

Demand-Side Transmission and Distribution Capacity from Energy-Efficiency Resources: Vermont's Evolving Approach

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Energy Efficiency as a Resource
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Vermont Energy Investment Corporation

Vermont Energy Investment Corporation (VEIC)

- non-profit organization
- 85 full-time employees
- \$17 million annual budget
- Mission: reduce the economic, social and environmental costs of energy consumption through the promotion of cost-effective energy efficiency and renewable energy technologies
- Efficiency Vermont contract
- Energy-Efficiency and Renewable Energy Consulting in 20+ States and 8 Countries

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Vermont's Regulatory Setting

Overview

- Statewide transmission utility (VELCO)
- Least-cost planning obligation for transmission and distribution utilities
- Distributed utility planning collaboratives

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Vermont's Regulatory Setting

Statewide transmission utility

- Vermont Electric Power Company - VELCO
- Owned by the 22 Distribution Utilities in Vermont
- "Northwest Vermont area faces serve reliability problems". VELCO proposes Northwest Reliability Project (NRP)

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Vermont's Regulatory Setting

T&D Least-cost planning obligation

- Section 248 of the V.S.A. 30
- "is required to meet the need for present and future demand for service which could not otherwise be provided in a more cost effective manner through energy conservation programs and measures and energy-efficiency and load management measures"

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Vermont's Regulatory Setting

Distributed Utility Planning Collaboratives

- Docket 5980 Memorandum of Understanding
 - Signed by all of Vermont's 22 distribution utilities
 - Created Efficiency Vermont
 - Requires the distribution utilities to pursue Distributed Utility Planning
 - Efficiency Vermont is obligated to fulfill DU collaborative requests for targeted efficiency

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Integrating Efficiency: Transmission & Distribution Planning

Transmission Planning

- Client: VELCO
- Performed an assessment of economically deliverable transmission capacity from targeted energy-efficiency

Distribution Planning

- Client: VT Distributed Utility Planning Collaborative
- Developed an area-specific energy-efficiency scoping tool

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Integrating Efficiency: Transmission Planning (VELCO)

Approach

- Large capital investment over a decade
- Promoting market-proven technologies and implementation strategies
- Supported by sustained marketing and generous financial incentives

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Integrating Efficiency: Transmission Planning (VELCO)

Summary of Analysis

- Based on 2002 Vermont Statewide Potential Study
 - included all of Vermont
 - included all sectors and all markets
 - included all measures
 - used penetration rates for 50/50 prediction
- VEIC and Optimal Energy, Inc. conducted both the Statewide and VELCO studies

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Integrating Efficiency: Transmission Planning (VELCO)

Summary of Analysis (con't.)

- Limited the measures to Northwest Vermont
- Excluded measures:
 - with limited peak demand impact
 - that require regional coordination
 - that rely on emerging technologies
 - not cost-effective (based on societal test)
- Lowered penetration rates to increase degree of confidence in results

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Integrating Efficiency: Transmission Planning (VELCO)

Summary of Residential Analysis

- Built up from end-use disaggregations
- 3 Markets: retail, retrofit and new construction
- 36 technologies, 2 building types, 70 measures
- Data Sources:
 - US EPA ENERGY STAR® Programs
 - Vermont DPS Residential Energy Assessment
 - US EIA Residential Energy Consumption Survey (RECS)
 - Vermont DSM program experience

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Integrating Efficiency: Transmission Planning (VELCO)

Summary of C&I Analysis

- Disaggregated sales forecast into building types and end-uses
- 4 Markets: Renovation, Replacement, Retrofit and New Construction
- 11 Building Types, 9 End-Uses
- Primary Data Sources:
 - Utility sales data by SIC
 - RER hourly load shapes
 - US EIA Commercial Energy Consumption Survey

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Integrating Efficiency: Transmission Planning (VELCO)

Energy Efficiency Findings

- Inner and Metro Region
- Includes Efficiency Vermont program savings
- 97 Summer MW saved economically by 2012
- \$268 million in net societal benefits¹
- **(\$3,007)/kW** or **(\$250)/kW-yr** net transmission cost

¹Does not include transmission benefits

Note: all dollar values are in 2003 dollars

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Integrating Efficiency: Transmission Planning (VELCO)

Evaluated Scenarios

- NRP - 115 kV and 345 kV transmission lines
- ARC 5 - 120 MW of CT and 74 MW DSM
- 4 other generation scenarios

