1 SUMMARY

1.1 BACKGROUND

The Vermont Department of Public Service commissioned GDS Associates, Inc. (GDS). to conduct an assessment of energy efficiency potential in Vermont. Part of the assessment includes a study of the electric energy efficiency potential for Efficiency Vermont (EVT) and Burlington Electric Department (BED), and a study of the natural gas energy efficiency potential for Vermont Gas (VGS). This document provides a high level overview of the results of these electric and natural gas energy efficiency assessments.

GDS first assessed the technical and economic potential for each EEU. Then we conducted analysis for two achievable potential scenarios. These scenarios are defined as:

- **Achievable Potential Scenario 1:** A "maximum" achievable potential, defined consistent with the NAPEEE, assuming 100% measure incentives and aggressive measure adoption rates.
- **Achievable Potential Scenario 2:** A "realistic" achievable potential that takes into account typical EEU incentive levels and measure adoption rates that are more closely calibrated to historical levels.

The results below provide the savings and costs estimates for all sectors combined for both of these achievable potential scenarios.

1.2 RESULTS OVERVIEW

The following tables provide summary results in terms energy, demand and natural gas savings as well as costs for two the two achievable potential scenarios, MAP and RAP. There is also a table showing technical and economic potential.

1.2.1 Savings Estimates

Table 1-1 provides a short summary of the technical and economic potential for each EEU across the 20-yr timeframe of the study.

Table 1-1// 20-Year Technical and Economic Potential

EEU or Statewide Totals	20-yr Total
EVT	
Technical Potential (MWh)	1,340,164
Economic Potential (MWh)	1,175,429
BED	
Technical Potential (MWh)	122,271
Economic Potential (MWh)	103,975
VGS	
Technical Potential (MMBtu)	4,731,837
Economic Potential (MMBtu)	4,187,423
Statewide Technical Potential	
Technical Potential (MWh)	1,462,434
Technical Potential (% of MWh sales)	25.1%
Technical Potential (MMBtu)	4,731,837
Technical Potential (% of MMBtu sales)	41.0%
Statewide Economic Potential	

EEU or Statewide Totals	20-yr Total
Economic Potential (MWh)	1,279,404
Economic Potential (% of sales)	25.1%
Economic Potential (MMBtu)	4,187,423
Economic Potential (% of MMBtu sales)	36.3%

Table 1-2 provides the savings estimates s in the MAP scenario for each EEU and the combined statewide total. Table 1-3 provides the energy and natural gas savings as a percentage of forecasted electric energy and natural gas sales. The 3-yr cumulative annual savings estimates are 9.1% of forecasted electric energy sales and 13.4% of forecasted natural gas sales.

Table 1-2// MAP Savings by EEU and Statewide (Energy, Demand, Natural Gas, Peak Day Gas)

All Sectors Combined	2018	2019	2020	2027	2037
EVT					
Energy (MWh)	220,164	412,775	457,764	782,345	927,901
Summer Demand (MW)	25.2	47.0	57.9	111.2	127.3
Winter Demand (MW)	37.1	70.9	67.9	101.8	120.4
Natural Gas (MMBtu)	52,183	45,621	42,965	-3,716	-31,656
Peak Day Gas (MMBtu)	0.0	0.0	0.0	0.0	0.0
BED					
Energy (MWh)	17,292	33,295	39,078	70,170	86,311
Summer Demand (MW)	2.0	3.9	4.7	9.6	12.0
Winter Demand (MW)	2.9	5.5	5.9	10.2	12.4
Natural Gas (MMBtu)	5,260	9,105	9,585	8,737	8,660
Peak Day Gas (MMBtu)	0.0	0.0	0.0	0.0	0.0
VGS					
Energy (MWh)	0	0	0	0	0
Summer Demand (MW)	0.0	0.0	0.0	0.0	0.0
Winter Demand (MW)	0.0	0.0	0.0	0.0	0.0
Natural Gas (MMBtu)	445,246	871,177	1,292,942	2,615,206	3,204,984
Peak Day Gas (MMBtu)	4,444.4	5,124.4	6,033.3	9,276.7	2,167.2
Statewide					
Energy (MWh)	237,457	446,070	496,842	852,514	1,014,212
Summer Demand (MW)	27.2	50.9	62.7	120.8	139.4
Winter Demand (MW)	40.0	76.5	73.8	112.0	132.8
Natural Gas (MMBtu)	502,689	925,902	1,345,492	2,620,227	3,181,989
Peak Day Gas (MMBtu)	4,444.4	8,680.3	12,982.2	19,714.1	26,178.8

Table 1-3// MAP Savings as a Percentage of Forecasted Energy and Natural Gas Sales

All Sectors Combined	2018	2019	2020	2027	2037
Statewide					
Energy (as % of forecast sales)	4.3%	8.2%	9.1%	15.4%	17.4%
Natural Gas (as % of forecast sales)	5.1%	9.3%	13.4%	24.4%	27.6%

Table 1-4 provides the savings estimates s in the RAP scenario for each EEU and the combined statewide total. Table 1-5 provides the energy and natural gas savings as a percentage of forecasted electric energy and natural gas sales. The 3-yr cumulative annual savings estimates are 5.1% of forecasted electric energy sales and 3.3% of forecasted natural gas sales.

Table 1-4// RAP Savings by EEU and Statewide (Energy, Demand, Natural Gas, Peak Day Gas)

All Sectors Combined	2018	2019	2020	2027	2037
EVT					
Energy (MWh)	100,695	191,486	262,673	663,110	804,471
Summer Demand (MW)	13.4	25.4	35.5	96.6	112.1
Winter Demand (MW)	15.4	29.7	38.6	87.1	104.7
Natural Gas (MMBtu)	25,976	28,697	34,338	14,349	-11,050
Peak Day Gas (MMBtu)	0.0	0.0	0.0	0.0	0.0
BED					
Energy (MWh)	5,163	10,762	15,278	48,615	69,152
Summer Demand (MW)	0.6	1.2	1.8	6.0	9.6
Winter Demand (MW)	0.8	1.7	2.3	7.2	10.0
Natural Gas (MMBtu)	1,295	3,589	5,771	6,999	6,727
Peak Day Gas (MMBtu)	0.0	0.0	0.0	0.0	0.0
VGS					
Energy (MWh)	0	0	0	0	0
Summer Demand (MW)	0.0	0.0	0.0	0.0	0.0
Winter Demand (MW)	0.0	0.0	0.0	0.0	0.0
Natural Gas (MMBtu)	85,220	178,377	286,104	1,091,005	2,033,281
Peak Day Gas (MMBtu)	799.3	1,117.6	1,600.7	5,516.4	9,460.0
Statewide					
Energy (MWh)	105,858	202,249	277,951	711,725	873,624
Summer Demand (MW)	14.0	26.6	37.3	102.7	121.7
Winter Demand (MW)	16.3	31.4	41.0	94.2	114.7
Natural Gas (MMBtu)	112,491	210,663	326,214	1,112,353	2,028,957
Peak Day Gas (MMBtu)	799.3	1,680.2	2,729.6	7,241.9	12,085.1

Table 1-5// RAP Savings as a Percentage of Forecasted Energy and Natural Gas Sales

All Sectors Combined	2018	2019	2020	2027	2037
Statewide					
Energy (as % of forecast sales)	1.9%	3.7%	5.1%	12.8%	15.0%
Natural Gas (as % of forecast sales)	1.1%	2.1%	3.3%	10.4%	17.6%

1.2.2 Cost Estimates

Table 1-6 provides the annual budget estimates by EDC and statewide totals in the MAP scenario. Table 1-7 provides the annual budget estimates by EDC and statewide totals in the MAP scenario.

Table 1-6// MAP Budget Estimates by EDC and Statewide Total

Year	EVT	BED	VGS	Total
2018	$94.4	$9.2	$31.3	$134.9
2019	$91.7	$8.2	$29.9	$129.8
2020	$75.0	$6.4	$29.7	$111.1
2021	$74.4	$6.4	$29.2	$110.0
2022	$72.4	$6.7	$28.5	$107.6
2023	$52.8	$3.9	$20.6	$77.3
2024	$52.6	$3.8	$20.6	$76.9
2025	$52.2	$3.7	$20.2	$76.1
2026	$53.7	$4.3	$20.1	$78.1
2027	$52.7	$4.2	$19.8	$76.7
2028	$55.4	$4.4	$20.2	$80.0
2029	$55.1	$4.3	$19.9	$79.4
2030	$58.5	$5.0	$21.2	$84.7
2031	$57.6	$4.6	$21.3	$83.5
2032	$58.9	$4.2	$21.4	$84.5
2033	$65.4	$5.7	$23.7	$94.9
2034	$68.4	$6.2	$23.4	$98.0
2035	$65.6	$5.8	$21.9	$93.3
2036	$67.9	$5.7	$22.7	$96.3
2037	$66.8	$5.5	$22.6	$94.9

Table 1-7// RAP Budget Estimates by EDC and Statewide Total

Year	EVT	BED	VGS	Total
2018	$33.1	$2.1	$4.8	$40.1
2019	$33.7	$2.3	$5.7	$41.7
2020	$35.0	$2.3	$7.2	$44.6
2021	$39.1	$2.6	$8.0	$49.7
2022	$39.8	$2.9	$8.1	$50.8
2023	$38.2	$2.8	$8.8	$49.9
2024	$37.9	$2.8	$8.8	$49.6
2025	$37.4	$2.8	$8.8	$49.0
2026	$35.3	$3.1	$8.8	$47.2
2027	$31.9	$3.1	$8.9	$43.8

Year	EVT	BED	VGS	Total
2028	$30.0	$2.1	$9.6	$41.7
2029	$30.1	$2.0	$9.6	$41.7
2030	$32.5	$2.4	$9.9	$44.8
2031	$32.2	$2.4	$10.0	$44.5
2032	$32.3	$2.0	$10.0	$44.4
2033	$39.5	$3.4	$11.1	$53.9
2034	$40.4	$3.5	$11.1	$55.0
2035	$38.8	$3.3	$11.0	$53.2
2036	$39.7	$3.1	$11.2	$54.0
2037	$38.8	$3.0	$11.2	$53.0

1.3 DESCRIPTION OF SUMMARY SPREADSHEETS

The DPS has included as an attachment to this executive summary a set of summary spreadsheets for each EEU. The summary spreadsheets are contained in a two files for each EEU – one for the residential sector and one for the residential sector. Each file includes 8 worksheets. These worksheets are listed and described below. The worksheets provide identical information across the EEUs with the exceptions noted.

1. Measure Data – This tab provides the measure assumptions. For the residential sector, this includes measure name, home type, income type, unit energy and demand savings, measure costs, VT societal test ratios, and 20-yr technical and economic potential for each measure. For the C&I sector, this includes similar information including building type.

2. MAP Savings – This tab provides the measure level incremental and cumulative MWh energy and MW summer and winter demand savings for each year from 2018-2037 in the Maximum Achievable Potential scenario.

3. MAP Costs – This tab provides the measure incentives and admin costs for each year from 2018-2037 in the Maximum Achievable Potential scenario.

4. RAP Savings – This tab provides the measure level incremental and cumulative MWh energy and MW summer and winter demand savings for each year from 2018-2037 in the Realistic Achievable Potential scenario.

