Reducing T&D Investments through Energy Efficiency: An Impact Assessment

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ABSTRACT

In 2007, the Vermont Public Service Board directed Efficiency Vermont to focus resources on specific geographic areas of the state to assess whether it is possible to defer or avoid transmission and distribution ("T&D") investments through energy efficiency. Four "geotargeted" ("GT") regions were identified as requiring substantial T&D investments within a five to ten year period. Efficiency Vermont developed and implemented a combination of new programs and intensified delivery of existing programs to test this concept.

In 2010, the Vermont Department of Public Service conducted an evaluation to assess whether efficiency programs can be effectively deployed for the purpose of reducing load impacts sufficiently to allow the utility to defer or avoid T&D investments. The evaluation included an in-depth review of EVT's program data and verified savings, an assessment of GT program progress in the context of utility billing and load data and a process evaluation.

Preliminary results suggest that the GT programs in some regions achieved the same level of savings two to three years earlier than the non-GT statewide programs and that the characteristics of the GT region were a major factor in the success of the GT efforts. There are also indications that intensive efforts may yield higher savings in the first two years with diminishing returns as implementation continues.

This paper provides a brief overview of the GT programs and goals, and discuss the results of the evaluation. The final section will synthesize the issues and provide a discussion of the applicability of this strategy to future efforts designed to reduce T&D investments.

Introduction

In 2007, the Vermont Public Service Board (“VPSB”) directed Efficiency Vermont (EVT) to focus additional efficiency efforts toward four specific geographic regions to assess whether it is possible to defer or delay transmission and distribution (“T&D”) upgrades through energy efficiency. The VPSB's directive was designed to assess how quickly energy and demand savings could be acquired in a concentrated area (VPSB 2007).[1]

The four "geotargeted" ("GT") regions were identified by the Vermont utilities as requiring substantial T&D investments within a five to ten year period. Efficiency Vermont developed and implemented a combination of new programs and intensified delivery of existing programs in the GT regions to test this concept. This GT program effort started in mid 2007 and continued through 2011. As of 2009, approximately 40% of EVT’s efficiency funds were directed to the GT areas (VPSB 2008).

The Vermont Department of Public Service ("VDPS") hired Navigant Consulting Inc. (Navigant), along with their subcontractors West Hill Energy and Computing and Grimason Associates, in 2010 to conduct an evaluation as a "proof of concept" to assess whether the GT approach was an

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[1] Order at 3, *Order Re Geographic Targeting of EEU Funds*. January 8, 2007. See: publicservice.vermont.gov/energy-efficiency/orderregeographictargetingoriginal.pdf

effective strategy for reducing load impacts sufficiently to allow the affected utility to defer or avoid T&D investments. This evaluation included four components: a review of the process for selecting the GT regions, a process evaluation of program implementation, an impact evaluation of EVT's claimed savings and a review of utility load and billing data on specific circuits to determine whether the efficiency efforts resulted in actual reduction in the system load (NCI 2010).

The evaluation conducted for the VDPS provides observations and recommendations with respect to the process employed for target area selection, collaboration, and program delivery, and also offers observations related to the measured impacts and effects on specific circuits. This work necessarily included the input and participation from a number of parties, including Efficiency Vermont, the affected distribution utilities, Vermont Electric Power Company, Inc., and the Vermont System Planning Committee ("VSPC").

The GT programs were designed to meet a specific targeted megawatt (MW) reduction in a fairly short time. In comparison to the statewide programs implemented by EVT, this objective can be achieved by pursuing faster, broader, and/or deeper savings. The definitions of these key terms are described below.

- Faster savings: Program implementation is accelerated (i.e., the overall savings may be the same as from the statewide non-GT programs, but they are achieved faster).
- Broader savings: Savings are acquired from a wider range of participants than may be reached through the statewide non-GT programs, and the GT program savings are similar on a per participant basis but higher overall due to increased participation.
- Deeper savings: More comprehensive savings are achieved at each site served, and the GT programs produce higher savings than the statewide non-GT programs.

Although these strategies are not mutually exclusive and actual implementation may employ two or all of these approaches, reviewing EVT's program performance in this context provides a conceptual foundation for the analysis.

