St Albans Reliability Plan

February 7, 2014

Executive Summary - On December 27, 2012, the Vermont System Planning Committee (VSPC) filed a report with the Vermont Public Service Board (VPSB) indicating that up to 3.2 MW of additional St. Albans area peak load reductions would be required now to keep loads under the critical load level of 28MW. The magnitude of required load reductions gradually declined over time to 2.5 MW in 2020.

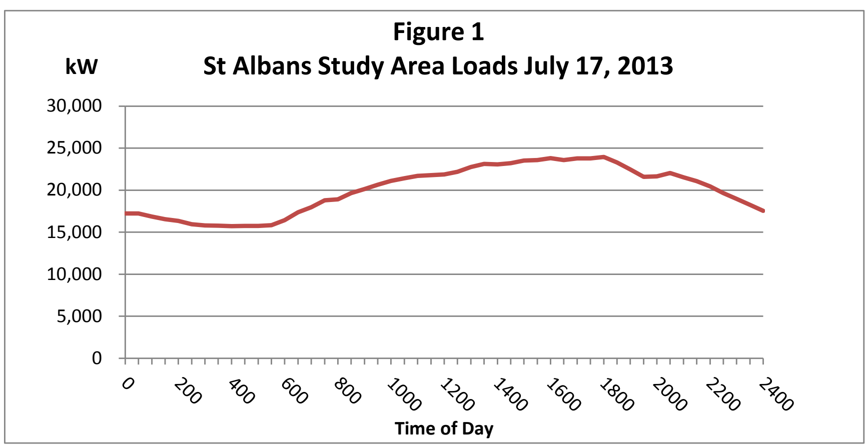
Since that report was filed Green Mountain Power (GMP), with the help of the VSPC, conducted additional studies to refine the load forecast and better understand the magnitude and timing of the reliability deficiency. These additional studies indicate that, even with aggressive assumptions for load growth, the earliest date that additional measures would be required is 2021. Even at that point it is questionable whether the magnitude of the deficiency would require any significant new measures.

Based on the foregoing findings, no additional new measures to address reliability are warranted at this time. GMP is proposing to collect empirical data over the next two summer peak seasons to verify the refined analysis and adjust the input assumptions as necessary.

A description of the additional studies and resulting findings are presented below.

Load Forecast – The December 2012 report assumed a 90/10 forecast of 26.35 MW plus 5.80 MW of new peak load for a total load of 32.15 MW. The new 5.8 MW of new load would come from "Ability to Serve" letters with an assumed 75% peak coincidence factor.

As a check on the forecast, GMP evaluated peak loads during the 2013 summer season and determined that the peak load for the study area occurred on July 17, 2013. Referring to Figure 1, a peak of 23,960 kW occurred between 6:00 and 6:30 PM. Although this is just one year of data, the extreme weather during this period strongly suggests that this level represents the new 90/10 peak load for the St Albans study area.



GMP also checked with customers and reviewed the latest available information to confirm the magnitude and timing of the new load associated with the "Ability to Serve" letters. GMP has determined that the Ability to Serve letters now represent 6.0 MW of additional gross load; and that the majority of this load came on line by the end of 2013. The actual peak coincidence factor, however, will not be known until the entire load comes on line and sufficient empirical data are collected during peak summer conditions.

Using the 75% peak load coincidence factor assumed in the December 2012 analysis, the 6.0 MW of additional load would contribute 4.5 MW to the peak load. As a sensitivity, the analysis was also run with a 90% peak load coincidence factor (5.4 MW of new peak load) to band the uncertainty associated with the new peak load coming from the "Ability to Serve" letters.

With the help of the VSPC, GMP also reconstituted the December 2012 load forecast to explicitly model the following three variables: 1) background load growth; 2) the 1.8 MW of EE earmarked for St Albans for the period 2012 – 2014; and 3) the EE that would come into St Albans for the period 2015 – 2023 under the statewide DRP. To provide modeling flexibility, variable input parameters were created for the peak coincident load factor, the background load growth factor and the solar coincidence factor. Supporting analyses for the 1.8 MW of EE earmarked for St Albans and the EE that would come into St Albans under the statewide DRP are presented in Attachment 1.

Assuming 2% background load growth[1], reconstituted forecasts were developed for two scenarios: a 75% peak load coincidence factor and a 90% peak load coincidence factor. The reconstituted load forecasts are presented below in Tables 1 and 2.

[1] Background load growth refers to the underlying growth that would have occurred if no additional demand side measures were implemented.

Table 1: Sensitivity of Reconstituted Load Forecast and Resulting Gaps (MW)

Critical Load (MW)		Peak Load Coincid. Factor	Bckgrnd Load Growth Factor (%)		Solar Coincid. Factor[2]
28		75%	2.0%		35%

Year	Current Forecast MW	Ability to Serve Letters Peak Coincid. Load	Bckgrnd Load Growth[1]	Total Estimated 90/10 Load	Resources Needed	Total EE Statewide + Incr = 1.8MW 2012-2014	2.6% of Statewide 20-yr DRP	Cumulative EE Statewide + Incr	Estimated Gap MW	
2013	23.96	4.50	0.00	28.46	0.46				0.46	0.46
2014	28.46	0.00	0.00	28.46	0.46	0.75		0.75	(0.29)	(0.29)
2015	28.46	0.00	0.57	29.03	1.03	0.35	0.21	1.31	(0.28)	(0.28)
2016	29.03	0.00	0.58	29.61	1.61		0.45	1.76	(0.15)	(0.15)
2017	29.61	0.00	0.59	30.20	2.20		0.47	2.22	(0.02)	(0.02)
2018	30.20	0.00	0.60	30.81	2.81		0.49	2.72	0.09	0.09
2019	30.81	0.00	0.62	31.42	3.42		0.50	3.22	0.20	0.20
2020	31.42	0.00	0.63	32.05	4.05		0.50	3.72	0.33	0.33
2021	32.05	0.00	0.64	32.69	4.69		0.50	4.21	0.48	0.48
2022	32.69	0.00	0.65	33.35	5.35		0.50	4.72	0.63	0.63
2023	33.35	0.00	0.67	34.01	6.01		0.50	5.22	0.79	0.79

Notes;

1 Assumes load from Ability to Serve Letters takes care of background load growth for 2013 and 2014.

2 With the summer peak ocurring later in the day (2013 peak ocurred after 6 PM), use a 35% coincidence (load shape) factor.

Table 2: Sensitivity of Reconstituted Load Forecast and Resulting Gaps (MW)

Critical Load (MW)		Peak Load Coincid. Factor	Bckgrnd Load Growth Factor (%)		Solar Coincid. Factor[2]
28		90%	2.0%		35%

Year	Current Forecast MW	Ability to Serve Letters Peak Coincid. Load	Bckgrnd Load Growth[1]	Total Estimated 90/10 Load	Resources Needed	Total EE Statewide + Incr = 1.8MW 2012-2014	2.6% of Statewide 20-yr DRP	Cumulative EE Statewide + Incr	Estimated Gap MW	
2013	23.96	5.40	0.00	29.36	1.36				1.36	0.46
2014	29.36	0.00	0.00	29.36	1.36	0.75		0.75	0.61	(0.29)
2015	29.36	0.00	0.59	29.95	1.95	0.35	0.21	1.31	0.64	(0.28)
2016	29.95	0.00	0.60	30.55	2.55		0.45	1.76	0.79	(0.15)
2017	30.55	0.00	0.61	31.16	3.16		0.47	2.22	0.93	(0.02)
2018	31.16	0.00	0.62	31.78	3.78		0.49	2.72	1.06	0.09
2019	31.78	0.00	0.64	32.42	4.42		0.50	3.22	1.20	0.20
2020	32.42	0.00	0.65	33.06	5.06		0.50	3.72	1.35	0.33
2021	33.06	0.00	0.66	33.73	5.73		0.50	4.21	1.51	0.48
2022	33.73	0.00	0.67	34.40	6.40		0.50	4.72	1.68	0.63
2023	34.40	0.00	0.69	35.09	7.09		0.50	5.22	1.87	0.79

Notes;

1 Assumes load from Ability to Serve Letters takes care of background load growth for 2013 and 2014.

2 With the summer peak ocurring later in the day (2013 peak ocurred after 6 PM), use a 35% coincidence (load shape) factor.