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Integrating Efficiency: Transmission Planning (VELCO)

Comparison of Integrated Scenarios

- NRP is \$66 million (5.4%) greater than ARC 5
 - Present value total societal costs
- NRP is \$17 million (1.4%) greater than ARC 5
 - Present value total societal costs adjusted for NEPOOL Transmission Tariff
- VELCO is economically indifferent between scenarios

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Integrating Efficiency: Transmission Planning (VELCO)

Energy Efficiency

- Advantages:
 - Negative Net Costs
 - Can be acquired in small blocks
 - Risk-mitigation: Savings vary with underlying load
- Disadvantages
 - Highly capital intensive
 - May be less certain a resource than transmission lines
 - Requires concerted effort by multiple parties
 - Cost are not currently socialized across power pool

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Integrating Efficiency: Transmission Planning (VELCO)

Transmission Project (NRP)

- Advantages:
 - Does not rely on multiple parties
 - Greater resource certainty
 - Costs are currently socialized across power pool
- Disadvantages
 - Construction delay risk
 - Permitting risk
 - Construction Cost risk
 - Resource is acquired in large blocks

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Integrating Efficiency: Distribution Planning (DUP)

Distributed Utility Planning Collaboratives

- The 22 distribution utilities in Vermont are required to pursue Distributed Utility Planning
- Efficiency Vermont is obligated to fulfill DU collaborative requests for targeted efficiency

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Integrating Efficiency: Distribution Planning (DUP)

Problem

- How to cost-effectively assess the energy-efficiency potential of distribution-constrained area
 - Distribution utilities no longer employ DSM staff in Vermont
 - All distribution-constrained areas are not equal
 - Need ability to quickly assess potential in an area

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Integrating Efficiency: Distribution Planning (DUP)

Solution

- DUP Scoping Tool
 - Quickly assesses if the energy-efficiency potential is large enough to cost-effectively defer distribution upgrades
 - Designed for constrained area of any size
 - Allows the DU to determine if a detailed study of an area is necessary
 - Includes currently planned Efficiency Vermont programs

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Integrating Efficiency: Distribution Planning (DUP)

Summary of DUP Tool

- Based on 2002 Vermont Statewide Potential Study and 2003 VELCO analysis
- VEIC and Optimal Energy, Inc. conducted both the Statewide and VELCO studies

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Integrating Efficiency: Distribution Planning (DUP)

Summary of DUP Tool (con't.)

- Excluded measures:
 - with limited peak demand impact
 - that require regional coordination
 - that rely on emerging technologies
 - not cost-effective (based on societal test)
- Penetration rates increased due to ability to focus marketing efforts in specific area

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DUP Scoping Tool: Sample Inputs

Microsoft Excel - Scoping Tool V3.1.xls

VT DSM Scoping Tool
Enter Data for the Analysis Area Only

Update Reset All Defaults Review Measures Print Sheets

Edit Defaults Edit Measures Edit Additional Edit Miscellaneous Edit Custom

Bldg ID	Building Type	Notes	Default Assumptions			Existing Customers in Area			New Buildings in Area				
			Substation Factor (%)	Elec Space Heat	Central A/C	Elec DMV	Existing % efficient	# of units	2 summer only	2 winter only	Yr. 1	Yr. 2	Yr. 3
R1	Single Family		2.4%	3.4%	56.0%	0%	500						
R2	Multi-Family	> 5 Units	36.4%	3.0%	26.6%	0%							

Bldg ID	Building Type	Notes	sq. ft. per buildings	kWh per sq. ft.	Existing % efficient	# of Bldg	Total kWh/yr	2 summer only	2 winter only	Thousands of sq. ft. per year			
										Yr. 1	Yr. 2	Yr. 3	Yr. 4
1	Small Office	<15,000 kWh/yr	5,000	14.25	0%	1	71						
2	Large Office	>15,000 kWh/yr	25,000	14.25	0%	1	356						
3	Retail	Secondary and primary only	20,000	8.5	0%	1	170						
4	Restaurants		3,250	29	0%	1	94						
5	Small Retail	<15,000 kWh/yr	2,500	10	0%	1	25						
6	Large Retail	>15,000 kWh/yr	20,000	10	0%	1	200						
7	Warehouse		15,000	23	0%	1	345						
8	Grocery		25,000	29	0%	1	725						
9	Leisure	BBQs; non-residential single family	15,000	11.65	0%	1	175						
10	Warehouses	Large; hospital; more exp. custom	20,000	25.5	0%	1	510						
11	Health		10,000	25.5	0%	1	255						
12	Small Industrial	Included; auto service; For large industrial use	1,500	10	0%	1	15						
13	Farm		2,350	10	0%	1	23.5						
14	Miscellaneous 1	Miscellaneous allows for custom combinations of other categories (e.g., 1/2 weighted average)			0%								
15	Miscellaneous 2				0%								
16	Custom 1	Custom allows for a completely new user defined energy intensity and loadshape.			0%								
17	Custom 2				0%								
18	Custom 3				0%								
19	Custom 4				0%								

