Narragansett Electric's Energy Efficiency Programs: Benefits for Rhode Island's Economic Development and Environment

Prepared for

Narragansett Electric Company
A National Grid Company

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For more than a decade, Narragansett Electric[1] has been implementing large scale energy efficiency programs for Rhode Island electricity consumers. This report examines how these programs have impacted the state's economy and environment.

The efficiency measures installed in a given year will continue to reduce electricity consumption until they wear out and are replaced. Some efficiency measures have lifetimes greater than 20 years, while others last only a few years. On average, the measures installed by Narragansett Electric in Rhode Island since 1990 have lifetimes exceeding 15 years.

Thus, in the year 2001, Rhode Island electricity consumption is lower due to the cumulative effect of more than a decade of efficiency programs. Absent ongoing efforts to increase efficiency, these savings will decline as currently installed measures reach the end of their useful lives. Alternatively, if Rhode Island continues to invest in new efficiency measures, the current level of savings can be maintained and increased.

For Narragansett Electric's Rhode Island efficiency programs implemented over the eleven year period 1990-2000, Table 1 summarizes the impacts upon the state's economic development and environment. The results in the "All Program Years" column are the impacts for *all* years during which the measures installed 1990-2000 save electricity. The results in the "Average Program Year" column are the impacts for *all* years during which the measures installed in a *single average year* 1990-2000 save electricity.

Table 1: Lifetime Impacts of Efficiency Programs Implemented 1990-2000

Avoided Emissions	All Program Years	Average Program Year
Carbon Dioxide: CO_2 (thousand tons)	5140	470
Nitrogen Oxides: NO_x (tons)	4880	445
Sulfur Dioxide: SO_2 (tons)	5850	530
Methane: CH_4 (tons)	175	15
Carbon Monoxide: CO (tons)	670	60
Total Suspended Particulate: TSP (tons)	760	70
Volatile Organic Compounds: VOC (tons)	90	10
Macro-economic indicators		
Employment (Person-Years)	3050	280
Earnings (2000$ millions)	85	8
Value-Added (2000$ milions)	124	11

[1] Narragansett Electric includes Blackstone Valley Electric Company and Newport Electric Corporation which were acquired on May 1, 2000." All references in this report to Narragansett Electric should be read as including the then-separate activities of Blackstone Valley and Newport Electric.

Table 1 Notes:
All results (other than for earnings & value-added) are rounded to the nearest 5.
Earnings and value-added are reported in terms of real (year 2000 value) dollars.
Employment: 1 person-year = 1 full time job for 1 person for 1 year.
Earnings: The compensation associated with this employment, as well as property income.
Value-added: The difference between the value of output (sales) and the cost of intermediate inputs (goods and services purchased from other businesses); stated another way, it represents the value that is added by the application of capital and labor in converting intermediate inputs to finished products. Summed across all industries, as it has been here, value-added is a measure of overall economic activity, which includes earnings (employee compensation), interest, and profits. It is equivalent to GDP (Gross Domestic Product) nationally.

Air Emissions Benefits

By reducing electricity consumption, efficiency programs reduce the need to operate existing power plants, as well as the need to build and operate new power plants. This will result in substantial air quality benefits. While the economic analysis model utilized does estimate reductions in air emissions associated with avoided electricity generation, it does not incorporate the economic benefits associated with these lower emissions (e.g., improvements in productivity and business competitiveness owing to lower costs for health care and pollution controls).

Absent efficiency programs, Rhode Island would suffer from reduced environmental quality and/or would have to undertake other costly measures to reduce emissions. Either way, electricity efficiency programs help to increase the efficiency of the overall economy and make the state a more attractive place to reside and do business.

Typically, the three emissions of greatest interest are NOx, SO_2, and CO_2, and that appears true in this analysis as well. Certainly, the quantity of these three emissions exceed those of the other four reported above.

