Stakeholder Meeting #3

Energy Waste Reduction (EWR) and Demand Response (DR) 2021 to 2040 Statewide Potential Studies

For the State of Michigan

Department of Licensing and Regulatory Affairs

June 17, 2021

Meeting Goals

1 Project and Schedule Update

2 Overview of Draft DR and EWR Results

3 Stakeholder Feedback and Next Steps

Agenda

1 Introductions and Meeting Overview

2 Project Schedule Update and Next Steps

3 EWR Potential Results

4 DR Potential Results

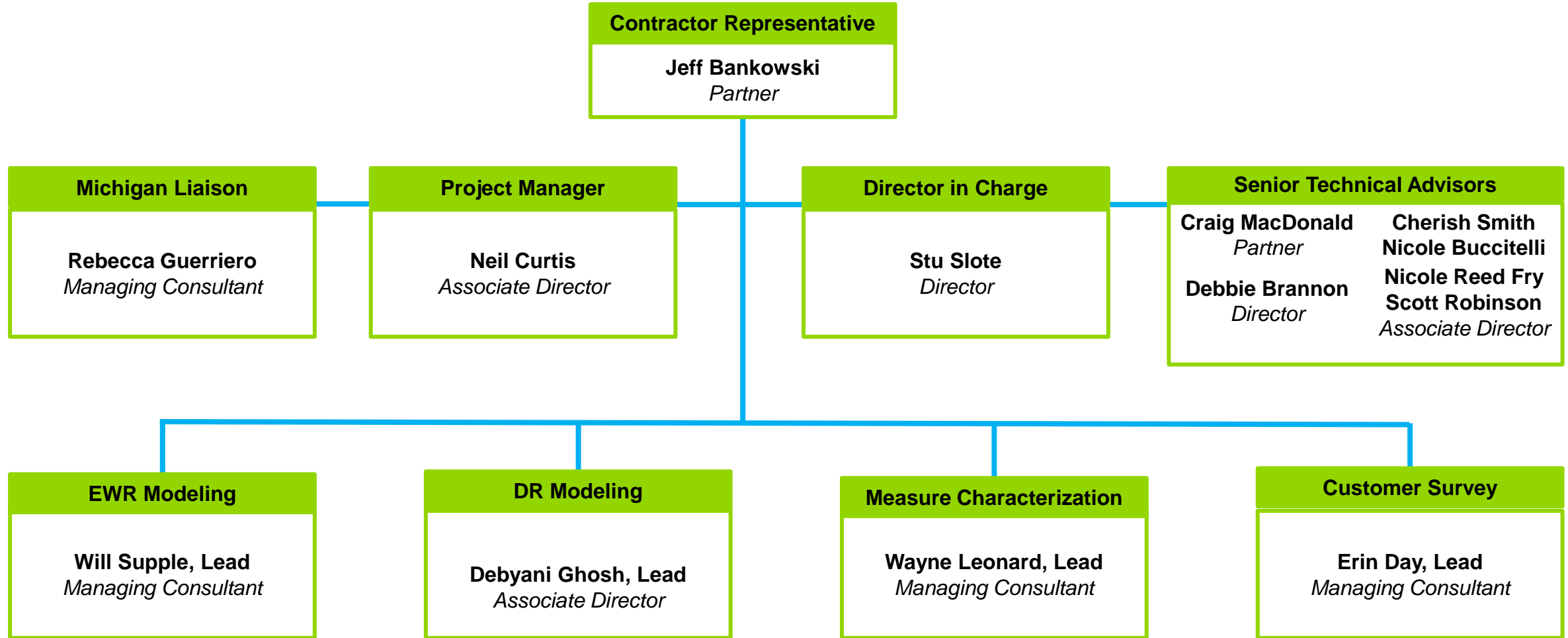**5** Questions

MPSC Project Team

Lynn Beck
Project Manager

Katie Smith
EWR Lead

Roger Doherty
DR Lead

Key Objectives
Energy Waste Reduction (EWR)

Quantify technical, economical and achievable potential energy efficiency savings for system planning and GHG reduction
- Differentiate Upper and Lower Peninsulas
- Sectors: Residential, Commercial, Industrial (C&I)

Propose energy savings targets through various scenarios

Propose appropriate EWR program funding levels

Provide program recommendations for residential and C&I customers to achieve EWR

Research and report on findings related to customer attitudes, beliefs and behaviors affecting their energy use

Examine effect of deployment and use of smart meters and interface with smart grid on enhancement of program opportunities

Market segment nuances:
- Income-eligible residential customers
- Agricultural customers
- Small commercial customers annual utility bill of $65,000 or less (for electricity and gas combined)
- Upper / Lower Peninsula

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Key Objectives
Demand Response (DR)

- If possible, identify benefits of integrating DR with EWR programs
- Program benefits for DR and EWR should be reported separately

Purpose: Assess technical, economic, and achievable potential for reducing on-peak electricity usage through DR programs for all customer classes

Calculate technical, economic, and achievable potential for demand response

Discuss barriers to achieve the identified potential and how these will affect the recommended program designs

Quantify potential peak demand savings for each DR program

Estimate cost per MW of potential demand savings

Estimate benefits from DR programs

Assess winter DR potential; in addition, assess emergency potential for each DR program

Assess how to maximize DR potential using AMI already installed in Michigan

Assess natural gas DR potential
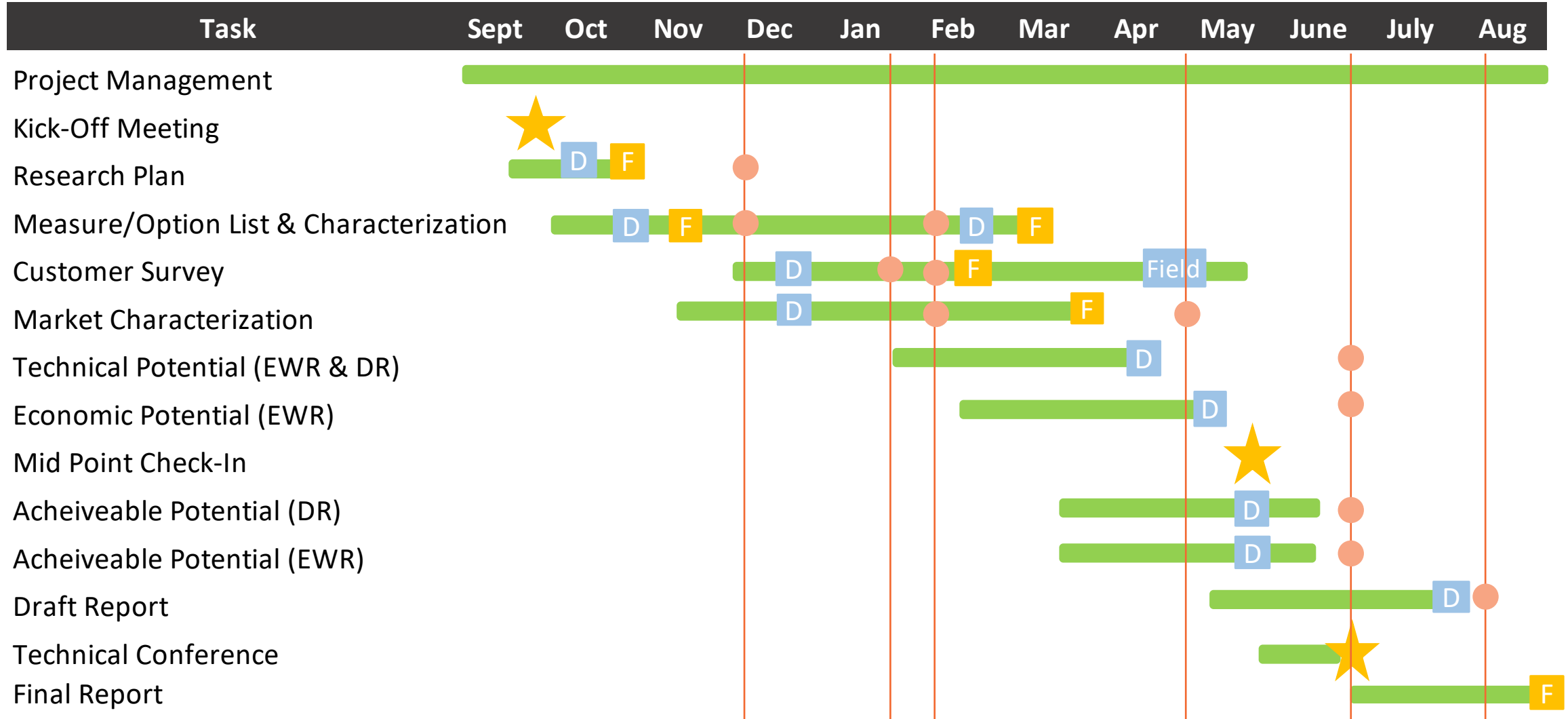
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Stakeholder Engagement and Feedback

Meeting	Topic	Timeframe
Initial Stakeholder Meeting	Project overview, stakeholder feedback of EWR Measure and DR Option lists	December 2, 2020
Second Stakeholder Meeting	Project update, presentation of Market Characterization results and customer survey stakeholder feedback	February 4, 2021
Third Stakeholder Meeting	Review draft EWR and DR potential results	June 17, 2021 *Today!*

Questions, comments, feedback: michigan.energystudy@guidehouse.com

Utility Data Request

- Guidehouse completed several rounds of data requests and review from Michigan utilities
- Utility data was used as the preferred source for model inputs
- Secondary sources, such as state census data and publicly-available EIA data, were used to estimate statewide input values after utility data gaps were identified

Technical Potential Inputs	Economic & Achievable Potential Inputs
Electricity and Gas Sales Forecast	Electric and Gas Loadshapes
Peak Demand Forecast	Electric and Gas Avoided Costs
End Use Allocations	Electric and Gas Retail Rates
Residential Building Stock (households)	Discount Rates
Commercial Building Stock (sqft)	Line Losses & Reserve Margin
Heating Fuel Type Multiplier	Inflation
Measure Density and Saturation	Historical Program Achievements

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EWR Study Segmentation

- One model encompass all segments, electricity and natural gas; calibration at sector and end use level
- Results to be presented by sector, segment, fuel, geographic location, and end use

Area	Metric
Location	Upper / Lower Peninsula
Fuel	Electric, Natural Gas
Sector	Residential, Commercial, Industrial
Income	Residential: Low Income / Non-Low Income
Characteristics	Multifamily, C&I Small Business

EWR Market Characterization

Data Category	Description
Segmentation	• Territory (Upper and Lower) • Sector and Segment (Income Level) • End Use
Utility Data	• Building Stock (# of Homes, 1000 sq. ft. building space, sector consumption) • Sales Forecast • Load Shapes • Avoided Costs • Retail Rates • Discount Rates • Line Losses
Customer Data	• End Use Allocations (% of segment consumption) • Space Heating and Hot Water Fuel Type Distribution • Willingness to Pay and Technology Awareness
Design Framework	• Fixed and Variable Program Administrative Costs • Historical Program Achievements • Incentive Strategy

Statewide Approach

1. Utility data request

2. Combine results, weight by utility sales where appropriate to develop state-wide model inputs

3. Fill utility data gaps with estimates based on data reported from comparable MI utilities

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DR Options

DR Options	Eligible Customers
1. Direct Load Control (DLC) - Switch for Space cooling and heating, Water Heating	All residential, small C&I, and medium C&I customers with eligible end uses
2. Direct Load Control (DLC) - Smart Thermostat BYOT	All residential, small and medium C&I customers with smart thermostats
3. Direct Load Control (DLC) - Smart Thermostat-Direct Install	Residential, small and medium C&I with central A/C and heat pumps
4. Smart Appliances Control (including Room AC)	Residential customers with smart appliances
5. Behavioral DR	All residential
6. Irrigation Load Control	Irrigation customers
7. Capacity Bidding Program	Large C&I, Extra-large C&I
8. Demand Bidding Program	Large C&I, Extra-large C&I
9. Emergency DR	Large C&I, Extra-large C&I
10. C&I Interruptible Rates	Large C&I, Extra-large C&I
11. Time-Of-Use Rates	Residential, All C&I, Irrigation
13. Critical Peak Pricing	Residential, All C&I, Irrigation
14. Peak Time Rebate	Residential, Small C&I
15. Real Time Pricing	Large C&I, Extra Large C&I
16. DR for Ancillary Services	All customers
17. EV Load Control	Customers with PHEV and EVs
18. Behind the Meter (BTM) battery	Customers with BTM batteries
19. Thermal Energy Storage	C&I customers with TES system
20. Voltage Optimization	All

DR Market Characterization

Level	Description
Level 1: Region	• Lower Peninsula, Upper Peninsula
Level 2: Sector	• Residential, Commercial and Industrial (C&I)

Level 3: Customer Class	• Residential
	• C&I customers (based on maximum demand values)
	  ▪ Small C&I <=30 kW
	  ▪ Medium C&I >30 and <=200 kW
	  ▪ Large C&I >200 and <=1000 kW
	  ▪ Extra Large C&I >1000 kW

Level 4: Segment / Building Type	• Residential customers
	  ▪ Single Family Non-Low Income
	  ▪ Single Family Low Income
	  ▪ Multi Family Non-Low Income
	  ▪ Multi Family Low Income
	• C&I customers (retain classification by size, based on max. demand values)*
	  ▪ Small C&I <=30 kW
	  ▪ Medium C&I >30 and <=200 kW
	  ▪ Large C&I >200 and <=1000 kW
	  ▪ Extra Large C&I >1000 kW

Level 5: End Use	• Residential (space cooling, space heating, water heating, appliances, total load) • C&I (HVAC, lighting, water heating, refrigeration, industrial loads, whole building/total facility) • Cross-cutting (battery, electric vehicles)

Approach

1. Primarily relied on utility-provided sales, count, and load data

2. Filled in gaps with data from secondary sources (FERC Form-1, EIA Form-861, etc.)

3. Developed count and peak demand projections (summer and winter) location, utility, and segment

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*NAICS code data not available to segment C&I customers by building type

Customer Survey Overview

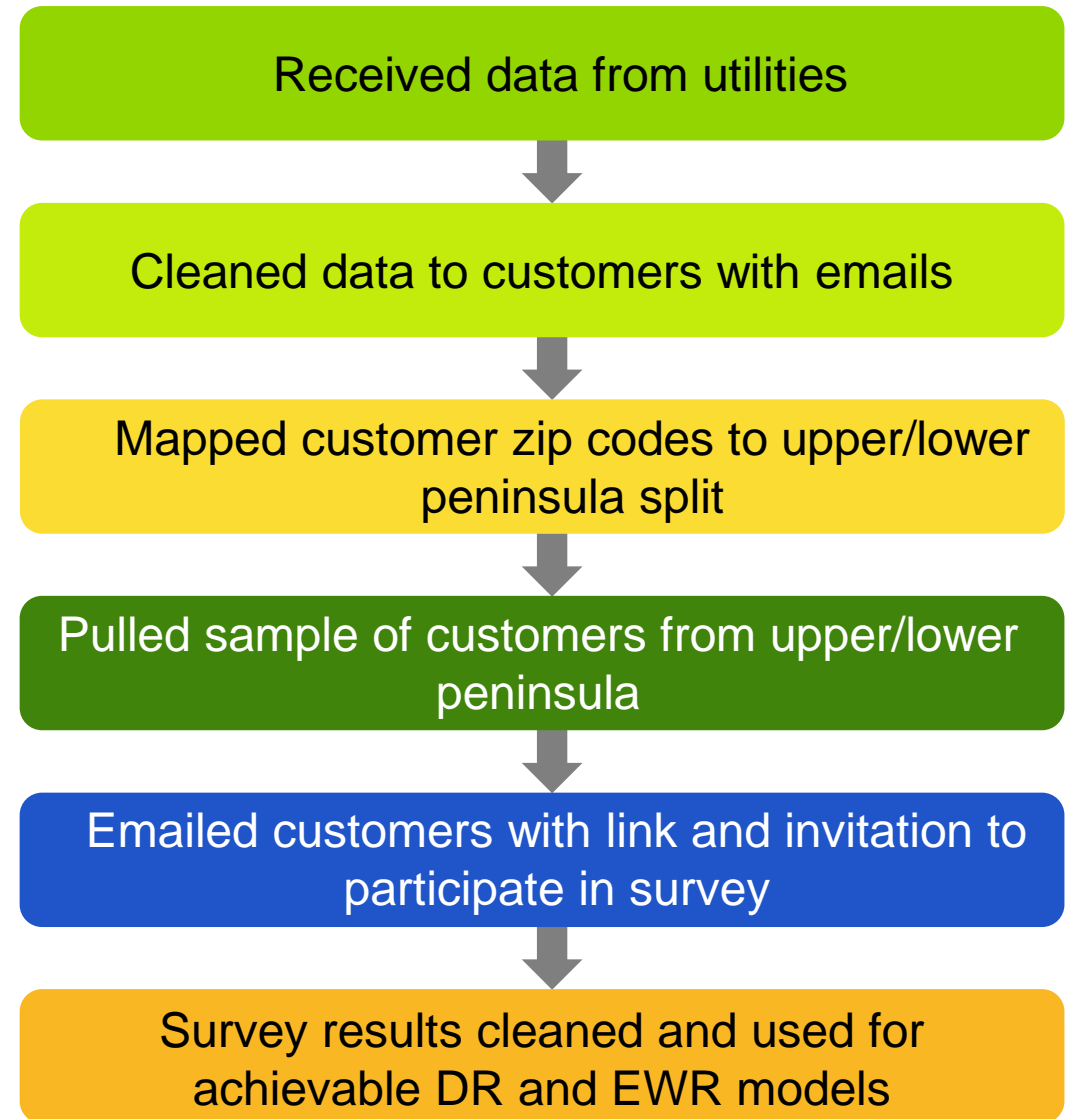## Primary Research Objectives

EWR
- Assess awareness of EWR measures
- Assess willingness to pay for EWR measures

DR
- Assess awareness of DR program types offered by the customer's utility
- Willingness to participate in DR programs

Secondary Research Objectives

- Effect of COVID-19 to inform modeling
- Customer barriers and recent energy use decisions to inform modeling
- Fill in any critical gaps discovered in existing baseline study results, as doable

Received data from utilities

↓

Cleaned data to customers with emails

↓

Mapped customer zip codes to upper/lower peninsula split

↓

Pulled sample of customers from upper/lower peninsula

↓

Emailed customers with link and invitation to participate in survey

↓

Survey results cleaned and used for achievable DR and EWR models

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Customer Survey Results

	Residential	C&I
Surveys Distributed	15,893	25,753
Target Responses	500	500
Received	591	470*
Percent of Target	118%	94%

Includes 408 small businesses (self reported <$65,000/year energy costs) and 62 large businesses.

– Results from EWR willingness to pay questions inform simple payback curves for achievable model

– Survey DR options are based on current MI utility programs and use current financial parameters to estimate customer impacts

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Energy Waste Reduction (EWR) Potential Results

EWR Potential Study Scenarios

1. Reference Case Assumptions

- 40% of incremental cost incentivized for all measures, other than low-income (100%)

- Calibrate customer adoption using historical Michigan EWR program data

- 0.8 UCT measure screening

- Administrative costs 40% of total portfolio spending

2. 100% Incentive Case Assumptions

- Same assumptions as reference case with all measures incentivized at 100% of incremental cost

3. Aggressive Case Assumptions

- 50% and 65% of incremental cost incentivized for electricity and gas, respectively (based on sensitivity analysis), other than low-income (100%)

- Benchmark best-in-class utilities to estimate higher adoption parameters achieved through innovative program designs, marketing, etc.

- Administrative costs 33% of total portfolio spending

- Reduce measure screening threshold to approximate a 1.0 UCT for service territories (UCT 0.7)

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EWR Potential Study – Key Assumptions and Scope Caveats

- Guidehouse completed detailed characterizations for ~100 measures. End use buckets were characterized at a high level to estimate remaining potential from established technologies.

- Potential from future unspecified technologies was not estimated.

- Average line losses were used to align with utility benefit-cost testing.

- Additional avoided costs not currently in place in Michigan (such as carbon adders) were not estimated.

- A regionally weighted utility weighted average cost of capital (WACC) was used for cost testing.

- Highly site-specific industrial measures were not characterized. End use custom characterizations capture measures common to industrial customers.