Reviewing EVT's approach to the GT programs and assessing the program accomplishments within the above context provides insight into the effectiveness of this strategy. The results show that EVT was successful in achieving substantially higher savings in the GT regions overall during the initial two-and-a-half years of GT program implementation. While simply comparing the magnitude of the savings between the statewide non-GT and GT programs provides a broad indication of the success of the GT efforts, further investigation into ways in which the savings were achieved, the differences in impacts across the individual GT regions and changes in penetration over time provide a more comprehensive picture of the GT efforts.

The more traditional impact evaluation results were also verified through a analysis of substation and feeder loads, both in the GT regions and in other areas of the states. The load analysis supports the impact evaluation results and indicates that at the system level, in aggregate, energy and demand savings are being achieved.

While the four GT regions were selected for this experimental approach due to the need for T&D upgrades, it was not expected that specific investments would be deferred in the short term. In two of the five GT regions, it was necessary to move ahead with specific T&D projects. In North Chittenden, there was insufficient lead time to allow the GT programs to accumulate the magnitude of savings required to avoid the upgrade, although continued T&D investments will be necessary in this area and further GT efforts may defer or eliminate the need for these additional improvements. In Newport, the utility was required to make the T&D upgrade immediately due to an unexpected event.

This paper covers the results of the impact evaluation component of this evaluation, and integrating some of the findings from the process evaluation and the load analysis. Due to space constraints, a discussion of the selection of the GT regions is not included in this paper. The following sections are organized as follows: background, EVT GT programs, methods, findings and conclusions.

Background

In 2006, the VPSB approved the Northwest Reliability Project, emphasizing that some aspects of the project may have been avoided or delayed through a timely substantial investment in energy efficiency. Following that project approval, the legislature and the VPSB undertook a number of actions that led to the development of an experimental approach to test whether such reliability projects could be delayed or avoided in whole or in part through concentrated energy efficiency efforts in constrained areas.

These efforts covered new ground without a lot of experience in Vermont or other states to guide the efforts. The selection of the GT regions was relatively informal, and enabled the utilities and Efficiency Vermont to quickly put the geotargeting plan in motion. The first designations in late 2006 were built from the bottom up, by experienced staff in the larger utilities: Green Mountain Power, Central Vermont Public Service, and Vermont Electric Company. Among the municipal utilities, Burlington Electric Department and the Vermont Public Power Supply Authority (a private authority that supplies power to municipal utilities and electric cooperatives in Vermont) took part in early discussions but did not go further.

By early 2007, the PSB approved four initial GT areas. The working group that proposed the geotargeted areas also began work on a set of principles which guided them in the 2009 selection process:

- The geotargeted areas were generally areas in which population and/or economic activity experienced the most growth in previous decades.
- The selected areas were known areas of concern with respect to specific utility systems' transmission and distribution capacity.
- Stakeholders agreed that the minimum planning horizon to attempt to defer an upgrade was two to three years, with preferred horizons of at least five years.
- There were no other circumstances requiring immediate investment in these areas.

The process of selecting the geotargeting areas was intended to move to the larger venue of the Vermont Systems Planning Committee (VSPC), as initiated by the wholesale electric system entity, Vermont Electric Company (VELCO). In practice, although the VSPC was formed and has been functioning, the selection process remained with the founding utilities.

Four geographic areas were targeted for program years (PY's) 2007 and 2008 within the distribution utility service territories of Central Vermont Public Service, Green Mountain Power, and the Vermont Electric Cooperative. Three of the original geographic areas, and one new area, were selected for the 2009-2011 period. The VPSB requested that the VDPS "work with Efficiency Vermont and the Vermont electric utilities to develop evaluation measurements that will verify that geographically targeted energy-efficiency can achieve the intended result of deferring transmission and distribution upgrades."[2]

EVT GT Program Activities

The first step in interpreting EVT's program activity within this context is to consider how the program implementation fits into this framework. EVT's statewide portfolio covers a wide range of types of activities targeted to both the residential and C&I sectors. Initiatives include rebates, upstream incentives to mid-market players, site-specific energy analyses and incentives and direct contact with

[2] Vermont Public Service Board, Order Regarding Geotargeting of Energy Efficiency Utility Funds, January 8, 2007, page 6.

large utility customers (key accounts). All of these initiatives were also offered in the GT regions. EVT enhanced its offerings in the GT regions as follows:

1. addition of a new and large-scale business direct installation lighting program called "Lighting Plus"
2. expansion of the key account approach for larger customers
3. implementation of the now statewide Express Refrigeration program
4. community-based initiatives
5. expansion of existing programs and aggressive promotion of compact fluorescent light bulb (CFL) sales

These activities indicate that EVT was employing all three strategies, with faster savings through bolstering existing programs, broader savings through Lighting Plus, Express Refrigeration, and community-based initiatives, and deeper savings through the key account approach for large customers. Assessing EVT's success in these areas through a review of verified savings necessarily has some limitations. The metrics for the three approaches to GT savings are overlapping, which tends to limit our ability to tease out the success of one strategy over another.