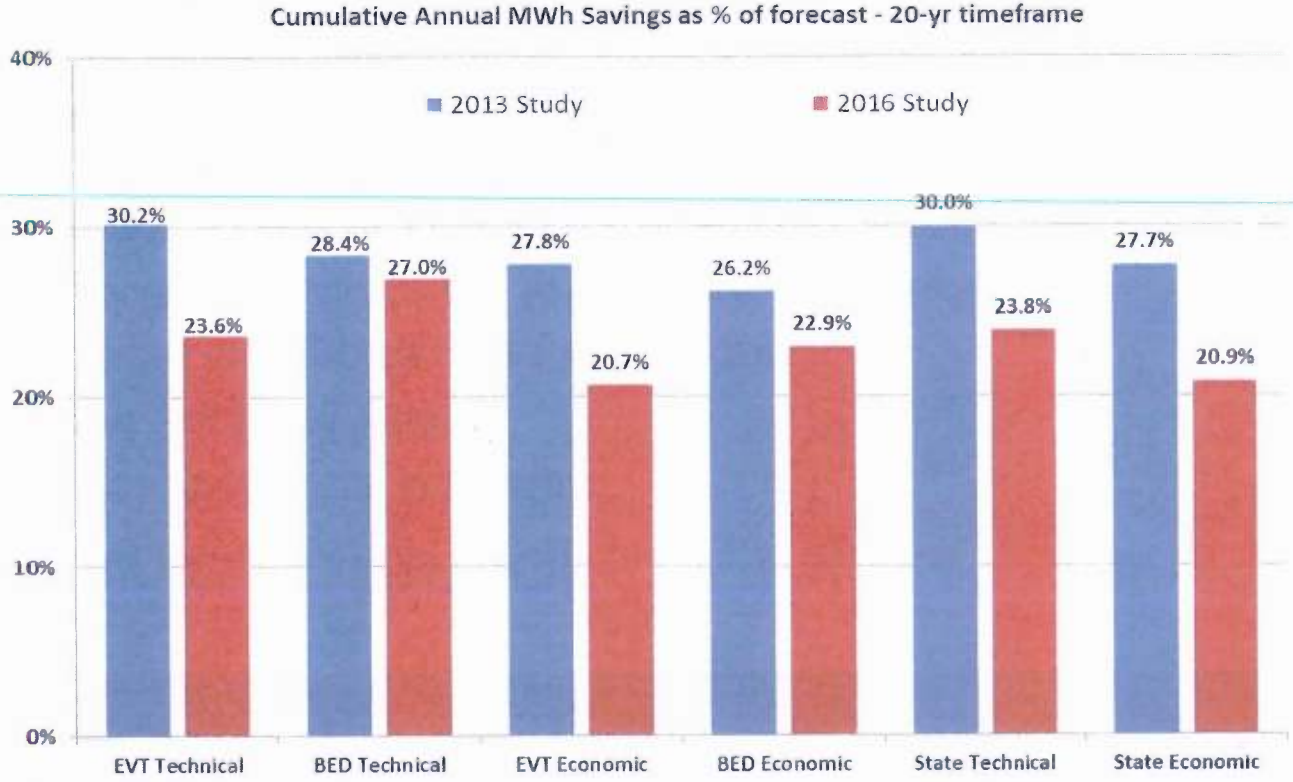
5. RAP Costs – This tab provides the measure incentives and admin costs for each year from 2018-2037 in the Realistic Achievable Potential scenario.

6. Summary – This tab provides the end-use level and total technical, economic, MAP and RAP MWh energy and MW demand (for EVT and BED; just MMBtu for VGS) for each year from 2018-2037.

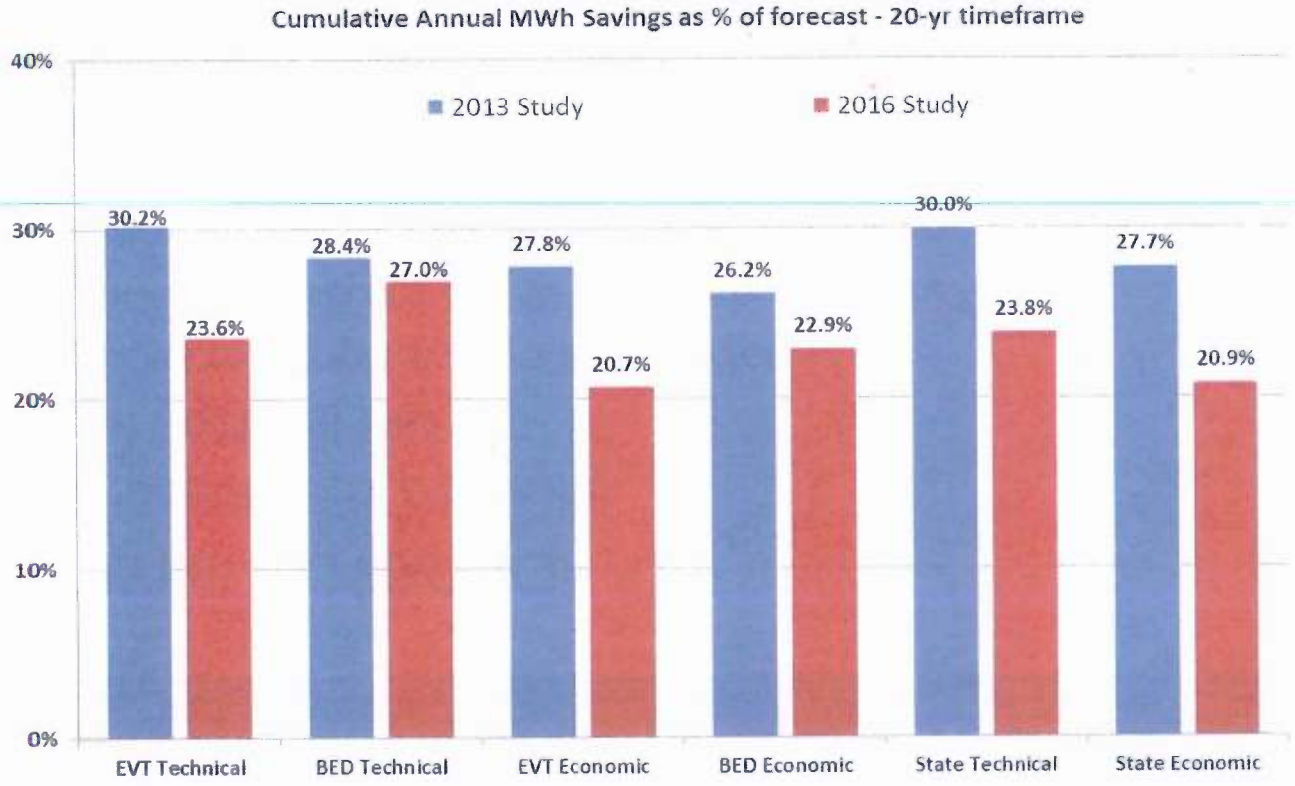
7. Board Outputs – This tab provides the data that satisfies the requirement for Board ordered outputs. This includes incremental and lifetime MWh, summer MW, winter MW, annual MMBtu savings; NPV lifetime TRBs, VT societal BC ratios, net NPV societal benefits, and lifetime greenhouse gas emissions avoided in metric tons.

8. Definitions – This tab provides several definitions of key terms and abbreviations used in the various worksheets in each file.

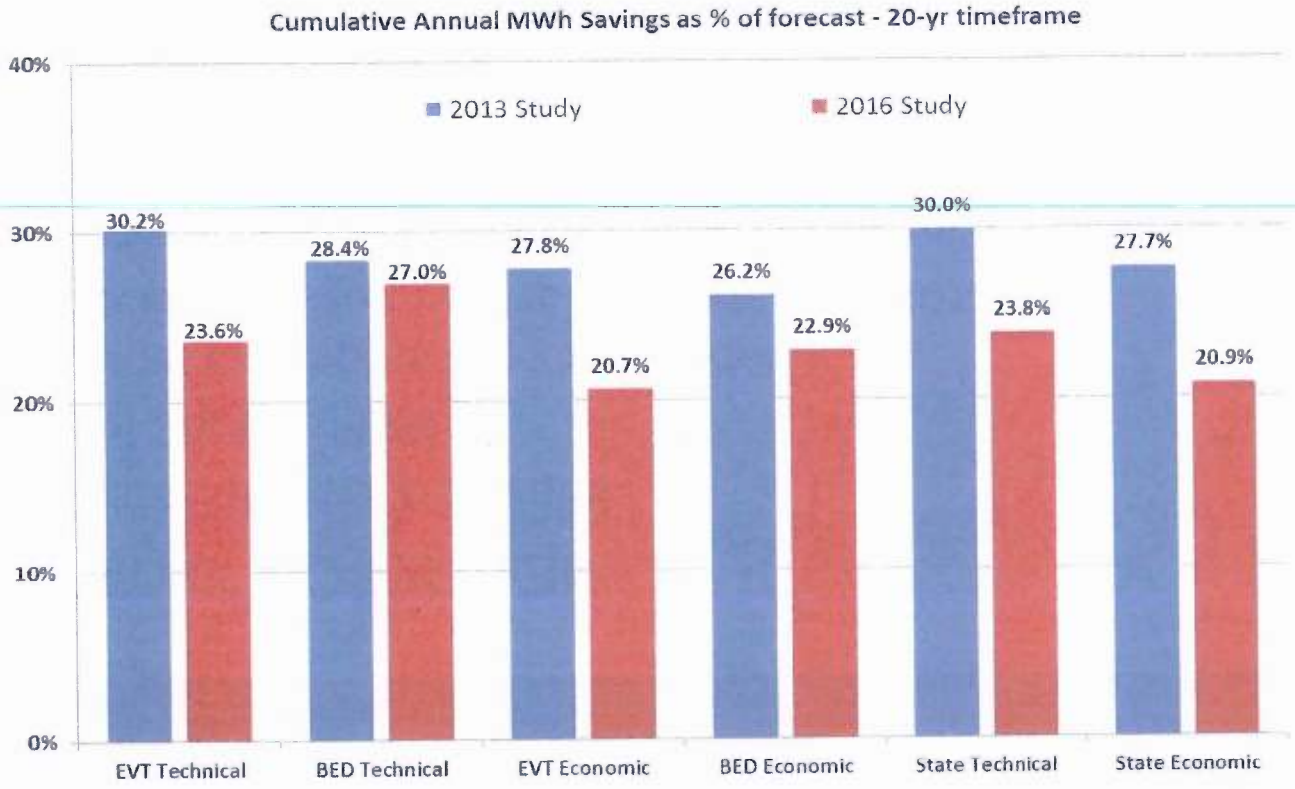
TECHNICAL AND ECONOMIC POTENTIAL 2013 VS 2016



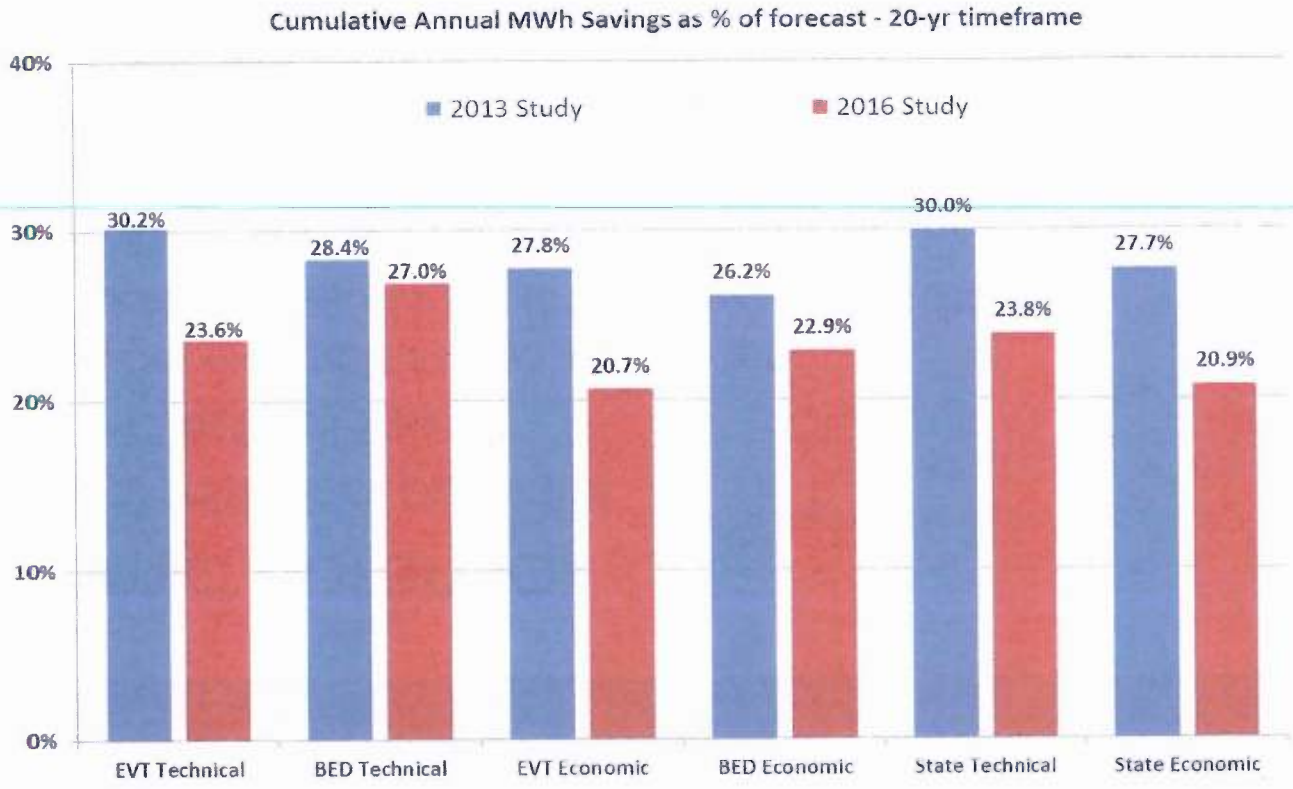
Technical and Economic Potential 2013 vs 2016



