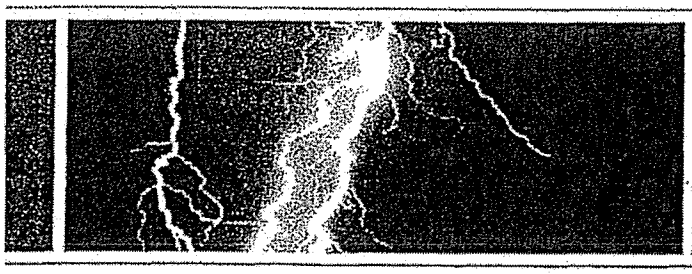
Synapse
Energy Economics, Inc.

Initial Report to the New Hampshire Senate Energy, Environment and Economic Development Committee on PSNH's Merrimack Station Scrubber Project

March 20, 2009



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Executive Summary

Background: Synapse Energy Economics, Inc, ("Synapse") was retained to assess the estimated cost of Public Service of New Hampshire's proposed Merrimack Station Scrubber Project and to investigate whether there are less expensive alternatives to the scrubber that would produce local jobs, reduce environmental impact, and avoid the risk of expensive future regulatory costs that would be borne by the citizens of New Hampshire.

Synapse Project Team: Members of the Synapse Project Team include David Schlissel, Christopher James, Dr. David White, Rachel Wilson, Dr. Jeremy Fisher, Dr. David Nichols, Douglas Hurley, Jennifer Kallay, Kenji Takahashi, Peter Lanzalotta and Bill Powers.

The Team's primary findings include:

1. There are technically and economically viable alternatives to the Scrubber Project for reducing the mercury and SO_x emissions from the Merrimack Station that are in regular use at coal-fired power plants around the United States.
2. PSNH significantly understates the possible future cost of power from the Merrimack Station and, therefore, substantially overstates the benefits from the scrubber project. In fact, the future cost of power from the Merrimack Station is likely to be between 10 and 47 percent higher than PSNH has claimed if more reasonable prices are assumed for purchasing carbon dioxide emissions prices under a federal greenhouse gas regulatory program.
3. There are a large number of cost-effective alternatives to generating power at the Merrimack Station, including, but not limited to, purchasing power from the market and energy efficiency.
4. Energy efficiency programs and developing alternative resources would create large numbers of new jobs.
5. PSNH has a significant financial interest in pursuing the Merrimack Station Scrubber Project.
6. PSNH has acknowledged that the contracts it has signed for the Scrubber Project are not "fixed price" contracts.

Finding 1. There are technically and economically viable alternatives to the Scrubber Project for reducing the mercury and SO_x emissions from the Merrimack Station that are in regular use at coal-fired power plants around the United States.

There are a number of ways to effectively reduce emissions of Mercury and SO_2 from coal-fired power plants like Merrimack Station in place of installing an expensive scrubber.

For example, a number of coal plants around the country, including plants with cyclone boilers like those at Merrimack Station, burn low sulfur coal and use Activated Carbon Injection to control SO_2 and mercury emissions. A few examples of the coal plants that do so include the Bridgeport Harbor plant (Connecticut), BL England (New Jersey), Powerton (Illinois), Joliet (Illinois), and Kincaid (Illinois). These coal-fired plants have reduced mercury and sulfur emissions, or are in the process of doing so, to meet or exceed their current state regulatory requirements. These state requirements are equal to or more stringent than New Hampshire's Clean Power Act requirements. Illinois' regulation requires 90% mercury reduction. Connecticut's regulation requires compliance with a 0.6 pounds mercury per trillion Btu heat input.

All of the Illinois plants previously listed have cyclone boilers like Merrimack. Because of their strict rule that impacts 57 coal units in that state, there are many more coal units in Illinois subject to strict mercury control requirements that will be using ACI for Hg compliance. In fact, the Institute of Clean Air Companies has reported over 90 ACI systems ordered or in service, many of these for use with low sulfur coal.

Low sulfur coal can be purchased from the Powder River Basin. Some of the plants listed above, and many others, including some on the east coast, have been converted to burn low sulfur Powder River Basin coal. And a number of the plants, such as Powerton, Kincaid and Joliet in Illinois, have cyclone boilers like Merrimack. Other low sulfur coal options include coal from Indonesia and South America, similar to what has been burned at some of the Dominion plants in Massachusetts and the Bridgeport Harbor plant in Connecticut.

If the Merrimack Station were converted to Powder River Basin coal, or another coal with similar sulfur levels, it should be possible to achieve 90 percent mercury removal using ACI and to also reduce SO_2 emissions due to the low sulfur content of the coal. Flue gas from Powder River Basin coal has little or no SO_3 present, in part, because of the low sulfur content. SO_3 is the culprit that poisons activated carbon and is why previous ACI tests at Merrimack showed limited results. Therefore, ACI can be very effective at capturing mercury from flue gas from PRB-fired boilers. Ninety percent reductions in mercury emissions have been achieved on PRB fueled boilers.