Methods

The three components of the study covered in this paper are the process evaluation, the impact evaluation and the analysis of the load impacts. The methods used for each of these three components are discussed in more detail below.

Process Evaluation

The main component of the process evaluation was a telephone survey with approximately 120 C&I program participants and 120 C&I nonparticipants, distributed evenly among the four initial GT areas (30 participants and 30 nonparticipants in each GT area), covering the period of PY 2007 through 2009. The survey examined attitudes toward the GT program, experience for participation and nonparticipation, and customer perspectives on program improvements.

Impact Evaluation

The impact evaluation of EVT's GT program was based on the program tracking system data and utility billing records provided by Efficiency Vermont, in conjunction with DPS's verification and impact evaluation activities. The primary impacts reported in this evaluation were the winter and summer peak kW reduction. The DPS conducted an impact evaluation for purposes of verifying savings for the ISO-NE Forward Capacity Market (WHEC 2010). The Forward Capacity Market (FCM) evaluation was a rigorous impact evaluation including on-site measurement for custom C&I initiatives and conducted for all program and measures in EVT's statewide portfolio for PY's 2007 and 2008. The realization rates from the FCM evaluation were used to adjust the winter and summer peak kW reduction.

The DPS also conducts annual savings verification. The annual savings verification consists of a review of EVT's algorithms and inputs used to calculate energy and demand savings and benefits resulting from the installed measures. Since the FCM impact evaluation only covered the peak kW reduction, the realization rates from the annual savings verification were applied to the energy savings and other inputs into the total resource benefits (TRB), including electric energy and demand, fossil fuel and water savings (VDPS 2008 and VDPS 2009).[3]

[3] The winter and summer peak kW reductions are the critical variables in the context of this evaluation, and the realization rates from FCM impact evaluation are based on direct measurement and meet the ISO-NE standard. Because the source of

The conceptual framework for this component of the impact evaluation was to assess whether the GT programs were effective at achieving deeper, broader and faster savings. Table 1 summarizes the key characteristics of these strategies and the issues with assessing EVT's performance in relation to these metrics.

Table 1. Metrics for Measurement of GT Program Impacts

Strategy	Metric	Measurement Method	Issues
Deeper Savings	Normalized Savings	Savings per utility premise MWh savings as % of utility sales Savings per participant	Savings per participant are difficult to measure in the residential sector as the number of participating households is not available. Variations among regions in the savings per participant may be driven by characteristics of the population as well as program implementation. Higher average savings per utility premise may be due to broader participation or more savings per participant.
Broader Savings/ Faster Savings	Participation Rate	Participants per utility premise	Higher participation rates may reflect a broader range of participants or accelerated participation by those who would have installed measures through non-GT statewide efforts at a later date.
Faster Savings/ Broader Savings/ Deeper Savings	Acceleration Rate	Savings per utility premise GT/ Savings per utility premise non-GT	The acceleration rates estimate the number of years it would take to achieve the same level of savings through the non-GT statewide efforts as was acquired through the GT programs in one year. The acceleration rate incorporates all of the reasons for higher savings, not only acceleration of current statewide efforts in the GT regions.
Deeper Savings	Costs	Levelized costs EVT costs/peak kW	Levelized costs will be higher for more comprehensive efficiency initiatives designed to acquire deeper savings at each site. EVT costs/peak kW provides a comparison among GT regions; however, all of the costs are loaded on the peak kW reduction, leading to higher values.

The winter and summer peak kW reported by EVT and evaluated as part of the DPS's FCM evaluation are calculated based on the ISO-NE peak periods of 5:00 to 7:00 p.m. weekdays in December and January and 1:00 to 5:00 p.m. weekdays from June through August (non-holidays). These were the only peak kW values available for EVT's programs and were used to compare peak kW target reduction with EVT's actual impacts. A review of the load data indicates that the GT system peaks were generally occurring during the same periods as the ISO-NE peaks, with the exception of the one GT region, the Southern Loop, where the winter peak occurred earlier in the day than the ISO-NE period.