Filename: Scoping Tool V3.1.xls

Inputs Potential Savings for Area EVT BED Prgm Savings for Ar

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DUP Scoping Tool: Sample Measures

Microsoft Excel - Scoping Tool V3.1.xls

Residential - Achievable Savings, Costs and Economics

Incremental Net Annual MWh at Meter

Measure Toggle	End-Use	Default's	Measure ID1	Measure ID2	Measure ID3	Cost1	Cost2	BCF	2003	2004	2005	2006
1 or 0	Adj. E. ▼	Measure Name	type	Use	ROI	\$/kW	\$/kW					
1	1.00	Calling Fan	MF	lighting	inc	1 (1163.63)	1 (0.07)	4.71	0.006	0.006	0.006	0.013
2	1	Central A/C (proper sizing/install)	MF	cooling	inc	1 (142.40)	1 (0.23)	280.91	0.000	0.001	0.001	0.002
3	1	CFL	MF	lighting	inc	1 (910.06)	1 (0.05)	3.32	0.024	0.029	0.039	0.069
4	1	Clothes Washer (E-Star)	MF	wash	inc	1 (2208.15)	1 (0.26)	3.90	0.050	0.048	0.053	0.100
5	1	Common area dehumidification/controls	MF	lighting	inc	1 (1145.05)	1 (0.07)	5.31	0.084	0.087	0.091	0.169
6	1	DMV fuel-switch	MF	dmv	inc	1 (366.63)	1 (0.07)	2.23	0.027	0.028	0.034	0.071
7	1	Dishwasher (E-Star)	MF	dish	inc	1 (890.56)	1 (0.11)	5.67	0.010	0.010	0.012	0.024
8	1	Dryer fuel-switch	MF	dryer	inc	1 (367.86)	1 (0.06)	2.92	0.122	0.127	0.154	0.321
9	1	Ekhout fan (E-Star)	MF	misc	inc	1 (382.71)	1 (0.04)	1.96	0.214	0.221	0.265	0.548
10	1	Fanrace fan	MF	heating	inc	1 (2,110.21)	1 (0.12)	4.95	0.016	0.026	0.047	0.124
11	1	GFZ (electric DMV only)	MF	dmv	inc	1 (138.22)	1 (0.03)	0.80	0.002	0.002	0.002	0.004
12	1	Hard-wired indoor age fixture	MF	lighting	inc	1 (1375.54)	1 (0.08)	1.95	0.410	0.436	0.542	1.151
13	1	Hard-wired outdoor fixture	MF	lighting	inc	1 (1448.00)	1 (0.08)	1.12	0.072	0.073	0.085	0.170
14	1	HVAC/Boil - Central A/C	MF	cooling	inc	1 (765.66)	1 (0.13)	4.12	0.003	0.003	0.003	0.007
15	1	HVAC/Boil - no A/C	MF	heating	inc	1 (160)	1 (0.07)	3.71	0.007	0.008	0.009	0.020
16	1	HVAC/Boil - Room A/C	MF	cooling	inc	1 (845.37)	1 (0.10)	4.32	0.006	0.009	0.011	0.022
17	1	Refrigerator (E-Star)	MF	refrig	inc	1 (652.66)	1 (0.03)	1.95	0.003	0.004	0.004	0.009
18	1	Calling Fan	SF	lighting	inc	1 (1188.71)	1 (0.07)	4.71	0.087	0.086	0.089	0.193
19	1	Central A/C (proper sizing/install)	SF	cooling	inc	1 (137.31)	1 (0.30)	566.77	0.007	0.009	0.011	0.025
20	1	CFL	SF	lighting	inc	1 (924.95)	1 (0.05)	3.30	0.257	0.270	0.330	0.654
21	1	Clothes Washer (E-Star)	SF	wash	inc	1 (1465.05)	1 (0.24)	2.33	0.196	0.199	0.192	0.107
22	1	DMV fuel-switch	SF	dmv	inc	1 (324.62)	1 (0.05)	1.91	0.725	0.754	0.912	1.904
23	1	Dishwasher (E-Star)	SF	dish	inc	1 (880.11)	1 (0.11)	5.62	0.074	0.076	0.091	0.186
24	1	Dryer fuel-switch	SF	dryer	inc	1 (375.27)	1 (0.06)	2.02	0.333	0.370	1.173	2.448
25	1	Ekhout fan (E-Star)	SF	misc	inc	1 (333.55)	1 (0.04)	1.95	0.161	0.162	0.162	1.462
26	1	Fanrace fan	SF	heating	inc	1 (1593.50)	1 (0.10)	3.85	0.079	0.132	0.233	0.672
27	1	GFZ (electric DMV only)	SF	dmv	inc	1 (435.06)	1 (0.05)	0.68	0.055	0.054	0.060	0.114
28	1	Hard-wired indoor fixture	SF	lighting	inc	1 (1403.31)	1 (0.08)	1.06	2.074	2.216	2.741	5.523
29	1	Hard-wired outdoor fixture	SF	lighting	inc	1 (1444.05)	1 (0.08)	1.13	0.263	0.267	0.430	0.861
30	1	HVAC/Boil - Central A/C	SF	cooling	inc	1 (648.23)	1 (0.13)	4.12	0.048	0.050	0.060	0.126
31	1	HVAC/Boil - no A/C	SF	heating	inc	1 (162)	1 (0.07)	3.70	0.063	0.066	0.080	0.167