EWR Technical, Economic, Achievable Potential – By Percent of Sales

- **Electricity**
  - Residential
  - Commercial
  - Industrial
- **Gas**
  - Residential
  - Commercial
  - Industrial

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EWR Technical, Economic, and Achievable Potential
Residential Sector, Electricity – Percent of Sales
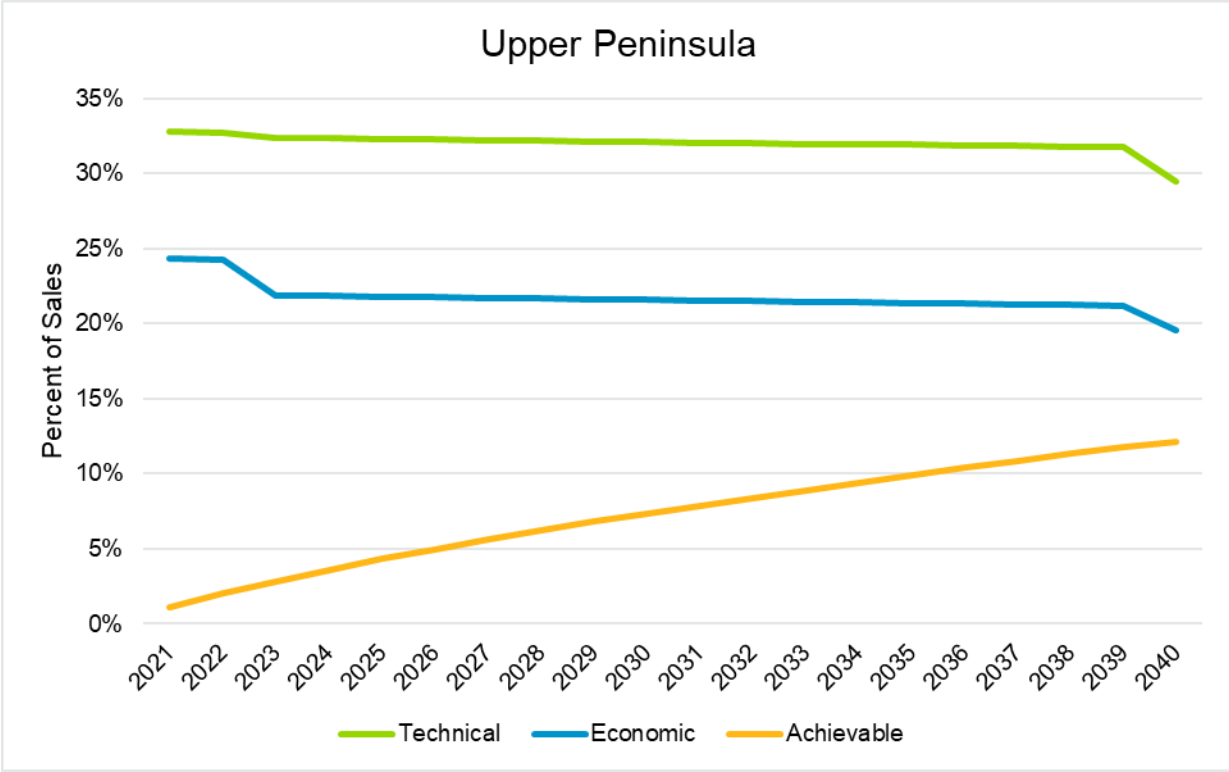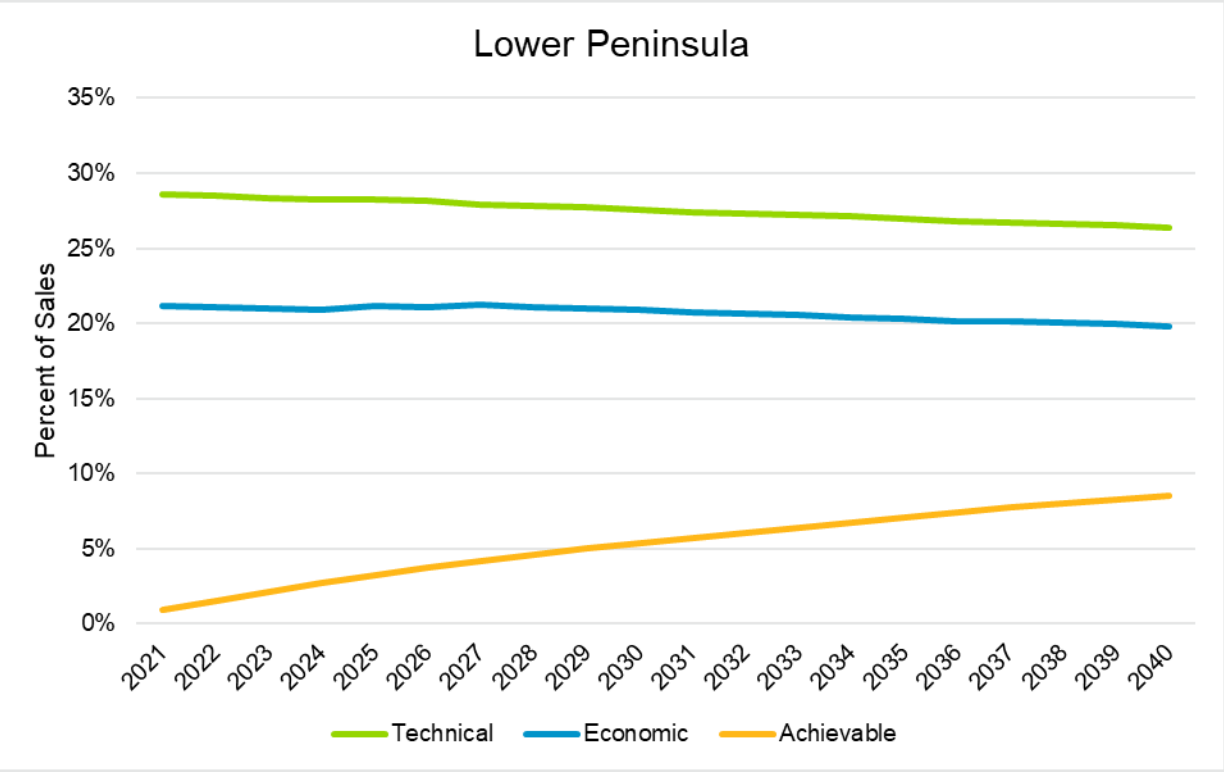
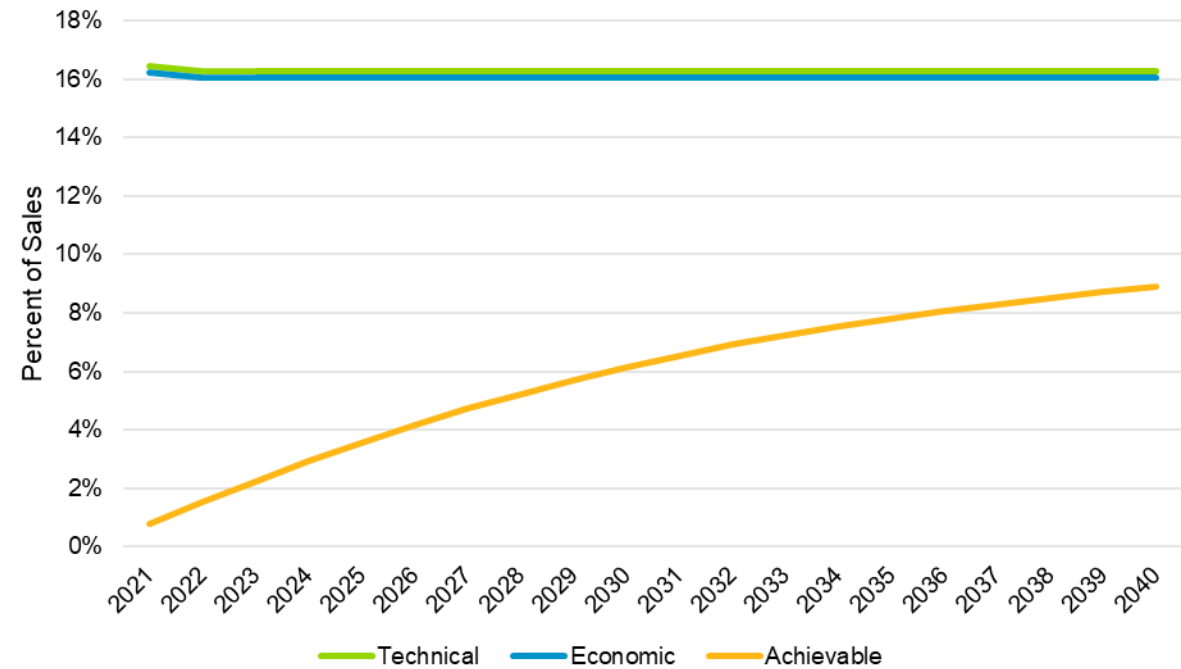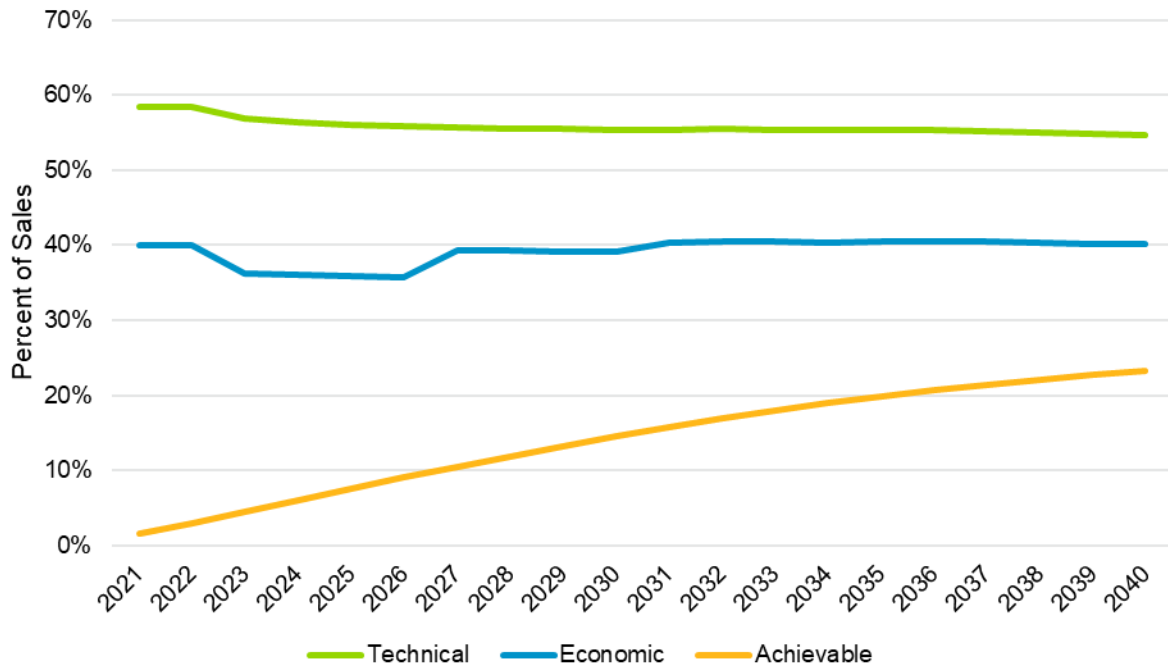*All results net at meter, reference case achievable potential shown as cumulative.*

Technical and economic potential are unconstrained.

EWR Technical, Economic, and Achievable Potential
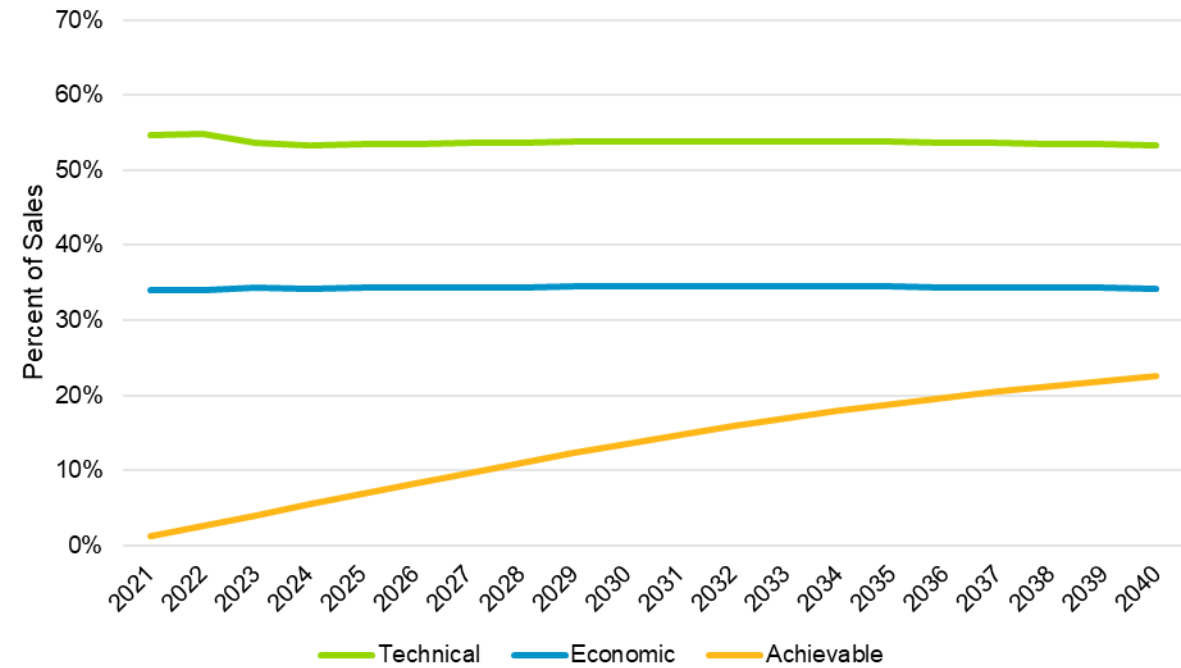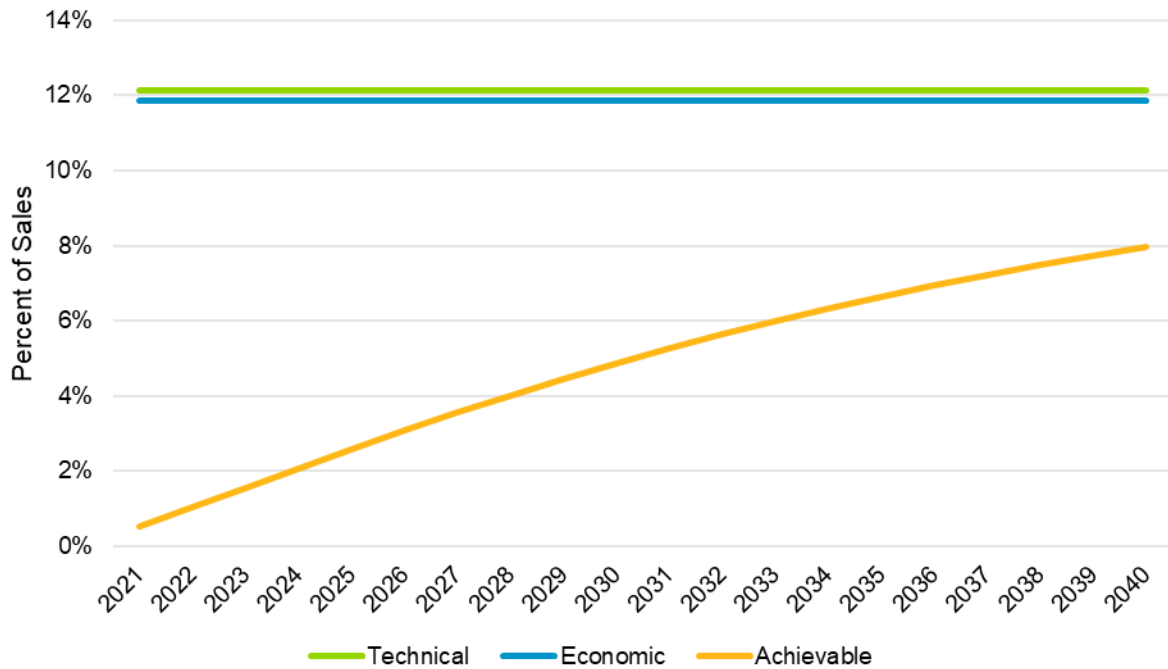## Commercial Sector, Electricity – Percent of Sales
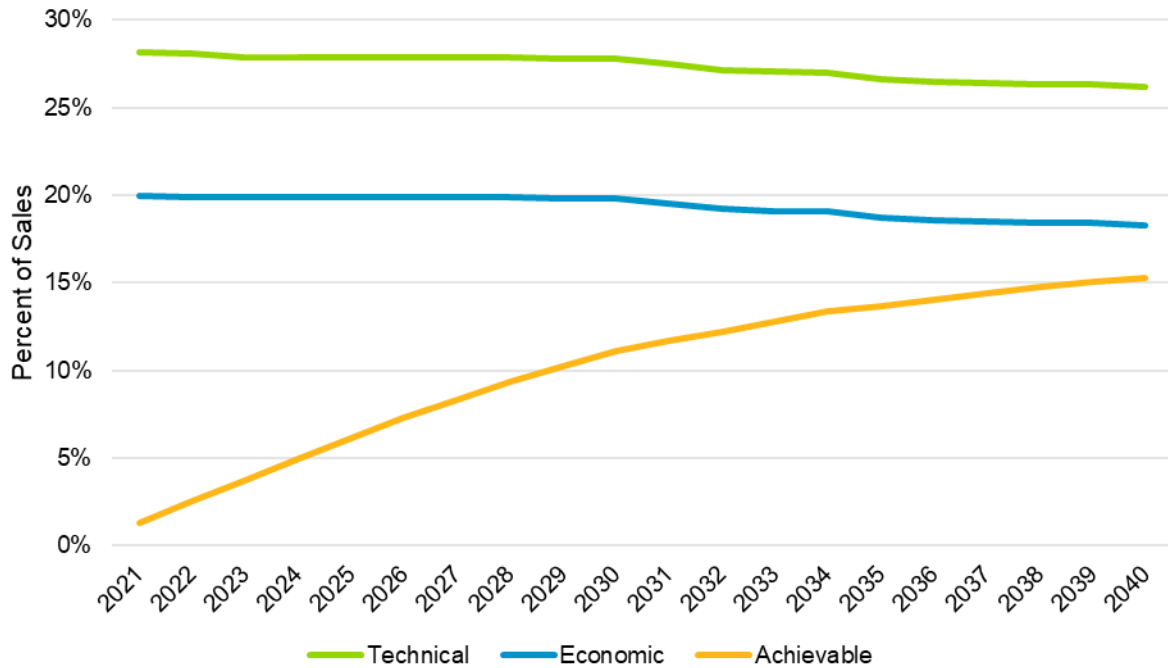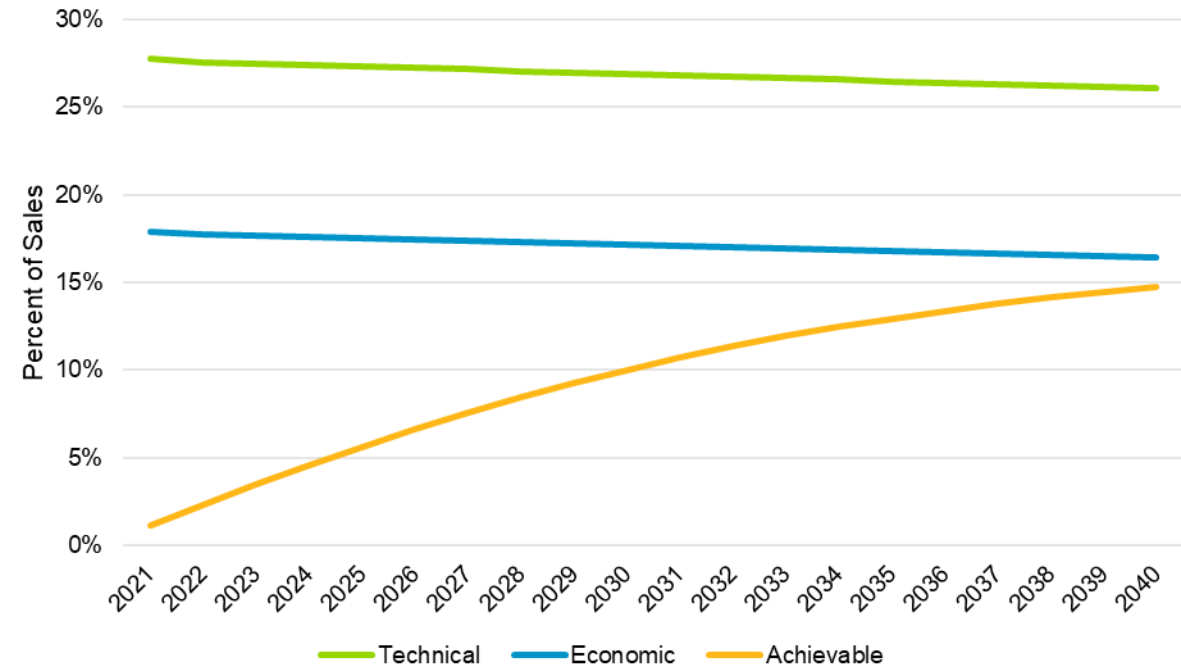
All results net at meter, reference case achievable potential shown as cumulative.

EWR Technical, Economic, and Achievable Potential
Industrial Sector, Electricity – Percent of Sales
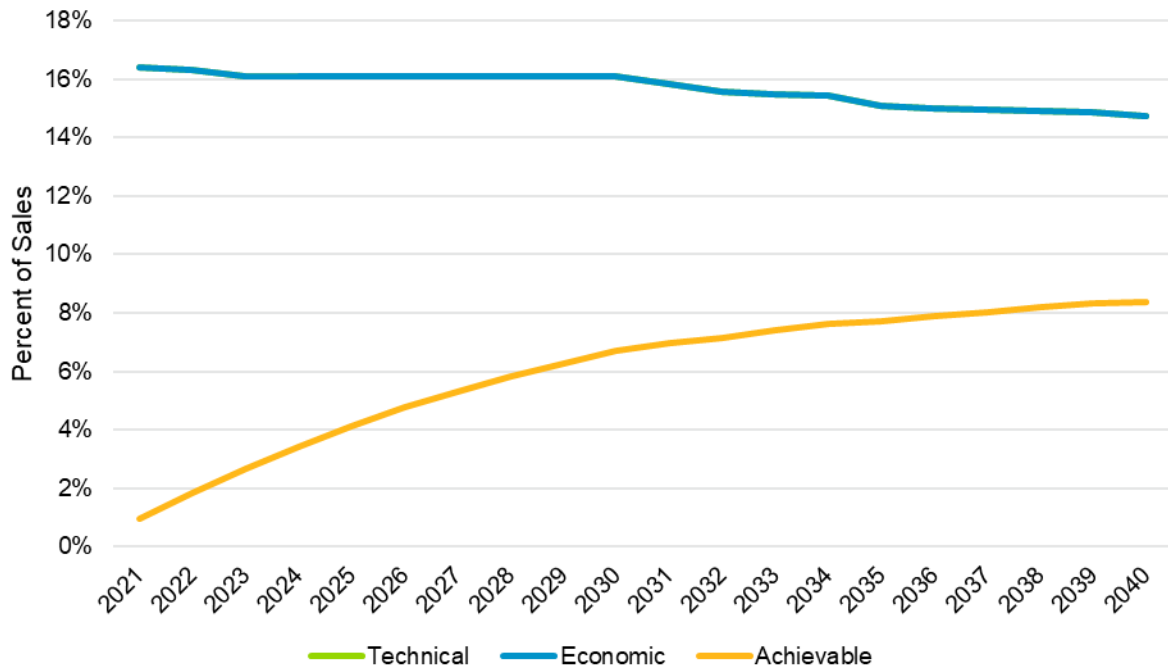
Technical and economic percentages identical

All results net at meter, reference case achievable potential shown as cumulative.