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the realization rates applied to the energy savings and other TRB inputs is the less rigorous annual verification process, there is greater uncertainty in these savings estimates. It is not possible, however, to determine whether the verified energy savings are biased in one direction or another.

Substation Analysis

The load analysis included a number of strategies to assess substation and feeder impacts. Methods used to estimate energy and demand savings must address and rigorously evaluate factors that can affect feeder load, including economic conditions, weather, customer migration, load transfers between feeders, and distributed generation and demand response programs.[4] These normalization methods utilized comparison groups comprised of participants and non-participants from feeders located within the GT areas and feeders located outside GT areas. The comparison groups consisted mostly of commercial customers, both due to the large of number of commercial and industrial participants and the availability of monthly demand usage derived from utility billing records.

The availability of customer billing data and utility records also was needed to confirm the methods used to derive savings were accurate. Since the percent reduction is small in comparison to total feeder and substation loads and these load vary for a wide range of reasons unrelated to efficiency improvements, circuits with high expected savings were selected for the analysis.

From this analysis, the evaluators determined that the use of utility billing records provides data that can be used to normalize measured load reductions over time, particularly for customer migration and where local economic factors impact electric demand. Specific steps included the following:

- The team examined peak load day hourly profiles for GT area feeders; data was scrubbed to remove outliers and inaccurate readings.
- The resulting hourly profiles were normalized by removing new and departing customers between 2007 and 2009 to enable an accurate comparison of pre- and post GT program loads.
- Pre- versus post-program GT area load factors were compared to discern any changes, including whether load factors increased due to lower peak demand; this premise was confirmed from our findings.
- Lastly, the team developed normalizing factors derived from billing data in each GT area; this approach allowed the team to compare participant and non-participant demand and energy usage and trends between 2007 (pre-program) and 2009 (post-program) during the peak load months.

This approach provided a rigorous assessment of the changes in substation and feeder loads between the pre- and post-installation periods that addresses the main sources of non-program related variation in demand.

Findings

In comparison to EVT's overall portfolio, results indicate the GT program implementation was effective in achieving substantially higher savings in a relatively short period of time. The GT regions accounted for a substantial portion of both the resources invested and the savings achieved. About 40% of EVT's costs were allocated to the GT regions and about 40% of the summer peak kW reduction was attributed to the GT components of EVT's portfolio in aggregate during program year 2009.

While it is noteworthy that EVT accomplished greater savings in the GT regions, the purpose of the exercise was to determine whether the GT programs are an effective strategy to reduce feeder and substation peak loads in the designated areas. In the first two-and-a-half years of program delivery, the GT regions reduced the loads during the peak periods by 4% to 7% of the 2007 utility system peak, based on the estimated program impacts as verified through the impact evaluation.

The results of the load analysis support the impact evaluation results and indicate that, in

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[4] Demand response (DR) was not a major factor in the GT program evaluation, as the utilities implemented DR very infrequently or not at all in some years of the analysis. However, if DR is implemented in the future, care must be exercised to avoid overstating savings.

aggregate, energy and demand savings are being achieved at the system level.[5] At the feeder level, energy and demand savings are less easily observed due to the small amount of demand reduction compared to feeder peak load and other factors that may not have been captured at the feeder level.

The remainder of this section is organized into the following subsections: faster savings, deeper savings, broader savings, comparison across GT regions, longer term impacts and substation analysis.

Faster Savings

EVT acquired savings in the GT areas at a substantially faster rate than through the statewide non-GT programs. It would take over twice as long at the statewide implementation rate to meet the level of savings achieved by the GT programs in PY 07/08. In three of the four original GT regions, the magnitude of the summer peak reduction would have taken three times longer to achieve through the non-GT statewide initiatives.

This success has been driven largely by high participation rates in the GT areas in the C&I sector. In addition, the average savings per C&I participant were slightly higher in the GT areas than the statewide non-GT programs. Further investigation suggests that these additional savings are coming primarily from lighting measures. Focusing on the C&I lighting market may provide savings in a short time frame. However, this focus raises the concern that other end uses may not be adequately addressed, making it more difficult and costly to obtain more comprehensive savings in the future.