Referring to Table 1, above, the reconstituted forecast based on the peak load observed on July 12, 2013 measurably changes the reliability need from what was reported in December 2012. There is no reliability deficiency through 2017. A 0.09 MW gap appears in 2018 and then slowly increases to 0.79 MW in 2023. By comparison, the December 2012 analysis indicated a 2.64 MW gap in 2014 which increased to 3.22 MW in 2017 and then decreased to 2.52 MW in 2020.

Applying a 90% peak load coincidence factor increases the peak load by 0.90 MW, resulting in a 0.61 MW gap in 2014 which increases to 1.87 MW in 2023.

Resources – The December 27, 2012 filing stated that GMP "consider cost-effective technologies that are not currently supported by Efficiency Vermont (such as ice storage) and encourage the development of generation that has a high on-peak coincidence." GMP assessed five other technologies and the results are summarized below.

3. Small DR – residential customers constitute only ~25% of the load in the study area. We assumed any further savings would be negligible.
4. Large DR – the VELCO Long-Range Plan (LRP) includes 2.5 MW for the study area. Since the LRP was filed, the ISO market rules have changed and the DR provider has withdrawn from ISO-NE. These 2.5 MW came from only two customers. Absent a DR provider GMP could explore contracting with these two customers to secure up to 2.5 MW of DR. Although this corresponds to 10% penetration of the total 25 MW C&I load, it represents only two customers. Therefore, we assumed up to an additional 2 MW of Large DR could be obtained for the Reliability Plan –if needed.
5. Ice storage – based on the pilot program in the Rutland area it appears that up to 1 MW of additional resource would be available in the St Albans study area.
6. Net metering – GMP surveyed the study area and determined 0.269 MW of net metering capacity is currently installed. Using the existing 4% legislative cap as a guide, we assumed an additional 1.128 MW would be available for the 28.46 MW forecasted peak (4% of (28.46-0.269) MW) and 1.164 MW for the 29.36 MW peak forecast. We assumed a 35% coincidence factor (35% of 1.128MW = 0.39MW) to account for the peak occurring later in the day and the existence of rooftop PV solar in the net metering program. The resources were uniformly distributed over the next ten years (0.39MW/10 = 39kW).
7. SPEED – GMP has been able to confirm that a new 2.2 MW PV solar project came on-line on November 3, 2013. A review of the 2013 solicitation indicates no resources are being proposed in the study area. Further, GMP conferred with the SPEED facilitator who indicated no knowledge of future projects being planned for the study area.

In addition, GMP engaged Green Energy Economics Group (GEEG) to develop an EE Calculator to estimate the costs of acquiring additional geo-targeted EE resources to include in the Reliability Plan. Using the calculator, a trial solution was developed to estimate the cost of geo-targeting an additional 300 kW of peak savings for the St Albans study area. The 300 kW would be implemented in 100 kW increments over the years 2015, 2016 and 2017.

Results from the trial solutions indicate that the total program spending over the three years would be approximately $2.2 million. The corresponding total resource cost would be approximately $1.9 million. Because the program targets peak kW savings, energy savings would actually decrease[2] each year by approximately 600 MWH.

The EE Calculator along with the trial solution for geo-targeting an additional 300 kW is presented in Attachment 2. A description of the EE Calculator along with user instructions is presented in Attachment 3.

Gap Analysis – The gap template from the December 2012 analysis was revised to incorporate the above five resources plus incremental geo-targeted EE. A gap analysis was then performed for both load scenarios, the 75% peak load coincidence factor, and the 90% factor. The results are presented in Tables 3 and 4, below. For simplicity the gaps are expressed in terms of kW instead of MW.

[2] EE programs typically target MWH savings. Geo-targeting peak kW savings would shift the emphasis from energy savings to kW savings during the peak, the net MWH savings decreases.

		Table 3: Gap Analysis		28,460	kW				
		Non-Reoccurring Resources (kW)			Resources That Accumulate (kW)				
Year	Resources Needed kW	Small DR[3]	Large DR[4]	Ice Storage[5]	Net Meter[6]	Existing SPEED[7]	Incrmental SPEED	Incrmental GT EE	Gap kW
2014	(287)	0	0	0	39	770			(1,097)
2015	(278)	0	0	0	39				(1,127)
2016	(148)	0	0	0	39				(1,036)
2017	(21)	0	0	0	39				(949)
2018	89	0	0	0	39				(878)
2019	203	0	0	0	39				(804)
2020	334	0	0	0	39				(712)
2021	477	0	0	0	39				(609)
2022	629	0	0	0	39				(496)
2023	795	0	0	0	39				(370)

The footnote references above refer to the resources on page 5.

		Table 4: Gap Analysis		29,360	kW				
		Non-Reoccurring Resources (kW)			Resources That Accumulate (kW)				
Year	Resources Needed kW	Small DR[3]	Large DR[4]	Ice Storage[5]	Net Meter[6]	Existing SPEED[7]	Incrmental SPEED	Incrmental GT EE	Gap kW
2014	612	0	0	0	41	770			(198)
2015	640	0	0	0	41				(211)
2016	789	0	0	0	41				(104)
2017	934	0	0	0	41				1
2018	1,064	0	0	0	41				90
2019	1,197	0	0	0	41				182
2020	1,348	0	0	0	41				293
2021	1,511	0	0	0	41				415
2022	1,684	0	0	0	41				547
2023	1,870	0	0	0	41				693

The footnote references above refer to the resources on page 5.

There is no deficiency during the 10-year study period for the 75% peak load coincidence factor case. Under the 90% peak load coincidence factor case there is no deficiency for the first three years of the study period. A 1 kW gap appears in 2017 increasing to 293 kW in 2020 and to 693 kW in 2023.

Conclusion - GMP performed a detailed analysis of loads, load forecasts and resources to refine the reliability need in the St Albans area. A key unknown in the analysis is the peak load coincidence factor for the 6.0 MW of additional load identified in the “Ability to Serve” letters.

Assuming a 75% peak load coincidence factor and 2% background load growth indicates no deficiency through the 10-year study period. A sensitivity analysis was performed where the coincidence factor was increased to 90% resulting in a 1 kW gap in 2017 which increases to 293 kW in 2020 and then to 693 kW in 2023.

An initial evaluation of substation ratings in the St Albans study area indicates that deficiencies of up to 300 kW can be accommodated through operational measures. Even under the aggressive scenario of 2% background load growth and a 90% peak load coincidence factor, no additional measures would be required until at least 2021 to address the deficiency, if then. Consequently, GMP is not proposing any additional measures at this time. GMP will collect empirical data during the 2014 and 2015 summer peak seasons to confirm the input assumptions and revise the analysis as appropriate.

ATTACHMENT 1

Supporting Analyses

St Albans EE Resources

Analysis of St Albans GT Target 2012 - 2014

St. Albans	2012*	2013				2014				Total Program
	Annual	1st Q	2nd Q	3rd Q	4th Q (Est)	1st Q (Est)	2nd Q (Est)	3rd Q (Est)	4th Q (Est)	
Cumulative savings (kW)	**584**	610	705	805	1,105	1,279	1,453	1,626	**1,800**	
Quarter net savings (kW)	584	26	95	100	300	174	174	174	174	**1,800**
Annual net savings (kW)	**584**	121		221	**521**	174	348	521	**695**	**1,800**

*2012 savings value from EVT Annual Report doc, page47(59)

Statewide DRP

	2015	2016	2017	2018	2019	2020	2021	2022	2023
Summer Peak kW (@ generator @ 10% losses)									
Incremental	16,307	17,326	17,911	18,976	19,325	19,131	19,160	19,287	19,288
Cumulative	16,307	31,996	48,449	65,627	82,203	93,879	110,883	127,493	144,096

Source: 2011 DRP Analysis, February 28, 2012 update. File name "COMBO DRP PST update.xlsm", tab name "Energy Summary".

Notes: Cumulative savings in the source file included savings from 2012-2014. Two methods were used to estimate the cumulative savings beginning in 2015 and then averaged.

The first method was simply to sum the incremental annual savings, which overstates the savings due to not accounting for measure savings decay.

The second method subtracts the 2014 cumulative savings, which understates the savings due to double counting the measure savings decay.

ATTACHMENT 2

EE Calculator

and

Trial Solution

Analysis of St. Albans Project Data (Update)

Green Energy Economics Group
December 31, 2013

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Introduction and Comparison to Previous Data Set

NOTE: This report has been further updated to account for additional fields provided at the end of November 2013 that covered end-uses covered by each project.