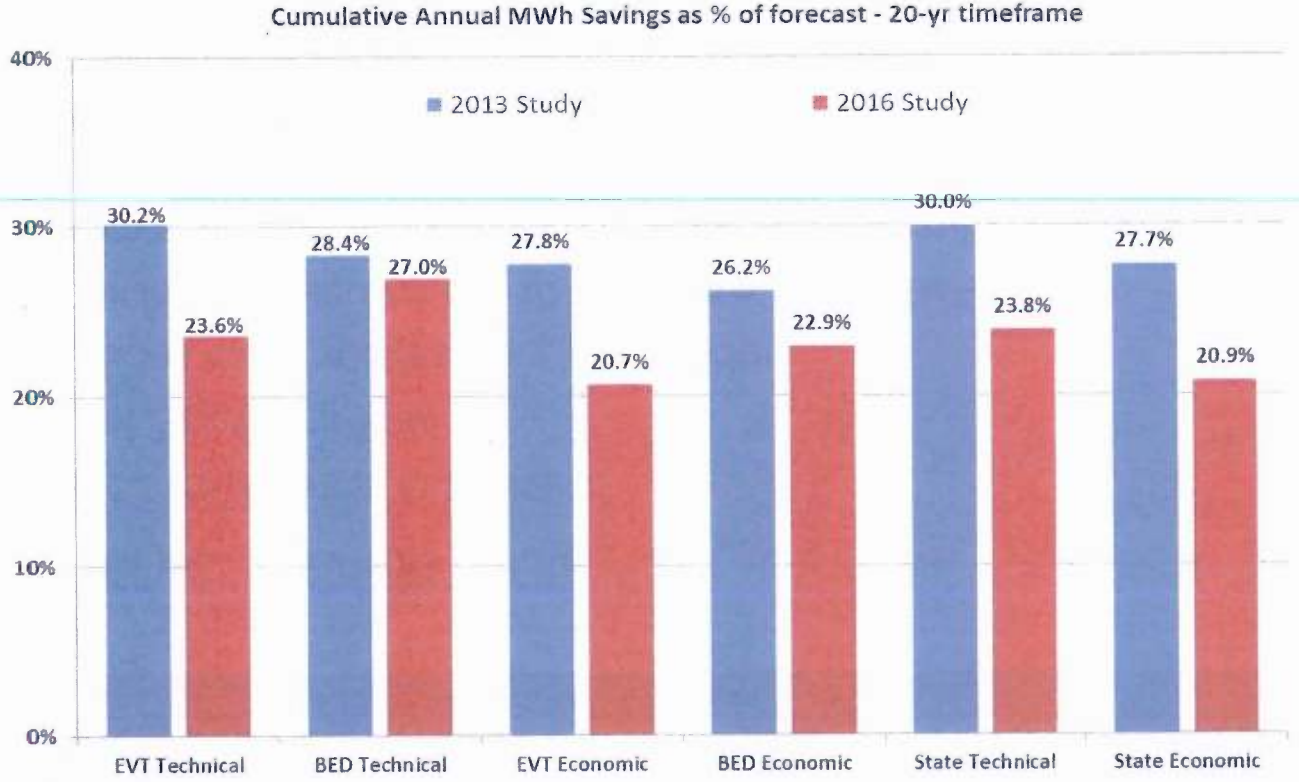
TECHNICAL AND ECONOMIC POTENTIAL 2013 VS 2016



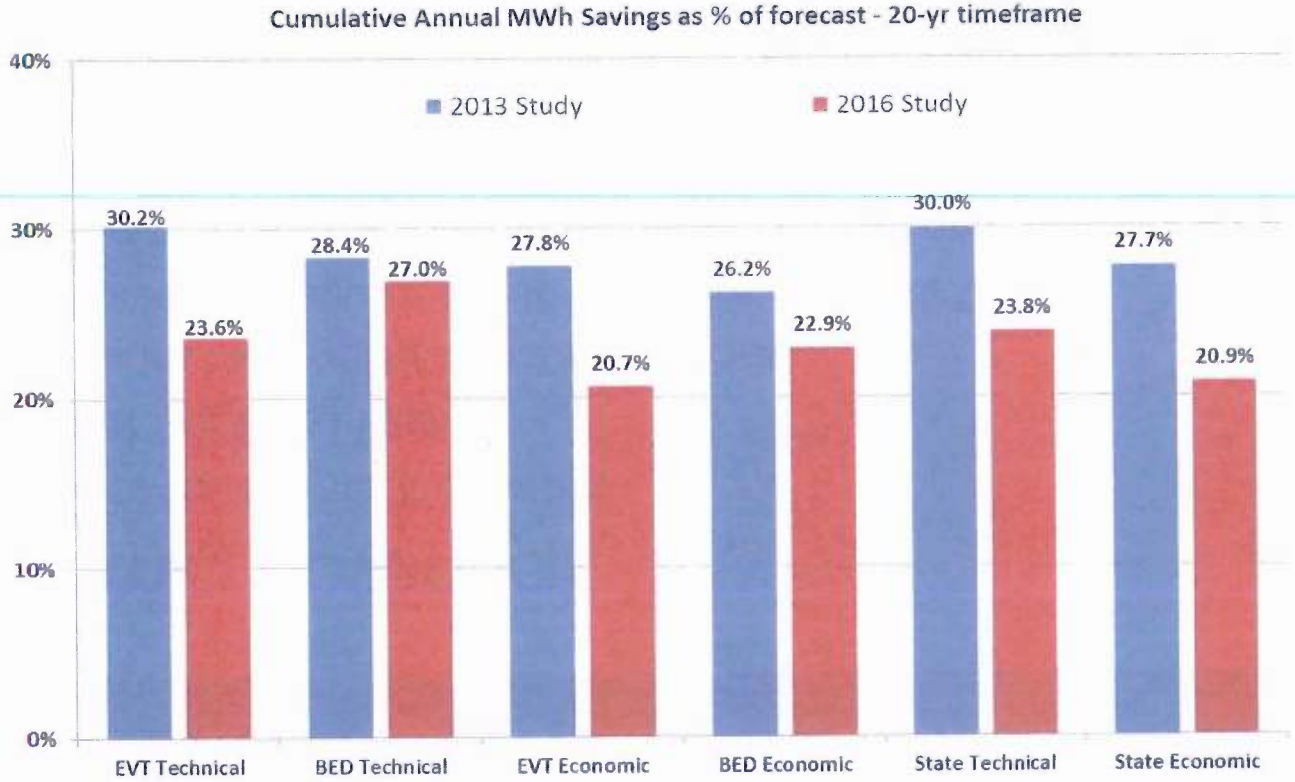
TECHNICAL AND ECONOMIC POTENTIAL 2013 VS 2016



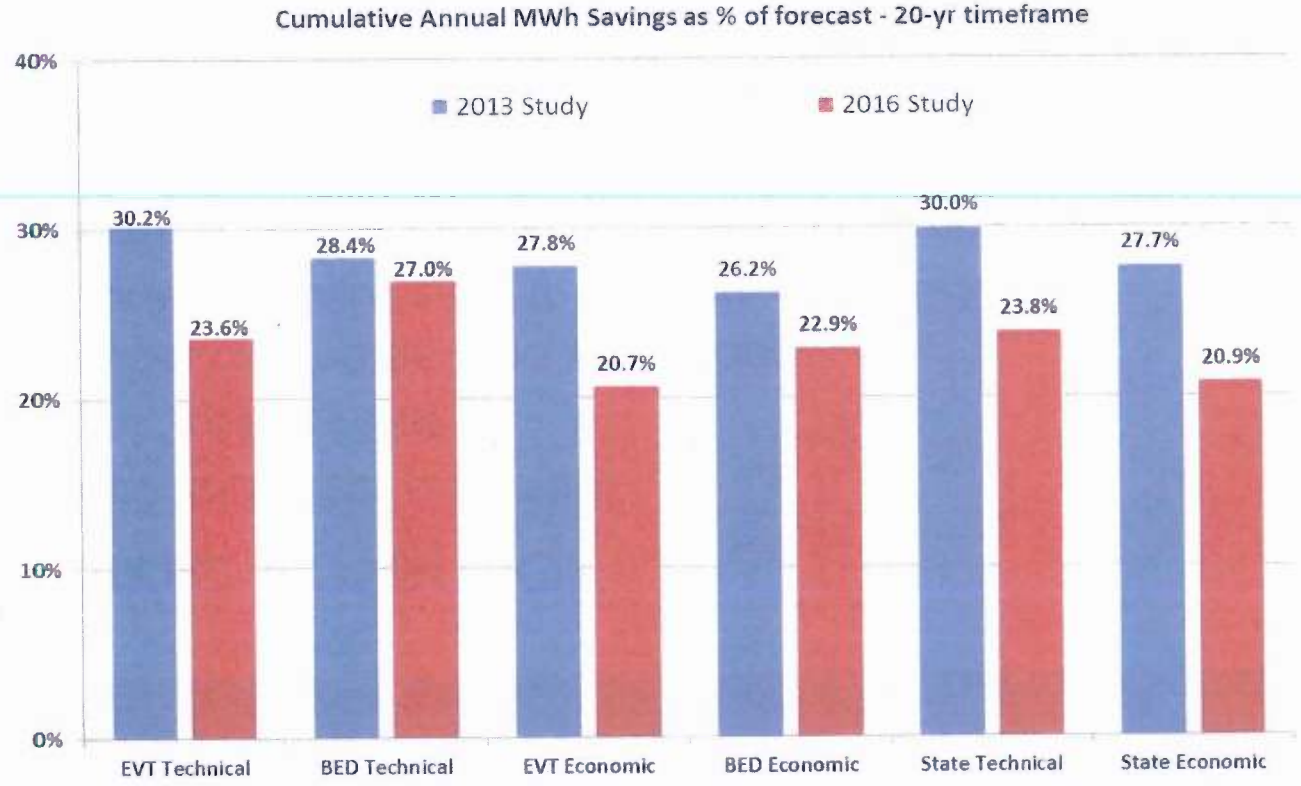
TECHNICAL AND ECONOMIC POTENTIAL 2013 VS 2016



