"Walking the Walk" of Distributed Utility Planning: Deploying Demand-Side Transmission and Distribution Resources in Vermont's "Southern Loop"

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ABSTRACT

Although Vermont's distribution utilities were relieved of responsibility for system-wide efficiency resource planning and acquisition with the establishment of Efficiency Vermont, they remain responsible for planning and acquiring additional targeted DSM if it would form part of a least-cost solution for meeting transmission and distribution (T&D) requirements. To meet least-cost planning requirements, Vermont statute and regulation obligate utilities to demonstrate that any proposed wires solutions constitute the lowest-cost alternatives among a full range of alternative resource configurations, which must include localized demand-side management and distributed generation options.

Served by Central Vermont Public Service Co. (CVPS), Vermont's "Southern Loop" stretches from southwestern to southeastern Vermont. CVPS and the state's transmission utility, Vermont Electric Power Company (VELCO), have found that reliability solutions are needed imminently at current loads, and that reliability needs intensify under continued load growth. CVPS used a distributed utility planning (DUP) scoping tool to assess potential for additional DSM to defer need for T&D upgrades. Preliminary analysis found that while additional DSM could not solve immediate reliability problems, it could potentially defer need for subsequent T&D investment to meet future reliability needs. Subsequently, CVPS and VELCO engaged consultants to gain better estimates of the potential costs and contributions from distributed resources to meet the region's future reliability needs. This paper reports the findings of this research and analysis. It presents the methodology used to refine estimates of localized electricity savings, the market strategies that would be deployed to procure additional DSM savings, to verify such savings, and findings and conclusions on the likely role of DSM in meeting future reliability needs in the Southern Loop.

Need to Address Transmission Issues in Vermont's Southern Loop

Vermont's Southern Loop is a 66-mile, 46 kilovolt (kV) transmission line running from Bennington to Brattleboro with a current peak demand (in winter) of about 120 megawatts (MW). Total annual energy sales are approximately 587 gigawatt-hours (GWh). There is a 69-kV line that supplies the Brattleboro area, and both the 69-kV and 46-kV lines are fed by 115-kV lines terminating in Bennington and Brattleboro (CVPS 2006). Over the past decade, peak winter demand has grown by about 0.5 percent annually, and energy use by about 1.3 percent annually, although this growth has seen two separate peaks (one in 1998-99 and one more recently in 2004-2005). There are about 27,000 single-family residential customers, 3,700 multifamily dwellings, and 5,700 commercial and industrial (C&I) customers. "Industrial" customers include

[1] The opinions expressed by the author are his and do not represent those of CVPS.

ski areas (with peak loads of 15 MW), hospitals, lumber yards, wood products manufacturers, plastics manufacturing, and food processors. There is only limited combined heat and power production, and no distributed generation.

CVPS reduced and managed load growth with DSM programs throughout the 1990s, emphasizing fuel-switching, high-efficiency snowmaking equipment, and aggressive load management contracts and mandatory time-of-use pricing for large customers and voluntary TOU pricing for small customers. Since 2000, Efficiency Vermont – the state's efficiency utility – continued and expanded efficiency investment. Despite these efforts at reducing load, additional solutions are needed to deal with five core issues (CVPS 2006):

- Reliability exposure to an unplanned loss of a transmission line or a transformer. Such a loss may cause unacceptably low voltage in Southern Vermont at as little as 45 percent of peak demand, which the Southern Loop experiences 66 percent of the time;
- Reliability exposure in Brattleboro to the unplanned loss of a transmission line or a transformer;
- Reliability exposure to a long-term loss of the Vermont Yankee nuclear power plant's transformer;
- Future demand growth, which may exceed the capability of the Southern Loop to operate properly even with all facilities in service; and
- Future problems in the wider regional transmission system.

The Southern Loop Leadership Team – comprised of local officials, legislators, planners and public interest group representatives and two utility officials – created the following problem statement: "Southern Vermont electrical transmission facilities have limited ability to support increased electrical demand and are unable to withstand failures of, or to have preventive maintenance conducted on, key components at present demand levels. The reliability of the regional bulk transmission system that connects southern Vermont, southwestern New Hampshire and northwest Massachusetts is at risk at existing demand levels, with increasing reliability risk as regional electrical levels increase."