EWR Technical, Economic, and Achievable Potential
Residential Sector, Gas – Percent of Sales
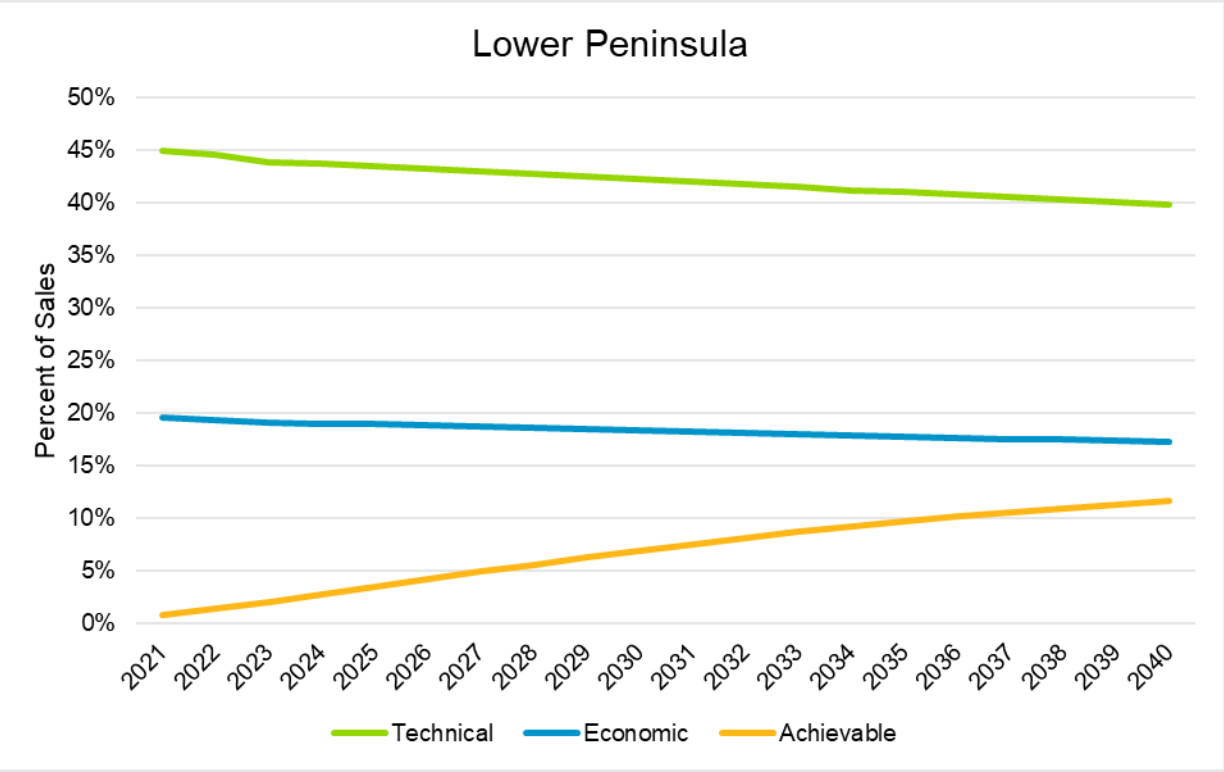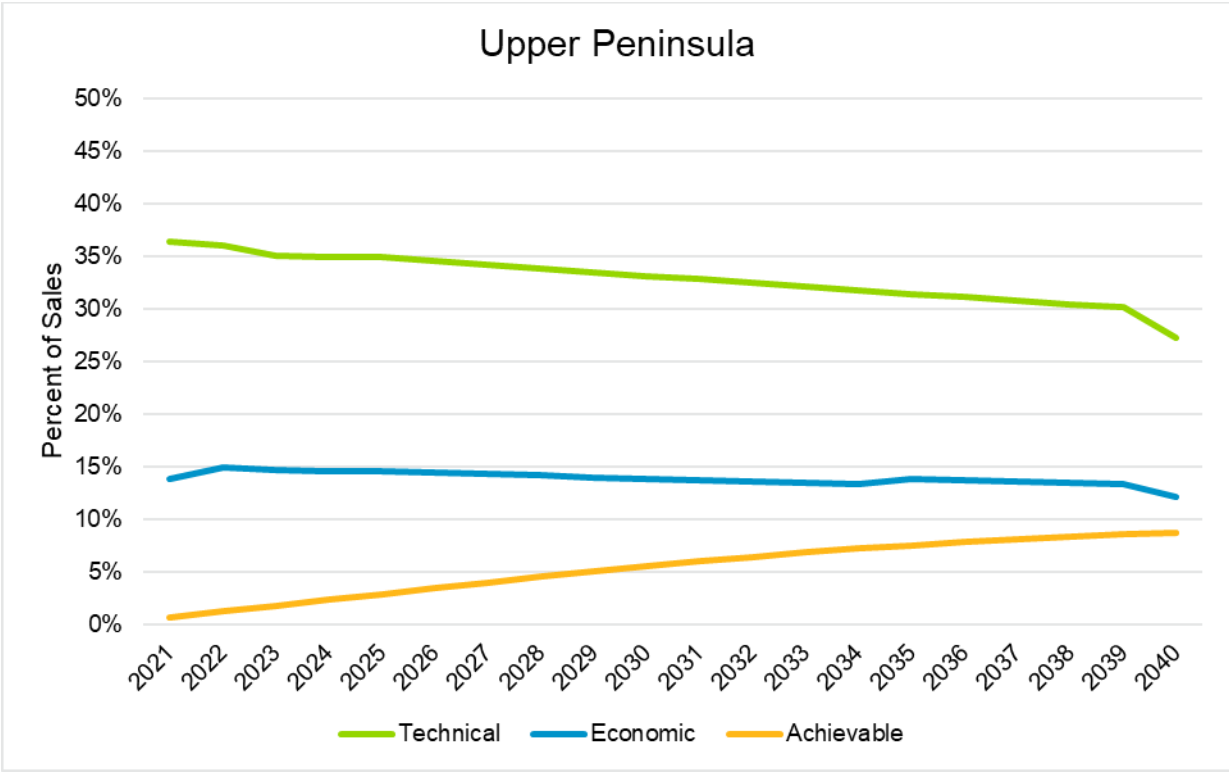
All results net at meter, reference case achievable potential shown as cumulative.

EWR Technical, Economic, and Achievable Potential
Commercial Sector, Gas – Percent of Sales

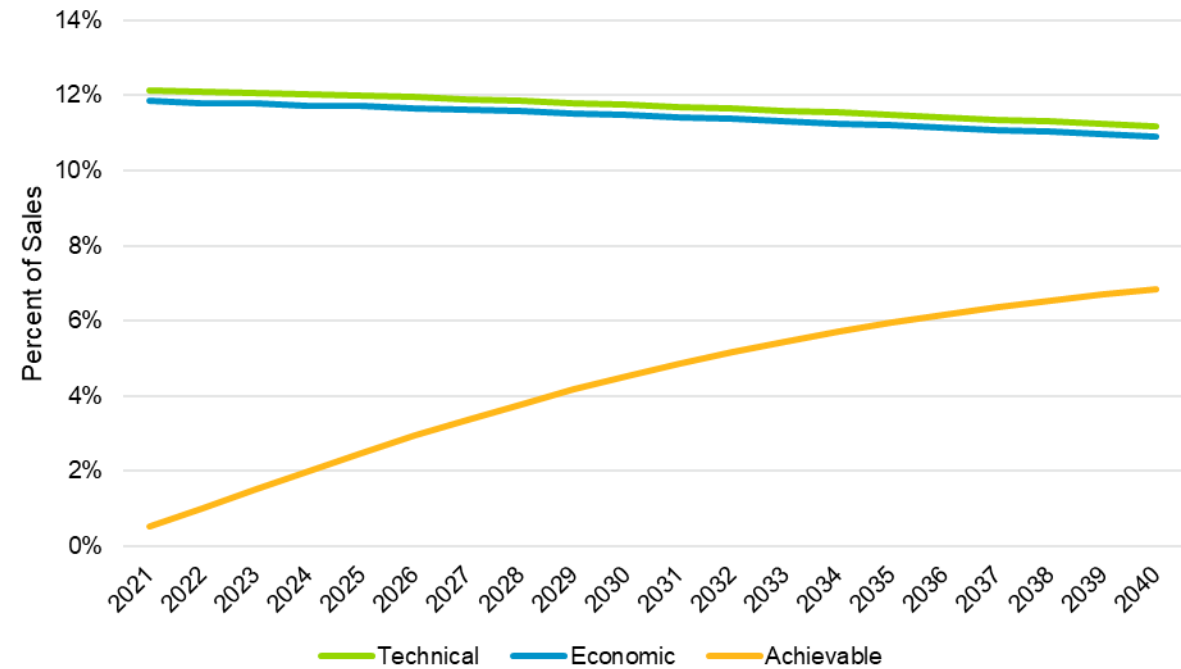*All results net at meter, reference case achievable potential shown as cumulative.*

EWR Technical, Economic, and Achievable Potential
Industrial Sector, Gas – Percent of Sales

All results net at meter, reference case achievable potential shown as cumulative.
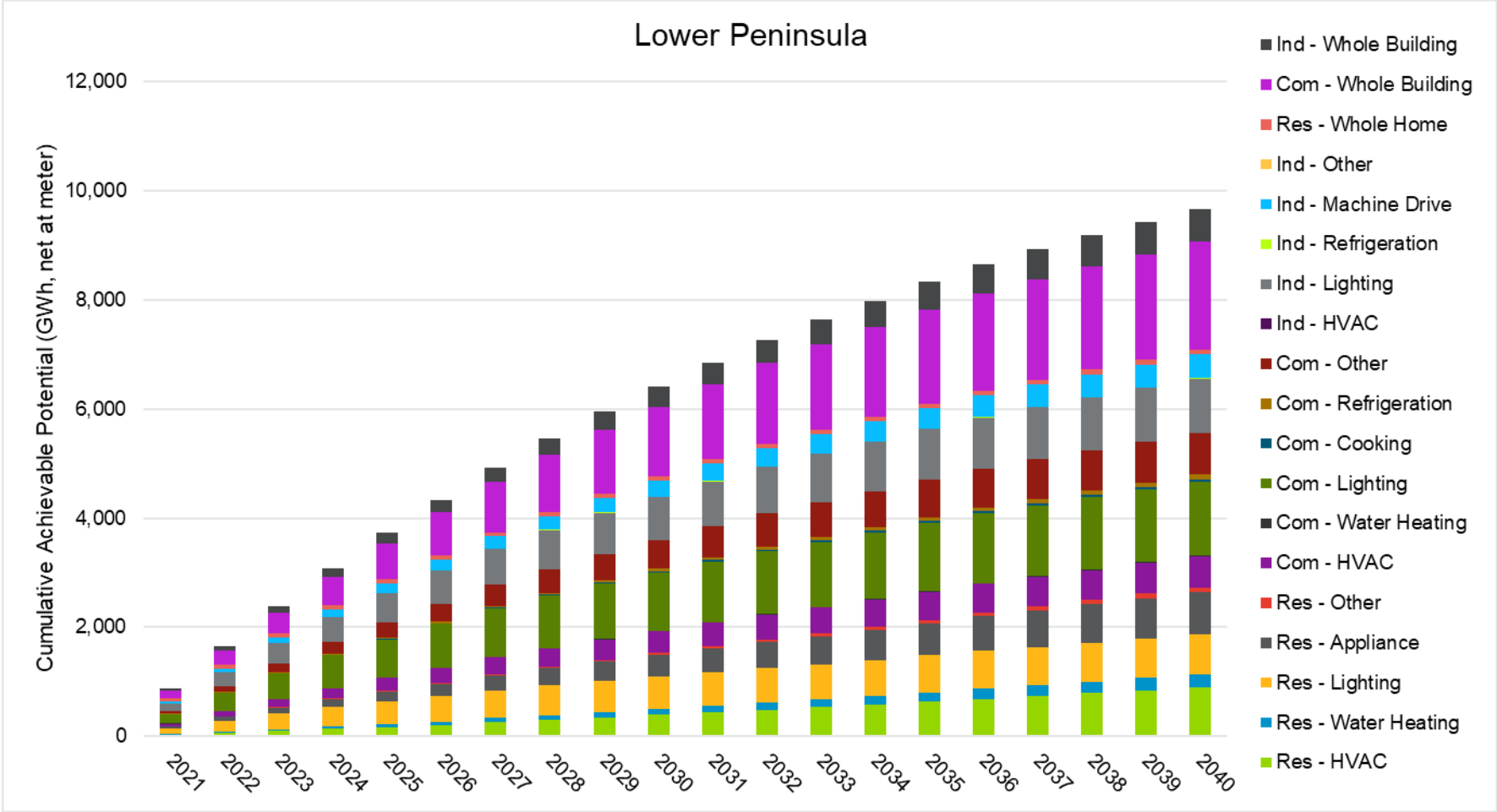
EWR Reference Case Summary

	Technical Potential 2030	Economic Potential 2030 (UCT)	Cumulative Achievable Potential 2021 (UCT)	Cumulative Achievable Potential 2030 (UCT)	Cumulative Achievable Potential 2040 (UCT)
Lower Peninsula Electric Savings as % of Sales Forecast					
Savings % - Residential	27.6%	20.9%	0.9%	5.4%	8.6%
Savings % - Commercial	27.8%	19.8%	1.3%	11.1%	15.3%
Savings % - Industrial	16.1%	16.1%	1.0%	6.7%	8.4%
Savings % - Total	24.6%	19.2%	1.1%	7.8%	10.9%
Upper Peninsula Electric Savings as % of Sales Forecast					
Savings % - Residential	32.1%	21.6%	1.1%	7.4%	12.1%
Savings % - Commercial	26.9%	17.2%	1.2%	10.0%	14.7%
Savings % - Industrial	16.3%	16.0%	0.8%	6.1%	8.9%
Savings % - Total	25.3%	18.5%	1.0%	7.6%	11.6%
Lower Peninsula Gas Savings as % of Sales Forecast					
Savings % - Residential	42.3%	18.4%	0.8%	6.9%	11.7%
Savings % - Commercial	55.4%	39.1%	1.5%	14.5%	23.3%
Savings % - Industrial	12.1%	11.9%	0.5%	4.9%	8.0%
Savings % - Total	44.6%	23.2%	0.9%	8.7%	14.3%
Upper Peninsula Gas Savings as % of Sales Forecast					
Savings % - Residential	33.1%	13.8%	0.6%	5.5%	8.6%
Savings % - Commercial	53.8%	34.5%	1.3%	13.6%	22.5%
Savings % - Industrial	11.8%	11.5%	0.5%	4.5%	6.8%
Savings % - Total	35.3%	16.5%	0.7%	6.5%	10.3%

EWR Reference Case Achievable Potential – By End Use
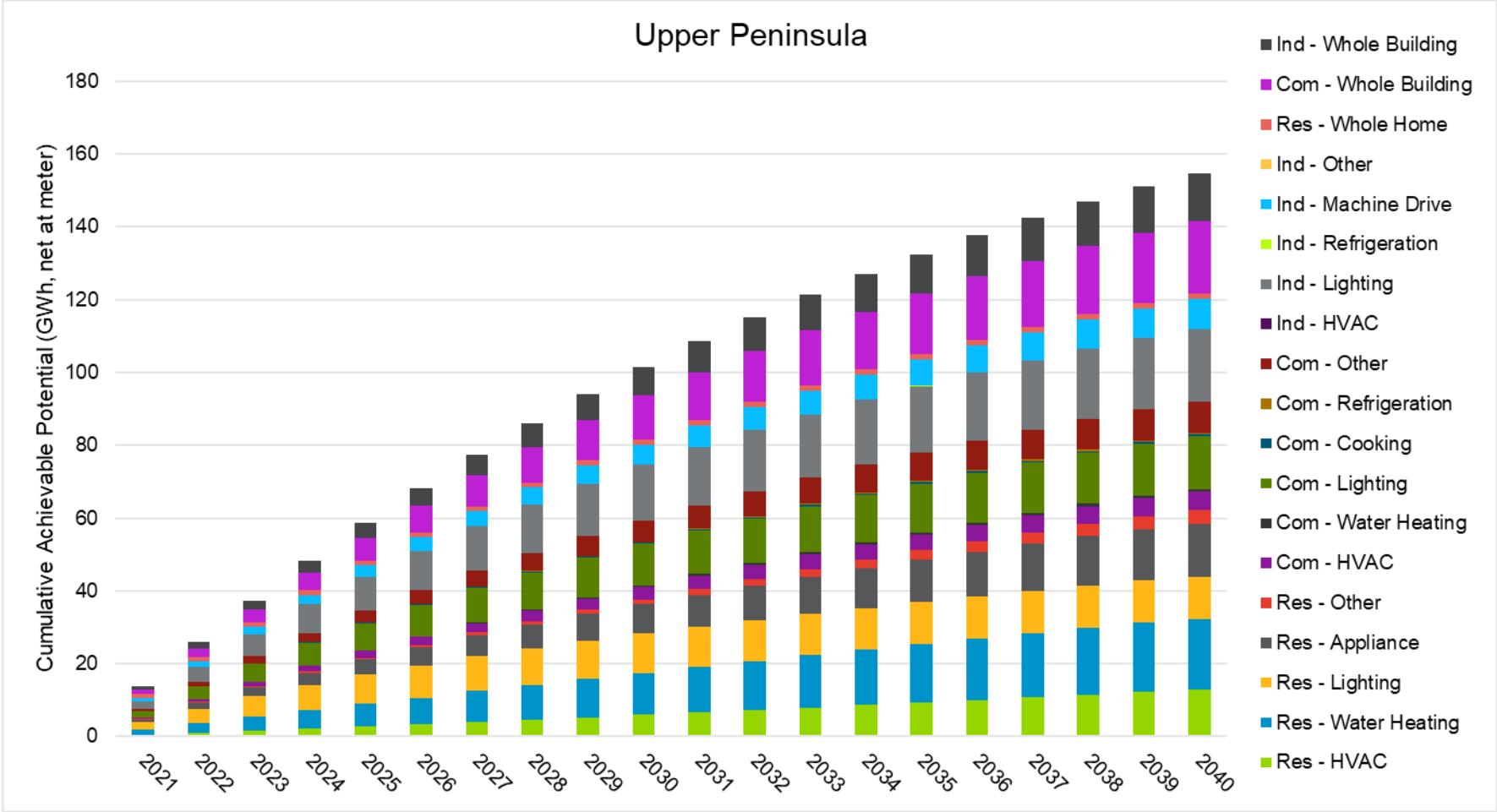
- **Electricity**

- **Gas**

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EWR Reference Case Cumulative Achievable Potential by End Use
Electricity Potential, GWh/Year, net at meter – Lower Peninsula
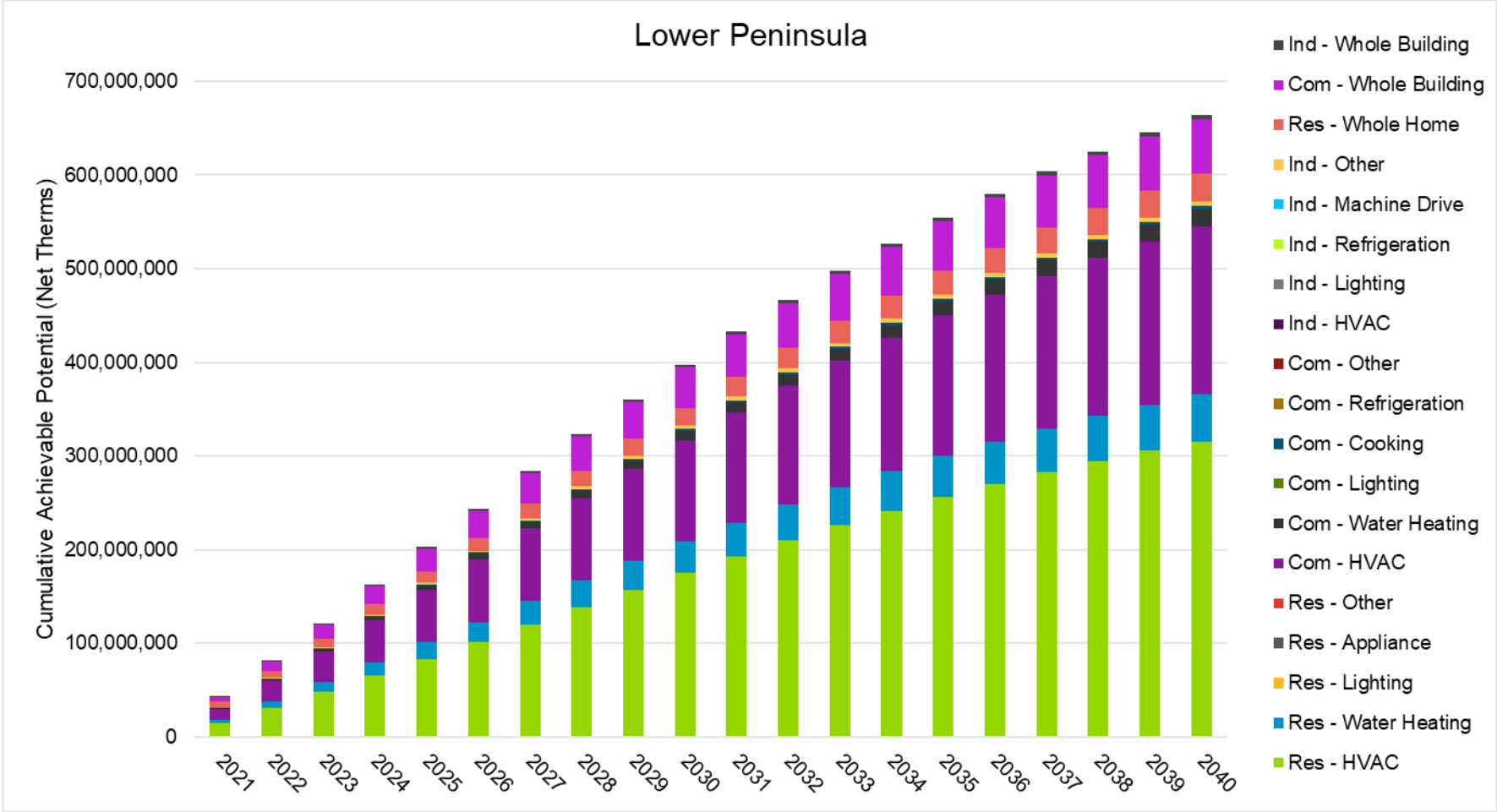
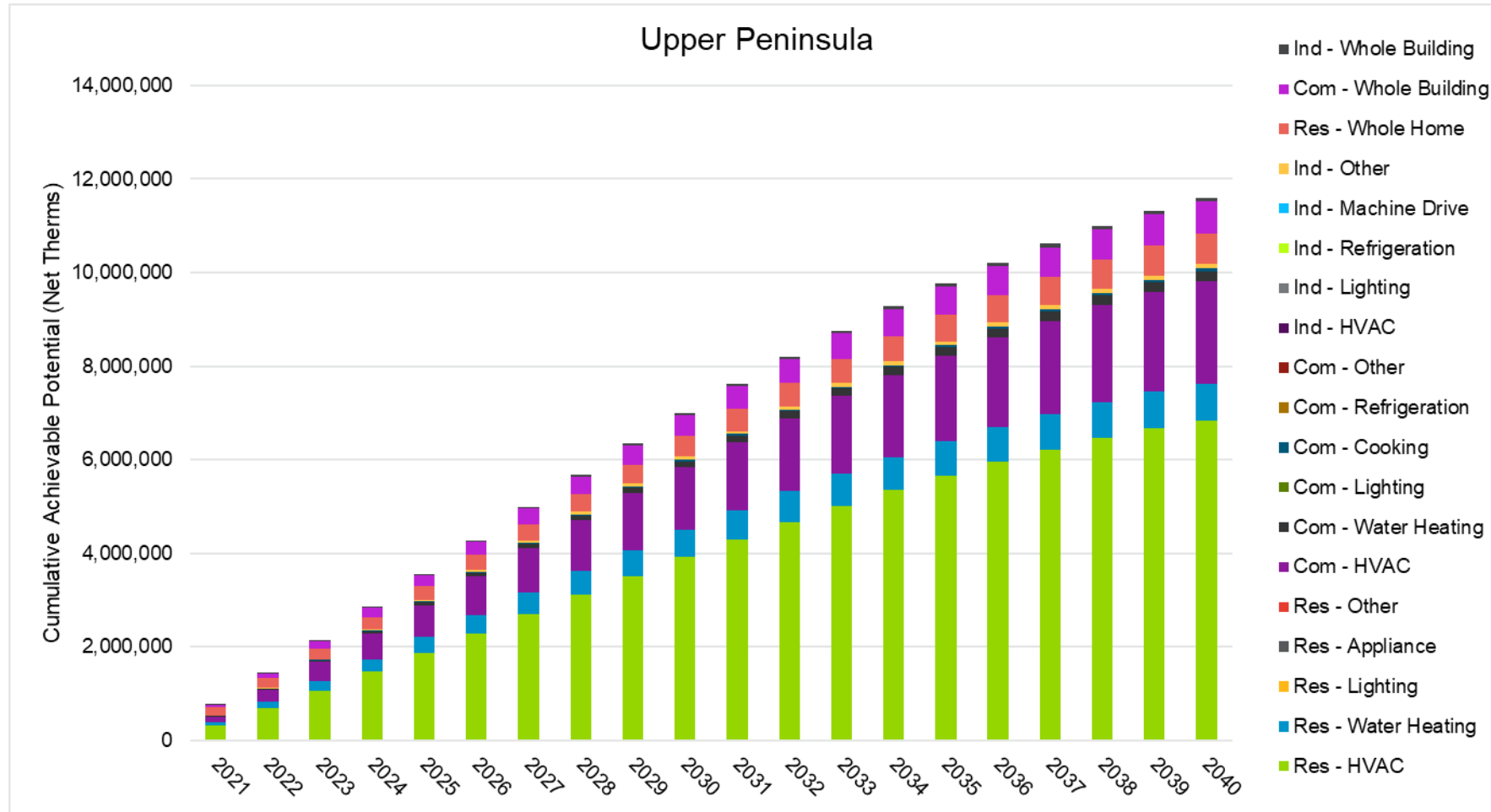# EWR Reference Case Cumulative Achievable Potential by End Use
Electricity Potential, GWh/Year, net at meter – Upper Peninsula