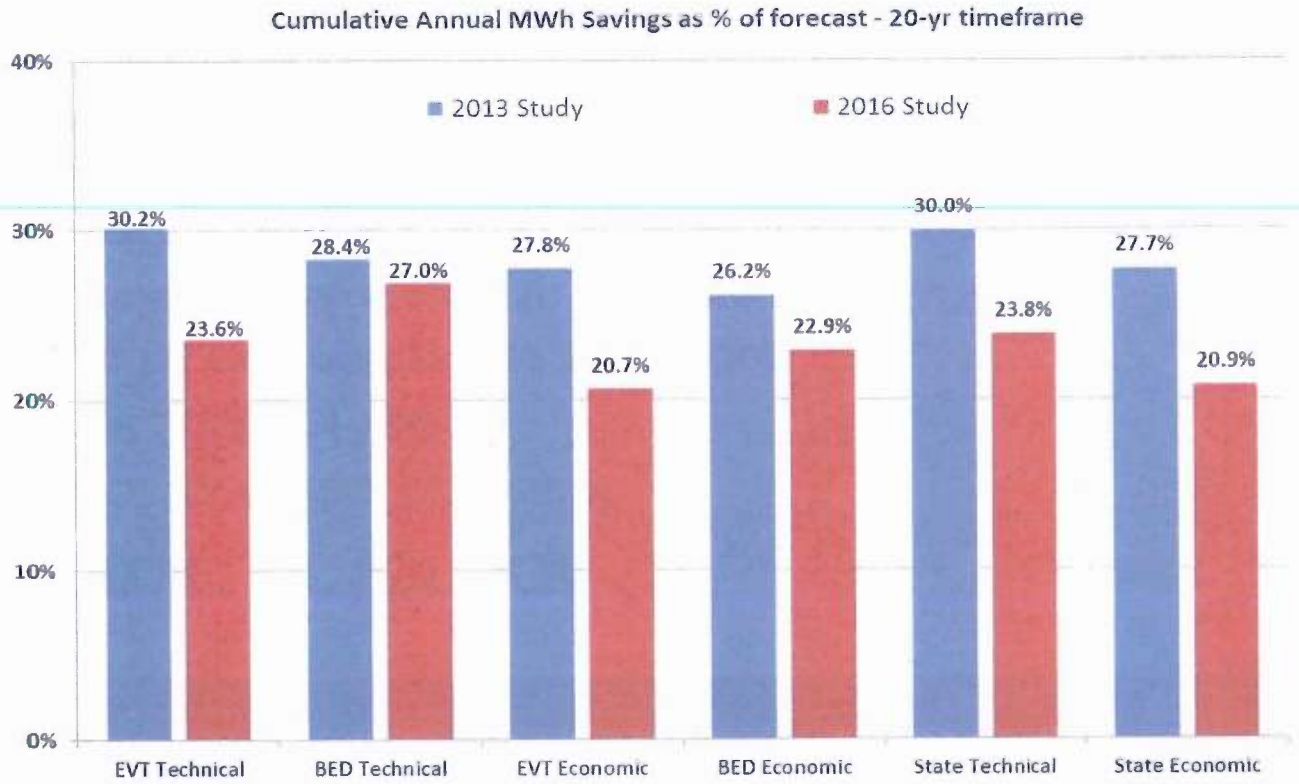
TECHNICAL AND ECONOMIC POTENTIAL 2013 VS 2016



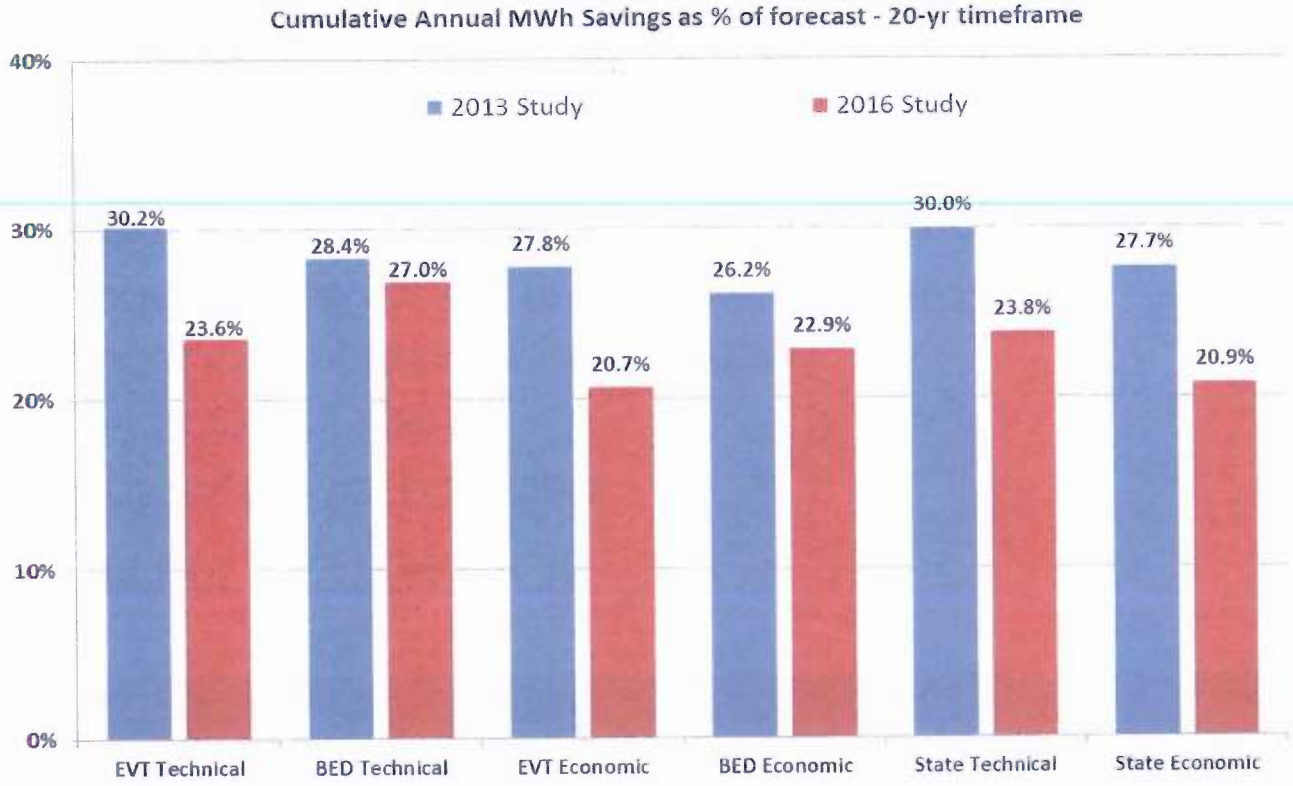
TECHNICAL AND ECONOMIC POTENTIAL 2013 VS 2016



TECHNICAL AND ECONOMIC POTENTIAL 2013 VS 2016



TECHNICAL AND ECONOMIC POTENTIAL 2013 VS 2016



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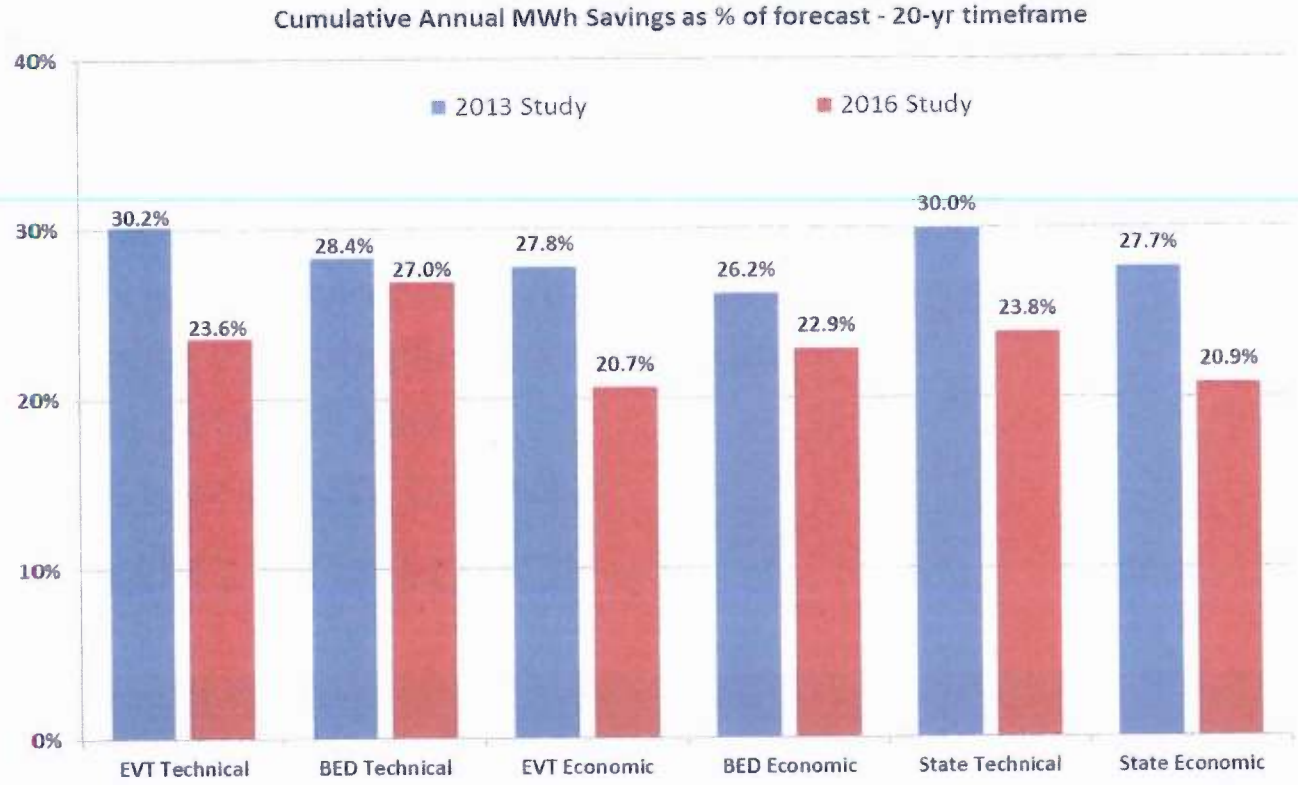

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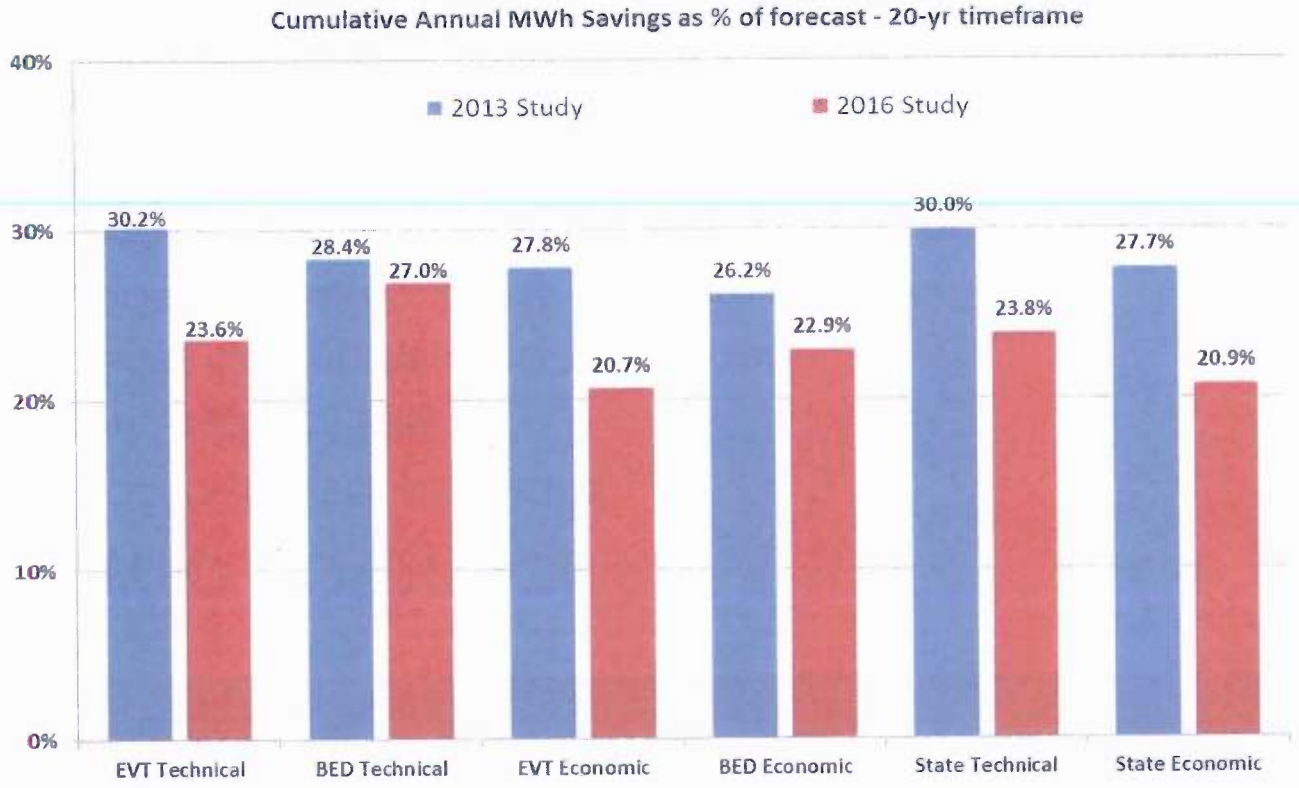
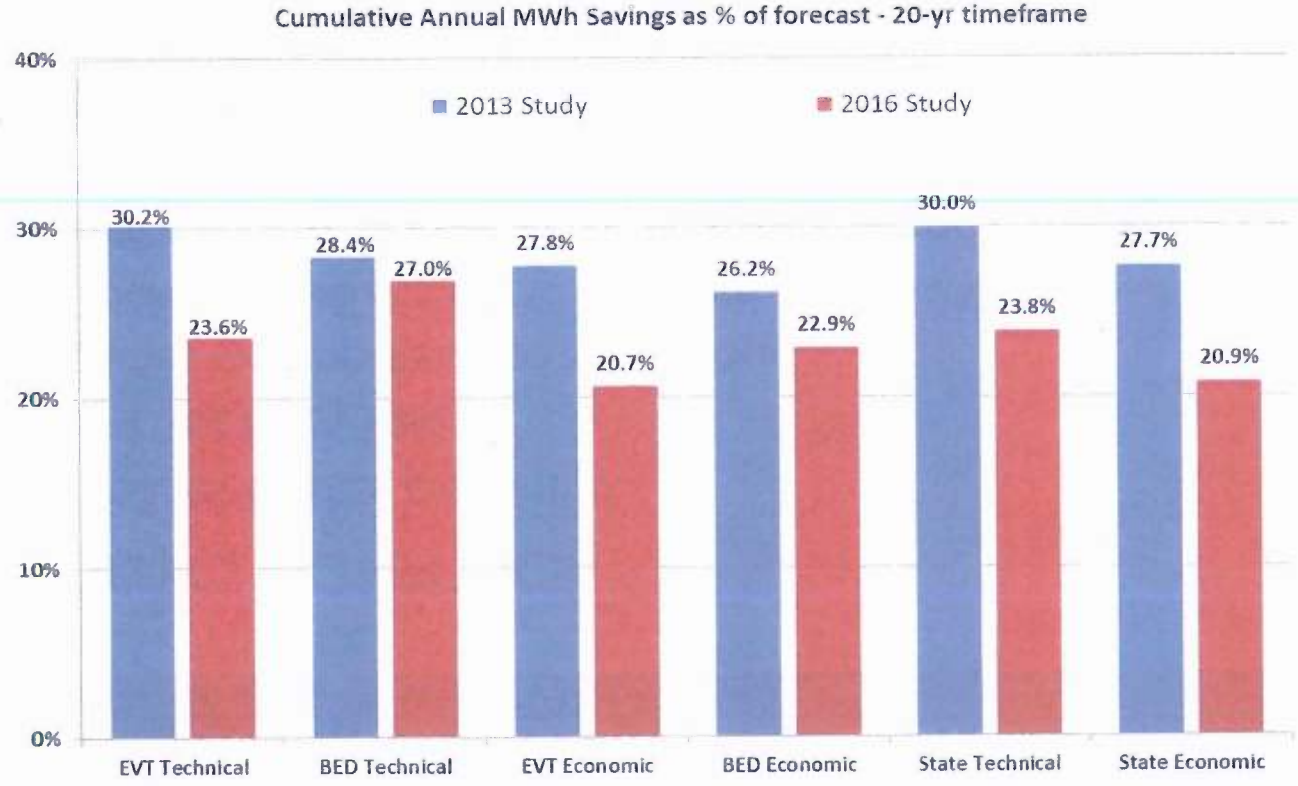


