

**Rhode Island Energy Efficiency and Resources
Management Council (EERMC):
Opportunity Report – Phase I**

Submitted on July 15, 2008 to:

*the RI Public Utilities Commission, the General Assembly,
the RI Office of Energy Resources, and National Grid*

Attachment I:

***The Opportunity for Energy Efficiency that is
Cheaper than Supply in Rhode Island***

By KEMA, Inc.



The Opportunity for Energy Efficiency that is Cheaper than Supply in Rhode Island

Phase I Report – Submitted July 15, 2008



Prepared by: KEMA, Inc.

Prepared for: Rhode Island Energy Efficiency and Resource Management Council

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1. Executive Summary

The Rhode Island Comprehensive Energy Conservation, Efficiency and Affordability Act of 2006 placed a requirement on the distribution utility to procure all energy efficiency that is less costly than supply. To help determine the quantity of such efficiency resources and the cost savings to be enjoyed by Rhode Island ratepayers, the General Assembly charged the Energy Efficiency and Resources Management Council (EERMC) with producing an Opportunity Report to identify the resource. This study was commissioned by the EERMC to meet this goal and accordingly estimates the size of the potential for energy and peak-demand savings from energy-efficiency measures in Rhode Island over the mid-term (3 years) and the long-term (10 years) that are cheaper than supply. This study demonstrates that significant additional and long-lasting cost-effective efficiency resources exist within the state, which can be procured by the distribution utility to save Rhode Island ratepayers money. This study also identifies a limited number of demand response type resources and measures including direct load control, displays, and storage cooling.

1.1 Study Scope – Energy Efficiency

This study assesses the magnitude and cost of the energy-efficiency resource potential for saving electricity in Rhode Island. It calculates technical, economic, and achievable efficiency potential savings for 3 years and 10 years, and is restricted to measures and practices that are presently commercially available. These energy savings through efficiency are quite large and low-cost and are measured in megawatt hours (MWh) and gigawatt hours (GWh).¹

1.2 Key Findings

This study estimates the potential for cost-effective energy (MWh or GWh) and peak-demand savings (MW) from cost-effective energy-efficiency measures, over the mid-term and the long-term.

¹ A megawatt hour is equal to 1,000 kilowatt hours (or kWh). A gigawatt hour is equal to 1,000,000 kilowatt kWh.

1.2.1 Electricity Peak-Demand Savings

If all the *technically* feasible energy-conservation measures analyzed in this study were implemented regardless of economics, the overall technical peak-demand savings could amount to some 614 mw. If, however, only the measures that are *economic* (i.e., cost-effective when compared to supply-side alternatives) were implemented, potential peak-demand savings would be roughly 457 MW, 25 percent lower than the technically feasible amount. The residential sector contributes the most to both technical and economic savings potential, followed by the commercial sector (See Figure 1-1 below). To capture all of the economic potential would require that all economically feasible measures which are lower cost than supply be installed. This would mean for example that in the case of the deployment of compact fluorescent light bulbs – an efficiency resource demonstrated to be cheaper than supply – that all incandescent light bulbs in Rhode Island be replaced by a compact fluorescent bulb.

While this represents the economic efficiency potential, for a variety of reasons this entire low-cost efficiency resource cannot be procured by the distribution utility. For that reason in order to provide reasonable estimates of potential savings from least cost energy efficiency procurement we develop estimates of achievable potential which are based on conventional assumptions of measure adoption and are based on assumptions about possible program offerings. This generally assumes traditional program approaches and consequently is a provisional first step but not definitive of what is actually achievable under RI law. This is because under Least Cost Procurement, it is possible to leverage higher savings through bolstered marketing, financing, and community-based delivery strategies.

Technical Potential Findings:

We estimated technical and economic potential for energy efficiency using KEMA's Demand Side Assyst model. In our this approach, we first estimate **technical potential** for energy savings by integrating key measure and market segment parameters using the following equation:

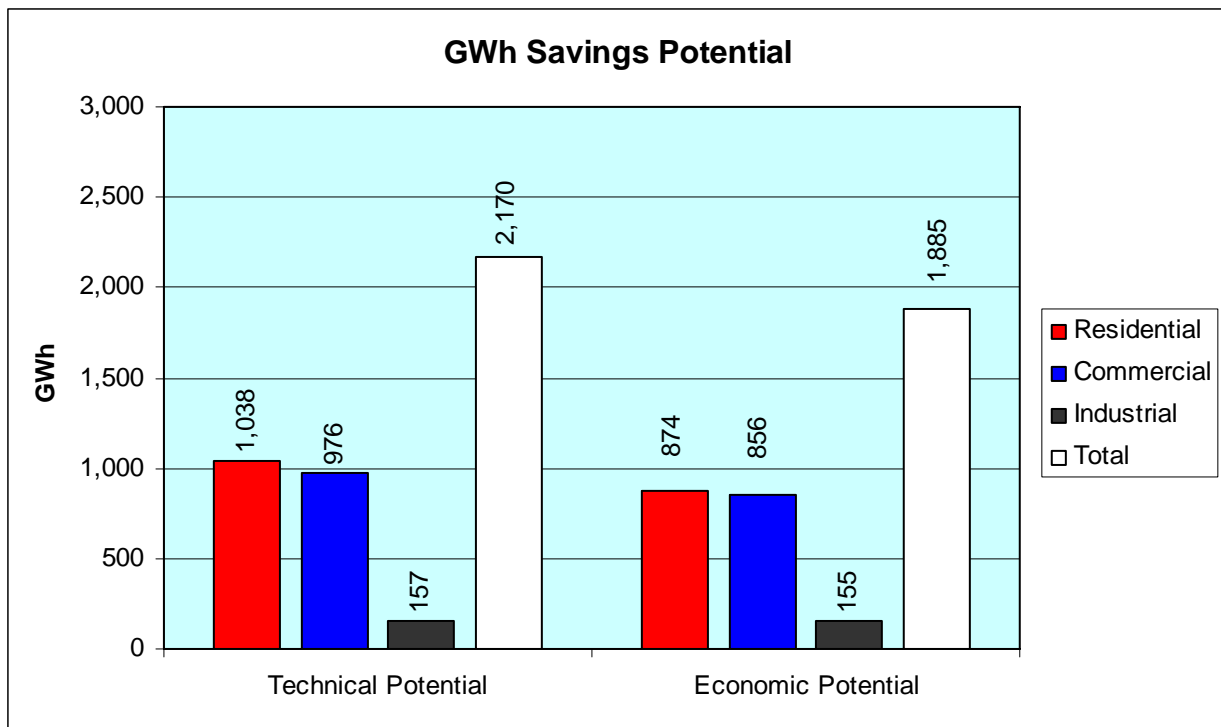
$$\begin{array}{cccccccc} \text{Technical} & & \text{Total} & & \text{Base Case} & & \text{Not} & & \\ \text{Potential of} & & \text{sq. ft. or} & & \text{Equipment} & & \text{Complete} & & \\ \text{Efficient} & = & \text{\# of} & \times & \text{EUI or UEC} & \times & \text{Factor} & \times & \text{Savings} \\ \text{Measure} & & \text{Dwellings} & & & & & & \text{Factor} \\ & & & & \text{Applicability} & & \text{Feasibility} & & \\ & & & & \text{Factor} & & \text{Factor} & & \end{array}$$

We then assess **economic potential** by first developing a supply-curve analysis. This analysis eliminates double counting of measure savings. On a market segment and end-use/technology

basis, measures are stacked in order of cost effectiveness, and the energy consumption of the system being affected by the efficiency measures goes down as each measure is applied. As a result, the savings attributable to each subsequent measure decrease if the measures are interactive. After eliminating double counting of savings, the benefits and costs associated with a given measure and market segment are compared using the Total Resource Cost (TRC) Test. The TRC Test is the ratio between the benefits of an efficiency measure and the cost of the efficiency measure including benefits and costs that accrue to ratepayers, the utility, and society. If the TRC is greater than 1.0, then the benefits (savings) of the efficiency resource are greater than the costs and the resource is cheaper than supply and should be procured pursuant to the Comprehensive Act of 2006 and the PUC's Standards for Energy Efficiency and System Reliability Procurement approved at the June 12, 2008 Open Meeting. The following figures illustrate the magnitude of the cumulative amount of efficiency resources that are cheaper than supply in Rhode Island (TRC >1.0) – depicted as the economic potential.

Figure 1-1 presents a summary of the technical potential and economic potential (efficiency resources that are cheaper than supply) in GWh for Rhode Island.

Figure 1-1



The Phase I study identifies more than 2,100 GWh of technical potential and more than 1,800 GWh of energy efficiency resources that are cheaper than supply in Rhode Island. This compares to an estimated total sales volume of roughly 8,000 GWh in Rhode Island in 2008. Figure 1-2 presents the GWh technical potential efficiency savings as a percent of total energy use for that sector.

Figure 1-2

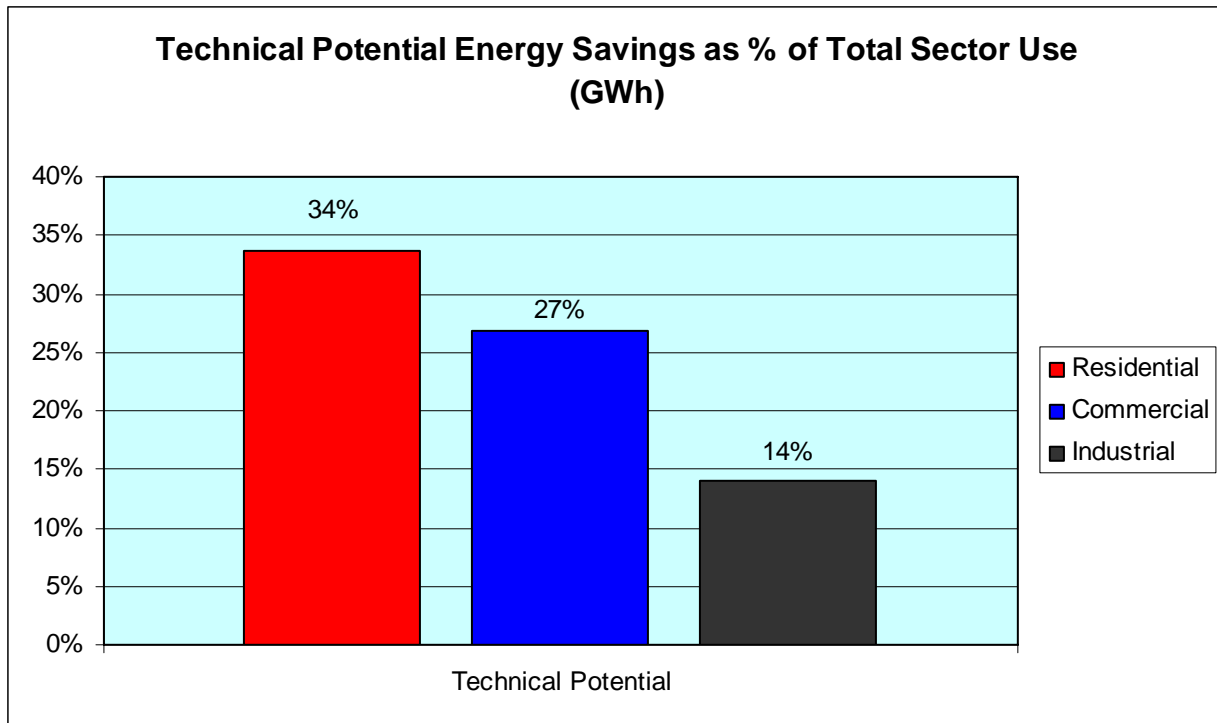
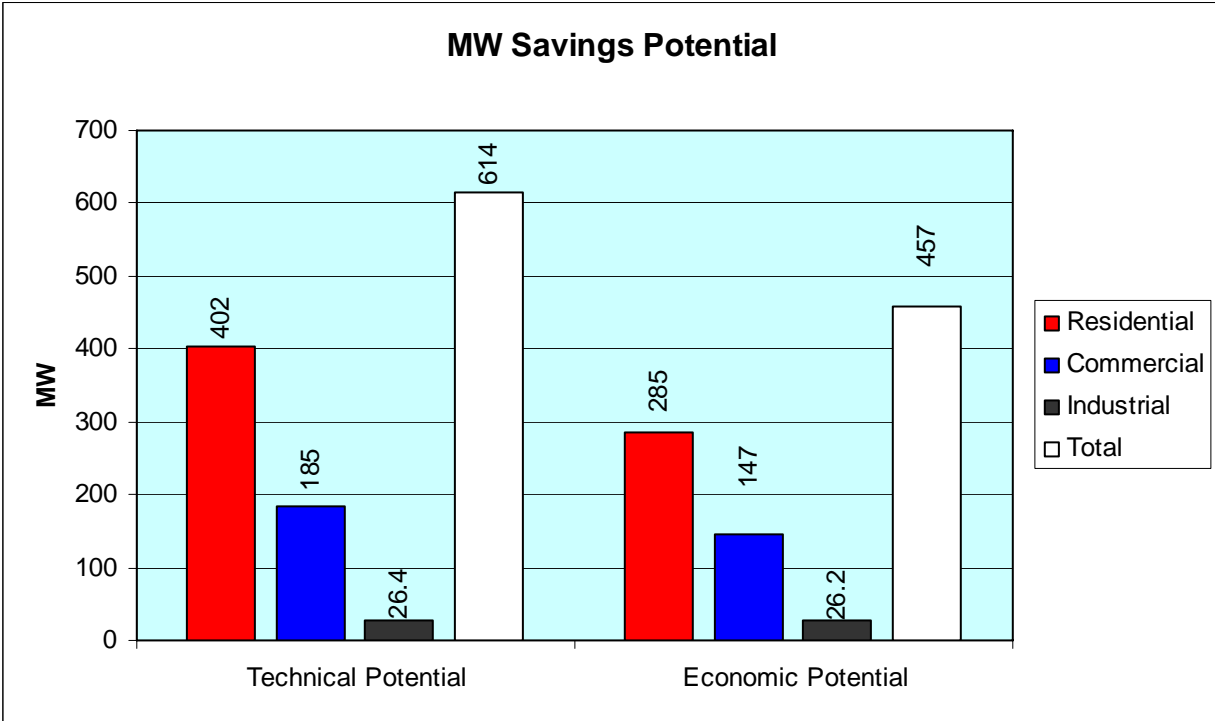


Figure 1-3 presents a summary of the technical potential and economic potential (efficiency resources that are cheaper than supply) in MW, or energy capacity, for Rhode Island.

Figure 1-3

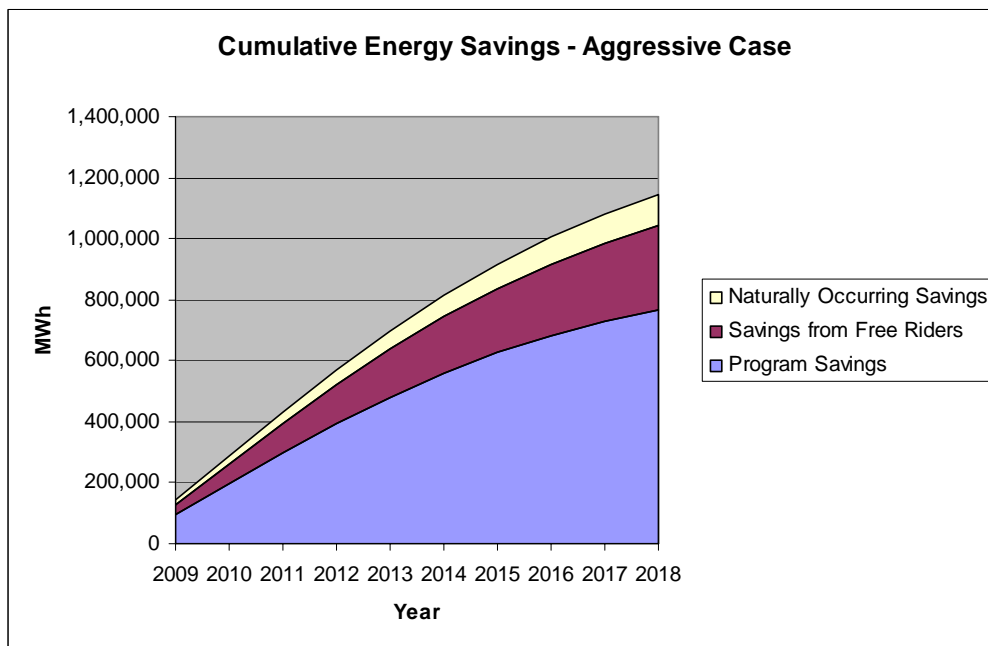
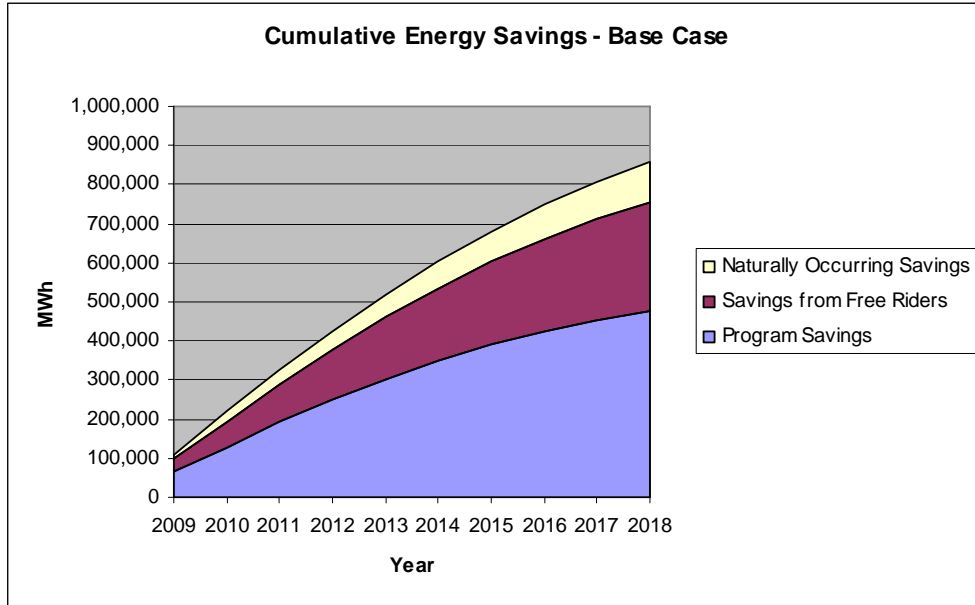


Achievable Potential

Achievable Potential is defined as the amount of potential that can be estimated from procurement and programmatic activity in the market. Namely it is an estimate of savings that will occur through efficiency procurement and program activity. Achievable potential can be calculated in several ways - some researchers calculate it as a fixed percentage of technical or economic potential; while others take a more nuanced more modeling approach, which is what was done here. Achievable potential is sometimes presented in MWh and MW per year over time. We calculated two scenarios of achievable potential – the Base Case – which is based on a funding level for energy efficiency that is comparable to 2008 and an Aggressive Case that is based on higher funding to go after cost-effective energy efficiency. The energy savings over time for these two cases are presented in Figure 1-4. The aggressive scenario is somewhat less cost effective than the base case as free ridership grows significantly over time. These are both presented here showing net savings, savings from free riders and savings from naturally occurring. Net savings plus savings from free riders is typically referred to as gross savings. It

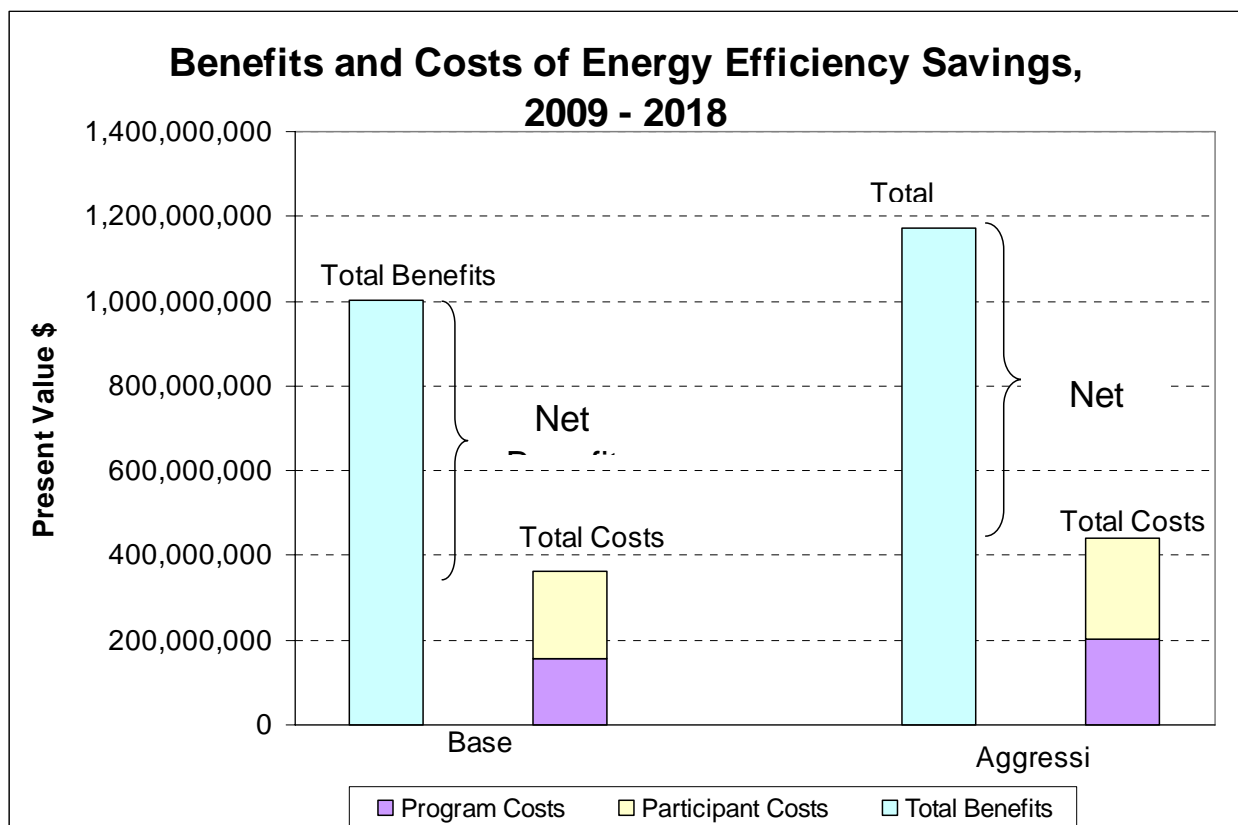
is important to note that the Aggressive Case still generally assumes traditional program approaches and consequently is a provisional first step and not definitive of what is actually achievable under RI law as under Least Cost Procurement, higher savings are possible through enhanced marketing, financing, and community-based delivery strategies

**Figure 1-4
Cumulative Energy Savings**



The overall cost effectiveness of the achievable potential is shown in Figure 1-5. This compares the total benefits of the efficiency resource (primarily avoided supply costs, etc.) with the total cost (utility program cost + customer participant cost). It illustrates that the economic benefits of the efficiency measures far exceed their total costs, generating a net benefit to Rhode Island ratepayers.

**Figure 1-5
Overall Cost Effectiveness**



The Achievable Base Case is presented in a Table Format for years 2009, 2010, 2011 and 2018 in Table 1-1 below. As part of this chart we also present budgets for programs that we did not model within Demand Side Assyst, namely direct load control and an initial scope of an appliance recycling program.

**Table 1-1
Summary of Base Case**

Total Base Case				
Year - Program Costs-Real	2009	2010	2011	2018
Administration	\$2,802,900	\$2,745,254	\$2,727,928	\$2,329,631
Marketing	\$224,130	\$226,549	\$228,995	\$246,869
Incentives	\$14,511,803	\$14,883,210	\$14,816,530	\$10,113,325
Total	\$17,538,833	\$17,855,014	\$17,773,453	\$12,689,825
Net Energy Savings - GWh	64	129	192	478
Net Peak Electricity Demand Savings - kW	12,584	25,335	37,756	101,474

Annual Participant Costs (Real)	\$23,964,484	\$23,931,306	\$23,318,488	\$13,765,174
Annual PV Participant Costs	\$23,964,484	\$23,689,528	\$22,849,696	\$12,562,957
Naturally Occurring and Free Rider Energy Savings Total (Annual)	46	45	44	29
Accumulated Naturally Occurring and FR Energy Savings Total (Annual)	46	91	135	381
Naturally Occurring Peak and FR Demand Savings Total (Annual)	5916	5812	5683	4048
Accumulated Naturally Occurring and FR Peak Demand Savings Total (Annual)	5916	11728	17411	51061
PV Avoided Costs	\$128,028,039	\$125,430,954	\$115,221,818	\$39,173,449
PV Program Costs	\$17,538,833	\$17,674,625	\$17,416,138	\$11,581,527
Annual TRC	3.08	3.03	2.86	1.62
Program Lifetime cents/kwh for that year	0.022	0.022	0.023	0.044

Additional Programs- Budget

Appliance Recycling	1053000	1053000	1053000	1053000
Direct Load Control	\$650,000	\$1,040,000	\$1,210,564	\$871,643
Total National Grid Budget	\$19,241,833	\$19,948,014	\$20,037,017	\$14,614,468

Our model has two embedded assumptions. First, once a measure is replaced, it is assumed to be efficient for the rest of the period. Second, in this phase we are not adding any new potential technologies that may become available during the course of this assessment. In both the Base Case and the Aggressive Case as we have modeled them, after 2015 most of the efficient retrofit measures have already been installed either through the program or by non-participants.

The Aggressive Achievable Case is presented for years 2009, 2010, 2011 and 2018 is presented in Table 1-2. Note that in 2011 with an efficiency program size of \$40 million (nearly a 250% increase from today's level of \$16 million) the TRC is still 2.62. That is, at that level of increased efficiency procurement, the economic benefits still greater out weigh the costs – by a factor of 2.6 to 1.

**Table 1-2
Summary of the Aggressive Case**

Total Aggressive Case				
Year	2009	2010	2011	2018
Administration	\$2,802,900	\$2,903,567	\$3,043,299	\$3,383,523
Marketing	\$224,130	\$350,716	\$536,788	\$1,553,784
Incentives	\$36,484,938	\$35,791,471	\$37,013,212	\$30,152,741
Total	\$39,511,968	\$39,045,754	\$40,593,299	\$35,090,048
Net Energy Savings - GWh	96	197	296	764
Net Peak Electricity Demand Savings - kW	24,136	49,089	74,088	216,392
Annual Participant Costs (Real)	\$3,081,765	\$3,017,751	\$2,840,478	\$1,162,571
Annual PV Participant Costs	\$3,081,765	\$2,987,263	\$2,783,373	\$1,061,035
Naturally Occurring Energy Savings Total (Annual)	3	3	3	3
Accumulated Naturally Occurring Energy Savings Total (Annual)	46	91	135	381
Naturally Occurring Peak Demand Savings Total (Annual)	5,916	5,812	5,683	4,048
Accumulated Naturally Occurring Peak Demand Savings Total (Annual)	5,916	11,728	17,411	51,061
PV Avoided Costs	\$204,221,811	\$208,762,089	\$203,937,187	\$104,547,662
PV Program Costs	\$39,094,273	\$41,201,037	\$42,159,336	\$32,963,094
Annual TRC	2.74	2.70	2.62	1.88
Program costs/ lifetime kwh for program year	\$0.03	\$0.03	\$0.03	\$0.08

Additional Programs presented in Base Case not presented here

1.3 New Program and Measure Areas:

As part of this study we also identified new opportunities for energy efficiency for Rhode Island. This was based on 4 tasks:

- 1) A review of Rhode Island's programs compared to best practice programs
- 2) A review of Rhode Island's programs compared to other state portfolios
- 3) Interviews with Rhode Island market actors; and
- 4) A review of Rhode Island measures compared to KEMA's master list

Our review of other portfolios as indicated in the Section 5 indicated the following potential new program areas for Rhode Island – they are characterized as short and long term opportunities;

- Adding an appliance recycling program (residential) – Short Term
- Adding a retro commissioning program (commercial/ industrial) – Short Term
- Direct ties to LEED – Long Term

-
- Adding a data center program – Long Term
 - Adding a direct load control program – Short Term
 - Performance based lighting program – Long Term

We also identified new potential measures that may be applicable in 2-5 years. This list was developed from a review of emerging technologies from ACEEE, LBL and other utilities. We list them here for consideration and plan to model them in Phase II.

- ED's
- Cool roofs
- Commissioning
- Smart AC
- EnergyStar or Better PC
- EnergyStar or Better TV
- EnergyStar or Better Set-Top
- Heat pump dryer
- Solar hot water heating

Potential new Commercial / Industrial Measures

- LED's (residential and C/I)
- Cool roofs
- Commissioning
- Energy recovery ventilation
- Smart AC
- LED Downlights
- Induction Lighting
- CDMi replacement for incandescent or halogen reflector lamps
- Data center package

At a conceptual level, there are three sources, or reservoirs, of efficiency resources that are cheaper than supply that can be procured by the utility in accordance with the 2006 Comprehensive Energy Act and the PUC's Standards for Energy Efficiency and System

Reliability Procurement LCP and SR Standards to generate large savings for Rhode Island ratepayers. These are:

- 1) **Existing Efficiency Measures and Resources** pursued by the utility today that have a TRC greater than 1.0 but have been underinvested in and not tapped for all cost savings.
- 2) **New Efficiency Measures and Resources** that are *not* currently pursued by the utility efficiency programs but have a demonstrated TRC greater than 1.0 so they would generate cost savings.
- 3) **New Approaches to Existing Efficiency Measures and Resources** that would enable a greater quantity of resource to be tapped with TRC greater than 1.0 and thus generate cost savings.

Figure 1-6 provide examples of the above opportunities into those 3 categories.

Figure 1-6
Three Categories of New Opportunities

- Existing Efficiency Measures and Resources (pursued today) – A key basis for the expansion of efficiency resource procurement is existing programs and measures that have a large cost-effective potential remaining.
- New Efficiency Measures and Resources – Piloting and initiating new cost effective measures such as solar water heaters, an appliance recycling program, a direct load control program for mass market customers, and new technologies such LEDs that are *not* currently pursued by the utility.
- New Approaches to Existing Efficiency Measures and Resources – New program concepts such as zero emission homes, additional marketing, creative use of financing, increased use of retro commissioning, and community-based delivery of energy efficiency.

1.4 Comparison to Supply Side Resources and Net Benefits

The figures presented in this section provide additional data related to using energy efficiency as part of a least cost procurement strategy.

Figure 1-7 compares the average cost of supply with the average cost of energy efficiency over study period. This figure illustrates how much less expensive energy efficiency is than electric supply – 3¢/kWh vs. 12.5¢/kWh.

