Chapter 4 – Energy Efficiency

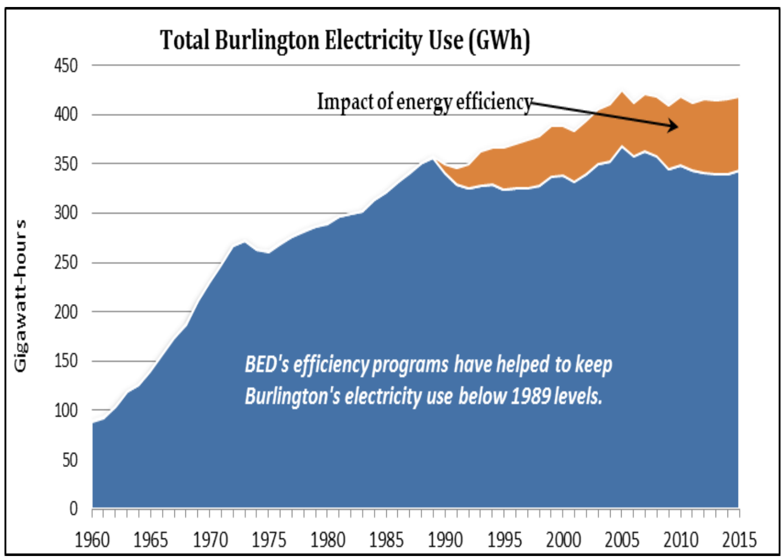
Introduction

Upon taking over the operations of Winooski One hydro-electric facility in September, 2014, the City of Burlington's 15 year quest to source all of its electricity from renewable resources was achieved. With the acquisition, however, comes a new set of challenges. To sustain its claim of 100 percent sourced renewability, BED must redouble its efforts to minimize load growth and lower peak demand even as Vermont pursues a policy of strategic electrification; a policy that will likely lead to higher electric loads.

In this section, BED describes the historical impact of energy efficiency on electric sales and how investments in future energy efficiency programs will help to ensure resource adequacy.

Energy Efficiency as a resource

To fully appreciate how energy efficiency can serve as a resource, a retrospective analysis of its impact is necessary.

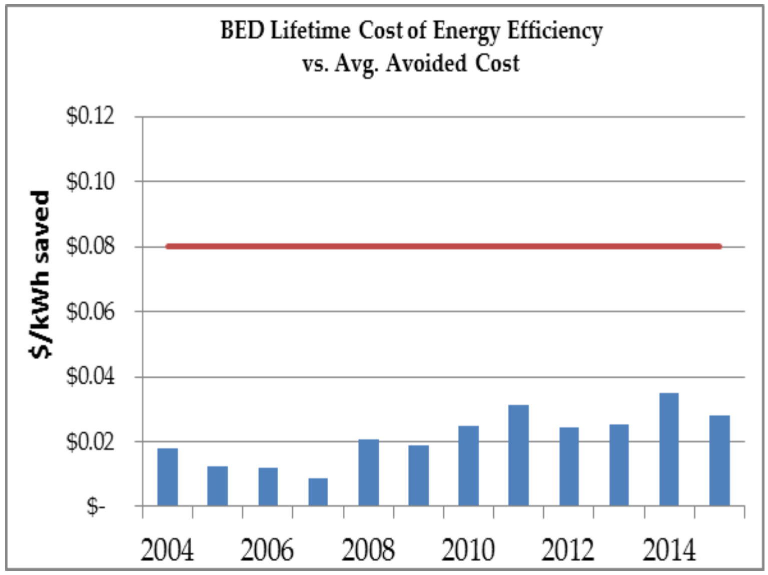


In 1990, the city of Burlington embraced energy efficiency wholeheartedly when Burlingtonians approved a bond to fund energy efficiency programs through 2002. Since then, BED has provided customers with a variety of technical services to ensure cost effective energy reduction opportunities are identified and efficiency projects implemented. Over the years, BED and participating customers have invested more than $56. 8 million in energy efficiency; money that could have been exported out of the region in the form higher electric bills had BED not offered energy efficiency alternatives.[1] The cumulative effect of these programs has been dramatic. As shown in the graph below, energy consumption today is roughly the same as it was in 1989 largely on account of BED's efficiency programs.