The emissions reductions associated with electricity efficiency are most significant for CO_2. Over their lifetime, the efficiency measures installed 1990-2000 will avoid CO_2 emissions equivalent to more than a third of Rhode Island's total annual CO_2 emissions, or more than all of Rhode Island's total annual CO_2 emissions specifically from either electric generation or transportation.[2]

[2] The electricity grid and power plants throughout New England operate as part of an integrated system, with interconnections to neighboring states and Canada. Thus, it can not be assumed with certainty that electricity consumed in Rhode Island is generated within the state, or vice versa. But it is reasonable to assume that efficiency programs implemented in Rhode Island (continued on next page)

Electricity efficiency programs have been a major ongoing activity in Rhode Island for more than ten years, and their cumulative contribution to reducing CO_2 emissions is quite impressive. Such programs have many benefits for the state, region, nation, and world; however, it is clear that they are a particularly effective and economical method of reducing carbon emissions.

By comparison, the effect of electricity efficiency programs upon NO_x emissions is substantial, but less so. Over their lifetime, the efficiency measures installed 1990-2000 avoid NO_x emissions equivalent to those of 240,000 automobiles used for one year (as compared to CO2, where the impact of DSM was equivalent to more than four times as many autos). But this difference is not surprising given that CO2 emissions are uncontrolled, while NO_x emissions from power plants (especially new power plants) have been greatly reduced by a variety of technologies.[3]

For SO_2, the emissions reductions associated with DSM are quite sizable in the context of Rhode Island, but far less significant in the arguably more relevant regional context. SO_2 emissions within Rhode Island are quite low, largely because the power plants within the state are mostly gas-fired (and in contrast to oil and coal, natural gas contains very little sulfur). However, the electricity grid within New England operates on a unified basis, and SO_2 emissions elsewhere in the region are substantially higher, including from power plants in neighboring Massachusetts formerly owned by subsidiaries of Narragansett Electric's predecessor companies. Moreover, to a far greater extent than for other emissions, electricity generation is the predominant source of SO_2.

Thus, while over its lifetime, the efficiency measures installed 1990-2000 avoid SO_2 emissions equivalent to more than Rhode Island's total annual SO_2 emissions, the effect is far less in comparison with electric utility and total SO_2 emissions in Connecticut and especially Massachusetts. Another way of looking at it is that SO_2 allowances are traded on an open market, and on this basis the value of the SO_2 emissions reductions associated with DSM is very small in comparison with the total benefits associated with DSM.

For other emissions, the impact of efficiency programs is less significant. For CH_4 (methane), the efficiency measures installed 1990-2000 avoid emissions equivalent to those of 150,000 automobiles used for one year. For CO, VOC, and TSP, the impacts are small relative to total emissions.

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reduce the need for electricity generation within the state and elsewhere in New England, and that this in turn reduces the air emissions associated with supplying Rhode Island's electricity demand.

[3] To be conservative, the TGG analysis has assumed that NO_x emissions from new gas fired combined cycle plants have been completely offset.

In summary, the emissions reduction benefits associated with electricity efficiency programs are quite significant overall, especially since they are attained at a negative cost; unlike many other emissions control strategies, efficiency programs reduce, rather than increase, the costs of supplying electricity and other goods sold in the marketplace. For the programs implemented to date, these benefits have been most impressive for CO_2, significant for NO_x, and less so for other emissions.

For future efficiency programs, the emissions reduction benefits will be smaller (per kWh saved) than historically, since the generation avoided will be from new very clean plants, rather than existing facilities with much higher emissions rates.[4] Still, as long as New England continues to rely upon fossil fueled generation, efficiency programs will remain an effective way to reduce CO_2 emissions.[5]

Economic Development Benefits

In comparing the economic development impacts of energy alternatives, it is important to consider the overall costs of the alternatives. Notably, when efficiency programs lower consumers' energy costs (i.e., efficiency is less expensive than the avoided electricity supply energy costs), consumers have more money to spend upon other (non-energy related) activities. Spending on these other activities is typically more beneficial to the economy than spending on energy-related activities]. In numerous previous studies, this respending of customer cost savings typically accounted for much of the total economic development benefit associated with efficiency programs.