This analysis is meant to complement work previously done on a data set provided from Efficiency Vermont at the end of 2012. The new data set ("St. Albans Data") includes only EVT funded projects in the GMP territory from January 1, 2009 to the September 2013, covering nine extra months in 2013. It also includes project job 6021 (Lighting Plus) as well as the two project jobs, 6012 for retrofits and 6013 for market replacement, included in the original data. The St. Albans Data has the same fields as the old data set with the following exceptions:

1. New fields in the St. Albans data, not in the previous data
    a. Primary Utility (always GMP)
    b. <50MWh project (calculated based on Net kWh Savings)
    c. >50MWh project (calculated based on Net kWh Savings)
    d. Water Conservation (1 if included in project, 0 otherwise)

Inclusion of the extra project job 6021 made the previous field titled "JOB_FLAG"[1] no longer useful. Instead, this field is now broken out in to two dummy variables for each of the project jobs; LIGHTING_PLUS (project job 6021) and RETROFIT (project job 6012), with a default assumption that the project is a market replacement (project 6013)

Overview of St. Albans Data

The original data received from EVT consisted of 3,990 projects with the characteristics described in the previous section. As with done in the previous analysis, we focused on predicting costs for gross savings in order to reduce the potential variability surrounding calculations of net savings from gross savings. We added 21 additional data fields that were calculated using the other data fields. These included fields on:

- Costs in 2013 dollars (inflated using top-line CPI)
- Costs of gross kW savings (in 2013 dollars)
- Dummy variables for project characteristics (such as job codes and verification status)

Once the full dataset was assembled, projects that appeared to contain anomalous data were removed. Table 1 outlines the criteria used for removing projects with erroneous data and the number of projects that were affected by that criteria.

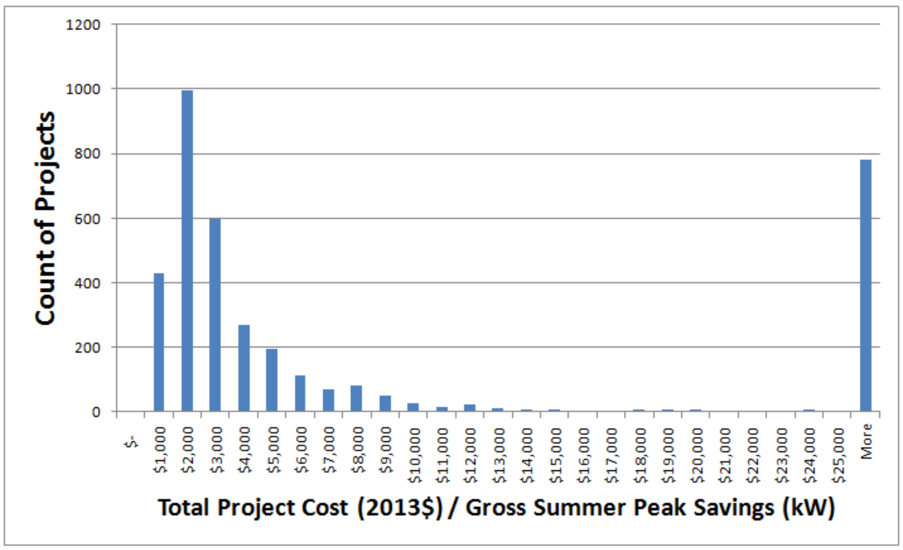
[1] JOB_FLAG was 1 if the code was 6012 and 0 if it was 6013

Table 1. Projects Removed from St. Albans Data

Reason	# of Projects
Starting Count	**3,990**
Total Removed	**266**
No kW Gross	124
No Ann Usage	16
Gross % Sav > 100%	108
Net % Sav > 100%	17
Total Costs <= $0	1
Ending Count	**3,724**

The resulting data had the distribution of the total project cost (in 2009 dollars) per kW of gross peak demand savings ("$/kW") as shown in Figure 1

Figure 1. Distribution of Project Cost per Summer Peak Demand Savings



Similar to the previous data set, the graph above shows that most of the projects were grouped around $1,000 – $3,000 per kW, with a "long-tail" of projects above that cost. The bar at the far right of the graph represents the projects, approximately 1,300, that had a total cost per kW greater than $25,000. The nature of this long-tail is also evident in the descriptive statistics outlined in Table 2.

Table 2. Descriptive Statistics of $/kW

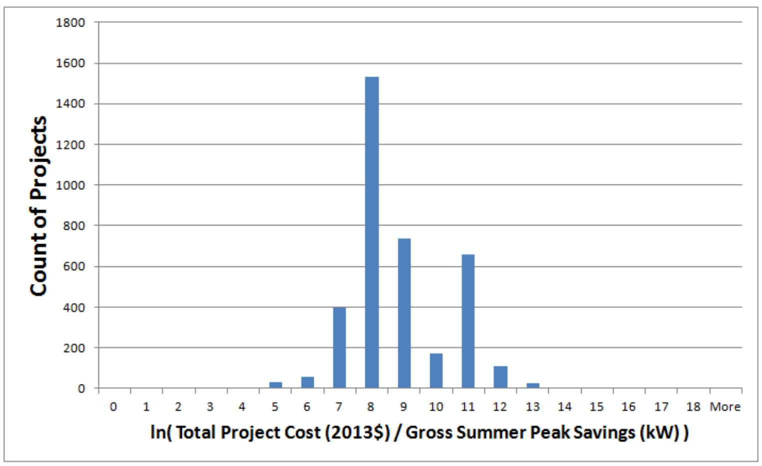
Stat	All Projects
Mean	$2,591
Median	$19,803
Minimum	$24
Maximum	$10,647,699

From Table 2, it is obvious from the wide disparity between the mean (average value) and the median (the number for which 50% of projects are lower and 50% of projects are higher) that the number of projects with very low kW savings and/or high costs are skewing costs for the whole group of projects upwards.

Regression Methodology

Linear regression analysis assumes that the data being tested follows a normal distribution. The distribution in Figure 1 and the summary statistics in Table 2 more closely resemble a Poisson distribution. Transforming the $/kW data using the natural log function (a typical technique to turn data with a Poisson distribution in to one more normally distributed) provides the histogram in Figure 2. The data in Figure 2 much more closely resembles the typical "bell-curve" of a normal distribution. So, in line with the analysis of the earlier data, we established that the natural log ("*ln()*") of $/kW makes the most sense as a dependent variable.

Figure 2. Distribution of Values for the Natural Log of $/kW



Instead of starting from scratch, the previous best-fit regression was examined with a few tweaks to various flags required by changes to the list of fields available. The JOB_FLAG was replaced with two dummy variables for the three different project jobs. The end-use flags for efficient lighting and air conditioning were removed since the St. Albans data no longer included them.

The two fields that showed whether savings were greater or less than 50 MWh did not seem to be a good choice for regression analysis, as they provided less information than the original savings field (which is assumed to be a continuous series). Instead, we decided to screen various gross kWh savings (SAVE_KWH_GROSS) on its own.

Since the nature of programs and markets has changed over the past few years, including an increasingly larger portion of LED measures in lighting plus projects, we felt it would be prudent to examine whether the passage of time had any effect on $/kW. To do this, we added a new variable called POST_2011, which was set to 0 if the job was completed on or before 12/31/2011, and 1 otherwise.

Testing all the various end-use flags showed that many of them were statistically significant. Various combinations of end-use flags and were then tested and a group of the most significant end-use flags was retained. Table 3 summarizes the initial changes to the previous best-fit regression tested.

Table 3. Changes to Regression Model Variables Analyzed

Variables Added	Variables Removed
LIGHTING_PLUS	EFF_AC
RETROFIT	JOB_FLAG
SAVE_KWH_GROSS	
POST_2011	
DESIGN_ASSISTANCE	
EFF_OTHER	
EFF_SPACE_HEAT	
OTHER_ACTIVITY	
FS_SPACE_HEAT	

It was found that the CUSTOM_FLAG and GTPREMISE variables were no longer statistically significant, but that all other variables were. In addition, each independent variable that was the same between the new and old regression model had the same sign and a value in close to each other.