There are several reasons for investing in energy efficiency. From the customer's perspective, installing more efficient appliances help to reduce electric bills. Similarly, investing in weatherization projects increase the comfort level of buildings as well as lower the

[1] See 2015 Annual Report, City of Burlington Electric Department, at pg. 7

homeowner's energy bill. For utilities, energy efficiency helps to defer infrastructure upgrades, reduces regional transmission expenses and improves customer relations. Investments can also lower regional greenhouse gas emissions. These benefits alone are sufficient to justify a continuation of cost effective energy efficiency programs. But in addition to these benefits, energy efficiency investments have historical proven to be a low cost resource as well as provide BED with a path for complying with 30 V.S.A. §218 c. Since 2004, the levelized (or lifetime) cost of energy efficiency has ranged between $0.02/kWh to $0.04/kWh, well below the average avoided wholesale cost of energy.[2] Moreover, every dollar invested in BED's efficiency programs has returned $4.65 in societal benefits, according to a Vermont Public Service Board report.[3] BED's long term commitment to energy efficiency has also accumulated in more than 125,000 MWhs of savings since 1990. These cumulative savings have amounted to annual MWh savings of between 0.72 percent and 2.15 percent of electric sales. Such consistent achievement is comparable to some of the best managed energy efficiecy utilities in the Nation.



Based on its proven track-record of performance, BED's investment in energy efficiency will continue into the foreseeable future. The only unanswered question that remains however is: what level of future investment would be reasonable and prudent?

Energy efficiency scenarios that ensure resource adequacy

This section examines a variety of scenarios based on historical yields, knowledge of the local market and anticipated impacts of rising efficiency standards and building codes on the remaining achievable potential for energy efficiency in the city of Burlington.

BED currently provides energy efficiency services and incentives through 5 main programs: Residential existing homes (including low income residences), residential new construction, efficient products, business new construction and business existing facilities. Investments and savings for these programs since 2010 are as follows:

[2] See Dkt 8606, BED Overall performance assessment, exh. 1, pg. 23.

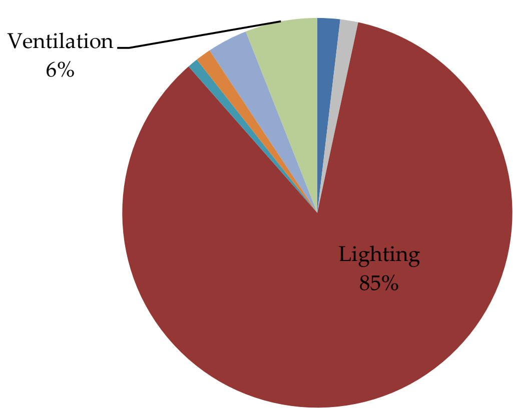
[3] See Evergreen Economics Independent Audit report to the Public Service Board, September 11, 2015.

Cumulative (2010 - 2015)		Incentives		Total BED investment, incl incentives		Participant Costs		Total investment	Net, MWh saved		First yr cost (BED only)		MWh Yld		Levelized Cost
Business Existing Facilities	$	4,069,904	$	6,745,953	$	4,018,980	$	10,764,933	17,570	$	0.384	$	26	$	0.032
Business New Construction	$	1,042,864	$	1,724,778	$	3,064,166	$	4,788,944	4,433	$	0.389	$	26	$	0.032
Efficient Products Program	$	1,435,815	$	1,939,258	$	1,844,654	$	3,783,912	14,227	$	0.136	$	73	$	0.011
Residential Existing Facilities	$	440,661	$	1,295,009	$	443,774	$	1,738,783	1,671	$	0.775	$	13	$	0.065
Residential New Construction	$	224,678	$	615,610	$	44,758	$	660,368	481	$	1.280	$	8	$	0.051

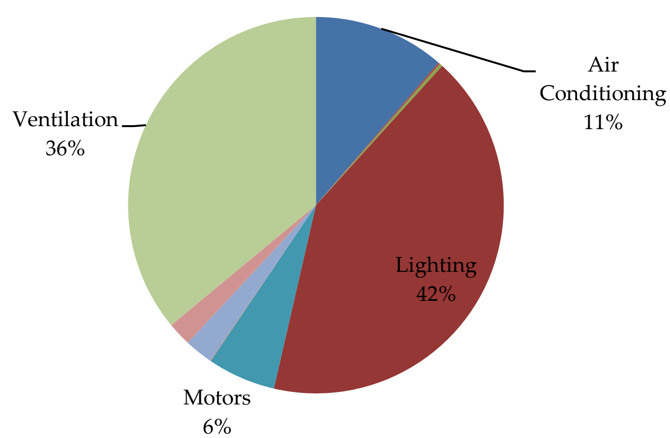
Over the past several years, the vast majority of the savings within each of the programs have been from lighting end-uses.