Regulatory Landscape

In the mid-1980's Central Vermont proposed that a third 46 kV transmission source be connected to the Southern Loop near its center. The Vermont Public Service Board reviewed the application and determined that, on a probabilistic basis, the company had not made a sufficient case for the need for the new source. The Board directed the company to implement aggressive load management and to analyze the reliability need based on the probability that the facility would need reinforcement in order to provide adequate service. For the subsequent 20 years Central Vermont, now in combination with Efficiency Vermont, has managed peak loads through aggressive pricing programs and energy efficiency targeted at lowering peak winter energy consumption.

The regulatory landscape for transmission and distribution (T&D) planning in Vermont changed in 2005 with the passage of Act 61, which amended Title 30, Chapter 5 of Vermont State Statutes. Companies need to identify T&D issues in advance (through a 10-year T&D plan) and quantify the extent to which DSM, distributed generation, and combined heat and power can defer or alleviate those problems. With this change in Vermont statute, the state's bulk transmission utility, the Vermont Electric Company (VELCO) now has the obligation to identify in its transmission planning process, the demand or supply parameters that generation, demand response, energy efficiency or other nontransmission strategies would need to address the identified reliability deficiencies. Vermont's distribution utilities have been required to integrate DSM into their distribution planning since the creation of the statewide energy-efficiency utility, Efficiency Vermont, in 2000.[2]

VELCO and Central Vermont Public Service (CVPS) started their recent planning for the Southern Loop in early 2003. VELCO and CVPS utilized Vermont's Distributed Utility Planning (DUP) Scoping Tool to develop a preliminary estimate the DSM potential in the area *at the same time as* they developed wires solutions to the reliability problem.[3] CVPS used the DUP Scoping Tool results as initial inputs to the economic and power planning models to determine which T&D elements might be deferred under lower forecast loads. Initial planning analysis using the DUP scoping results found that while potential DSM load reductions would not be sufficient to solve the immediate reliability problem in the Southern Loop, such reductions could potentially permit VELCO and CVPS to cost effectively postpone and/or alter future aspects of a series of investments in wires solutions.

With favorable findings from the preliminary analysis, CVPS and VELCO proceeded to develop DSM savings and cost estimates suitable for comparison with the potential transmission investments. The savings and cost estimates were designed to meet local characteristics, the distribution of load across six analysis zones, and the particular timing needs for deferring T&D investments. The results will then be used by the economic and power planning models to develop several potential resource configurations involving different combinations of wires and non-wires solutions, including the energy-efficiency load reductions found in our planning analysis for VELCO and CVPS.

Distributed Utility Planning Scoping Tool Results

As a first step at estimating the DSM potential CVPS used the Distributed Utility Planning (DUP) Scoping Tool, developed for the Vermont Department of Public Service. Based on the number of residential customers and commercial and industrial electricity sales data in the transmission-constrained area, this tool scales the results from two Vermont 2003 achievable potential studies to provide a preliminary estimate of the DSM potential over 10 years.

The preliminary findings from the DUP Scoping Tool indicated that additional DSM could not defer immediate transmission problems, but may defer need for subsequent transmission investment to meet reliability needs in the future. Overall, the tool estimated that over a 10-year timeframe, DSM could provide 25.8 MW of Winter peak demand reduction at the customer meter (29.4 MW at generation) and energy savings of 136 GWh per year (cumulative) at the meter, or 20 percent of forecast demand and energy use. The DUP Scoping Tool also helped identify the most likely energy end-uses and sectors to provide significant savings. Table 1 shows the top ten residential efficiency measures predicted to provide the most winter

[2] PSB Decision in Docket 5980, 1999.

[3] The DUP scoping tool is an Microsoft Excel workbook created by the authors to enable Vermont's twenty-plus electric utilities to assess whether more detailed DSM analysis would be warranted, i.e., whether potentially achievable load reductions could cost-effectively defer planned distribution investments.

peak MW savings potential (at the customer meter).[4] Fuel-switching and lighting measures account for 73 percent of the residential winter peak MW savings.