The reports on the past tests of ACI at Merrimack show that these tests were run with fuel blends that resulted in mid-to-high sulfur coal. This, combined with the SCR, resulted in high levels of SO_3 in the flue gas. The problem with SO_3 is that it competes with the mercury to be absorbed on the surface of carbon. So, when there are significant levels of SO_3 present, ACI becomes less effective at capturing mercury.

Another option would be to retrofit Merrimack with a fabric filter. A fabric filter would enable high mercury capture with ACI, and potentially little need for the ACI. This option would have higher capital costs than switching to low sulfur coal with ACI, but it would be much less expensive than a scrubber.

Finding 2. **PSNH significantly understates the possible future cost of power from the Merrimack Station and, therefore, substantially overstates the benefits from the scrubber project. In fact, if more reasonable prices are assumed for purchasing carbon dioxide emissions prices under a federal greenhouse gas regulatory program, then the future cost of power from the Merrimack Station is likely to be between 10 and 47 percent higher than PSNH has claimed.**

PSNH has not adequately quantified the future rate impacts of the Scrubber Project and the relative cost of power from Merrimack Station versus energy efficiency and other alternatives. The most important cost that PSNH has underestimated is the cost of purchasing allowances for future carbon dioxide ("CO_2") emissions in a federal cap-and-trade program.

Federal regulation of greenhouse gas emissions is a matter of when, not if. Both Houses of Congress and the new Obama Administration have stated their intent to adopt a plan to significantly reduce the nation's emissions of greenhouse gases, most particularly, CO_2. The federal government (through the Department of Energy), large financial institutions, and numerous state regulatory commissions, have concluded that it is now necessary to include carbon costs (that is, the price of purchasing CO_2 emissions allowances) in energy resource planning.

The plan proposed by the new Administration is typical of the stringent plans that have been introduced in Congress and would:

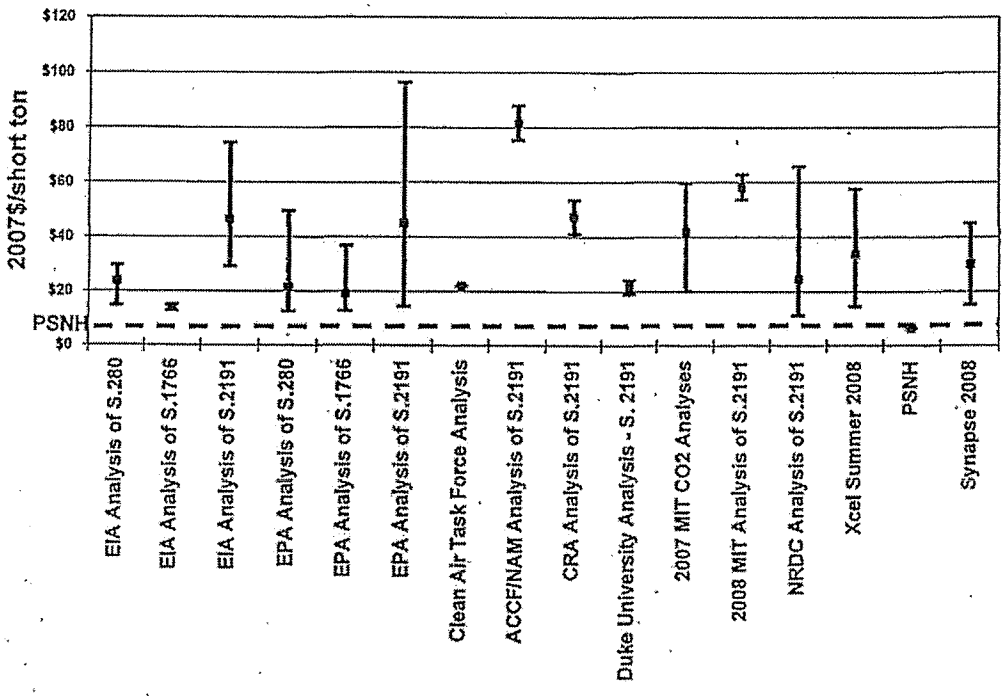
- create a federal cap-and-trade system
- require that CO2 emissions be reduced to 14 percent below 2005 levels by 2020 and 83 percent below 2005 levels by 2050
- auction all emissions allowances – none would be distributed free to generators.

Because there is currently no commercially viable technology for capturing and sequestering the CO_2 emissions from coal-fired power plants and none is anticipated to be available for 10-20 years, companies like PSNH will have to purchase allowances for the CO_2 emitted by their power plants. The estimated cost of such emissions allowances is, therefore, a critical input into the expected future cost of generating power.