Broader Savings

EVT increased program participation in the GT regions by almost fourfold over the statewide non-GT programs. During the initial implementation period, 12% of C&I customers in the GT areas participated in an EVT program and installed measures during PYs 2007/2008, as compared with 3% in the statewide non-GT areas. The participation rates among the GT regions were fairly consistent during PYs 2007/2008 (in the range of 10% to 13%), with the exception of Newport where a participation rate of 22% was achieved.

The process evaluation also supports the conclusion that EVT successfully broadened its outreach. The results of the telephone surveys of C&I customers indicate that 71 percent were first time participants in energy efficiency programs, suggesting that EVT was quite successful in bringing new participants into the efficiency programs. Most participants came into the program through some form of direct outreach from EVT or its installation contractors.

Deeper Savings

Winter and summer peak kW reductions per utility premise in the GT programs were more than twice (100% greater than) the non-GT peak savings, indicating that EVT achieved deeper savings through its GT efforts. This outcome is predominantly due to activity in the C&I sector, where the GT savings per utility premise on average were more than four times greater than the statewide non-GT peak savings during the initial implementation period. In the residential sector, the average GT peak savings per premise were about 25% higher than the non-GT statewide peak savings.

Increased GT savings are primarily from lighting measures, as shown in Table 2. In comparison to the initiatives fielded in the statewide non-GT regions, the GT programs were more heavily dependent on savings from C&I lighting measures. More research would be needed into the remaining potential in each GT region to determine whether there are substantial savings in other end uses.

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[5] The availability of utility customer billing detail was essential to normalize loads and account for customer migration. The same level of rigor may be needed prospectively to retain the same level of confidence in future analyses.

Table 2: Comparison of Source of C&I Savings for GT and Non-GT Programs

	GT Programs	Statewide Non-GT Programs
% of all C&I Savings from Lighting	67%	49%
% of participating C&I facilities that installed only lighting	73%	55%
% of participating C&I facilities with measures in only one end use	78%	74%

The GT programs as implemented are cost effective using the statewide avoided costs and other Vermont screening tool assumptions. With benefit/cost ratios around 2, there may be room to pursue more comprehensive savings that are more costly to obtain. Modification to program designs to target more comprehensive savings at each site may open up further opportunities for savings in the existing GT regions.

Comparison Across GT Regions

Although implementation strategies were fairly consistent, the outcomes were certainly different across the GT regions, suggesting that other factors are affecting the impacts in each region. Table 3 compares the peak MW reduction as a percentage of the 2007 peak MW load across the four original GT regions. Newport has the lowest percent at 2.8% as compared to North Chittenden with 6.7%.

Table 3: MW Reduction as Percent of 2007 MW Peak for the Initial Four GT Regions

Region	2007 Peak MW	Total Net Peak MW Reduction Achieved (2007 - 2009)[6]	MW Reduction as % of 2007 Peak MW
North Chittenden	64	4.30	6.7%
St. Albans	78	3.07	3.9%
Southern Loop	70	3.15	4.5%
Newport	18	0.69	3.8%

Since the difference in outcome is more likely to relate to the characteristics of the regions than program implementation, some key descriptive factors of the regions are provided in Table 4. This analysis clearly shows that the Southern Loop stands out as covering a large area that is largely rural, residential, and has fewer large C&I customers. In contrast, the Rutland GT region is predominantly commercial/industrial, with a high percentage of C&I customers and second only to North Chittenden in the number of large C&I accounts. These factors can be seen in the outcomes of the GT programs by region.

[6] Peak reductions are reports as gross at generation for the purposes of this comparison, i.e., the peak demand savings include line losses but is not adjusted for free riders or spill over.

Table 4. Key Characteristics of GT Regions

Characteristic	North Chittenden	Saint Albans	Southern Loop	Newport	Rutland
Urban vs. Rural	Urban	Largely Urban	*Largely Rural*	Urban	Urban
Size of Territory Covered	Small	Moderate	*Large*	Small	Small
C&I vs. Residential : C&I % of Sales	65%	64%	*48%*	64%	78%
C&I Large Customers: # of Premises with > 500 MWh annually	72	42	*38*	15	52

EVT clearly has a better record at achieving savings in the GT areas with more large commercial and industrial customers. Rutland, the GT region added in 2009, and North Chittenden consistently outperformed the other GT regions in terms of the major metrics, as discussed below.