The next step was to examine various transformations of gross kWh savings to determine a better fit. In addition, we examined various interactive terms between savings, both kW and kWh, and the three relevant dummy variables (LIGHTING_PLUS, RETROFIT, and POST_2011). We found that both kWh and 1/kWh screened along with a number of interactive terms.

Selected Model

The selected model is presented in the “St Alban Data Model 2013_1120.xls” that accompanies this summary document. It utilizes ln($/kW) as the dependent variable and is summarized in Table 4.

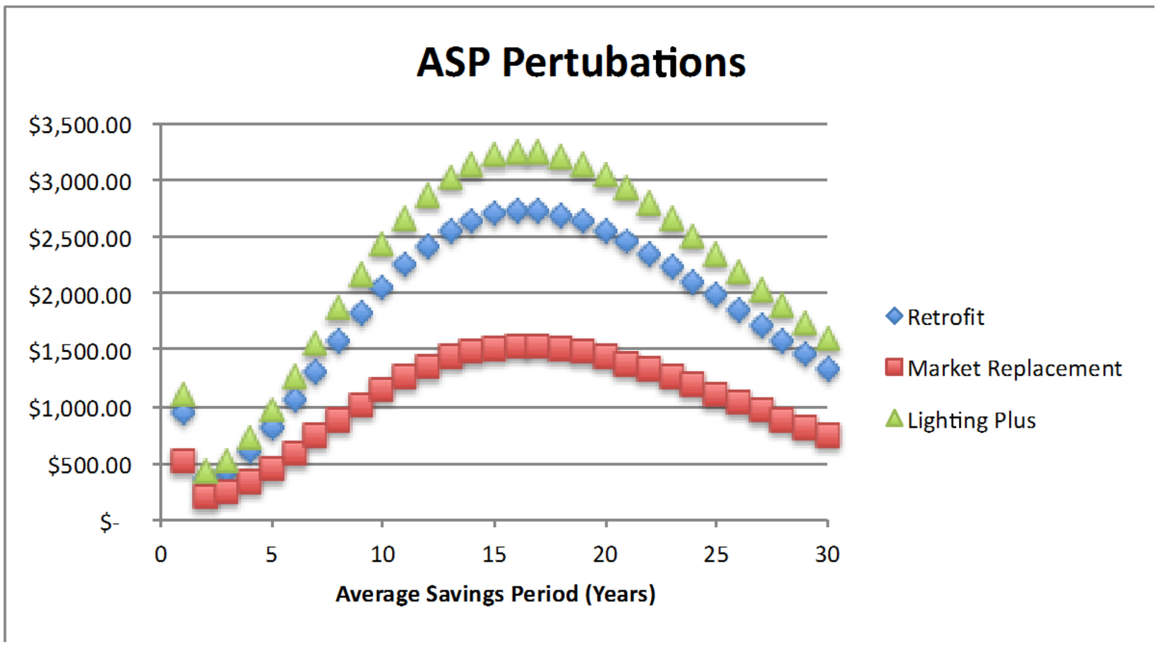
Table 4. Selected Regression Model

	Mult. R-sq	0.9875			
	Adj. R-sq	0.9874			
	Degrees of Freedom	3699			
	Residual standard Error	0.9537			
Category	**Variable**	**Coefficient**	**Stand. Error**	**T value**	**Pr(>|t|)**
Average Savings Period (ASP)	ASP	(0.207)	0.009	(23.053)	<2.00E-16
	1/ASP	6.782	0.259	26.230	<2.00E-16
	ln(ASP)	3.799	0.058	65.224	<2.00E-16
Gross Peak Savings (kW)	1/kW	0.0008	0.0002	4.3620	1.32E-05
	ln(kW)	(0.525)	0.016	(33.003)	<2.00E-16
Gross Energy Savings (kWh)	kWh	8.50E-06	7.03E-07	12.091	<2.00E-16
	1/kWh	(6.695)	0.919	(7.284)	3.94E-13
Flags (1 is true 0 false)	LIGHTING_PLUS	0.549	0.077	7.151	1.03E-12
	RETROFIT	0.505	0.049	10.385	<2.00E-16
	POST_2011	0.243	0.041	5.943	3.06E-09
	DESIGN_ASSISTANCE	0.554	0.181	3.052	2.29E-03
	EFF_LIGHTING	(0.240)	0.054	(4.465)	8.25E-06
	EFF_OTHER	0.196	0.059	3.324	8.98E-04
	EFF_SPACE_HEAT	0.291	0.123	2.358	1.84E-02
	OTHER_ACTIVITY	1.542	0.214	7.221	6.22E-13
	FS_SPACE_HEAT	1.469	0.380	3.862	1.15E-04
Interactive Terms (based on combining flags and savings)	(1/kW) x RETROFIT	0.003	0.001	5.047	4.71E-07
	(1/kW) x POST_2011	(0.0027)	0.0004	(6.143)	8.96E-10
	ln(kW) x RETROFIT	0.168	0.025	6.772	1.47E-11
	ln(kW) x LIGHTING_PLUS	(0.352)	0.043	(8.221)	2.76E-16
	ln(kW) x POST_2011	(0.110)	0.019	(5.760)	9.10E-09
	kWh x RETROFIT	-4.60E-06	8.84E-07	(5.202)	2.08E-07
	kWh x LIGHTING_PLUS	3.56E-05	4.23E-06	8.402	<2.00E-16
	(1/kWh) x RETROFIT	(25.000)	5.711	(4.378)	1.23E-05
	(1/kWh) x LIGHTING_PLUS	(71.150)	13.590	(5.234)	1.75E-07

All the coefficients of the independent variables in the regression are statistically significant with a 99.9% confidence-level, except for design assistance (99.0% confidence-level) and efficient space-heating (95% confidence-level). The adjusted r-squared statistic for the estimated equation, which measures the percentage of the variance in the dependent variable accounted for by the regression model, is quite high, although it should be cautioned that this is probably inflated due to the natural log transformation of the $/kW values.

In order to isolate the effect of the average savings period on the $/kW, Figure 3 shows what happens to the $/kW if the kW savings are set to the project average of 2.22 kW for each different job type and all other flags are set to 0.

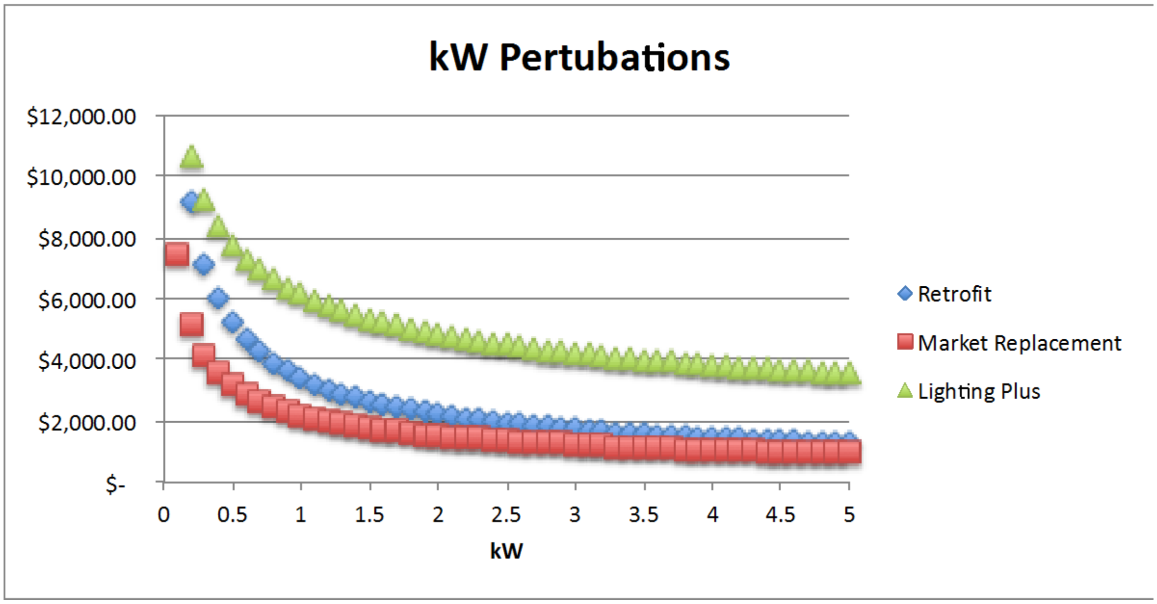
Figure 3. $/kW given Changing ASP and Constant Other Terms



The range of values for the ASP in the data set was from 1 to 30 years. $/kW starts high at 1 year drops very quickly to a minimum at 2 years before gradually climbing to a high around 15 years before starting to decline to a midpoint around 30 years. Since the median and mean of the ASP were both around 15 years, we can expect that a large group of projects will have average costs near the top of the ASP curve. The different curves for the different jobs indicate how large an impact a change in average savings period has on the $/kW. Going from a 2 year ASP to a 15 year ASP has almost twice as much of an impact for lighting plus and retrofit jobs as it does for market replacement jobs.