PSNH, however, has assumed a price for the cost of future CO_2 regulations that is significantly below the costs projected in objective analyses by the U.S. Department of Energy, the U.S. EPA, the Massachusetts Institute of Technology, and Duke University. The figure below shows the levelized cost estimates for CO_2 allowances as modeled by

these agencies and universities compared to the estimated used by PSNH in its analysis of the future costs for power from the Merrimack Station.

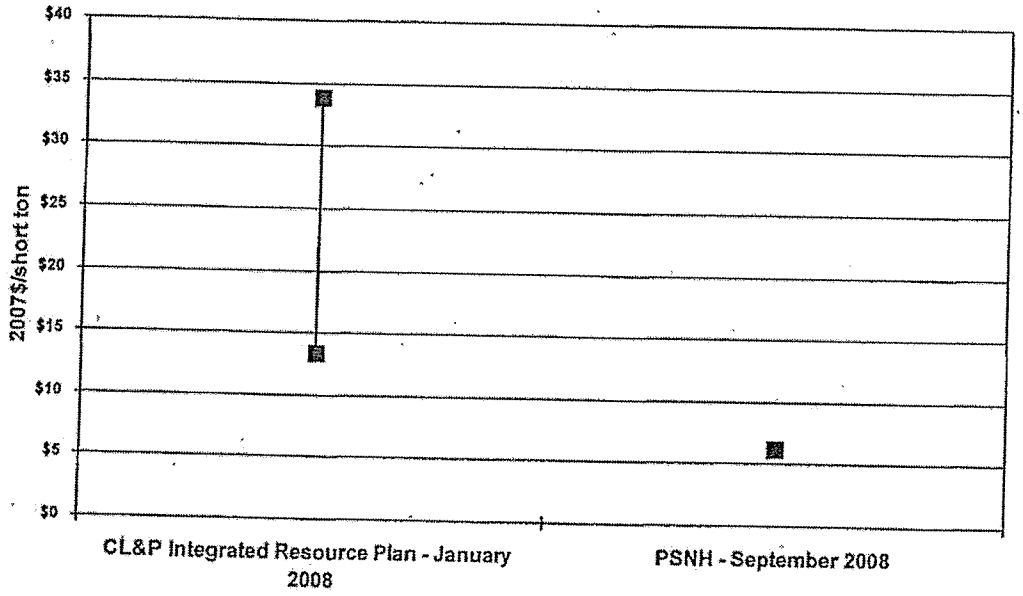
Projected CO2 Emissions Allowance Prices – PSNH vs. Results of Independent Modeling of Climate Change Legislation[1]



As can be seen below, PSNH even has assumed future prices for purchasing CO_2 emissions allowances that are significantly lower than another NU-owned utility, Connecticut Light & Power Company, assumed in its 2008 Integrated Resource Plan filing to the Connecticut Department of Public Utility Control.

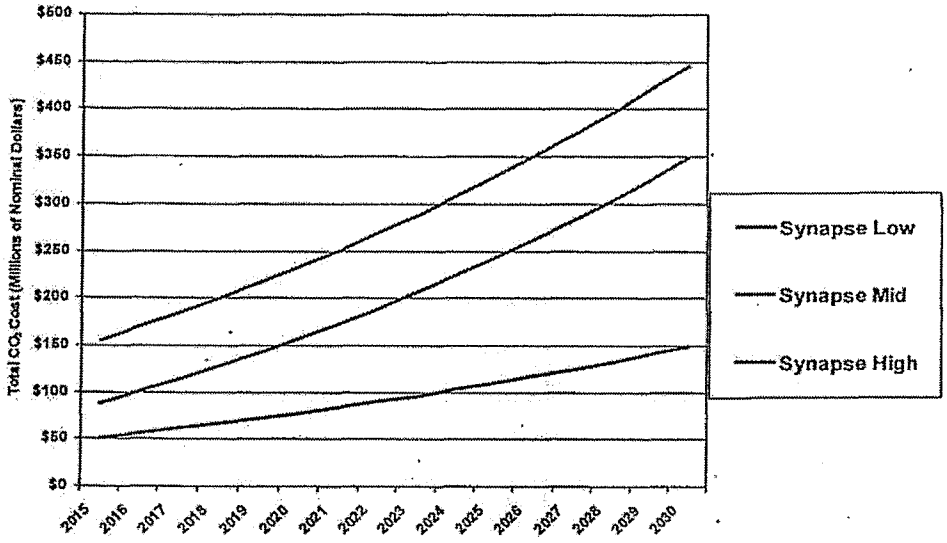
[1] See the *Synapse 2008 CO2 Price Forecasts*, July, 2008, for more information on the analyses presented in this figure and the factors underlying the range of future CO2 prices that Synapse recommends be used in resource planning. A copy of this report is available at http://www.synapse-energy.com/Downloads/SynapsePaper.2008-07.0.2008-Carbon-Paper.A0020.pdf.