Figure 1-7
Electric Supply vs. Efficiency Costs

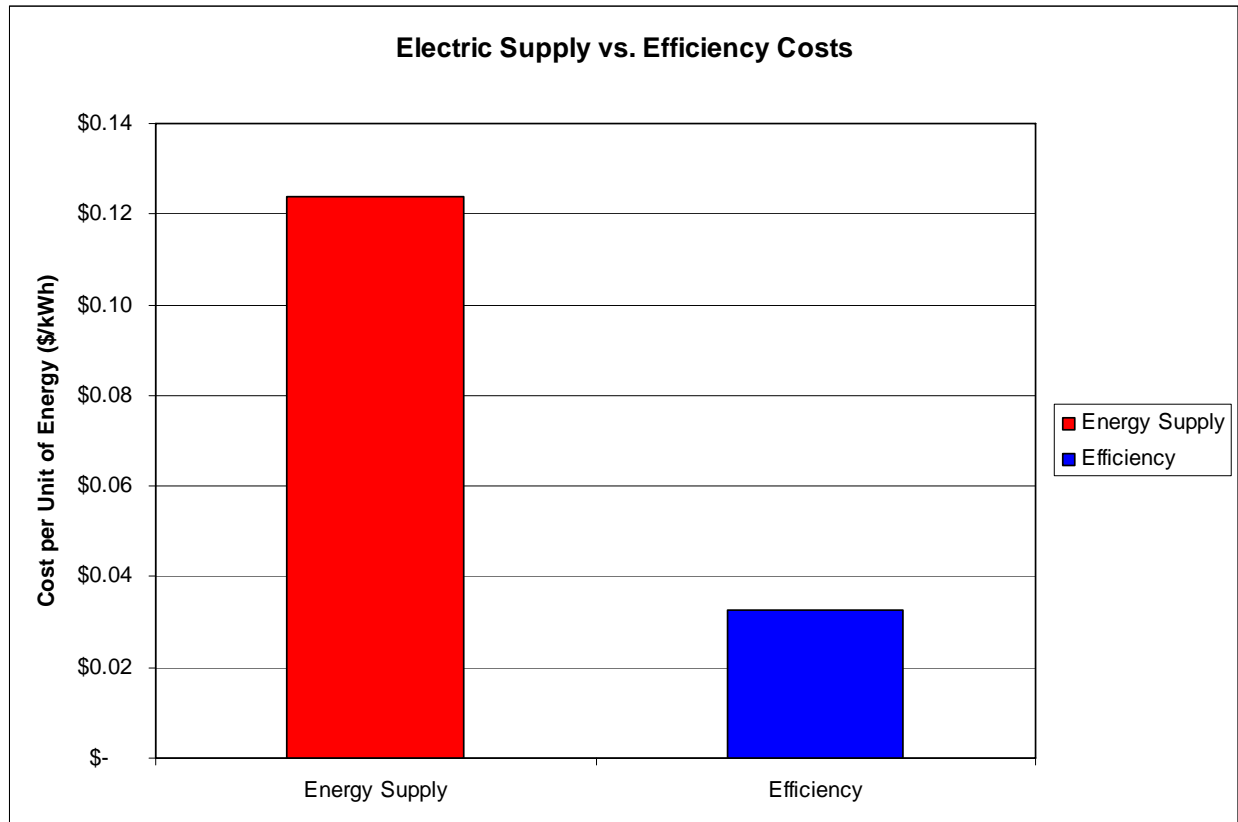
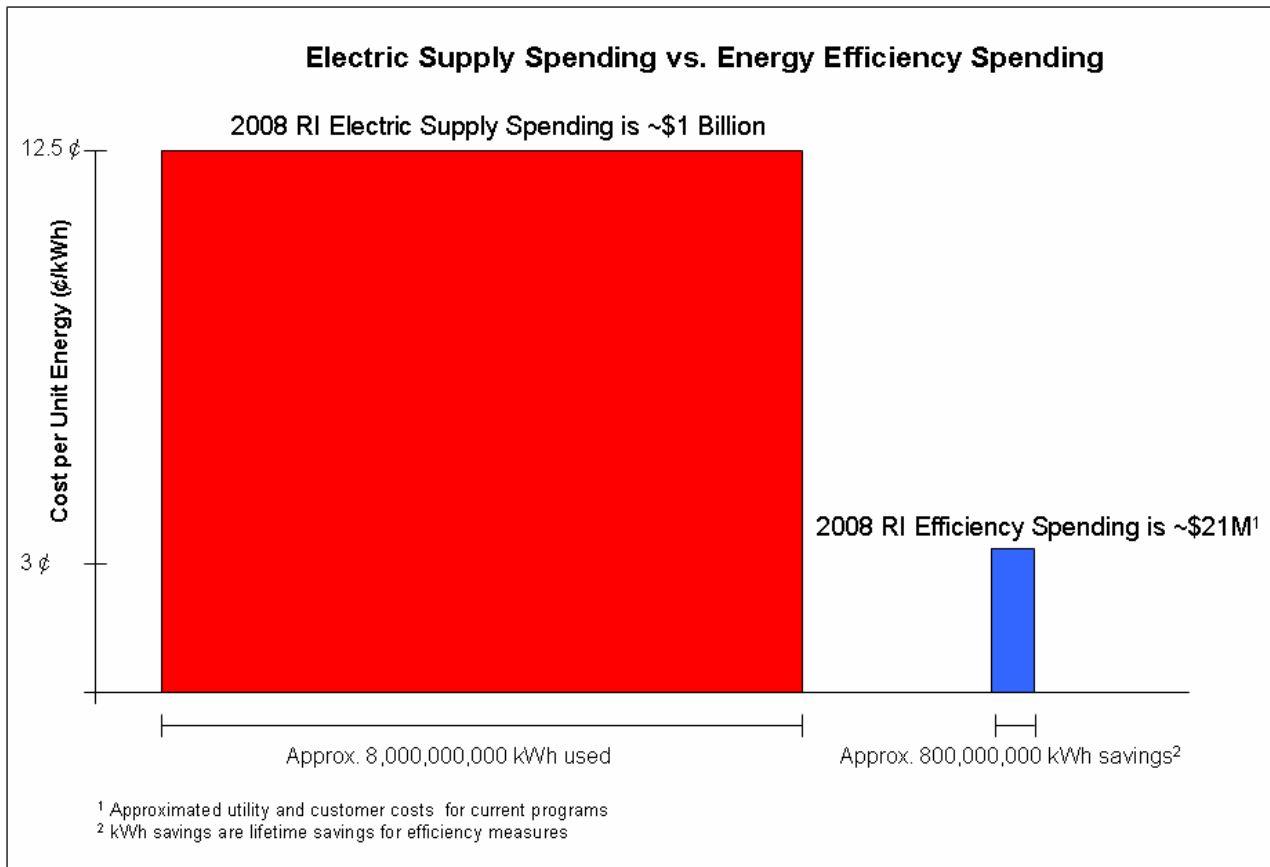


Figure 1-8 illustrates how the 2008 status quo of spending is heavily weighted toward higher cost supply – resulting in hundred of millions dollars in unwarranted energy costs for Rhode Island ratepayers. This is an imbalance in resource acquisition and the strong opportunity exists for National Grid to remedy this imbalance through its 2009-2012 Energy Efficiency Procurement Plan. We found there is ample additional low cost efficiency ready to be procured.

The goal of the Plans will be to ensure that Rhode Island ratepayers no longer spend so much for high cost electric supply when less expensive efficiency resources are available in the state.

Figure 1-8
Electric Supply Spending vs. Energy Efficiency Spending



Our findings indicate there is a very large energy efficiency potential available that is cheaper than electric supply. The results of our study are summarized in Figure 1-9 which lists the technical, economic, and achievable potential for energy savings in gigawatt hours. It is important to note that the achievable Assumes traditional program approaches and is a provisional first step and not definitive of what is achievable under RI law. Under Least Cost Procurement larger savings can be achieved via bolstered marketing, financing, and community based delivery strategies.

Figure 1-9
Energy Efficiency Potential, 10-year (2009-2018)

GWh	Technical Potential		Economic Potential		"Conventional" Achievable Potential	
	GWh	% of Forecast	GWh	% of Forecast	GWh	% of Forecast
Residential	1,038	34%	870	28%	273	9%
Commercial	1,161	32%	1,026	28%	371	10%
Industrial	156	14%	154	14%	120	11%
Overall	2,354	28%	2,050	24%	764	9%

Figure 1-10 shows the big economic efficiency potential that's much cheaper than supply.

Figure 1-10
Current Electric Supply & Efficiency Spending vs. Least Cost Efficiency Opportunity

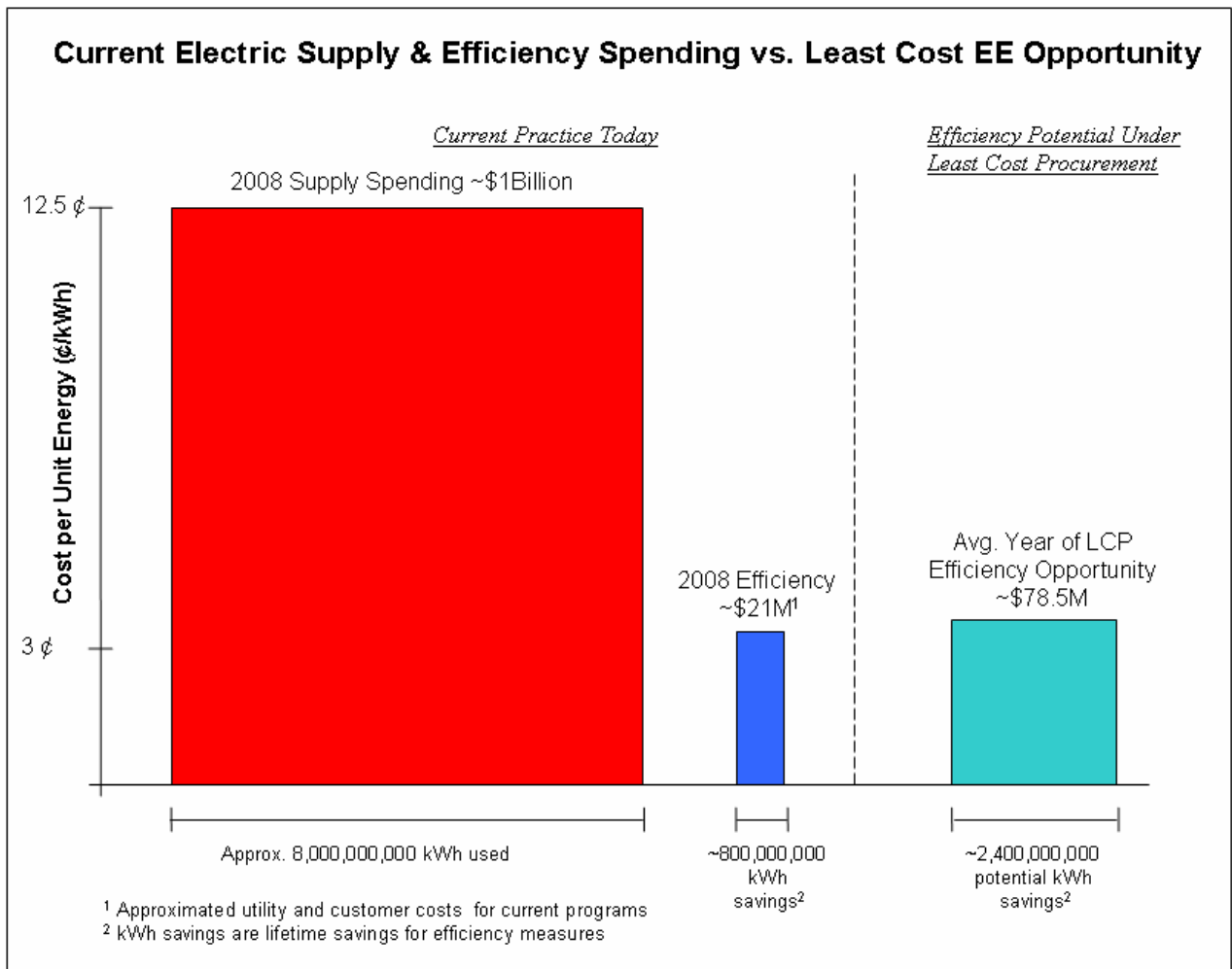


Figure 1-10 illustrates that the investment in low-cost efficiency resources could be quadrupled – to generate hundreds of millions of dollars in savings for ratepayers – and still remain much cheaper than the cost of electric supply. As annual average, from 2009-2018 we found there is roughly 2,400,000,000 kWh of approximately 3¢/kWh efficiency resources available.

We quantified the amount of aggregate savings that could be secured for Rhode Island ratepayers through Least Cost Procurement by 2018 in Figure 1-11 finding more than \$1 billion in savings available in Rhode Island during that time.

Figure 1-11
Cumulative Lifetime Savings from Least Cost Procurement by 2018

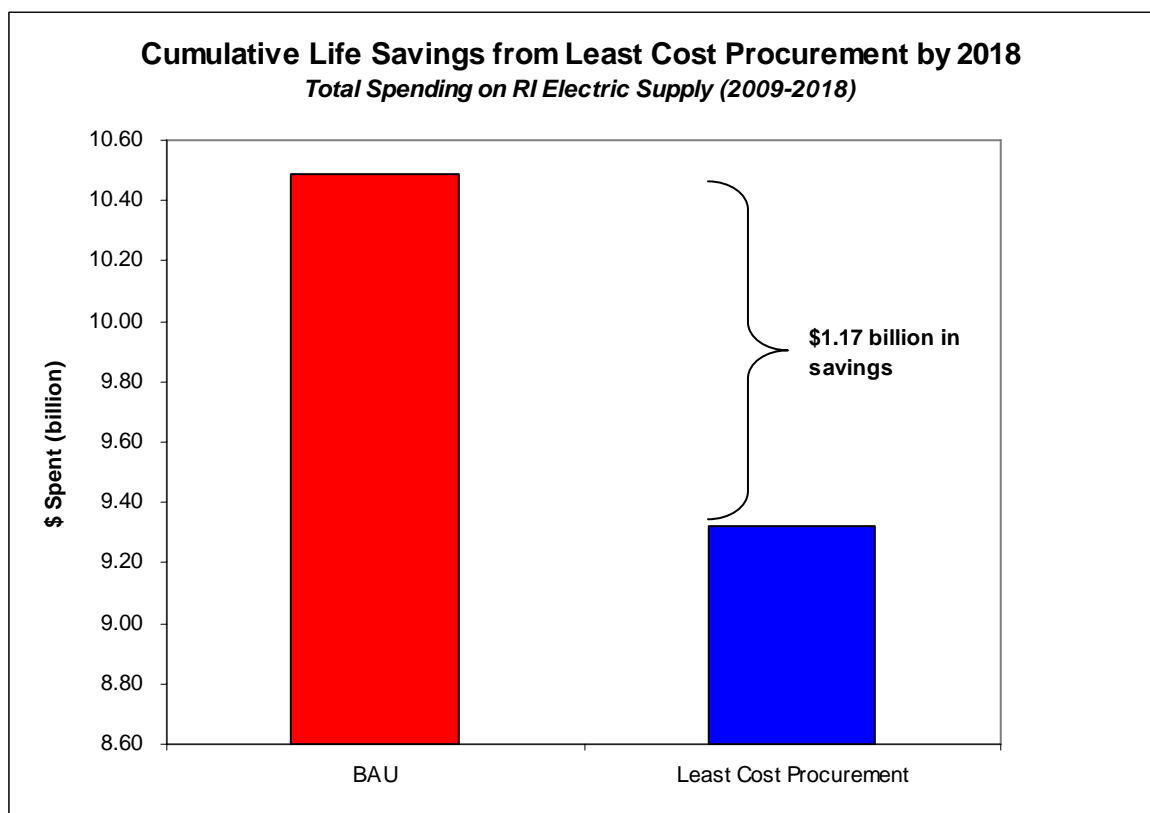
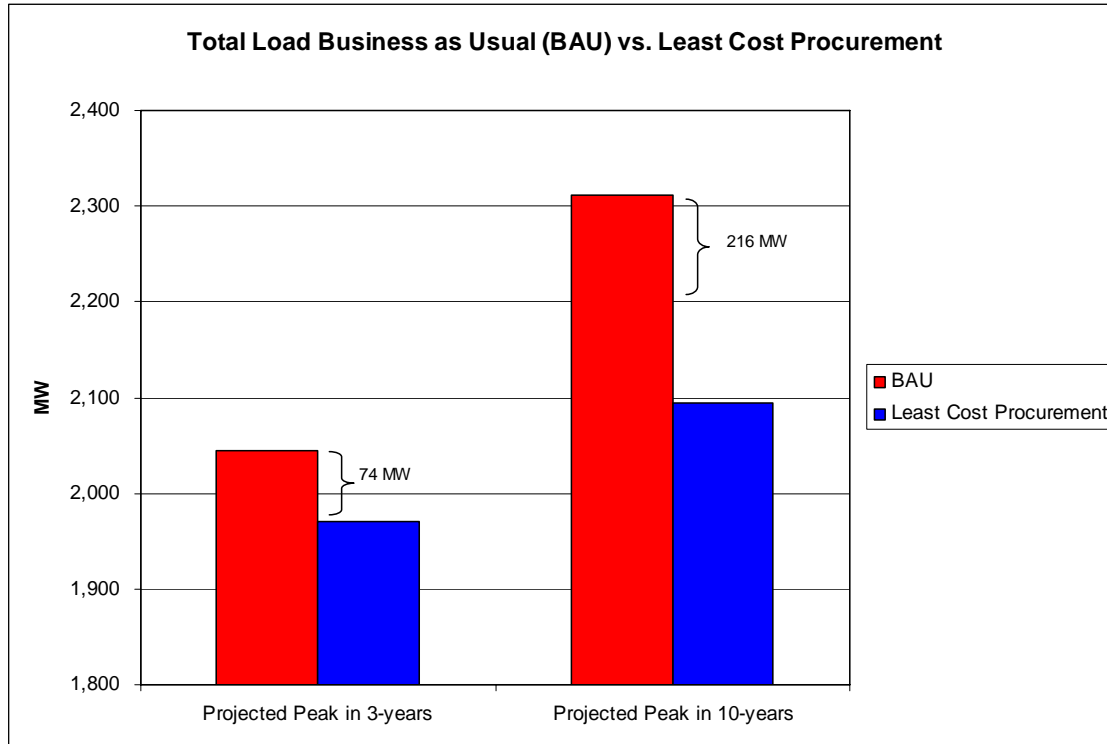


Figure 1-12 presents the impact of using least cost procurement on the peak both at three years and 10 years. As this figure illustrates the peak is reduced by over 216 MW over 10 years.

Figure 1-12
Electric Supply Spending vs. Efficiency Spending



2. Introduction

This report summarizes the findings of the first phase of the Rhode Island Energy Efficiency Opportunities project. This report is organized in the following manner:

- 1) Executive Summary
- 2) Introduction
- 3) Methodology
- 4) Review of other potential studies
- 5) Program and measure review
- 6) Initial estimates of potential and supply curves
- 7) Key Assumptions
- 8) Estimates of program savings for potential new programs

The results presented in this report indicate there is a large, untapped efficiency resource that is cheaper than supply in all ratepayer sectors in Rhode Island. In addition to quantifying the magnitude of this low cost resource, this report also identifies some potential new program areas and new measures to be considered more carefully in the Utilities Procurement and Program Plans and in Phase II of this analysis.

3. Methodology

Our original proposed methodology for this study given the time frame was:

- 1) Review of other potential studies
- 2) Data collection and interviews
- 3) Program review
- 4) Development of initial technical data on measures
- 5) Initial measure list

In addition to our proposed methodology we developed initial estimates of technical, economic and Achievable potential based on our Demand Side ASSYST model to better support the needs of the RI EERMC.

3.1.1 Review of other potential studies

In this task we reviewed eleven recent potential studies to develop initial estimates of technical, economic and achievable potential for electricity. Studies generally find that economic potential can range from 13 percent to 27 percent for electricity and 21-35 percent for gas. Achievable potential, which is the estimate of what can actually be achieved from programs, ranges from 10 percent to 33² percent for electric and 8-10 percent for gas.³ Methodologies for Achievable potential can vary greatly. This analysis is discussed in Section 4 and provides an initial range for the estimates of potential. Phase II of the Opportunity Report will confirm or revise the findings regarding technical, economic and achievable potential based upon on-site and phone

² The maximum achievable potential is higher than the maximum economic potential because one study did not report economic potential but provided a high estimate for achievable potential.

³ Steve Nadel, Anna Shipley, and R. Neal Elliot, The Technical, Economic and Achievable Potential for Energy Efficiency in the US – A Meta-Analysis of Recent Studies, American Council for an Energy Efficient Economy, Proceedings from the 2004 ACEEE Summer Study on Energy Efficiency in Buildings.

survey research to be conducted in Rhode Island. The timing and focus of the Phase II work will be informed by results from Phase I through direction from the EERMC.

One primary task in Phase II is to conduct 300 completed phone surveys and 150 completed site visits. The site visits will likely be reserved for C&I sectors. The residential sector may need to be further broken down into the low income, non-low income, single-family and multi-family sectors subject to conversations with the EERMC.

3.1.2 Data collection and Interviews

Following from discussions at the project initiation meeting on April 30th, KEMA developed a list of all relevant data sources required for the project. This included:

- Data from any previous market characterization studies ;
- Data from recent utility programs;
- Data from recent best practices studies;
- Data from measure studies;
- Interviews with staff and market actors
- Load forecasting data;
- Impacts of new or pending federal or state legislation;
- Interviews with Rhode Island implementation vendors
- Review of recent process evaluations
- Review of other recent saturations surveys such as Vermont and Connecticut
- Review of recent new construction and retrofit projects
- Market research data ; and
- Studies for the state and other entities.

We did find that while there was much program data available for Rhode Island, there was very little data on:

- energy use by building type
- energy use by end use
- market penetrations and saturations of measures and end uses

This is discussed further in Section 6 and will be supplement with the onsite and phone survey data in Phase II.

3.2 Program Review

Our approach to program review was based on best practices. Best practices in energy efficiency program design have evolved over a period of 20 years, and continue to evolve as markets, regulatory agendas, and technologies change. For the most part, statements of best practice derive from the experience of organizations with long histories of efficiency/Demand-Side Management (DSM) program activity. These organizations have refined both their efficiency program designs and resource acquisition strategies and the processes through which such programs and acquisitions are developed and revised through long years of trial and error. Lessons learned from this experience are captured in a number of channels: conference papers and presentations, evaluation studies, and white papers by selected organizations to name a few.

3.2.1 Technical Data on Efficient Measure Opportunities

Estimating the potential for efficiency/DSM resources and options that are cheaper than supply requires a comparison of the costs and savings of efficiency/DSM measures relative to standard equipment and practices. Standard equipment and practices are often referred to in DSM analyses as base cases. Our team has collected measure cost data from a number of studies and sources, including data from California's Database for Energy-Efficient Resources (DEER, for which Itron is the prime contractor) and the Northwest Power Planning Council's RTF database/website, among others. Additional measure cost information has been obtained from the utility filings, as well as other secondary sources and interviews with utility program managers and other industry experts. Most of our savings data for Phase I comes from utility data, appropriate regional evaluation studies, and the recent DEER study, with appropriate adjustments for baseline conditions in Rhode Island. We have supplemented using other data for measures where data may not be available.

Estimates of DSM measure savings as a percentage of base equipment usage were developed from a variety of sources, including:

- Current program data;
- Analysis of actual measured savings from ex-post evaluation studies of energy efficiency programs;
- Other recent New England studies such as Vermont and the Nstar/ Cape Light study
- Industry-standard engineering calculations; and

-
- Estimated savings from the DEER databases; and
 - Secondary sources, including our team’s recent DSM potential studies as well as that of the Energy Trust of Oregon and Northwest Energy Efficiency Alliance.

3.2.2 Initial Energy Efficiency Measure Screening

In this task we developed an initial energy efficiency measure list and provide an initial screening of measures to undergo further analysis. To implement the initial measure screening, we developed initial runs of our DSM ASSYST model.

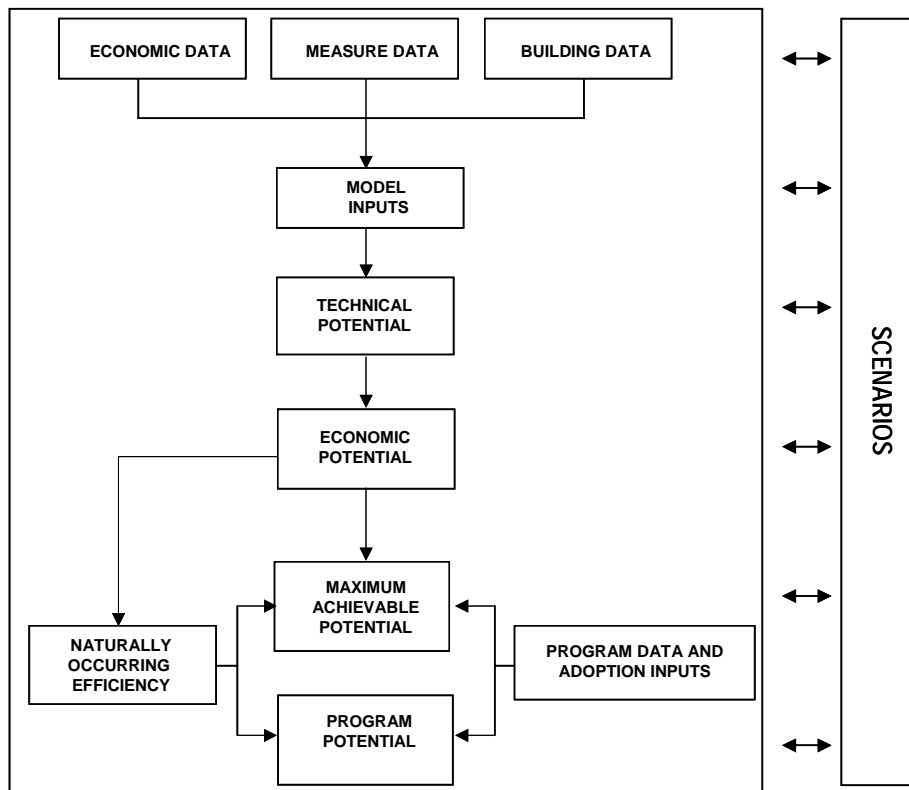
3.2.3 Initial Runs of Demand Side Assyst

We used the data available to develop initial estimates of potential using Demand Side ASSYST prior to the data collection that will be done in Phase II of this project. Our method for estimating potential for energy efficiency in is a “bottom-up” approach, utilizing DSM ASSYST™, our MS-Excel®-based forecasting model. The basic analytical steps are shown in Figure 3-1. In this approach, we assess costs and savings at the market segment and energy efficiency measure level. This method requires data regarding targeted measures and market segments, including the following elements to determine how much efficiency resource is available that is less expensive than supply:

- Energy efficiency measure costs
- Energy efficiency measure savings
- Base energy consumption by market segment and end use
- Applicability of a measure to a given market segment and end use
- The current saturation of the measure in the market segment
- The fraction of the market segment that can feasibly utilize the measure
- The number of consuming units (i.e., square feet or number of homes) within a market segment
- End-use load shapes
- Avoided-cost forecasts
- Rate forecasts
- Program funding levels by category (marketing, incentives, and administration).

Limited Rhode Island data were available to complete this analysis at this time. We had complete measure data, but very limited building data. This effort will be supplemented by the Phase II onsite and phone survey work.

**Figure 3-1
Simplified Conceptual Overview of Modeling Process**



In our bottom-up approach, we first estimate **technical potential** for energy savings by integrating key measure and market segment parameters using the following equation:

$$\begin{array}{r}
 \text{Technical} \\
 \text{Potential of} \\
 \text{Efficient} \\
 \text{Measure} \\
 = \\
 \text{Total} \\
 \text{sq. ft. or} \\
 \text{\# of} \\
 \text{Dwellings} \\
 \times \\
 \text{Base Case} \\
 \text{Equipment} \\
 \text{EUI or UEC} \\
 \times \\
 \text{Applicability} \\
 \text{Factor} \\
 \times \\
 \text{Not} \\
 \text{Complete} \\
 \text{Factor} \\
 \times \\
 \text{Feasibility} \\
 \text{Factor} \\
 \times \\
 \text{Savings} \\
 \text{Factor}
 \end{array}$$

We then assess **economic potential** by first developing a supply-curve analysis. This analysis eliminates double counting of measure savings. On a market segment and end-use/technology basis, measures are stacked in order of cost effectiveness, and the energy consumption of the

system being affected by the efficiency measures goes down as each measure is applied. As a result, the savings attributable to each subsequent measure decrease if the measures are interactive. After eliminating double counting of savings, the benefits and costs associated with a given measure and market segment are compared using the Total Resource Cost (TRC), which is the test specified by the Least Cost Procurement and System Reliability Standards.

4. Review of Other Potential Studies

For this study we reviewed twelve other potential studies. They are listed below as well as their percentage estimates of technical and economic potential. These results present a similar pattern – The residential and commercial sectors typically have a technical potential of around 30 percent.

Review of Selected Technical Potential Studies								
Source	State	Residential %		Commercial %		Industrial %		Length of Study - years
		Technical	Economic	Technical	Economic	Technical	Economic	
KEMA	New Jersey	25.8%	18.9%	24.4%	18.7%	9.8%	7.9%	2004 - 2020
KEMA	Ireland	43.0%	36.0%	29.0%	29.0%	12.0%	11.0%	2007 - 2020
ITRON/KEMA	California	30.0%	23.0%	15.0%	12.0%	17.0%	15.0%	2004 - 2016
ICF	Georgia	33.0%	21.0%	33.0%	22.0%	17.0%	15.0%	2005 - 2015
ICF	Ontario	24.6%	20.5%	31.4%	23.5%	20.1%	17.9%	2004 - 2015
GDS Associates	Vermont	39.8%	20.6%	31.9%	16.5%	20.7%	14.5%	2007 - 2015
GDS Associates	North Carolina	39.7%	17.8%	32.2%	12.1%	21.5%	10.8%	2008 - 2017
SWEEP	Arizona	29.9%		37.2%	37.2%	33.3%		2003 - 2020
SWEEP	Colorado	22.1%		37.0%		28.8%		2003 - 2020
KEMA	California	27.9%	21.4%	18.0%	13.0%			2003 - 2012
Excel Energy	Colorado	20.0%	15.0%	22.0%	17.0%	14.0%	13.0%	2006 - 2013
Average		30.5%	21.6%	31.4%	20.1%	19.4%	13.1%	
Median		30.0%	21.4%	31.4%	18.7%	20.1%	15.0%	

Industrial is typically lowest with an average around 20% for technical potential. Economic potential is typically 8-10 percentage points less than technical potential. Jurisdictions that have been more active have lower potential than studies in places such as North Carolina and Ireland where there has been little programmatic activity. We attempted to compare achievable potential to economic potential on a consistent basis from these studies but found that it was either not calculated or was done in a consistent manner across studies. We were able to calculate a relationship between technical potential and economic potential which is shown below:

Sector	Relationship between achievable potential and technical potential
Residential	68.8 %
Commercial	67.8 %
Industrial	76.3 %

This is based on a sub set of four to five of the studies.