EWR Reference Case Cumulative Achievable Potential by End Use

Gas Potential, Net Therms – Lower Peninsula

EWR Reference Case Cumulative Achievable Potential by End Use

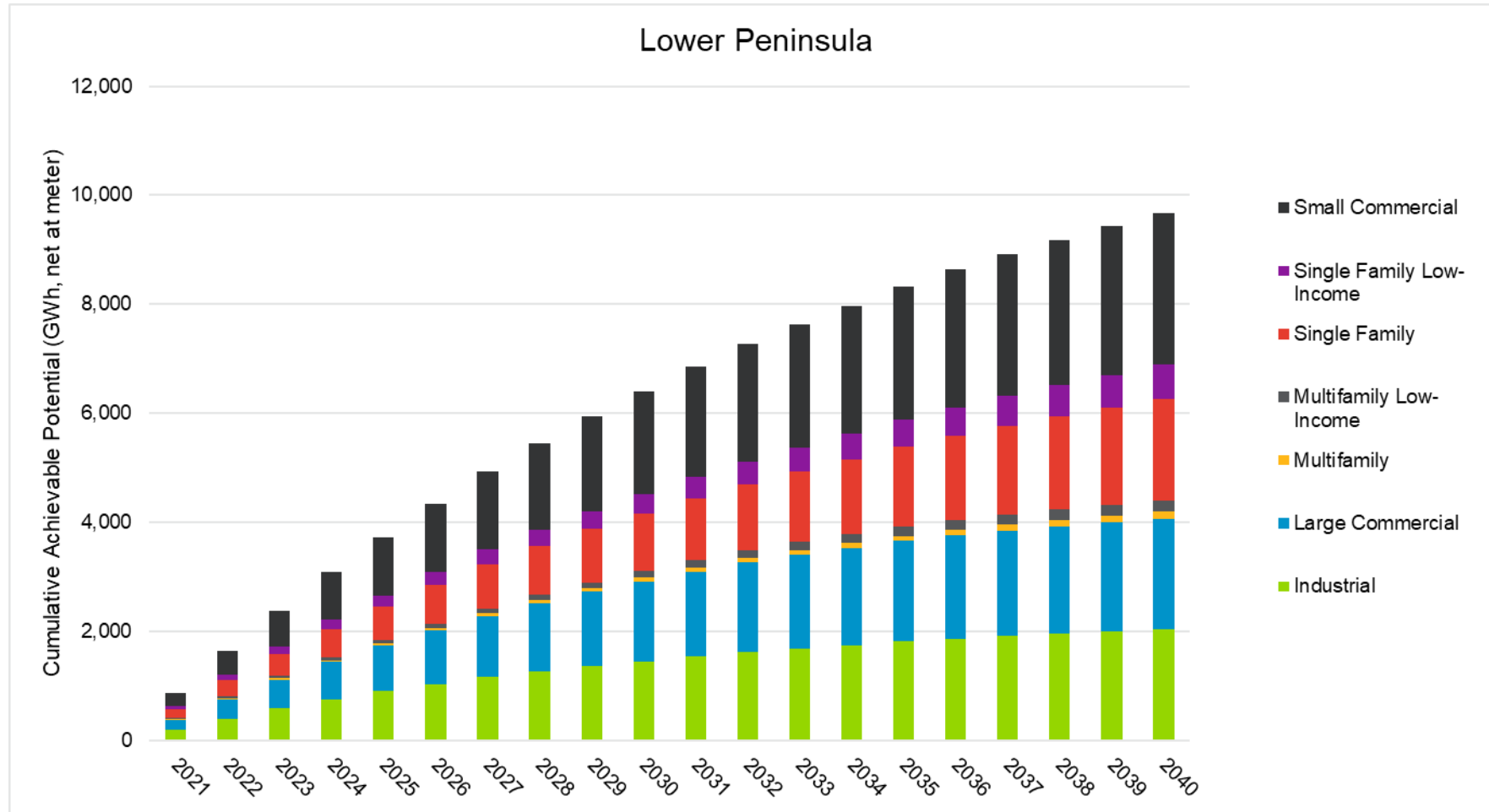Gas Potential, Net Therms – Upper Peninsula

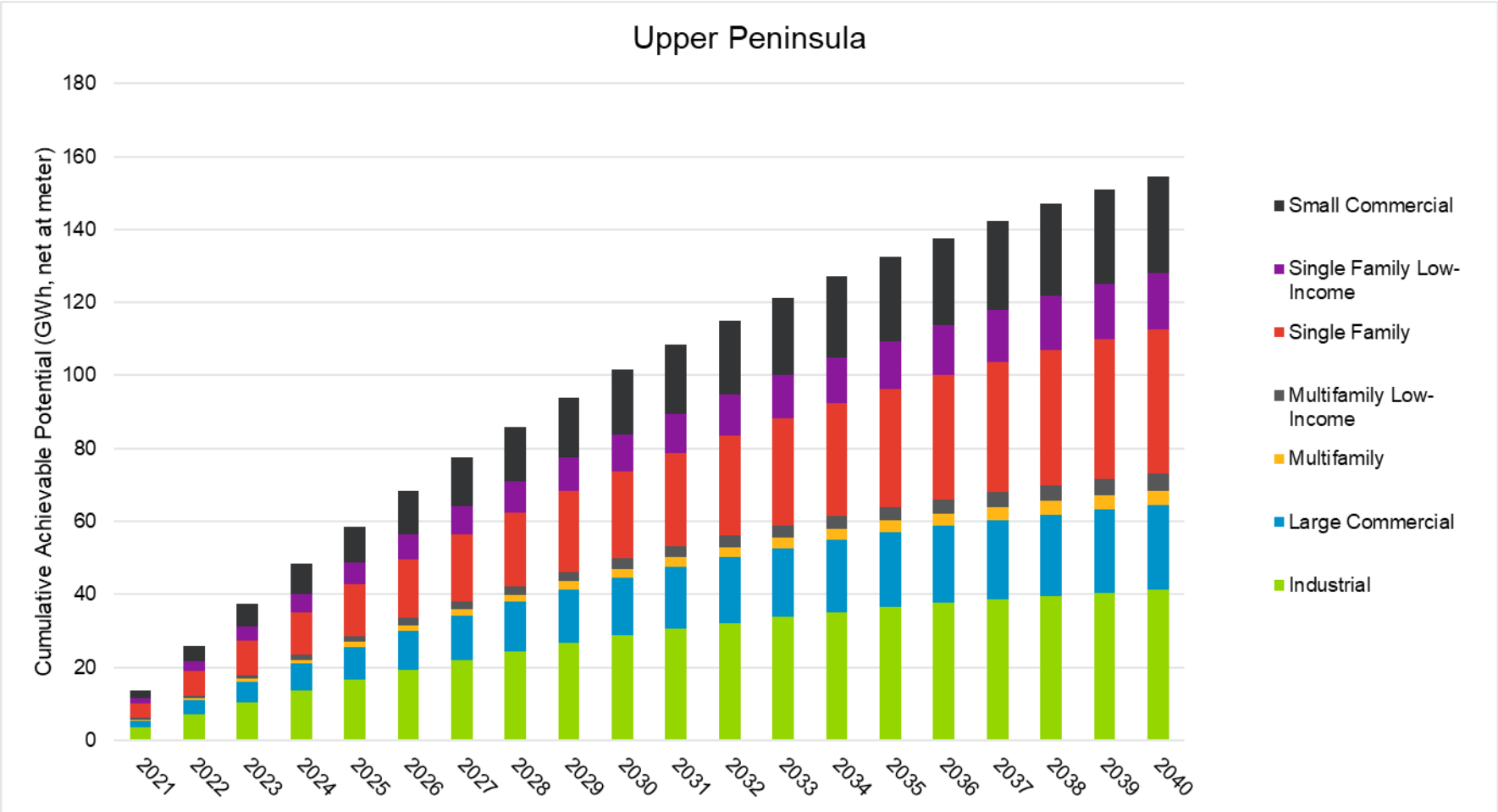# EWR Reference Case Achievable Potential – by Segment

- **Electricity**

- **Gas**

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EWR Reference Case Cumulative Achievable Potential by Segment
Electricity Potential, GWh/Year, net at meter – Lower Peninsula
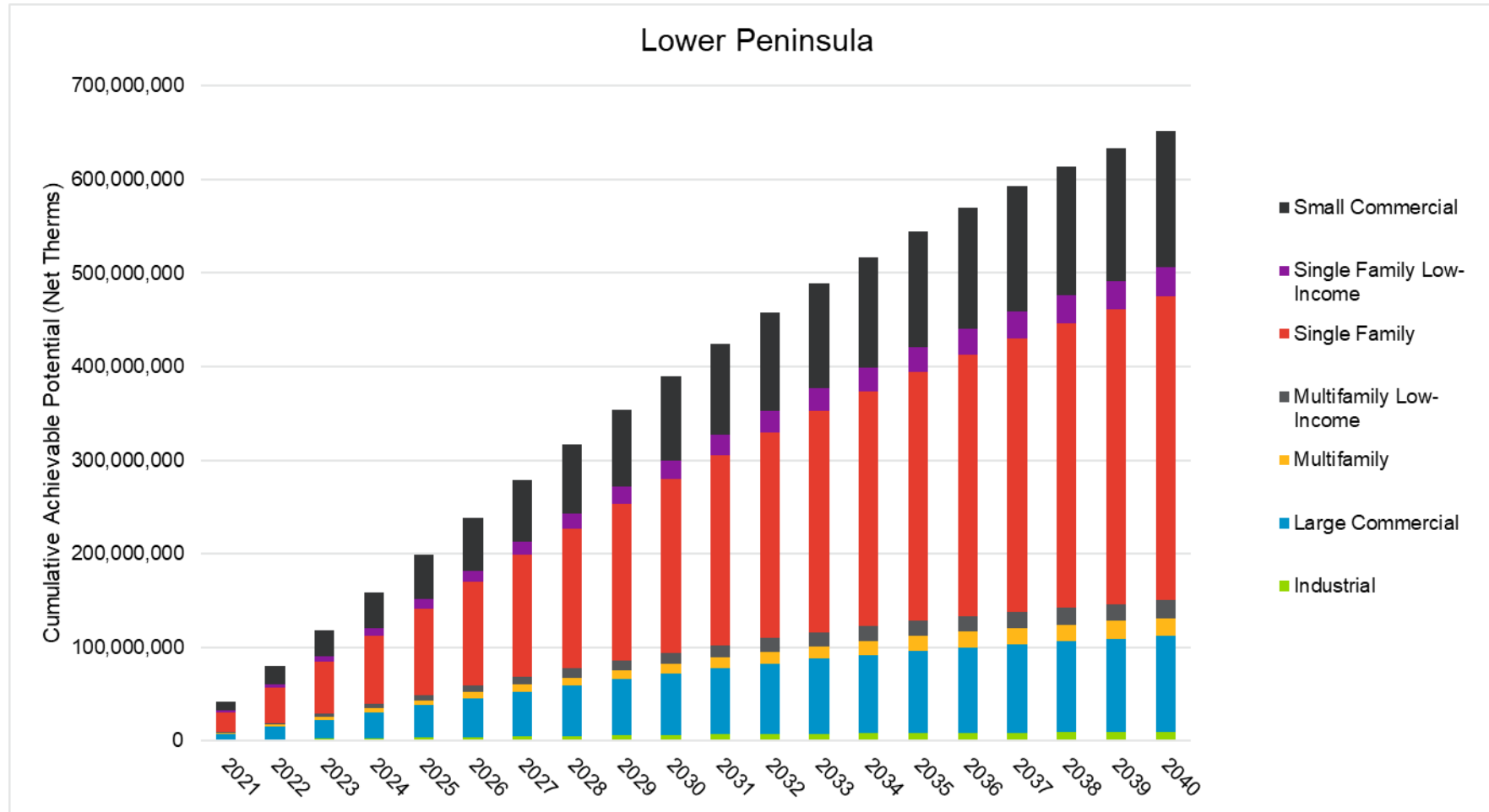
EWR Reference Case Cumulative Achievable Potential by Segment
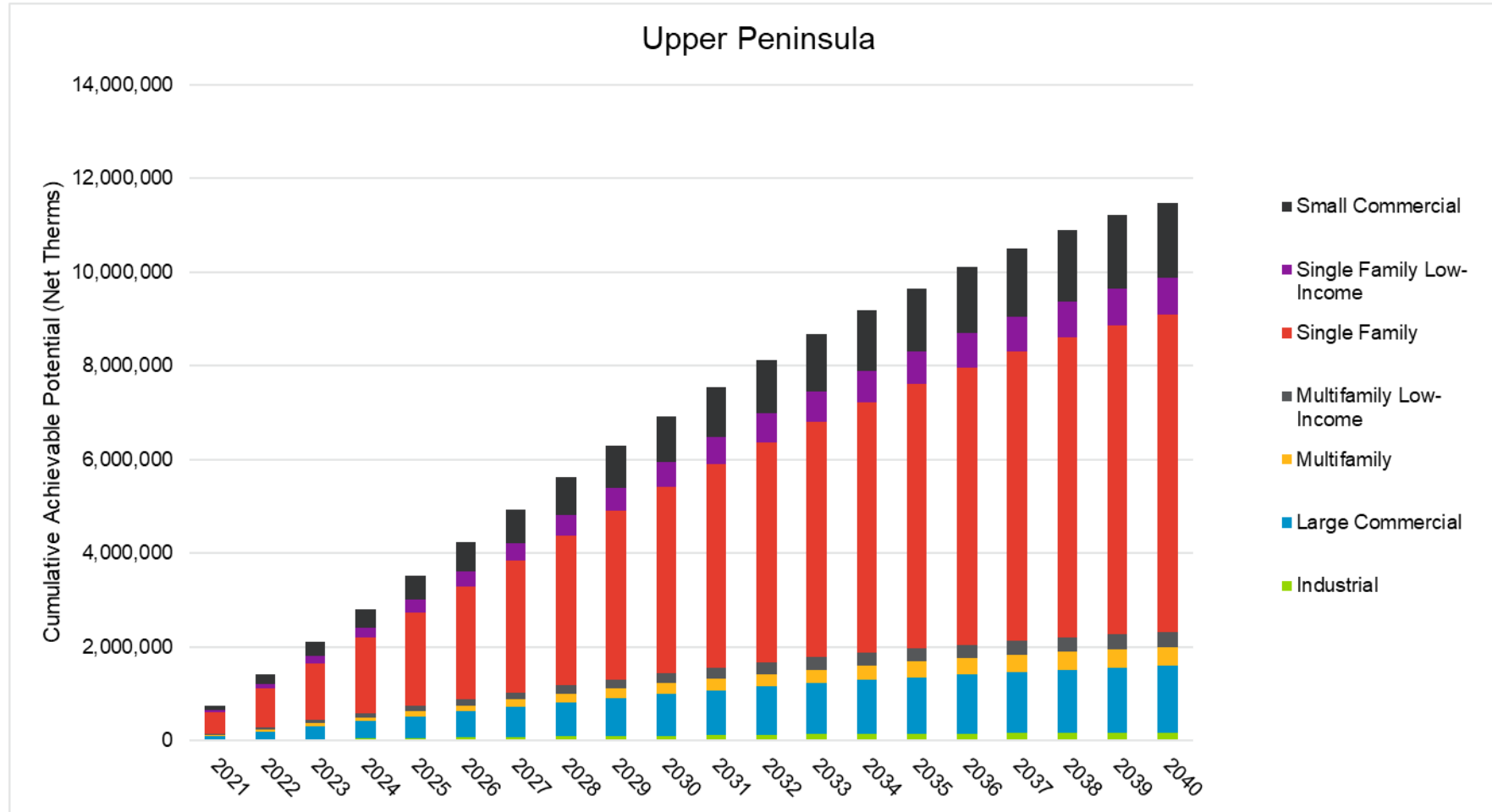Electricity Potential, GWh/Year, net at meter – Upper Peninsula

EWR Reference Case Cumulative Achievable Potential by Segment
Gas Potential, Net Therms – Lower Peninsula

EWR Reference Case Cumulative Achievable Potential by Segment
Gas Potential, Net Therms – Upper Peninsula

EWR Reference Case Achievable Potential – Top Measures

EWR Reference Case Achievable Potential
Top 20 Measures: 2021 – Lower Peninsula

Rank	Measure Name – Electricity	2021 Incremental Annual Achievable Potential (GWh/year, net at meter)	Percent of Total
1	Ind - Lighting - RET Only - Electric	117.8	14%
2	Res - Home Energy Reports - RET Only - Elec	64.5	7%
3	Com - Energy Management System (EMS) - RET Only - Electric	62.4	7%
4	Res - LED Bulbs - RET Only - Electric	46.7	5%
5	Com - Strategic Energy Management (SEM) - RET Only - Electric	41.4	5%
6	Com - LED Tube - RET Only - Electric	32.4	4%
7	Com - Lighting, Advanced Controls - RET Only - Electric	30.9	4%
8	Ind - Strategic Energy Management (SEM) - RET Only - Electric	30.0	3%
9	Res - LED Specialty Bulbs - RET Only - Electric	27.6	3%
10	Com - Lighting Controls (Occ and Daylight) - RET Only - Electric	25.8	3%
11	Res - Heat Pumps, Mini-Split - RET Only - Electric	24.9	3%
12	Ind - Air Compressors Controls - RET Only - Electric	20.5	2%
13	Com - Custom - RET Only - Electric	20.4	2%
14	Com - VFD (Process Fans) - RET Only - Electric	19.5	2%
15	Com - LED Refrigerator Case Lighting - RET Only - Electric	19.3	2%
16	Res - Res Appliance - ROB and NEW - Electric	16.1	2%
17	Com - Demand Controlled Ventilation - RET Only - Electric	14.0	2%
18	Res - Appliance Recycling, Fridge-Freezer - RET Only - Electric	13.7	2%
19	Ind - Lighting - ROB and NEW - Electric	13.5	2%
20	Com - VFD (Process Pumps) - RET Only - Electric	13.0	1%

Top 20 measures represent 75% of net achievable potential in 2021

Rank	Measure Name – Gas	2021 Incremental Annual Achievable Potential (Net Therms)	Percent of Total
1	Res - Furnaces - RET Only - Gas	7,942,542	19%
2	Com - Demand Controlled Ventilation - RET Only - Gas	5,260,224	12%
3	Res - Home Energy Reports - RET Only - Gas	5,193,602	12%
4	Com - HVAC - ROB and NEW - Gas	3,952,528	9%
5	Res - Furnace Tune-up - RET Only - Gas	3,063,373	7%
6	Com - Custom - RET Only - Gas	2,878,502	7%
7	Res - Boiler - RET Only - Gas	2,009,927	5%
8	Res - Thermostats - RET Only - Gas	1,845,562	4%
9	Res - Showerheads - RET Only - Gas	1,744,664	4%
10	Com - Strategic Energy Management (SEM) - RET Only - Gas	1,248,770	3%
11	Res - Air Sealing - RET Only - Gas	1,071,701	3%
12	Res - Low Flow Aerators - RET Only - Gas	971,908	2%
13	Com - Gas Storage Water Heater - ROB and New - Gas	897,889	2%
14	Com - Energy Management System (EMS) - RET Only - Gas	841,279	2%
15	Com - Thermostats - RET Only - Gas	732,353	2%
16	Res - Pipe Insulation - RET Only - Gas	493,073	1%
17	Com - Demand Controlled Ventilation - New Only - Gas	394,394	1%
18	Com - Furnaces - ROB and NEW - Gas	352,129	1%
19	Com - Steam Traps - RET Only - gas	290,631	1%
20	Ind - Heat Recovery - RET Only - Gas	259,755	1%

Top 20 measures represent 97% of net achievable potential in 2021

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EWR Reference Case Achievable Potential
Top 20 Measures: 2021 – Upper Peninsula

Rank	Measure Name – Electricity	2021 Incremental Annual Achievable Potential (GWh/year, net at meter)	Percent of Total
1	Ind - Lighting - RET Only - Electric	1.9	14%
2	Res - Home Energy Reports - RET Only - Elec	1.3	9%
3	Res - Water Heaters, Heat Pump - ROB and NEW - Electric	1.2	9%
4	Res - LED Bulbs - RET Only - Electric	1.0	7%
5	Ind - Strategic Energy Management (SEM) - RET Only - Electric	0.6	5%
6	Res - LED Specialty Bulbs - RET Only - Electric	0.6	4%
7	Com - Strategic Energy Management (SEM) - RET Only - Electric	0.5	3%
8	Com - Energy Management System (EMS) - RET Only - Electric	0.5	3%
9	Ind - Air Compressors Controls - RET Only - Electric	0.4	3%
10	Res - Res Appliance - ROB and NEW - Electric	0.3	3%
11	Com - LED Tube - RET Only - Electric	0.3	2%
12	Res - Appliance Recycling, Fridge-Freezer - RET Only - Electric	0.3	2%
13	Com - Lighting, Advanced Controls - RET Only - Electric	0.3	2%
14	Res - Heat Pumps, Mini-Split - RET Only - Electric	0.3	2%
15	Com - Lighting Controls (Occ and Daylight) - RET Only - Electric	0.3	2%
16	Com - VFD (Process Fans) - RET Only - Electric	0.2	2%
17	Res - LED Bulb Exterior - ROB and NEW - Electric	0.2	2%
18	Com - LED Refrigerator Case Lighting - RET Only - Electric	0.2	2%
19	Com - Custom - RET Only - Electric	0.2	2%
20	Res - LED Tube - RET Only - Electric	0.2	2%

Rank	Measure Name – Gas	2021 Incremental Annual Achievable Potential (Net Therms)	Percent of Total
1	Res - Furnaces - RET Only - Gas	139,911	19%
2	Res - Home Energy Reports - RET Only - Gas	136,367	18%
3	Res - Boiler - RET Only - Gas	73,346	10%
4	Com - Demand Controlled Ventilation - RET Only - Gas	62,940	8%
5	Res - Furnace Tune-up - RET Only - Gas	53,812	7%
6	Com - HVAC - ROB and NEW - Gas	48,563	6%
7	Res - Thermostats - RET Only - Gas	46,172	6%
8	Res - Showerheads - RET Only - Gas	35,448	5%
9	Com - Custom - RET Only - Gas	27,203	4%
10	Res - Air Sealing - RET Only - Gas	24,539	3%
11	Res - Low Flow Aerators - RET Only - Gas	18,577	2%
12	Com - Strategic Energy Management (SEM) - RET Only - Gas	16,751	2%
13	Com - Thermostats - RET Only - Gas	9,214	1%
14	Res - Pipe Insulation - RET Only - Gas	8,487	1%
15	Com - Gas Storage Water Heater - ROB and New - Gas	8,399	1%
16	Com - Energy Management System (EMS) - RET Only - Gas	5,772	1%
17	Ind - Heat Recovery - RET Only - Gas	4,694	1%
18	Com - Furnaces - ROB and NEW - Gas	4,155	1%
19	Com - Steam Traps - RET Only - gas	3,670	0%
20	Com - Cooking - ROB and NEW - Gas	3,275	0%