Cost-effective energy efficiency reduces the cost of living and operating businesses and thus promotes economic development in Rhode Island. It increases the efficiency of the overall economy and makes the state a more attractive place to reside and do business.

Consistent with numerous previous studies for Rhode Island and other jurisdictions, this analysis has also found that spending on efficiency produces more benefits than a comparable amount of spending upon electricity supply. The simple explanation is that electricity supply includes a large fuel cost component, but spending upon fuels that are produced outside of the state contributes little to the local economy. For the non-fuel components of electricity supply costs (building and operating power plants and power lines), the overall

[4] Relative to existing plants (mostly steam turbines fueled with oil, coal, and natural gas), new power plants have very low emissions owing to their high efficiency (combined cycle plants [gas turbine combined with steam turbine] require less fuel per kWh produced), and their reliance on natural gas and advanced pollution control technology (lower emissions per Btu of fuel burned).

[5] All fossil fuels contain carbon, and there is no currently commercially viable method to prevent this carbon from being released to the atmosphere when such fuels are combusted.

benefits to the Rhode Island economy (per dollar of spending) are almost as large as those for efficiency programs.

The efficiency programs implemented 1990-2000 have benefited the Rhode Island economy. They are estimated to increase macro-economic indicators such as employment, earnings, and value-added. However, in contrast with emissions, the overall improvement is fairly small in the context of the overall state economy.

On the other hand, the economic benefits estimated in this study likely understate the total impacts of efficiency programs. First, as noted above, absent efficiency programs, Rhode Island would suffer from reduced environmental quality and/or would have to undertake other costly measures to reduce emissions.

Second, this study relies upon estimates of avoided cost for new electricity supply that were developed two years ago. Since then, supply costs have increased substantially, owing in large part to much higher natural gas prices. With today's much higher avoided costs, Rhode Island electricity consumers are reaping even larger than expected benefits in terms of electricity cost savings. Stated another way, electricity efficiency is helping to shelter the state from the adverse impacts of increased fuel and other supply costs, and the current analysis does not fully reflect these benefits in terms of employment and other measures of economic development.

However, even with the previously projected avoided costs, the energy efficiency programs implemented 1990-2000 were highly cost-effective. On average, each kilowatthour of energy savings is estimated to avoid 7.1¢ in supply costs (for generation, transmission, and distribution); however, it has cost Narragansett Electric and its customers only 4.8¢ per kilowatthour to achieve these energy savings.[6] Thus, every dollar spent on energy efficiency is estimated to yield almost $1.50 in supply cost savings.

The costs for efficiency programs reported above consider both expenses paid by Narragansett Electric and those borne by the customers participating in the programs. Considering only the utility's share of these expenses, it has cost Narragansett Electric just 3.5¢ per kilowtthour to achieve these energy savings. Thus, every dollar spent by the utility on energy efficiency during 1990-2000 has resulted in over two dollars in estimated supply cost savings.

[6] Cost are expressed in real (year 2000 value) dollars.

Impacts Upon Individual Industries and Types of Employment

As reported above, the energy efficiency programs implemented 1990-2000 are estimated to have increased Rhode Island employment, earnings, and value-added. However, even if the overall impact is positive, it is relevant to explore whether certain industries have been advantaged or disadvantaged as a result, and what this might imply for types of employment.

The economic development impacts provided in this report are the sum of the following three components: (1) the *increase* in economic activity as a result of expenditures on efficiency programs, (2) the *decrease* in economic activity as a result of decreased expenditures on electricity supply, and (3) the *increase* in economic activity as consumers *increase* their spending for other goods and services (to the extent that efficiency programs reduce consumers' overall costs, these savings are available for other spending).

For Rhode Island electricity efficiency programs implemented 1990-2000, the employment associated with components (1) and (2) are roughly similar. In other words, the jobs gained by increased spending on efficiency are offset by the jobs lost owing to lower spending on supply. As noted above, energy efficiency does give rise to more employment per dollar spent than does supply. However, Rhode Island efficiency programs have been highly cost-effective, such that a dollar of spending on efficiency avoids more than a dollar of spending on supply.