Business Existing Facilities

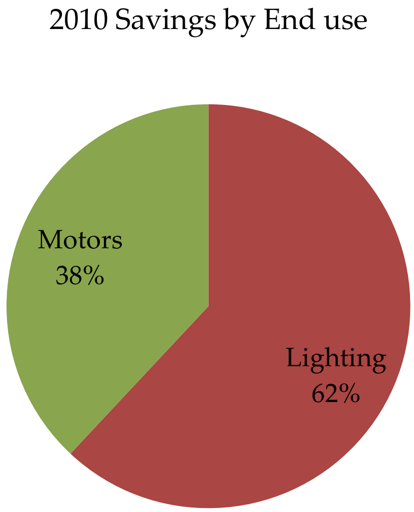
2010 Savinging by End use

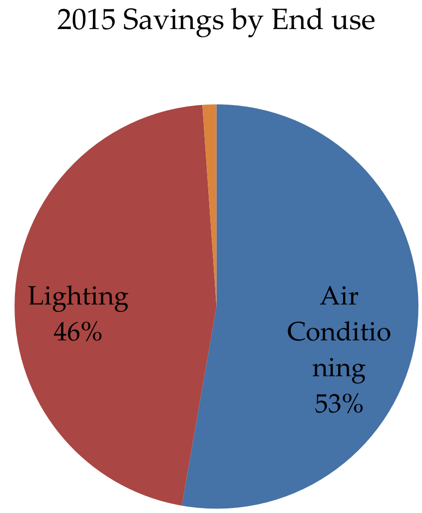


2015 Savings by End use

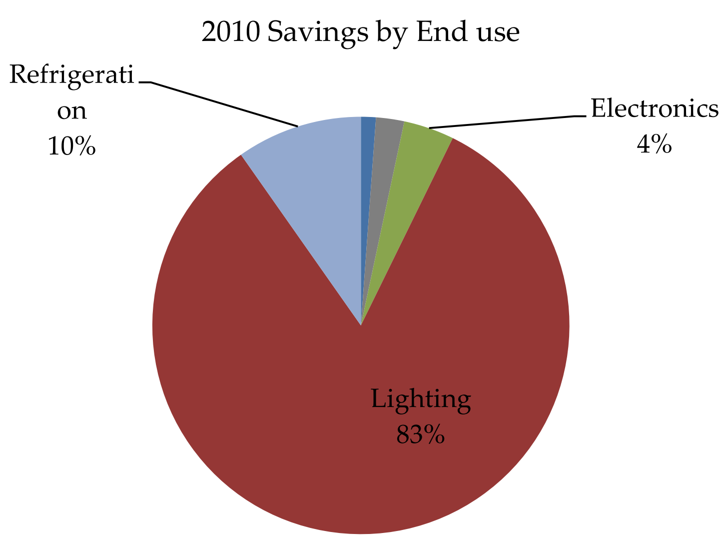


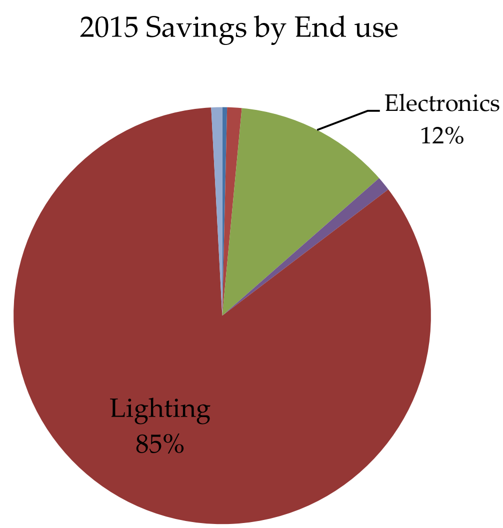
Business New Construction



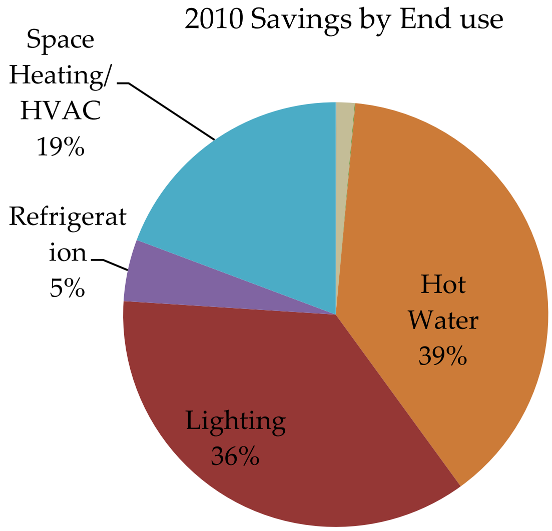


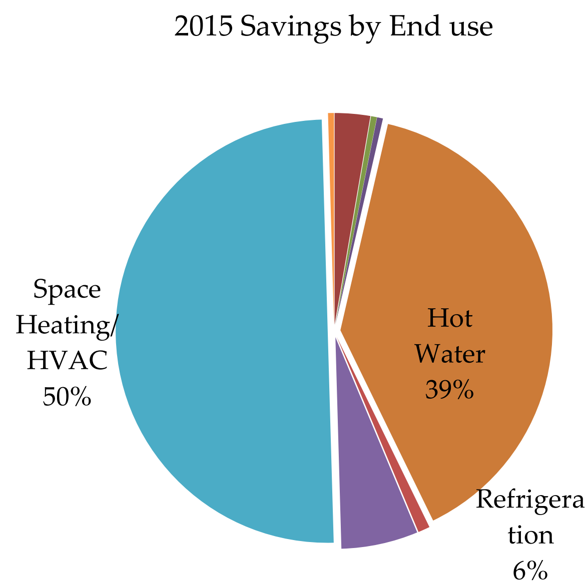
Efficient Products



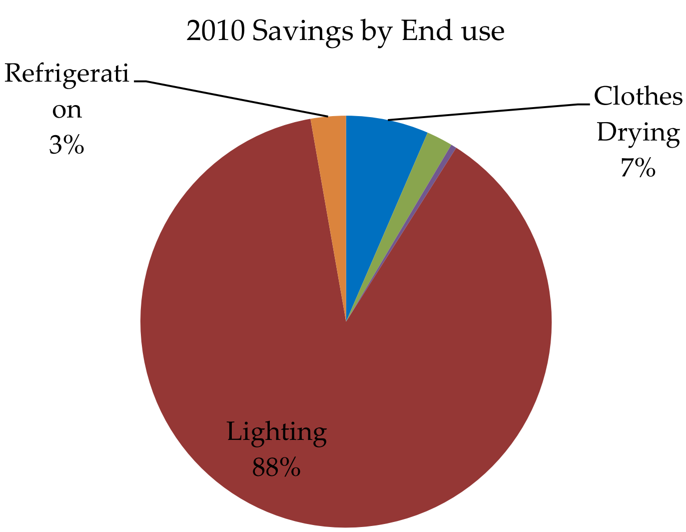


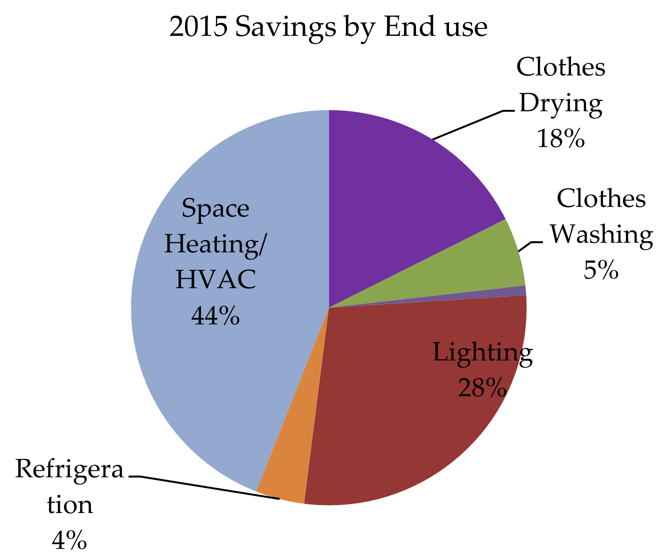
Residential Existing Homes





Residential New Construction





First year cost of savings by major end-use has ranged from $0.13per kWh to $1.28[4], on average, or about $0.03 on a levelized basis, assuming a 12 year average measure life across all end uses. Up to 2015, the cost of savings for lighting has been the least expensive at about $0.18 to 0.22/kWh[5]. However, BED does not anticipate that past experience will be indicative of future realities.