Remaining Costs Defaults Residential Commercial

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DUP Scoping Tool: Sample Outputs

Microsoft Excel - Scoping Tool V3.1.xls

VERMONT DISTRIBUTED UTILITY PLANNING COLLABORATIVE
DSM SCOPING TOOL
CUMULATIVE ANNUAL ELECTRICITY IMPACTS - TOTAL POTENTIAL
PROJECTED SAVINGS FOR ANALYSIS AREA

	YEAR							
	1	2	3	4	5	6	7	8
PEAK DEMAND (MW)	2003	2004	2005	2006	2007	2008	2009	2010
Summer	0.01	0.04	0.07	0.11	0.17	0.22	0.26	0.30
Winter	0.01	0.04	0.06	0.13	0.20	0.26	0.31	0.37
Spring/Fall	0.01	0.04	0.08	0.13	0.20	0.26	0.31	0.36
ENERGY (MWh)								
Summer peak	26	75	139	223	331	427	516	595
Summer off-peak	20	55	100	158	233	298	361	414
Winter peak	27	76	141	225	339	439	533	614
Winter off-peak	8	23	43	69	104	136	165	190
Total energy	80	230	422	675	1,008	1,299	1,576	1,813

**INCREMENTAL ANNUAL ELECTRICITY IMPACTS - TOTAL POTENTIAL
PROJECTED SAVINGS FOR ANALYSIS AREA**

	YEAR							
	1	2	3	4	5	6	7	8
PEAK DEMAND (MW)	2003	2004	2005	2006	2007	2008	2009	2010
Summer	0.01	0.02	0.03	0.04	0.05	0.05	0.05	0.04
Winter	0.01	0.03	0.04	0.05	0.07	0.06	0.06	0.05
Spring/Fall	0.01	0.03	0.04	0.05	0.07	0.06	0.06	0.05
ENERGY (MWh)								
Summer peak	26	49	64	84	109	96	90	85
Summer off-peak	20	36	45	58	75	66	63	60
Winter peak	27	50	64	84	114	100	95	90
Winter off-peak	8	15	20	26	36	31	30	28
Total energy	80	149	193	252	333	292	277	263

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DUP Scoping Tool: Sample Outputs

Microsoft Excel - Scoping Tool V3.1.xls

VERMONT DISTRIBUTED UTILITY PLANNING COLLABORATIVE
DSM SCOPING TOOL
COSTS OF ELECTRICITY SAVINGS FOR ANALYSIS AREA - TOTAL POTENTIAL
(Present Worth in 2003 Dollars)