Assumed CO2 Emissions Allowance Prices – PSNH vs. CL&P



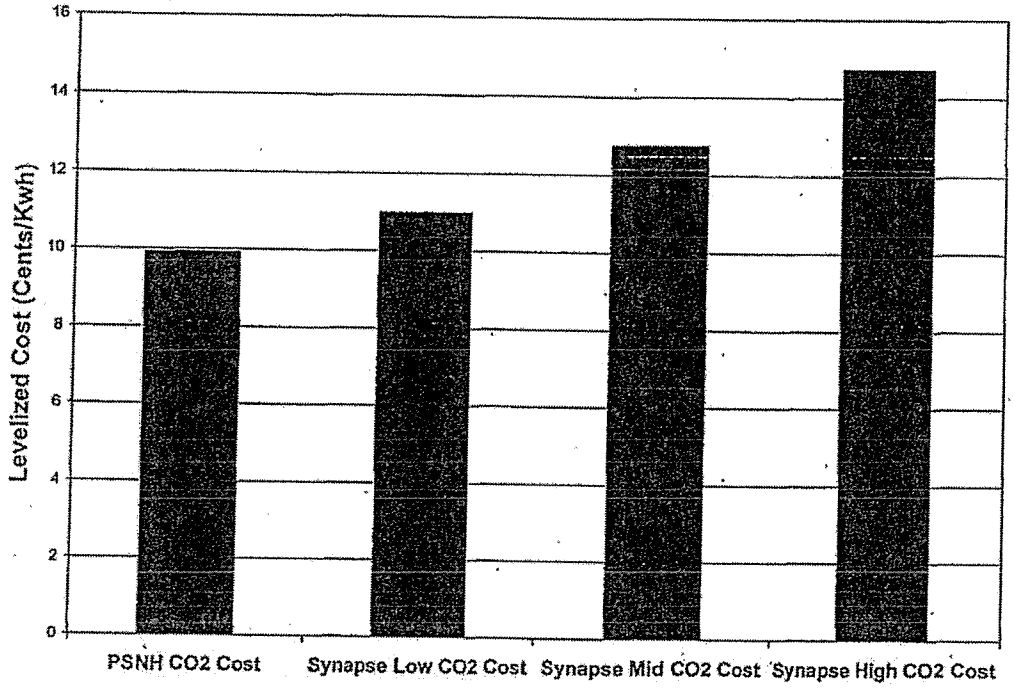
It is therefore clear that when the federal government begins to regulate greenhouse gas emissions, paying for the CO_2 emissions from the Merrimack Station will be very expensive. As shown in the following figure, PSNH's ratepayers can expect to pay between $50 to $150 million in 2015 just for CO_2 emissions allowances with the cost rising to between $110 and $325 million in 2025. It is reasonable to expect that PSNH will seek to pass these costs along to its ratepayers.

Total Annual Expenditures for CO_2 Emissions Allowances under Synapse CO_2 Price Forecasts



The costs presented in this figure were calculated by multiplying the 3.7 million tons of CO_2 that Merrimack Station can be expected to emit each year by the estimated cost of purchasing each emissions allowance (that is, one allowance for each ton of CO_2 emitted). As can be seen, adjusting PSNH's calculations to reflect a more reasonable range of future CO_2 emission allowance prices results in a substantially higher range for the potential cost for power from the Merrimack Station that will then be passed on to the ratepayers.

Cost of Power from Merrimack: PSNH and Synapse Low, Mid and High CO2 Emission Allowance Prices



In fact, the future levelized cost of power from Merrimack Station is more likely to be in the range of 11 cents to 14.7 cents per kilowatt hour as opposed to the approximately 10 cents per kilowatt hour claimed by PSNH in its September 2008 PUC Filing.

Finally, PSNH also has not accounted for any future costs associated with either an EPA mandated conversion of Merrimack Station to a closed-cycle cooling system or from any new federal coal ash regulations. These costs would raise the cost of power from Merrimack Station even higher than the 11 to 14.7 cents per kilowatt shown above.