- Savings per premise in the North Chittenden region were the highest among the GT regions in PYs 2007/2008 and only exceeded by Rutland in 2009.
- The acceleration rate in North Chittenden was consistent between the two time periods and indicates that it would take about three times longer for the statewide programs to achieve the same levels of savings as the GT programs.
- Rutland had by far the highest savings per utility premise (energy, winter and summer kW) of all of the GT regions during PY2009.
- While the other GT regions experienced a sharp drop in participation between 2007/2008 and 2009, the participation rate per utility premise in Rutland was similar to the 2007/2008 rates for the other GT areas.

Through the telephone surveys conducted as part of the process evaluation, we also learned that the participating C&I firms tended to be larger businesses than non participants as measured by revenues and number of employees.

In contrast, the Southern Loop, covering a large area that is largely rural and dominated by a couple of large resorts, had the worst performance on many of the metrics and certain indicators show that the GT programs were only a marginal improvement over the statewide non-GT programs. The energy, winter and summer kW peak savings per utility premise are the lowest of the five GT regions in both time periods. The winter kW peak acceleration rate is 1.5 for the initial period and 1.2 for PY 2009, indicating that the program implementation during the latter period was similar to the statewide programs. Difficulties in achieving savings in this area were apparently compounded by the high level of seasonal activity in and around the resort areas.

Despite the Southern Loop's low performance on many metrics, the GT programs in this region were estimated to save 4.1% in comparison to the utility 2007 peak, which is in the same range as the other GT regions. Given that the substation and feeder analysis indicated that the winter peak occurs earlier in the day than the ISO-NE peak period (early evening) and a high percentage of savings are from lighting in commercial establishments (with many closing around 5 PM), it seemed that the peak savings based on program data for the Southern Loop could be understated in this analysis. However, the substation analysis found that the impacts in the Southern Loop were indeterminate due to shifts in customer usage and the small savings in relation to the system load, particularly for a few large C&I customers that changed usage patterns in response to rate incentives.

Longer Term Impacts

There are signs that the initial high level of savings in the GT regions may not be sustainable over a longer time horizon as the programs are currently implemented. For some areas, falling participation rates and lower savings per utility premise suggest that it will be more difficult to achieve accelerated savings in the future. Given the dramatic drop in participation across the board in PY 2009, the evaluators reviewed the data to assess whether these effects were related to non-program factors, such as the economic downturn, or an indication of slowing activity in the GT regions.

This analysis indicated that some of this decrease may be due to the economic downturn. However the decrease in participation was more precipitous in the three GT regions with consistent participation over the two-and-a-half years of implementation in comparison to statewide non-GT initiatives. Overall, the statewide non-GT participation rate dropped from 3.2% to 2.2% between PY 07/08 and PY 2009 (a reduction of 32%). The three GT regions with implementation during both periods show an average decrease from 11.4% to 4.1% (a reduction of 64%). In addition, the reduction in participation in the GT regions was largely due to lower activity in the C&I sector, which could be related to lower program incentives for the Lighting Plus program,[7] the economic downturn, having reached the more accessible parts of the C&I market during the initial implementation period, or other factors. In contrast, the primary driver of the lower savings in the statewide non-GT regions was a drop in CFL purchases and updated estimated savings for CFL's. These results suggest that the GT activity is slowing in most of the GT regions with program implementation covering the entire period. North Chittenden appears to be a possible exception to this trend.

Substation Analysis

Navigant's impact evaluation of GT area load patterns indicates savings from customers participating in the program can be detected at the utility system level, but with some uncertainty, particularly in areas with large shifts in electric consumption among customers. Confounding factors such as customer migration and economic variations, were addressed through the analysis of feeders and substations inside and outside of the GT regions and accounting for participation in EVT programs, as explained in more detail above in the "Methods" section. Specific findings are described briefly below:

- The use of substation or feeder hourly load when coupled with normalization factors derived from billing data support verified demand savings from program records. A higher number of participants would enhance confidence in measured results to further support this finding.
- The level of demand reduction detected at the feeder level was relatively small compared to total feeder maximum demand (7MW versus 180MW total). Nonetheless, the methods employed to measure savings enabled the team to reasonably predict results. Further, the level of variability in achieved savings may be viewed as consistent with uncertainties associated with load projections.
- The impact of GT programs for CVPS' Southern Loop is less firm than other regions, as shifts in customer usage and low savings relative to the GT area peak resulted in demand reduction estimates with a higher level of uncertainty.
- Findings indicate the level of demand savings from GT programs versus statewide programs do not show a high level of variance in demand savings for the summer peak months.
- Sufficient lead time is needed by utility planners to use GT as an effective method to defer investments, as near-term upgrades were constructed due to uncertainty that sufficient GT peak demand reductions would be achieved. A minimum five-year planning horizon is recommended.