*Top 20 measures represent 80% of net achievable potential in 2021

*Top 20 measures represent 97% of net achievable potential in 2021

EWR Achievable Potential – Reference Case Sensitivity Analysis
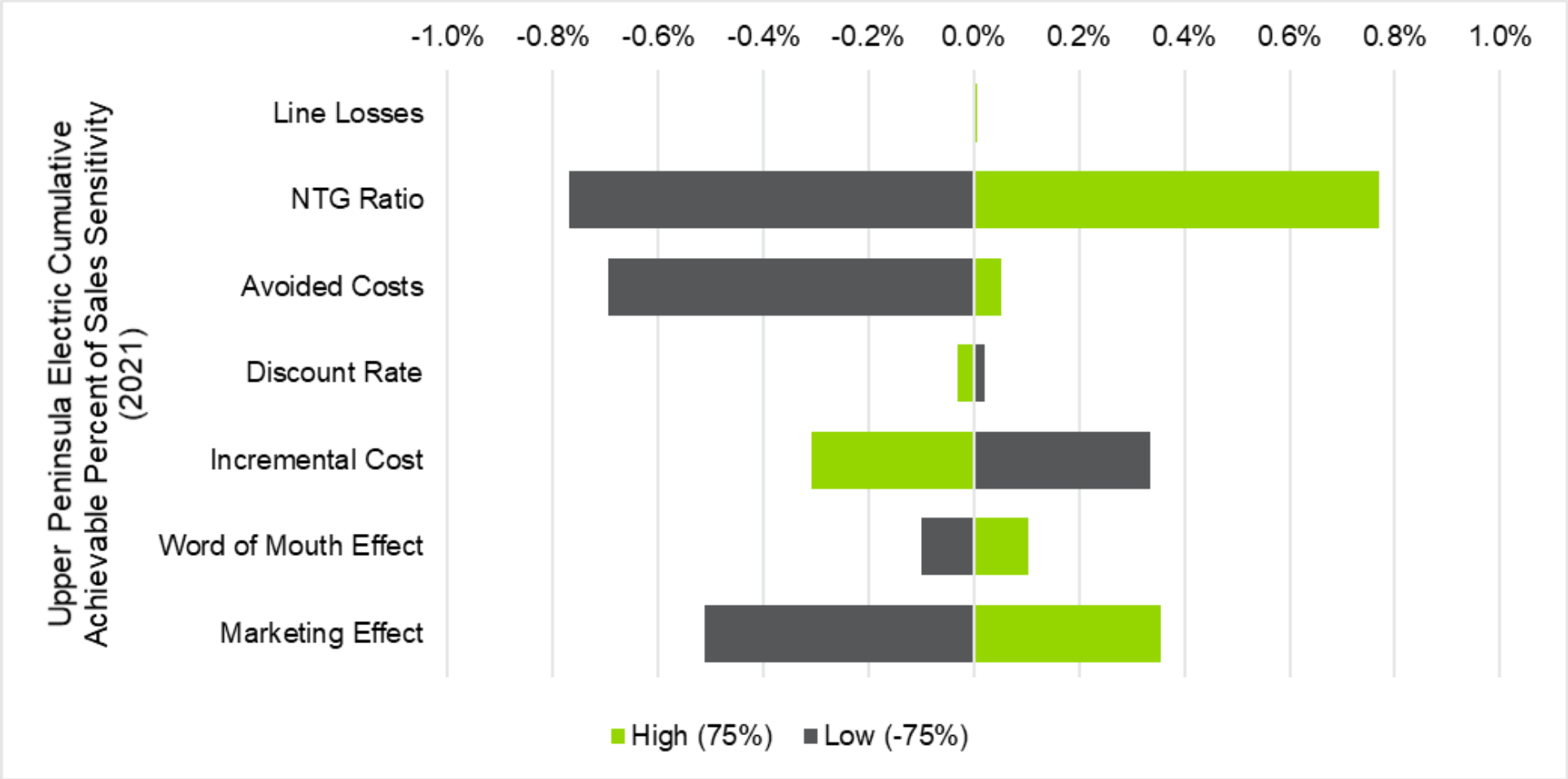
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EWR Potential Study Sensitivity Analysis
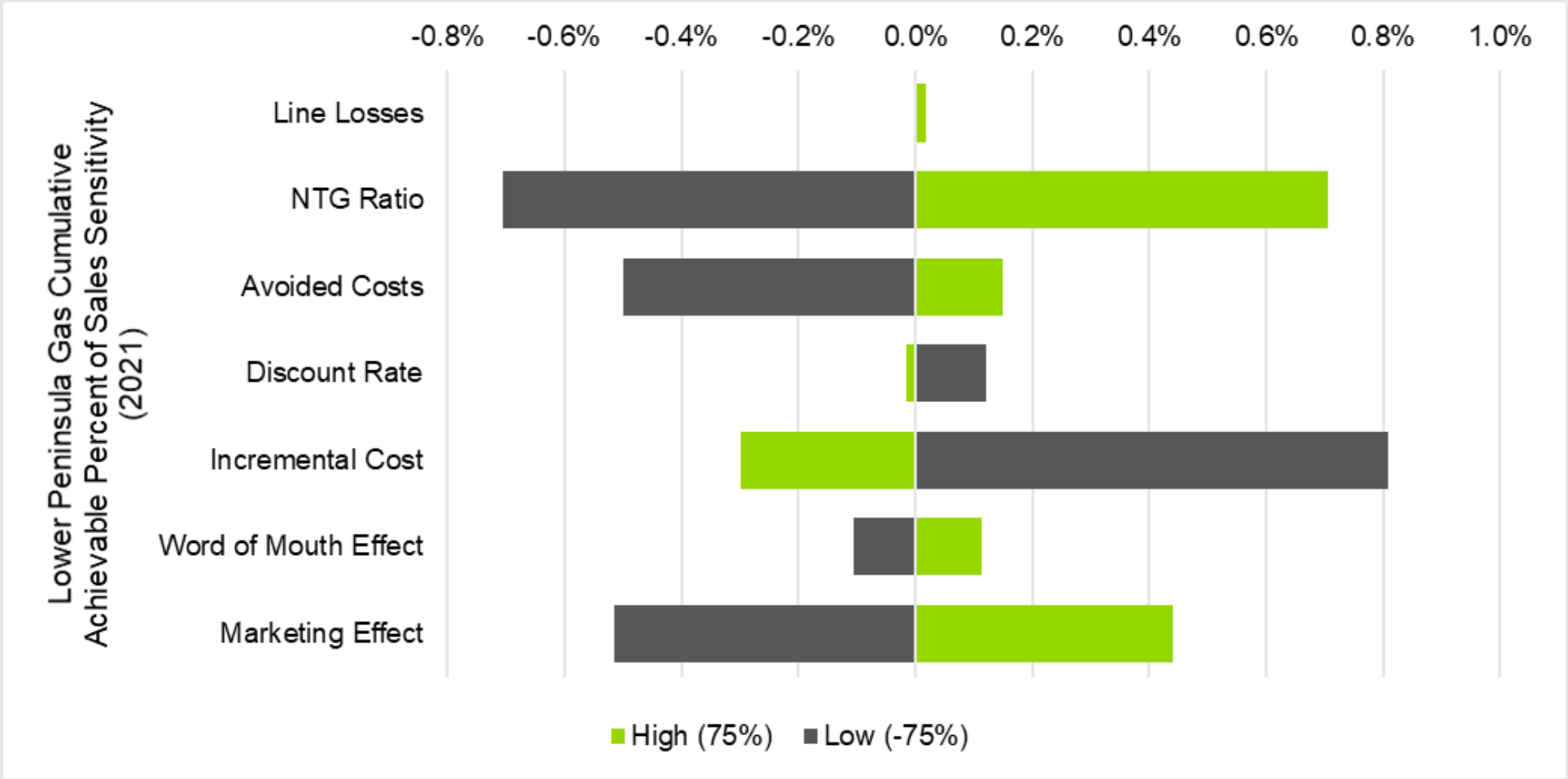Electricity, Percent of Sales (net at meter) – Lower Peninsula
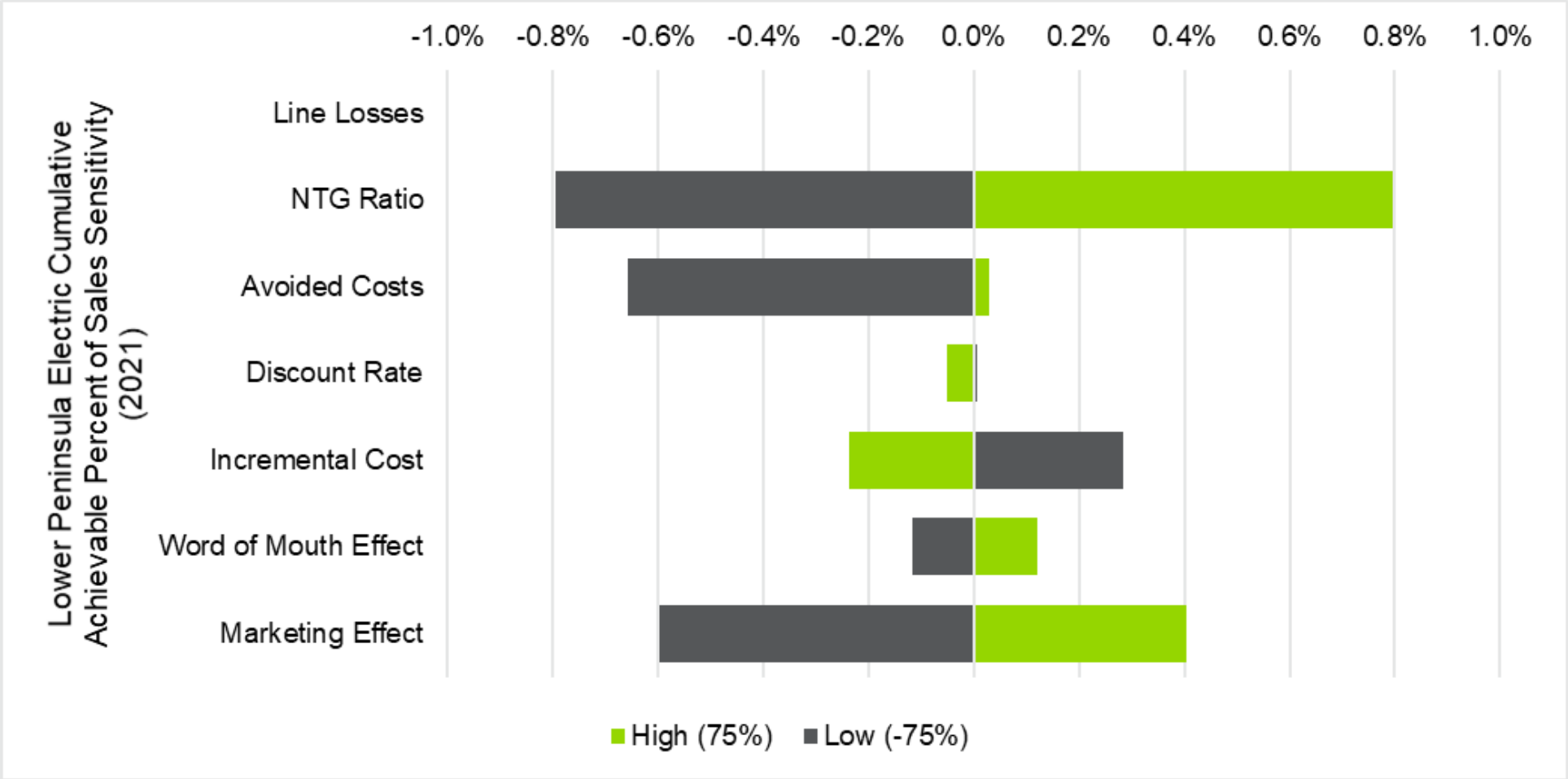
EWR Potential Study Sensitivity Analysis
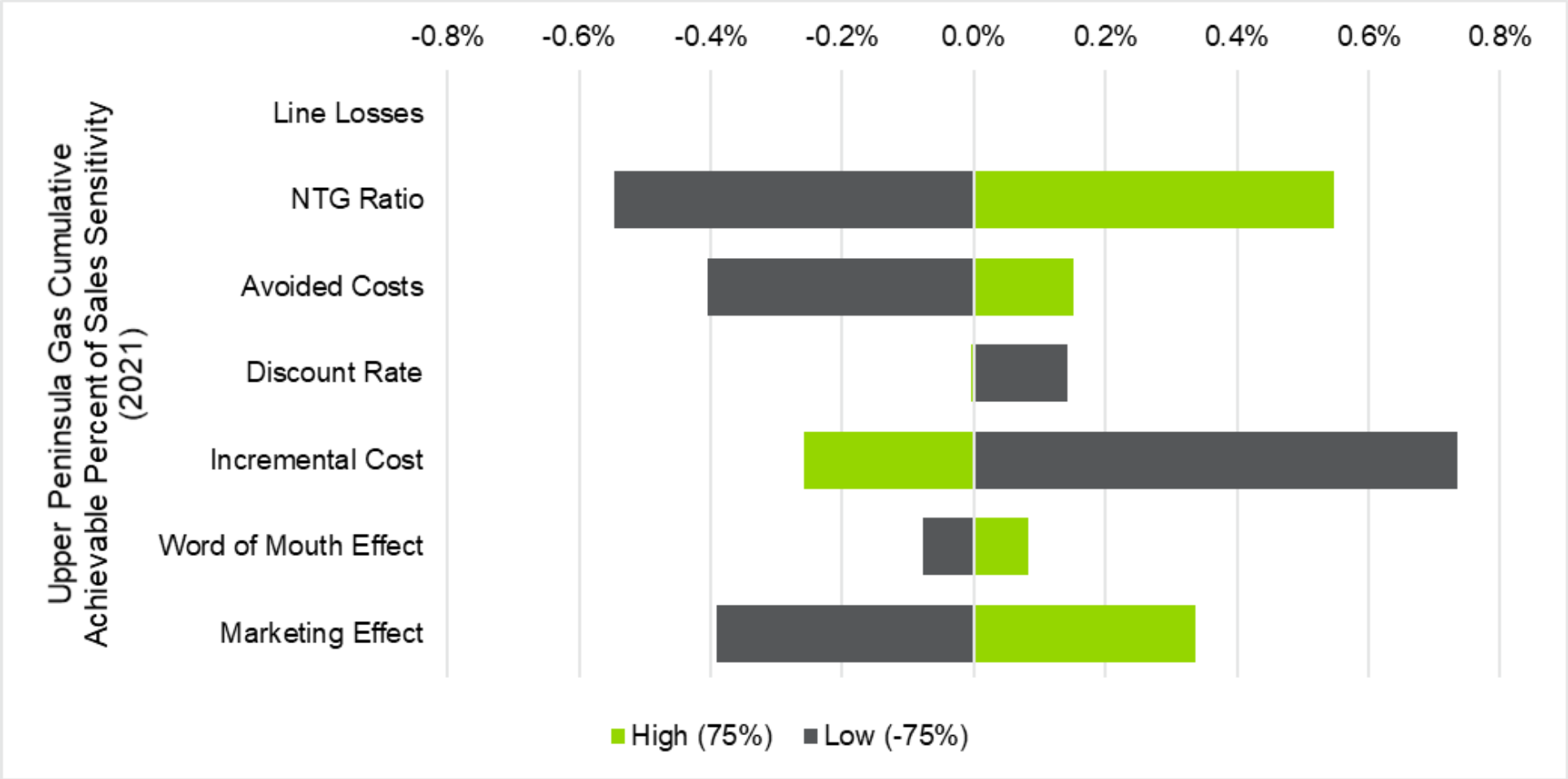Electricity, Percent of Sales (net at meter) – Upper Peninsula

EWR Potential Study Sensitivity Analysis
Gas, Percent of Sales (net) – Lower Peninsula
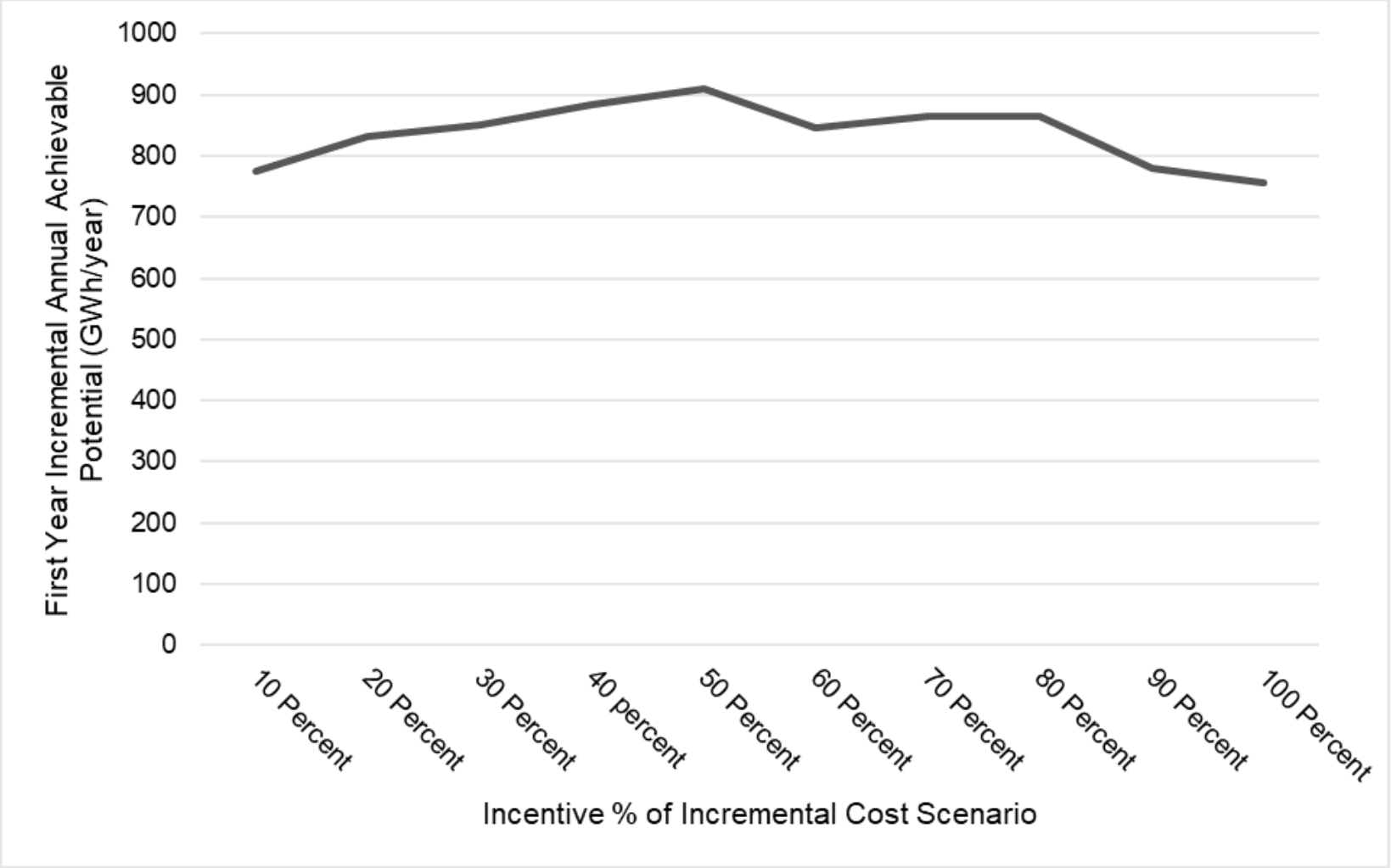
EWR Potential Study Sensitivity Analysis
Gas, Percent of Sales (net) – Upper Peninsula

EWR Achievable Potential – Scenarios

EWR Reference Case – Incentive Scenarios
Savings potential does not increase directly with incentive spending

EWR Scenarios Comparison
Electricity, Cumulative Achievable Potential, % of Sales, net at meter
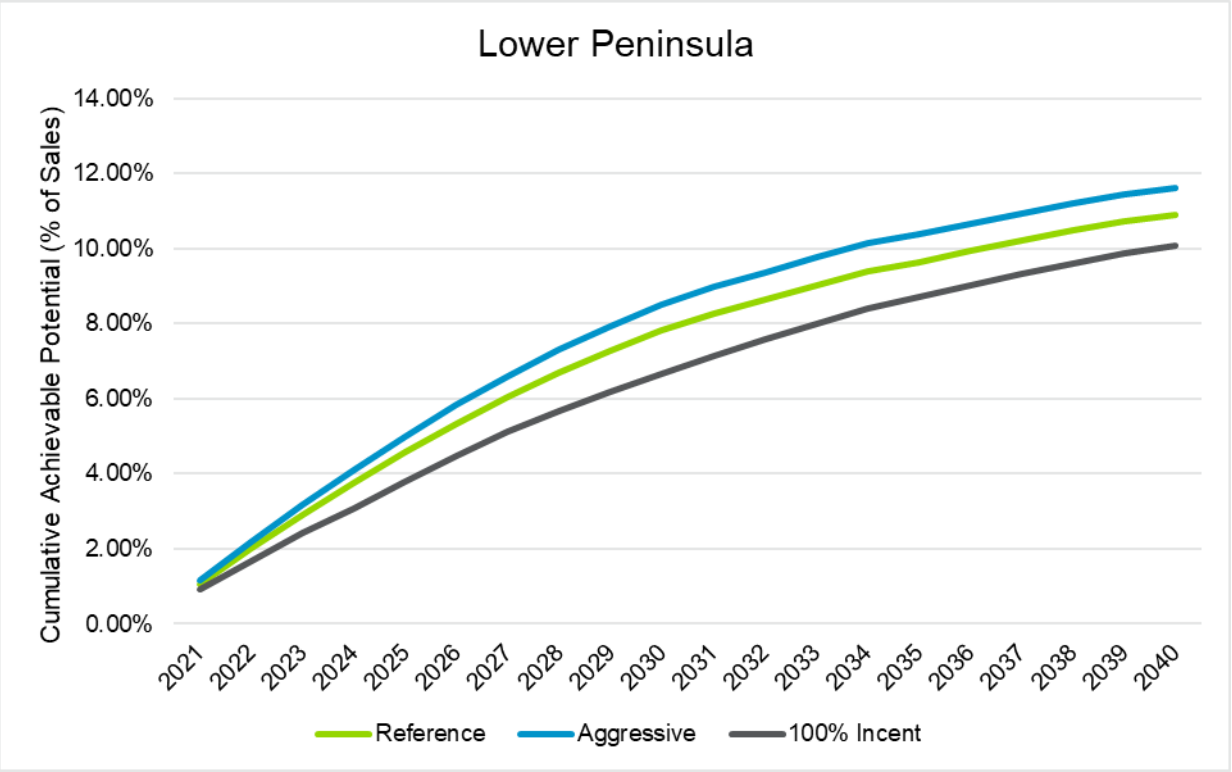
Aggressive case achieves ~10% more savings year over year than reference case, and costs ~20% more.
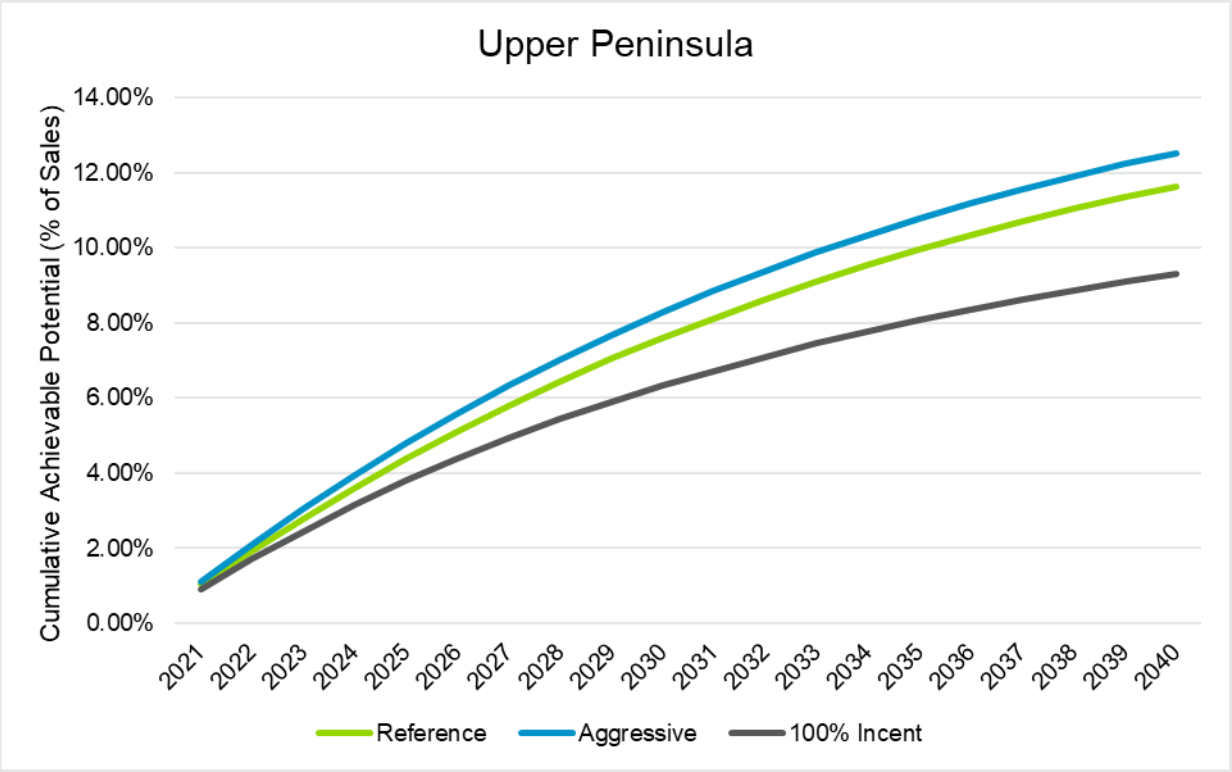
Aggressive case achieves ~9% more savings year over year than reference case, and costs ~20% more.