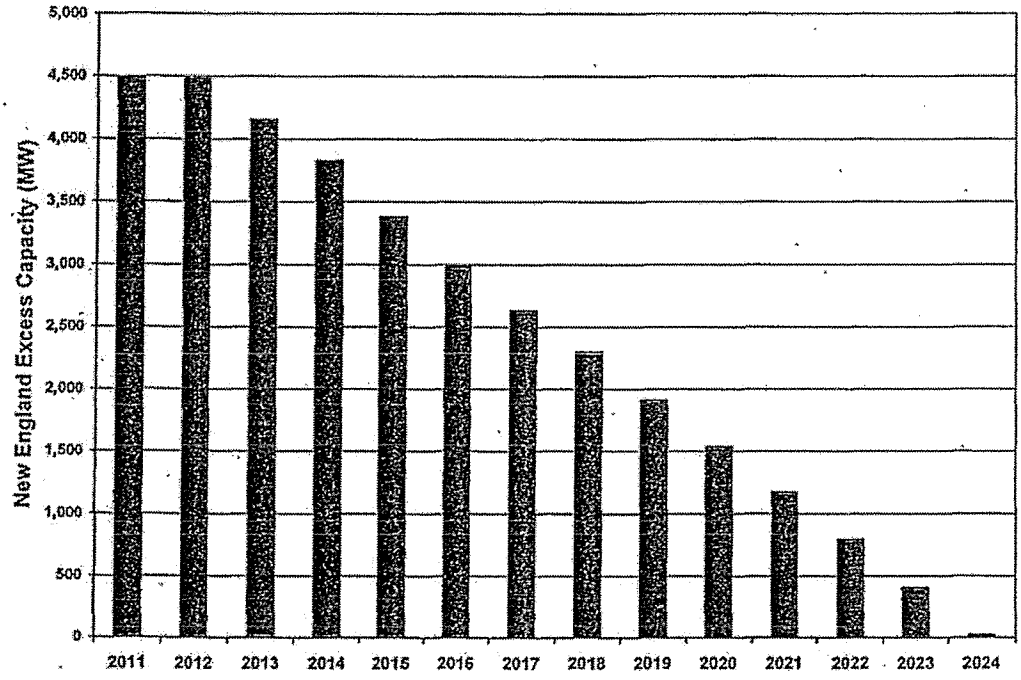
Finding 3. There are a large number of cost-effective alternatives to generating power at the Merrimack Station, including, but not limited to, purchasing power from the market and energy efficiency.

There are a number of lower cost alternatives to generating power at Merrimack Station if the plant were phased out over a reasonable period of time. These alternatives include purchasing power from the market, energy efficiency savings, conversion of one or both units at Merrimack to burn biomass, the addition of other renewable resources, generating more power at existing power plants in the area, building a new combustion turbine or combined cycle facility at the Merrimack Station site and transmission system upgrades.

A. There will be a significant amount of excess capacity in New England that could be used to replace the generation of power at Merrimack Station.

The following figure shows that there will be substantial amounts of excess capacity in New England after 2012 that could be purchased to replace Merrimack Station. In fact, New England can be expected to have more than 500 MW of excess capacity, or more than the capacity of the Merrimack Station, through 2022.

Excess Capacity in New England, 2012-2024



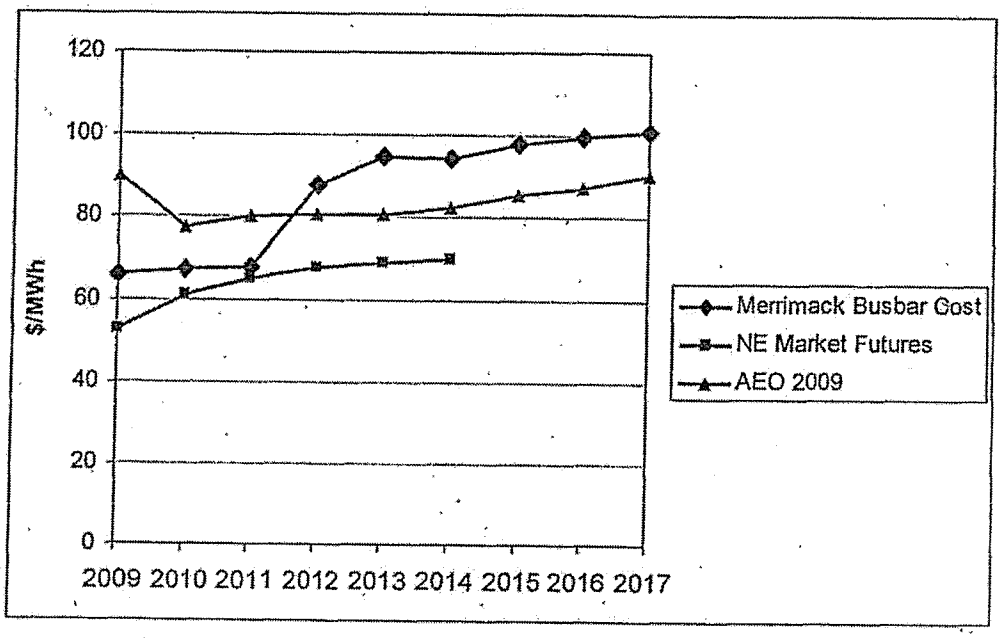
These estimates of future regional excess capacity are based on (1) the actual amount of capacity bid into the future capacity market for the 2011- 2012 power year and (2) ISO-NE's most recent load and energy sales forecasts. Moreover, these estimates are very conservative given that:

- They reflect only very modest amounts of energy efficiency savings – therefore, they do not reflect the additional potential for energy efficiency that has been identified in New Hampshire and the other New England states.
- They do not reflect any additions of the new renewable resources that will be needed after 2011 to meet the renewable portfolio standards.