In order to isolate the effect of the kW savings on $/kW, Figure 4 shows what happens to the $/kW if the ASP is set to the project average of 13.1 years for each different job type and all other flags are set to 0.

Figure 4. $/kW given kW Savings and a Constant Other Terms



Every increase in the kW savings from a project decreases the $/kW. The decrease is very steep between 0 and 1 kW, before leveling off and becoming much more gradual. The slopes of the curves are not that different between the job types, but the positive shift on the y-axis can show how all else equal, the lighting plus jobs are more expensive than retrofits, which in turn are more expensive than market replacement jobs. Interestingly, retrofit jobs start out the most expensive, but as they acquire more kW approach, but don't reach the same cost as market replacement jobs.

Figure 5 isolates the effect of the new term for kWh savings.

Figure 5. $/kW given kWh Savings and Constant Other Terms

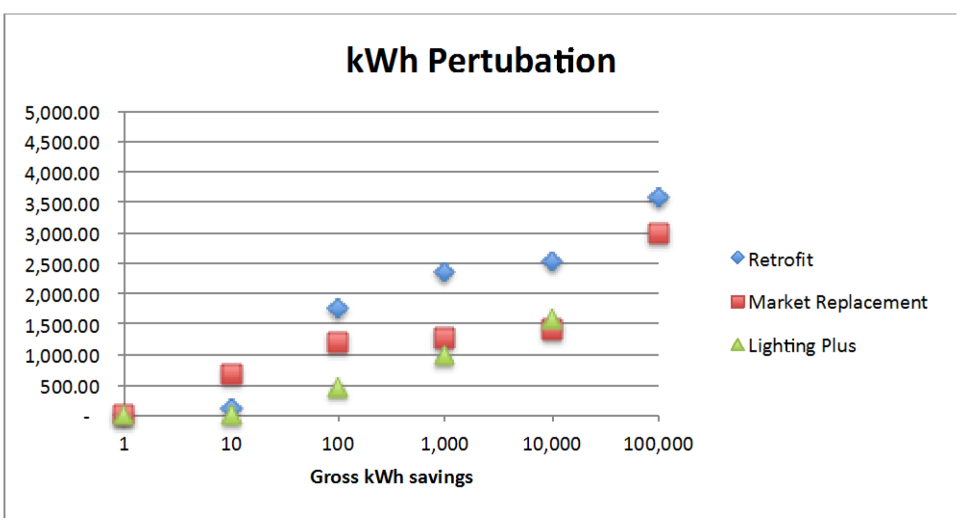


Figure 5 is different from the other graphs in that the x-axis scale is logarithmic (with a base of 10). This allows us to see the trends more clearly between a large range of kWh savings. One thing not shown on the graph is the very high value for lighting plus jobs at 100,000 kWh (over $60,000 per kW). This indicates that this model may not be very accurate for projects that have large kWh savings, but it does provide useful information that the cost of kW savings does begin to climb again for projects with very large kWh savings.

The previous three graphs may be found in the accompanying workbook.

Table 5 describes the effect that changing the flags has on the $/kW. Since the interactive terms have been added to the regression model, it is very difficult to summarize how an individual flag affects $/kW, since it is dependent ultimately upon both kW and kWh savings, but the table makes an attempt to give a general idea.

Table 5. Interpretation of Flags' Effects on $/kW

Input	Effect
LIGHT_PLUS	In general, a lighting plus job (6021) is more expensive than the default job (6013) and slightly more expensive than a retrofit.
RETROFIT	In general, a retrofit job (6012) is more expensive than a default job (6013) and slightly less expensive than a lighting plus job (6021
POST_2011	Jobs that were completed after 2011 are more expensive than jobs completed before 2011.
DESIGN_ASSISTANCE	Jobs that received design assistance were more expensive than those that did not receive assistance.
EFF_LIGHTING	Jobs with efficient lighting were slightly less expensive than jobs without efficient lighting
EFF_OTHER	Jobs with non-standard efficiency measures were slightly more expensive than other jobs.
EFF_SPACE_HEAT	Jobs with efficient space heating were more expensive, on a kW basis, than those without.
OTHER_ACTIVITY	Jobs that had non-efficiency or non-fuel-switching activity were significantly more expensive than those without these additional expenses.
FS_SPACE_HEAT	Jobs that were classified as fuel-switching for space heating were significantly more expensive per kW than those that were not fuel switching space heating.

Using the Model to Predict Efficiency Investment Cost per kW

To get an estimate the total project cost per kW savings, use the orange cells in the "St Alban Data Model 2013_1120.xlsx" file. There are 12 input cells, which are described in Table 6.

Table 6. Input Cells for Regression Model

Cell	Description
G11	The average savings period in years
G16	The project's summer peak demand savings in kW
G21	The project's energy savings in kWh
G27	If the job is a lighting plus job (code 6021)
G28	1 if the project is a retrofit job (code 6012), 0 otherwise
G29	1 if the project is completed after 12/31/2011, 0 otherwise
G30	1 if the project received design assistance, 0 otherwise
G31	1 if the project included efficient lighting, 0 otherwise
G32	1 if the project included non-standard efficiency measures, 0 otherwise
G33	1 if the project included efficient space heating, 0 otherwise
G34	1 if the project included other activity, 0 otherwise
G35	1 if the project included switching space heating fuels, 0 otherwise

Once the 12 values have been entered in you can see the predicted $/kW in cell C8.

In order to provide guidance for input values, the median, mean, minimum, and maximum values from the dataset for each input are shown in columns H through J. In order to provide even more analysis in this summary the mean and median values for each subset of job codes (market rate, retrofit, and lighting plus) are presented in Table 7 along with predicted cost per kW for jobs completed before 2011 and after 2011.

Table 7. Median and Mean Values for Subsets of Projects along with Predicted 2013$/kW

	Ave. Savings Period	Gross kW Savings	Gross kWh Savings	Predicted 2013$/kW *2009-2011*	*2012-2013*
Market Replacement (6013)					
Mean	13.76	1.003	7,381	**$2,125**	**$2,702**
Median	15.00	0.160	1,696	**$5,478**	**$8,406**
Retrofit (6012)					
Mean	11.89	4.227	22,980	**$1,978**	**$2,149**
Median	12.23	1.355	5,922	**$2,832**	**$3,485**
Lighting Plus (6021)					
Mean	13.30	2.590	10,116	**$2,290**	**$2,627**
Median	13.50	1.318	5,588	**$3,398**	**$4,195**

This table shows that costs are much larger for 2012-2013 projects than 2009-2012 projects. It also shows that retrofits have a slightly cheaper $/kW, on average, than lighting plus jobs. However, it is interesting to see that using mean and median market replacement values provides higher predicted $/kW estimates than mean and median values from retrofits and lighting plus, even though, all else equal, market replacement jobs should be cheaper than retrofits and lighting plus jobs. This is due to the fact that the mean and median gross kW savings are significantly lower for market replacement jobs than the retrofit and light plus jobs. As shown in Figure 4, $/kW rises steeply the lower the kW savings.