As it happens, a smaller amount of spending on more labor intensive efficiency appears to yield a similar amount of overall employment as does a larger amount of spending on less labor intensive supply. However, since efficiency has cost less than avoided supply, there is still a net increase in overall employment, as a result of the respending of these cost savings [component (3) above].

The economic analysis software utilized in preparation of this report provides detailed estimates of which industries within the Rhode Island economy are affected by spending on (1) efficiency and (2) supply. For reasons that will be discussed below, the software does not provide such detailed estimates for (3) respending. Table 2 presents results reported in terms of jobs per million $ of expenditures (with expenditures in year 2000 $, and a job defined as one year of full time employment), and as a proportion of total jobs.

Table 2: Jobs by Industry Grouping for Efficiency Programs and Avoided Supply

Industry Grouping	Jobs per million $ (year 2000 $) Efficiency	Supply
Construction	1.5	3.0
Manufacturing of Electrical and Non-Electrical Equipment & Machinery	4.0	0.6
Other Manufacturing	0.8	0.9
Transport, Utilities, Agriculture & Mining	0.4	0.7
Wholesale & Retail Trade	2.2	1.2
Business Services and Government	5.7	2.4
TOTAL	14.6	8.8

Industry Grouping	Proportion of total jobs Efficiency	Supply
Construction	10%	35%
Manufacturing of Electrical and Non-Electrical Equipment & Machinery	27%	6%
Other Manufacturing	5%	11%
Transport, Utilities, Agriculture & Mining	3%	7%
Wholesale & Retail Trade	15%	14%
Business Services and Government	39%	27%
TOTAL	100%	100%

The pattern of jobs from efficiency and avoided supply are roughly similar in many areas, but there are some notable differences. In interpreting the data, it is useful to remember that these are for employment in Rhode Island, and they take into account whether goods and services will be supplied in-state or outside. For there to be a large impact in the above data, it is necessary both for the activity to require substantial amounts of inputs from the industries in question, but also for the industries to be located in-state.

Also, the data for proportion of total jobs should be viewed in the context that these results are calculated as a percentage of a total jobs and add to 100% (although may not appear to owing to rounding). Thus, if there is a large concentration of jobs in one category, this will help to reduce the percentage of the total assigned to other categories

Finally, as noted above, the total number of jobs from the efficiency programs implemented 1990-2000 and avoided supply are similar (prior to considering additional jobs from respending). Thus, it is possible to evaluate whether efficiency programs will result in a shift of employment from one industry to another by comparing the figures in Table 2 for proportion of total jobs. For example, relative to supply, efficiency has a much higher percentage of jobs associated with manufacturing of electrical and non-electrical equipment and machinery. This indicates potential job gains in this industry as a result of efficiency. Conversely, supply has a higher share of constructions jobs, indicating potential job losses.

Two factors help to explain why supply has much more construction than efficiency. First, avoided supply includes operation of power plants; in the economic analysis software underlying this report, maintenance work has been assigned to the construction sector (as opposed to utilities).

Second, avoided supply includes building new power plants and T&D (transmission and distribution) facilities. T&D is especially construction intensive since it involves so much on-site work, as opposed to power plants and efficiency, where much of the cost is for manufactured equipment and business services (such as design and management).

However, some of the apparent differences between efficiency and supply in this regard may be overstated and a function of how expenditures were assigned to specific activities. In other words, some of what has been assigned to construction for supply may actually be business services (such as design and engineering), and some of what has been assigned to business services for efficiency may actually be construction.

As mentioned above, efficiency involves much more manufacturing than does supply, specifically for electrical and non-electrical equipment and machinery. This is not at all surprising. Basically, this is the equipment that uses electricity, and that controls and regulates its use. Much of the cost of efficiency is for equipment that uses electricity more efficiently than it would be by baseline technology (such as high efficiency chillers) or for equipment that facilitates greater efficiency in electricity use by other equipment (such as energy management systems).