If more aggressive energy efficiency spending and savings and additional renewable resources were included, even more excess capacity would be available in New England well into the 2020s or maybe even the 2030s.

Not surprisingly, given that there will be excess capacity and that current natural gas prices are low, it also appears that the cost of purchasing power in New England will be substantially lower than PSNH's estimated cost of power from Merrimack.

Cost of Power from Merrimack vs. Cost of Purchasing Power from the Market



The New England Market Futures prices in the above figure were taken from NYMEX's all-hours prices of March 13, 2009, adjusted to include a capacity charge. These NYMEX prices reflect the prices that could be paid today for energy to be delivered through 2014. The AEO 2009 prices reflect the estimated New England generation costs in the US Department of Energy's Annual Energy Outlook for 2009.

B. Energy Efficiency Savings could replace the power generated at Merrimack Station

A February 2009 study by GDS Associates for the New Hampshire PUC examined the energy efficiency potential for the State.[2] As shown in the following two tables, this study found that there was a potential for cost effective energy efficiency of between 255 MW and 330 MW by 2018, in the state as a whole, and between 184 MW and 330 MW just in PSNH's service area.

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2 *Additional Opportunities for Energy Efficiency in New Hampshire, Final Report – January 2009*, prepared for the New Hampshire Public Utilities Commission by GDS Associates, Inc., at page 16.

Potential Energy Efficiency Savings – State of New Hampshire

	Estimated Annual Energy Savings by 2018	Estimated Annual Demand Savings by 2018
	(GWh)	(MW)
Maximum Achievable Cost Effective	2,680	455
Potentially Obtainable	1,404	255

Potential Energy Efficiency Savings – PSNH Service Area

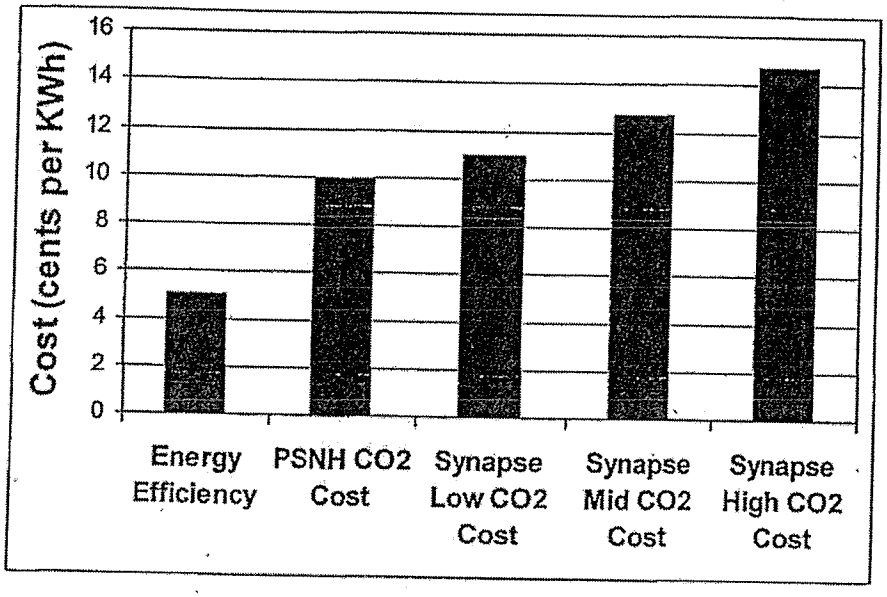
	Estimated Annual Energy Savings by 2018	Estimated Annual Demand Savings by 2018
	(GWh)	(MW)
Maximum Achievable Cost Effective	1,956	330
Potentially Obtainable	1,023	184

Thus, if you only focus on savings achievable in the PSNH service area, by 2018 energy efficiency could replace one-half to three-quarters of the capacity supplied by Merrimack Station and one-third to approximately 60 percent of the energy generated at the plant, and that is if you only focus on savings achievable in the PSNH service area. If you look at the state of New Hampshire as a whole, between one-half and all of the capacity from Merrimack and between 45 and 85 percent of the energy from the plant, could be replaced by energy efficiency savings.

Indeed, it appears that New Hampshire can achieve even higher savings from energy efficiency than are estimated in the GDS report. New Hampshire's 2007 energy efficiency program was the lowest performing in New England. Neighboring Vermont, with about one-half the electricity consumption of New Hampshire, saved 103 GWh of electricity in 2007, compared to 78 GWh in New Hampshire. Vermont's energy savings rates are more than twice that of New Hampshire. Connecticut and Massachusetts's energy savings rates are 25% to 50% higher than those achieved to date in New Hampshire.

It also is reasonable to expect that these savings could be achieved at lower cost than even PSNH's low projected cost of power from Merrimack Station. For example, analyses have shown that substantial amounts of energy efficiency savings are available at expenditure levels of 3 to 5 cents per kilowatt. As shown below, this is substantially lower than either PSNH's projected cost of power from Merrimack or from the cost of power from the plant which reflects the Synapse Low, Mid and High forecast CO_2 emissions allowance prices.