5. Review of Rhode Island Programs and Possible New Program and Measure Areas

This section presents the findings of the review of Rhode Island programs compared to Best Practice and Other Portfolios. Additionally, based on this review we identified possible new program areas and emerging technologies.

5.1 Best Practices Review

We reviewed Rhode Island's programs relative to two major best practices studies:

www.eebestpractices.com⁴ and

EPA's National Energy Action Plan⁵

The best practices study conducted by Quantum (now Itron) was sponsored by the California Utilities. This review covered both overarching best practices and best practices relative to individual program sectors for energy efficiency program design. We used this study to compare Rhode Island's programs at an individual program area. Many of the programs offered by National Grid in Rhode Island were listed in this study as best practice as show in Table 5-1 below:

⁴ Study sponsored by PG&E and other California utilities, authored by Quantum Consulting, (now Itron) – can be found at: www.eebestpractices.com

⁵ <http://www.epa.gov/cleanenergy/energy-programs/napee/resources/action-plan.html>

**Table 5-1
Programs offered by National Grid**

Program Area	National Grid programs included:	Samples of other programs included
Residential Lighting	Massachusetts Energy Star Lighting Program	Energy Star Lighting - UI
Residential AC		Residential AC program – FP&L
Residential Single Family - Comprehensive	Energy Wise	Residential High Use - NSTAR
Residential Multi Family – Comprehensive	Energy Wise	
Residential- informational	Massachusetts Electric RCS Audit	E+ Audit for Your Home – Northwestern Energy
Residential New Construction		Vt Energy Star New Homes CA Energy Star New Homes
C/I - Lighting		Small Business Energy Express – CA Small Business Energy Advantage- NU
C/I - HVAC		Chiller Efficiency Program
Large Comprehensive	Comprehensive Chiller Program Energy Initiative	Power Smart Partners – BC Hydro
New Construction	Design 2000	Design 2000

Overarching Best Practices

We used both www.eebestpractices and the EPA national energy plan to distill overarching best practices.⁶

At the energy efficiency program level, some of the key lessons learned are as follows.

⁶ For example, the website www.eebestpractices.com, which contains the results of best practices research commissioned by Pacific Gas & Electric and *The National Action Plan for Energy Efficiency*, Chapter 6.

-
- Efficiency programs and resource acquisition should harness the motivations and knowledge of market participants, not compete with firms and individuals on the supply side of markets (trade allies) for energy-related products and services.
 - Efficiency programs and resource acquisition should be designed specifically to address barriers to the acceptance of energy-efficient goods and services, as identified through market studies in the jurisdiction or elsewhere.
 - Promote non-energy benefits of energy-efficient designs and products, such as increased occupant comfort or control over production machinery. These often have greater value to decision-makers than energy savings.
 - Keep participation for customers and vendors simple.
 - Target incentives to the key decision makers in the value chain. For example, incentives in residential new construction programs are best targeted to builders, who effectively make most decisions in regard to energy-related home features.
 - Leverage existing brands such as utility brands and the Energy Star Brand
 - Understand local market conditions
 - Use evaluation to improve efficiency programs and resource acquisition over time
 - Perform appropriate market research to understand markets and baselines
 - Use electronic means as much as possible for program efficiency
 - Use existing channels

At the portfolio level, key lessons learned include the following:

- Have efficiency programs and resource acquisition for all sectors
- Focus efficiency program efforts and resource acquisition on market segments and technologies in which there are large untapped potential savings.
- Maintain flexibility to add, drop, or revise efficiency measure eligibility and rebates in response to feedback from the field and formal evaluations.
- Tie employees incentives to overall portfolio goals
- Have stable, predictable budgets

Our review of National Grid's programs indicates the programs offered in Rhode Island generally meet many of these practices. Areas where there could be improvement include:

- Performing more regular evaluations of the RI efficiency programs
- Obtaining baseline data such as market saturations and penetrations for efficiency
- Combining electric and gas program infrastructure for efficiency
- Additional comprehensiveness of efficiency resource acquisition in large Commercial / Industrial programs

5.2 Comparison to Other Portfolios

We compare the Rhode Island programs on a cost basis to portfolios presented in the EPA's National Action Plan⁷ for Energy Efficiency as the data is presented in a consistent manner. The results of the 2006 RI programs are presented below:

Year: 2006	Sector	Approved Budget	Year End	Actual MW	Lifetime mwh	Lifetime MW	Lifetime MWH	\$/ lifetime MWH
EnergyWise	Residential	\$1,888.4	\$2,018.6	0.345	3,408	3.633	39,027.0	0.052
Single Family Low Income Services	Residential	\$1,684.4	\$1,922.5	0.128	1,227	1.859	16,854.0	0.114
ENERGY STAR Appliances	Residential	\$345.3	\$319.5	0.358	1,468	4.696	20,405.0	0.016
ENERGY STAR Heating Program	Residential	\$109.8	\$101.0	0.000	10	0.001	117.0	0.863
ENERGY STAR Central A/C Program	Residential	\$174.9	\$118.7	0.028	17	0.479	285.0	0.416
ENERGY STAR Lighting	Residential	\$780.6	\$760.4	1.022	16,076	6.490	101,235.0	0.008
ENERGY STAR Homes	Residential	\$988.0	\$1,112.3	0.235	1,323	4.600	13,487.0	0.082
Energy Efficiency Education Programs	Residential	\$48.6	\$55.9	n/a	n/a	n/a	n/a	n/a
	SUBTOTAL	\$6,020.0	\$6,408.9	2.116	23,529	21.758	191,410.0	0.033
Design 2000plus	Large Commer	\$2,729.0	\$2,339.5	1.696	8,326	28.079	136,946.0	0.017
Energy Initiative	Large Commer	\$3,842.5	\$4,615.9	4.731	29,498	59.332	371,494.0	0.012
	SUBTOTAL	\$6,571.5	\$6,955.4	6.427	37,824	45.079	508,440.0	0.014
Small Business Services	Small Commer	\$3,592.1	\$4,061.8	2.160	9,297	26.115	112,961.0	0.036
	SUBTOTAL	\$3,592.1	\$4,061.8	2.160	9,297	26.115	112,961.0	0.036
	Overall		\$17,426.1				812,811.0	0.021

Source:
National Grid 2006 Year-End Report

The costs/lifetime MWH in the EPA best Practices report ranged from \$.01/ lifetime MWH to \$.05 per lifetime MWH. The Rhode Island portfolio falls comfortably in this range at: \$.021/ lifetime MWH. As in most of the other portfolios, large C/I is typically the lowest cost/ lifetime MWH.

⁷ <http://www.epa.gov/cleanenergy/energy-programs/napee/resources/action-plan.html>

The utilities, public administrator and states used in this comparison are presented below:

Utilities used in EPA Portfolio Comparison

Nevada	Connecticut
SMUD	Seattle City Light
Austin Energy	BPA
Minnesota	NYSERDA
Efficiency Vermont	Massachusetts
Wisconsin Department of Administration	California IOUs

All of these portfolios like Rhode Island have comprehensive programs for all customer classes. A program review was conducted as part of this effort. Program areas/ efficiency measures that are not offered by Rhode Island included:

- Appliance Recycling (Ca utilities)
- Rebates for more efficient computer equipment (Ca utilities)
- Ties to LEED in new construction programs (Austin, Nevada))
- Water heater rebates (Ca utilities)
- Load control of AC for small C/I and residential (many including Austin Energy and Ca Utilities)
- Retrocommissioning (Nevada)
- Solar hot water heat (Ca utilities)
- Data center rebates (Ca utilities)
- Cool roofs programs or measures (Ca and Nevada)
- Performance based Commercial Lighting (suggested from the RI interviews)

5.3 Identification of New Program Areas and Measures

Our review of other portfolios as indicated in the previous section indicated the following potential new energy efficiency program areas and resource acquisition strategies for Rhode Island:

- Adding an appliance recycling program (residential)
- Adding a retro commissioning program (commercial/ industrial)
- Direct ties to LEED in new construction programs
- Adding a data center program
- Adding a direct load control program

We have included an appliance recycling component in the technical and economic potential described in section 7 and the direct load control program in the load response section. We plan to model both a data center program, more direct ties to LEED and retro commissioning as part of the Phase II study as the data is more speculative.

We also identified new potential measures that may be applicable in 2-5 years. This list was developed from a review of emerging technologies from ACEEE, LBL and other utilities. We list them here for consideration and plan to model them in Phase II.

Potential New Residential Energy Efficiency Measures

- LED's
- Cool roofs
- Commissioning
- Energy recovery ventilation
- Smart AC
- EnergyStar or Better PC
- EnergyStar or Better TV
- EnergyStar or Better Set-Top
- Heat pump dryer

-
- Solar hot water heating
 - AC control

Potential new Commercial / Industrial Efficiency Measures

- LED's (residential and C/I)
- Cool roofs
- Commissioning
- Energy recovery ventilation
- Smart AC
- LED Downlights
- Induction Lighting
- CDMi replacement for incandescent or halogen reflector lamps
- Data center package
- AC control

6. Draft Tech and Economic Potential from DSM ASSYST

6.1 Breakdown of Potential and Benefits

In this section we provide additional information on the estimates of electric efficiency potential developed for this study. We discuss results by customer class, end use, and type of measure.

6.1.1 Electric Technical and Economic Potential

All Sectors. The technical and economic potential for energy savings in the Rhode Island energy service territory are shown in Figure 6-1 and Table 6-1. Overall technical potential for energy savings in the residential, commercial, and industrial sectors is approximately 688 MW and the potential for economic energy savings is estimated to be approximately 518 MW. That is, more than 500 MW of energy efficiency that is cheaper than supply have been estimated to exist as an untapped resource in Rhode Island. The residential sector contributes the most to both technical and economic savings potential, followed by the commercial sector.

Figure 6-1 presents a summary of the technical potential and economic potential (efficiency resources that are cheaper than supply) in MW for Rhode Island.

**Figure 6-1
Technical and Economic Demand Savings Potential
by Market Sector in Rhode Island – MW**

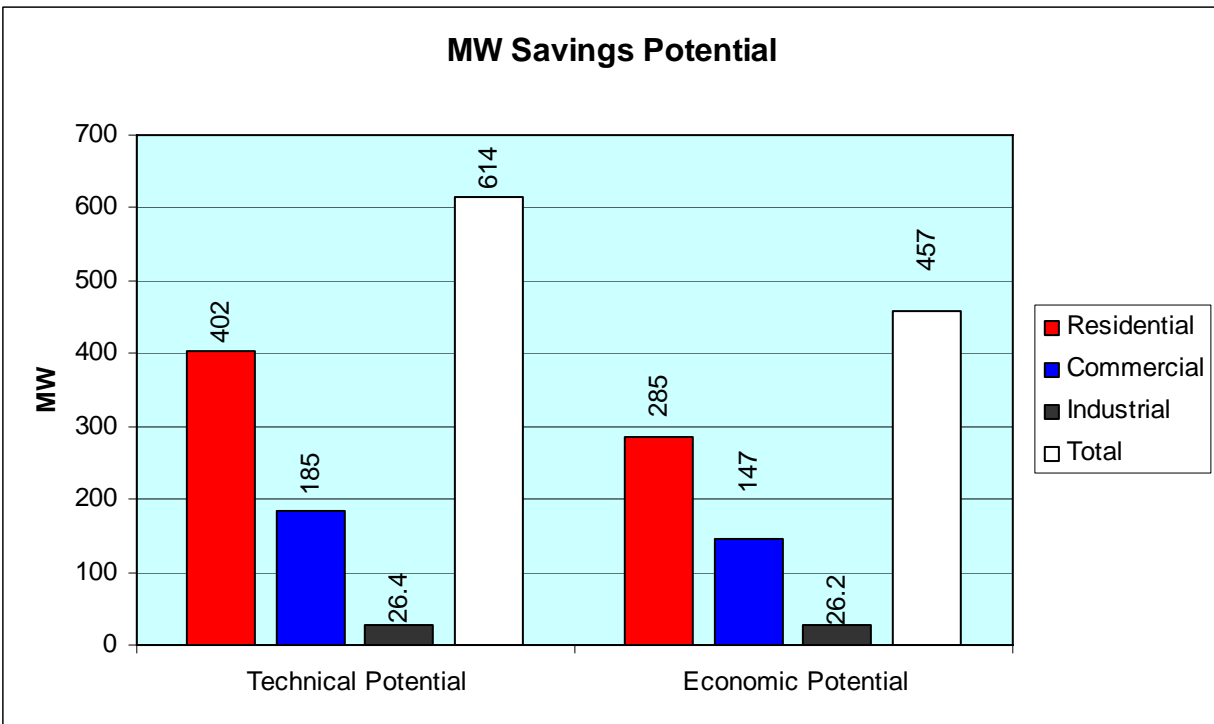


Figure 6-2 presents a summary of the technical potential and economic potential (efficiency resources that are cheaper than supply) in GWh savings for Rhode Island. This chart shows a similar pattern to the MW chart as far as savings from each sector.

Figure 6-2
Technical and Economic Demand Savings Potential
by Market Sector in Rhode Island –GWh

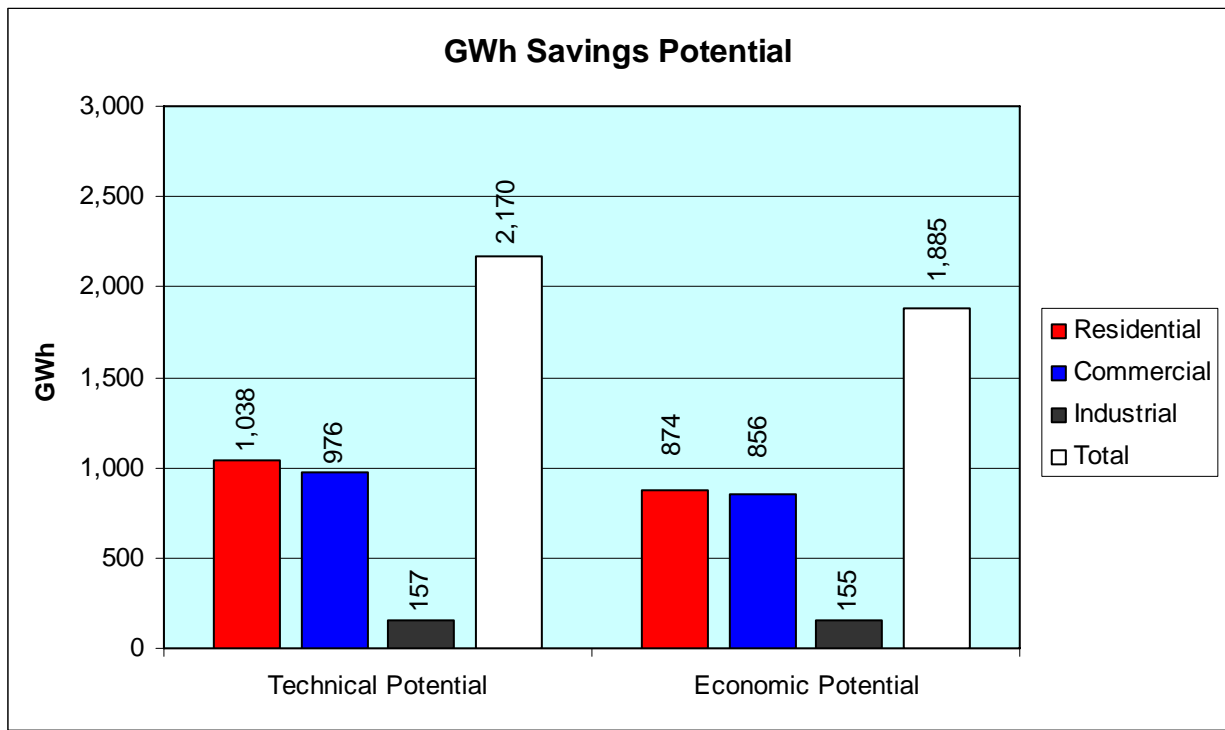


Table 6-1
Technical and Economic Demand Savings Potential
by Market Sector in Rhode Island – MW
2017 Electric Demand Savings

MW	Technical Potential	Economic Potential
Residential	402.3	284.7
Commercial	185	146.6
Industrial	26.4	26.2
Overall	613.5	457.5

Annual GWh savings are presented in Figure 6-3 for Rhode Island. Figure 6-4 presents GWh technical potential efficiency savings as percent of total energy for that Sector.

Figure 6-3
Technical Electric Energy Savings Potential by Market Sector
in Rhode Island in 2017 in GWh/Year

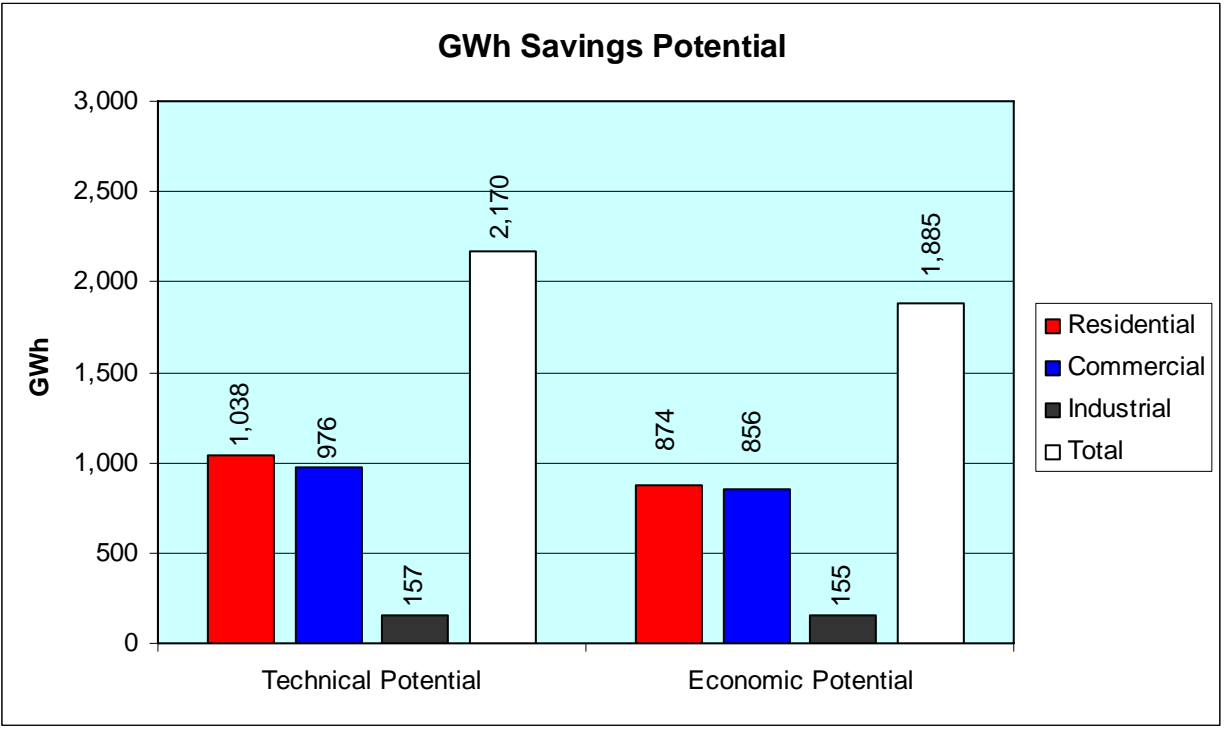


Figure 6-4

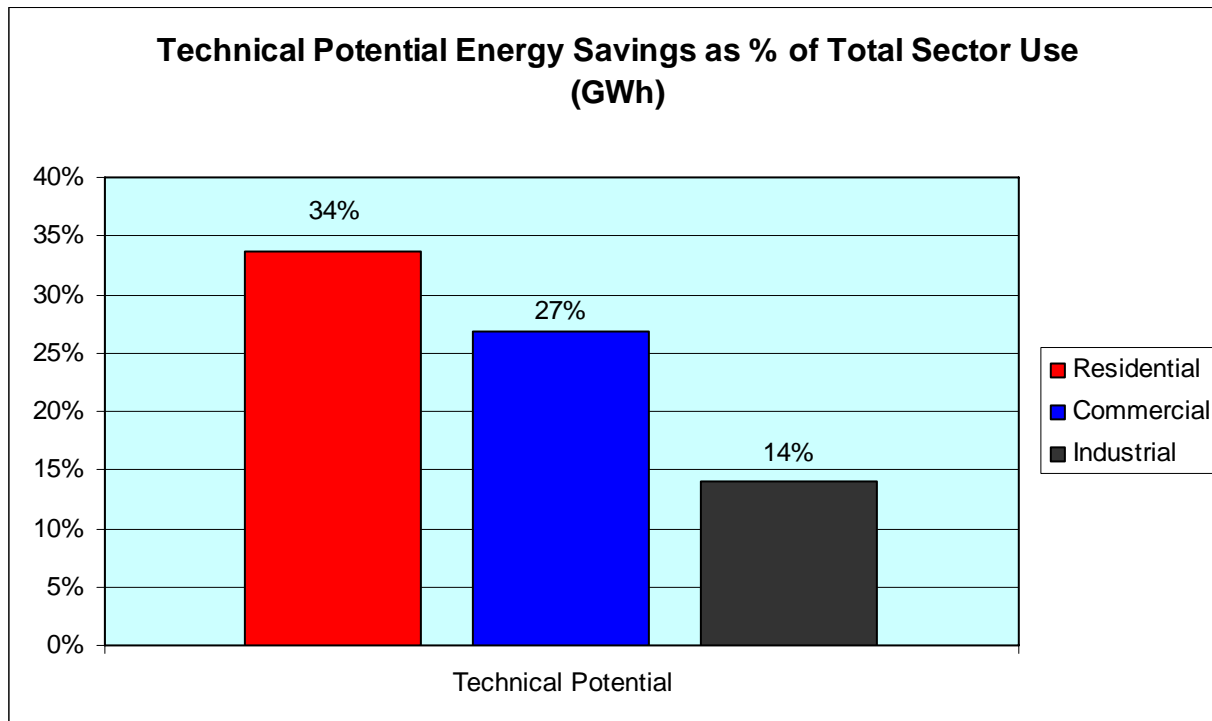
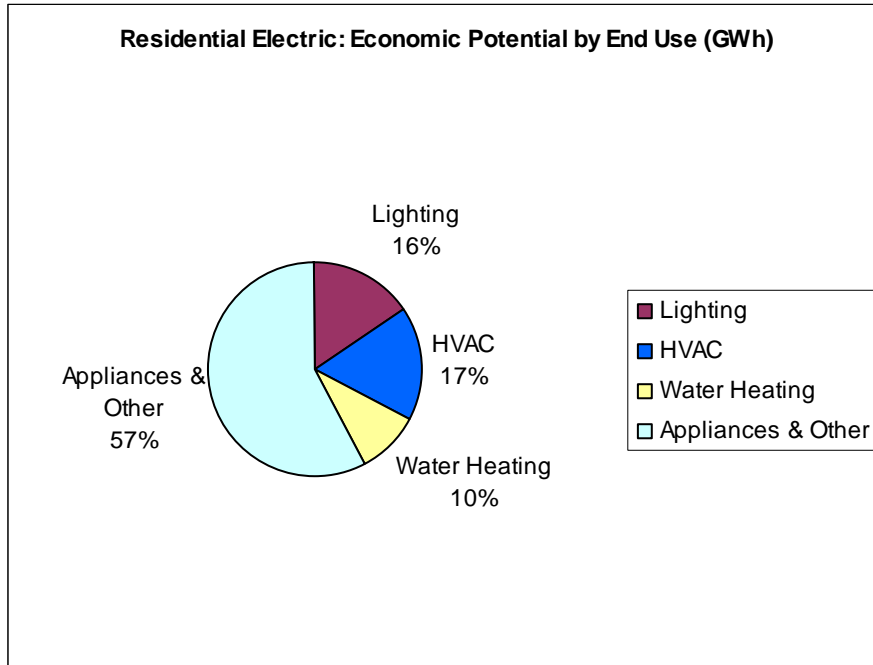


Table 6-2
Technical and Economic Electric Energy Savings Potential
by Market Sector in Rhode Island

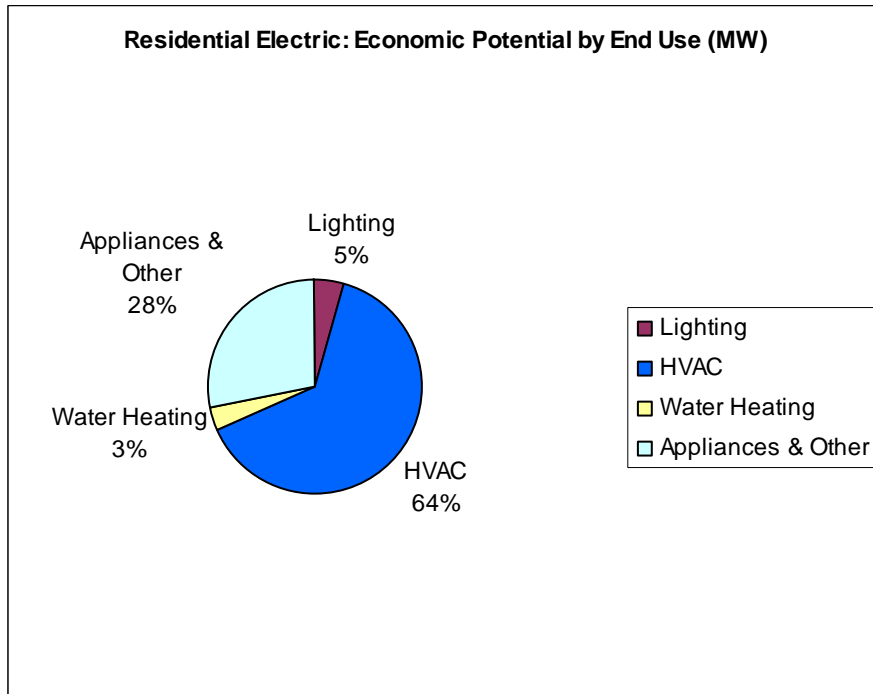
GWh/Year	Technical Potential	Economic Potential
Residential	1,038	874
Commercial	976	856
Industrial	157	155
Overall	2,170	1,885

Residential Sector. Residential economic potential in Rhode Island is presented by key end use in Figure 6-5. Key contributors to overall economic potential for energy are from appliances, HVAC and lighting. Most of the demand savings come from HVAC as shown in Figure 6-6.

**Figure 6-5
Residential Energy Use Economic Potential by End Use (GWh)**



**Figure 6-6
Residential Demand Economic Potential by End Use (MW)**



Commercial Sector. Total economic potential for the commercial sector is approximately 1,026 GWh. Figure 6-7 and Figure 6-8 show commercial sector economic potential estimates by key end use. Lighting dominates both the energy savings (73 percent of total) and demand savings (66 percent). End uses in the “other” category include refrigeration, water heating, and office equipment.