Relative to efficiency, supply does involve somewhat more manufacturing other than electrical and non-electrical equipment. This difference mainly relates to fabricated metals, together with primary metals and chemicals, all of which are utilized to build and operate generation and transmission and distribution facilities.

Relative to efficiency, supply also involved more utilities. This relates to the large supply-side expenditures for natural gas to fuel power plants, which were assumed to give rise to activity in the companies responsible for delivering this fuel.[7] Finally, efficiency does result in significantly more activity in business

[7] To avoid potential confusion, please note that the economic analysis software used in this study does not assign activities relating to operation of power plants and efficiency programs to the utility industry classification, even though it may involve entities such as Narragansett Electric which are utilities. While it would have been convenient to utilize the standard classification for electric utilities, this would have seriously distorted the results, since the aggregate utility category (continued on next page)

services than does supply. This reflects the heavy reliance of efficiency upon professional services (design, legal, and management), but may also represent some judgments made as to whether certain activities lay within the construction sector, or were outsourced to business services.

Having now considered in great detail how specific industries are affected by expenditures on efficiency and avoided supply, none of the differences between energy efficiency and avoided supply would appear to be of much concern in the context of the overall Rhode Island economy. It does not seem that the employment associated with efficiency is dramatically different from that associated with supply in terms of the types of industries and jobs affected, or the "quality" of those jobs. To the extent that supply-side activities give rise to attractive high wage employment, efficiency would seem to be similar both in terms of the types of jobs and compensation levels.

As noted earlier, Rhode Island electricity efficiency programs implemented 1990-2000 have been highly cost-effective, giving rise to substantial employment from respending of these energy cost savings. In contrast to the employment associated with efficiency and supply, it would be somewhat arbitrary to attempt to characterize the specific industries that will be affected by respending, especially since most of it is assumed to be by Commercial and Industrial (C&I) customers.[8]

With residential customers, it is reasonable to assume that they will respend their electricity cost savings similarly to how they generally spend money: on a wide mix of consumer goods and services, with some assigned to savings. And because much of consumer spending goes to local businesses (such as restaurants), it produces a substantial amount of in-state jobs per dollar.

Relative to residential customers, it is much harder to know what effect electricity cost savings will have on C&I customers and where respending will be directed. Some may result in increased profits, and these profits will flow to business owners, who may in-state or outside. Some may result in lower prices for what the C&I customers are producing, and the benefits of these lower prices will flow to both the in-state and other purchasers of these products.

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is not representative of the very specific supply-side and demand-side activities modeled in the analysis software. Thus, supply and efficiency are modeled as if they were outsourced to entities that could provide the relevant goods and services (such as accounting and construction), even if in fact they would be preformed in-house by utility personnel.

[8] The C&I sector accounts for the majority of Narragansett Electric's total sales and efficiency spending. For simplicity, this study has assumed that respending [the net benefits of efficiency, i.e. reduced supply costs minus the cost of efficiency [including customer contributions] will be allocated to customer groupings in proportion to the pattern of efficiency spending (including customer contributions and evaluation). Thus, overall respending by residential customers is smaller than that of C&I customers.

Of course, if the C&I customers lower their prices, they might be able to sell more of whatever they are producing. And this could lead to increased production either in-state or outside to satisfy the increased demand. And the C&I customers might make investments to upgrade and expand their facilities (in-state and outside), to satisfy increased demand (possibly from lower prices) or in pursuit of other corporate goals.

The description above deals with for-profit businesses, and the C&I sector also includes government (public sector entities), and institutions (such as universities) and other non-profits. But in broad terms, the description above does capture the range of how any C&I customer might react to changes in electricity costs (e.g., government could react to lower costs by expanding services, reducing debt, or by reducing taxes).

In advance (or even after the fact), it is difficult to know how C&I customers react to changes in electricity costs. There are economic models that attempt to make such determinations, but they are considerably more expensive (and complicated) to use than the methodologies that have been employed in preparing this report. The economic analysis software utilized in this study calculates the economic developments impacts for respending by C&I customers based on multipliers for capital spending (new plant and equipment). The multipliers for such spending are intermediate between the results for various assumptions regarding the possible impacts of such respending, and as such appear reasonable (and likely conservative).