Projected Cost of Energy Efficiency vs. Cost of Power from Merrimack Station



There also is a significant potential for cost effective energy efficiency in the other New England states as well as a substantial potential for cost effective renewable resources in both New Hampshire, specifically, and in New England, as a whole.

C. Other potential sources for power if Merrimack Station were phased out

In addition to purchasing power from the market and energy efficiency, there are other potential alternatives sources for the capacity and energy currently being provided from Merrimack Station. These include: renewable wind and biomass facilities, repowering one or both units at Merrimack to burn biomass, generating more energy at existing and underutilized power plants in the State and the region, and building a new combustion turbine or combined cycle facility at the Merrimack Station site. The cost of generating power at these alternatives can be expected to be lower than the cost of power from Merrimack Station, especially if reasonable CO_2 costs are considered.

D. Transmission system upgrades

Transmission system upgrades to allow additional imports of power are another alternative source for the capacity and energy currently being provided from Merrimack. For example, Northeast Utilities is planning to construct a new transmission line from Quebec through northern New Hampshire (to connect wind resources being constructed in Coos County) to a location near Merrimack Station. The 1200 MW capacity of the line is three times that of Merrimack. Once constructed, this line will provide new energy and capacity resources at less cost than Merrimack, and avoid saddling NH citizens with future costs from new mercury, clean water and greenhouse gas regulations

Finding 4. Energy efficiency programs and developing alternate capacity would create large numbers of new jobs.

There is a reasonable concern that potential construction and permanent jobs would be lost if the Merrimack Station Scrubber Project is not pursued. However, PSNH's claim that the project would create large number of new jobs, 1200 we believe, needs to be scrutinized closely for several reasons. First, the number of new jobs that would be create must reflect the adverse impact of the higher electric rates that PSNH's customers would have to pay for the $457 million cost of the project. These higher rates will dampen economic activity and, thereby, offset the number of new jobs created. Second, the number of jobs that would be created as a result of the Scrubber Project must be measured against the numbers of jobs that would be created if alternate activities were undertaken in place of installing a scrubber at Merrimack.

For example, achieving the cost-effective energy efficiency that GDS Associates identified for New Hampshire in its recent report for the Public Utilities Commission would create an estimated 700 to 1345 net new long-term jobs in New Hampshire that cannot be outsourced to other states or countries. These jobs would last longer than the three year construction jobs that PSNH is offering as part of the Scrubber Project. They also would lead to the creation of hundreds to thousands of long term indirect jobs.

By way of contrast, PSNH appears to be offering a total of perhaps 6 to 10 new permanent long-term jobs once the construction of the scrubber is completed.

Renewable resource alternatives and/or the construction of new gas-fired capacity also would provide both short-term construction jobs and long-term permanent operations and maintenance jobs. Thus, jobs would be created if an alternative to the Scrubber Project is chosen. The real question is which investments would provide more construction and long-term jobs for New Hampshire's residents. Indeed, much of the $457 million cost for the scrubber will be for financing costs and the cost of fabricating equipment out of state. Benefits will accrue to out-of-state workers and out-of state companies.

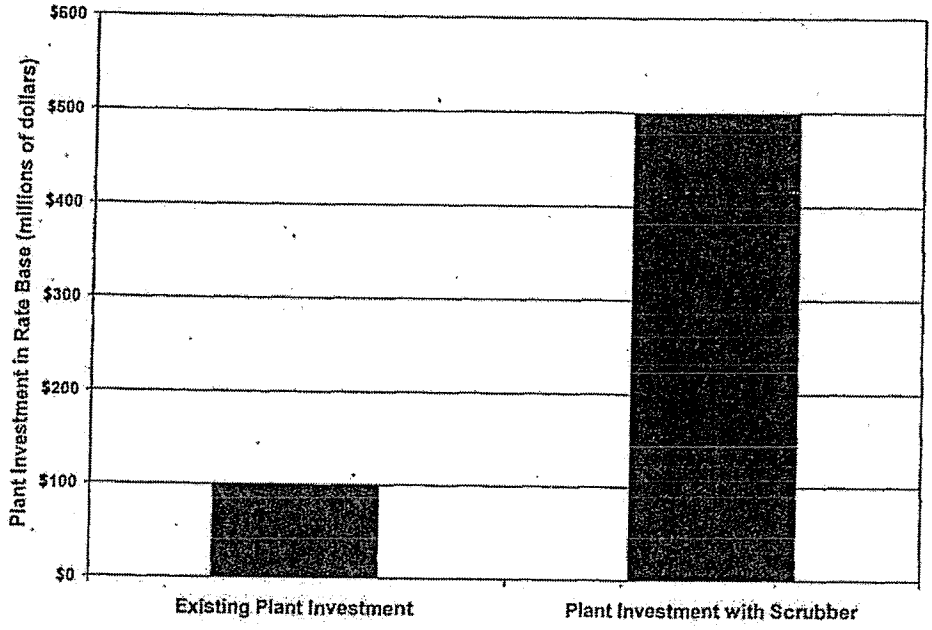
Finding 5. PSNH has a significant financial interest in pursuing the Merrimack Station Scrubber Project.