Figure 6-7
Commercial Energy Use Economic Potential by End Use (GWh)

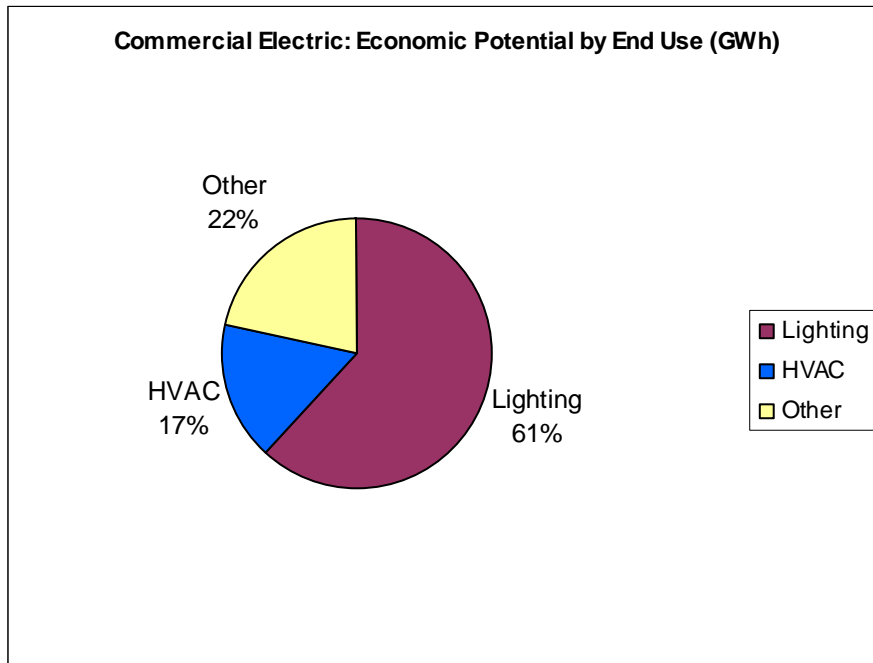
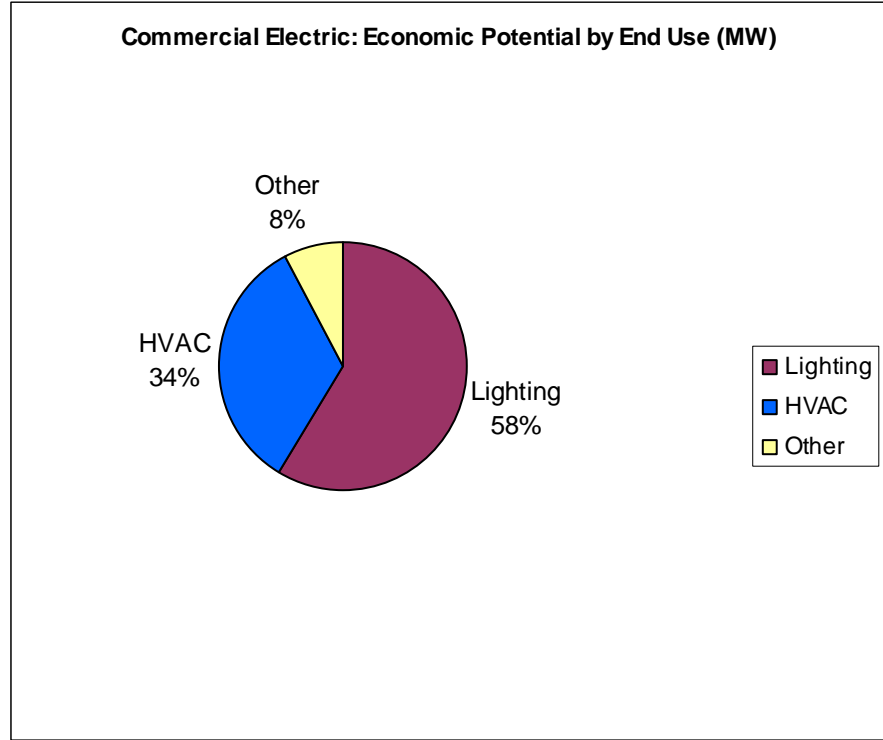
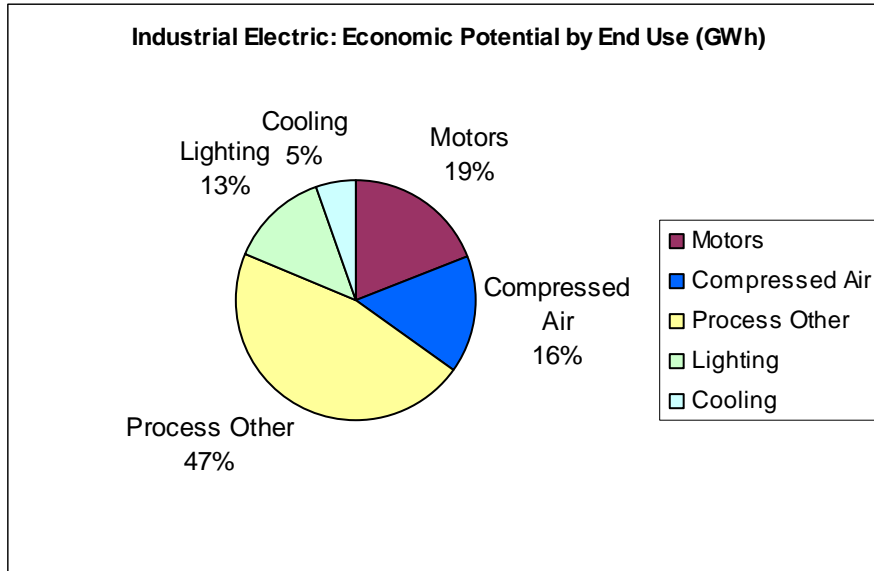


Figure 6-8
Commercial Demand Economic Potential by End Use (MW)

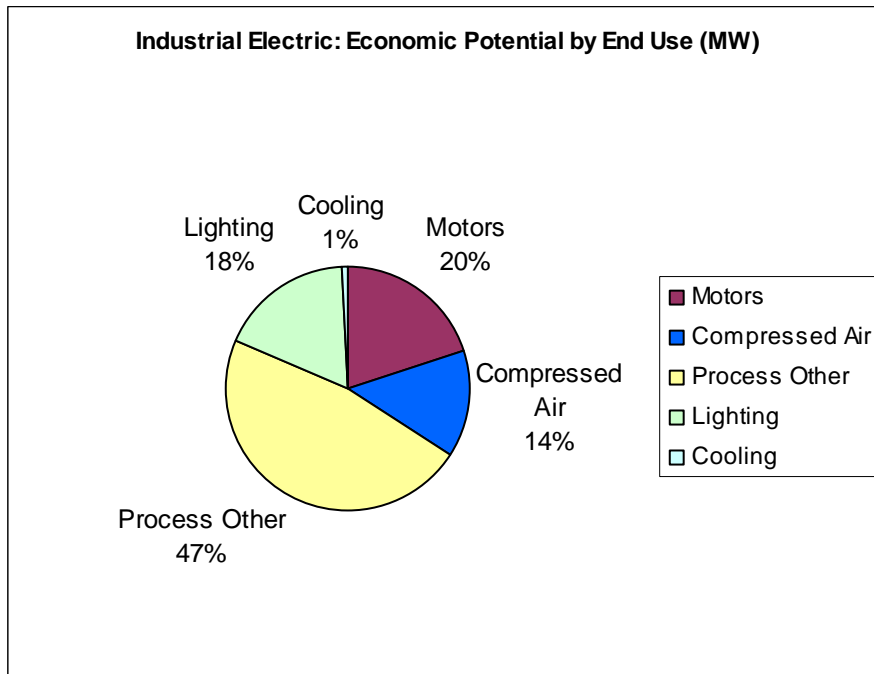


Industrial Sector. Total industrial sector economic potential estimates by key end use. The technical potential is dominated by process improvements. Figure 6-9 presents the breakdown by enduses for energy. Figure 6-10 presents similar data for demand.

**Figure 6-9
Industrial Energy Use Economic Potential by End Use (GWh)**



**Figure 6-10
Industrial Demand Economic Potential by End Use (MW)**



6.2 Achievable Potential and Net Benefits

We developed two cases of achievable potential – Base and aggressive. A summary of the two cases is provided below in Table 6-3 and Table 6-4. The base case is similar to the existing funding level and the aggressive case has a significantly higher funding level. We developed the Aggressive case by significantly increasing the marketing budgets for some program areas as well as increasing the incentives. We used a simpler approach to this process than will be conducted in phase II. We developed overall achievable cases at the sector level not the program level except for new construction. We did develop estimates for some new programs outside the model - namely for a mass market (residential and small commercial load control) and appliance recycling. These are presented in Section 9.



**Table 6-3
Summary of the Base Case**

Residential Base Case				
Year	2009	2010	2011	2018
Administration	\$748,700	\$774,910	\$785,497	\$753,567
Marketing	\$141,700	\$143,230	\$144,776	\$156,076
Incentives	\$4,383,156	\$4,576,990	\$4,647,010	\$4,290,619
Total	\$5,273,556	\$5,495,130	\$5,577,283	\$5,200,263
Net Energy Savings - GWh	16	33	49	129
Net Peak Electricity Demand Savings - kW	4,219	8,528	12,811	38,676
Annual Participant Costs (Real)	\$7,061,100	\$6,892,775	\$6,601,562	\$4,024,193
Annual PV Participant Costs	\$7,061,100.13	\$6,823,137.44	\$6,468,845.15	\$3,672,729.43
Naturally Occurring Energy Savings Total (Annual)	12	11	10	6
Naturally Occurring Peak Demand Savings Total (Annual)	1,782	1,632	1,499	874
PV Avoided Costs	\$35,193,568	\$34,639,985	\$32,351,318	\$15,355,514
PV Program Costs	\$5,273,556	\$5,439,613	\$5,465,158	\$4,746,084
Annual TRC	2.85	2.82	2.71	1.82
Commercial Base Case				
Year	2009	2010	2011	2018
Administration	\$1,602,280	\$1,528,377	\$1,532,945	\$1,440,954
Marketing	\$64,430	\$65,126	\$65,829	\$70,967
Incentives	\$7,569,027	\$7,802,972	\$7,850,238	\$5,057,460
Total	\$9,235,737	\$9,396,475	\$9,449,011	\$6,569,381
Net Energy Savings - GWh	28	57	87	229
Net Peak Electricity Demand Savings - kW	4,074	8,457	12,949	36,833
Annual Participant Costs (Real)	\$13,821,619	\$14,020,780	\$13,876,448	\$8,578,410
Annual PV Participant Costs	\$13,821,619.02	\$13,879,128.00	\$13,597,477.35	\$7,829,192.83
Naturally Occurring Energy Savings Total (Annual)	31	30	30	20
Naturally Occurring Peak Demand Savings Total (Annual)	3,492	3,523	3,521	2,646
PV Avoided Costs	\$50,420,905	\$51,797,809	\$49,738,270	\$16,970,826
PV Program Costs	\$9,235,737	\$9,301,542	\$9,259,050	\$5,995,627
Annual TRC	2.19	2.23	2.18	1.23
Industrial Base Case				
Year	2009	2010	2011	2018
Administration	\$451,920	\$441,967	\$409,487	\$135,110
Marketing	\$18,000	\$18,194	\$18,391	\$19,826
Incentives	\$2,559,620	\$2,503,248	\$2,319,282	\$765,246
Total	\$3,029,540	\$2,963,409	\$2,747,159	\$920,182
Net Energy Savings - GWh	20	39	56	120
Net Peak Electricity Demand Savings - kW	4,290	8,351	11,996	25,965
Annual Participant Costs (Real)	\$3,081,765	\$3,017,751	\$2,840,478	\$1,162,571
Annual PV Participant Costs	\$3,081,765	\$2,987,263	\$2,783,373	\$1,061,035
Naturally Occurring Energy Savings Total (Annual)	3	3	3	3
Naturally Occurring Peak Demand Savings Total (Annual)	642	657	663	528
PV Avoided Costs	\$42,413,566	\$38,993,160	\$33,132,229	\$6,847,109
PV Program Costs	\$3,029,540	\$2,933,470	\$2,691,931	\$839,816
Annual TRC	6.94	6.59	6.05	3.60
Total Base Case				
Year - Program Costs-Real	2009	2010	2011	2018
Administration	\$2,802,900	\$2,745,254	\$2,727,928	\$2,329,631
Marketing	\$224,130	\$226,549	\$228,995	\$246,869
Incentives	\$14,511,803	\$14,883,210	\$14,816,530	\$10,113,325
Total	\$17,538,833	\$17,855,014	\$17,773,453	\$12,689,825
Net Energy Savings - GWh	64	129	192	478
Net Peak Electricity Demand Savings - kW	12,584	25,335	37,756	101,474
Annual Participant Costs (Real)	\$23,964,484	\$23,931,306	\$23,318,488	\$13,765,174
Annual PV Participant Costs	\$23,964,484	\$23,689,528	\$22,849,696	\$12,562,957
Naturally Occurring Energy Savings Total (Annual)	46	45	44	29
Accumulated Naturally Occurring Energy Savings Total (Annual)	46	91	135	381
Naturally Occurring Peak Demand Savings Total (Annual)	5916	5812	5683	4048
Accumulated Naturally Occurring Peak Demand Savings Total (Annual)	5916	11728	17411	51061
PV Avoided Costs	\$128,028,039	\$125,430,954	\$115,221,818	\$39,173,449
PV Program Costs	\$17,538,833	\$17,674,625	\$17,416,138	\$11,581,527
Annual TRC	3.08	3.03	2.86	1.62
Program Lifetime cents/kwh for that year	0.022	0.022	0.023	0.044
Additional Programs- Budget				
Appliance Recycling	1053000	1053000	1053000	1053000
Direct Load Control	\$650,000	\$1,040,000	\$1,210,564	\$871,643
Total National Grid Budget	\$19,241,833	\$19,948,014	\$20,037,017	\$14,614,468
Additional ISO				

Both Tables present the same pattern – spending drops off later in the period as most of the lighting in all sectors has been converted to more efficient stock.

**Table 6-4
Summary of the Aggressive Case**

Aggressive Case				
Residential Aggressive Case				
Year	2009	2010	2011	2018
Administration	\$748,700	\$811,596	\$836,513	\$908,902
Marketing	\$141,700	\$212,659	\$280,923	\$1,048,212
Incentives	\$14,725,008	\$15,948,308	\$16,472,190	\$17,852,723
Total	\$15,615,408	\$16,972,564	\$17,589,627	\$19,809,837
Net Energy Savings - GWh	32	65	97	273
Net Peak Electricity Demand Savings - kW	12,512	25,304	38,022	122,500
Annual Participant Costs (Real)	\$10,566,984	\$10,626,998	\$10,366,996	\$8,150,119
Annual PV Participant Costs	\$10,566,984	\$10,519,633	\$10,158,580	\$7,438,308
Naturally Occurring Energy Savings Total (Annual)	12	11	10	6
Naturally Occurring Peak Demand Savings Total (Annual)	1,782	1,632	1,499	874
PV Avoided Costs	\$79,415,834	\$79,044,847	\$74,139,884	\$39,041,939
PV Program Costs	\$15,615,408	\$16,801,090	\$17,236,007	\$18,079,695
Annual TRC	3.03	2.89	2.71	1.53
Commercial Aggressive				
Year	2009	2010	2011	2018
Administration	\$1,602,280	\$1,650,004	\$1,797,300	\$2,339,510
Marketing	\$64,430	\$138,057	\$255,865	\$505,573
Incentives	\$18,730,390	\$19,843,162	\$20,541,022	\$12,300,018
Total	\$20,397,100	\$21,631,223	\$22,594,186	\$15,145,101
Net Energy Savings - GWh	44	93	144	371
Net Peak Electricity Demand Savings - kW	7,333	15,434	24,070	67,927
Annual Participant Costs (Real)	\$21,798,101	\$22,373,794	\$22,577,637	\$13,223,600
Annual PV Participant Costs	\$16,648,068	\$16,648,069	\$16,648,070	\$16,648,071
Naturally Occurring Energy Savings Total (Annual)	31	30	30	20
Naturally Occurring Peak Demand Savings Total (Annual)	3,492	3,523	3,521	2,646
PV Avoided Costs	\$82,392,411	\$87,303,677	\$87,383,738	\$23,092,158
PV Program Costs	\$20,397,100	\$21,412,684	\$22,139,955	\$13,822,365
Annual TRC	1.95	2.00	1.97	0.89
Industrial Aggressive				
Year	2009	2010	2011	2018
Administration	\$451,920	\$441,967	\$409,487	\$135,110
Marketing	\$18,000	\$18,194	\$18,391	\$19,826
Incentives	\$2,559,620	\$2,503,248	\$2,319,282	\$765,246
Total	\$3,029,540	\$2,963,409	\$2,747,159	\$920,182
Net Energy Savings - GWh	20	39	56	120
Net Peak Electricity Demand Savings - kW	4,290	8,351	11,996	25,965
Annual Participant Costs (Real)	\$3,081,765	\$3,017,751	\$2,840,478	\$1,162,571
Annual PV Participant Costs	\$3,081,764.61	\$2,987,263.04	\$2,783,373.50	\$1,061,034.67
Naturally Occurring Energy Savings Total (Annual)	3	3	3	3
Naturally Occurring Peak Demand Savings Total (Annual)	642	657	663	528
PV Avoided Costs	\$42,413,566	\$38,993,160	\$33,132,229	\$6,847,109
PV Program Costs	\$3,081,765	\$2,987,263	\$2,783,373	\$1,061,035
Annual TRC	6.88	6.53	5.95	3.23
Total Aggressive Case				
Year	2009	2010	2011	2018
Administration	\$2,802,900	\$2,903,567	\$3,043,299	\$3,383,523
Marketing	\$224,130	\$350,716	\$536,788	\$1,553,784
Incentives	\$36,484,938	\$35,791,471	\$37,013,212	\$30,152,741
Total	\$39,511,968	\$39,045,754	\$40,593,299	\$35,090,048
Net Energy Savings - GWh	96	197	296	764
Net Peak Electricity Demand Savings - kW	24,136	49,089	74,088	216,392
Annual Participant Costs (Real)	\$3,081,765	\$3,017,751	\$2,840,478	\$1,162,571
Annual PV Participant Costs	\$3,081,765	\$2,987,263	\$2,783,373	\$1,061,035
Naturally Occurring Energy Savings Total (Annual)	3	3	3	3
Accumulated Naturally Occurring Energy Savings Total (Annual)	46	91	135	381
Naturally Occurring Peak Demand Savings Total (Annual)	5,916	5,812	5,683	4,048
Accumulated Naturally Occurring Peak Demand Savings Total (Annual)	5,916	11,728	17,411	51,061
PV Avoided Costs	\$204,221,811	\$208,762,089	\$203,937,187	\$104,547,662
PV Program Costs	\$39,094,273	\$41,201,037	\$42,159,336	\$32,963,094
Annual TRC	2.74	2.70	2.62	1.88
Program costs/ lifetime kwh for program year	\$0.03	\$0.03	\$0.03	\$0.08

Additional Programs presented in Base Case not presented here

As shown above we developed estimates cases for both the direct load control program and the appliance recycling program that we did not model in Demand Side Assyst that are presented in Section 9.

Our model has two embedded assumptions – first once a measure is replaced – it is assumed to be efficient for the rest of the period. Secondly in this phase we are not adding any new potential technologies that may become available further out in time. In both the Base Case and the Aggressive Case as we have modeled them, after 2015 the most of the efficient retrofit measures have already been installed either through the program or by non –participants. Both cases are highly cost effective, even though they become less cost effective over time.

Figure 6-11 presents the annual gwh savings of the scenarios over time. As this figure indicates the base case remains relatively stable over time and the aggressive case slowly declines over tie after having an initial budget level of approximately \$36 M.

**Figure 6-11
GWH Impacts of Achievable Scenarios**

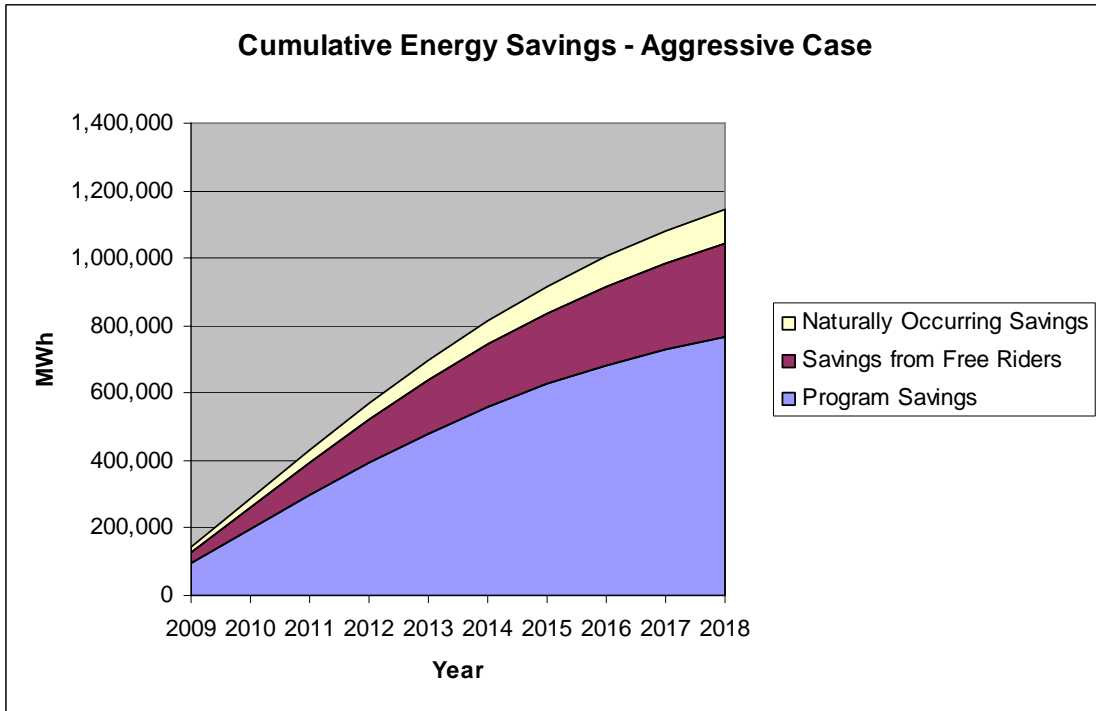
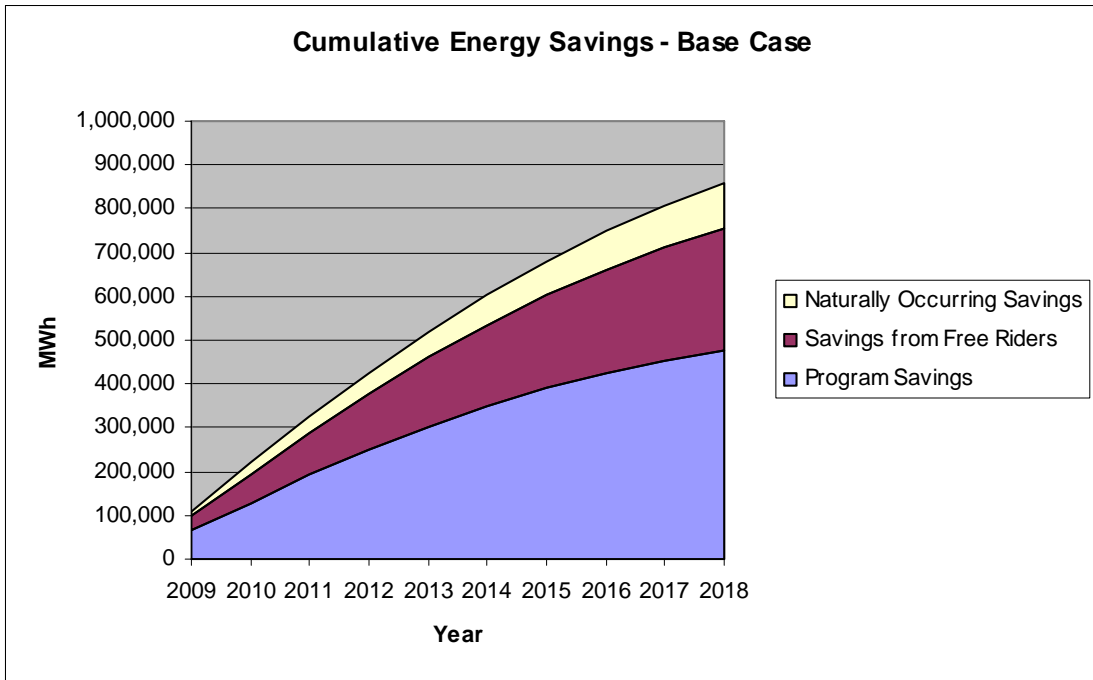


Figure 6-12 presents the overall cost effectiveness of the two achievable scenarios and indicates these cases present significant net economic benefits.

Figure 6-12
Overall Cost Effectiveness of Achievable Scenarios

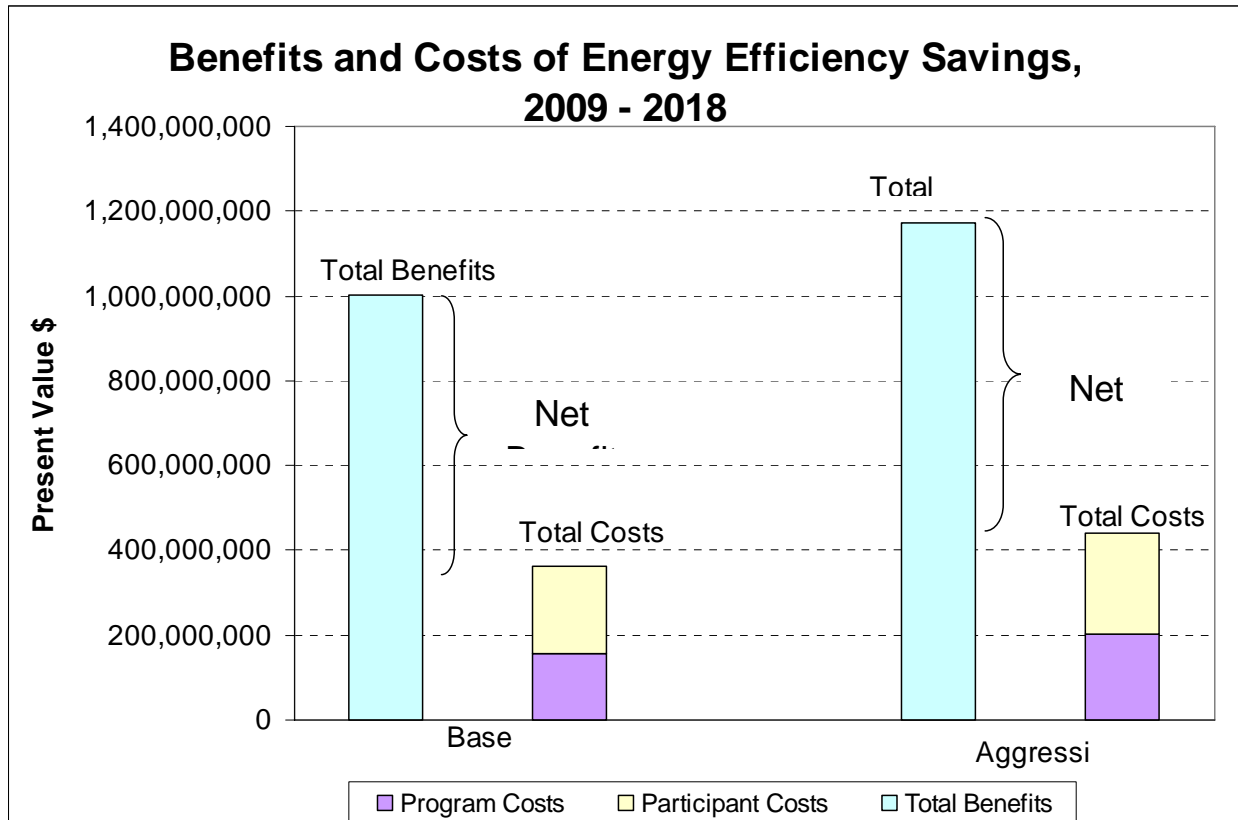
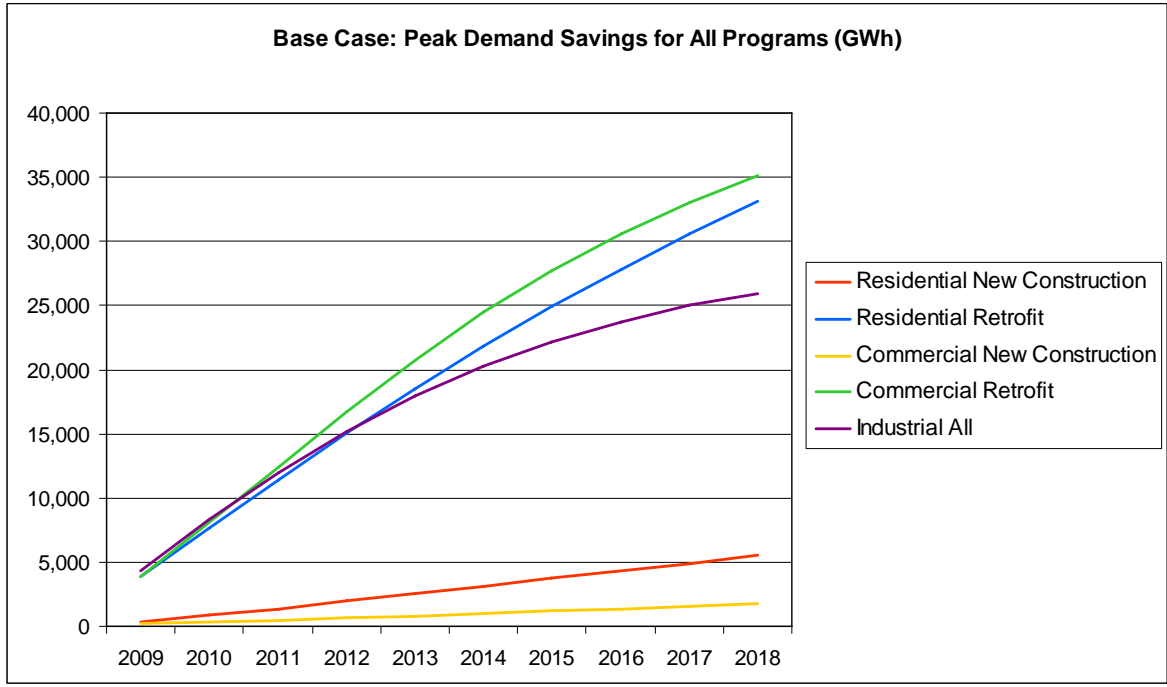


Figure 6-13 presents the base case by market sector first for KW and then for GWH.