Stepping back from all these details, both economic theory and commonsense indicate that lowering the cost of living and doing business (without an offsetting loss of amenities) will encourage economic development. Rhode Island is operating in a regional, national, North American, and global economy. DSM helps to make the state a more attractive place to live and work, and this will help to make the state more prosperous.

Study Methodology

The E^3AS Software

The economic development and air emissions impacts provided in this Report were estimated using the E^3AS (Energy, Economic, and Environmental Analysis System) software. E^3AS was developed by TGG (The Goodman Group, Ltd.) on behalf of the US EPA and is available free of charge to assist government agencies in evaluating the economic and environmental impacts of energy supply and efficiency programs. Narragansett Electric retained TGG to perform the E^3AS model analysis for this report.

The E^3AS software is designed to consider both the benefits and costs of energy alternatives. To estimate economic development impacts, the E^3AS software uses an input-output model. Input-output models generate regional economic impact estimates by first tracing the industries involved in a study region throughout successive rounds of supply linkages. At each step, they trace the portion of the inputs required from each industry which are supplied locally (within the regional economy being modeled).

For example, the impacts of Rhode Island lighting equipment purchases are not only based on the effects upon in-state lighting product manufacturers, but also include the effects on other in-state industries (e.g., fabricated metals) supplying in-state lighting manufacturers. Total impacts also include the effects of expenditures by households and governments as they spend the personal income and taxes derived from in-state businesses (in the example above, the businesses supplying lighting equipment and inputs to the lighting equipment suppliers).

The E^3AS software incorporates input-output multipliers for a wide variety of energy supply and efficiency technologies, e.g., employment generated per dollar spent on commercial lighting fixtures. The results in this report were developed using the Rhode Island-specific version of E^3AS, which contains multipliers estimated using the Rhode Island version of the IMPLAN input-output model. The IMPLAN model was developed at the US Forest Service and University of Minnesota and is now maintained by Minnesota IMPLAN Group.

In order to develop the input-output multipliers in E^3AS, the total expenditures upon each type of energy efficiency and supply technology had to be disaggregated into expenditures upon each of the 528 industries represented in the IMPLAN model. The data used to perform this translation for each activity is called a bill of goods (BOG). The BOG data utilized in E^3AS were developed by TGG in an extensive research effort commencing in 1992.

For efficiency technologies, BOG data were principally derived from Massachusetts Electric (an affiliate company to Narragansett Electric) accounting records which incorporated all aspects of costs (program administration, overhead, labor, and consulting services, as well as materials and equipment). For electricity supply technologies, BOG data were largely based on (1) engineering studies performed by Oak Ridge National Laboratories for inclusion in the U.S. Department of Energy (DOE), Energy Economic Database, (2) utility accounting records, and (3) Electric Power Research Institute (EPRI) Technology Assessment Guide (TAG) data.

For energy efficiency and supply, the E^3AS model reports employment for each of 40 industry classifications. These classifications were developed by TGG as groupings of the 528 industries in the IMPLAN input-output model. To facilitate quick review by readers, in Table 2 above, results for the E^3AS model's 40 industries have been further aggregated into six classifications.

The air emissions impacts provided in this report are those avoided by efficiency programs owing to the decreased need for electricity generation.

Inputs to The E^3AS Software

In order to use the E^3AS software to produce results for this Report, various input data were required for 1990-2000 Rhode Island efficiency programs and the electricity supply that will be avoided by these programs.

Efficiency Programs

Data on efficiency programs was provided by Narragansett Electric personnel, derived from previously prepared reports. The E^3AS software is designed to evaluate efficiency programs; it is not set up to consider load management programs such as interuptibles.[9] Thus, the costs of load management programs were excluded from the data inputs to the E^3AS software.