This preliminary analysis suggests greater savings, both on a participant and total system basis, have

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[7] Incentives for the Lighting Plus initiative were lowered from a 100 percent free direct-install program to one requiring the customer's portion of first costs is be based on an estimated one-year payback.

been achieved from GT versus statewide EE programs. However, the relatively low level of demand reduction versus total GT area load for this impact evaluation introduces the potential for anomalies or errors that may distort demand trends.

Conclusions

This experimental approach to assessing the potential for deferring or delaying transmission and distribution ("T&D") upgrades through energy efficiency suggests that it is possible to achieve substantial reduction within a confined region in a relatively short period of time (two to three years), as determined through the impact evaluation of EVT's program savings and supported by the analysis of substation and feeder load data. Through its GT initiative, EVT achieved deeper, faster and broader savings in comparison to the statewide non-GT efforts. Savings per premise were more than double and achieved two to three times faster by means of the GT-specific program enhancements. The GT approach resulted in reductions of up to 7% of the peak load.

The GT programs as implemented are cost effective using the statewide avoided costs and other Vermont screening tool assumptions. Lighting efficiency, particularly in the C&I sector, was the primary vehicle for EVT's accomplishments in the GT regions. Also, as shown by the high saving per C&I premise and supported by the results of the telephone survey, the EVT programs have been quite successful among the large C&I customers. With benefit/cost ratios around 2, there is room to pursue more comprehensive savings that may be more costly to obtain. Sustained savings may be essential as up to five years lead time could be needed to defer certain T&D investments. Further, sufficient time is needed to achieve a level of savings that would reduce load in amounts large enough to enable a utility to rely on GT to defer the investment. Modification to program designs to target more comprehensive savings at each site may open up further opportunities for savings in the existing GT regions.

This study provides insight that may be useful for the planning of GT programs in terms of the timing of the savings and the characteristics of the regions where GT efforts are more likely to be effective. Given the program delivery mechanisms used by EVT, it appears that the accelerated pace can be maintained for two to three years, suggesting that a lead time of three years may provide substantial benefits depending on the level of reduction required. Transmission and distribution (T&D) deferrals that are planned ten years in the future will likely benefit equally from statewide programs and not require accelerated implementation. It is possible that modifications to program design, such as focusing on end uses other than lighting or the addition of new lighting technologies, may allow for greater savings through future programs activities. More information about the remaining efficiency potential would need to be collected to support further program planning.

While EVT's delivery mechanisms were fairly consistent over the GT regions, the resulting savings were widely varied, indicating that the characteristics of the region exerted a greater influence over the end results than the methods used to achieve the savings. The results of the analysis suggest that GT activities are more likely to be effective in condensed urban areas with a high level of C&I activity. The Southern Loop stands out as covering a large area that is largely rural, residential, has fewer large C&I customers, and also has the lowest performance of the five GT regions as found through both the traditional impact methods and the substation/feeder analysis. In contrast, the Rutland and Chittenden regions are more predominantly commercial/industrial, with a high percentage of C&I customers and the highest number of large C&I accounts. These two regions showed consistently strong results in all aspects of the analysis.

One of the key findings in our analysis is that total savings derived using utility load and billing data was reasonably close, in aggregate, to calculated savings. We also confirmed the reduction in use per GT participant was higher than for non-participants. Lastly, we confirmed that more savings were achieved in the GT regions as compared to the non-GT areas.

The impact evaluation further illuminated the many challenges associated with measuring GT savings via utility substation and feeder load data. Because the amount of firm demand savings is often a small percentage of peak demand, load data must be carefully scrubbed and normalized to account for customer migration, weather, feeder reconfiguration, distributed generation, demand response programs, rate incentives, and other factors to avoid under or overstating savings. The availability of detailed billing data was essential in this study to normalize the load data.

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