EWR Scenarios Comparison
Gas, Cumulative Achievable Potential, % of Sales, net
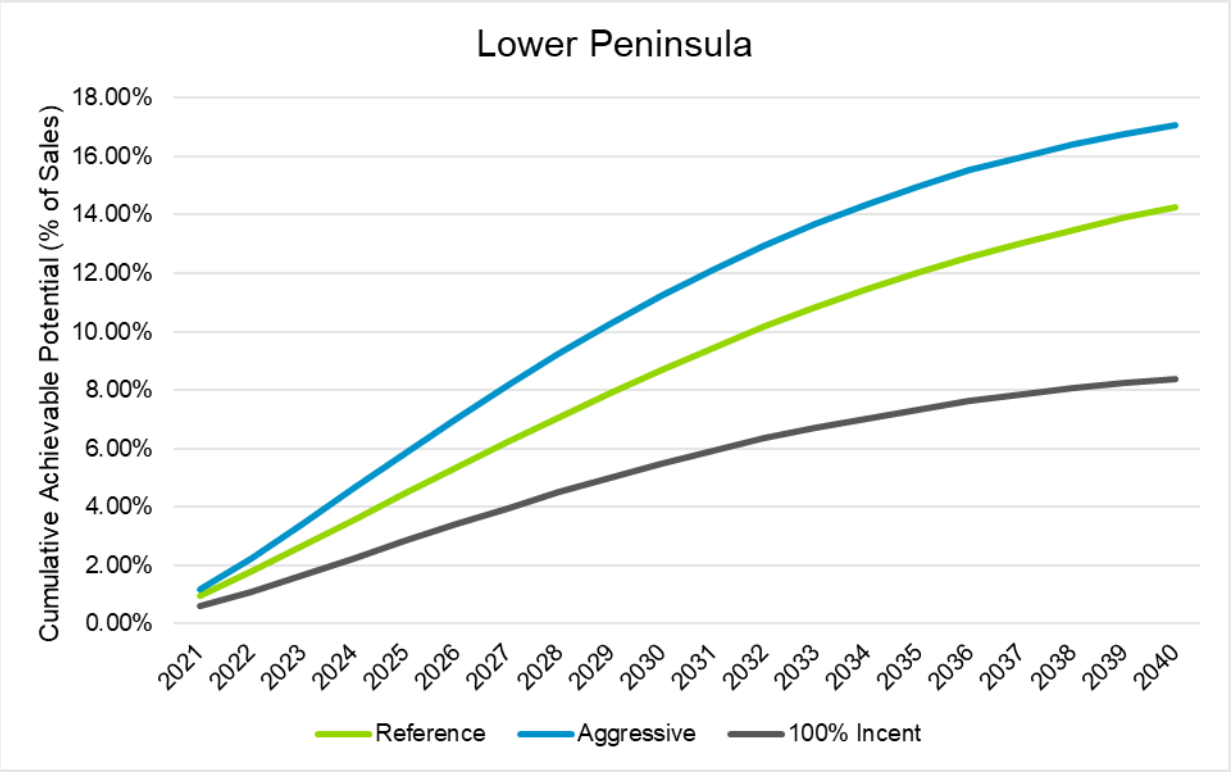
Aggressive case achieves ~25% more savings year over year than reference case, and costs ~110% more.
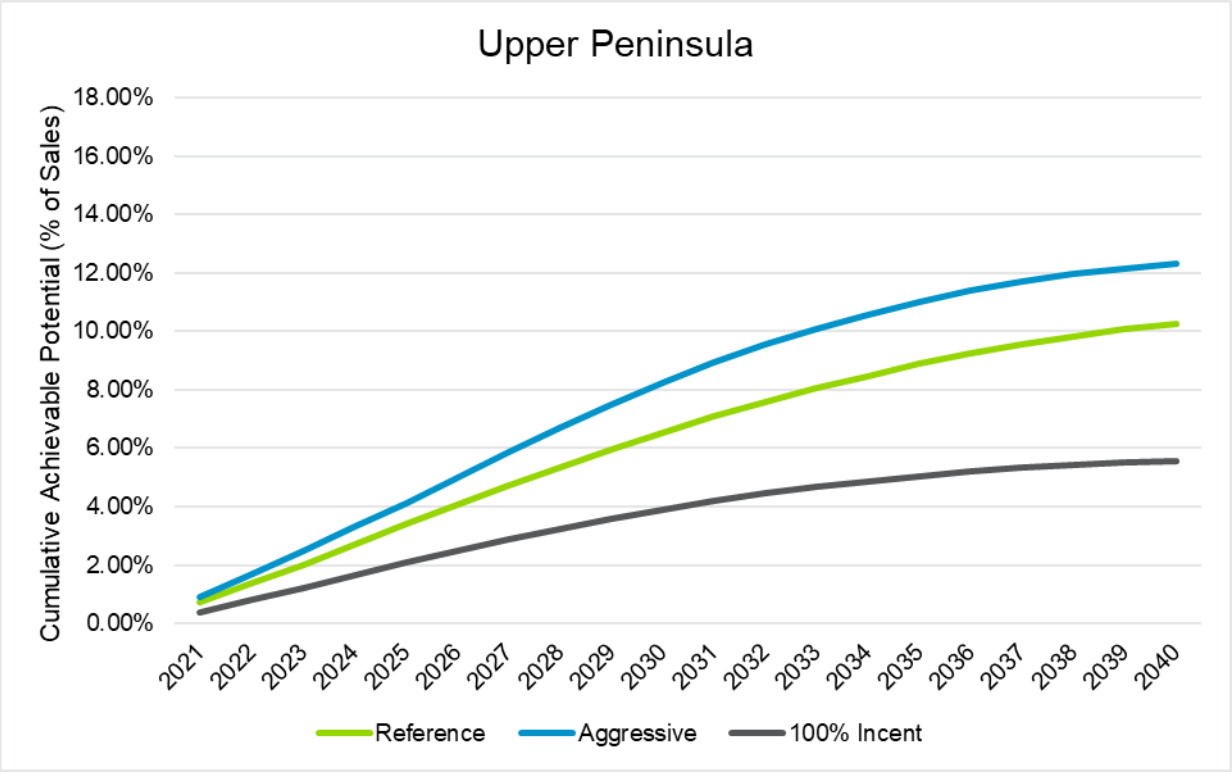
Aggressive case achieves ~25% more savings year over year than reference case, and costs ~75% more.

Demand Response (DR) Potential Results

DR Achievable Potential – Electric Reference Case

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DR Potential Study Scenarios

1. Reference Case Assumptions

- Uses EWR reference case results for baseline adjustments and technology saturations

- Incorporates current program incentive levels offered by MI utilities

- Incorporates participation assumptions from survey results assuming current and "typical" program incentive levels

- 0.8 UCT screening of DR options

2. Aggressive Case Assumptions

- Uses EWR aggressive case results for baseline adjustments and technology saturations

- Considers higher incentive levels than are currently offered (5% to 50% increase)

- Incorporates participation assumptions from survey results assuming "high" incentive levels

- No change in 0.8 UCT screening of DR options

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DR Achievable Potential by Option (MW at Meter)
Reference Case, Summer Peak Reduction Potential – Lower Peninsula

DR Achievable Potential by Option (MW at Meter)
Reference Case, Summer Peak Reduction Potential – Upper Peninsula
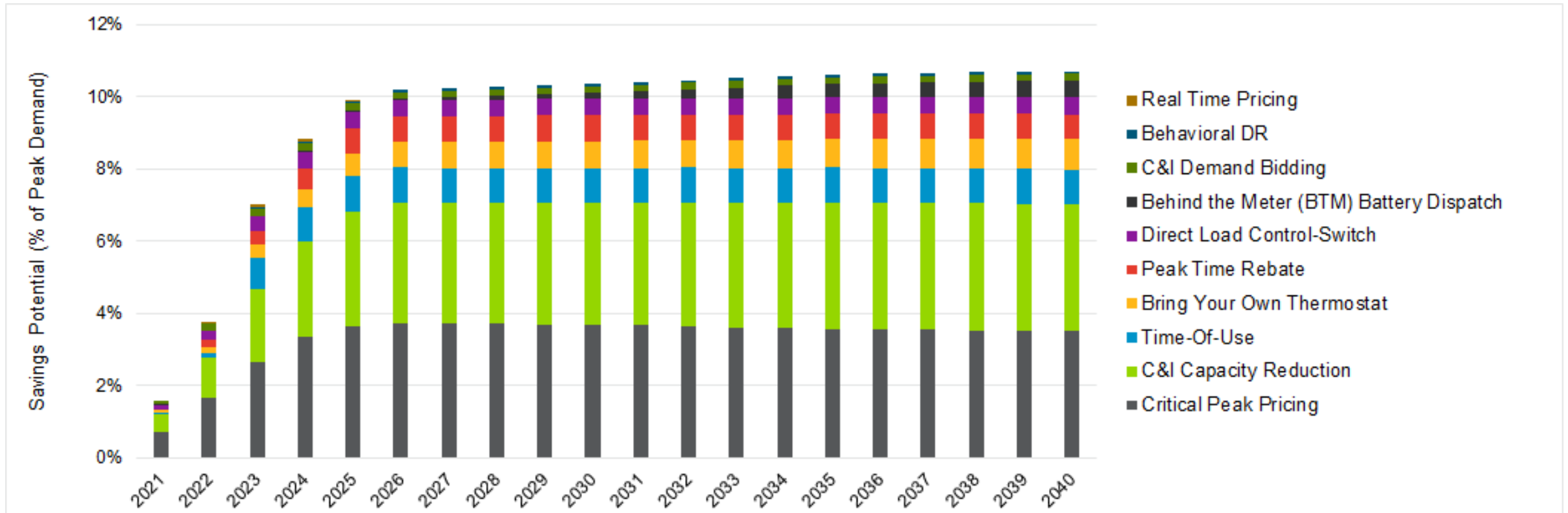
Cost-effective DR Options

DR Achievable Potential by Option (% of peak demand)
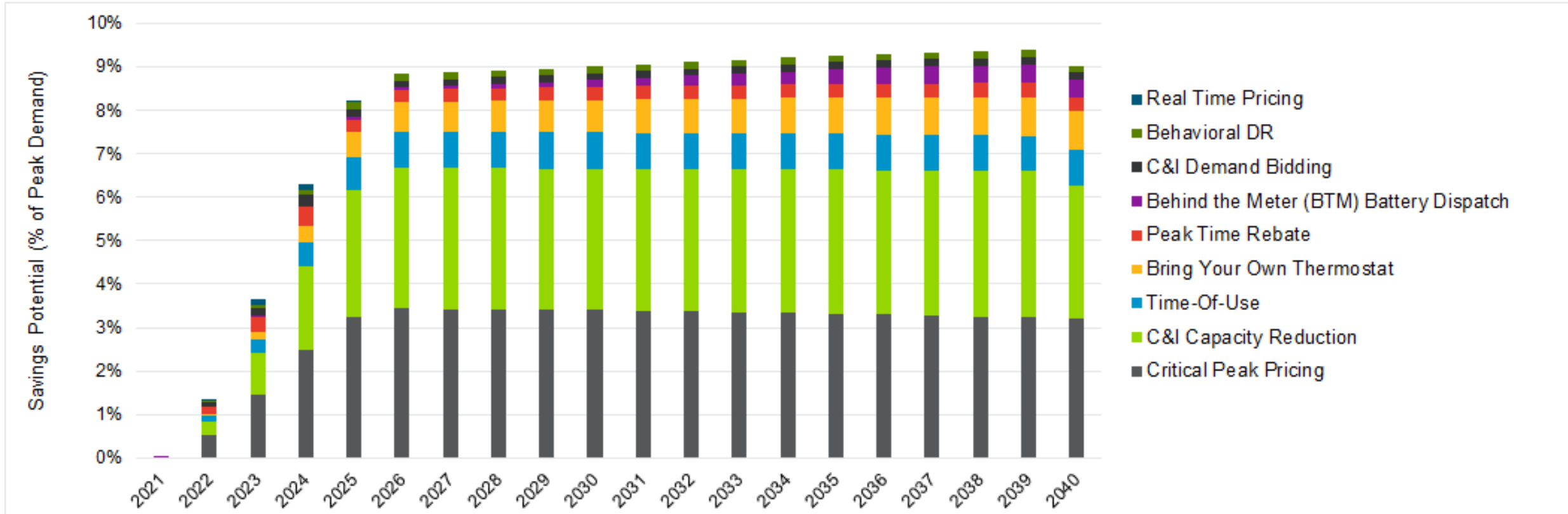## Reference Case, Summer Peak Reduction Potential – Lower Peninsula

Cost-effective DR Options

DR Achievable Potential by Option (% of peak demand)
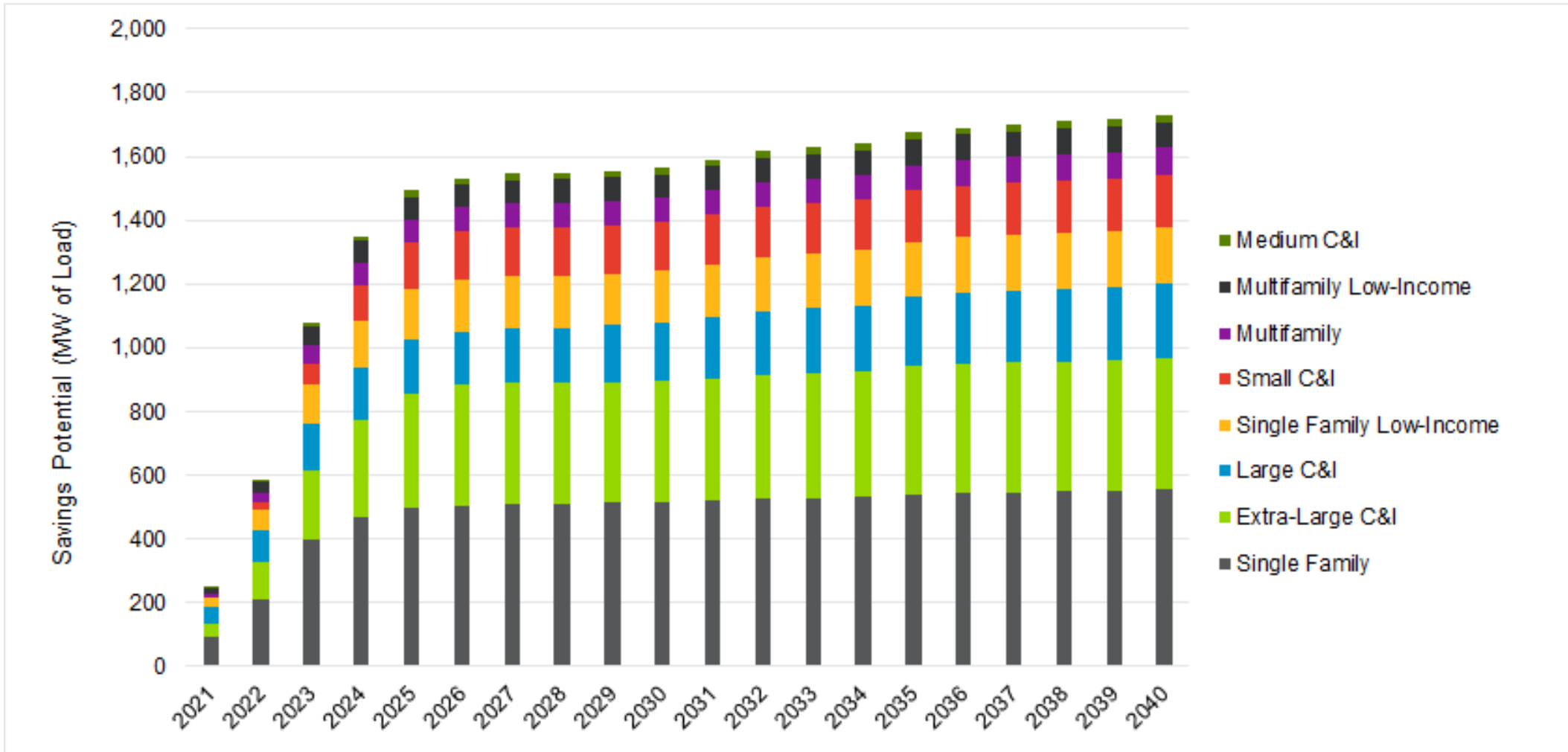## Reference Case, Summer Peak Reduction Potential – Upper Peninsula

Cost-effective DR Options

DR Achievable Potential by Customer Segment (MW at Meter)
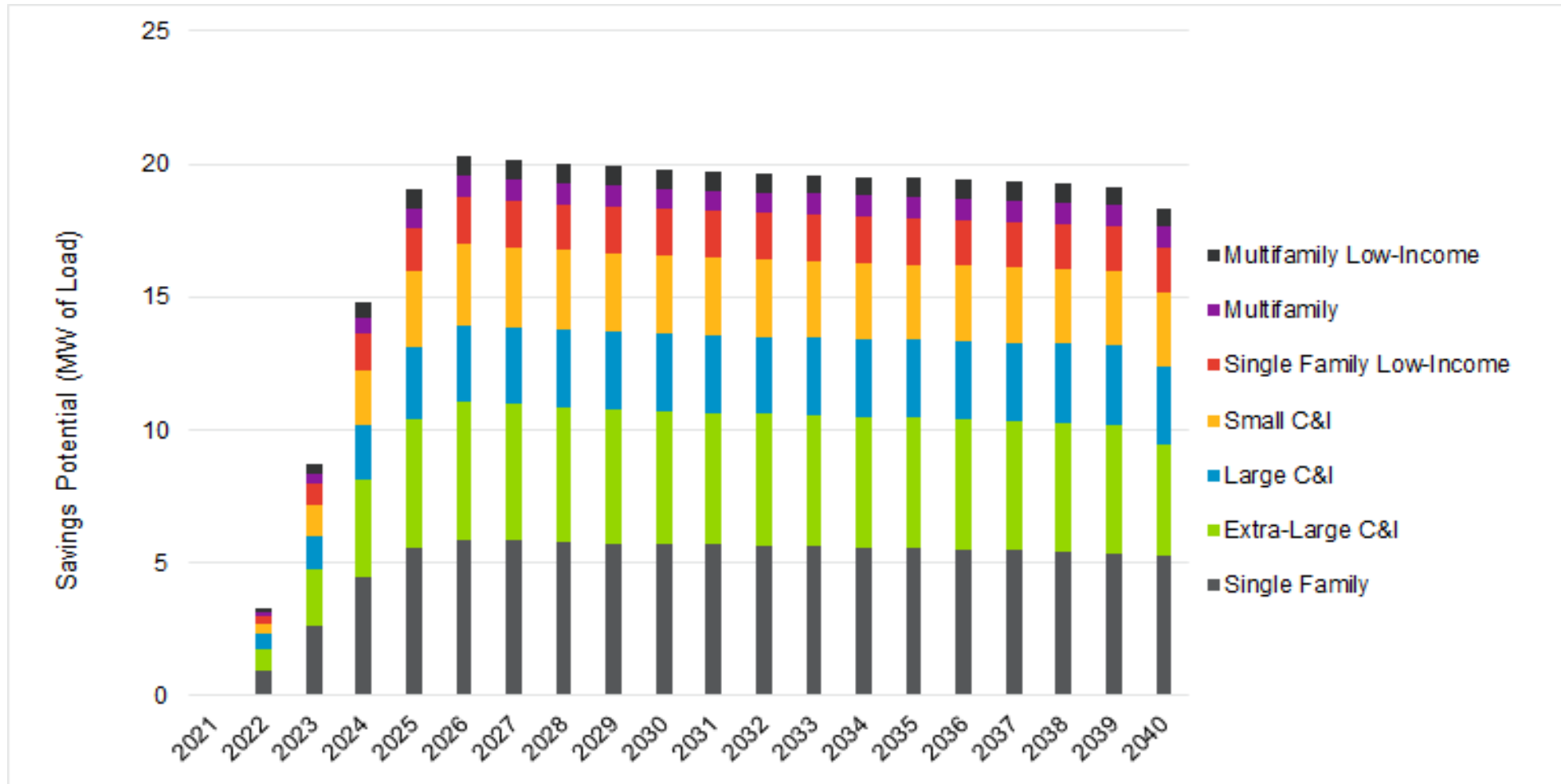## Reference Case, Summer Peak Reduction Potential – Lower Peninsula