Figure 6-13
Demand Savings- Base Case KW



Base Case – Energy Savings - GWh

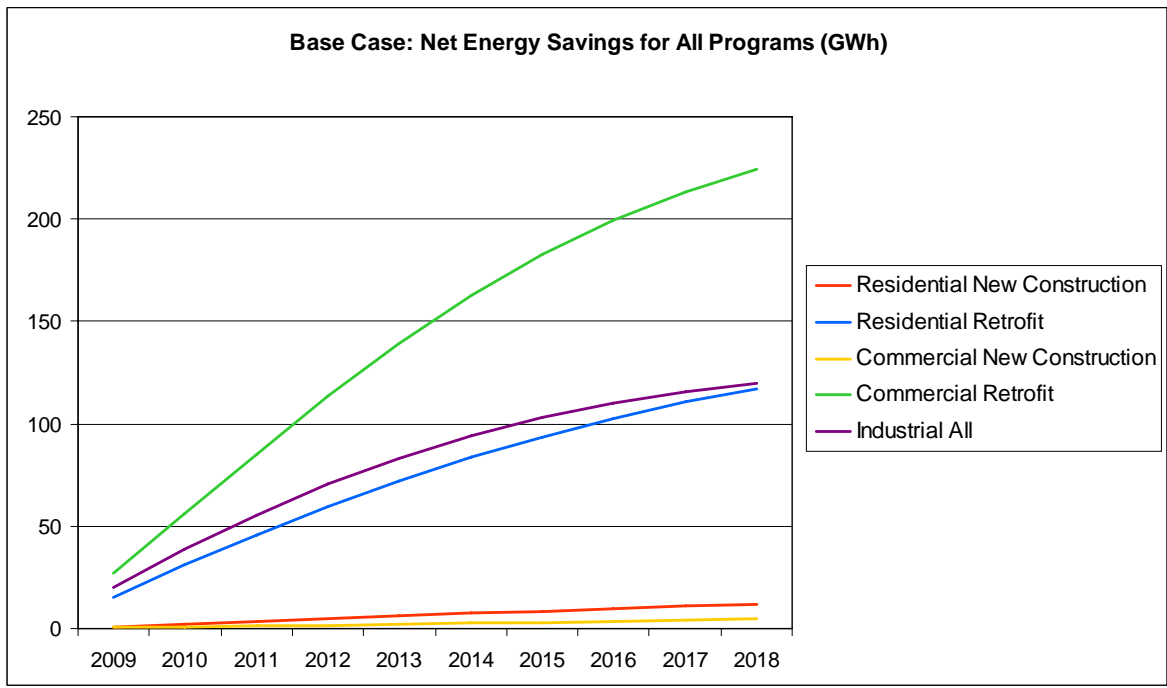
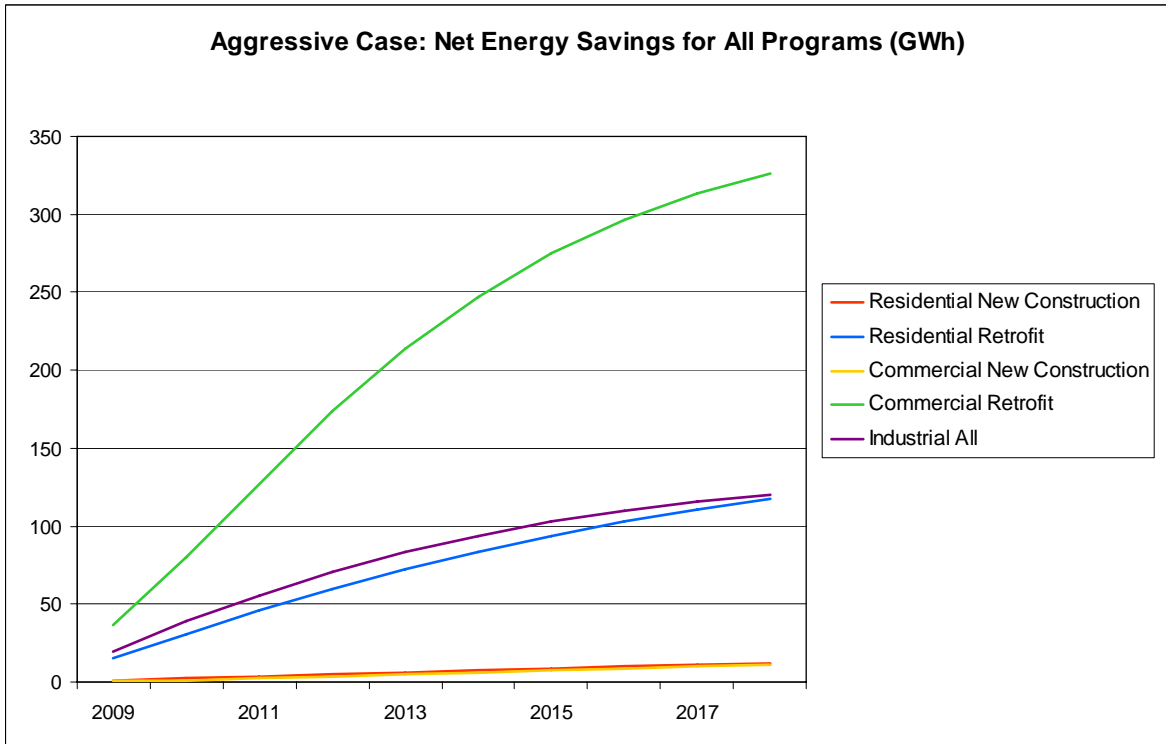
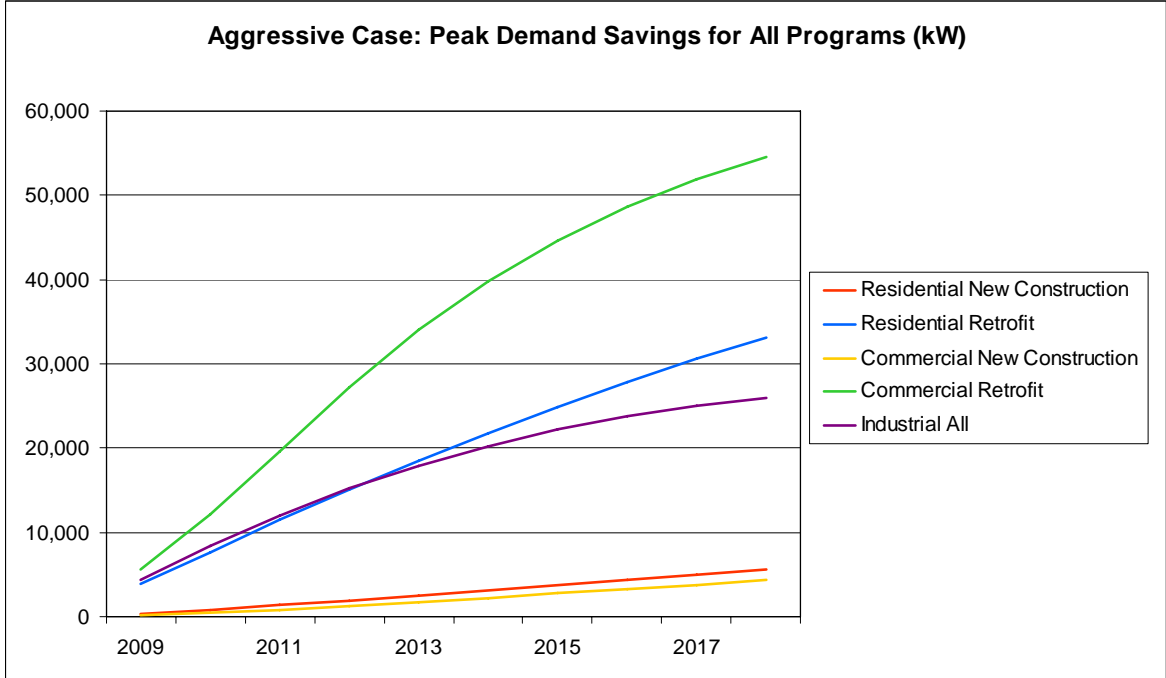


Figure 6-14 presents the demand data for the Aggressive Case.

Figure 6-14
Peak Demand Savings for All Programs



6.3 Supply curves

A common way to illustrate the amount of energy savings per dollar spent is to construct an energy-efficiency supply curve. A supply curve typically is depicted on two axes—one captures the cost per unit of saved energy (e.g., \$/kWh saved), and the other shows energy savings at each level of cost. The costs of the measures are levelized over the life of the savings achieved (e.g., levelized \$/kWh saved). What is important to note is that in the energy efficiency supply curve, the measures are sorted by relative cost—from least to most expensive. In addition, the energy consumption of the system being affected by the efficiency measures goes down as each measure is applied. As a result, the savings attributable to each subsequent measure decrease if the measures are interactive. For example, an occupancy sensor measure would save more at less cost per unit saved if it were applied to the base-case consumption before installation of higher efficiency lamps (e.g., premium T8 lamps). Because the premium T8 lamp is more cost-effective, however, it is applied first, reducing the energy savings potential for the occupancy sensor. Thus, in a typical EE supply curve, the base-case end-use consumption is reduced with each unit of energy efficiency that is acquired. The total end-use GWh consumption is recalculated after each measure is implemented, thus reducing the base energy available to be saved by the next measure.

Figures 6-15 to 6-17 present the energy-efficiency supply curves constructed for this study for both residential and commercial/institutional buildings. Each curve represents energy savings as a percentage of total energy consumption in Rhode Island in the year 2020. Savings potentials and levelized costs for the individual measures that comprise the supply curve are provided in Appendix A.

Figure 6-15
Residential Electric Supply Curve – Potential in 2020

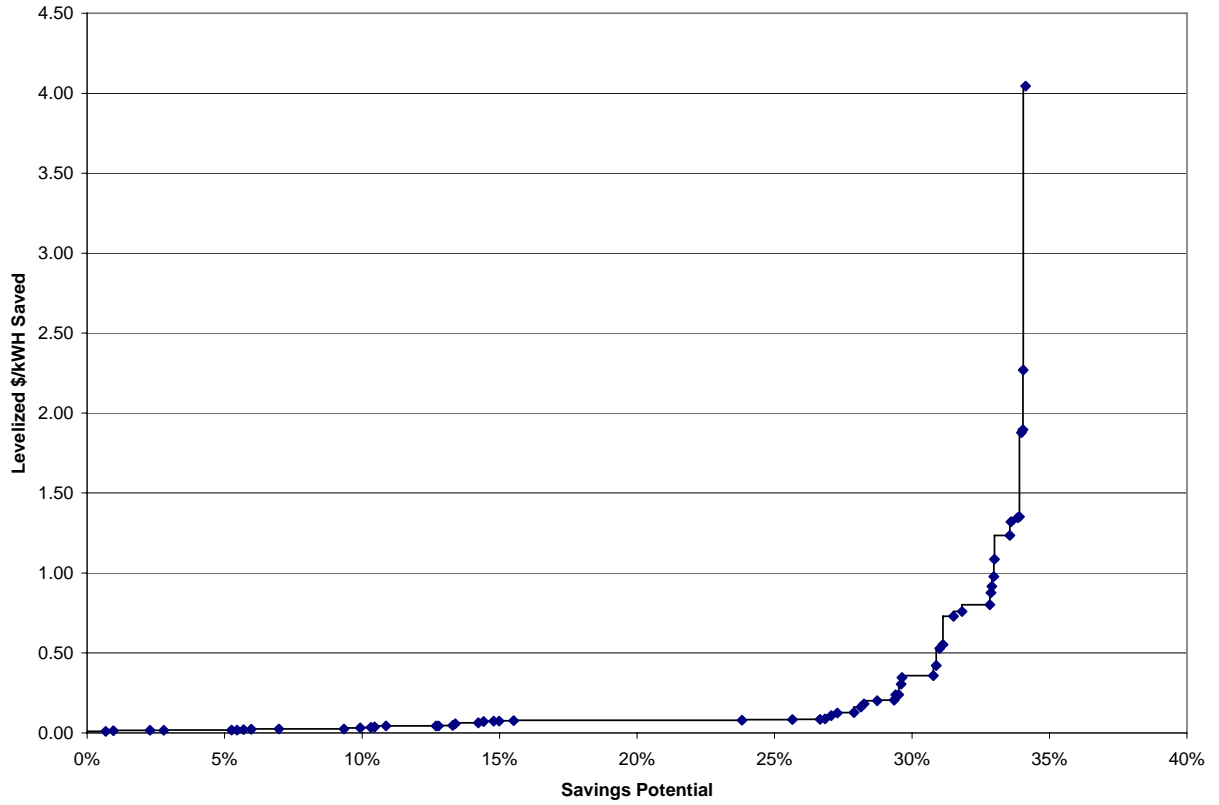


Figure 6-16
Commercial/Institutional Electric Supply Curve – Potential in 2020

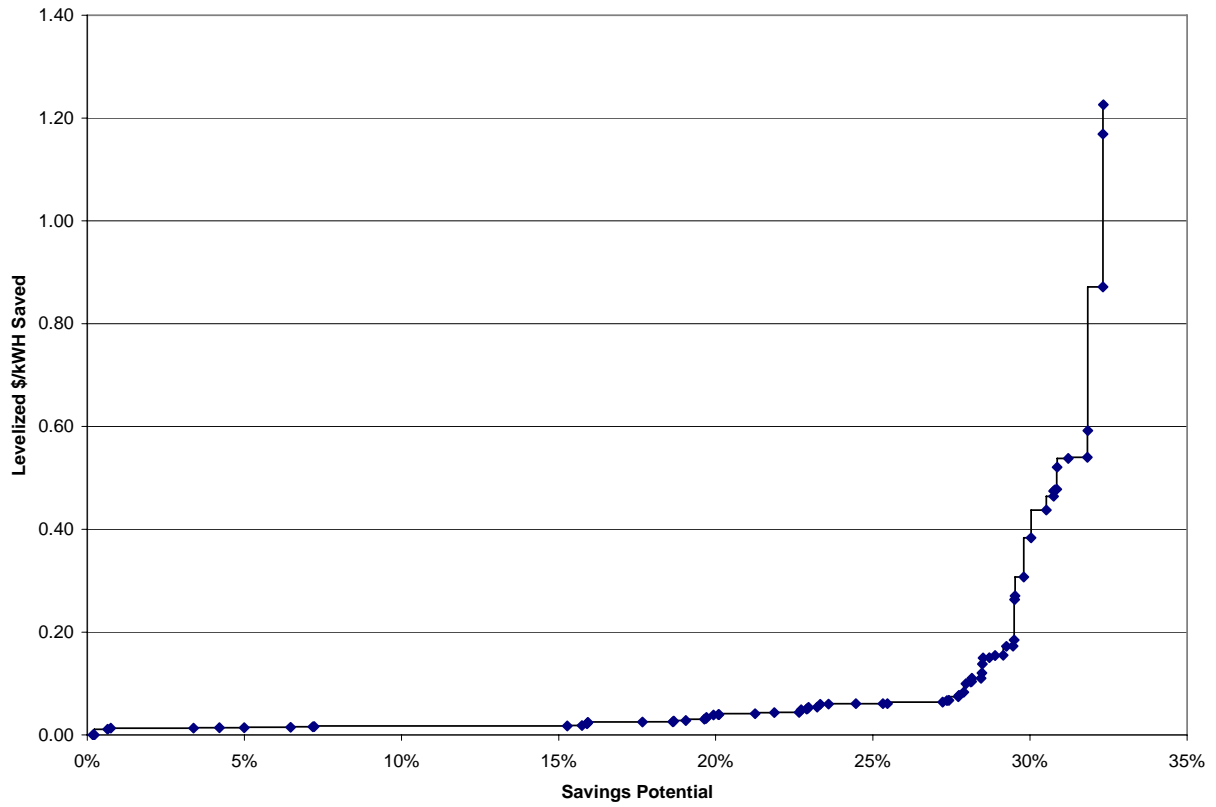
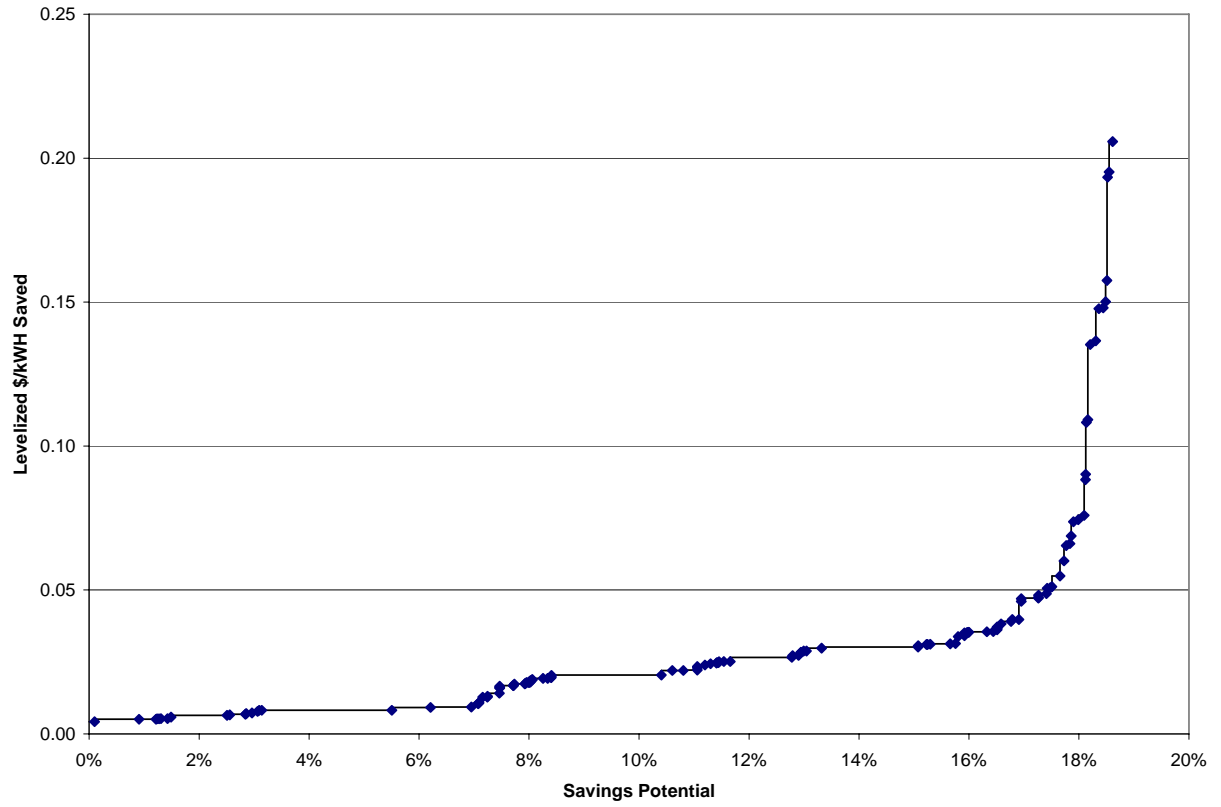


Figure 6-17
Industrial Electric Supply Curve – Potential in 2020



6.4 Measure lists

As indicated in the previous section, most of the measures we reviewed were cost effective from a total resource cost test point of view. In Tables 6-5 to 6-7 we present the top 10 most cost effective measures for each retrofit customer sector and the 10 with the most savings.

**Table 6-5
Top Industrial Retrofit Measures**

DSM ASSYST ADDITIVE SUPPLY ANALYSIS						
Measure	Measure	Cumulative GWH Savings	Cumulative MW Savings	Marginal Energy Cost \$/kWH	Marginal Capacity Cost \$/kW	Total Resource Cost Test TRC

Top 10 Measures by Total Resource Cost (Existing Industrial)

417	O&M - Extruders/Injection Moulding	1.07	0.49	0.00	9.29	42.90
406	Gap Forming papermachine	0.40	0.10	0.01	21.86	28.06
401	Bakery - Process (Mixing) - O&M	0.23	0.05	0.01	22.78	27.89
407	High Consistency forming	0.38	0.09	0.01	22.11	27.74
104	Compressed Air- Sizing	3.34	0.64	0.01	26.47	27.41
301	Pumps - O&M	8.85	1.58	0.01	28.33	27.14
201	Fans - O&M	1.31	0.23	0.01	31.06	25.55
551	Efficient Refrigeration - Operations	0.70	0.13	0.01	31.91	22.09
101	Compressed Air-O&M	11.11	2.14	0.01	33.51	21.65
427	Drives - Optimization process (M&T)	0.50	0.16	0.01	25.87	19.56
403	Air conveying systems	0.21	0.02	0.01	62.12	18.40

Top 10 Measures by MW Savings (Existing Industrial)

302	Pumps - Controls	25.56	4.58	0.01	46.30	16.59
801	RET 2L4' Premium T8, 1EB	19.12	4.23	0.03	136.20	4.81
303	Pumps - System Optimization	21.88	3.91	0.02	113.82	6.76
701	Centrifugal Chiller, 0.51 kW/ton, 500 tons	2.75	2.34	0.02	26.07	11.35
101	Compressed Air-O&M	11.11	2.14	0.01	33.51	21.65
202	Fans - Controls	12.20	2.09	0.03	154.87	5.13
712	DX Packaged System, EER=10.9, 10 tons	2.38	2.02	0.01	16.63	17.80
301	Pumps - O&M	8.85	1.58	0.01	28.33	27.14
103	Compressed Air - System Optimization	8.02	1.55	0.01	48.88	14.83
802	CFL Hardwired, Modular 36W	7.69	1.54	0.01	46.09	15.31
711	DX Tune Up/ Advanced Diagnostics	1.54	1.31	0.05	57.37	5.16

Table 6-6
Top Commercial Retrofit Measures

Measure Number	Measure	GWH Savings	MW Savings	Cost \$/kWH	Cost \$/kW	Cost Test TRC
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Top 10 Measures by Total Resource Cost (Existing Commercial)

181	ROB 4L4' Premium T8, 1EB	28.63	4.77	0.01	64.43	14.99
186	ROB 2L4' Premium T8, 1EB	44.24	7.43	0.01	75.71	13.23
611	PC Manual Power Management Enabling	31.10	1.95	0.01	199.82	12.21
301	Centrifugal Chiller, 0.51 kW/ton, 500 tons	18.41	10.07	0.02	30.63	12.19
612	PC Network Power Management Enabling	61.18	3.85	0.01	203.12	12.01
622	Monitor Power Management Enabling	29.21	1.84	0.01	215.55	11.32
166	CFL Hardwired, Modular 18W	23.26	4.34	0.02	126.18	11.23
161	CFL Screw-in 18W	69.78	13.01	0.02	115.10	9.89
805	Tankless Water Heater	1.70	0.04	0.01	661.39	9.67
221	High Pressure Sodium 250W Lamp	3.57	0.00	0.01	N/A	9.13
120	Lighting Control Tuneup	52.11	9.29	0.02	99.53	8.19

Top 10 Measures by MW Savings (Existing Commercial)

313	Window Film (Standard)	33.44	18.30	0.06	103.39	4.65
115	RET 2L4' Premium T8, 1EB, Reflector	80.44	14.51	0.02	127.02	6.58
139	Lighting Control Tuneup	80.02	14.12	0.05	291.86	4.19
161	CFL Screw-in 18W	69.78	13.01	0.02	115.10	9.89
318	Economizer	19.55	10.70	0.39	712.85	0.66
301	Centrifugal Chiller, 0.51 kW/ton, 500 tons	18.41	10.07	0.02	30.63	12.19
120	Lighting Control Tuneup	52.11	9.29	0.02	99.53	8.19
117	Occupancy Sensor, 4L4' Fluorescent Fixtures	26.11	8.55	0.46	1,399.65	0.38
186	ROB 2L4' Premium T8, 1EB	44.24	7.43	0.01	75.71	13.23
317	Optimize Controls	11.16	6.11	0.27	501.77	0.91
133	RET 2L4' Premium T8, 1EB	16.92	5.41	0.81	2,529.80	0.34

**Table 6-7
Top Residential Retrofit Measures**

Measure Number	Measure	GWH Savings	MW Savings	Cost \$/kWH	Cost \$/kW	Cost Test TRC
<u>Top 10 Residential Measures by Total Resource Cost (Existing Residential)</u>						
902	High Efficiency One Speed Pool Pump (1.5 hp)	20.58	7.71	0.01	26.48	16.10
120	Ceiling R-0 to R-19 Insulation(.29)	5.76	10.53	0.07	38.91	7.93
151	Double Pane Clear Windows to Double Pane Low-E Windows	1.98	3.84	0.06	31.35	7.83
221	CFL (18-Watt integral ballast), 6.0 hr/day	40.50	4.04	0.02	162.09	7.11
508	Water Heater Blanket	14.98	1.68	0.02	145.60	6.93
211	CFL (18-Watt integral ballast), 3.0 hr/day	74.66	7.45	0.02	171.36	6.72
901	Two Speed Pool Pump (1.5 hp)	30.41	11.38	0.02	64.15	6.64
153	Ceiling R-0 to R-19 Insulation (.29)	11.32	20.69	0.07	39.44	6.55
311	Refrigerator - Early Replacement	71.61	11.62	0.02	148.16	5.09
231	ROB 2L4'T8, 1EB	8.30	0.83	0.01	131.74	4.82
113	Proper Refrigerant Charging and Air Flow	7.42	14.96	0.11	55.27	4.76
<u>Top 10 Residential Measures by MW Savings (Existing Residential)</u>						
148	Window Film	19.12	35.45	1.09	589.07	0.72
601	Energy Star CW CEE Tier 1 (MEF=1.42)	251.47	32.57	0.08	612.51	1.54
150	Default Window With Sunscreen	15.24	29.58	0.25	128.76	2.28
115	Window Film	15.07	27.94	0.56	301.26	1.32
117	Double Pane Clear Windows to Double Pane Low-E Windows	11.54	22.40	0.11	54.83	4.34
153	Ceiling R-0 to R-19 Insulation (.29)	11.32	20.69	0.07	39.44	6.55
142	HE Room Air Conditioner - EER 12	9.91	19.98	0.72	354.58	0.73
116	Default Window With Sunscreen	10.28	19.95	0.29	146.94	1.89
103	17 SEER Split-System Air Conditioner	9.43	19.02	1.06	528.08	0.60
113	Proper Refrigerant Charging and Air Flow	7.42	14.96	0.11	55.27	4.76
311	Refrigerator - Early Replacement	71.61	11.62	0.02	148.16	5.09

Table 6-6 illustrates for several energy efficiency measures for the commercial sector and what the total GWh savings are, the cost of the resource, and the TRC test result (greater than 1.0 means it is cheaper than supply), as well as other results. This is the level of detailed used to obtain the study results. Table 6-8 illustrates this same information on many efficiency measures for the residential sector.

**Table 6-8
Additive Supply Analysis**

DSM ASSYST ADDITIVE SUPPLY ANALYSIS									
Vintage	E						Marginal	Marginal	Total
Batch	1	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Energy	Capacity	Resource
Measure		GWH	MW	Energy	Capacity	Resource	Cost	Cost	Cost Test
Number	Measure	Savings	Savings	Cost	Cost	Cost Test	\$/kWh	\$/kW	TRC
114	RET 4L4' Premium T8, 1EB	10.39	2.40	1.15	1,146.73	13.40	0.11	478.03	1.29
115	RET 2L4' Premium T8, 1EB, Reflector	62.12	11.77	1.57	1,572.43	379.19	0.03	133.58	6.10
117	Occupancy Sensor, 4L4' Fluorescent Fixtures	21.83	6.90	11.79	11,790.19	6.95	0.54	1,707.81	0.32
118	Continuous Dimming, 5L4' Fluorescent Fixtures	0.52	0.03	0.02	20.55	1.46	0.04	692.04	2.80
120	Lighting Control Tuneup	34.78	6.76	0.89	887.25	187.18	0.03	131.18	5.38
133	RET 2L4' Premium T8, 1EB	17.21	5.60	15.00	14,999.79	4.93	0.87	2,676.97	0.29
134	RET 1L4' Premium T8, 1EB, Reflector OEM	10.78	2.11	0.80	802.49	31.64	0.07	380.37	2.93
136	Occupancy Sensor, 8L4' Fluorescent Fixtures	9.44	2.18	1.46	1,459.90	11.17	0.15	669.19	1.18
137	Continuous Dimming, 10L4' Fluorescent Fixtures	0.52	0.03	0.02	17.72	1.70	0.03	590.18	3.29
139	Lighting Control Tuneup	62.92	12.31	4.02	4,017.82	215.20	0.06	326.35	3.42
152	RET 2 - 2L4' Premium T8, 1EB	5.52	1.25	0.57	567.02	7.96	0.10	453.64	1.44
153	RET 2 - 1L4' Premium T8, 1EB, Reflector OEM	21.94	4.15	0.95	953.23	76.15	0.04	229.54	3.47
155	Occupancy Sensor, 4L8' Fluorescent Fixtures	28.31	5.49	1.24	1,239.90	92.35	0.04	225.80	3.26
156	Continuous Dimming, 5L8' Fluorescent Fixtures	12.80	3.99	6.89	6,888.71	4.13	0.54	1,724.92	0.32
161	CFL Screw-in 18W	288.07	55.83	5.06	5,057.10	3,190.74	0.02	90.57	11.08
166	CFL Hardwired, Modular 18W	94.51	18.35	1.26	1,255.62	1,207.84	0.01	68.44	12.78
176	High Bay T5	30.73	5.74	1.87	1,871.91	89.78	0.06	326.14	2.92
181	ROB 4L4' Premium T8, 1EB	15.33	3.05	0.17	166.90	210.68	0.01	54.73	13.75
182	Occupancy Sensor, 4L4' Fluorescent Fixtures	6.28	1.25	0.32	315.28	17.17	0.05	251.53	2.74
183	Lighting Control Tuneup	0.34	0.02	0.01	8.38	1.50	0.02	413.85	4.38
186	ROB 2L4' Premium T8, 1EB	29.29	5.79	0.41	405.38	331.57	0.01	69.96	11.32
187	Occupancy Sensor, 8L4' Fluorescent Fixtures	9.63	1.89	0.52	519.63	28.08	0.05	275.53	2.91
188	Lighting Control Tuneup	0.60	0.03	0.01	13.88	2.71	0.02	396.63	4.55
191	LED Exit Sign	5.64	1.11	0.47	468.29	8.80	0.08	423.78	1.56
221	High Pressure Sodium 250W Lamp	3.27	0.00	0.04	N/A	25.48	0.01	N/A	7.79
222	Outdoor Lighting Controls (Photocell/Timeclock)	41.15	0.37	1.69	1,692.25	106.61	0.04	4,534.66	2.59
301	Centrifugal Chiller, 0.51 kW/ton, 500 tons	16.73	10.09	0.31	308.48	183.38	0.02	30.58	10.96
302	Window Film (Standard)	2.49	1.07	0.25	248.08	4.34	0.10	231.09	1.75
303	EMS - Chiller	1.00	0.60	0.05	51.31	3.98	0.05	84.85	3.96
304	Cool Roof - Chiller	0.81	0.23	0.12	94.84	0.94	0.15	419.75	1.16
305	Chiller Tune Up/Diagnostics	1.48	0.92	0.71	707.24	1.01	0.48	764.96	0.68
306	VSD for Chiller Pumps and Towers	1.07	0.68	0.20	197.24	1.83	0.18	291.83	1.72
307	EMS Optimization	1.21	0.33	0.15	145.16	1.41	0.12	441.04	1.17
308	Economizer	5.60	3.37	0.22	220.44	28.99	0.04	65.47	5.18