The E^3AS software is designed to consider the expenditures associated with efficiency programs, regardless of who bears the costs. Thus, the input data utilized included both expenditures by utilities and customer contributions. On the other hand, costs associated with utility performance incentives were excluded from the input data.[10]

Finally, to facilitate a more precise modeling of efficiency technologies, the E^3AS software allows users to specify input data for a variety of technologies (e.g. commercial lighting, residential water heating). Narragansett Electric Staff and TGG collaborated to assign total efficiency expenditures into the E^3AS technology categories.

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[9] Efficiency programs are typically customers with the same (or greater) energy services [e.g., motive power] that they would have received with the baseline technologies. By contrast, load management typically involves a reduction in energy services to the customer, and this loss of services can have economic impacts that are difficult to estimate. For example, an interruptible program for industrial customers could result in lost production. Thus, the E3AS software was not designed to evaluate load management programs.

[10] From the perspective of economic impact modeling, such incentive payments could be considered as a transfer payment (from utility customers to shareholders), rather than a resource cost.

Avoided Electricity Supply

The E^3AS software does not incorporate a dispatch or system expansion model. Thus, the user must provide the E^3AS input data regarding how efficiency programs will reduce the need for electricity supply. As was the case for efficiency, the E^3AS software allows users to specify input data for a variety of supply expenditures (e.g. existing oil/gas steam plant non-fuel O&M, new combined cycle with SCR capital cost).

The starting point for preparing E^3AS input data were the energy and capacity savings data reported by the utilities. These were adjusted to exclude the savings associated with load management.[11] TGG then developed the following assumptions regarding avoided electricity supply based upon the most recent avoided cost study[12] and consultation with the authors of that study. The assumptions selected were intended to be reasonable, but somewhat conservative (i.e., they understate the benefits of efficiency programs).

The efficiency program energy and capacity savings provided by Narragansett Electric were grossed up by TGG to account for avoided line losses of 7% for energy and 11% for capacity. These loss factor assumptions were developed by TGG based upon data and other information provided by Narragansett Electric. TGG then further grossed up capacity savings by 17% to account for avoided reserve margin.

The efficiency programs were estimated to avoid the operation of existing generating units from 1990 to 2001. These avoided units were assumed to be steam plants, with a heat rate averaging 11,000 Btu/kWh and a fuel mix shifting from 80% residual oil and 20% natural gas in 1990, to 50% oil/50% gas in 1998 and subsequent years.[13] Fuel cost and variable O&M were based upon the avoided cost study assumptions.[14]

Starting in 2002, efficiency programs were deemed to have avoided the construction and operation of new gas-fired combined cycle units equipped with SCR. Capital and operating cost (fuel, fixed and variable O&M) and heat rate were based upon the avoided cost study assumptions; the E^3AS default data for these factors were overridden.

[11] As noted above, E3AS is not designed to consider load management.

[12] Avoided Energy-Supply Costs For Demand-Side Management Screening in Massachusetts, Resource Insight and Synapse Energy Economics, July 7, 1999.

[13] Data provided by the avoided cost study authors indicated that some of the avoidable supply from existing units was coal-fired. Nonethless to be conservative, it was assumed that all of the avoided supply from existing units was oil and gas-fired (which have lower emissions than coal).

[14] For 1990-1999, the avoided cost study year 2000 real dollar values were assumed, except for the cost of oil. Based upon a review of US Department of Energy data for New England power plants (from report DOE/EIA-0191), year 2000 values for oil were assumed in 1998-99, but higher prices comparable to those for gas were assumed for years 1990-1997.

For existing units, the E^3AS software default values for emission rates (specified in pounds per MMBtu) were utilized. For new combined cycle plants, the E^3AS software default values were used for CO_2 (for which there is no currently available control technology). For all other emissions, the software default values were overridden and a zero emissions rate was assumed.[15]

Finally, efficiency programs were also assumed to reduce T&D (transmission and distribution) capital investments based upon the avoided cost values provided by Narragansett Electric.

[15] Emissions rates for new plants continue to decline as technology improves and regulators require lower emissions. Also, for some emissions (notably NOx), there are requirements for new plants to obtain pollution allowances and/or offsets. Nonetheless, the zero emission rates selected should be viewed as conservative.