TECHNICAL AND ECONOMIC POTENTIAL 2013 VS 2016



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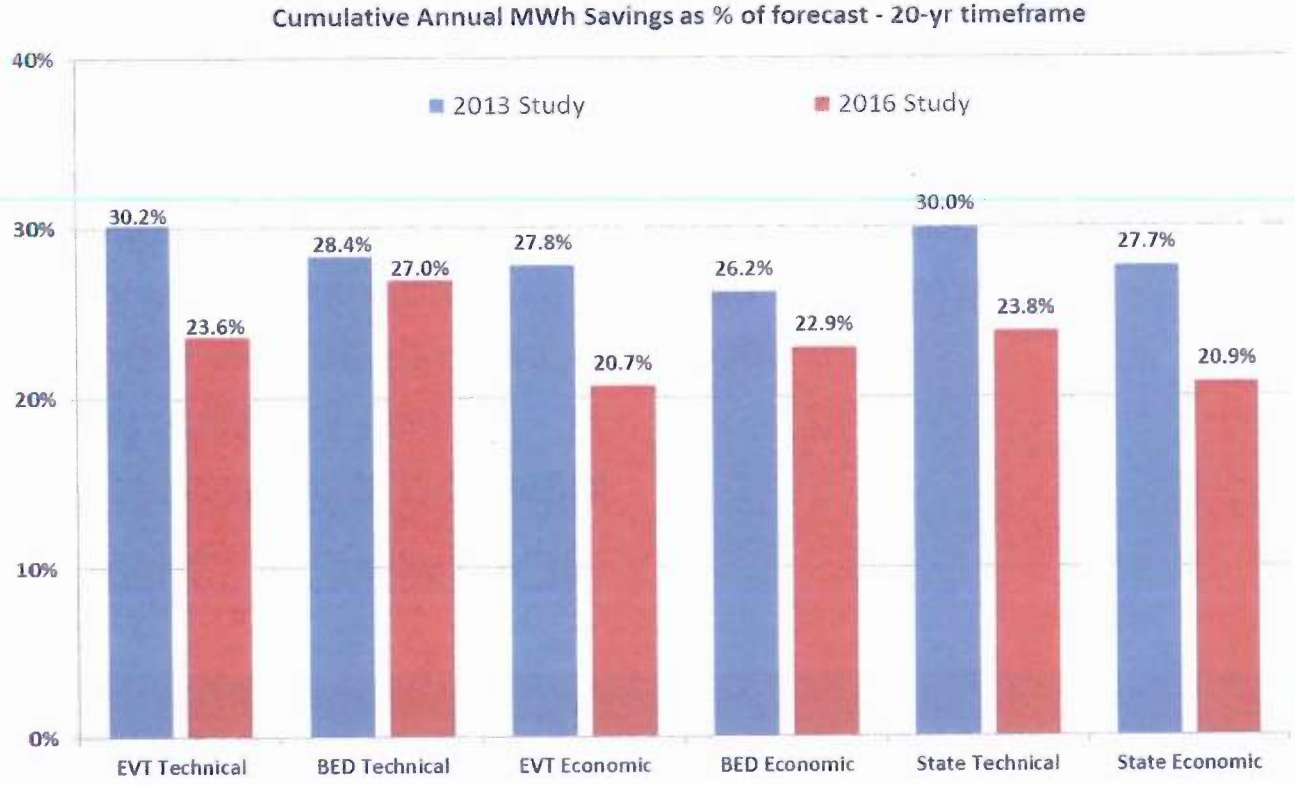

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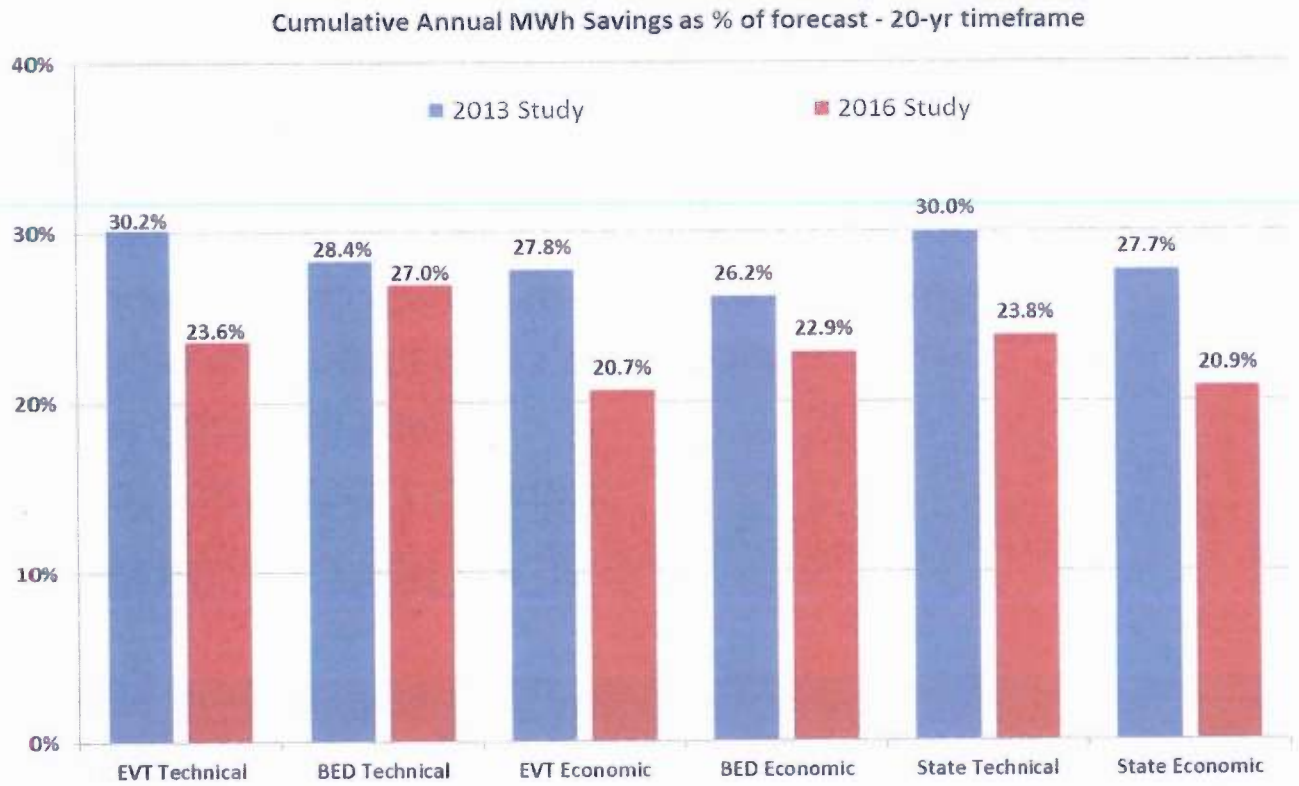

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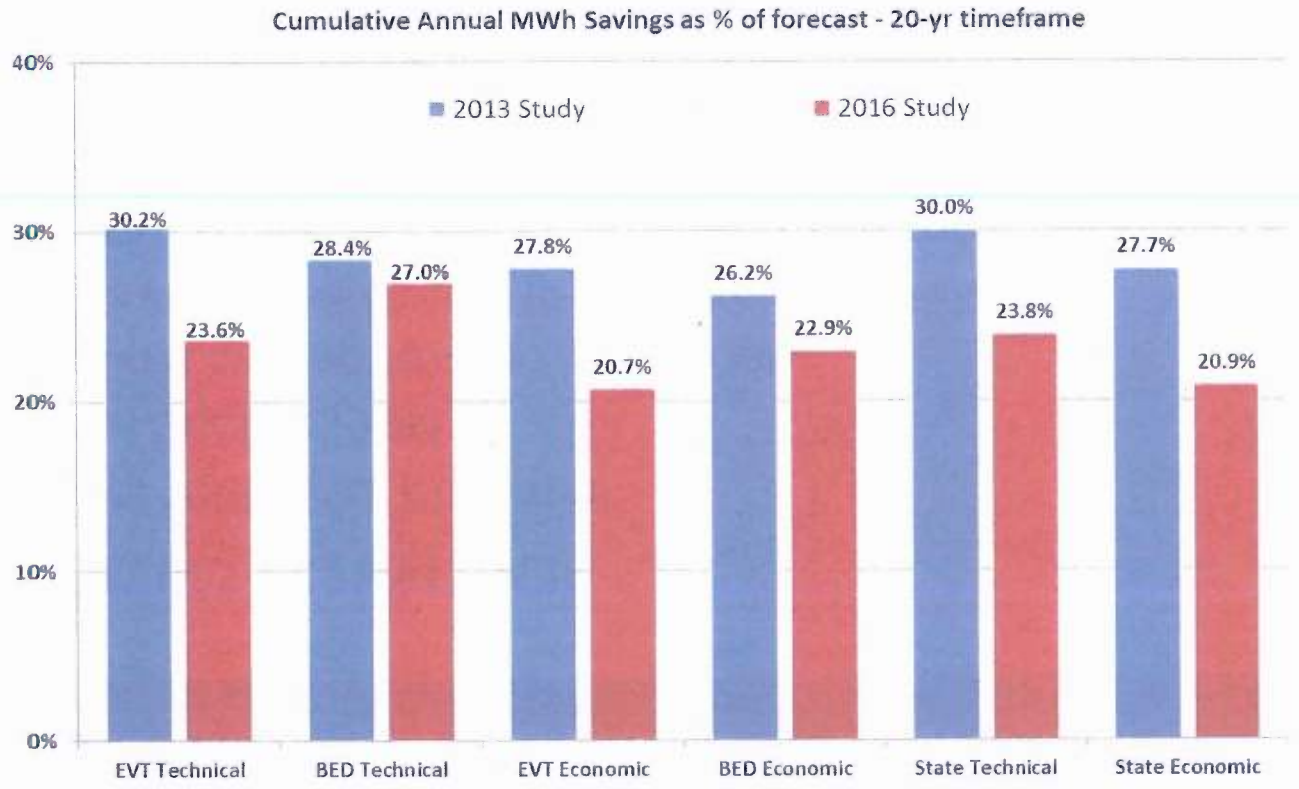