Table 1. Top Residential Measures from DUP Scoping Tool

Top 10 Measures	Program	Winter Peak Savings (MW)	% of Total
ESH Fuel Switch	Retrofit	3.76	29%
DHW Fuel Switch	Retrofit	2.81	22%
Dryer Fuel Switch	Retrofit	1.36	10%
Clothes Washer (E-Star)	Retail	0.41	3%
1st Refrig Early Retirement	Retrofit	0.40	3%
Ceiling Fan	Retrofit	0.40	3%
Torchiere	Retrofit	0.39	3%
CFL (Screw-Base)	Retail	0.34	3%
Hard-wired indoor fixture	Retrofit	0.28	2%
Torchiere	Retail	0.28	2%

Source: DUP Scoping Tool Results

Table 2 shows the top 15 commercial and industrial measures predicted to provide the most winter peak MW savings potential (again at the customer meter).

Table 2. Top Commercial & Industrial Measures from DUP Scoping Tool

Top 15 Measures	Winter Peak Savings (MW)	% of Total
Heat Fuel Switch – Resistance	2.06	20%
HE fixtures/design Tier I	1.84	18%
Heat Fuel Switch – HP	1.14	11%
WH Fuel Switch	0.70	7%
CFL – interior	0.69	7%
Specular Reflectors	0.58	6%
Retrocommissioning	0.48	5%
EMS/Controls – HEAT	0.42	4%
Integrated Building Design	0.31	3%
High Performance Glazing - HEAT	0.27	3%
Occupancy on/off	0.26	3%
T8 lamp/ballast	0.21	2%
Heat pump water heaters WH	0.21	2%
Commissioning	0.20	2%
Industrial Process	0.15	1%

Source: DUP Scoping Tool Results

Table 3 provides the commercial and industrial achievable potential savings by building type and indicates which energy end-uses dominate. As the results indicate, the demand-reduction potential estimated by the DUP Scoping Tool is highly sensitive to market saturation of electric resistance heat (e.g., space heating, domestic hot water, residential appliances) and energy-efficient lighting. Significant deviations from statewide averages would result in under-

[4] The Southern Loop is winter peaking, due in most part to the ski areas.

or over-estimates of the achievable potential. The current version of the tool has also not integrated recent advances in lighting technology not covered in the tool – notably "Super T8" and "high-intensity fluorescent" systems – and also simplifies an analysis of the industrial efficiency potential.

Table 3. Commercial and Industrial Savings by Building Type

Building Type	Winter Demand Savings (MW)	% of Total	Savings Dominated by
Retail	2.12	20%	Space heating, then light.
Education	1.98	10%	Lighting, then space heat
Office	1.80	17%	Space heating & lighting
Health	1.32	13%	Space heating & lighting
Lodging	0.99	10%	Space heating
Restaurant	0.80	8%	Water heating, then light.
Industrial	0.64	6%	Indoor lighting, then misc.
Grocery	0.60	6%	Indoor lighting
Warehouse	0.09	1%	Indoor lighting
Agriculture	0.02	0%	Ventilation

Source: DUP Scoping Tool Results

The DUP Scoping Tool's results are also sensitive to Efficiency Vermont's performance to date in the Southern Loop. A review of the Efficiency Vermont database identified completed and active projects in the Southern Loop. Efficiency Vermont's 5-year efforts (March 2000 through September 2005) yielded claimed winter demand savings (at generation) of 5.9 MW and annual energy savings of 30 GWh (at generation). The single largest measure category contributing to winter demand reduction was energy-efficient snowmaking at the ski areas, comprising 3 MW of the demand reduction and 6.6 GWh of energy use reduction. Table 4 shows the remaining contributions to winter demand reduction by measure category.

These results suggest that Efficiency Vermont has either not found or not pursued the space heat fuel switch potential identified by the DUP Scoping Tool or that the tool has identified an on-peak end use that is much less prevalent in this subregion than the statewide potential studies would suggest. Additionally, industrial process efficiency – particularly with "mountain operations" at ski resorts – can play a greater role in demand reduction than forecast by the DUP Scoping Tool.