While having a firm understanding of the historical achievements and first year cost of savings is important, it is highly likely that local market conditions as well as rising appliance standards and more stringent building codes will create strong headwinds for BED's energy efficiency utility. Indeed, the cost of savings across all end uses is expected to increase statewide. In some cases, such cost increases could be substantial enough to warrant a re-examination of whether continuation of incentives for certain technologies is prudent given the expected low cost of avoided energy. Equally likely is the potential that the rate of annual incremental savings will decline – possibly by a substantial amount. As noted above, BED has typically acquired annual savings equal to or greater than 1.0 percent of electric load. Moving forward, the annual rate of savings could drop to 0.5 percent of load, especially since BED will be aggressively pursuing strategic electrification opportunities through 2032.

Local market conditions affecting BED's energy efficiency acquisitions have been highlighted in numerous filings submitted with the Public Service Board over the past several years. Most recently, BED included an overview of such conditions in its Overall Performance Assessment filing in Docket No. 8606. As noted in those previous filings, the characteristics of the local market having the greatest impact on BED's achievable potential include the following:

- The top twenty commercial accounts represent nearly 50% of BED's total energy consumption;
- Commercial, industrial and institutional customers represent 75 % of the total energy consumption;
- 11,000 residential customers use 500 kWh per month or less;
- 60% of residential customers rent their homes;
- There is a high proportion of college-age renters living in the City who move frequently between rented apartments resulting in a 35% annual turnover rate;

[4] This includes first year cost of residential new construction which typically has a measure life of 20 – 30 years, meaning that levelized savings for this program average about $0.05 per kWh.
[5] General administrative costs have been omitted as these costs are not allocated to specific measures. Instead, general administrative costs are assigned to individual programs and non-resource activities.

- A high percentage of the buildings in Burlington are connected to VGS's natural gas network (residential: 85%; C& I: 95%); and
- About 70% of commercial customers lease their buildings.

In addition to changing local market conditions, rising appliance standards and building codes will also impact BED's achievable potential. The most significant of these changes are the federal EPA rules implementing the Energy Independence and Security Act (2007) or EISA. These rules are designed to usher into the consumer market dramatically more efficient and higher quality appliances and lighting products. Some of the EISA rules pertaining to lighting efficiency are already in effect. But additional rules will become effective on a rolling basis through 2023. As these rules go into effect, LED products that consume 80 to 90 percent less energy than the incandescent lamps of yesteryear will eventually become standard products over time and will therefore be ineligible for incentives around 2025. In essence, lighting products will cease being the source of large energy efficiency potential that it has been up to now.[6]

A similar effect will occur as building codes become more stringent. The Department of Public Service (DPS) spearheads statewide efforts to update Vermont's building energy codes every four years. The updates are based on both national standards and Vermont specific "market characterization" studies of current building practices. While raising building codes incrementally over time is sound public policy, their impact on achievable energy efficiency can be significant. The most recent residential building code update now requires that 75 percent of all lighting fixtures in a new home be energy efficient, an increase from 50 percent in the 2013 code. And, for commercial buildings, occupancy and motion sensors are now required for all new construction and renovation projects.

Knowing that the market for more efficient products and advanced building practices is transforming at a faster clip than in previous years, and that such transformation is affecting the realistically achievable efficiency potential, BED developed future efficiency acquisitions scenarios on the premise that lighting savings will begin to dissipate at an accelerating rate starting in 2020 [7]. To capture this phenomenon, BED's model de-rated lighting savings by 2.0 percent annually through 2025, and at an even steeper rate thereafter. However, these losses will most likely be partially offset under the base case scenario by gains in savings from other end-uses such as heating and cooling (i.e. end-of-life HVAC equipment and better building control strategies) and large new construction projects (i.e. UVM, UVM Medical Center, Burlington Town Center, City Market South, 700 apartments on the former Burlington College site).

[6] However, advanced lighting controls, trimming, daylighting, task lighting and other lighting strategies will still be a source of energy efficiency potential beyond 2025.
[7] This is the first year of the next Triennial Demand resource planning period.