**Table 6-9
Additive Supply Analysis II**

DSM ASSYST ADDITIVE SUPPLY ANALYSIS									
Vintage	E						Marginal	Marginal	Total
Batch	1	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Energy	Capacity	Resource
Measure	Measure	GWH	MW	Energy	Capacity	Resource	Cost	Cost	Cost
Number	Number	Savings	Savings	Cost	Cost	Cost Test	\$/kWh	\$/kW	TRC
103	17 SEER Split-System Air Conditioner	7.46	15.05	10.04	10,042.63	3.28	1.35	667.48	0.44
105	Programmable Thermostat	0.75	1.34	0.81	809.11	0.45	1.09	602.29	0.61
110	Ceiling Fans	0.75	1.12	0.26	259.97	1.06	0.35	231.35	1.41
111	Whole House Fans	1.66	2.47	3.14	3,139.72	0.34	1.90	1,269.13	0.21
112	Attic Venting	2.71	4.05	0.83	829.08	4.09	0.31	204.54	1.51
113	Proper Refrigerant Charging and Air Flow	6.65	13.41	0.83	826.75	32.55	0.12	61.63	4.89
114	Duct Repair (0.32)	3.65	7.36	0.66	664.48	16.62	0.18	90.25	4.55
115	Window Film	11.55	21.42	8.42	8,417.08	8.65	0.73	392.97	0.75
116	Default Window With Sunscreen	14.58	28.31	2.93	2,931.03	49.73	0.20	103.54	3.41
117	Double Pane Clear Windows to Double Pane Low-E Window	16.04	31.14	1.23	1,228.42	109.16	0.08	39.44	6.80
118	Double Pane Clear Windows to Double Pane Low-E2 Window	2.22	4.31	4.17	4,166.09	0.53	1.88	967.26	0.24
120	Ceiling R-0 to R-19 Insulation(.29)	5.76	10.53	0.41	409.85	45.72	0.07	38.91	7.93
121	Ceiling R-19 to R-38 Insulation (.27)	1.31	2.37	1.15	1,152.55	0.63	0.88	485.40	0.48
122	Wall 2x4 R-0 to Blow-In R-13 Insulation (0.14)	3.06	6.41	1.29	1,288.97	4.77	0.42	200.94	1.56
142	HE Room Air Conditioner - EER 12	9.33	18.82	7.08	7,084.08	6.77	0.76	376.41	0.73
143	Programmable Thermostat	1.18	2.13	1.56	1,560.10	0.46	1.32	731.99	0.39
145	Ceiling Fans	0.92	1.38	0.85	846.83	0.45	0.92	613.90	0.49
146	Whole House Fans	2.73	4.07	11.03	11,026.74	0.25	4.05	2,707.88	0.09
147	Attic Venting	3.59	5.36	1.98	1,983.66	2.58	0.55	369.84	0.72
148	Window Film	16.91	31.36	20.89	20,885.07	8.45	1.24	665.97	0.50
150	Default Window With Sunscreen	18.63	36.16	3.81	3,808.95	75.94	0.20	105.35	4.08
151	Double Pane Clear Windows to Double Pane Low-E Window	2.71	5.26	0.12	120.36	37.83	0.04	22.87	13.96
152	Double Pane Clear Windows to Double Pane Low-E2 Window	0.23	0.44	0.52	515.08	0.05	2.27	1,168.73	0.20
153	Ceiling R-0 to R-19 Insulation (.29)	11.07	20.25	0.82	815.87	70.58	0.07	40.30	6.37
154	Ceiling R-19 to R-38 Insulation (.27)	1.87	3.37	2.52	2,523.76	0.60	1.35	748.11	0.32
155	Wall 2x4 R-0 to Blow-In R-13 Insulation (0.14)	4.00	8.39	2.11	2,111.19	5.86	0.53	251.74	1.47
181	Variable Speed Furnace Fan	25.27	0.00	1.59	N/A	40.14	0.06	N/A	1.59
191	Dbl Pane Clear Windows to HE Windows	2.09	0.00	2.05	N/A	0.24	0.98	N/A	0.12
192	Ceiling R-0 to R-38 Insulation - Batts	15.63	0.00	0.73	N/A	31.62	0.05	N/A	2.02
193	Ceiling R-11 to R-38 Insulation - Batts	3.35	0.00	0.80	N/A	1.32	0.24	N/A	0.39
194	Ceiling R-19 to R-38 Insulation - Batts	7.42	0.00	1.20	N/A	4.33	0.16	N/A	0.58
195	Wall Blow-in R-0 to R-13 Insulation	7.27	0.00	0.15	N/A	33.51	0.02	N/A	4.61
196	Infiltration Reduction (0.4)	6.92	0.00	0.75	N/A	6.07	0.11	N/A	0.88
197	Floor R-0 to R-19 Insulation-Batts	1.71	0.00	0.41	N/A	0.69	0.24	N/A	0.40
198	Programmable Thermostat	5.32	0.00	0.46	N/A	5.86	0.09	N/A	1.10
201	CFL (18-Watt integral ballast), 0.5 hr/day	8.40	0.84	0.20	197.60	25.06	0.02	235.70	2.98
211	CFL (18-Watt integral ballast), 3.0 hr/day	74.66	7.45	1.28	1,277.29	502.05	0.02	171.36	6.72
221	CFL (18-Watt integral ballast), 6.0 hr/day	40.50	4.04	0.66	655.42	287.95	0.02	162.09	7.11
231	ROB 2L4T8, 1EB	8.30	0.83	0.11	109.18	39.99	0.01	131.74	4.82
232	RET 2L4T8, 1EB	6.06	0.61	0.11	109.18	21.32	0.02	180.42	3.52
301	HE Refrigerator - Energy Star version of above	55.40	8.99	4.63	4,632.19	80.82	0.08	515.17	1.46
311	Refrigerator - Early Replacement	71.61	11.62	1.72	1,721.93	364.18	0.02	148.16	5.09
401	HE Freezer	17.98	2.92	0.57	571.43	68.39	0.03	195.78	3.80
501	Heat Pump Water Heater (EF=2.9)	30.64	3.43	2.62	2,616.83	40.59	0.09	762.69	1.32
502	HE Water Heater (EF=0.93)	11.87	1.33	0.40	403.76	39.43	0.03	303.75	3.32
503	Solar Water Heat	18.35	2.06	2.33	2,332.15	16.36	0.13	1,134.67	0.89
504	Tankless Water Heater	3.01	0.34	0.17	174.26	5.87	0.06	517.75	1.95
505	Low Flow Showerhead	12.70	1.42	0.55	548.04	32.94	0.04	385.24	2.59
506	Pipe Wrap	3.96	0.44	0.15	146.50	12.12	0.04	330.07	3.06
507	Faucet Aerators	6.08	0.68	0.45	449.12	9.22	0.07	659.65	1.52
508	Water Heater Blanket	14.98	1.68	0.24	244.33	103.85	0.02	145.60	6.93
601	Energy Star CW CEE Tier 1 (MEF=1.42)	251.47	32.57	19.95	19,950.47	386.93	0.08	612.51	1.54
602	Energy Star CW CEE Tier 2 (MEF=1.60)	30.74	3.98	24.66	24,657.54	4.68	0.80	6,192.90	0.15
710	High Efficiency CD (EF=3.01 w/moisture sensor)	34.63	5.04	12.43	12,428.64	12.38	0.36	2,466.39	0.36
801	Energy Star DW (EF=0.58)	54.87	5.11	2.41	2,405.22	148.42	0.04	470.39	2.71
901	Two Speed Pool Pump (1.5 hp)	30.41	11.38	0.73	730.39	202.03	0.02	64.15	6.64
902	High Efficiency One Speed Pool Pump (1.5 hp)	20.58	7.71	0.20	204.11	331.29	0.01	26.48	16.10

Complete measure lists are included in Appendix B.

7. Key Assumptions

This section presents the key assumptions that were used in the analysis of potential. These assumptions include:

Avoided Costs

Current usage and load forecast

Building Stock

7.1 Avoided costs

The avoided costs which are used to value the energy and demand saved are based on the Synapse Avoided Cost Study⁸. The avoided generation costs are presented in Table 7-1 below.

⁸ Avoided Energy Supply Cost in New England - 2007 Final Report v. 1/3/08)

**Table 7-1
Avoided Generation Costs**

						Doc 3892	
	Winter Peak Energy	Winter Off-Peak Energy	Summer Peak Energy	Summer Off-Peak Energy	Annual Market Capacity Value	Avoided Trans. Capacity Value	Avoided Res. Distrib. Capacity Value
	See Note 2				Note 3		
Units / Year	\$/kWh	\$/kWh	\$/kWh	\$/kWh	\$/kW-yr	\$/kW-yr	\$/kW-yr
2008	0.115	0.081	0.105	0.076		44	128.4
2009	0.105	0.078	0.106	0.071		44	128.4
2010	0.105	0.075	0.106	0.069	68.6	44	128.4
2011	0.100	0.071	0.104	0.066	123.6	44	128.4
2012	0.101	0.073	0.104	0.069	138.3	44	128.4
2013	0.095	0.067	0.100	0.067	146.9	44	128.4
2014	0.099	0.068	0.101	0.067	146.9	44	128.4
2015	0.097	0.068	0.105	0.066	146.9	44	128.4
2016	0.099	0.070	0.107	0.070	146.9	44	128.4
2017	0.102	0.072	0.110	0.070	146.9	44	128.4
2018	0.100	0.071	0.107	0.071	146.9	44	128.4
2019	0.100	0.070	0.110	0.071	146.9	44	128.4
2020	0.100	0.072	0.112	0.072	146.9	44	128.4
2021	0.101	0.073	0.115	0.071	146.9	44	128.4
2022	0.107	0.073	0.118	0.074	146.9	44	128.4
2023	0.108	0.074	0.120	0.075	146.9	44	128.4
2024	0.110	0.075	0.121	0.076	146.9	44	128.4
2025	0.111	0.076	0.123	0.077	146.9	44	128.4
2026	0.113	0.077	0.125	0.078	146.9	44	128.4
2027	0.115	0.079	0.127	0.080	146.9	44	128.4
2028	0.116	0.080	0.128	0.081	146.9	44	128.4
2029	0.118	0.081	0.130	0.082	146.9	44	128.4
2030	0.120	0.082	0.132	0.083	146.9	44	128.4
2031	0.121	0.083	0.134	0.084	146.9	44	128.4
2032	0.123	0.084	0.136	0.086	146.9	44	128.4
2033	0.125	0.086	0.138	0.087	146.9	44	128.4
2034	0.127	0.087	0.140	0.088	146.9	44	128.4
2035	0.129	0.088	0.142	0.089	146.9	44	128.4
2036	0.130	0.089	0.144	0.091	146.9	44	128.4
2037	0.132	0.091	0.146	0.092	146.9	44	128.4
2038	0.134	0.092	0.148	0.093	146.9	44	128.4
2039	0.136	0.093	0.150	0.095	146.9	44	128.4
2040	0.138	0.095	0.153	0.096	146.9	44	128.4

We also included demand response induced pricing effect (DRIPE) in our calculations. These values are presented in Table 7-2 below:

**Table 7-2
Values for DRIPE**

DRIPE for Installations in 2008				
Winter Peak Energy	Winter Off-Peak Energy	Summer Peak Energy	Summer Off-Peak Energy	Annual Market Capacity Value
\$/kWh	\$/kWh	\$/kWh	\$/kWh	\$/kW-yr
0.016	0.013	0.026	0.011	
0.047	0.037	0.077	0.033	
0.044	0.035	0.072	0.032	81.6
0.027	0.021	0.044	0.019	158.6
				102
				45.3

We also included the benefit from reduced line losses. The values we used are provided below in Table 7-3 and are from National Grid.

**Table 7-3
Values for Line Losses**

LINE LOSSES from National Grid					
Sectors	Energy				Capacity
	Winter Peak	Winter Off-Peak	Summer Peak	Summer Off-Peak	Summer Gener.
Residential	7.20%	4.00%	7.20%	4.00%	11.20%
Com/Ind	5.90%	3.00%	5.90%	3.00%	9.50%

7.2 Current Usage and load forecast

We calibrated Demand Side Assyst to existing energy usage by rate class. The data we used were provided by Narragansett and are presented below in Table 7-4:

**Table 7-4
Historical and Predicted Energy and Demand**

Historical and Forecast GWh Sales								
YEAR	Residential without Electric Heat	Residential with Electric Heat	Total Residential	Commercial	Industrial	Street Light	Sales for Resale	Total
1998	2,262.902	237.531	2,500.434	2,839.409	1,428.162	61.387	0.656	6,830.048
1999	2,394.822	239.028	2,633.849	2,962.778	1,414.073	61.915	0.708	7,073.324
2000	2,365.724	241.263	2,606.986	3,089.688	1,406.947	61.693	0.711	7,166.026
2001	2,454.139	235.075	2,689.214	3,231.227	1,357.889	62.074	0.792	7,341.196
2002	2,568.084	231.217	2,799.301	3,327.314	1,325.874	62.304	0.821	7,515.614
2003	2,702.082	253.250	2,955.332	3,418.260	1,256.555	63.054	0.890	7,694.092
2004	2,727.795	243.594	2,971.390	3,489.108	1,297.438	63.480	0.864	7,822.280
2005	2,887.353	242.330	3,129.682	3,580.945	1,210.959	62.886	0.863	7,985.335
2006	2,774.630	217.694	2,992.324	3,534.610	1,141.426	63.169	0.801	7,732.329
2007	2,850.410	223.639	3,074.049	3,625.716	1,116.802	62.274	0.814	7,879.655
Forecast								
2008	2,853.711	215.929	3,069.640	3,630.370	1,100.690	62.241	0.748	7,863.688
2009	2,903.274	216.501	3,119.775	3,687.695	1,106.430	62.241	0.771	7,976.912
2010	2,963.336	211.589	3,174.926	3,762.282	1,112.737	62.241	0.789	8,112.974
2011	3,023.288	206.822	3,230.110	3,816.911	1,116.600	62.241	0.807	8,226.670
2012	3,076.236	202.092	3,278.329	3,844.969	1,117.867	62.241	0.825	8,304.230
2013	3,125.454	197.386	3,322.839	3,860.349	1,117.831	62.241	0.843	8,364.103
2014	3,172.274	192.724	3,364.998	3,872.672	1,117.819	62.241	0.861	8,418.591
2015	3,216.335	188.108	3,404.443	3,884.597	1,117.653	62.241	0.880	8,469.812
2016	3,259.067	183.538	3,442.605	3,899.082	1,117.599	62.241	0.898	8,522.424
2017	3,302.634	179.015	3,481.650	3,919.169	1,117.664	62.241	0.916	8,581.639

Historical and Forecast Customer Counts								
YEAR	Residential without Electric Heat	Residential with Electric Heat	Total Residential	Commercial	Industrial	Street Light	Sales for Resale	Total
1998	385,036	19,230	404,266	45,846	2,576	n/a	n/a	452,688
1999	389,105	19,087	408,191	46,972	2,556	n/a	n/a	457,720
2000	390,821	18,452	409,273	50,673	2,578	n/a	n/a	462,523
2001	393,189	18,144	411,333	52,433	2,550	n/a	n/a	466,316
2002	395,216	18,603	413,819	52,819	2,473	n/a	n/a	469,111
2003	397,792	18,629	416,421	53,559	2,420	n/a	n/a	472,400
2004	399,879	18,488	418,366	54,160	2,364	n/a	n/a	474,890
2005	403,137	18,478	421,615	54,611	2,313	n/a	n/a	478,539
2006	404,564	18,325	422,888	55,172	2,222	n/a	n/a	480,283
2007	406,555	18,226	424,781	55,796	2,165	n/a	n/a	482,742
Forecast								
2008	405,908	18,023	423,932	56,037	2,117	n/a	n/a	482,086
2009	406,856	17,890	424,747	56,201	2,173	n/a	n/a	483,120
2010	408,642	17,776	426,418	56,723	2,208	n/a	n/a	485,349
2011	410,517	17,663	428,180	57,114	2,227	n/a	n/a	487,521
2012	412,566	17,549	430,115	57,299	2,234	n/a	n/a	489,648
2013	414,571	17,435	432,006	57,398	2,235	n/a	n/a	491,638
2014	416,420	17,322	433,741	57,490	2,233	n/a	n/a	493,464
2015	418,027	17,208	435,234	57,593	2,229	n/a	n/a	495,057
2016	419,380	17,094	436,474	57,732	2,225	n/a	n/a	496,432
2017	420,732	16,981	437,712	57,937	2,221	n/a	n/a	497,870

Historical and Forecast Peak Demand (MW)		
1998	1,418.4	1,134.9
1999	1,516.2	1,187.8
2000	1,464.7	1,258.4
2001	1,659.0	1,217.7
2002	1,692.1	1,203.6
2003	1,581.9	1,280.9
2004	1,618.3	1,382.9
2005	1,773.0	1,381.1
2006	1,937.9	1,298.5
2007	1,768.0	1,317.5
Forecast		
2008	1,928.4	1,366.5
2009	1,968.0	1,385.3
2010	2,007.5	1,404.5
2011	2,045.3	1,422.3
2012	2,083.3	1,439.7
2013	2,121.1	1,457.1
2014	2,158.8	1,474.4
2015	2,196.4	1,491.5
2016	2,234.2	1,508.5
2017	2,272.3	1,526.0

7.3 Building stock assumptions

7.3.1 Rhode Island Commercial Buildings

In order to obtain commercial building statistics for Rhode Island we first gathered data from the Rhode Island Research and Economic Database.⁹ We generated custom industry reports to retrieve the number of commercial establishments to match up to DSM Assyst categories. This data has been gathered and placed in the tables below. Several smaller sectors were combined into one category order to match up with DSM Assyst categories.

For the average square footage of Rhode Island commercial buildings, we used statistics from the 2003 Commercial Buildings Energy Consumption Survey – Overview of Building Characteristics (CBECS)¹⁰. The average square feet per building is lower in New England compared to the national average. As a result, we developed a ratio to calculate the average square feet for New England and applied the ratio to the national averages for each individual sector.

For energy use per square feet, we used the 2006 data from the Commercial Buildings Energy Consumption Survey -- Electricity Consumption and Expenditure Intensities (Table C14).¹¹ For those sectors that are combined into one category, we averaged their collective electricity consumption per square foot. Sectors that were averaged are: Food Sales & Services, and Public Administration & Services. Data was unavailable for two categories: Administrative & Waste Management, and Arts, Entertainment, & Recreation For these two categories, the “Other” category electricity consumption per square foot numbers were applied.

For estimated energy consumption, we multiplied the average square feet for each category with the energy use per square foot.

⁹ <http://www.dlt.ri.gov/rired/default.asp>

¹⁰ <http://www.eia.doe.gov/emeu/cbecs/cbecs2003/introduction.html>

¹¹ http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/detailed_tables_2003.html#consumexpen03

7.3.2 Rhode Island Industrial Buildings

In order to obtain the number of industrial building establishments by desired category, we gathered data from the 2002 Economic Census Geographic Series.¹² We then calculated the national electricity consumption average per building using statistics from the 2002 Economic Census Industry Statistics Sampler and the 2002 Manufacturing Energy Consumption -- First Use of Energy for All Purposes (Fuel and Nonfuel).¹³ We then derived sales by building type. This was then calibrated to the actual Rhode Island usage.

7.3.3 Residential Homes Data

We used the number of electric space heat and non electric space heat customers from National Grid for Rhode Island to develop the number of homes.

¹² http://www.census.gov/econ/census02/guide/02EC_RI.HTM

¹³ <http://www.census.gov/econ/census02/data/industry/index.html>
http://www.eia.doe.gov/emeu/mecs/mecs2002/data02/pdf/table1.1_02.pdf

8. Phase II

The goal of Phase II of the Opportunity Report is to confirm or revise the findings regarding technical, economic and achievable potential from Phase I and to provide greater detail and recommendations with regard to: 1) Existing Efficiency Measures and Resources pursued by the utility today that have a TRC greater than 1.0 but have been underinvested in and not tapped for all cost savings; 2) New Efficiency Measures and Resources that are not currently pursued by the utility efficiency programs but have a demonstrated TRC greater than 1.0 so they would generate cost savings; and 3) New Approaches to Existing Efficiency Measures and Resources that would enable a greater quantity of resource to be tapped with TRC greater than 1.0 and thus generate cost savings.

Phase II will be completed through Rhode Island on-site and phone survey research to be conducted after July 15th. The exact timing and focus of the Phase II work will be informed by results from Phase I and through direction from the EERMC.

One primary task of Phase II is to conduct 300 completed phone surveys and 150 completed site visits. The site visits can likely be reserved for C&I sectors. The residential sector may need to be further broken down into the low income, non-low income, single-family and multi-family sectors subject to direction from the EERMC.

9. Initial Estimate for new program concepts

In this section we model the possible new program areas for Rhode Island. This will be done for Appliance Recycling and Direct Load Control. Additional new areas will be modeled in Phase II. We choose these two as we thought it would be possible to get programs up and running in 2009 for both.

9.1 Appliance Recycling

We based our estimates for this program on data from one of the implementation vendors that offers this program.¹⁴ A sample scenario is provided below. This sample was provided by JACO which is one of the vendors who offers this program. Additional information can be found in Appendix C.

¹⁴ Several phone calls with Sam Sirkin at Jaco



Appendices

2008-2010 REFRIGERATOR RECYCLING PROGRAM (RRP) SCENARIO ANALYSES

SCENARIO: 1.5% Annual Harvest Rate (AHR)

Program Assumptions	Values	Notes			
Market Penetration					
Total Res. Elec Svc Accts	424,781				
Annual Harvest Rate (units / residential elec svc accts)	1.5%	pilot program = up to 0.5%; highest experienced = 3.5 to 4.0%			
Measure Savings Attributes: Refrigerators					
Refrigerator Fraction of Total Program Volumes	80%	typical/midrange % refrigerators in JACO RRP implementations in recent years			
Refrigerator Net Energy Savings (annual kWh/unit)	681	KEMA-Xenergy, "Measurement and Evaluation Study of 2002 Statewide Residential Appliance Recycling Program", 2/2004; value assumes 1946 gross kWh and 35% NTG (NTG corrects for full and partial free ridership, and partial year use); value is conservative relative to what will be reported for 2004-2005 program in ADM final report to be published by 12/2007			
Refrigerator Net Demand Savings (avg kW)	0.08	based on net energy savings value and 8760 hr/yr			
Measure Savings Attributes: Freezers					
Freezer Fraction of Total Program Volumes	20%	typical/midrange % freezers in JACO RRP implementations in recent years			
Freezer Net Energy Savings (annual kWh/unit)	897	KEMA-Xenergy, "Measurement and Evaluation Study of 2002 Statewide Residential Appliance Recycling Program", 2/2004; value assumes 1662 gross kWh and 54% NTG (NTG corrects for full and partial free ridership, and partial year use); value is similar to what will be reported for 2004-2005 program in ADM final report to be published by 12/2007			
Freezer Net Demand Savings (avg kW)	0.10	based on net energy savings value and 8760 hr/yr			
Measure Savings Attributes: Weighted Net Avg (Refrigerator/Freezer)					
Wtd. Avg. Net Energy Savings (annual kWh/unit)	724	calculated based on above assumptions			
Wtd. Avg. Net Demand Savings (avg kW)	0.08	based on net energy savings value and 8760 hr/yr			
Measure Life (applic. to refrigerators and freezers)					
	8	Kema, "Residential Refrigerator Recycling Ninth Year Retention Study", Study ID's 546B, 563; prepared for SCE, 7/22/2004; available from Calmac web site as study # SCE0130.01			
Per-Unit Implementation Cost Assumptions					
Incentive	\$ 30.00	identical to 2007 incentive levels used in implementations in ID, NM, NV, UT, WA, and WY			
Advertising, Marketing and PR	\$ 17.50	logically consistent with stipulated avg annual program volumes (typically consists primarily of newspaper ad inserts, TV commercial spots, collection truck signage, search engine marketing, internet banners, and PR event -- excludes bill stuffer costs, since utility typically handles internally			
Direct Implementation	\$ 117.50	includes collection, transportation, recycling, CFC-11 destruction, and infrastructure (including call center, web site, check fulfillment, database/reporting, and project mgmt)			
Total Implementation Cost	\$ 165.00	total; excludes utility program admin and EM&V more generally			
Macroeconomic Assumption					
Discount Rate	6.5%	JACO estimate for IOU			
Annual and 3-Year Total Program Metrics (note: PY = "program year")					
	PY 2008	PY 2009	PY 2010	3 PY Totals	
Unit Volumes (refrigerators and freezers)	6,372	6,372	6,372	19,115	
Program Costs (excl. Prog. Admin and EM&V)					
Incentive	\$ 191,151	\$ 191,151	\$ 191,151	\$ 573,454	% of Total
Advertising, Marketing and PR	\$ 111,505	\$ 111,505	\$ 111,505	\$ 334,515	18%
Direct Implementation	\$ 748,677	\$ 748,677	\$ 748,677	\$ 2,246,030	11%
Total Program Implementation Costs	\$ 1,051,333	\$ 1,051,333	\$ 1,051,333	\$ 3,153,999	71%
Net 1st Year Load Impacts					
Annual kWh	4,614,906	4,614,906	4,614,906	13,844,717	
avg kW	527	527	527	1,580	
Detailed Year-by-Year Analysis for 3-Year Total Program Levelized Cost Calcs (assumes all units in PY X begin accruing benefits on Jan 1 of PY X)					
	PY 2008	PY 2009	PY 2010	PV of Sum for 3 PY's	
Program Costs	\$ 1,051,333	\$ 1,051,333	\$ 1,051,333	\$ 2,965,418	
Net Annual kWh Load Impact Info					
	PY 2008	PY 2009	PY 2010	Sum for 3 PY's	
2008	4,614,906			4,614,906	
2009	4,614,906	4,614,906		9,229,811	
2010	4,614,906	4,614,906	4,614,906	13,844,717	
2011	4,614,906	4,614,906	4,614,906	13,844,717	
2012	4,614,906	4,614,906	4,614,906	13,844,717	
2013	4,614,906	4,614,906	4,614,906	13,844,717	
2014	4,614,906	4,614,906	4,614,906	13,844,717	
2015	4,614,906	4,614,906	4,614,906	13,844,717	
2016		4,614,906	4,614,906	9,229,811	
2017			4,614,906	4,614,906	
Total Net Annual kWh Impacts, 2008-2017	36,919,246	36,919,246	36,919,246	110,757,738	
PV of Net Annual kWh Impacts, 2008-2017				84,408,508	
Overall 2008-2010 Program Levelized Costs (\$/kWh)				\$ 0.035	



Appendices

This program would have a budget of approximately \$1 Million per year and would save over 4,600,000 kwh annually in each year. Annual MW savings would be about 500 kw.

9.2 Small commercial and residential direct load control

This possible program area would control central AC in residences and small commercial facilities using smart thermostats. It is modeled after the City of Austin's program. KW savings per unit would be approximately .8-1 kW per unit and cost / units of \$250-300.

Sample initial calculations are provided below:

AC Control - demand control, residential , multifamily and small commercial

Year	2009	2010	2011	2012	2013	2014
Number Participants	1500	2500	3000	3500	5000	5500
Net Energy Savings - kWh	0	0	0	0		
Net Peak Demand Savings - kW	1,350	3,600	6,300	9,450	13,950	18,900
Incremental Energy Savings kWh	0					
Incremental Demand Savings - kW	1,350	2,250	2,700	3,150	4,500	4,950
Program Costs - Real Dollars						
Administration	\$50,000	\$75,000	\$75,000	\$75,000	\$75,000	\$75,000
Marketing	\$75,000	\$65,000	\$65,564	\$67,531	\$69,556	\$71,643
Evaluation		\$25,000	\$20,000	\$25,000	\$25,000	\$25,000
Incentives						
Other equipment costs to utility	\$525,000	\$875,000	\$1,050,000	\$1,225,000	\$1,750,000	\$1,925,000
Total	\$650,000	\$1,040,000	\$1,210,564	\$1,392,531	\$1,919,556	\$2,096,643
Avoided costs						
PV Avoided Costs	\$770,766	\$1,284,610	\$1,541,532	\$1,798,454	\$2,569,220	\$2,826,142
PV Annual Program Costs	\$601,852	\$962,963	\$1,120,893	\$1,289,381	\$1,777,367	\$1,941,336
PV Participant Costs						
TRC	1.28	1.33	1.38	1.39	1.45	1.46

Appendix A – Measure Assumptions

Energy Supply Curve - Residential New Construction					
Measure Number	Measure	Measure	Cumulative Measure	Marginal Energy	
		GWH Savings	GWH Savings Percent Savings	Cost \$/kWH	
508	Water Heater Blanket	0	0	0.57%	0.01
231	ROB 2L4'T8, 1EB	0	0	1.03%	0.01
902	High Efficiency One Speed Pool Pump (1.5 hp)	0	0	1.82%	0.01
232	RET 2L4'T8, 1EB	0	0	2.16%	0.01
221	CFL (18-Watt integral ballast), 6.0 hr/day	0	0	4.40%	0.01
211	CFL (18-Watt integral ballast), 2.5 hr/day	0	1	8.53%	0.01
201	CFL (18-Watt integral ballast), 0.5 hr/day	0	1	8.99%	0.02
505	Low Flow Showerhead	0	1	9.50%	0.02
901	Two Speed Pool Pump (1.5 hp)	0	1	10.66%	0.02
401	HE Freezer	0	1	11.34%	0.03
502	HE Water Heater (EF=0.93)	0	1	11.78%	0.04
506	Pipe Wrap	0	1	11.90%	0.04
507	Faucet Aerators	0	1	12.13%	0.04
801	Energy Star DW (EF=0.58)	0	2	14.22%	0.04
151	Double Pane Clear Windows to Double Pane Low-E Windows	0	2	14.61%	0.05
504	Tankless Water Heater	0	2	14.73%	0.06
181	Variable Speed Furnace Fan	0	2	15.69%	0.06
117	Double Pane Clear Windows to Double Pane Low-E Windows	0	2	16.15%	0.06
501	Heat Pump Water Heater (EF=2.9)	0	2	17.31%	0.08
113	Proper Refrigerant Charging and Air Flow	0	2	17.62%	0.10
503	Solar Water Heat	0	2	18.32%	0.13
114	Duct Repair (0.32)	0	2	18.48%	0.16
601	Energy Star CW CEE Tier 1 (MEF=1.42)	0	2	20.92%	0.17
150	Default Window With Sunscreen	0	2	21.51%	0.24
116	Default Window With Sunscreen	0	2	21.94%	0.26
301	HE Refrigerator - Energy Star version of above	0	3	24.04%	0.29
112	Attic Venting	0	3	24.15%	0.31
710	High Efficiency CD (EF=3.01 w/moisture sensor)	0	3	25.47%	0.36
115	Window Film	0	3	26.08%	0.52
110	Ceiling Fans	0	3	26.14%	0.53
147	Attic Venting	0	3	26.27%	0.54
91	15% above Standards	0	3	26.77%	0.61
142	HE Room Air Conditioner - EER 12	0	3	27.18%	0.65
602	Energy Star CW CEE Tier 2 (MEF=1.60)	0	3	28.60%	0.66
105	Programmable Thermostat	0	3	28.63%	0.88
148	Window Film	0	3	29.42%	1.00
145	Ceiling Fans	0	3	29.48%	1.20
143	Programmable Thermostat	0	3	29.51%	1.46
118	Double Pane Clear Windows to Double Pane Low-E2 Windows	0	3	29.59%	1.65
111	Whole House Fans	0	3	29.67%	1.88
152	Double Pane Clear Windows to Double Pane Low-E2 Windows	0	3	29.72%	2.27
103	17 SEER Split-System Air Conditioner	0	3	30.11%	2.61
122	Wall R-19 to R-21	0	3	30.12%	2.93
92	20% above Standards	0	3	30.26%	3.23
146	Whole House Fans	0	3	30.38%	4.32
155	Wall R-19 to R-21	0	3	30.39%	4.84
120	Ceiling R-30 to R-38	0	3	30.40%	9.65
121	Ceiling R-30 to R-49	0	3	30.42%	10.83
153	Ceiling R-30 to R-38	0	3	30.43%	13.85
154	Ceiling R-30 to R-49	0	3	30.46%	15.57