Table 4. Efficiency Vermont Winter MW Savings in the Southern Loop by Measure Category

Measure Category	Winter Demand Savings (MW)	Percent of Total
Light Bulb/Lamp	0.71	12.18%
Lighting Hardwired Fixture	0.55	9.43%
Space Heat Fuel Switch	0.28	4.76%
Industrial Process Efficiency	0.26	4.42%
Refrigeration	0.25	4.32%
Lighting Efficiency/Controls	0.23	3.91%
Compressed Air	0.19	3.28%
Cooking and Laundry	0.11	1.96%
Motor Controls	0.10	1.73%
Other Fuel Switch	0.08	1.40%
Hot Water Fuel Switch	0.07	1.16%
Ventilation	0.04	0.61%
Hot Water Efficiency	0.02	0.42%
Design Assistance	0.02	0.36%
Motors	0.02	0.28%
Space Heat Efficiency	0.01	0.23%
Air Conditioning Efficiency	0.01	0.19%
Thermal Shell	0.01	0.11%

Source: Query of Efficiency Vermont database 2000-2005

Refining the Economically Achievable DSM Potential

To provide a determination of potentially achievable DSM savings, a more current analysis more specific to the Southern Loop area was required. CVPS and VELCO engaged Optimal Energy Inc., Vermont Energy Investment Corporation and Green Energy Economics Group to assist in a detailed analysis of potential efficiency, renewable and cogeneration options.

While the DUP Scoping Tool provided a general sense as to the potential magnitude of DSM savings, CVPS and VELCO needed more geographically-specific results. The DUP Scoping Tool relies upon the most recent Vermont statewide DSM potential study, but the Southern Loop has substantially different characteristics from the rest of the state:

- Load in two of the analysis zones is dominated by ski areas, which make them and the Southern Loop as a whole winter-peaking, unlike the rest of the state and the region;
- A significant portion of the residential load comes from ski condominiums, with more electric heat than the statewide average and different occupancy rates and tenant/landlord relationships;
- Different mixes of large commercial and industrial customers than the statewide average; and
- Declining sales in the small and medium commercial market.

As a result, the analysis team developed a methodology to "ground" the initial statewide analysis with direct field experience and stratified site visits. For example, Efficiency Vermont has experience implementing the Home Performance with ENERGY STAR® program in the

Southern Loop. The project database and field experience provided information on baseline technologies and systems (e.g., electric space heat and electric domestic hot water systems). Working with CVPS and Efficiency Vermont, refinements were made to establish counts of homes with electric space heat, domestic hot water and appliances and to reflect installations that have occurred in the Southern Loop, both prior to and by Efficiency Vermont.

For the commercial and industrial sector, site visits were conducted for many of the large customers (with demand greater than 100 kW) and to a stratified sample of smaller accounts. Of the 140 large commercial and industrial accounts, 44 locations were visited to assess efficiency opportunities and another 10 have completed projects through Efficiency Vermont. The sites visited represented 61 percent of the large C&I MWh energy use. The efficiency opportunities at the visited sites were then applied to the other large C&I customers of the same building or facility type. For the small to medium commercial and industrial customers walkthroughs were conducted at more than 50 locations. The information found from the walkthroughs was used to refine general assumptions, such as baseline equipment, for the customers with similar building types.

The analysis also assessed the generation potential for photovoltaic systems and combined heat and power. For photovoltaic systems, basic information on the number and type of electric accounts for each area was used as a basis for developing scoping estimates of potential summer and winter peak capacity savings, annual electric generation and associated costs. Further inputs to the analysis included average available roof space by account type, average applicability, average costs and annual output, and summer and winter peak capacity coincidence factors. For combined heat and power, the analysis team developed a survey instrument to capture information on thermal and electric loads at a wide range of facilities, including minimum, average, and maximum loads, type of heat distribution (e.g., hot water, low pressure steam, high pressure steam), and coincidence hours between heat and electric loads. These survey results were translated into general measure characterizations, matching loads to generation technologies with associated costs, fuel use, and other operation and maintenance characteristics.

Based on the results from the DUP scoping analysis and Efficiency Vermont's experience in the Southern Loop area, the team developed program concepts that would target the end uses and markets with high savings potential that could be acquired cost effectively. Generally, the team focused on two program types:

- Retrofit programs that would aggressively capture demand savings in the first four years, providing the demand reduction needed to respond to special needs such as offsetting high power costs and potentially deferring transmission upgrades; and
- Lost Opportunity projects that increase incentive offers above and beyond what Efficiency Vermont currently offers, and that make use of a more aggressive sales approach that leads to greater completion rates (Kleinman et al. 2006).