NTA St. Albans Data

Dataset	All cleaned data
Mult. R-sq	0.9875
Adj. R-sq	0.9874
Degrees of Freedom	3699
Residual standard Error	0.9537

Predicted Value $ 1,439.33

Variable	Coefficient	Stand. Error	T value	Pr(>|t|)		Predicted Input Value	Median	Mean	Min	Max	Predicted Value	Median Pred. Val	Mean Pred. Val
										Pred Val	*$ 1,439.33*	*$ 2,978.82*	*$ 1,439.33*
										ln(Pred Val)	*7.272*	*7.999*	*7.272*
AVG_SAVE_PERIOD						13.1	14.57	13.1	1	31.96			
ASP	-0.2073	0.008994	-23.053	<2.00E-16	***						-2.71563	-3.020361	-2.71563
ASP^2											0	0	0
1/ASP	6.782	0.2586	26.23	<2.00E-16	***						0.517709924	0.465477008	0.517709924
ln(ASP)	3.799	0.05824	65.224	<2.00E-16	***						9.773353863	10.17738659	9.773353863
SAVE_KW_GROSS						2.2217	0.5137	2.2217	0.0001	255.2136			
kW											0	0	0
kW^2											0	0	0
1/kW	0.0008299	0.0001902	4.362	0.0000132	***						3.74E-04	0.00161566	0.000373543
ln(kW)	-0.5251	0.01591	-33.003	<2.00E-16	***						-0.419172978	0.349818318	-0.419172978
SAVE_KWH_GROSS						13,622	3,226	13,622	1	1,180,827			
kWh	0.0000085	0.000000703	12.091	<2.00E-16	***						1.16E-01	2.74E-02	1.16E-01
kWh^2											0	0	0
1/kWh	-6.695	0.9191	-7.284	3.94E-13	***						-0.000491484	-0.002075325	-0.000491484
ln(kWh)											0	0	0
FLAGS												*flags are always 0*	
LIGHTING_PLUS	0.5488	0.07675	7.151	1.03E-12	***	0		0.0921			0	0	0
RETROFIT	0.5049	0.04862	10.385	<2.00E-16	***	0		0.3354			0	0	0
POST_2011	0.243	0.04089	5.943	3.06E-09	***	0		0.3869			0	0	0
DESIGN_ASSISTANCE	0.5535	0.1813	3.052	2.29E-03	**	0					0	0	0
EFF_LIGHTING	-0.2398	0.05371	-4.465	8.25E-06	***	0					0	0	0
EFF_OTHER	0.1957	0.05888	3.324	8.98E-04	***	0					0	0	0
EFF_SPACE_HEAT	0.2908	0.1233	2.358	1.84E-02	*	0					0	0	0
OTHER_ACTIVITY	1.542	0.2135	7.221	6.22E-13	***	0					0	0	0
FS_SPACE_HEAT	1.469	0.3803	3.862	1.15E-04	***	0					0	0	0
Interactive Terms													
KWPOW_X_RETROFIT	0.003286	0.0006512	5.047	4.71E-07	***	0					0	0	0
KWPOW_X_POST2011	-0.002691	0.000438	-6.143	8.96E-10	***	0					0	0	0
KWLOG_X_RETROFIT	0.1676	0.02475	6.772	1.47E-11	***	0					0	0	0
KWLOG_X_LIGHTINGPLUS	-0.3518	0.04279	-8.221	2.76E-16	***	0					0	0	0
KWLOG_X_POST2011	-0.1103	0.01915	-5.76	9.10E-09	***	0					0	0	0
KWH_X_RETROFIT	-4.599E-06	8.842E-07	-5.202	2.08E-07	***	0					0	0	0
KWH_X_LIGHTINGPLUS	0.00003557	0.000004234	8.402	<2.00E-16	***	0					0	0	0
KWHPOW_X_RETROFIT	-25	5.711	-4.378	1.23E-05	***	0					0	0	0
KWHPOW_X_LIGHTING_PLUS	-71.15	13.59	-5.234	1.75E-07	***	0					0	0	0

Green Energy Economics Group

St. Albans Energy Efficiency Resource Acquisition: Final Regresssion with Primary Efficiency Measures

November 22, 2013

1 Select characteristics of EE retrofit resource investment													
a Study period				**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Total**
b Targeted custom retrofit projects substituting for EEU base case													
i Incremental annual peak kW savings from BEF custom retrofit in targeted area				0	100	100	100	0	0	0	0	0	300
(a) % increase over base case (see below)				0%	48%	47%	46%	0%	0%	0%	0%	#DIV/0!	18%
(b) Cumulative				-	100	200	300	300	300	300	300	300	
ii Calculate total annual targeted savings required													
(a) Peak kW/yr				-	308	315	316	-	-	-	-	-	938
(b) Annual energy, MWh/yr				-	2	2	2	-	-	-	-	-	5
iii Project sizing	**Large**	**Medium**	**Small**										
(a) Project size category peak savings as share of total	**33%**	**25%**	42%										
(b) Average peak kW load per participant	**486**	**36**	**10**										
Number of customers to target	**30**	**118**	**250**										
targeted customers, % of total population	**5%**	**18%**	**37%**										
(c) Average % savings	**6.0%**	**10.0%**	**15.0%**										
(d) Calculate average peak kW savings per project	**29.2**	**3.6**	**1.5**										
(e) Targeted kW by project size category			**Large**	-	103	105	105	-	-	-	-	-	313
			Medium	-	77	79	79	-	-	-	-	-	235
			Small	-	128	131	132	-	-	-	-	-	391
			Total	-	**308**	**315**	**316**	-	-	-	-	-	**938**
(f) Target project counts by project size category			**Large**	-	**4**	**4**	**4**	-	-	-	-	-	**11**
			Medium	-	**21**	**22**	**22**	-	-	-	-	-	**65**
			Small	-	**83**	**85**	**85**	-	-	-	-	-	**253**
			Total	-	**108**	**110**	**111**	-	-	-	-	-	**329**
2 EEU base case savings and spending from DRP													
a Statewide BEF retrofit savings													
i Peak kW/yr				7,983	7,982	8,258	8,299	8,100	8,545	7,530	7,459	-	64,156
ii Annual energy, MWh/yr				83,770	83,496	86,122	85,960	85,464	90,012	79,157	78,389	-	672,370
iii Energy savings peak load factor				120%	119%	119%	118%	120%	120%	120%	120%		
b Targered area BEF retrofit savings													
i % of statewide total peak kW/yr				2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	
ii % of statewide total annual energy, MWh/yr				2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	
iii Peak kW/yr				**208**	**208**	**215**	**216**	**211**	**222**	**196**	**194**	**-**	**1,668**
iv Annual energy, MWh/yr				2,178	2,171	2,239	2,235	2,222	2,340	2,058	2,038	-	17,482
c EEU base case statewide BEF retrofit program spending by year													
i Financial incentives				$ 10,657,069	$ 11,480,228	$ 11,388,099	$ 11,194,110	$ 12,264,472	$ 12,946,067	$ 11,319,960	$ 11,014,229	$ -	$ 92,264,234
i Average share of total project capital costs				71%	71%	71%	71%	71%	71%	71%	71%	71%	
iii Program implementation costs				$ 4,093,417	$ 4,081,034	$ 4,332,713	$ 4,555,302	$ 4,659,242	$ 4,895,852	$ 4,579,197	$ 4,722,376	$ -	$ 35,919,132
d EEU base case BEF retrofit expenditures in targeted area				**$ 383,513**	**$ 404,593**	**$ 408,741**	**$ 409,485**	**$ 440,017**	**$ 463,890**	**$ 413,378**	**$ 409,152**	**$ -**	**$ 3,332,768**
3 Regression prediction for total project capital cost	**Large**	**Medium**	**Small**										
a Independent variable values													
i Average kW/project by size category (16(d), above)	**29.2**	**3.6**	**1.5**										
ii Average savings period, yrs Weighted 12.7	**11.7**	**13.1**	**13.3**										
iii (a) Energy savings peak load factor (0-100%)	**66%**	**71%**	**45%**										
(b) Annual energy savings, kWh/y	**169,967**	**22,643**	**6,030**										