Under state regulation, PSNH earns an allowed rate of return on its investment in rate base where rate base is the current value of the capital expenditures it has made on plant and equipment. The investment in power plants generally declines over time as the original rate base investment is depreciated (although there are periodic capital expenditures that increase the rate base value of the plant) Thus, an aging plant like Merrimack Station can be expected to have a relatively small rate base value and, consequently, will produce declining profits for PSNH unless an expensive capital expenditure is made and/or the plant is retired and an expensive replacement is built whose cost can then be placed into the utility's rate base. This is the context in which PSNH is pursuing the Merrimack Station Scrubber Project.

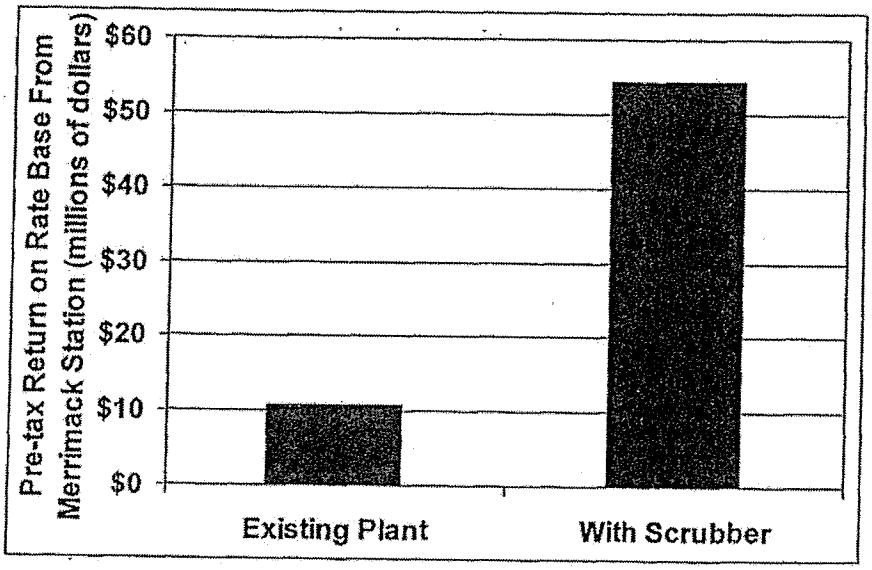
An expensive, capital-intensive investment like the Scrubber Project will dramatically increase PSNH's investment in the Merrimack Station and, consequently, will

significantly increase its pre- and post-tax earnings from the plant. This can be seen in the following two figures which reflect the rate base investments and PSNH's pre-tax return on rate base in the year 2013 if (a) the Scrubber Project is not undertaken or (b) the Scrubber Project is completed and its cost is added to rate base. The year 2013 is being used as an illustration because that is the year the scrubber is scheduled to go into service.

Impact of Scrubber Project on Investment in Merrimack Station in Year 2013



Impact of Scrubber Project on PSNH's Yearly Return on its Investment in Merrimack Station in Year 2013



A less expensive capital project to reduce mercury emissions, such as the installation of an Activated Carbon Injection System, when combined with the purchase of low sulfur coal (which would also reduce mercury emissions) would not increase PSNH's rate base or return on rate base as much as the Scrubber Project because the cost of purchasing the coal is not an investment. Purchasing fuel is treated as an expense, the cost of which is passed along to ratepayers. Therefore, PSNH benefits substantially more from the capital-intensive Scrubber Project than from a less expensive alternative.

Finding 6. PSNH has acknowledged that the contracts it has signed for the Scrubber Project are not "fixed price" contracts.

PNSH has repeatedly said that the majority of the contracts for the Scrubber Project and were "fixed price."[3] However, at the March 13, 2009 legislative hearing, PSNH CEO Gary Long said that there are escalator clauses in the contracts which mean that the price could increase over time. This means that these are not "fixed price" contracts.

Moreover, Company acknowledges that only $250 million of the total $457 million of the estimated cost for the Scrubber Project is under what it has called "fixed price contracts." This leaves over $200 million of estimated project costs exposed to future escalation. Much of this $200 million would be for financing costs that are extremely uncertain in the current financial crisis and, consequently, these financing costs could be substantially higher than PSNH has estimated.

[3] For example, see PSNH's March 5, 2009 Responses to Questions from the Office of Consumer Advocate and the March 13, 2009 report on *The Economic Impacts of Constructing a Scrubber at Merrimack Station*, at page 3.