The residential program concepts evaluated were:

- Ski Area Residential/Multifamily New Construction
- Enhanced Community Challenges
- Targeted High Use Residential Direct Install
- Appliance Turn-In

- Ski Area Fuel Switch
- Efficient Products
- Low Income (single- and multifamily)
- HVAC lost opportunity
- Home Performance with ENERGY STAR®

The commercial and industrial program concepts evaluated were:

- Small-Medium Commercial Direct Install
- Targeted Large Commercial & Industrial Retrofit
- Enhanced Prescriptive Offers (C&I Lost Opportunity)
- Photovoltaics
- Combined Heat & Power (CHP)

For retrofit opportunities the analysis separated large commercial and industrial customers with greater than 100 kW demand from the small to medium commercial customers. Savings were separately estimated for each of the large commercial and industrial customers, but the small to medium commercial savings were estimated as groups by building type.

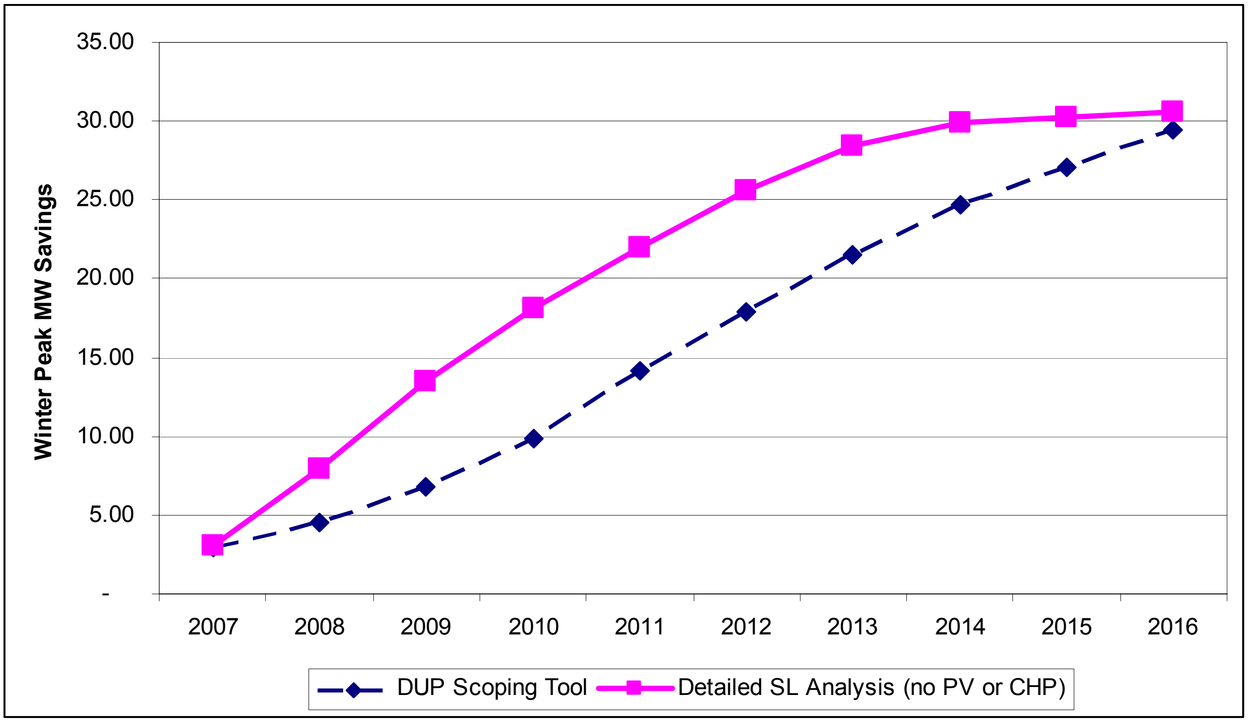
Results

Interestingly, the Southern Loop analysis forecasts an achievable potential very close to that estimated by the DUP scoping tool, although the specific program design (with its focus on retrofit programs) yields demand savings at a faster rate. Table 8 shows that the analysis projects potential winter demand savings (at generation) of about 31 MW, compared to the 29 MW estimated by the tool. The rate of demand savings acquisition can be better seen in Figure 1 - within the first four years, the Southern Loop program design is expected to achieve about 18 MW, as opposed to the DUP Scoping Tool's projection of 10 MW over the same time period.