TARGETED INITIATIVE	Targeted Initiative Costs					Less: Other Savings			DEFAULT Statewide T&D Capacity Savings
	Direct Technology	Other Costs	Total Costs	Delivery Costs*	Total Gross Societal Costs	Direct Energy Savings	Avoided Externalities	Generation Capacity Savings	
Residential									
New construction	\$44,637	\$19,251	\$63,888	\$26,589	\$90,477	\$33,485	\$10,215	\$18,455	\$20,821
Products and appliances	\$108,220	(\$21,850)	\$86,370	\$18,277	\$104,647	\$140,554	\$19,204	\$30,540	\$39,013
Retrofit	\$382,654	\$129,888	\$512,542	\$94,473	\$607,015	\$916,935	\$93,792	\$195,094	\$214,488
Subtotal residential	\$535,511	\$127,323	\$662,834	\$139,339	\$802,173	\$1,045,973	\$102,210	\$244,099	\$274,323
Commercial/Industrial									
New construction	\$18,472	\$293	\$18,765	\$18,766	\$37,532	\$58,235	\$6,179	\$16,663	\$17,160
Existing facilities	\$225,572	\$23,796	\$249,368	\$42,292	\$291,760	\$397,811	\$46,505	\$131,574	\$149,576
Custom facilities	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Subtotal CAI	\$244,044	\$24,089	\$268,133	\$61,058	\$329,192	\$456,047	\$52,684	\$148,237	\$166,736
TOTAL TARGETED INITIATIVE	\$779,555	\$151,412	\$930,967	\$200,437	\$1,131,405	\$1,502,020	\$154,894	\$392,336	\$441,059

*Delivery Costs are an approximation for delivering a complete program.

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DUP Scoping Tool: Sample Outputs

Microsoft Excel - Scoping Tool V3.1.xls

VERMONT DISTRIBUTED UTILITY PLANNING COLLABORATIVE
DSM SCOPING TOOL
COSTS OF ELECTRICITY SAVINGS FOR ANALYSIS AREA - TOTAL POTENTIAL
(Present Worth in 2003 Dollars)

Delivery Costs*	Total Gross Societal Costs	Direct Energy Savings	Avoided Externalities	Generation Capacity Savings	DEFAULT Statewide T&D Capacity Savings	Total Savings	Net Societal Costs			Cumulative Savings Through 2012	
							Net Costs (Costs - Savings)	Net Cost/ kW	Disc Rate 6.80% Net Cost/ kW-yr	Total Sum MW	Total MWh
\$26,589	\$90,477	\$83,485	\$10,215	\$18,495	\$20,821	\$142,975	(\$52,498)	(\$13,595)	(\$1168.98)	0.01	113
\$19,277	\$102,881	\$140,054	\$18,204	\$30,540	\$39,013	\$228,311	(\$125,630)	(\$5,780)	(\$589.09)	0.04	269
\$34,473	\$606,816	\$811,635	\$83,792	\$195,014	\$214,488	\$1,304,930	(\$638,114)	(\$3,051)	(\$743.52)	0.11	911
\$133,339	\$799,973	\$1,045,673	\$102,210	\$244,009	\$274,323	\$1,676,216	(\$376,243)	(\$8.436)	(\$725.32)	0.16	1,293
\$19,766	\$37,532	\$58,235	\$6,179	\$16,663	\$17,950	\$98,237	(\$50,706)	(\$10.481)	(\$886.69)	0.02	86
\$42,392	\$291,760	\$397,811	\$46,505	\$131,574	\$148,576	\$726,466	(\$433,706)	(\$4,524)	(\$444.44)	0.18	788
\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0.00	0.00	0
\$81,198	\$229,292	\$456,047	\$52,694	\$149,237	\$166,736	\$823,704	(\$494,412)	(\$5,901)	(\$565.01)	0.21	974
\$200,497	\$1,123,285	\$1,501,720	\$184,894	\$392,246	\$441,059	\$2,498,919	(\$1,270,655)	(\$4,912)	(\$441.65)	0.37	2,166

*Delivery Costs are an approximation for delivering a complete program.

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Integrating Efficiency: Prospects for the Future

Will Energy-Efficiency help mitigate future Transmission and Distribution upgrades in Vermont?

- VELCO is submitting filing this summer proposing constructing of the NRP
- Distribution utilities in Vermont are using the DUP Scoping Tool

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