#	Item	Large	Medium	Small	Category	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Total
iv	**Job Flags**														
	(a) Lighting Plus (DI, 1=yes, otherwise just retrofit	**0**	**0**	**1**											
	(b) Retrofit Project (vs. end of life replacement)	**1**	**1**	**0**											
	(c) Lighting	**0**	**1**	**0**											
	(d) Design assistance	**0**	**0**	**0**											
	(e) Other	**0**	**0**	**0**											
b i	**Calculate $/kW capital cost by project size category**	$ 1,528	$ 1,931	$ 3,456											
ii	**Previous values**	$ 1,482	$ 2,012	$ 2,455	/kW										
c	**Calculate total annual retrofit project capital costs**				**Large**	$ -	$ 151,900	$ 155,443	$ 155,978	$ -	$ -	$ -	$ -	$ -	463,322
					Medium	$ -	$ 154,661	$ 158,268	$ 158,812	$ -	$ -	$ -	$ -	$ -	471,741
					Small	$ -	$ 314,517	$ 321,853	$ 322,960	$ -	$ -	$ -	$ -	$ -	959,330
					Total	$ -	$ 621,078	$ 635,564	$ 637,750	$ -	$ -	$ -	$ -	$ -	$ 1,894,393
d	**Calculate average retrofit project capital costs**				**Large**	$ 43,240									
					Medium	$ 7,302									
					Small	$ 3,788									
					Total	$ 5,765									
4	**Electric energy and other resource savings**														
a	**Electric energy**	**Large**	**Medium**	**Small**											
i	**Savings load factor**	**66%**	**71%**	**45%**											
					Large	-	597	611	613	-	-	-	-	-	1,821
					Medium	-	480	491	492	-	-	-	-	-	1,463
					Small	-	501	512	514	-	-	-	-	-	1,527
					Total	-	1,577	1,614	1,620	-	-	-	-	-	4,811
ii	**Incremental MWh/y**					**-**	**(594)**	**(625)**	**(615)**	**-**	**-**	**-**	**-**	**-**	
iii	**Cumulative MWh/y**					**-**	**(594)**	**(1,219)**	**(1,834)**	**(1,834)**	**(1,834)**	**(1,834)**	**(1,834)**	**(1,834)**	
b	**Natural gas savings**				subsample mean values for GT										
i	**GT Therms saved/kWh saved**	**0.0069**	**0.0004**	**(0.0080)**											
					Large	-	4,114	4,210	4,225	-	-	-	-	-	
					Medium	-	183	188	188	-	-	-	-	-	
					Small	-	(4,017)	(4,111)	(4,125)	-	-	-	-	-	
					Total	-	280	287	288	-	-	-	-	-	
ii	**Base case**			**0.0102**		**22,282**	**22,210**	**22,908**	**22,865**	**22,733**	**23,943**	**21,056**	**20,851**	**-**	**178,848**
iii	**Incremental therms/yr**					-	(21,929)	(22,621)	(22,577)	-	-	-	-	-	(67,128)
iv	**Cumulative therms/yr**					**-**	**(21,929)**	**(44,551)**	**(67,128)**	**(67,128)**	**(67,128)**	**(67,128)**	**(67,128)**	**(67,128)**	
c	O&M														
i	GT **Levelized $/kWh saved**	**$ 0.0019**	**$ 0.0185**	**$ 0.0144**											
					Large	$ -	$ 1,125	$ 1,151	$ 1,155	$ -	$ -	$ -	$ -	$ -	
					Medium	-	8,896	9,103	9,134	-	-	-	-	-	
					Small	-	7,186	7,353	7,379	-	-	-	-	-	
					Total	$ -	$ 17,207	$ 17,608	$ 17,669	$ -	$ -	$ -	$ -	$ -	
ii	**Base case**			**$ 0.0158**		**$ 34,485**	**$ 34,373**	**$ 35,454**	**$ 35,387**	**$ 35,183**	**$ 37,055**	**$ 32,587**	**$ 32,270**	**$ -**	
III	**Incremental levelized annual O&M savings**					**$ -**	**$ (17,166)**	**$ (17,846)**	**$ (17,719)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
d	Water	**Assume none**													

Green Energy Economics Group

St. Albans Energy Efficiency Resource Acquisition: Final Regresssion with Primary Efficiency Measures

November 22, 2013

2 Targeted program budget

					2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
a	**Customer financial incentives**												
		Avg project payback	**Payback buydown**	**Buydown % capital cost**									
i	**L**	**9**	**1**	**89%**	$ -	$ 135,023	$ 138,172	$ 138,647	$ -	$ -	$ -	$ -	$ 411,841
ii	**M**	**8**	**0.5**	**94%**	-	144,995	148,376	148,887	-	-	-	-	442,257
iii	**S**	**7**	**0**	**100%**	-	314,517	321,853	322,960	-	-	-	-	959,330
iv	**Calculate targeted EE retrofit financial incentive budget**			**Total**	$ -	$ 594,534	$ 608,401	$ 610,494	$ -	$ -	$ -	$ -	$ 1,813,429
v	**Calculate incremental EE retrofit ressource annual financial incentive budget**				$ -	$ 296,048	$ 312,310	$ 319,447	$ -	$ -	$ -	$ -	$ 927,805
b	**Implementation costs**												
i	Fixed costs by year												
	(a) Administration				**$ -**	**$ 150,000**	**$ 150,000**	**$ 150,000**	**$ -**		**$ -**	**$ -**	$ 450,000
	(b) Marketing				**$ -**	**$ 100,000**	**$ 100,000**	**$ 100,000**	**$ -**		**$ -**	**$ -**	$ 300,000
	(c) Evaluation				**$ -**		**$ 50,000**	**$ 50,000**	**$ 50,000**	**$ -**		**$ -**	$ 150,000
	Total fixed implementation costs				$ -	$ 250,000	$ 300,000	$ 300,000	$ 50,000	$ -	$ -	$ -	$ 900,000
ii	Variable costs per project by size category												
		(a) Project acceptance rate	(b) Project development/audit cost	(c) Project Inspection cost									
	L	**80%**	**$ 10,000**	**$ 1,000**									
	M	**85%**	**$ 3,000**	**$ 500**									
	S	**90%**	**$ 1,000**	**$ 300**									
	(d) Project development/audit costs				$ -	$ 210,930	$ 215,850	$ 216,592	$ -	$ -	$ -	$ -	$ 643,371
	(e) Project inspection costs				$ -	$ 39,014	$ 39,924	$ 40,061	$ -	$ -	$ -	$ -	$ 118,998
	(f) Total variable implementation costs				$ -	$ 249,944	$ 255,773	$ 256,653	$ -	$ -	$ -	$ -	$ 762,370
iii	**Calculate total annual implementation costs**				$ -	$ 499,944	$ 555,773	$ 556,653	$ 50,000	$ -	$ -	$ -	$ 1,662,370
iv	**Calculate incremental annual EE retrofit program implementation costs**				$ -	$ 393,837	$ 443,123	$ 438,215	$ -	$ -	$ -	$ -	$ 1,275,175
c	Calculate total annual targeted EE retrofit program expenditures				**$ -**	**$ 1,094,478**	**$ 1,164,174**	**$ 1,167,147**	**$ 50,000**	**$ -**	**$ -**	**$ -**	**$ 3,475,799**
	Calculate incremental annual targetred EE retrofit program expenditures				$ -	$ 689,885	$ 755,433	$ 757,662	$ -	$ -	$ -	$ -	$ 2,202,980
	Inrease over base case				**0%**	**171%**	**185%**	**185%**	**0%**	**0%**	**0%**	**0%**	**66%**
d	**Calculate annual incremental EE total resource costs**				$ -	$ 594,512	$ 661,658	$ 666,040	$ -	$ -	$ -	$ -	$ 1,922,210
	Inrease over base case				0%	113%	125%	126%	0%	0%	0%	0%	

3 Combine EE incremental retrofit resource acquisition costs and savings with other NT ARC components

ATTACHMENT 3

EE Calculator

Description and Instructions

GT EE Calculator

Instruction Manual

Introduction - Green Mountain Power (GMP) contracted with Green Energy Economics Group (GEEG) to develop a model to estimate the amount energy efficiency resources to include in the St Albans Reliability Plan. The model, "GT EE Calculator", bridges the gap between existing EEU programs and the maximum achievable EE savings by estimating the $/kW cost of procuring a given increment of geographically targeted energy efficiency peak load reductions in the study area. The GT EE Calculator is designed to be a planning tool with a confidence level sufficient to determine the approximate magnitude of incremental EE resources to include in the Reliability Plan and justify a bottom-up, investment grade analysis of the prospective EE costs and savings before embarking on the Plan.

Overview – The model is powered by a regression analysis which predicts empirical capital costs of peak load reductions from EE investment using past (2009-11) EEU business retrofit data. The statistical analysis is transparent to the user, however, making the model relatively simple to operate.

Three sets of data entries are required: information on the proposed geo-targeted savings, information on the existing EEU program; and information on the implementation and administrative costs of the proposed program. The model does the rest of the work, calculating the measure costs which are then incorporated into estimates of annual program expenditures and total resource costs.