Table 8. Comparison of Scoping Tool and Detailed Analysis Winter Peak MW Savings (Excluding PV and CHP)

Cumulative annual	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
DUP Scoping Tool	2.97	4.55	6.77	9.86	14.12	17.95	21.53	24.67	27.11	29.42
Detailed SL Analysis (no PV or CHP)	3.06	7.88	13.45	18.15	21.93	25.56	28.40	29.92	30.29	30.61

Figure 1. Comparison of Scoping Tool and Detailed Analysis Winter Peak MW Savings



The more localized analysis does, however, produce a significantly different budget estimate. The DUP Scoping Tool projected the combination of measure costs and program delivery costs at $66.1 million (2006 present worth]. Currently, the Southern Loop analysis estimates the implementation budget (financial incentive and other program delivery costs) at $89.3 million. This may be partly explained by the use of retrofit programs to achieve demand savings earlier in the time horizon, rather than relying upon lost opportunity programs to achieve demand savings at each market event. It is also explained by Efficiency Vermont data indicating higher costs (on a per-kWh-saved basis) than those utilized in the DUP Scoping Tool.

Table 9 presents net costs (both societal and utility) per winter peak kW reduction. These net costs deduct the value of avoided energy use (in the case of utility costs) as well as other resource costs (in the case of societal costs, e.g., fossil fuel use, water use, operations and maintenance costs, and air emission externalities). The analysis shows that demand savings can be achieved at a negative net societal cost by factoring in these other savings.

Table 9. Societal and Utility Costs for Southern Loop Initiatives

2006$	Net Societal Cost Per Winter Peak kW-Yr	Net Utility Cost Per Winter Peak kW-Yr
Direct Install	$45.81	($100.53)
Efficient Products	($459.00)	($304.62)
Home Performance	($96.24)	($124.79)
HVAC	($203.27)	($70.40)
Low Income	$88.40	$21.00
Res New Construction	($1,872.51)	$1,168.18
Appliance Turn-In	$191.23	$655.16
Commercial Direct Install	($284.48)	($316.18)
Large C/I Retrofit	($280.21)	($271.80)
C/I Lost Opportunity	($393.22)	($154.75)
C/I New Construction	($336.39)	($94.44)
Combined Heat & Power	$97.71	($285.94)
Photovoltaics	$1,800.40	$622.93

Next Steps

Summary of Significant Risks in the Analysis Conducted to Date

While these estimates of energy efficiency resource availability are a significant improvement relative to the original scoping analysis, additional work is necessary to design programs, provide information for program management, to monitor and evaluate the effectiveness of the investments and to design financing and cost allocation mechanisms. Levels of customer incentives and delivery mechanisms can be adjusted to respond to program delivery monitoring results such as market penetration. Since the investments are intended to defer future capacity constraints from future load growth, the increase in background load growth net of the energy efficiency and large, threshold growth such as ski area or residential developments can be monitored to guide program delivery changes and/or development of transmission facilities to maintain reliability. In addition to the results of the pro forma economic analysis, the magnitude and timing of DSM investments must also be evaluated. As the Vermont Public Service Board noted in its 2002 Order regarding statewide energy efficiency funding: “The least-cost provision of … [Vermont statutes] does not require that the Board always choose the option that has the lowest total life-cycle cost. It requires a reasonable balancing of all factors including the magnitude of the initial investment and the timing of those investments, to achieve the optimum long-term benefits to Vermont ratepayers without short-term costs that are unacceptable.”

Financing and cost allocation mechanisms will need to be developed to align the financial liability with the asset owners and to assign the costs in alignment with the benefits. For example, a distribution utility has difficulty raising capital for an asset owned by the customer; also, more benefits flow to customers with efficiency measures.

Community Workshops Exploring DSM and Other Alternatives

A community working group of about 20 people will help CVPS and VELCO refine the recommendations for solving the transmission problem in the Southern Loop and make public presentations on how the proposals were developed. A series of open houses will be held to keep the public apprised of the community working group's efforts and gain more feedback from the public. This process is ongoing; by the time this paper is presented, it is likely that to have produced updated results.