Cost-effective DR Options

DR Achievable Potential by Customer Segment (MW at Meter)
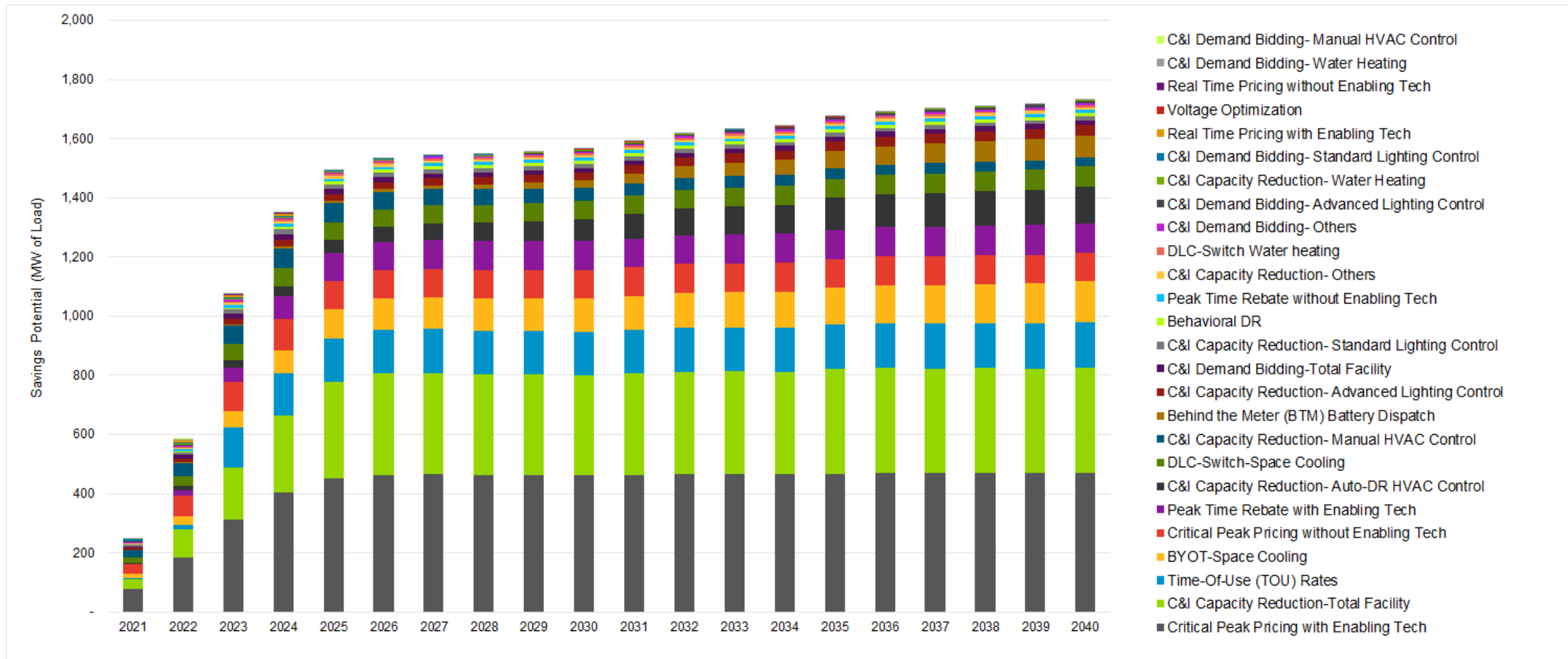## Reference Case, Summer Peak Reduction Potential – Upper Peninsula

Cost-effective DR Options

DR Achievable Potential by Sub-Option (MW at Meter)
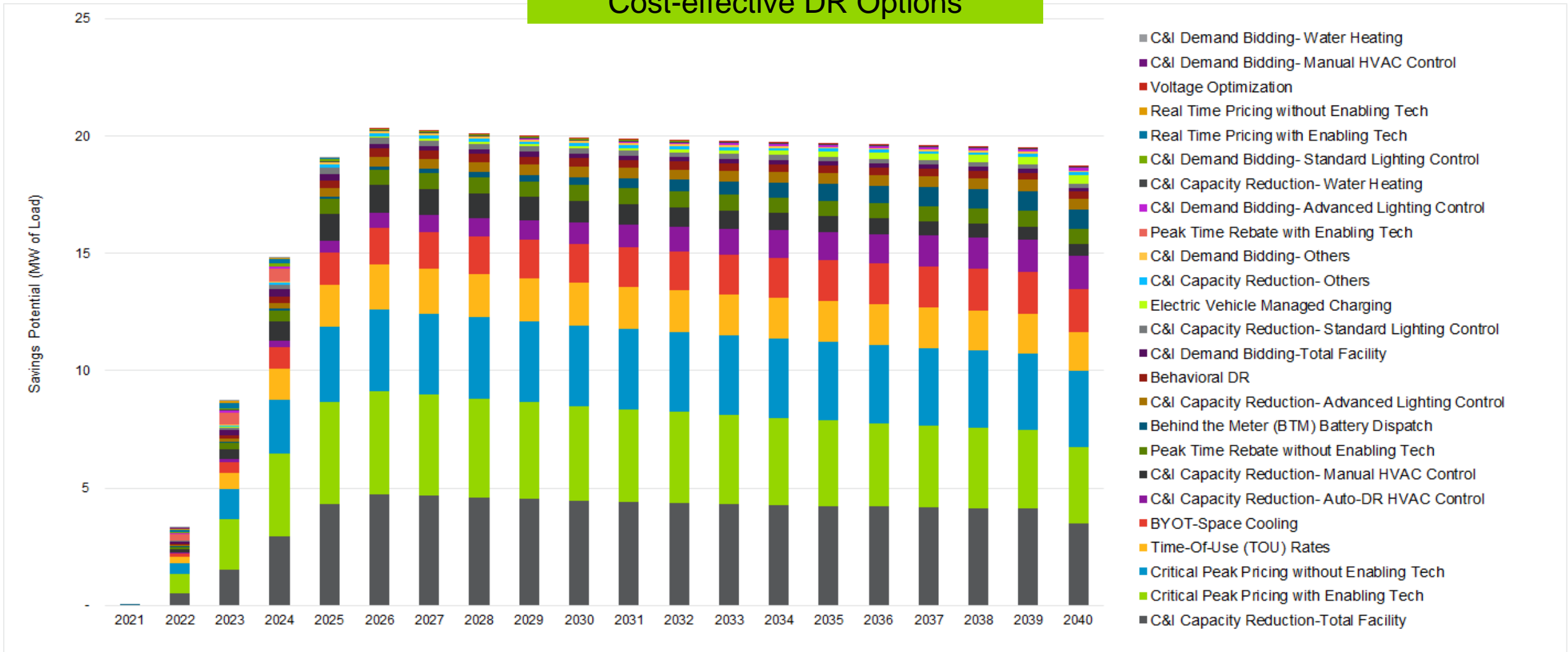## Reference Case, Summer Peak Reduction Potential – Lower Peninsula

Cost-effective DR Options

DR Achievable Potential by Sub-Option (MW at Meter)
Reference Case, Summer Peak Reduction Potential – Upper Peninsula

DR Achievable Potential by Option (MW at Meter)
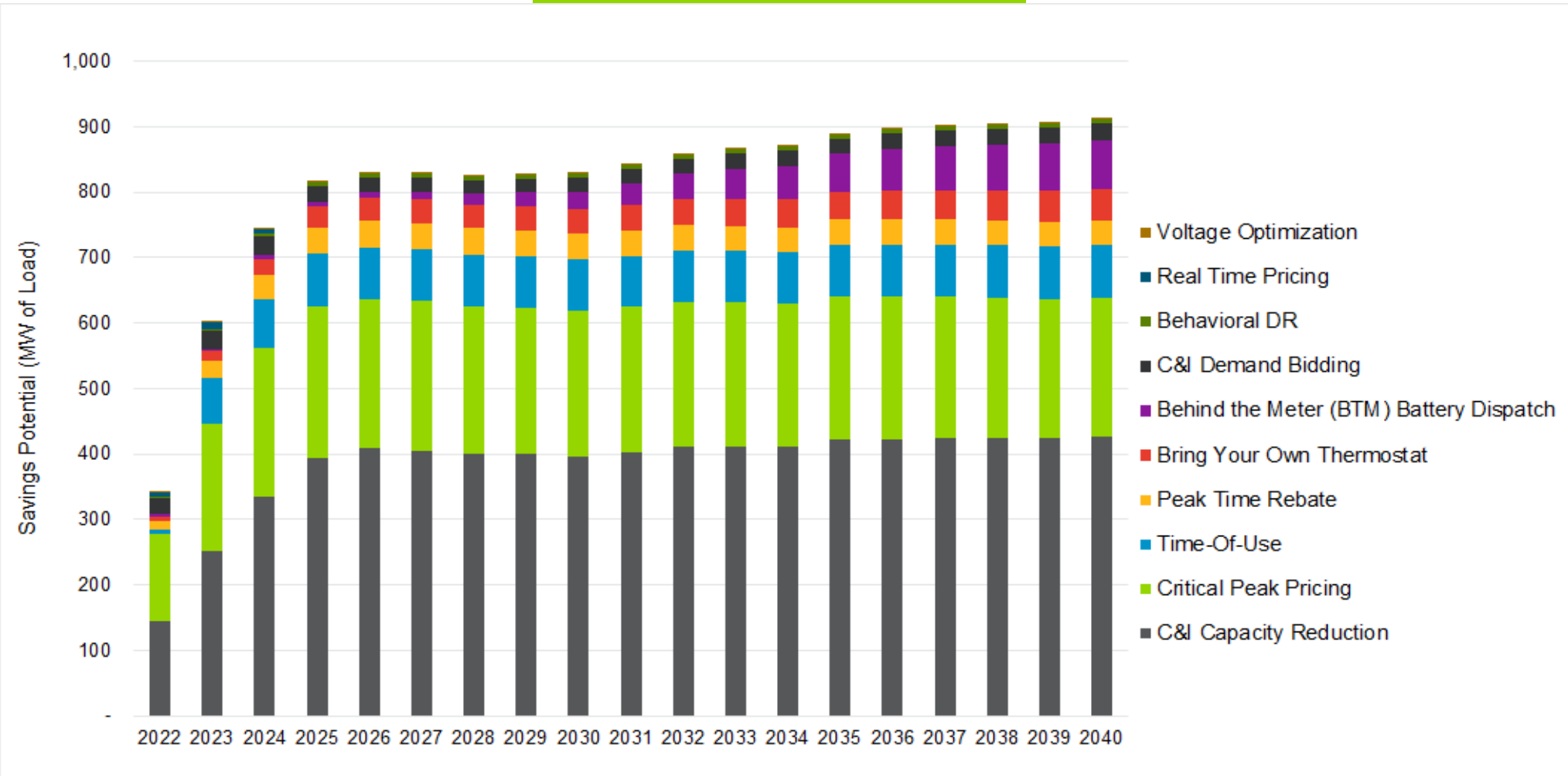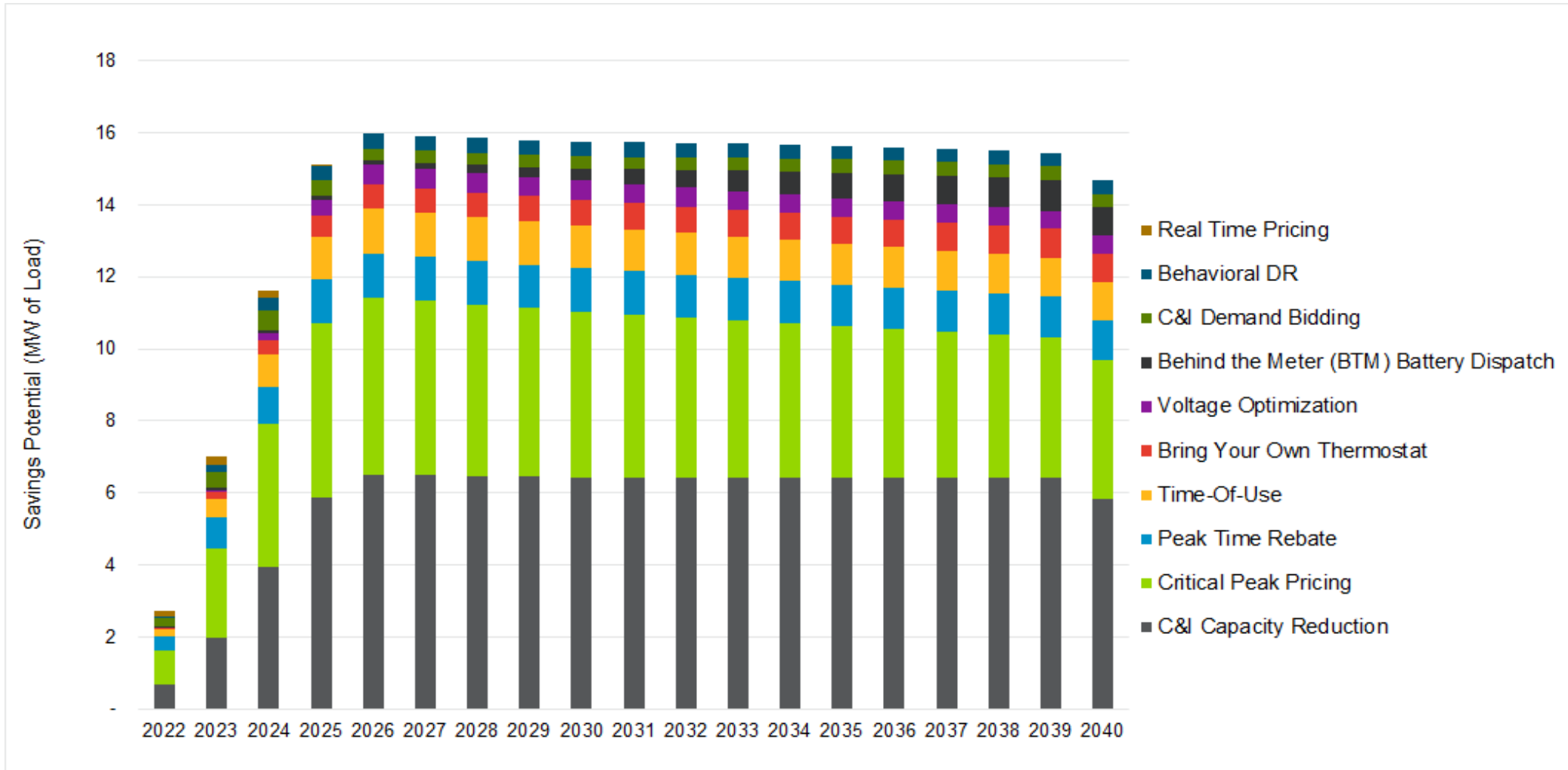## Reference Case, Winter Peak Reduction Potential – Lower Peninsula

Cost-effective DR Options

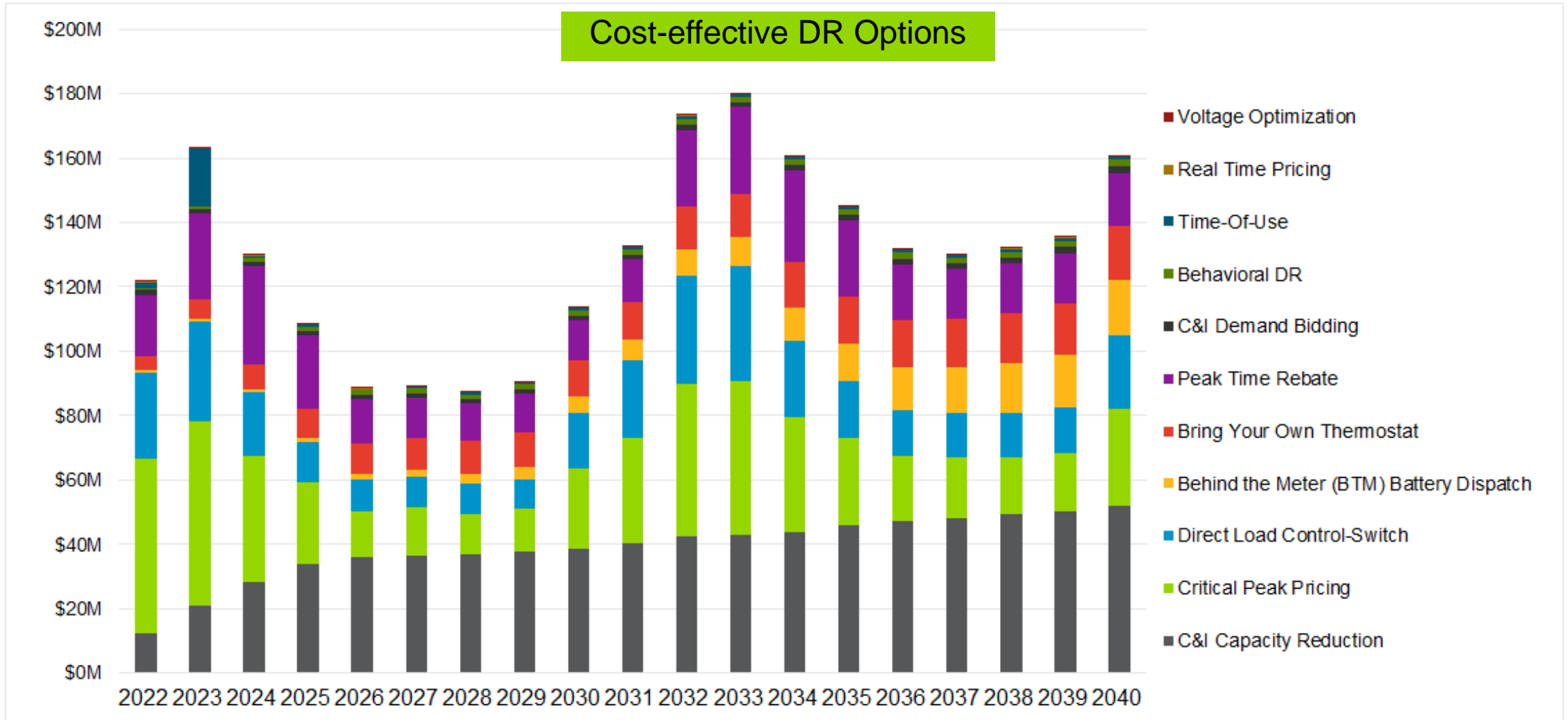# DR Achievable Potential by Option (MW at Meter)
Reference Case, Winter Peak Reduction Potential – Upper Peninsula
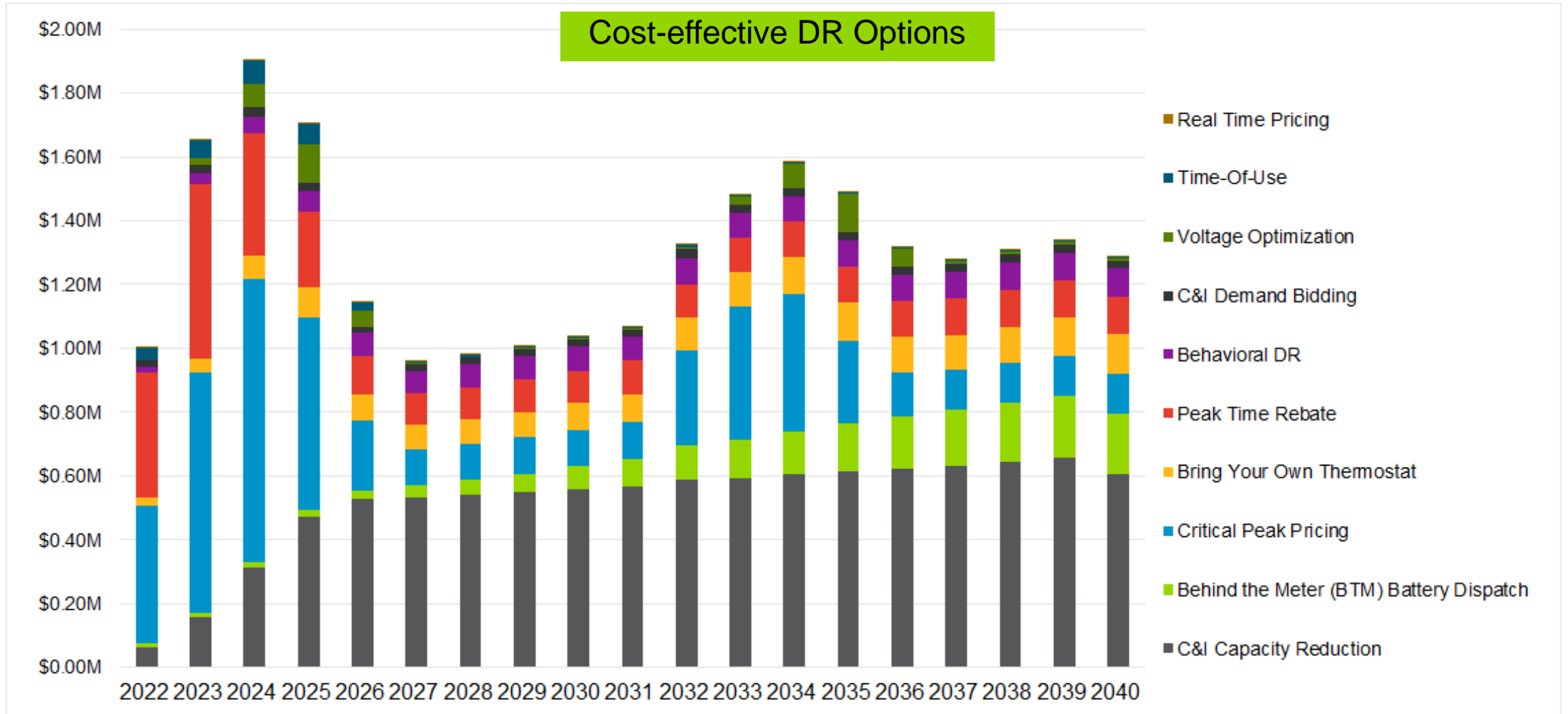
Cost-effective DR Options

Annual Program Costs by DR Option
Reference Case – Lower Peninsula

Annual Program Costs by DR Option
Reference Case – Upper Peninsula

Cost-Effectiveness Assessment Results
Reference Case – Lower Peninsula

DR_Options	NPV Benefits ($)	NPV Costs ($)	BCR
Real Time Pricing	$ 7,647,708	$ 525,827	14.5
Time-Of-Use	$ 150,000,852	$ 16,297,901	9.2
C&I Demand Bidding	$ 34,066,294	$ 8,537,999	4.0
C&I Capacity Reduction	$ 563,694,812	$ 195,873,997	2.9
Critical Peak Pricing	$ 638,311,684	$ 255,020,587	2.5
Voltage Optimization	$ 584,079	$ 373,728	1.6
Behind the Meter (BTM) Battery Dispatch	$ 33,897,029	$ 25,747,190	1.3
Bring Your Own Thermostat	$ 122,878,264	$ 94,214,411	1.3
Behavioral DR	$ 11,239,141	$ 8,970,002	1.3
Peak Time Rebate	$ 116,472,926	$ 143,939,591	0.8
Electric Vehicle Managed Charging	$ 9,087,363	$ 13,597,652	0.7
Direct Load Control-Switch	$ 165,989,671	$ 280,551,679	0.6
Smart Appliances Control (Bring Your Own device)	$ 29,763,039	$ 164,921,403	0.2
Thermal Energy Storage (TES)	$ 12,870	$ 238,479	0.1
Total	**$ 1,883,645,733**	**$ 1,208,810,446**	**1.6**