The EE Calculator consists of the following three work sheets:

- **Base Case & Targeted Savings** – a user input sheet where existing EEU programs in the study area and the amount of desired incremental EE resources are entered. This sheet also includes inputs for the regression analysis to characterize independent variables such as project size, average life of savings, types of measures as well as the types of projects (new, retrofit, geo-targeted or prescriptive).
- **Program Budget** – is both an input and an output sheet. The inputs consist of cost estimates for implementing and administering the proposed incremental EE program. Another set of inputs deals with project acceptance rates by targeted customers. The results of the EE Calculator are displayed at the bottom of the sheet; and
- **Regression Capital Cost** – this sheet contains the regression analysis which calculates the capital cost of the incremental EE measures. This sheet contains no user inputs or output and has been locked.

Step by step instructions for each sheet are provided below.

Base Case & Targeted Savings Sheet

This sheet requires various inputs to define the characteristics of the proposed EE resource investment as well as the savings and spending in the existing EEU program (base case). The items below are labeled to correspond to the numbering system in the model. All of the inputs are to be entered in the yellow shaded cells:

a Study Period Enter the years of the study in cells K6-S6.

b This section defines the EE projects being proposed instead of those expected under the existing EEU business retrofit program.

b.i Targeted kW Savings Enter the annual peak kW savings that are desired in cells K9-S9 (expected values consistent with a 50:50 savings or load forecast, i.e., 50% probability that actual value falls above or below expected).

b.ii Total annual savings desired No input required. The model calculates the total (existing EEU programs + desired savings) Peak kW/yr and Annual energy (MWH).

b.iii Project sizing The model allows up to three different size projects for the proposed program (Large, Medium and Small) For each size project enter the following:

(a) The expected percentage of the total savings from average projects in large and medium size classifications in cellsH15 and I15. The model automatically calculates the percentage of total saving from Small projects in cell J15.

(b) The average peak kW load per participant in each of the three size categories in cells H16-J16.

(c) The average savings per participant, expressed as a percentage of total load, for each of the three size categories in cells H17-J17.

(d) No input required. The model calculated the total kW savings for each project size category.

(f) No input required. The model calculated the number of projects in each size category.

c This section characterizes the existing statewide EEU business retrofit program serving the study area (base case, i.e., business as usual with no geotargeting).

c.i(a) Statewide peak kW/yr savings in cells K30-S30.

c.i(b) Statewide annual energy savings (MWH/yr) in cells K31-S31.

c.ii(a) Percentage of statewide total Peak kW/yr savings expected in the study area, cells K33-S33. Based on area annual energy sales to elegible customers as a percentage of the statewide total sales to all business customers statewide.

c.ii(b) Percentage of statewide total annual energy savings expected to occur in the study area, cells K34-S34.

c.iii(a) Statewide planned EEU program expendityures on incentives for existing business facilities retrofit, cells K36-S36.

c.iii(b) Expected share of total retrofit project capital costs covered by program financial incentives, as a percentage, cells K37-S37.

c.iii(c) Annual program implementation (non-incentive) costs planned by the EEUf for business existing facility retrofits , cells K38-S38.

d The regression analysis operates on multiple independent variables and includes 'Job Flags' to customize the analysis to the specific types of measures and projects being proposed. This section requires the following inputs for the regression analysis:

d.i(a) Average kW/project for each of the size categories defined above. The model automatically calculates these values based on the information entered in section b.iii.

d.i(b) Average savings period. Enter the average savings period in years for each of the project size categories in cells H44-J44.

d.i(c) Job Flags. For each of the project size categories enter "1" to indicate the presence of the following characteristics:

1 Lighting measures included in the program.

2 Air Conditioning included in the program.

3 Retrofit project. Set to 1. Entering a "0" would indicate the project is an end of life replacement, which is not the objective of the GT program.

4 Custom project. Set to 1. Entering a "0" would indicate the project is prescriptive, not the objective of the GT program.

5 Geo-Targeted project. Set to 1. Entering a "0" would indicate a non-GT project.

d.ii No input required. The model calculates the capital cost ($/kW) for each size category.

d.ii No input required. The model calculates the annual capital cost ($$) for each size category.

e This section contains the estimated savings of electric energy and other resources. It is not used in the calculation of GT program costs directly; rather, these attributes of the GT EE projects must be accounted for in the calculation of the full benefits of the incremental GT EE resource acquisition, which in turn figure into the calculation of the net cost per kW of peak demand savings from GT EE These other inputs include:

d.i Electric energy savings Enter the savings load factor (percentage of kW savings that produce energy savings) for each project size category in cells H60-J60. The model calculates the annual energy savings (MWH) for the three project size categories in cells K61:S63.

b.ii Load Shape No input required. Placeholder for obtaining breakdown of annual savings according to four seasonal and diurnal energy costing periods, i.e., summer and winter, on- and off-peak.

b.iii Thermal Savings Assume none.

b.iii Water Savings Assume none.

Program Budget This sheet contains both the inputs to develop the estimated costs to implement and administer the program and the output from the GT EE Calculator. The following is a step by step description of the work sheet.

a Customer financial incentives This section contains the input data that define the financial incentives. In cells E9-E11 enter the desired average project payback (in years) for the three size categories. In cells G9-G11 enter the desired payback buy-down (in years) for the three size categories of project. A pay-back buy-down of “1” indicates the program would provide incentives such that the project owner is paid back in the first year. A “0” buy-down indicates the project is full funded by incentives.

The model assumes that all customers in the study area will be offered these incentives. The alternative would be that certain customers participate in the program at the EEU base case level of incentives while the remaining customers participate at the higher level of incentives offered with the incremental program. The alternative approach is judged to be untenable.

a.iv Targeted budget for EE financial incentives No input required. The total budget for financial incentives, including the EEU base case and the desired incremental EE savings.

a.v Budget for financial incentives for incremental EE No input required. The model backs out the cost of financial incentives for the EEU base case to estimate the cost of incentives for the incremental EE resources.

b Implementation costs This section contains the input data estimate both the fixed and variable costs to implement the program..

b.i Fixed cost Enter the cost in each year to administer, market and evaluate the program in cells K17:S19.

b.ii Variable costs Consist of the following three components:

- Project acceptance rate, enter the acceptance rates for the three size categories of projects in cells E23-E25;
- Project development & audit cost, enter the estimated development & audit cost for the three size categories of projects in cells H23-H25;
- Project Inspection costs, enter the estimated inspection costs for the three size categories of projects in cells L23-L25.

b.ii(d) Annual project development & audit cost No input required. The model calculates the estimated cost to develop and audit the entire program, EEU base case plus the incremental EE resources.

b.ii(e) Annual project inspection cost No input required. The model calculates the estimated cost for project inspections of the entire program, EEU base case plus the incremental EE resources.

b.ii(f) Total variable implementation cost No input required. The model calculates the total variable implementation cost of the entire program, EEU base case plus the incremental EE resources.

b.iii Total annual implementation cost No input required. The model calculates the total annual implementation cost of the entire program, EEU base case plus the incremental EE resources.

b.iv Total annual incremental implementation cost No input required. The model backs out the implementation cost of the EEU base case to estimate the implementation cost for the incremental resources.

C This step calculates the total annual expenditures for the incremental EE program. The program expenditures include financial incentives and both fixed and variable implementation cost. Any measure costs are borne by the customer and not included in the calculation. The calculated program expenditure is also known as the “ratepayer cost”.

D The final step calculates the total annual resource cost for the for the incremental EE program. The total resource cost includes the cost of the measure and the fixed and variable implementation costs. It does not include the cost of financial incentives. The calculated total resource cost is also known as the “societal cost”.

Regression Capital Cost This sheet contains the regression analysis. Input data are pulled in from the other two sheets. Primary output from the regression analysis consist of the $/kW cost for the three size categories of projects in cells H52-J52 of the "Base case & targeted savings" sheet. A synopsis of the regression analysis is presented in Attachment A, "Empirical Capital Cost Predictions from Analysis of EEU Business retrofit data."

The Regression capital cost" sheet contains no user inputs and has been locked down to prevent inadvertent typing over formulas.

Conclusion The GT EE Calculator provides a rational method to estimate the cost of procuring additional, incremental energy-efficiency resources through a geographically targeted retrofit program in a user defined study area. The model requires input data to characterize the existing EEU program and informed judgment to design a program of custom retrofit projects to obtain the incremental resources. The confidence level in the results of the model are judged to be adequate to formulate a reliability plan and justify and investment grade analysis prior to launching a specific multi-year GT program.