GDS Associates, Inc.
ENGINEERS & CONSULTANTS

In Partnership With

CADMUS

VERMONT ENERGY EFFICIENCY POTENTIAL STUDY

RESULTS WORKSHOP

MONTPELIER VT

January 26, 2017

Agenda Overview

- Introductions & Key Personnel
- Study Overview & Key Considerations
- Technical and Economic Potential
  - Results & Comparison to Prior Studies
- Achievable Potential
  - Maximum vs Realistic Potential
  - Results by EEU
- DPS Rate and Bill Impact Analysis
- Next Steps
- Additional Q&A

INTRODUCTIONS

VT Energy Efficiency Potential Study

The GDS/Cadmus Team

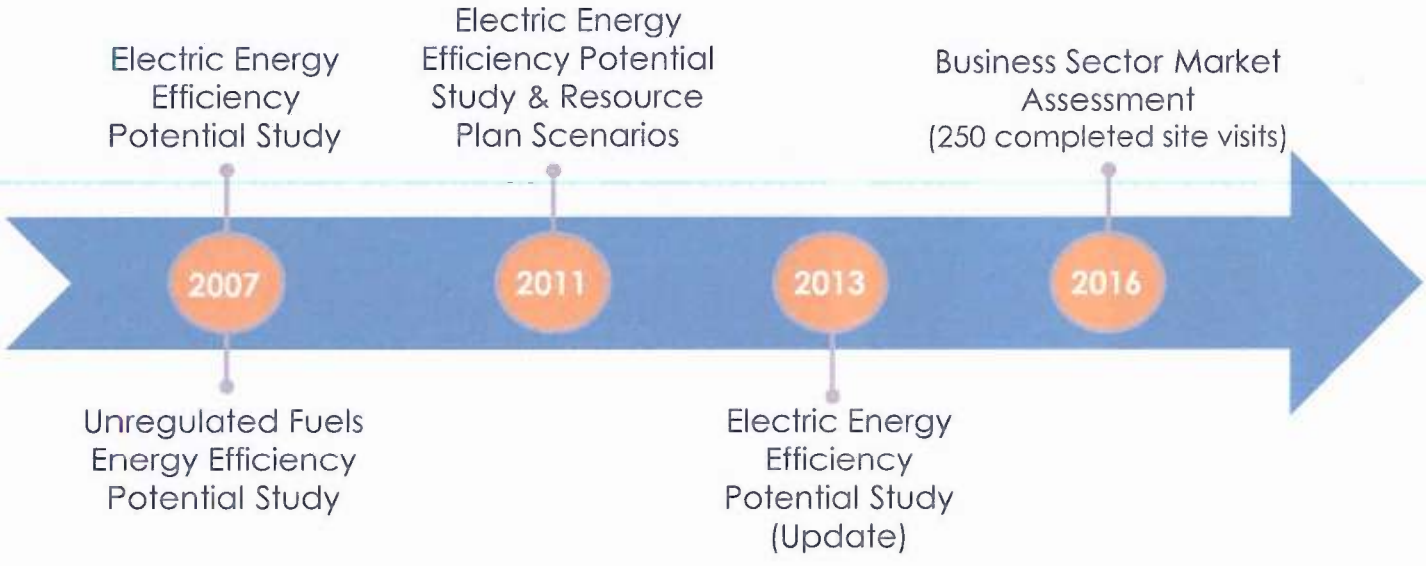
GDS Associates, Inc.
ENGINEERS & CONSULTANTS

- Engineering consulting firm headquartered in Marietta, GA with offices in Alabama, Florida, Illinois, Texas, Wisconsin, New Hampshire, and Maine
- Provides a wide range of services for utility and government clients ranging from traditional utility consulting services to energy efficiency and renewable energy services including:
  - Potential studies
  - DSM program design
  - Energy efficiency program implementation
  - Renewable energy and CHP feasibility studies
  - Program evaluation

CADMUS

- Energy Services Division provides services in energy policy, energy efficiency, demand response, renewable and distributed generation, potential studies, resource planning, finance, carbon, and smart grid
- Expertise in engineering and statistical analysis, market and consumer research, marketing assessments, and cost-effectiveness and economic impact analysis.

THE GDS/CADMUS TEAM



GDS & Cadmus have also been involved in energy efficiency program evaluations for Vermont since 2000.

STUDY OVERVIEW & KEY CONSIDERATIONS

VT Energy Efficiency Potential Study

Overview and Key Considerations

- Key Modeling Assumptions
  - EEU Load Forecasts
  - Lighting baseline change
  - Active measures & Replacement
  - Cold-climate heat pumps
  - Market adoption rates*
- Notes
  - Assessment of potential should be focus, not implementation plan
  - Customer sector equity shares present in scenario modeling not applied to initial estimates of potential
  - Includes EEU and DSS costs only

LOAD FORECAST

- EEU forecasts exclude impacts of future DSM programs
- Global Foundries, OMYA, and NGA excluded
- EVT and BED forecasts show less future sales than previous study

Year	2018	2019	2020	2027	2037
EVT (MWh)	4,690,339	4,775,018	4,840,663	5,486,613	5,680,736
BED (MWh)	367,233	376,145	380,502	408,754	453,526
VGS (Mcf)	10,540,440	10,661,897	10,800,797	11,553,353	12,480,406

- CAGR of 1.02% for electric load
- CAGR of 0.89% for natural gas load

Lighting Baseline Changes

- Shift to LED as the baseline as early as 2020
  - More aggressive than EISA
- Based on discussions with Department and EVT regarding program planning assumptions from 2018-2024
- Limited lighting potential in residential sector compared to prior potential analyses
  - Same assumptions for screw-based lighting in nonresidential sector, but a smaller proportion of the lighting end-use

Active Measures and Measure Replacement

- Active measures; efficient technologies currently installed in homes or businesses
  - Prior study eliminated active measures from estimates of future potential
  - 2016 study allows active measures to be re-introduced into the eligible market
    - All market opportunity measures, at time of replacement
    - Select retrofit measures
  - Allows for incomplete market transformation or for future improvements in technologies to continue to offer savings potential

Cold Climate Ductless Heat pumps

- Baseline and measure kWh estimates based on BEopt modeling tied to forecast calibration, and/or recent evaluation studies
- Analyzed market opportunity and early replacement options
  - Ex: Market opportunity (Res.) – high efficiency vs. federal standard
  - Ex: Early replacement (Res.) – high efficiency vs. baseboard/space heater
- Did not specifically analyze load building options for EVT and BED
- Analyzed as 'dual fuel' heat pump systems for VGS
  - Offsets gas furnace load down to ~5 degrees
- In both sectors, accounts for a small portion of realistic achievable potential (2018-2020) for EVT and BED; slightly larger portion of RAP for VGS

TECHNICAL & ECONOMIC POTENTIAL

VT Energy Efficiency Potential Study

Scope of Analysis

Category	Residential	Commercial	Industrial
Gas			
Unique Measures	44	81	20
Permutations	242	2,738	215
Electric			
Unique Measures	121	216	44
Permutations	487	12,100	446

Technical and Economic Potential

Technical Potential

- Theoretical maximum, only constrained by technical feasibility and applicability of measures
- Bottom-up approach
  - Residential example:

- Analysis covers a 20 year time-frame
- Competing measure with most savings generally given priority

Electric Technical and Economic Potential 2013 vs 2016

- 20-yr technical potential decreased for EVT, but increased slightly for BED
- Economic potential decreased for both EEUs as well
- Overall statewide economic potential decreased by 25%

EEU or Statewide Totals	2013	2016
EVT		
Technical Potential (MWh)	1,736,976	1,340,164
Economic Potential (MWh)	1,602,098	1,175,429
BED		
Technical Potential (MWh)	120,962	122,271
Economic Potential (MWh)	111,673	103,975
Statewide Technical Potential		
Technical Potential (MWh)	1,857,938	1,462,434
Technical Potential (% of MWh sales)	30.0%	23.8%
Statewide Economic Potential		
Economic Potential (MWh)	1,713,770	1,279,404
Economic Potential (% of sales)	27.7%	20.9%

Technical and Economic Potential 2014 vs 2016

Totals	2014	2016
VGS	15-yr	20-yr
Economic Potential (MMBtu)	3,732	4,187
Economic Potential (% of MMBtu sales)	27.3%	32.8%

- 2014 analysis completed by Optimal Energy
- Different study timeframes
  - 2014: 15 year analysis
  - 2016: 20 year analysis
- 2014 study found higher economic potential per year than 2016 study

ACHIEVABLE POTENTIAL

VT Energy Efficiency Potential Study

ACHIEVABLE POTENTIAL SCENARIOS

Achievable Potential

- "Maximum" Achievable Potential (MAP) assumes 100% incentives, and immediate implementation of aggressive measure adoption rates
  - Most similar to achievable potential in 2013
- "Realistic" Achievable Potential; assumes incentive levels and less aggressive measure adoption rates that are closely calibrated to historical levels in early years.
- Long term measure adoption rates informed by secondary market research on the link between incentives and adoption rates (i.e. likelihood to purchase efficient technologies at different incentive levels or payback)

Market Adoption Rates

Sector	End-Use	0% Incentives	50% Incentives	75% Incentives	100% Incentives
Commercial	Appliances	34%	50%	57%	64%
Commercial	Central AC	34%	58%	69%	80%
Commercial	Lighting	25%	35%	46%	62%
Commercial	Other	33%	57%	68%	81%
Commercial	Refrigeration	53%	83%	89%	90%
Commercial	Space Heating	23%	51%	62%	78%
Commercial	Ventilation	33%	62%	71%	90%
Commercial	Weatherization	28%	50%	65%	80%
Industrial	Industrial	40%	64%	71%	80%
Residential	Appliances	44%	62%	70%	86%
Residential	Central AC	27%	45%	58%	77%
Residential	LED	49%	65%	75%	86%
Residential	Other	38%	55%	64%	80%
Residential	Pool Pump	9%	28%	34%	41%
Residential	Space Heating	28%	46%	59%	77%
Residential	Water Heaters	39%	54%	64%	77%
Residential	Weatherization	32%	51%	60%	75%

EVT Achievable Potential Results – MAP & RAP

All Sectors Combined	2018	2019	2020	2027	2037
EVT					
Energy (MWh)	220,164	412,775	457,764	782,345	927,901
Summer Demand (MW)	25.2	47.0	57.9	111.2	127.3
Winter Demand (MW)	37.1	70.9	67.9	101.8	120.4
Energy (as % of forecast sales)	4.7%	8.6%	9.5%	14.3%	16.3%

All Sectors Combined	2018	2019	2020	2027	2037
EVT					
Energy (MWh)	100,695	191,486	262,673	663,110	804,471
Summer Demand (MW)	13.4	25.4	35.5	96.6	112.1
Winter Demand (MW)	15.4	29.7	38.6	87.1	104.7
Energy (as % of forecast sales)	2.1%	4.0%	5.4%	12.1%	14.2%