It is worth noting that over the last ten years, BED's energy efficiency utility's savings goals have been negotiated with the Department of Public Service. These goals were based on potential studies that attempted to assess the amount of "achievable" potential for energy efficiency in the City. However, these studies merely reflected statewide efficiency results that were extrapolated to Burlington even though the City is unlike most other regions in Vermont (see above noted bullet points). BED has argued that establishing savings goals in this manner is no longer appropriate. The unique characteristics of the city, rising standards, more stringent building codes and increased saturation of efficiency necessitate an evaluation of efficiency potential that is specific to Burlington. The Department has recently agreed with BED's assertion. In the Fall of 2016, a Burlington – specific energy efficiency potential study will commence. Results of this study are expected to be available in the Winter of 2017 and will inform BED's goals and budgets for the next energy efficiency triennial performance period, which starts on January 1, 2018.

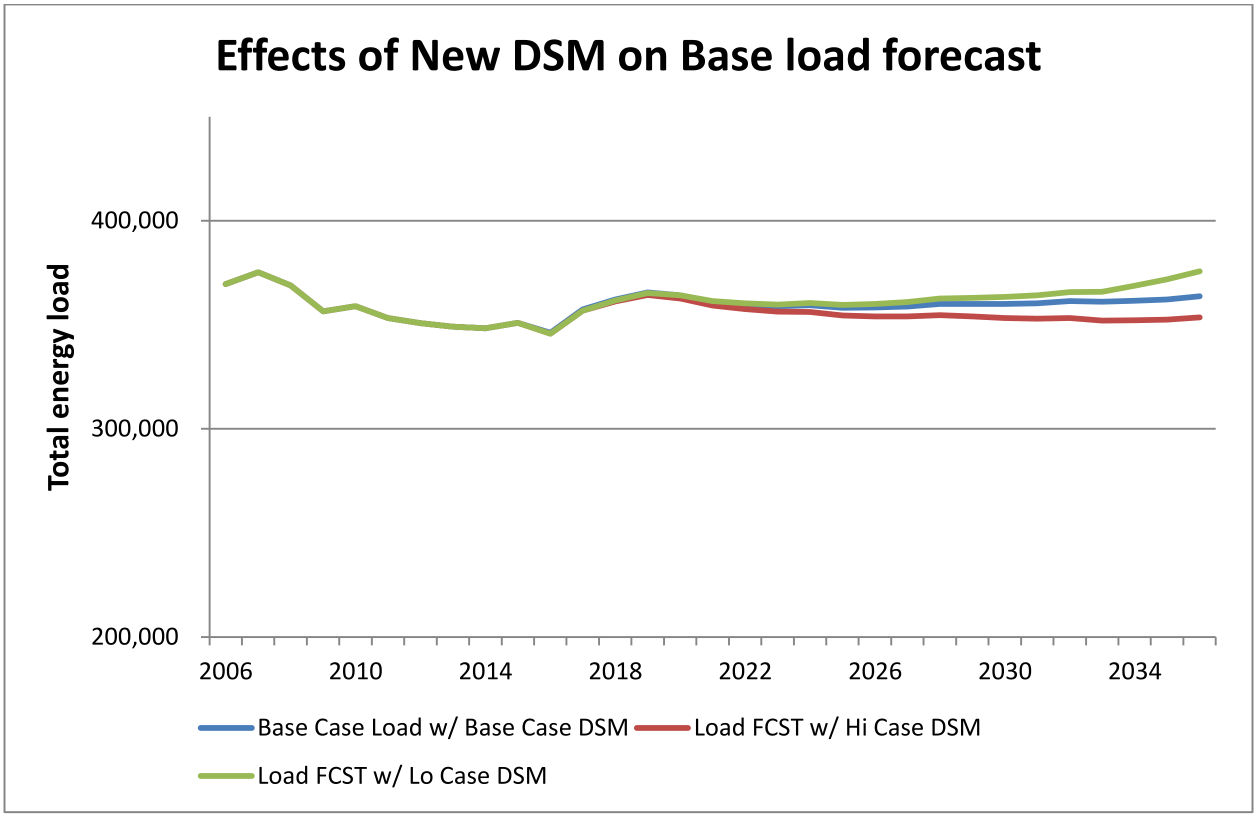
In the absence of an energy efficiency potential study that is specific to the city of Burlington, BED modeled three energy efficiency scenarios to reflect the ebb and flow of the aforementioned market conditions, changes in appliance standards and building codes as well as anticipated new efficiency resource acquisition opportunities. A summary of the scenarios is follows:

1. High case EE – This scenario represents the status quo and assumes that current budgets are increased 5 percent annually. Similarly, BED assumes that under this scenario, MWh yields would remain unchanged. In other words, BED would be able to acquire the same amount of energy efficiency per $10,000 invested[8] that it has in the past. However, because the budget is increased over time, the amount of the annual MWh savings increases. The effect of the budget increase is to decrease the total forecasted energy load relative to the base case EE scenario. In BED's opinion, this scenario is unrealistic.
2. Base case EE – under this scenario, lighting savings were de-rated by 2 percent annually through 2023. In 2024, lighting was de-rated further by 20 percent to account for the full implementation of EISA, which is expected to increase the efficiency of baseline lighting products and decrease the amount of savings. But, as noted above, losses in lighting savings are offset by new efficiency acquisitions in heating and cooling end uses and large commercial new construction projects. In addition to reductions in lighting savings, budgets were increased 5 percent in years 2016, 2017 and 2018; thereafter, budgets increase 1 percent annually.
3. Low case EE – under this scenario, base case EE assumptions apply with respect to lighting de-rates and new efficiency opportunities (i.e. HVAC and commercial new construction projects) but the current budget is reduced by 20 percent in 2018, and kept

[8] Includes only Resource Acquisition budgets.

at this level through the year 2020. Starting in 2021, budgets are reduced 1 percent annually. In addition, the MWh yield is de-rated 2.0 percent annually, meaning that for every $10,000 invested in energy efficiency the amount of MWh acquired is less.

The graph below reflects the impact of each energy efficiency scenario on base case energy forecasts through 2036. The solid green line represents the low DSM/EE case scenario. With lower cumulated savings, the total energy to be delivered is expected to increase. The solid red line indicates aggressive DSM/EE efficiency programs will remain in place and reduce total load in the out years. The solid blue line is indicative of the base case DSM/EE scenario.



Energy efficiency decay

As with previous DSM forecasts, the effects of energy efficiency decay has been incorporated into the various efficiency scenarios. In essence, decay assumes that individual measure savings taper off as measures reach the end of their expected lives. But rather than be replaced with an even more efficient product, the user replaces the existing measure with a then standard product. Thus, individual measure energy savings follow a downward sloping trajectory. Countering this downward trajectory, future energy efficiency programs introduce newer technologies and practices which more than offset the decay of older measures. The offsets help to ensure that efficiency gains continue into the future and that overall loads remain either flat or decline.

Forecasted Base Case DSM impacts and budgets are as follows:

Base Case DSM Scenario Year	Annual Incremental	Cumulative Savings	Total Budget	First yr of saved energy	MWh yield
2016	6,459	6,459	$ 2,208,830	$ 0.30	33.8
2017	6,714	13,173	$ 2,319,272	$ 0.31	32.2
2018	6,979	20,153	$ 2,435,235	$ 0.41	24.1
2019	6,877	27,030	$ 2,459,588	$ 0.42	23.5
2020	6,779	33,809	$ 2,484,183	$ 0.44	23.0
2021	6,685	40,493	$ 2,509,025	$ 0.45	22.2
2022	6,594	47,088	$ 2,534,116	$ 0.47	21.4
2023	6,507	53,595	$ 2,559,457	$ 0.48	20.7
2024	6,423	60,018	$ 2,585,051	$ 0.50	20.0
2025	6,343	66,362	$ 2,610,902	$ 0.52	19.3
2026	6,267	72,628	$ 2,637,011	$ 0.54	18.6
2027	6,193	78,821	$ 2,663,381	$ 0.56	18.0
2028	6,122	84,944	$ 2,690,015	$ 0.58	17.3
2029	6,055	90,999	$ 2,716,915	$ 0.60	16.7
2030	5,990	96,988	$ 2,744,084	$ 0.62	16.2
2031	5,927	102,915	$ 2,771,525	$ 0.64	15.6
2032	5,867	108,782	$ 2,799,240	$ 0.66	15.1
2033	5,810	114,592	$ 2,827,232	$ 0.69	14.5