan for the Southern United States,*** **REPP, January 2002. Ecotope, Inc., American Council for an Energy-Efficient Economy, Tellus Institute, Inc., 2003,** ***Energy Efficiency and Conservation Measure Resource Assessment,*** **(Energy Trust of Oregon Inc., January 2003. Elliott, R. Neal, et al., 2007,** ***Potential for Energy Efficiency, Demand Response and Onsite Renewable Energy to Meet Texas' Growing Electricity Needs,*** **American Council for an Energy-Efficient Economy, March 2007. Laitner, John "Skip," Maggie Eldridge, and R. Neal Elliot, 2007,** ***The Economic Benefits of an Energy Efficiency and Onsite Renewable Energy Strategy to Meet Growing Electricity Needs in Texas,"*** **American Council for an Energy-Efficient Economy, September 2007. Optimal Energy Inc, et al., 2003,** ***Energy Efficiency and Renewable Energy Resource Development Potential in New York State,*** **August 2003. Prindle, William, R. Rooney, Tom, et al., 2004,** ***Estimating the Potential for Cost Effective Electric and Peak Demand Savings in Connecticut,*** **2004 ACEEE Summer Study on Energy Efficiency in Buildings, 2004. Southwest Energy Efficiency Project,** ***The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest,*** **November 2002, p. 3-13. Stoft, Steven,** ***The Economics of Conserved-Energy "Supply" Curves,*** **Program on Workable Energy Regulation, April 1995.**
Wyandotte Municipal Services Optimization Plan, Michigan Public Service Commission, Case No. U-18558, p. 6.

IMPACT OF CLIMATE POLICY ON PEAK LOAD: FPL



Source: Direct Testimony of Steven R. Sims, Docket No. 090009-EI, SRS-1;
linear interpolation of five-year interval data. H.R. 2454 is set at 20% below 2009 Peak Projection
454 is set at 20% below 2009 Peak Projection.

IMPACT OF CLIMATE POLICY ON PEAK LOAD: FPL



Source: Direct Testimony of Steven R. Sims, Docket No. 090009-EI, SRS-1;
linear interpolation of five-year interval data. H.R. 2454 is set at 10% below 2009 Peak Projection
454 is set at 20% below 2009 Peak Projection.

Appendix B:
NERA Reasons to Consider Waiting to Construction Until the Second Wave of Reactors

Technology Risk:

A second-wave project that can avoid commitment to a reactor design (or that can switch reactor designs without large costs) should be able to choose from several standard reactor designs that will have been approved by 2014. As these approved reactor designs start construction, the degree of detailed engineering will be much higher than today and the approach to construction (i.e., modular construction) will be better known. Second-wave projects may also be able to learn from the outcomes of first-wave EPC contracts.

While the timing remains uncertain, there is a possibility that one or more alternate reactor designs (e.g., micro-reactors and Generation IV reactors) now in the research and development phase will be commercially available as an option for a second-wave project.

A first-wave project may face higher risks and costs, including scarce nuclear industry resources… some degree of first-of-a-kind (FOAK) risks and higher costs.

Policy Risk:

It is possible that the US approach to control carbon emissions will be in place by 2014, allowing a second-wave project sponsor to better understand the financial implications for new nuclear power plants.

New nuclear plants may benefit from programs or taxes that are targeted at controlling carbon emissions. A year ago, there was hope that a change of administration would result in quick and clear action on controlling carbon. This has not happened and any real action on carbon control may be delayed or watered down or both as a result of the economic recession.

DOE loan guarantees are a critical item, so the current limits suggest that only 2 or 3 plants will be built in the first wave. DOE Loan guarantees for nuclear remain limited to $18.5 billion... Given the high cost estimates for new nuclear power plants, this will only cover a few nuclear units. Also, the terms, conditions, and costs of the DOE nuclear loan guarantees may not be attractive. DOE is reported to be negotiating with a short list of loan guarantee hopefuls; projects not in this short list may not have much chance of a loan guarantee.

Regulation Risk:

To the extent that a second-wave project has delayed the NRC COL process (i.e., the project has the ability to modify the COL application or other details), the lessons from the first-wave projects should provide a clearer view of the timing, issues, and potential for legal challenges to the COL process up to the COL approval point.

One or more new US nuclear power plants may have been built, approved, and placed into commercial operation, providing a much better view of how the NRC COL ITAAC process will work.

Regulated first-wave projects will have placed nuclear plant investments into rate base (and into rates), providing some lessons and guidance for second-wave project sponsors, state regulators, and others.

Execution Risk:

New nuclear power projects outside the US may be close to completion and some may have started commercial operation, reducing uncertainty about total project cost, construction times, reactor design operating performance, modular construction approaches, market success of reactor designs and vendors, and other issues.

Second-wave project sponsors as well as investors, regulators, and others will have a clearer view of the costs of new nuclear power plants and the time required to build them. The differences in cost, time to construct, and operating performance across reactor designs and vendors will also be much clearer.

The learning during construction of the first-wave nuclear plants may allow second-wave buyers to obtain lower costs, less risk, and shorter and more certain schedules from EPC vendors. Modifications to detailed designs and construction approaches to improve quality, lower cost, and shorten time in construction may also be available.

There will be even more experience with new nuclear plants outside the US. Reactor vendors that are not now in the US market may have entered the US market based on the success of build programs outside the US, giving second-wave buyers more options.

Nuclear build experience so far is mixed. There was some hope that nuclear project development experience outside the US would resolve uncertainties to the benefit of the US projects that would follow, but this has not yet happened. The Olkiluoto EPR project has experienced significant cost overruns and delays and is now in arbitration proceedings and the Chinese have just started construction on the first AP1000 unit.

The nuclear fuel cycle, including the used fuel disposition issue and approach to re-processing used nuclear fuel, may be more settled. Several new uranium enrichment facilities may be operational in the US and uranium market prices may be more stable.

Marketplace Risk:

The impact on electricity demand and the need for new baseload generation due to the current economic recession, the building of renewable generation, and other factors will be better known.

Demand for electricity is growing at a slower rate in many parts of the US as a result of the current economic downturn, so that the projected need for baseload capacity may be less and later than the capacity need projected a year ago. For some utilities with industrial customers, this may be a significant change.

Current nuclear power plant cost estimates are high, even though these estimates are considered conservative and may mean fewer cost overruns when the projects are completed. However, the recent cost estimates are much higher than cost estimates from only a few years ago. As these higher nuclear cost estimates are incorporated into generation expansion planning models and policy analyses, new nuclear power plants may no longer be the least-cost generation expansion option.

Financial Risk:

World financial markets are tight and financing any large capital project is difficult. Financing a new nuclear power plant would have been very difficult even without the financial crisis; with this crisis, it may not be possible to finance a new nuclear project. Financial markets will recover, but this may not happen in time for a first-wave project.

Also, the construction funding arranged by first wave developers may provide lessons for developers and lenders that will mean easier access to construction funding for second-wave projects. The real response of the stock market to new nuclear plant investment decisions will be known and will allow a second-wave sponsor to better assess its own decision to invest.

First-wave projects will have arranged and closed permanent financing, providing lessons and guidance for investors, lenders, and developers.

Source: Edward Kee, First Wave or Second Wave? It is time for US nuclear power plant projects with a first wave build strategy to consider moving to the second wave, NERA, July 24, 2009, pp. 4-6.