EVT Achievable Potential Budgets – MAP & RAP

- 10-yr annual incentive and admin budgets for MAP and RAP

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
MAP Incentives	$70.9	$68.7	$56.1	$55.8	$53.5	$39.6	$39.6	$39.7	$39.7	$39.2
MAP Admin	$23.5	$22.9	$18.9	$18.6	$18.9	$13.2	$13.0	$12.6	$14.0	$13.5
MAP Total	$94.4	$91.7	$75.0	$74.4	$72.4	$52.8	$52.6	$52.2	$53.7	$52.7

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
RAP Incentives	$22.4	$22.8	$23.8	$26.6	$26.7	$25.9	$25.8	$25.7	$23.7	$21.3
RAP Admin	$10.7	$10.9	$11.3	$12.5	$13.1	$12.4	$12.1	$11.7	$11.6	$10.5
RAP Total	$33.1	$33.7	$35.0	$39.1	$39.8	$38.2	$37.9	$37.4	$35.3	$31.9

**Nominal dollars, resource acquisition costs only*

BED Achievable Potential Results – MAP & RAP

All Sectors Combined	2018	2019	2020	2027	2037
BED					
Energy (MWh)	17,292	33,295	39,078	70,170	86,311
Summer Demand (MW)	2.0	3.9	4.7	9.6	12.0
Winter Demand (MW)	2.9	5.5	5.9	10.2	12.4
Energy (as % of forecast sales)	4.7%	8.9%	10.3%	17.2%	19.0%

All Sectors Combined	2018	2019	2020	2027	2037
BED					
Energy (MWh)	5,163	10,762	15,278	48,615	69,152
Summer Demand (MW)	0.6	1.2	1.8	6.0	9.6
Winter Demand (MW)	0.8	1.7	2.3	7.2	10.0
Energy (as % of forecast sales)	1.4%	2.9%	4.0%	11.9%	15.2%

BED Achievable Potential Budgets – MAP & RAP

- 10-yr annual incentive and admin budgets for MAP and RAP

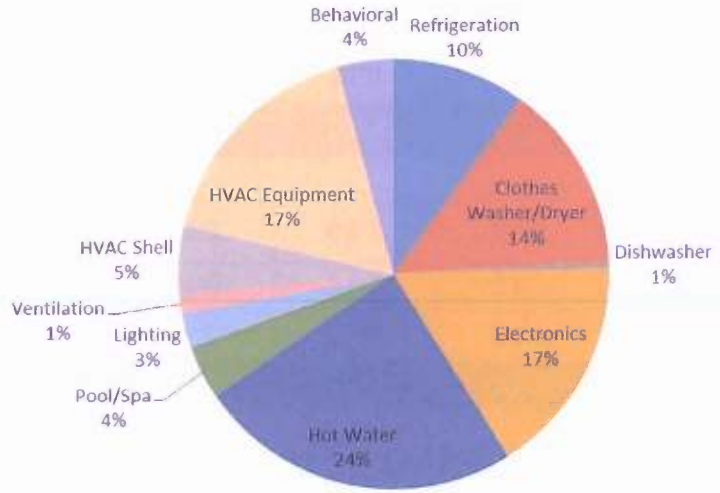
Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
MAP Incentives	$6.2	$5.8	$4.7	$4.7	$4.6	$3.0	$2.9	$2.9	$3.0	$3.0
MAP Admin	$3.0	$2.5	$1.7	$1.8	$2.0	$0.9	$0.8	$0.8	$1.3	$1.2
MAP Total	$9.2	$8.2	$6.4	$6.4	$6.7	$3.9	$3.8	$3.7	$4.3	$4.2

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
RAP Incentives	$1.3	$1.4	$1.6	$1.8	$1.8	$1.8	$1.9	$1.9	$1.9	$1.9
RAP Admin	$0.9	$0.9	$0.8	$0.8	$1.0	$1.0	$1.0	$1.0	$1.2	$1.2
RAP Total	$2.1	$2.3	$2.3	$2.6	$2.9	$2.8	$2.8	$2.8	$3.1	$3.1

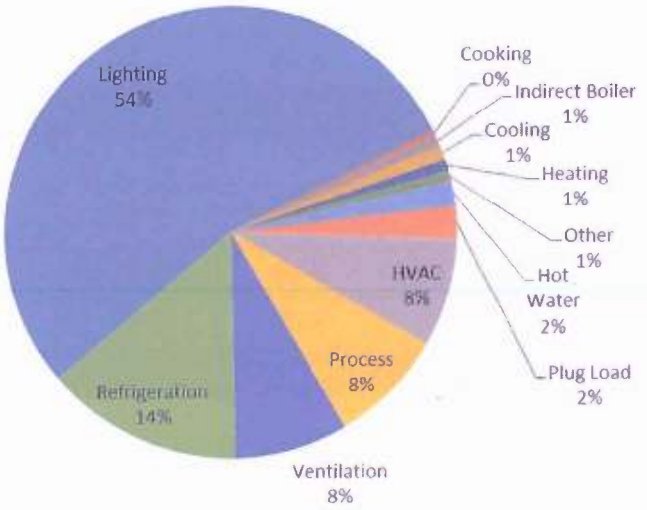
**Nominal dollars, resource acquisition costs only*

EVT 2037 RAP By Sector

Residential Sector

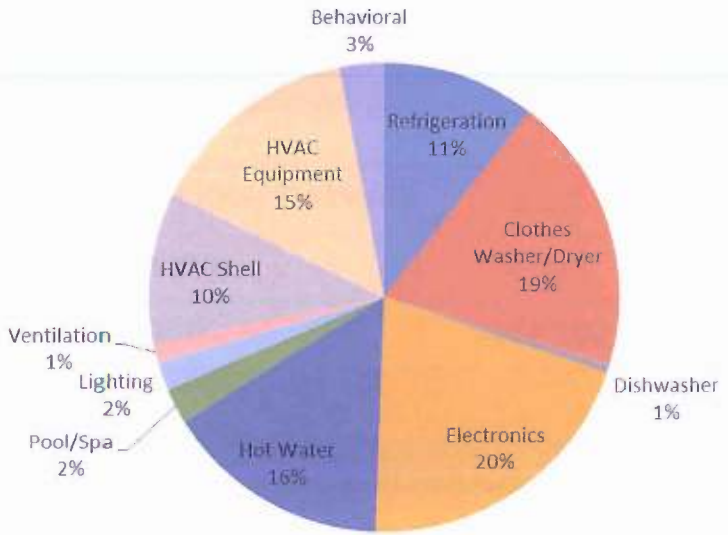


Nonresidential Sector



BED 2037 RAP By Sector

Residential Sector



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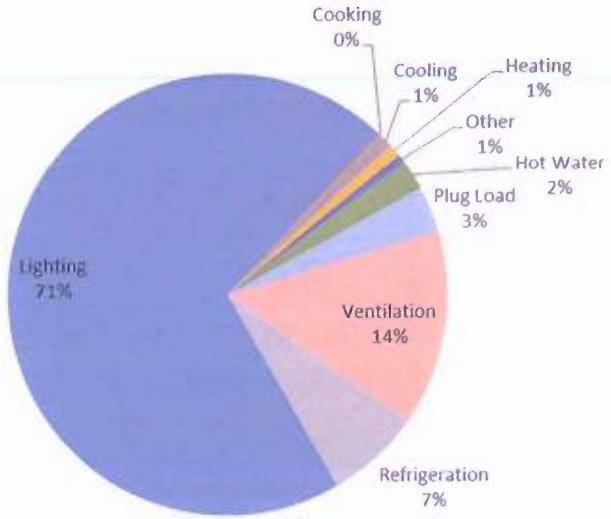


VGS Achievable Potential Results – MAP & RAP

All Sectors Combined	2018	2019	2020	2027	2037
VGS					
Natural Gas (MMBtu)	445,246	871,177	1,292,942	2,615,206	3,204,984
Peak Day Gas (MMBtu)	4,444	5,124	6,033	9,277	2,167
Natural Gas (as % of forecast sales)	4.1%	8.0%	11.7%	22.1%	25.1%

All Sectors Combined	2018	2019	2020	2027	2037
VGS					
Natural Gas (MMBtu)	112,491	210,663	326,214	1,112,353	2,028,957
Peak Day Gas (MMBtu)	799	1,680	2,730	7,242	12,085
Natural Gas (as % of forecast sales)	1.0%	1.9%	2.9%	9.4%	15.9%

VGS Achievable Potential Budgets – MAP & RAP

- 10-yr annual incentive and admin budgets for MAP and RAP

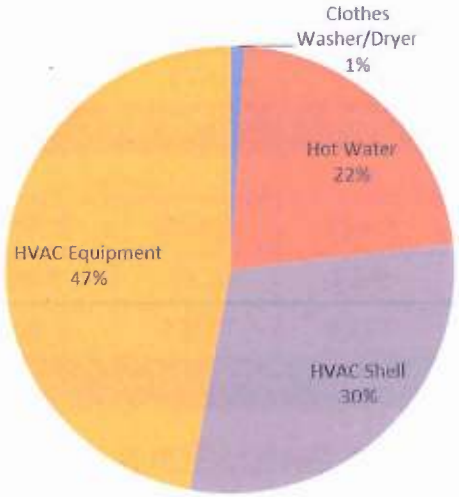
Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
MAP Incentives	$23.3	$22.2	$22.1	$21.7	$21.0	$15.5	$15.4	$15.1	$15.0	$14.8
MAP Admin	$8.1	$7.7	$7.6	$7.5	$7.4	$5.1	$5.2	$5.0	$5.1	$4.9
MAP Total	$31.3	$29.9	$29.7	$29.2	$28.5	$20.6	$20.6	$20.2	$20.1	$19.8

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
RAP Incentives	$3.3	$3.8	$4.7	$5.2	$5.2	$5.7	$5.7	$5.7	$5.7	$5.7
RAP Admin	$1.5	$1.9	$2.5	$2.8	$2.9	$3.1	$3.1	$3.1	$3.1	$3.1
RAP Total	$4.8	$5.7	$7.2	$8.0	$8.1	$8.8	$8.8	$8.8	$8.8	$8.9

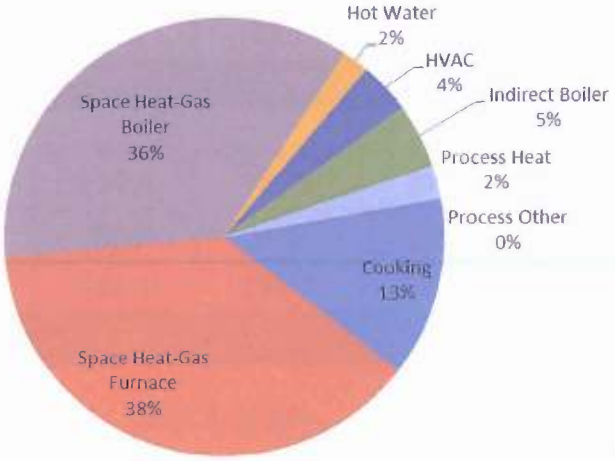
**Nominal dollars, resource acquisition costs only*

VGS 2037 RAP By Sector

Residential Sector



Nonresidential Sector



Addison County Breakout

Service Area	2018	2019	2020	2027	2037
Addison County Expansion					
Technical	18,997	19,665	10,040	7,414	3,168
Economic	17,027	17,648	9,021	6,846	3,172
MAP	12,755	13,244	6,781	5,142	2,328
RAP	2,488	4,071	3,410	3,570	1,870
Remaining Footprint					
Technical	126,461	119,837	126,242	121,415	126,131
Economic	111,651	105,906	111,838	109,504	114,870
MAP	82,689	78,591	83,241	82,390	87,031
RAP	26,868	32,899	47,140	55,321	58,552

NEXT STEPS

VT Energy Efficiency Potential Study

Next Steps

- Receive feedback and adjust MAP and RAP as necessary
- Finalize BED and VGS modeling scenarios
- Issue potential study draft report

ADDITIONAL Q&A

VT Energy Efficiency Potential Study

CONTACT

Jeffrey Huber

Project Manager, GDS Associates
Office (770) 799-2399
jeffrey.huber@gdsassociates.com

Travis Walker

Senior Associate, Cadmus
Office (503) 575-4564
travis.walker@cadmusgroup.com

GDS Associates, Inc.