Energy Supply Curve - Residential Existing Homes					
Measure Number	Measure	Measure	Cumulative Measure	Percent	Marginal Energy Cost
		GWH Savings	GWH Savings	Savings	\$/kWH
902	High Efficiency One Speed Pool Pump (1.5 hp)	21	21	0.71%	0.01
231	ROB 2L4'T8, 1EB	8	29	1.00%	0.01
221	CFL (18-Watt integral ballast), 6.0 hr/day	41	69	2.41%	0.02
508	Water Heater Blanket	15	84	2.93%	0.02
211	CFL (18-Watt integral ballast), 3.0 hr/day	75	159	5.52%	0.02
232	RET 2L4'T8, 1EB	6	165	5.73%	0.02
195	Wall Blow-in R-0 to R-13 Insulation	8	173	6.00%	0.02
201	CFL (18-Watt integral ballast), 0.5 hr/day	8	181	6.30%	0.02
901	Two Speed Pool Pump (1.5 hp)	30	212	7.35%	0.02
311	Refrigerator - Early Replacement	72	283	9.84%	0.02
401	HE Freezer	18	301	10.46%	0.03
502	HE Water Heater (EF=0.93)	12	313	10.88%	0.03
506	Pipe Wrap	4	317	11.01%	0.04
505	Low Flow Showerhead	13	330	11.45%	0.04
192	Ceiling R-0 to R-38 Insulation - Batts	17	346	12.03%	0.04
801	Energy Star DW (EF=0.58)	55	401	13.94%	0.04
504	Tankless Water Heater	3	404	14.04%	0.06
181	Variable Speed Furnace Fan	25	430	14.92%	0.06
151	Double Pane Clear Windows to Double Pane Low-E Windows	2	432	14.99%	0.06
507	Faucet Aerators	6	438	15.20%	0.07
120	Ceiling R-0 to R-19 Insulation(.29)	5	443	15.39%	0.07
153	Ceiling R-0 to R-19 Insulation (.29)	11	454	15.76%	0.08
198	Programmable Thermostat	6	460	15.96%	0.08
301	HE Refrigerator - Energy Star version of above	55	515	17.88%	0.08
501	Heat Pump Water Heater (EF=2.9)	31	546	18.95%	0.09
196	Infiltration Reduction (0.4)	7	553	19.21%	0.10
113	Proper Refrigerant Charging and Air Flow	7	560	19.46%	0.11
117	Double Pane Clear Windows to Double Pane Low-E Windows	10	571	19.82%	0.12
503	Solar Water Heat	18	589	20.45%	0.13
194	Ceiling R-19 to R-38 Insulation - Batts	8	597	20.73%	0.15
602	Energy Star CW CEE Tier 2 (MEF=1.60)	153	750	26.06%	0.16
114	Duct Repair (0.32)	4	754	26.20%	0.17
197	Floor R-0 to R-19 Insulation-Batts	2	756	26.26%	0.22
193	Ceiling R-11 to R-38 Insulation - Batts	4	760	26.38%	0.22
150	Default Window With Sunscreen	15	774	26.90%	0.26
122	Wall 2x4 R-0 to Blow-In R-13 Insulation (0.14)	5	779	27.06%	0.27
112	Attic Venting	3	782	27.16%	0.30
110	Ceiling Fans	1	783	27.19%	0.31
116	Default Window With Sunscreen	9	792	27.51%	0.32
710	High Efficiency CD (EF=3.01 w/moisture sensor)	35	827	28.71%	0.36
155	Wall 2x4 R-0 to Blow-In R-13 Insulation (0.14)	5	832	28.88%	0.43
115	Window Film	17	848	29.47%	0.50
147	Attic Venting	4	852	29.59%	0.54
121	Ceiling R-19 to R-38 Insulation (.27)	2	854	29.66%	0.63
142	HE Room Air Conditioner - EER 12	10	864	30.00%	0.71
105	Programmable Thermostat	1	865	30.04%	0.79
191	DbI Pane Clear Windows to HE Windows	2	867	30.12%	0.92
145	Ceiling Fans	1	868	30.14%	1.02
103	17 SEER Split-System Air Conditioner	10	877	30.48%	1.05
148	Window Film	19	896	31.12%	1.12
154	Ceiling R-19 to R-38 Insulation (.27)	2	898	31.20%	1.18
143	Programmable Thermostat	1	899	31.24%	1.36
111	Whole House Fans	2	901	31.29%	2.09
152	Double Pane Clear Windows to Double Pane Low-E2 Windows	0	901	31.30%	2.57
118	Double Pane Clear Windows to Double Pane Low-E2 Windows	2	903	31.35%	2.69
146	Whole House Fans	2	905	31.44%	4.47



Appendices

Energy Supply Curve - Commercial New Construction					
Measure Number	Measure	Measure	Cumulative	Percent Savings	Marginal
		GWH Savings	Measure GWH Savings		Energy Cost \$/kWH
101	Lighting 15% More Efficient Design	1	1	6.13%	0.01
301	Cooling & Ventilation 10% More Efficient Design	1	2	10.91%	0.02
501	Refrigeration 10% More Efficient Design	0	2	11.79%	0.03
302	Cooling & Ventilation 30% More Efficient Design	2	4	19.53%	0.04
102	Lighting 25% More Efficient Design	1	5	22.49%	0.05
502	Refrigeration 20% More Efficient Design	0	5	23.08%	0.09

Energy Supply Curve - Commercial Existing Buildings					
Measure Number	Measure	Measure	Cumulative Measure	Percent Savings	Marginal Energy Cost
		GWH Savings	GWH Savings		\$/kWH
621	Energy Star or Better Monitor	7	7	0.20%	0.00
631	Energy Star or Better Monitor	0	7	0.20%	0.00
641	Energy Star or Better Copier	1	9	0.24%	0.00
181	ROB 4L4' Premium T8, 1EB	29	37	1.03%	0.01
221	High Pressure Sodium 250W Lamp	4	41	1.13%	0.01
611	PC Manual Power Management Enabling	31	72	1.98%	0.01
186	ROB 2L4' Premium T8, 1EB	44	116	3.20%	0.01
612	PC Network Power Management Enabling	61	177	4.88%	0.01
622	Monitor Power Management Enabling	29	207	5.68%	0.01
805	Tankless Water Heater	2	208	5.73%	0.01
301	Centrifugal Chiller, 0.51 kW/ton, 500 tons	18	227	6.23%	0.02
120	Lighting Control Tuneup	52	279	7.67%	0.02
801	Demand controlled circulating systems	6	285	7.84%	0.02
188	Lighting Control Tuneup	1	286	7.87%	0.02
161	CFL Screw-in 18W	70	356	9.79%	0.02
183	Lighting Control Tuneup	1	357	9.81%	0.02
115	RET 2L4' Premium T8, 1EB, Reflector	80	437	12.02%	0.02
166	CFL Hardwired, Modular 18W	23	460	12.66%	0.02
911	Vending Misers (cooled machines only)	16	476	13.09%	0.02
804	Hot Water Pipe Insulation	1	477	13.11%	0.02
137	Continuous Dimming, 10L4' Fluorescent Fixtures	1	478	13.13%	0.03
651	Printer Power Management Enabling	25	503	13.82%	0.03
510	Demand Defrost Electric	2	504	13.86%	0.03
118	Continuous Dimming, 5L4' Fluorescent Fixtures	1	505	13.88%	0.03
422	Variable Speed Drive Control, 40 HP	10	515	14.15%	0.03
308	Economizer	6	521	14.32%	0.04
222	Outdoor Lighting Controls (Photocell/Timeclock)	45	566	15.57%	0.04
803	High Efficiency Water Heater (electric)	2	569	15.63%	0.04
303	EMS - Chiller	1	570	15.66%	0.05
187	Occupancy Sensor, 8L4' Fluorescent Fixtures	19	589	16.18%	0.05
182	Occupancy Sensor, 4L4' Fluorescent Fixtures	15	603	16.58%	0.05
413	Air Handler Optimization, 15 HP	11	615	16.89%	0.05
412	Variable Speed Drive Control, 15 HP	4	619	17.01%	0.05
139	Lighting Control Tuneup	80	699	19.21%	0.05
176	High Bay T5	25	724	19.90%	0.05
642	Copier Power Management Enabling	6	730	20.07%	0.05
153	RET 2 - 1L4' Premium T8, 1EB, Reflector OEM	7	737	20.27%	0.05
155	Occupancy Sensor, 4L8' Fluorescent Fixtures	6	743	20.43%	0.05
411	Fan Motor, 15hp, 1800rpm, 92.4%	1	744	20.46%	0.06
313	Window Film (Standard)	33	778	21.38%	0.06
423	Air Handler Optimization, 40 HP	3	781	21.46%	0.06
134	RET 1L4' Premium T8, 1EB, Reflector OEM	14	794	21.84%	0.06
401	Fan Motor, 5hp, 1800rpm, 89.5%	5	799	21.97%	0.06
421	Fan Motor, 40hp, 1800rpm, 94.1%	1	800	21.99%	0.07
191	LED Exit Sign	6	806	22.16%	0.08
302	Window Film (Standard)	3	809	22.24%	0.08
307	EMS Optimization	2	811	22.29%	0.09
505	Efficient compressor motor	1	812	22.32%	0.09
114	RET 4L4' Premium T8, 1EB	11	823	22.62%	0.10
509	Demand Hot Gas Defrost	0	823	22.63%	0.10
507	Floating head pressure controls	0	823	22.63%	0.11
304	Cool Roof - Chiller	1	825	22.66%	0.11
402	Variable Speed Drive Control, 5 HP	9	833	22.91%	0.13
315	Prog. Thermostat - DX	10	843	23.18%	0.13
314	Evaporative Pre-Cooler	5	848	23.31%	0.13
312	DX Packaged System, EER=10.9, 10 tons	7	855	23.51%	0.13
136	Occupancy Sensor, 8L4' Fluorescent Fixtures	10	865	23.79%	0.14
152	RET 2 - 2L4' Premium T8, 1EB	1	866	23.81%	0.14
306	VSD for Chiller Pumps and Towers	1	867	23.84%	0.17
511	Anti-sweat (humidistat) controls	1	868	23.86%	0.23
502	Strip curtains for walk-ins	1	869	23.88%	0.25
317	Optimize Controls	11	880	24.19%	0.27
316	Cool Roof - DX	11	891	24.49%	0.29
503	Night covers for display cases	0	892	24.51%	0.36
318	Economizer	20	911	25.04%	0.39
632	Monitor Power Management Enabling	0	911	25.04%	0.41
311	DX Tune Up/ Advanced Diagnostics	9	920	25.29%	0.43
305	Chiller Tune Up/Diagnostics	2	922	25.33%	0.43
501	High-efficiency fan motors	2	924	25.39%	0.45
117	Occupancy Sensor, 4L4' Fluorescent Fixtures	26	950	26.11%	0.46
506	Compressor VSD retrofit	0	950	26.12%	0.52
156	Continuous Dimming, 5L8' Fluorescent Fixtures	3	954	26.21%	0.67
133	RET 2L4' Premium T8, 1EB	17	970	26.68%	0.81
504	Evaporator fan controller for MT walk-ins	0	971	26.68%	0.92
708	Refrigeration Commissioning	0	971	26.69%	1.13

Energy Supply Curve - Industrial Buildings					
Measure Number	Measure	Measure	Cumulative		Marginal
		GWH Savings	Measure GWH Savings	Percent Savings	Energy Cost \$/kWH
417	O&M - Extruders/Injection Moulding	1	1	0.10%	0.00
301	Pumps - O&M	9	10	0.91%	0.01
104	Compressed Air- Sizing	3	13	1.21%	0.01
401	Bakery - Process (Mixing) - O&M	0	13	1.24%	0.01
406	Gap Forming papermachine	0	14	1.27%	0.01
407	High Consistency forming	0	14	1.31%	0.01
201	Fans - O&M	1	16	1.43%	0.01
551	Efficient Refrigeration - Operations	1	16	1.49%	0.01
309	Pumps - ASD (6-100 hp)	3	20	1.81%	0.01
101	Compressed Air-O&M	11	31	2.83%	0.01
403	Air conveying systems	0	31	2.85%	0.01
507	Near Net Shape Casting	1	32	2.90%	0.01
109	Comp Air - ASD (6-100 hp)	1	33	3.02%	0.01
501	Bakery - Process	1	34	3.12%	0.01
510	Heating - Optimization process (M&T)	0	34	3.15%	0.01
427	Drives - Optimization process (M&T)	1	35	3.20%	0.01
302	Pumps - Controls	26	60	5.54%	0.01
802	CFL Hardwired, Modular 36W	8	68	6.24%	0.01
103	Compressed Air - System Optimization	8	76	6.98%	0.01
204	Fans- Improve components	1	78	7.10%	0.01
423	Process control	0	78	7.10%	0.01
404	Replace V-Belts	0	78	7.12%	0.01
604	Efficient processes (welding, etc.)	1	79	7.20%	0.01
603	New transformers welding	1	79	7.27%	0.01
504	Top-heating (glass)	0	79	7.27%	0.01
712	DX Packaged System, EER=10.9, 10 tons	2	82	7.49%	0.01
707	Energy Star Transformers	0	82	7.49%	0.02
607	Refinery Controls	0	82	7.49%	0.02
216	Refinery Controls	0	82	7.49%	0.02
426	Efficient drives - rolling	3	84	7.73%	0.02
717	Energy Star Transformers	0	85	7.74%	0.02
805	Energy Star Transformers	0	85	7.76%	0.02
505	Efficient electric melting	2	87	7.95%	0.02
903	Energy Star Transformers	0	87	7.96%	0.02
217	Energy Star Transformers	0	87	7.98%	0.02
431	Energy Star Transformers	0	88	8.02%	0.02
553	Energy Star Transformers	0	88	8.03%	0.02
512	Energy Star Transformers	0	88	8.05%	0.02
608	Energy Star Transformers	0	88	8.05%	0.02
429	Machinery	0	88	8.08%	0.02
430	Efficient Machinery	0	88	8.08%	0.02
102	Compressed Air - Controls	2	90	8.28%	0.02
405	Drives - EE motor	1	91	8.36%	0.02
402	O&M/drives spinning machines	1	92	8.43%	0.02
602	Efficient desalter	0	92	8.43%	0.02
315	Refinery Controls	0	92	8.43%	0.02
511	Heating - Scheduling	0	92	8.43%	0.02

Energy Supply Curve - Industrial Buildings					
Measure Number	Measure	Measure	Cumulative Measure	Percent	Marginal Energy Cost
		GWH Savings	GWH Savings	Savings	\$/kWH
425	Drives - Process Control	2	116	10.64%	0.02
508	Heating - Process Control	2	118	10.84%	0.02
701	Centrifugal Chiller, 0.51 kW/ton, 500 tons	3	121	11.09%	0.02
115	Refinery Controls	0	121	11.09%	0.02
902	Membranes for wastewater	0	121	11.09%	0.02
418	Extruders/injection Moulding-multipump	2	123	11.23%	0.02
715	Prog. Thermostat - DX	1	123	11.29%	0.02
210	Fans - Motor practices-1 (6-100 HP)	1	124	11.39%	0.02
316	Energy Star Transformers	0	125	11.42%	0.02
552	Optimization Refrigeration	1	126	11.53%	0.02
116	Energy Star Transformers	0	126	11.54%	0.02
214	Optimize drying process	0	126	11.55%	0.03
413	Clean Room - Controls	1	127	11.64%	0.03
509	Efficient Curing ovens	1	128	11.75%	0.03
209	Fans - ASD (6-100 hp)	1	129	11.80%	0.03
428	Drives - Scheduling	0	129	11.82%	0.03
202	Fans - Controls	12	141	12.94%	0.03
408	Optimization control PM	1	142	13.04%	0.03
605	Process control	0	142	13.04%	0.03
420	Injection Moulding - Impulse Cooling	1	143	13.09%	0.03
112	Comp Air - ASD (100+ hp)	2	145	13.26%	0.03
312	Pumps - ASD (100+ hp)	4	149	13.64%	0.03
801	RET 2L4' Premium T8, 1EB	19	168	15.40%	0.03
424	Process optimization	0	168	15.40%	0.03
502	Drying (UV/IR)	0	168	15.41%	0.03
601	Other Process Controls (batch + site)	1	169	15.47%	0.03
713	Window Film - DX	1	170	15.56%	0.03
304	Pumps - Sizing	3	173	15.81%	0.03
110	Comp Air - Motor practices-1 (6-100 HP)	1	173	15.86%	0.03
203	Fans - System Optimization	4	177	16.20%	0.03
310	Pumps - Motor practices-1 (6-100 HP)	1	178	16.31%	0.03
901	Replace V-belts	0	178	16.31%	0.04
416	Process Drives - ASD	0	178	16.33%	0.04
113	Comp Air - Motor practices-1 (100+ HP)	1	179	16.37%	0.04
212	Fans - ASD (100+ hp)	2	181	16.57%	0.04
313	Pumps - Motor practices-1 (100+ HP)	1	182	16.69%	0.04
419	Direct drive Extruders	1	183	16.76%	0.04
606	Power recovery	0	183	16.76%	0.04
215	Power recovery	0	183	16.76%	0.04
705	Chiller Tune Up/Diagnostics	0	183	16.78%	0.04
414	Clean Room - New Designs	1	184	16.85%	0.04
703	EMS - Chiller	1	185	16.97%	0.04
207	Fans - Motor practices-1 (1-5 HP)	0	186	16.99%	0.04
421	Injection Moulding - Direct drive	0	186	17.03%	0.05
415	Drives - Process Controls (batch + site)	3	189	17.34%	0.05
503	Heat Pumps - Drying	0	189	17.35%	0.05
114	Power recovery	0	189	17.35%	0.05



Appendices

Energy Supply Curve - Industrial Buildings					
Measure Number	Measure	Measure	Cumulative		Marginal
		GWH Savings	Measure GWH Savings	Percent Savings	Energy Cost \$/kWH
314	Power recovery	0	191	17.49%	0.05
706	Cooling Circ. Pumps - VSD	1	192	17.55%	0.05
107	Comp Air - Motor practices-1 (1-5 HP)	0	192	17.56%	0.05
307	Pumps - Motor practices-1 (1-5 HP)	0	192	17.59%	0.05
804	Occupancy Sensor, 8L4' Fluorescent Fixtures	2	194	17.74%	0.05
211	Fans - Replace 100+ HP motor	1	194	17.81%	0.06
702	Window Film - Chiller	1	195	17.88%	0.07
422	Efficient grinding	0	195	17.90%	0.07
213	Fans - Motor practices-1 (100+ HP)	0	196	17.94%	0.07
111	Comp Air - Replace 100+ HP motor	0	196	17.98%	0.07
311	Pumps - Replace 100+ HP motor	1	197	18.07%	0.07
716	Cool Roof - DX	1	198	18.17%	0.08
205	Fans - Replace 1-5 HP motor	0	199	18.19%	0.09
506	Intelligent extruder (DOE)	0	199	18.20%	0.09
105	Comp Air - Replace 1-5 HP motor	0	199	18.21%	0.11
305	Pumps - Replace 1-5 HP motor	0	199	18.24%	0.11
108	Comp Air - Replace 6-100 HP motor	0	200	18.28%	0.14
308	Pumps - Replace 6-100 HP motor	1	201	18.38%	0.14
208	Fans - Replace 6-100 HP motor	1	201	18.44%	0.15
714	Evaporative Pre-Cooler	1	202	18.52%	0.15
206	Fans - ASD (1-5 hp)	0	202	18.54%	0.15
704	Cool Roof - Chiller	1	203	18.59%	0.15
106	Comp Air - ASD (1-5 hp)	0	203	18.60%	0.18
306	Pumps - ASD (1-5 hp)	0	203	18.63%	0.18
803	Metal Halide, 50W	1	204	18.69%	0.21



Appendices

Appendix B – Results

DSM ASSYST ADDITIVE SUPPLY ANALYSIS - Residential New Construction										
Vintage	New		Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Marginal	Marginal	Total
Batch	2		GWH	MW	Energy	Capacity	Resource	Energy	Capacity	Resource
Measure		Measure	Savings	Savings	Cost	Cost	Cost Test	Cost	Cost	Cost Test
Number								\$/kWh	\$/kW	TRC
91		15% above Standards	0.05	0.14	0.03	33.26	0.05	0.61	245.61	0.98
92		20% above Standards	0.02	0.04	0.05	49.88	0.00	3.23	1,300.30	0.19
103		17 SEER Split-System Air Conditioner	0.04	0.11	0.11	113.16	0.01	2.61	1,051.00	0.27
105		Programmable Thermostat	0.00	0.01	0.00	2.89	0.00	0.88	378.83	1.09
110		Ceiling Fans	0.01	0.01	0.00	3.25	0.01	0.53	258.06	1.19
111		Whole House Fans	0.01	0.02	0.02	16.05	0.00	1.88	906.49	0.26
112		Attic Venting	0.01	0.02	0.00	3.53	0.02	0.31	148.29	2.05
113		Proper Refrigerant Charging and Air Flow	0.03	0.08	0.00	3.47	0.19	0.10	41.72	5.81
114		Duct Repair (0.32)	0.02	0.04	0.00	2.79	0.09	0.16	62.97	5.22
115		Window Film	0.07	0.16	0.04	35.35	0.11	0.52	220.53	1.65
116		Default Window With Sunscreen	0.05	0.11	0.01	12.17	0.12	0.26	106.10	2.60
117		Double Pane Clear Windows to Double Pane Low-E Windows	0.05	0.12	0.00	3.28	0.43	0.06	26.65	8.48
118		Double Pane Clear Windows to Double Pane Low-E2 Windows	0.01	0.02	0.01	14.86	0.00	1.65	677.92	0.32
120		Ceiling R-30 to R-38	0.00	0.00	0.01	9.14	0.00	9.65	4,118.41	0.05
121		Ceiling R-30 to R-49	0.00	0.00	0.02	19.86	0.00	10.83	4,653.92	0.05
122		Wall R-19 to R-21	0.00	0.00	0.00	3.05	0.00	2.93	1,153.77	0.16
142		HE Room Air Conditioner - EER 12	0.05	0.11	0.03	29.75	0.04	0.65	262.72	0.88
143		Programmable Thermostat	0.00	0.01	0.01	5.25	0.00	1.46	630.53	0.42
145		Ceiling Fans	0.01	0.01	0.01	7.73	0.00	1.20	577.84	0.46
146		Whole House Fans	0.01	0.03	0.06	56.41	0.00	4.32	2,087.06	0.11
147		Attic Venting	0.01	0.03	0.01	8.02	0.01	0.54	259.98	0.96
148		Window Film	0.09	0.21	0.09	87.72	0.10	1.00	422.65	1.11
150		Default Window With Sunscreen	0.06	0.16	0.02	15.81	0.21	0.24	100.50	3.20
151		Double Pane Clear Windows to Double Pane Low-E Windows	0.04	0.11	0.00	2.37	0.50	0.05	22.40	11.36
152		Double Pane Clear Windows to Double Pane Low-E2 Windows	0.00	0.01	0.01	10.82	0.00	2.27	933.84	0.23
153		Ceiling R-30 to R-38	0.00	0.00	0.03	26.22	0.00	13.85	5,911.62	0.03
154		Ceiling R-30 to R-49	0.00	0.01	0.05	53.41	0.00	15.57	6,689.65	0.03
155		Wall R-19 to R-21	0.00	0.00	0.01	7.58	0.00	4.84	1,904.74	0.10
181		Variable Speed Furnace Fan	0.11	0.00	0.01	6.66	0.17	0.06	2,394.94	1.64
201		CFL (18-Watt integral ballast), 0.5 hr/day	0.05	0.01	0.00	1.01	0.17	0.02	196.79	3.26
211		CFL (18-Watt integral ballast), 2.5 hr/day	0.46	0.05	0.01	6.30	3.46	0.01	138.33	7.59
221		CFL (18-Watt integral ballast), 6.0 hr/day	0.25	0.02	0.00	3.34	1.92	0.01	135.33	7.76
231		ROB 2L4T8, 1EB	0.05	0.01	0.00	0.46	0.35	0.01	89.65	6.86
232		RET 2L4T8, 1EB	0.04	0.00	0.00	0.46	0.19	0.01	122.76	5.01
301		HE Refrigerator - Energy Star version of above	0.23	0.04	0.07	67.74	0.10	0.29	1,793.65	0.41
401		HE Freezer	0.08	0.01	0.00	2.40	0.28	0.03	195.78	3.75
501		Heat Pump Water Heater (EF=2.9)	0.13	0.01	0.01	10.92	0.17	0.08	757.87	1.32
502		HE Water Heater (EF=0.93)	0.05	0.01	0.00	1.70	0.15	0.04	316.50	3.16
503		Solar Water Heat	0.08	0.01	0.01	9.85	0.07	0.13	1,136.79	0.88
504		Tankless Water Heater	0.01	0.00	0.00	0.73	0.02	0.06	527.43	1.89
505		Low Flow Showerhead	0.06	0.01	0.00	1.18	0.29	0.02	188.05	5.25
506		Pipe Wrap	0.01	0.00	0.00	0.51	0.04	0.04	347.88	2.88
507		Faucet Aerators	0.03	0.00	0.00	1.07	0.07	0.04	366.49	2.70
508		Water Heater Blanket	0.06	0.01	0.00	0.41	1.09	0.01	57.72	17.28
601		Energy Star CW CEE Tier 1 (MEF=1.42)	0.27	0.03	0.05	46.84	0.18	0.17	1,342.63	0.68
602		Energy Star CW CEE Tier 2 (MEF=1.60)	0.16	0.02	0.10	103.56	0.03	0.66	5,106.94	0.20
710		High Efficiency CD (EF=3.01 w/moisture sensor)	0.15	0.02	0.05	52.20	0.05	0.36	2,466.39	0.35
801		Energy Star DW (EF=0.58)	0.23	0.02	0.01	10.10	0.61	0.04	470.39	2.66
901		Two Speed Pool Pump (1.5 hp)	0.13	0.05	0.00	3.07	0.83	0.02	64.15	6.52
902		High Efficiency One Speed Pool Pump (1.5 hp)	0.09	0.03	0.00	0.86	1.37	0.01	26.48	15.80



Appendices

DSM ASSYST ADDITIVE SUPPLY ANALYSIS - Residential Existing Construction									
Measure Number	Measure	Cumulative GWH Savings	Cumulative MW Savings	Cumulative Energy Cost	Cumulative Capacity Cost	Cumulative Resource Cost Test	Marginal Energy Cost \$/kWh	Marginal Capacity Cost \$/kW	Total Resource Cost Test TRC
103	17 SEER Split-System Air Conditioner	9.56	23.73	10.04	10,042.63	6.98	1.05	423.29	0.73
105	Programmable Thermostat	1.02	2.38	0.81	809.11	1.20	0.79	339.97	1.17
110	Ceiling Fans	0.83	1.71	0.26	259.97	1.55	0.31	151.70	1.87
111	Whole House Fans	1.50	3.11	3.14	3,139.72	0.37	2.09	1,010.18	0.25
112	Attic Venting	2.77	5.73	0.83	829.08	5.72	0.30	144.78	2.06
113	Proper Refrigerant Charging and Air Flow	7.43	18.45	0.83	826.75	43.28	0.11	44.82	5.82
114	Duct Repair (0.32)	3.93	9.75	0.66	664.48	20.79	0.17	68.14	5.29
115	Window Film	16.75	39.61	8.42	8,417.08	25.78	0.50	212.53	1.54
116	Default Window With Sunscreen	9.27	22.51	2.93	2,931.03	21.42	0.32	130.21	2.31
117	Double Pane Clear Windows to Double Pane Low-E Windows	10.17	24.69	1.23	1,228.42	50.19	0.12	49.75	4.94
118	Double Pane Clear Windows to Double Pane Low-E2 Windows	1.55	3.77	4.17	4,166.09	0.32	2.69	1,106.27	0.20
120	Ceiling R-0 to R-19 Insulation(.29)	5.50	12.88	0.41	409.85	52.35	0.07	31.82	9.52
121	Ceiling R-19 to R-38 Insulation (.27)	1.83	4.27	1.15	1,152.55	1.89	0.63	270.20	1.03
122	Wall 2x4 R-0 to Blow-In R-13 Insulation (0.14)	4.81	12.20	1.29	1,288.97	15.75	0.27	105.63	3.28
142	HE Room Air Conditioner - EER 12	9.96	24.73	7.08	7,084.08	8.85	0.71	286.44	0.89
143	Programmable Thermostat	1.14	2.66	1.56	1,560.10	0.54	1.36	586.81	0.47
145	Ceiling Fans	0.83	1.71	0.85	846.83	0.48	1.02	493.78	0.58
146	Whole House Fans	2.47	5.10	11.03	11,026.74	0.27	4.47	2,160.23	0.11
147	Attic Venting	3.65	7.55	1.98	1,983.66	3.58	0.54	262.60	0.98
148	Window Film	18.61	44.00	20.89	20,885.07	16.25	1.12	474.65	0.87
150	Default Window With Sunscreen	14.75	35.81	3.81	3,808.95	41.48	0.26	106.37	2.81
151	Double Pane Clear Windows to Double Pane Low-E Windows	1.91	4.63	0.12	120.36	18.08	0.06	25.99	9.48
152	Double Pane Clear Windows to Double Pane Low-E2 Windows	0.20	0.49	0.52	515.08	0.04	2.57	1,057.89	0.21
153	Ceiling R-0 to R-19 Insulation (.29)	10.73	25.15	0.82	815.87	83.41	0.08	32.44	7.77
154	Ceiling R-19 to R-38 Insulation (.27)	2.15	4.99	2.52	2,523.76	1.18	1.18	505.49	0.55
155	Wall 2x4 R-0 to Blow-In R-13 Insulation (0.14)	4.91	12.47	2.11	2,111.19	13.51	0.43	169.25	2.75
181	Variable Speed Furnace Fan	25.27	0.66	1.59	1,585.89	45.50	0.06	2,394.94	1.80
191	Dbl Pane Clear Windows to HE Windows	2.23	0.09	2.05	2,048.74	0.32	0.92	22,333.51	0.14
192	Ceiling R-0 to R-38 Insulation - Batts	16.68	0.68	0.73	730.87	41.82	0.04	1,067.60	2.51
193	Ceiling R-11 to R-38 Insulation - Batts	3.58	0.15	0.80	804.52	1.75	0.22	5,479.05	0.49
194	Ceiling R-19 to R-38 Insulation - Batts	7.91	0.32	1.20	1,201.13	5.73	0.15	3,697.15	0.72
195	Wall Blow-in R-0 to R-13 Insulation	7.76	0.32	0.15	149.57	44.32	0.02	469.68	5.71
196	Infiltration Reduction (0.4)	7.39	0.30	0.75	745.28	8.03	0.10	2,458.12	1.09
197	Floor R-0 to R-19 Insulation-Batts	1.83	0.08	0.41	406.55	0.91	0.22	5,420.61	0.50
198	Programmable Thermostat	5.68	0.23	0.46	462.73	7.75	0.08	1,984.54	1.36
201	CFL (18-Watt integral ballast), 0.5 hr/day	8.40	0.84	0.20	197.60	26.93	0.02	235.70	3.21
211	CFL (18-Watt integral ballast), 3.0 hr/day	74.66	7.45	1.28	1,277.29	539.41	0.02	171.36	7.22
221	CFL (18-Watt integral ballast), 6.0 hr/day	40.50	4.04	0.66	655.42	309.38	0.02	162.09	7.64
231	ROB 2L4T8, 1EB	8.30	0.83	0.11	109.18	42.96	0.01	131.74	5.18
232	RET 2L4T8, 1EB	6.06	0.61	0.11	109.18	22.91	0.02	180.42	3.78
301	HE Refrigerator - Energy Star version of above	55.40	8.99	4.63	4,632.19	86.57	0.08	515.17	1.56
311	Refrigerator - Early Replacement	71.61	11.62	1.72	1,721.93	390.12	0.02	148.16	5.45
401	HE Freezer	17.98	2.92	0.57	571.43	73.26	0.03	195.78	4.07
501	Heat Pump Water Heater (EF=2.9)	30.64	3.43	2.62	2,616.83	43.71	0.09	762.69	1.43
502	HE Water Heater (EF=0.93)	11.87	1.33	0.40	403.76	42.46	0.03	303.75	3.58
503	Solar Water Heat	18.35	2.06	2.33	2,332.15	17.62	0.13	1,134.67	0.96
504	Tankless Water Heater	3.01	0.34	0.17	174.26	6.32	0.06	517.75	2.10
505	Low Flow Showerhead	12.70	1.42	0.55	548.04	35.47	0.04	385.24	2.79
506	Pipe Wrap	3.96	0.44	0.15	146.50	13.05	0.04	330.07	3.29
507	Faucet Aerators	6.08	0.68	0.45	449.12	9.93	0.07	659.65	1.63
508	Water Heater Blanket	14.98	1.68	0.24	244.33	111.84	0.02	145.60	7.46
602	Energy Star CW CEE Tier 2 (MEF=1.60)	153.48	19.88	24.66	24,657.54	125.19	0.16	1,240.32	0.82
710	High Efficiency CD (EF=3.01 w/moisture sensor)	34.63	5.04	12.43	12,428.64	13.26	0.36	2,466.39	0.38
801	Energy Star DW (EF=0.58)	54.87	5.11	2.41	2,405.22	159.87	0.04	470.39	2.91
901	Two Speed Pool Pump (1.5 hp)	30.41	11.38	0.73	730.39	214.65	0.02	64.15	7.06
902	High Efficiency One Speed Pool Pump (1.5 hp)	20.58	7.71	0.20	204.11	351.98	0.01	26.48	17.10