Detailed Design and Implementation Planning for First-Stage Programs

CVPS and VELCO will now work to develop more detailed verification, financial, design and implementation planning for first-stage programs. Efforts will likely begin by focusing on a town-specific initiative in Manchester – one of the towns on the Southern Loop. The Manchester analysis will be at a finer level of granularity then the analysis of the whole Southern Loop.

All of this work may culminate with applications for regulatory approval by CVPS to proceed with both first-stage DSM and the initial wires solution of adding a synchronous condenser. The application for the DSM would fall under Section 209 involving a rate surcharge mechanism. The application for the synchronous condenser would fall under Section 248, requiring approval for a certificate of public convenience.

Findings and Conclusions

Vermont is certainly unique in many ways. Aside from its small size, low density, and cool climate compared to the rest of the U.S., it operates under an unusually advanced regulatory regime concerning DSM that requires full integration of DSM in electricity resource planning, including transmission and distribution. Vermont also has a statewide energy-efficiency utility delivering a full range of DSM services to all electricity consumers. These features make Vermont an excellent proving ground for demonstrating the potential contribution targeted DSM could make toward avoiding some of the billions of dollars worth of T&D investment planned over the next decade throughout the rest of the country. Experience so far by VELCO and CVPS reveals potentially valuable study findings and uncertainties for utilities and regulators everywhere looking to procure energy-efficiency as clean and economical alternatives to supply solutions to reliability problems.

The first lesson from the Vermont Southern Loop experience is that a preliminary DSM scoping tool can provide useful information to help determine whether further investigation of DSM alternatives to reliability problems is worthwhile. Such a scoping tool enables a utility to take a relatively low-cost first cut at the potential contribution from energy-efficiency in any zone of its network.

The second lesson is that such scoping analysis is not sufficient for detailed analysis and planning needed to configure and initially compare reliability investment alternatives. More detailed analysis is needed to reflect actual end-use efficiency conditions and opportunities, especially when the area has already been and/or is likely to be served for a long time by pre-existing DSM programs and aggressive peak period pricing. The VELCO/CVPS analysis found greater but substantially different efficiency opportunities than uncovered by the preliminary analysis using the DUP scoping tool. One reason was the amount of time – three years – that had elapsed since the potential analysis underlying the scoping tool**.** Significant differences in the customer mix and end-uses in the subregion relative to the statewide study were major contributors to the discrepancies between the DUP scoping tool estimate and the detailed analysis results. Efficiency markets had evolved considerably, and Efficiency Vermont had accomplished significant savings in key areas of opportunity identified by the scoping tool.

Another finding from the VELCO/CVPS analysis that reinforces the need for more detailed DSM verification is that substantial effort is needed to synchronize and reconcile estimates of DSM potential with the utility's underlying load forecasts for sub-zones of the Southern Loop. Efficiency potential estimates are predicated on end-use analysis, whereas forecasts of loads on distribution substations are usually based on historical trends.

The results of the Southern Loop analysis also have wide applicability in at least two respects. First, the projected value of electric energy savings from end-use efficiency improvements approaches and sometimes exceeds the projected present worth of the entire costs of the efficiency resources. This means that the net societal cost per kW or per kW-year of demand-side transmission and distribution capacity can be close to or less than zero. This is consistent to the profile of generation solutions to reliability needs, where the market value of energy production is credited against the total cost of the supply. The lower costs of efficiency, however, coupled with current and expected market prices for electric energy in the much of the US, will tend to show similarly low or negative net societal costs per kW of peak load reduction.

Finally, the VELCO/CVPS analysis confirms what previous analysis of and experience with targeted DSM have shown: accelerated investment in energy-efficiency is far more likely to have a material effect on planned T&D investment several years into the future than in the very short term. This follows naturally from the fact that it takes time even for concerted DSM investment to reach a strategic scale with respect to anticipated T&D capacity investments. This means that for targeted DSM to be part of a least-cost integrated solution to reliability problems, it must be factored into the analysis and verified early in the process of developing, analyzing, and planning wires solutions.

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