ENGINEERS & CONSULTANTS

1850 Parkway Place, Suite 800
Marietta, Georgia 30067
(770) 425-8100
(866) 611-3791 fax

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GDS Associates, Inc.
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2013 Vermont Energy Efficiency Potential Study Update

Final Report

Prepared for:
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GDS Associates, Inc.
1850 Parkway Place
Suite 800
Marietta, GA 30067
770.425.8100
770.426.0303 (Fax)
www.gdsassociates.com

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1 EXECUTIVE SUMMARY

The Vermont Public Service Department (PSD) commissioned GDS Associates, Inc. to conduct a limited update to the 2011 study[1] of the potential for electric energy efficiency to reduce electric consumption and peak demand throughout the State of Vermont. The 2013 edition of the study incorporates several updates, including updates to the load forecasts, avoided costs and energy efficiency measure assumptions. This energy efficiency potential study provides reliable estimates of how much of Vermont's future electric service needs could be met through energy efficiency. The authors of this report emphasize that only energy efficiency measures that have a benefit-cost ratio of greater than or equal to 1.0 under the Vermont societal test are considered to be cost effective.

This technical memorandum presents results from the evaluation of opportunities for energy efficiency programs in the service areas of Vermont's two energy efficiency utilities. The Vermont Public Service Board (Board) has appointed the Burlington Electric Department (BED) as the EEU for the City of Burlington, and the Board has appointed the Vermont Energy Investment Corporation as the EEU for the remainder of the State, under the name "Efficiency Vermont" (EVT). For purposes of this report, "BED" will be used to refer to the area served by the Burlington Electric Department, and "EVT" will be used to refer to the area served by VEIC.

Estimates of technical potential, economic potential, and maximum achievable potential from 2014-2033 (a 20-year period) are provided for the residential and commercial/industrial (C&I) sectors. All results were developed using customized residential and commercial/industrial (C&I) sector-level potential assessment computer models and Vermont-specific cost effectiveness criteria including the most recent Vermont avoided cost projections for electricity and other fuels. The study relied heavily on recent Vermont market assessment reports of residential and commercial building and equipment characteristics. These market assessment reports provided valuable insight regarding the current saturation of electrical equipment and baseline levels of energy efficiency throughout the state of Vermont.

The results of this study provide detailed information on energy efficiency measures that are cost effective and have potential kWh and kW savings. The data used for this report were the best available at the time this analysis was developed.

1.1 STUDY SCOPE

The study examines the potential to reduce electric consumption and peak demand through the implementation of energy efficiency technologies and practices in residential, commercial, and industrial facilities. The study assessed energy efficiency potential throughout the EVT and BED service areas over twenty years, from 2014 through 2033.

The study had the following main objectives:

- Update the load forecasts;
- Update the avoided costs;
- Update measure lists and assumptions;
- Review market assessment studies to update baseline saturation data

[1] http://publicservice.vermont.gov/sites/psd/files/Topics/Energy_Efficiency/Energy%20Efficiency%20Potential%202011.pdf

- Re-evaluate the maximum achievable potential for the 2014-2033 timeframe

The scope of this study distinguishes among three types of energy efficiency potential; (1) technical, (2) economic, and (3) maximum achievable. The definitions used in this study for energy efficiency potential estimates are as follows:

- **Technical Potential** is the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints such as cost-effectiveness and the willingness of end-users to adopt the efficiency measures. It is often estimated as a "snapshot" in time assuming immediate implementation of all technologically feasible energy saving measures, with additional efficiency opportunities assumed as they arise from activities such as new construction.[2]
- **Economic potential** refers to the subset of the technical potential that is economically cost-effective as compared to conventional supply-side energy resources. Both technical and economic potential are theoretical numbers that assume immediate implementation of efficiency measures, with no regard for the gradual "ramping up" process of real-life programs. In addition, they ignore market barriers to ensuring actual implementation of efficiency. Finally, they only consider the costs of efficiency measures themselves, ignoring any programmatic costs (e.g., marketing, analysis, administration) that would be necessary to capture them.[3]
- **Achievable potential** is the amount of energy use that efficiency can realistically be expected to displace assuming the most aggressive program scenario possible (e.g., providing end-users with payments for the entire incremental cost of more efficiency equipment). This is often referred to as maximum achievable potential. Achievable potential takes into account real-world barriers to convincing end-users to adopt efficiency measures, the non-measure costs of delivering programs (for administration, marketing, tracking systems, monitoring and evaluation, etc.), and the capability of programs and administrators to ramp up program activity over time.[4] The achievable potential for this study is a maximum achievable potential because the incentives are assumed to be 100% of the measure incremental cost.

Limitations to the scope of study: As with any assessment of energy efficiency potential, this study necessarily builds on a large number of assumptions, including the following:

- Energy efficiency measure lives, measure savings and measure costs
- The discount rate for determining the net present value of future savings
- Projected penetration rates for energy efficiency measures
- Projections of electric generation avoided costs for electric capacity and energy
- Projections of avoided costs for externalities (e.g. carbon)
- Projections of avoided costs for other fuels (heating oil, natural gas, propane)
- Electric transmission and distribution avoided costs
- Project budgetary limitations prevented GDS from performing a full-scale update

[2] National Action Plan for Energy Efficiency, "Guide for Conducting Energy Efficiency Potential Studies", page 2-4.
[3] Id.
[4] Id.

While the authors have sought to use the best available data, there are many assumptions where there may be reasonable alternative assumptions that would yield somewhat different results. Furthermore, while the lists of measures examined in this study represent most commercially available measures, as well as several measures that are considered emerging technologies, these measure lists are not exhaustive.

1.2 RESULTS OVERVIEW

Figure 1-1, presented below, shows that cost effective electric energy efficiency resources can play a significantly expanded role in the Vermont energy resource mix over the next 20 years. For the total State of Vermont, the technical potential for energy efficiency is 30.0% of forecasted kWh sales in 2033, twenty years from now.[5] The energy efficiency economic and achievable potential in 2033 are 27.7% and 23.4% of forecasted kWh sales in 2033. The technical, economic and achievable electric demand savings for the state as a whole are 22.4%, 21.3% and 17.8% respectively, of forecasted winter peak demand in 2033. The technical, economic and achievable electric demand savings for the state as a whole are 23.1%, 22.2% and 18.1%, respectively, of forecasted summer peak demand in 2033.

Figure 1-1: 2033 DSM Potential Savings Summary for State of Vermont (DSM Potential as a Percent of Forecasted Vermont kWh Sales in 2033)

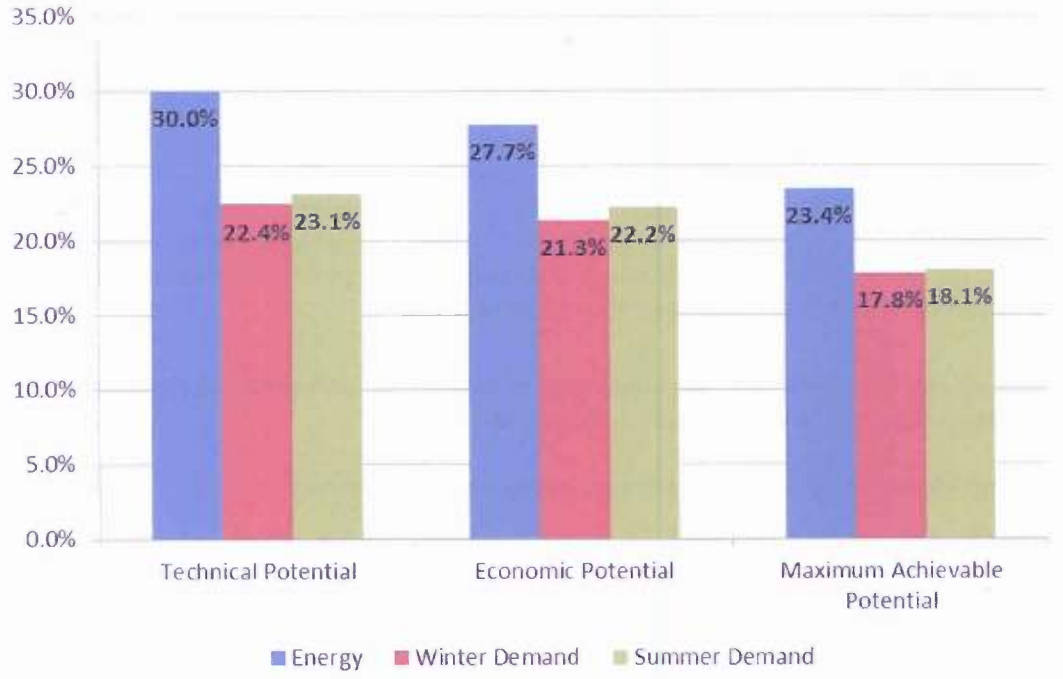

Table 1-1 below presents detailed information on the technical, economic and achievable energy efficiency savings potential for all sectors combined for the BED service area, for the EVT service area, and for the BED and EVT service areas combined. Further information on the energy efficiency potential by sector is provided in Sections 3 and 4 of this memorandum.

[5] All energy and demand savings presented in this report are at the end-consumer (meter) level unless specifically noted otherwise in this report.

Table 1-1: DSM Potential Savings Detail (by Region and Customer Class)

	MWh	% of 2033 MWh Sales	Winter MW	% of 2033 Winter Peak	Summer MW	% of 2033 Summer Peak
All Sectors Combined						
State-wide						
Technical Potential	1,857,938	30.0%	248	22.4%	296	23.1%
Economic Potential	1,713,770	27.7%	235	21.3%	285	22.2%
Maximum Achievable Potential	1,450,000	23.4%	197	17.8%	232	18.1%
EVT						
Technical Potential	1,736,976	30.2%	232	22.4%	279	23.2%
Economic Potential	1,602,098	27.8%	221	21.3%	268	22.3%
Maximum Achievable Potential	1,351,816	23.5%	184	17.7%	218	18.1%
BED						
Technical Potential	120,962	28.4%	15	23.3%	18	21.3%
Economic Potential	111,673	26.2%	15	22.4%	17	20.5%
Maximum Achievable Potential	98,184	23.0%	12	19.1%	14	17.5%
Residential Sector						
State-wide						
Technical Potential	992,767	40.4%	166	33.3%	183	40.1%
Economic Potential	914,996	37.2%	156	31.2%	174	38.1%
Maximum Achievable Potential	723,116	29.4%	124	24.8%	131	28.7%
EVT						
Technical Potential	948,381	40.0%	158	33.0%	175	39.9%
Economic Potential	873,819	36.9%	148	30.9%	166	38.0%
Maximum Achievable Potential	689,083	29.1%	117	24.5%	125	28.5%
BED						
Technical Potential	44,387	49.1%	8	41.2%	8	45.2%
Economic Potential	41,177	45.6%	8	39.0%	8	42.6%
Maximum Achievable Potential	34,033	37.7%	6	31.4%	6	33.3%
Commercial/Industrial Sector						
State-wide						
Technical Potential	865,171	22.2%	82	13.5%	114	13.7%
Economic Potential	798,774	20.5%	80	13.2%	111	13.4%
Maximum Achievable Potential	726,884	18.6%	73	12.0%	101	12.2%
EVT						
Technical Potential	788,596	22.1%	75	13.4%	104	13.7%
Economic Potential	728,278	20.4%	73	13.1%	102	13.3%
Maximum Achievable Potential	662,733	18.6%	67	11.9%	92	12.1%
BED						
Technical Potential	76,575	22.8%	7	15.3%	10	14.8%
Economic Potential	70,495	21.0%	7	14.9%	9	14.5%
Maximum Achievable Potential	64,151	19.1%	6	13.6%	9	13.2%

Table 1-2 below presents the results of the Vermont Societal Test calculations for the achievable potential for three areas: the BED service area, the EVT service area, and the combined service areas of EVT and BED. It is clear that the level of kWh and kW savings represented by the achievable potential is very cost effective, with a Societal Test benefit/cost ratio for the overall state of 3.6 to 1. This means that for every dollar spent by Vermont ratepayers on energy efficiency programs, approximately $3.60 of societal benefits are accrued.

Table 1-2: VT Societal Test Benefits & Costs (Achievable Potential - All Sectors Combined)

	Benefits (in Millions)	Cost (in Millions)	B/C Ratio
Statewide			
NVP $2014	$4,240.6	$1,188.9	3.6
EVT Territory			
NVP $2014	$4,001.5	$1,116.1	3.6
BED Territory			
NVP $2014	$239.1	$72.8	3.3