DSM ASSYST ADDITIVE SUPPLY ANALYSIS - Commercial New Construction									
Measure Number	Measure	Cumulative GWH Savings	Cumulative MW Savings	Cumulative Energy Cost	Cumulative Capacity Cost	Cumulative Resource Cost Test	Marginal Energy Cost \$/kWh	Marginal Capacity Cost \$/kW	Total Resource Cost Test TRC
101	#N/A	1.26	0.22	0.01	14.97	15.19	0.01	68.99	12.06
102	#N/A	0.61	0.10	0.03	31.52	1.67	0.05	301.72	2.76
301	#N/A	0.98	0.54	0.01	14.97	13.04	0.02	27.86	13.27
302	#N/A	1.59	0.87	0.07	67.37	7.60	0.04	77.39	4.78
501	#N/A	0.18	0.01	0.01	5.08	0.66	0.03	553.24	3.66
502	#N/A	0.12	0.01	0.01	11.24	0.14	0.09	1,788.80	1.13



Appendices

DSM ASSYST ADDITIVE SUPPLY ANALYSIS - Commercial Existing Buildings										
Measure Number	Measure	Cumulative GWH Savings	Cumulative MW Savings	Cumulative Energy Cost	Cumulative Capacity Cost	Cumulative Resource Cost Test	Marginal Energy Cost \$/kWh	Marginal Capacity Cost \$/kW	Total Resource Cost Test	Total TRC
114	RET 4L4' Premium T8, 1EB	11.01	2.27	1.09	1,087.96	16.25	0.10	478.72	1.48	
115	RET 2L4' Premium T8, 1EB, Reflector	80.44	14.51	1.84	1,843.37	529.60	0.02	127.02	6.58	
117	Occupancy Sensor, 4L4' Fluorescent Fixtures	26.11	8.55	11.97	11,969.78	9.86	0.46	1,399.65	0.38	
118	Continuous Dimming, 5L4' Fluorescent Fixtures	0.77	0.04	0.02	23.54	2.90	0.03	617.13	3.75	
120	Lighting Control Tuneup	52.11	9.29	0.92	924.35	426.59	0.02	99.53	8.19	
133	RET 2L4' Premium T8, 1EB	16.92	5.41	13.68	13,677.12	5.82	0.81	2,529.80	0.34	
134	RET 1L4' Premium T8, 1EB, Reflector OEM	13.71	2.42	0.82	823.24	49.35	0.06	340.18	3.60	
136	Occupancy Sensor, 8L4' Fluorescent Fixtures	9.89	1.97	1.34	1,343.63	13.63	0.14	683.02	1.38	
137	Continuous Dimming, 10L4' Fluorescent Fixtures	0.73	0.04	0.02	19.09	3.19	0.03	537.57	4.39	
139	Lighting Control Tuneup	80.02	14.12	4.12	4,121.73	335.68	0.05	291.86	4.19	
152	RET 2 - 2L4' Premium T8, 1EB	0.91	0.21	0.13	130.82	1.14	0.14	625.67	1.26	
153	RET 2 - 1L4' Premium T8, 1EB, Reflector OEM	7.04	1.39	0.37	374.57	25.22	0.05	269.41	3.59	
155	Occupancy Sensor, 4L8' Fluorescent Fixtures	5.95	1.18	0.32	317.69	21.21	0.05	270.31	3.57	
156	Continuous Dimming, 5L8' Fluorescent Fixtures	3.28	1.17	2.21	2,211.80	1.21	0.67	1,895.92	0.37	
161	CFL Screw-in 18W	69.78	13.01	1.50	1,497.44	690.10	0.02	115.10	9.89	
166	CFL Hardwired, Modular 18W	23.26	4.34	0.55	547.20	261.28	0.02	126.18	11.23	
176	High Bay T5	25.21	5.05	1.31	1,307.50	71.24	0.05	259.13	2.83	
181	ROB 4L4' Premium T8, 1EB	28.63	4.77	0.31	307.63	429.05	0.01	64.43	14.99	
182	Occupancy Sensor, 4L4' Fluorescent Fixtures	14.52	2.31	0.69	691.68	42.06	0.05	299.14	2.90	
183	Lighting Control Tuneup	0.69	0.03	0.02	15.15	3.63	0.02	486.49	5.28	
186	ROB 2L4' Premium T8, 1EB	44.24	7.43	0.56	562.14	585.39	0.01	75.71	13.23	
187	Occupancy Sensor, 8L4' Fluorescent Fixtures	18.93	3.01	0.88	881.71	61.18	0.05	292.55	3.23	
188	Lighting Control Tuneup	0.97	0.04	0.02	19.58	5.65	0.02	438.19	5.81	
191	LED Exit Sign	6.20	1.06	0.47	468.29	10.95	0.08	440.92	1.76	
221	High Pressure Sodium 250W Lamp	3.57	0.00	0.04	N/A	32.57	0.01	N/A	9.13	
222	Outdoor Lighting Controls (Photocell/Timeclock)	45.26	0.46	1.69	1,692.25	139.08	0.04	3,698.43	3.07	
301	Centrifugal Chiller, 0.51 kW/ton, 500 tons	18.41	10.07	0.31	308.48	224.40	0.02	30.63	12.19	
302	Window Film (Standard)	2.97	1.05	0.25	248.08	6.11	0.08	236.32	2.06	
303	EMS - Chiller	1.10	0.60	0.05	51.31	4.87	0.05	84.93	4.41	
304	Cool Roof - Chiller	1.10	0.23	0.12	94.84	1.73	0.11	419.04	1.58	
305	Chiller Tune Up/Diagnostics	1.63	0.89	0.71	707.24	1.21	0.43	792.13	0.74	
306	VSD for Chiller Pumps and Towers	1.18	0.64	0.20	197.24	2.17	0.17	306.70	1.85	
307	EMS Optimization	1.61	0.33	0.15	145.16	2.56	0.09	435.49	1.58	
308	Economizer	6.19	3.39	0.22	220.44	35.87	0.04	65.11	5.80	
311	DX Tune Up/ Advanced Diagnostics	8.83	4.83	3.76	3,761.67	21.55	0.43	778.98	2.44	
312	DX Packaged System, EER=10.9, 10 tons	7.31	3.38	0.98	981.52	10.78	0.13	290.27	1.47	
313	Window Film (Standard)	33.44	18.30	1.89	1,891.94	155.46	0.06	103.39	4.65	
314	Evaporative Pre-Cooler	4.70	0.97	0.61	612.62	5.29	0.13	631.86	1.13	
315	Prog. Thermostat - DX	10.15	2.10	1.32	1,318.63	13.58	0.13	629.36	1.34	
316	Cool Roof - DX	11.10	2.29	3.16	2,783.97	12.95	0.29	1,215.14	1.17	
317	Optimize Controls	11.16	6.11	3.06	3,064.91	10.19	0.27	501.77	0.91	
318	Economizer	19.55	10.70	7.62	7,624.14	12.96	0.39	712.85	0.66	
401	Fan Motor, 5hp, 1800rpm, 89.5%	5.04	0.35	0.31	306.63	10.49	0.06	888.63	2.08	
402	Variable Speed Drive Control, 5 HP	8.75	0.16	1.10	1,097.85	7.87	0.13	6,768.39	0.90	
411	Fan Motor, 15hp, 1800rpm, 92.4%	1.25	0.09	0.07	69.03	2.82	0.06	806.78	2.26	
412	Variable Speed Drive Control, 15 HP	4.32	0.08	0.22	218.12	8.72	0.05	2,724.77	2.02	
413	Air Handler Optimization, 15 HP	11.33	0.21	0.56	555.62	24.82	0.05	2,643.93	2.19	
421	Fan Motor, 40hp, 1800rpm, 94.1%	0.59	0.04	0.04	42.93	0.99	0.07	1,063.58	1.67	
422	Variable Speed Drive Control, 40 HP	9.80	0.18	0.32	317.01	31.93	0.03	1,744.11	3.26	
423	Air Handler Optimization, 40 HP	2.80	0.05	0.16	158.44	5.18	0.06	3,056.38	1.85	
501	High-efficiency fan motors	2.20	0.11	0.98	984.26	0.51	0.45	8,736.24	0.23	
502	Strip curtains for walk-ins	0.58	0.03	0.14	143.89	0.24	0.25	4,858.58	0.42	
503	Night covers for display cases	0.49	0.00	0.18	N/A	0.12	0.36	N/A	0.25	
504	Evaporator fan controller for MT walk-ins	0.07	0.00	0.06	N/A	0.01	0.92	N/A	0.10	
505	Efficient compressor motor	1.11	0.06	0.10	104.36	1.21	0.09	1,843.12	1.10	
506	Compressor VSD retrofit	0.41	0.01	0.21	212.83	0.08	0.52	19,457.50	0.19	
507	Floating head pressure controls	0.35	0.00	0.04	N/A	0.29	0.11	N/A	0.83	
508	Refrigeration Commissioning	0.42	0.02	0.48	478.62	0.04	1.13	22,031.98	0.09	
509	Demand Hot Gas Defrost	1.76	0.01	0.02	15.85	0.16	0.10	1,955.34	1.03	
510	Demand Defrost Electric	0.13	0.09	0.05	50.18	6.19	0.03	565.62	3.58	
511	Anti-sweat (humidistat) controls	0.76	0.02	0.17	171.67	0.33	0.23	8,405.95	0.43	
611	PC Manual Power Management Enabling	31.10	1.95	0.39	390.61	379.63	0.01	199.82	12.21	
612	PC Network Power Management Enabling	61.18	3.85	0.78	781.22	734.82	0.01	203.12	12.01	
621	Energy Star or Better Monitor	7.33	0.74	0.00	0.00	732,608.63	0.00	0.00	99,999.00	
622	Monitor Power Management Enabling	29.21	1.84	0.40	395.82	330.59	0.01	215.55	11.32	
631	Energy Star or Better Monitor	0.00	0.00	0.00	0.00	55.84	0.00	0.00	99,999.00	
632	Monitor Power Management Enabling	0.05	0.00	0.02	20.83	0.02	0.41	6,544.61	0.37	
641	Energy Star or Better Copier	1.44	0.15	0.00	0.00	144,309.69	0.00	0.00	99,999.00	
642	Copier Power Management Enabling	6.09	0.38	0.32	323.79	17.22	0.05	845.68	2.82	
651	Printer Power Management Enabling	24.81	1.56	0.66	655.29	118.34	0.03	420.87	4.77	
801	Demand controlled circulating systems	6.37	0.14	0.13	125.13	46.55	0.02	887.38	7.30	
803	High Efficiency Water Heater (electric)	2.32	0.05	0.10	103.34	13.41	0.04	2,013.43	5.78	
804	Hot Water Pipe Insulation	0.99	0.02	0.02	24.27	5.76	0.02	1,103.38	5.80	
805	Tankless Water Heater	1.70	0.04	0.02	24.94	16.49	0.01	661.39	9.67	
911	Vending Misers (cooled machines only)	15.64	1.01	0.38	380.64	92.96	0.02	376.68	5.94	



Appendices

DSM ASSYST ADDITIVE SUPPLY ANALYSIS - Industrial Buildings										
Vintage	E							Marginal	Marginal	Total
Batch	1							Energy	Capacity	Resource
Measure			Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cost	Cost	Cost Test
Number	Measure		GWH Savings	MW Savings	Energy Cost	Capacity Cost	Resource Cost Test	\$/kWh	\$/kW	Cost Test TRC
101	Compressed Air-O&M		11.11	2.14	0.07	71.75	240.53	0.01	33.51	21.65
102	Compressed Air - Controls		2.11	0.41	0.04	40.73	15.31	0.02	100.08	7.25
103	Compressed Air - System Optimization		8.02	1.55	0.08	75.77	118.95	0.01	48.88	14.83
104	Compressed Air- Sizing		3.34	0.64	0.02	17.05	91.58	0.01	26.47	27.41
105	Comp Air - Replace 1-5 HP motor		0.14	0.03	0.02	15.19	0.18	0.11	562.80	1.29
106	Comp Air - ASD (1-5 hp)		0.14	0.00	0.03	25.10	0.08	0.18	8,090.97	0.59
107	Comp Air - Motor practices-1 (1-5 HP)		0.14	0.03	0.01	6.91	0.37	0.05	264.04	2.75
108	Comp Air - Replace 6-100 HP motor		0.46	0.09	0.06	62.06	0.47	0.14	703.79	1.03
109	Comp Air - ASD (6-100 hp)		1.28	0.03	0.01	8.79	19.94	0.01	309.34	15.57
110	Comp Air - Motor practices-1 (6-100 HP)		0.53	0.10	0.02	17.92	2.16	0.03	176.26	4.11
111	Comp Air - Replace 100+ HP motor		0.42	0.08	0.03	30.98	0.79	0.07	383.57	1.89
112	Comp Air - ASD (100+ hp)		1.79	0.04	0.05	52.21	6.59	0.03	1,293.19	3.67
113	Comp Air - Motor practices-1 (100+ HP)		0.54	0.10	0.02	19.23	2.13	0.04	183.79	3.94
114	Power recovery		0.00	0.00	0.00	0.00	0.00	0.05	133.94	3.46
115	Refinery Controls		0.00	0.00	0.00	0.00	0.00	0.02	63.47	7.30
116	Energy Star Transformers		0.11	0.02	0.00	2.79	0.64	0.02	128.57	5.64
201	Fans - O&M		1.31	0.23	0.01	7.02	33.60	0.01	31.06	25.55
202	Fans - Controls		12.20	2.09	0.32	324.36	62.56	0.03	154.87	5.13
203	Fans - System Optimization		3.70	0.35	0.13	126.58	13.08	0.03	366.36	3.54
204	Fans- Improve components		1.34	0.23	0.01	14.04	17.51	0.01	60.85	13.04
205	Fans - Replace 1-5 HP motor		0.25	0.04	0.02	22.52	0.39	0.09	515.87	1.54
206	Fans - ASD (1-5 hp)		0.25	0.01	0.04	37.21	0.18	0.15	7,401.48	0.72
207	Fans - Motor practices-1 (1-5 HP)		0.26	0.04	0.01	10.25	0.87	0.04	232.03	3.41
208	Fans - Replace 6-100 HP motor		0.62	0.14	0.09	91.99	0.60	0.15	647.27	0.97
209	Fans - ASD (6-100 hp)		0.52	0.04	0.01	13.03	2.00	0.03	322.00	3.88
210	Fans - Motor practices-1 (6-100 HP)		1.09	0.19	0.03	26.57	6.11	0.02	141.71	5.60
211	Fans - Replace 100+ HP motor		0.76	0.13	0.05	45.92	1.72	0.06	351.25	2.26
212	Fans - ASD (100+ hp)		2.17	0.06	0.08	77.39	6.28	0.04	1,198.99	2.89
213	Fans - Motor practices-1 (100+ HP)		0.40	0.16	0.03	28.51	1.00	0.07	173.80	2.46
214	#N/A		0.15	0.05	0.00	3.66	0.97	0.03	70.44	6.64
215	Power recovery		0.00	0.00	0.00	0.00	0.00	0.04	102.72	4.51
216	Refinery Controls		0.00	0.00	0.00	0.00	0.00	0.02	45.70	10.13
217	Energy Star Transformers		0.23	0.04	0.00	4.14	1.77	0.02	103.79	7.65
301	Pumps - O&M		8.85	1.58	0.04	44.90	240.32	0.01	28.33	27.14
302	Pumps - Controls		25.56	4.58	0.21	212.14	423.94	0.01	46.30	16.59
303	Pumps - System Optimization		21.88	3.91	0.45	445.16	147.95	0.02	113.82	6.76
304	Pumps - Sizing		2.72	1.16	0.09	89.79	14.72	0.03	77.26	5.40
305	Pumps - Replace 1-5 HP motor		0.33	0.06	0.04	36.01	0.41	0.11	611.12	1.26
306	Pumps - ASD (1-5 hp)		0.32	0.01	0.06	59.48	0.19	0.18	8,785.55	0.58
307	Pumps - Motor practices-1 (1-5 HP)		0.32	0.06	0.02	16.39	0.86	0.05	286.71	2.68
308	Pumps - Replace 6-100 HP motor		1.08	0.19	0.15	147.08	1.08	0.14	764.20	1.01
309	Pumps - ASD (6-100 hp)		3.50	0.07	0.02	20.84	62.58	0.01	287.75	17.90
310	Pumps - Motor practices-1 (6-100 HP)		1.23	0.22	0.04	42.47	4.92	0.03	191.68	4.00
311	Pumps - Replace 100+ HP motor		0.98	0.18	0.07	73.41	1.82	0.07	416.50	1.85
312	Pumps - ASD (100+ hp)		4.22	0.09	0.12	123.73	15.37	0.03	1,402.97	3.64
313	Pumps - Motor practices-1 (100+ HP)		1.27	0.23	0.05	45.58	4.86	0.04	199.86	3.84
314	Power recovery		0.00	0.00	0.00	0.00	0.00	0.05	135.06	3.43



Appendices

DSM ASSYST ADDITIVE SUPPLY ANALYSIS - Industrial Buildings									
Measure Number	Measure	Cumulative GWH Savings	Cumulative MW Savings	Cumulative Energy Cost	Cumulative Capacity Cost	Cumulative Resource Cost Test	Marginal Energy Cost \$/kWh	Marginal Capacity Cost \$/kW	Total Resource Cost Test TRC
315	Refinery Controls	0.00	0.00	0.00	0.00	0.00	0.02	55.76	8.30
316	Energy Star Transformers	0.27	0.05	0.01	6.61	1.51	0.02	137.44	5.60
401	#N/A	0.23	0.05	0.00	1.19	6.34	0.01	22.78	27.89
402	#N/A	0.69	0.14	0.01	13.51	5.01	0.02	96.36	7.24
403	#N/A	0.21	0.02	0.00	1.42	3.94	0.01	62.12	18.40
404	#N/A	0.13	0.05	0.00	1.45	2.06	0.01	30.40	15.39
405	Drives - EE motor	0.94	0.24	0.02	18.21	7.28	0.02	77.33	7.73
406	Gap Forming papermachine	0.40	0.10	0.00	2.10	11.18	0.01	21.86	28.06
407	High Consistency forming	0.38	0.09	0.00	2.02	10.51	0.01	22.11	27.74
408	Optimization control PM	1.16	0.28	0.03	31.58	6.28	0.03	113.19	5.42
413	Clean Room - Controls	0.95	0.18	0.02	23.93	5.35	0.03	132.62	5.62
414	Clean Room - New Designs	0.76	0.14	0.03	28.90	2.75	0.04	201.38	3.65
415	Drives - Process Controls (batch + site)	3.40	0.43	0.16	160.47	10.26	0.05	372.01	3.02
416	Process Drives - ASD	0.14	0.03	0.00	4.86	0.54	0.04	186.64	3.94
417	O&M - Extruders/Injection Moulding	1.07	0.49	0.00	4.57	45.84	0.00	9.29	42.90
418	Extruders/injection Moulding-multipump	1.52	0.70	0.04	36.23	11.65	0.02	51.89	7.68
419	Direct drive Extruders	0.78	0.36	0.03	28.18	3.95	0.04	78.56	5.08
420	Injection Moulding - Impulse Cooling	0.55	0.25	0.02	15.85	3.52	0.03	62.46	6.38
421	Injection Moulding - Direct drive	0.48	0.22	0.02	22.14	1.92	0.05	99.94	3.99
422	Efficient grinding	0.28	0.06	0.02	19.16	0.59	0.07	311.44	2.10
423	Process control	0.06	0.01	0.00	0.61	0.78	0.01	48.36	13.53
424	Process optimization	0.04	0.01	0.00	1.15	0.18	0.03	138.68	4.72
425	Drives - Process Control	2.21	0.20	0.05	48.76	12.37	0.02	245.43	5.59
426	Efficient drives - rolling	2.66	0.24	0.04	44.74	19.51	0.02	187.22	7.32
427	Drives - Optimization process (M&T)	0.50	0.16	0.00	4.12	9.85	0.01	25.87	19.56
428	Drives - Scheduling	0.23	0.01	0.01	5.83	1.00	0.03	436.16	4.42
429	Machinery	0.30	0.08	0.01	5.62	2.48	0.02	66.95	8.24
430	Efficient Machinery	0.03	0.01	0.00	0.56	0.22	0.02	106.47	7.26
431	Energy Star Transformers	0.47	0.10	0.01	8.48	3.76	0.02	88.30	7.92
501	#N/A	1.12	0.05	0.01	8.14	16.87	0.01	158.90	15.13
502	#N/A	0.15	0.00	0.00	4.67	0.51	0.03	1,307.99	3.42
503	#N/A	0.05	0.00	0.00	2.23	0.11	0.05	676.57	2.38
504	Top-heating (glass)	0.03	0.00	0.00	0.44	0.28	0.01	295.14	8.45
505	Efficient electric melting	2.12	0.04	0.04	36.86	12.87	0.02	970.57	6.08
506	Intelligent extruder (DOE)	0.04	0.00	0.00	3.78	0.05	0.09	5,025.78	1.17
507	Near Net Shape Casting	0.58	0.01	0.00	3.83	9.22	0.01	369.71	15.96
508	Heating - Process Control	2.17	0.04	0.05	47.90	10.44	0.02	1,228.30	4.80
509	Efficient Curing ovens	1.26	0.06	0.03	31.80	5.59	0.03	491.15	4.42
510	Heating - Optimization process (M&T)	0.33	0.02	0.00	2.68	4.54	0.01	125.35	13.89
511	Heating - Scheduling	0.08	0.00	0.00	1.57	0.40	0.02	1,439.99	5.14
512	Energy Star Transformers	0.26	0.01	0.00	4.60	1.53	0.02	607.88	5.99
551	#N/A	0.70	0.13	0.00	4.08	15.38	0.01	31.91	22.09
552	#N/A	1.20	0.22	0.03	29.62	6.31	0.02	134.15	5.25
553	#N/A	0.04	0.01	0.00	0.77	0.31	0.02	97.94	7.20
601	Other Process Controls (batch + site)	0.60	0.11	0.02	18.67	2.69	0.03	163.91	4.48
602	Efficient desalter	0.00	0.00	0.00	0.00	0.00	0.02	54.48	8.50
603	New transformers welding	0.75	0.25	0.01	9.52	9.48	0.01	38.72	12.72
604	Efficient processes (welding, etc.)	0.90	0.17	0.01	11.46	9.80	0.01	67.50	10.92
605	Process control	0.00	0.00	0.00	0.11	0.02	0.03	159.27	4.85
606	Power recovery	0.00	0.00	0.00	0.00	0.00	0.04	101.37	4.57
607	Refinery Controls	0.00	0.00	0.00	0.00	0.00	0.02	44.77	10.34
608	Energy Star Transformers	0.05	0.01	0.00	0.91	0.38	0.02	87.24	7.74
701	Centrifugal Chiller, 0.51 kW/ton, 500 tons	2.75	2.34	0.06	61.02	31.22	0.02	26.07	11.35
702	Window Film - Chiller	0.74	0.63	0.05	48.60	2.81	0.07	77.60	3.81
703	EMS - Chiller	1.30	1.11	0.05	51.81	8.26	0.04	46.71	6.34
704	Cool Roof - Chiller	0.50	0.43	0.08	75.62	0.85	0.15	176.35	1.68
705	Chiller Tune Up/Diagnostics	0.18	0.18	0.01	6.56	1.32	0.04	37.16	7.55
706	Cooling Circ. Pumps - VSD	0.64	0.54	0.03	32.28	3.16	0.05	59.64	4.96
707	Energy Star Transformers	0.04	0.04	0.00	0.66	0.66	0.02	18.66	15.86
711	DX Tune Up/ Advanced Diagnostics	1.54	1.31	0.08	75.23	7.95	0.05	57.37	5.16
712	DX Packaged System, EER=10.9, 10 tons	2.38	2.02	0.03	33.64	42.31	0.01	16.63	17.80
713	Window Film - DX	1.04	0.88	0.03	32.61	8.34	0.03	36.87	8.03
714	Evaporative Pre-Cooler	0.87	0.74	0.13	128.77	1.47	0.15	174.42	1.70
715	Prog. Thermostat - DX	0.66	0.29	0.02	15.87	4.68	0.02	53.89	7.11
716	Cool Roof - DX	1.15	0.98	0.09	87.47	3.80	0.08	89.45	3.31
717	Energy Star Transformers	0.07	0.06	0.00	1.25	1.11	0.02	19.75	14.99
801	RET 2L4' Premium T8, 1EB	19.12	4.23	0.58	576.31	92.02	0.03	136.20	4.81
802	CFL Hardwired, Modular 36W	7.69	1.54	0.07	70.88	117.81	0.01	46.09	15.31
803	Metal Halide, 50W	0.69	0.13	0.14	142.68	0.48	0.21	1,083.49	0.69
804	Occupancy Sensor, 8L4' Fluorescent Fixtures	1.62	0.47	0.09	89.05	4.55	0.05	190.19	2.80
805	Energy Star Transformers	0.15	0.03	0.00	2.67	1.29	0.02	79.66	8.34
901	Replace V-belts	0.01	0.00	0.00	0.24	0.03	0.04	146.48	4.20
902	#N/A	0.01	0.00	0.00	0.34	0.09	0.02	115.34	6.05
903	Energy Star Transformers	0.08	0.02	0.00	1.37	0.65	0.02	77.57	8.31

Appendix C – JACO spreadsheets (1.5% scenario used)

2008-2010 REFRIGERATOR RECYCLING PROGRAM (RRP) SCENARIO ANALYSES				
Organization: National Grid - Rhode Island Electric				
QUANTIFICATION OF NET GHG IMPACTS OF 2008-2010 RRP				
Purpose: show magnitude of avoided CO2e emissions for each harvested unit, and for overall program				
GHG/CO2e Element	1% Annual Harvest Rate (AHR)	1.5% Annual Harvest Rate (AHR)	2% Annual Harvest Rate (AHR)	Notes
Avoided Electricity Generation Emissions				
CO2 emissions (lbs/kWh generated)	0.99	0.99	0.99	Value is for combined cycle/combustion turbine natural gas power plant. Value is based on avg natural gas generation plant in US as of 1999, adjusted by ratio of typical heat rates. In 1999, avg gas-fired power plant generated 1.32 lbs CO2/kwh of output (Table 1 from DOE 7/200 report at http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2_report.html#electric); heat rates for typical gas-fired power plant and combined-cycle gas turbine are 10,000 and 7,500 btu/kWh, respectively (per http://www.nei.org/index.asp?catnum=2&catid=262)
Tons/Lb (k)	0.0005	0.0005	0.0005	constant (1 ton = 2000 lbs)
Net avoided annual tons CO2/unit	0.36	0.36	0.36	per above data; net annual kWh/unit is weighted value across refrigerators and freezers, and per scenario assumptions
Net avoided lifecycle tons CO2/unit (not discounted)	2.87	2.87	2.87	per above data; measure life value is per scenario assumptions
Net avoided lifecycle tons CO2 (3-year totals; not discounted)	36,550	54,825	73,100	per above data; total net [lifecycle] annual kWh is per scenario assumptions
CFC-11 Destruction Impacts				
Frac. Of RRP-Harvested Refrigerators and Freezers with CFC-11 foam (%)	81%	81%	81%	recent (2006 program year) typical experience for JACO (most program-specific data are not in public domain)
Foam Total Weight (lb/unit)	9.5	9.5	9.5	recent (2006 program year) typical experience for JACO (most program-specific data are not in public domain)
CFC-11 content of Foam (%)	10%	10%	10%	JACO estimate - typical harvested unit with CFC-11 foam
CFC-11 CO2e Global warming potentials (GWP; k)	4,680	4,680	4,680	US EPA, "Class I Ozone-Depleting Substances", per www.epa.gov/ozone/ods.html
Tons/Lb (k)	0.0005	0.0005	0.0005	constant (1 ton = 2000 lbs)
NTG (regarding CFC-11)	100%	100%	100%	JACO observation: CFC-11 destruction <u>only</u> occurs in presence of "sophisticated" appliance recycling programs (CFC-11 is usually simply ignored)
Per unit net avoided tons CO2e	1.80	1.80	1.80	per above data
Program net avoided tons CO2e (3-year totals; not discounted)	22,946	34,419	45,892	per above data; total program units is per scenario assumptions
CFC-12 Destruction Impacts				
Frac. Of RRP-Harvested Refrigerators and Freezers with CFC-12 refrigerant (%)	90%	90%	90%	recent (2006 program year) typical experience for JACO (most program-specific data are not in public domain)
CFC-12 harvested (lbs/unit)	0.4	0.4	0.4	recent (2006 program year) typical experience for JACO (most program-specific data are not in public domain)
CFC-12 CO2e Global warming potentials (GWP; k)	10,720	10,720	10,720	US EPA, "Class I Ozone-Depleting Substances", per www.epa.gov/ozone/ods.html
Tons/Lb (k)	0.0005	0.0005	0.0005	constant (1 ton = 2000 lbs)
NTG (regarding CFC-12)	100%	100%	100%	JACO observation: CFC-12 destruction <u>only</u> occurs in presence of "sophisticated" appliance recycling programs (CFC-12 is usually recycled rather than destroyed)
Per unit net avoided tons CO2e	1.93	1.93	1.93	per above data
Program net avoided tons CO2e (3-year totals; not discounted)	24,590	36,885	49,179	per above data; total program units is per scenario assumptions
Total GHG Impacts				
Per unit net avoided tons CO2 & CO2e/unit (not discounted)	6.60	6.60	6.60	per above data; reference point: a typical avg passenger car/light-duty truck driven in the U.S. produces 6.16 tons (5.59 metric tons) of CO2 equiv. annually, per http://www.usctgateway.net/tool/resources/cars_trucks.html
Program net avoided tons CO2 and CO2e (3-year totals; not discounted)	84,086	126,129	168,172	per above data