Cost-Effectiveness Assessment Results
Reference Case – Upper Peninsula

DR_Options	NPV Benefits ($)	NPV Costs ($)	BCR
Real Time Pricing	$ 120,657	$ 8,007	15.1
Time-Of-Use	$ 1,789,093	$ 149,761	11.9
C&I Demand Bidding	$ 381,855	$ 110,172	3.5
Critical Peak Pricing	$ 6,421,192	$ 2,160,453	3.0
C&I Capacity Reduction	$ 6,005,534	$ 2,253,652	2.7
Bring Your Own Thermostat	$ 1,374,541	$ 637,914	2.2
Voltage Optimization	$ 6,893	$ 5,016	1.4
Behavioral DR	$ 266,941	$ 219,538	1.2
Behind the Meter (BTM) Battery Dispatch	$ 342,194	$ 320,480	1.1
Peak Time Rebate	$ 672,900	$ 712,371	0.9
Electric Vehicle Managed Charging	$ 105,666	$ 130,167	0.7
Direct Load Control-Switch	$ 2,500,969	$ 4,874,824	0.5
Smart Appliances Control (Bring Your Own device)	$ 510,322	$ 2,610,569	0.2
Thermal Energy Storage (TES)	$ 269	$ 5,937	0.1
Total	**$ 20,499,024**	**$ 14,198,860**	**1.4**

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DR Achievable Potential by Option (MW at Meter)
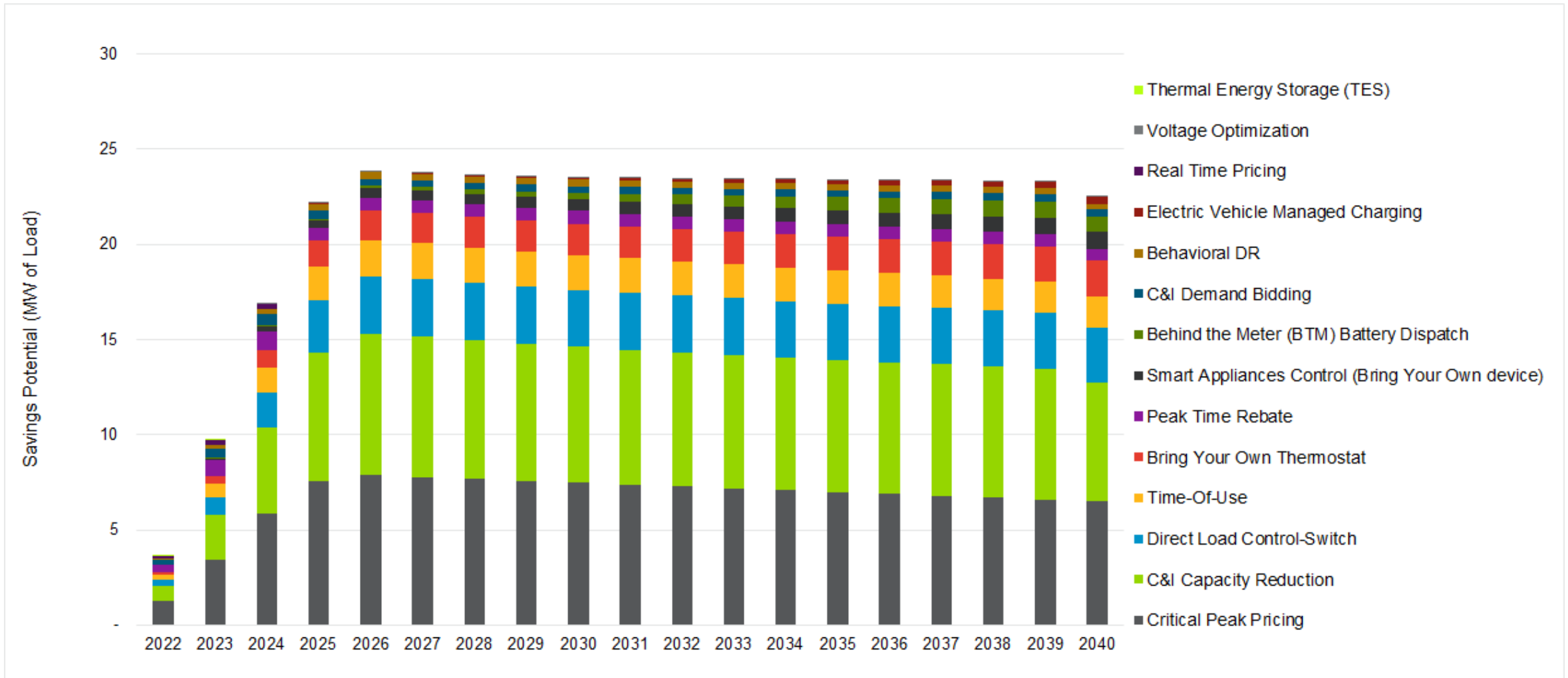## Reference Case, Summer Peak Reduction Potential – Lower Peninsula

All DR Options
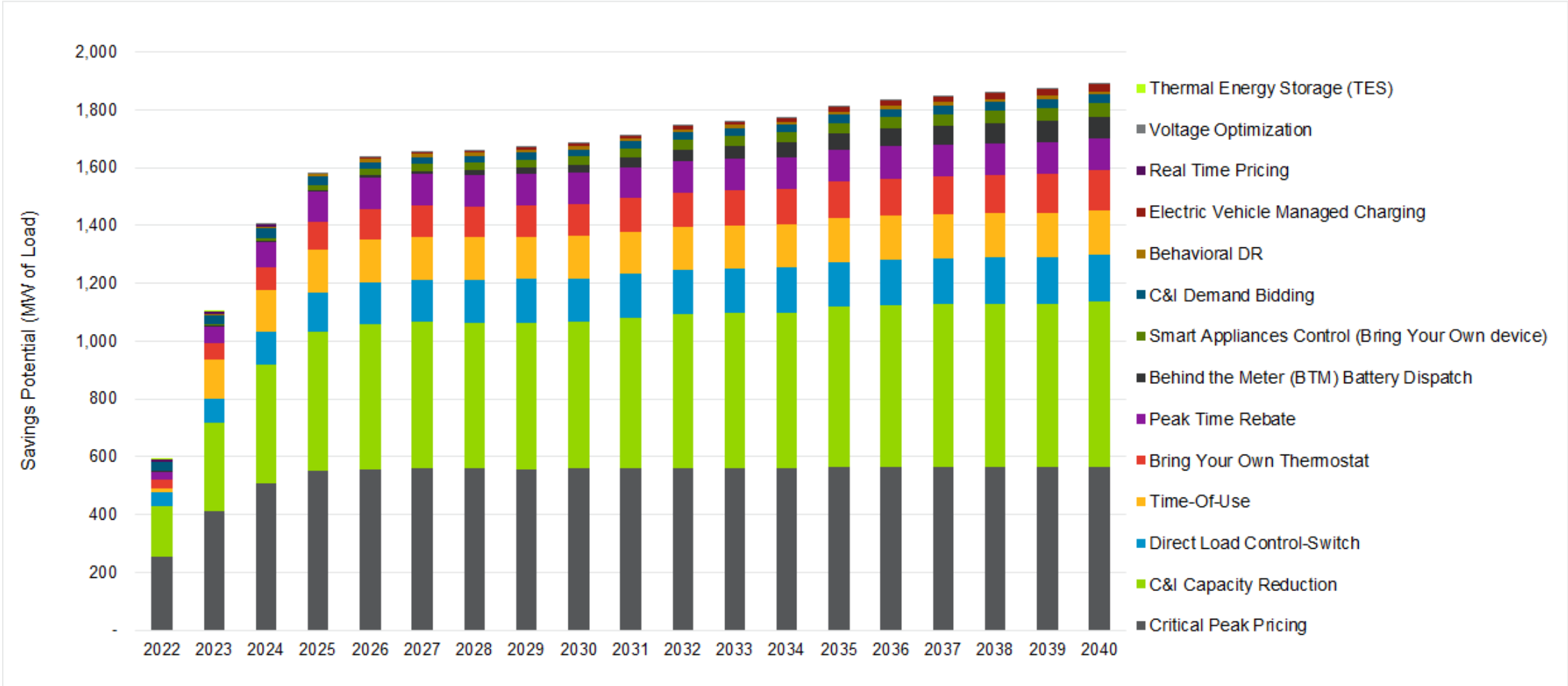
DR Achievable Potential by Option (MW at Meter)
Reference Case, Summer Peak Reduction Potential – Upper Peninsula
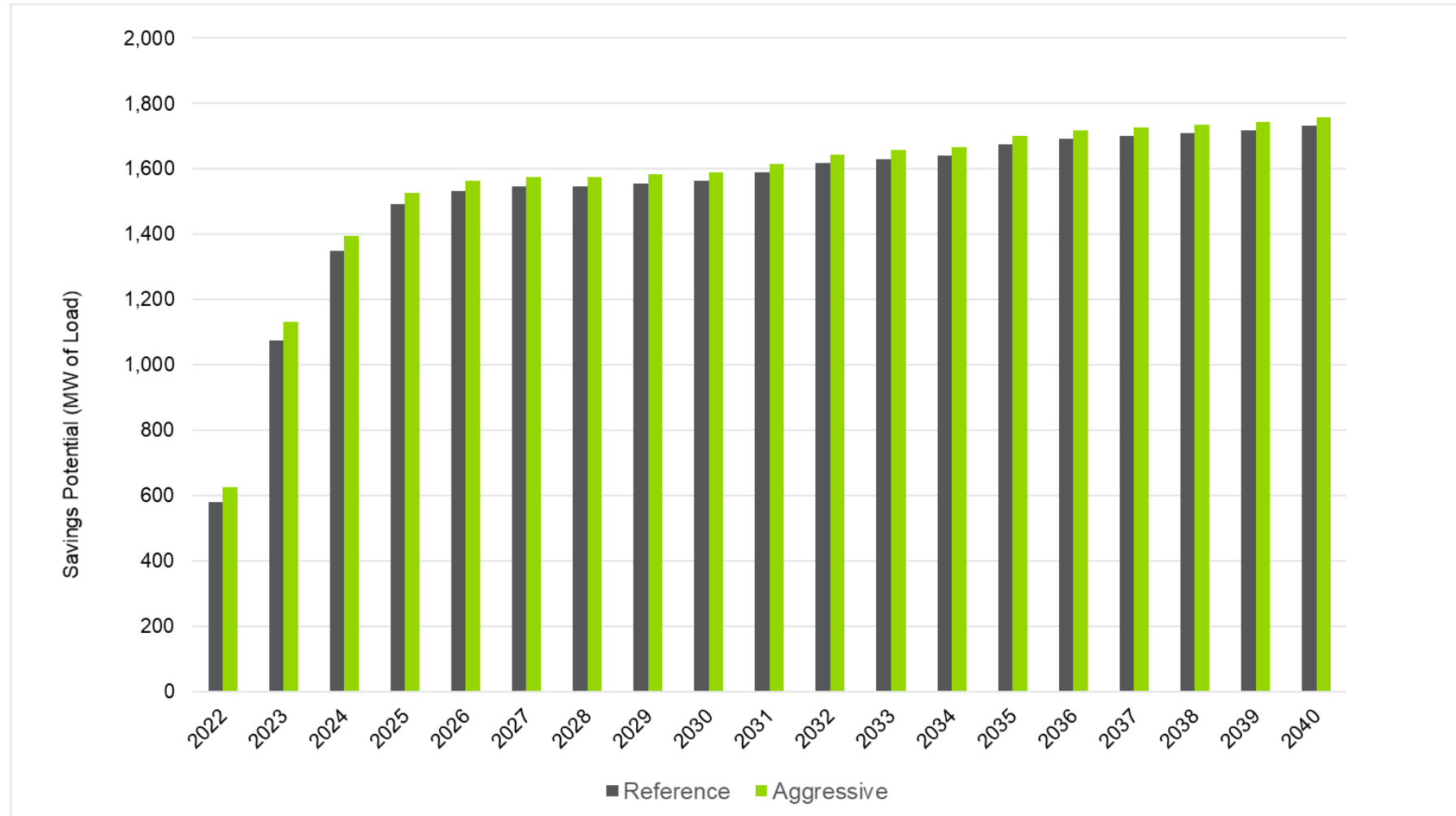
All DR Options

DR Achievable Potential – Electric Aggressive Case

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DR Achievable Potential by Scenario (MW at Meter)
Reference Case Summer Peak Reduction Potential – Lower Peninsula
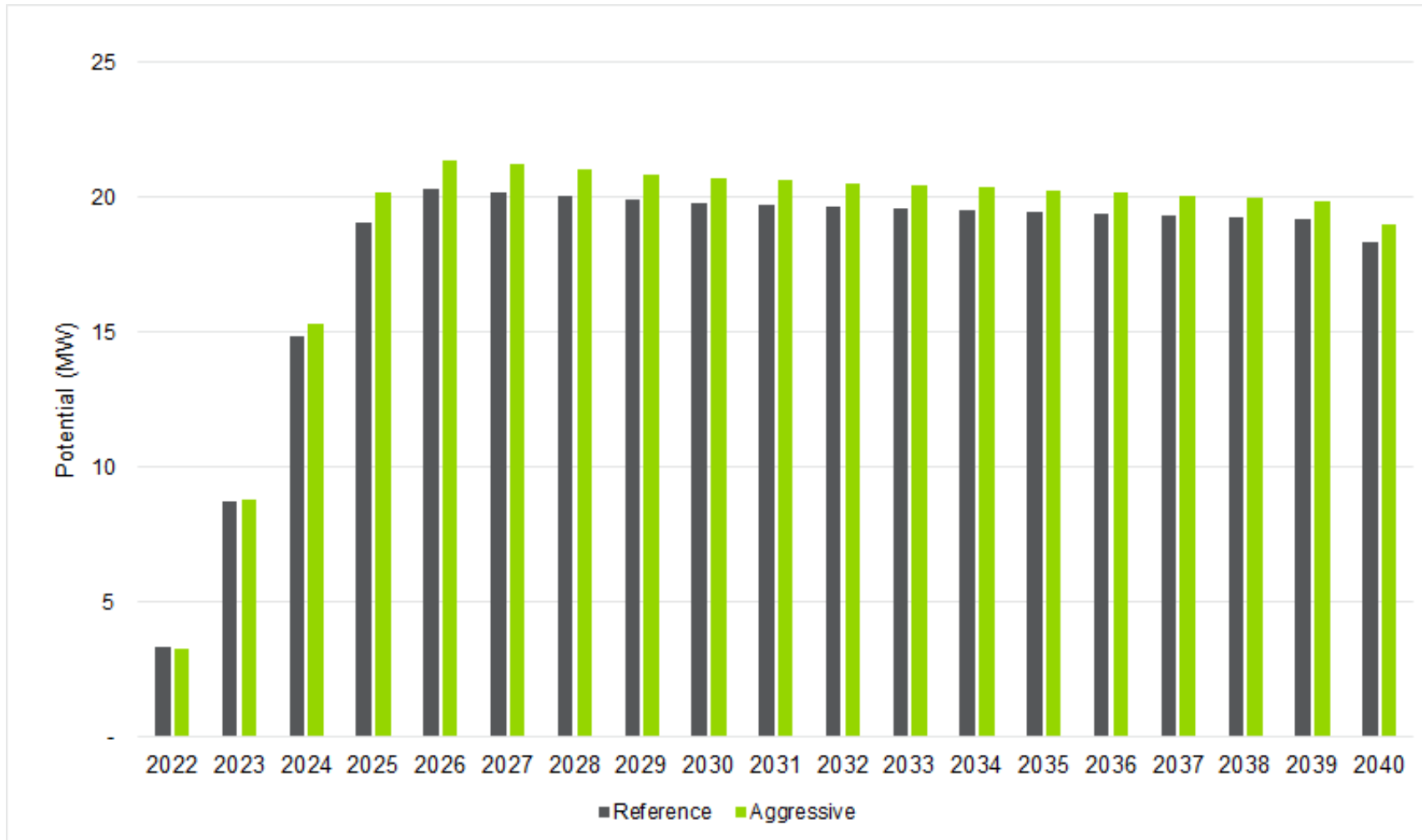

Cost-effective DR Options

- Potential under Reference and Aggressive cases remain almost the same

- PTR no longer cost-effective under the Aggressive scenario

DR Achievable Potential by Scenario (MW at Meter)
Reference Case Summer Peak Reduction Potential – Upper Peninsula
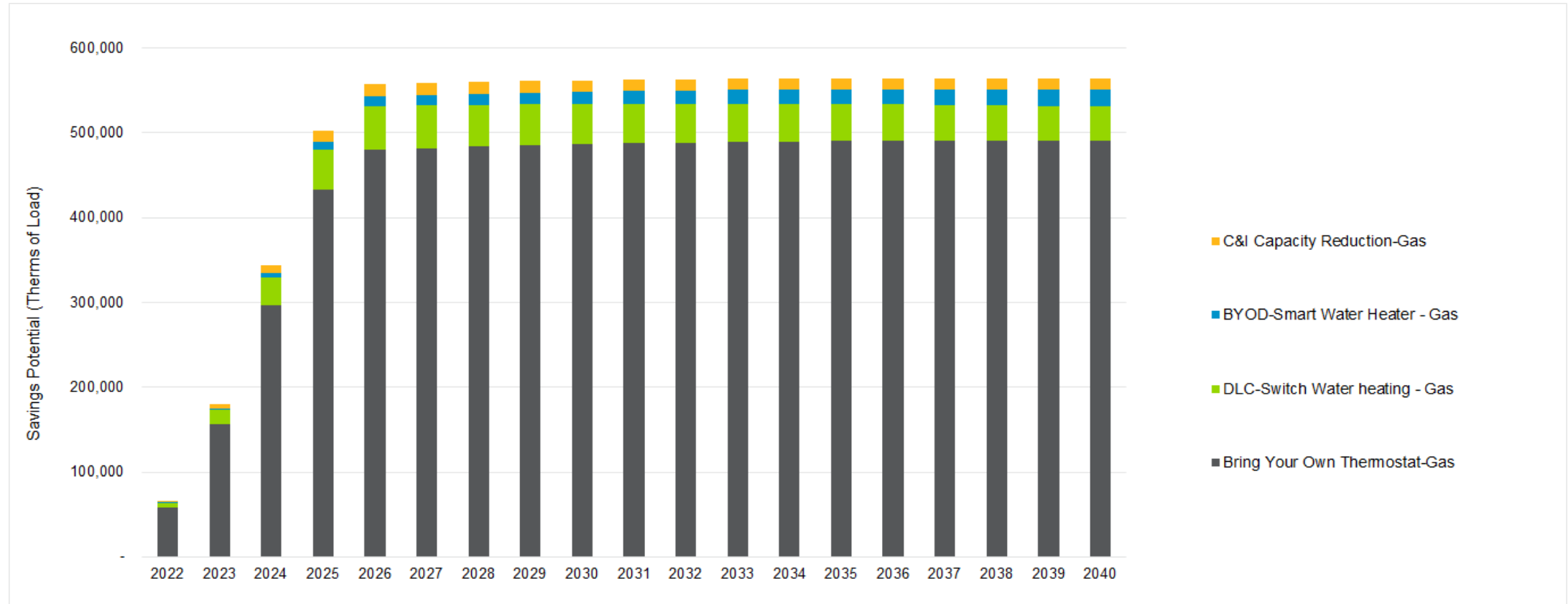

Cost-effective DR Options

- Potential under Aggressive case ~3% higher than Reference Case potential

- PTR no longer cost-effective under the Aggressive scenario

DR Achievable Potential – Gas

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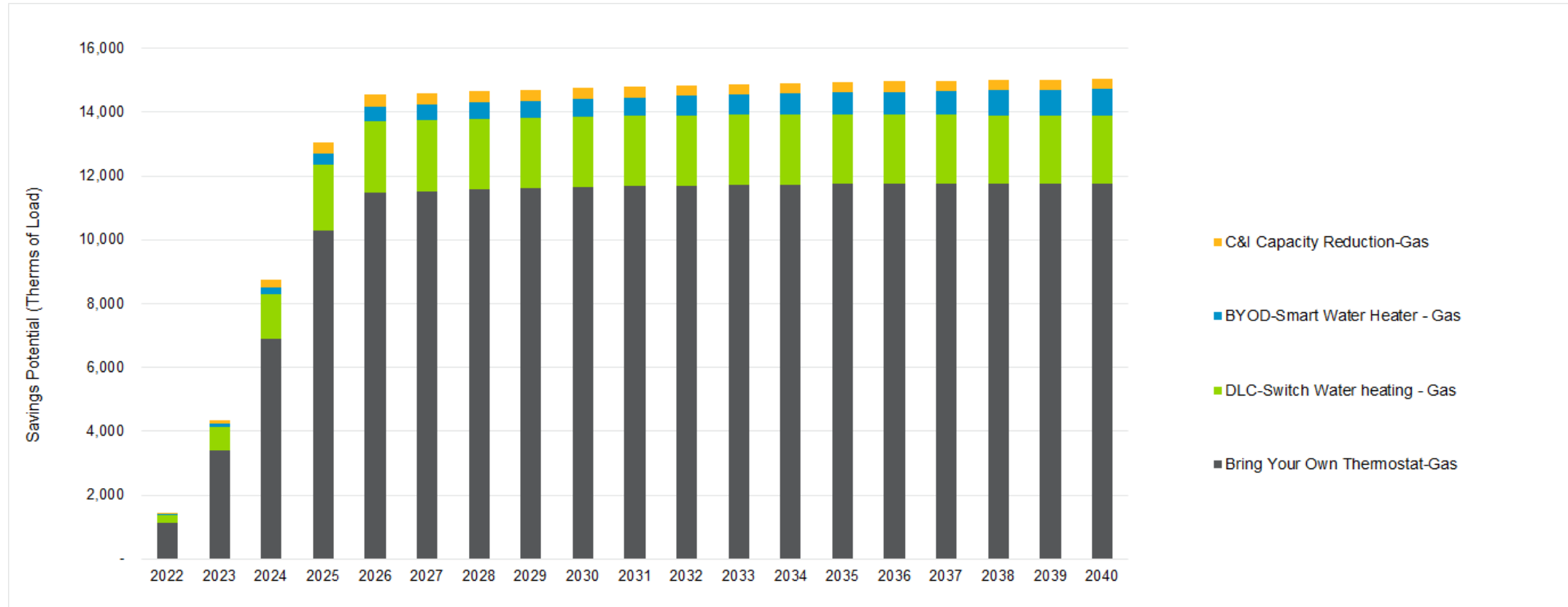# Achievable Potential by DR Option
Lower Peninsula

None of the DR Options were assessed to be cost-effective based on available gas avoided costs.

Achievable Potential by DR Option
Upper Peninsula

All DR Options

None of the DR Options were assessed to be cost-effective based on available gas avoided costs.

Next Steps

Next Steps

Stakeholder presentation
- June 17 (Today)

Stakeholder feedback
- Thursday, July 1

Draft report review & feedback
- Friday, July 30 - Monday, August 9

Final report
- August 31

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Questions

Appendix

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Guidehouse Contacts

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