Memo

STATE OF RHODE ISLAND
ENERGY EFFICIENCY & RESOURCE MANAGEMENT COUNCIL

To: Rhode Island Public Utilities Commission (PUC)
From: Energy Efficiency & Resource Management Council
Date: July 16, 2020
RE: Rhode Island Market Potential Study Updated Demand Response Results

I. INTRODUCTION

This memo summarizes changes to the Rhode Island Market Potential Study's (MPS) Demand Response module. The changes to estimated savings potential are relatively minor and result from feedback delivered by National Grid in response to the draft potential study report. The feedback identified areas for improvement and therefore at the request of the Energy Efficiency & Resource Management Council (EERMC) via its Consultant Team, the Dunsky Energy Consulting team that conducted the MPS was directed to produce an updated demand response analysis for Rhode Island.

II. UPDATED RESULTS

Table 1, below, shows the original and updated demand response maximum achievable potential.

Table 1. Current Demand Response Targets and Updated Maximum Achievable Potential, 2021-2023

Year	Current Targets (MW)	Updated Results (MW)
2021	33.9	32.9
2022	52.7	51.5
2023	74.5	73.6

The key changes between the original and updated results consisted primarily of modifications to individual measure inputs, including measure costs. Specifically, the following adjustments were implemented in the Demand Response module and are reflected in the Updated Results column in table 1.

- Adjusted WiFi Thermostats to apply just to homes and small businesses with central AC
- Updated impact and cost information for Thermal Energy Storage measure
- Added Medium & Large Battery storage as a bring-your-own-device measure
- Limited the Max scenario incentive values to avoid adverse outcome of very high spending which captures very little marginal savings

III. IMPLICATIONS OF CHANGES

As can be seen, the savings potential results are only modestly different. Though costs were not part of the target-setting process, it is worth noting that the overall costs associated with the maximum achievable demand response potential were roughly one third lower in the updated results.

While the updated results are a more appropriate reference point for planning processes going forward, the EERMC, based on input from its Consultant Team, believes these changes are sufficiently small that, even if formally adopted as new targets, they are unlikely to materially affect demand response program planning decisions. As a result of this review of the updated results, the EERMC voted at the July 16, 2020 Council Meeting to provide this update to the PUC with the recommendation that it may be acceptable to simply provide notice of these updated results to the PUC without formally refiling targets.

While we represent this as a sufficient resolution, we respectfully are prepared to submit an adjustment more formally to the Targets to reflect this minor change if that is the preference of the PUC.

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STATE OF RHODE ISLAND
ENERGY EFFICIENCY & RESOURCE MANAGEMENT COUNCIL

Rhode Island Energy Efficiency Market Potential Study

Final Results (REVISED)

Original: March 13, 2020
Revised: June 9, 2020

Slides with this red bar along the bottom were revised June 9th, 2020 to reflect changes to the demand response module.

Agenda

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- Introduction
- Study Overview
- Results
  - Energy Efficiency
  - Demand Response
  - Combined Heat and Power
  - Heating Electrification
  - Cumulative impact on energy sales
- Conclusions

TEAM

Dunsky is comprised of **30+** clean energy professionals.

Among them, today's presenters:

Alex Hill
Managing Partner

Nick Martin
Senior Analyst

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OVERVIEW

EXPERTISE

Efficiency — **Renewables** — **Mobility**

SERVICES

Assess Opportunities — **Design** Strategies — **Evaluate** Performance

CLIENTS

Study Overview

Study Overview: Key Parameters

Study Period	2021 to 2026
Study Geography	Rhode Island*
Sectors	Residential ▪ Low-Income Residential ▪ Commercial ▪ Industrial
Savings Streams	Energy Efficiency ▪ Combined Heat & Power ▪ Demand Response Heating Electrification ▪ Distributed Generation
Fuels	Electricity ▪ Natural Gas ▪ Oil ▪ Propane
DEEP Model	Applies bottom up models, using detailed RI markets and measures

*Savings are estimated based on National Grid's customer territory and will be scaled for Block Island Utility District and Pascoag Utility District
Results presented in this slide deck represent savings for National Grid customers only

Energy Efficiency (EE)

EE: Achievable Scenarios

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Three program scenarios are explored in this study:

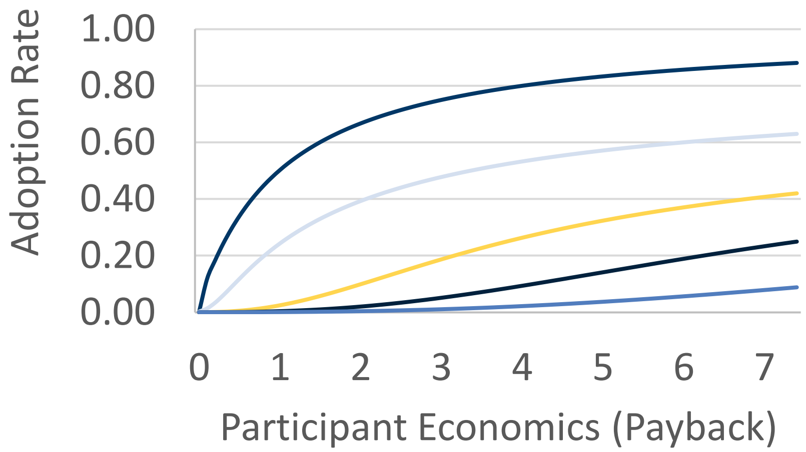
Low
Applies incentives and enabling activities in line with National Grid's 2020 Energy Efficiency Plan to simulate **business as usual**

Mid
Increases incentives and enabling activities **above and beyond** levels within National Grid's 2020 Energy Efficiency Plan

Max
Completely eliminates customer costs and further reduces customer adoption barriers to estimate **maximum achievable potential**

EE: DEEP Model

	TECHNICAL	ECONOMIC	ACHIEVABLE
MEASURE INTERACTIONS	Chaining		
ECONOMIC SCREENING	n/a	RI Test	n/a
MARKET BARRIERS	No Barriers	No Barriers	Adoption Curves
COMPETING MEASURES	Winner takes all (most efficient)		Competition Groups
NET SAVINGS	Gross	Gross	Program NTGR, Measure RR



- Achievable adoption is based on U.S. Department of Energy adoption curves, which estimate customer adoption as a function of the customer's economic payback.

EE: Significant changes since February EERMC Meeting

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Additional quality control resulted in the following changes:

- Electric savings **increased** primarily due to model calibration on lighting measures where preliminary results were significantly under estimating savings as compared to current program savings.
- Gas savings **decreased** – particularly in the study's initial years – due to program ramp rates for measures that have low adoption in existing programs, but that have market data suggesting a larger opportunity exists.
  - Gas savings slightly **increased** in the study's later years as gas measures ramped up to full potential and savings increased for a small number of measures due to additional refinements

Percent change to 2021-2023 average savings since preliminary results presented to EERMC on February 27, 2020

Fuel	Lifetime	Annual
Electric	+8.2%	+6.4%
Gas	-2.3%	-2.4%

EE: Electric Savings Potential

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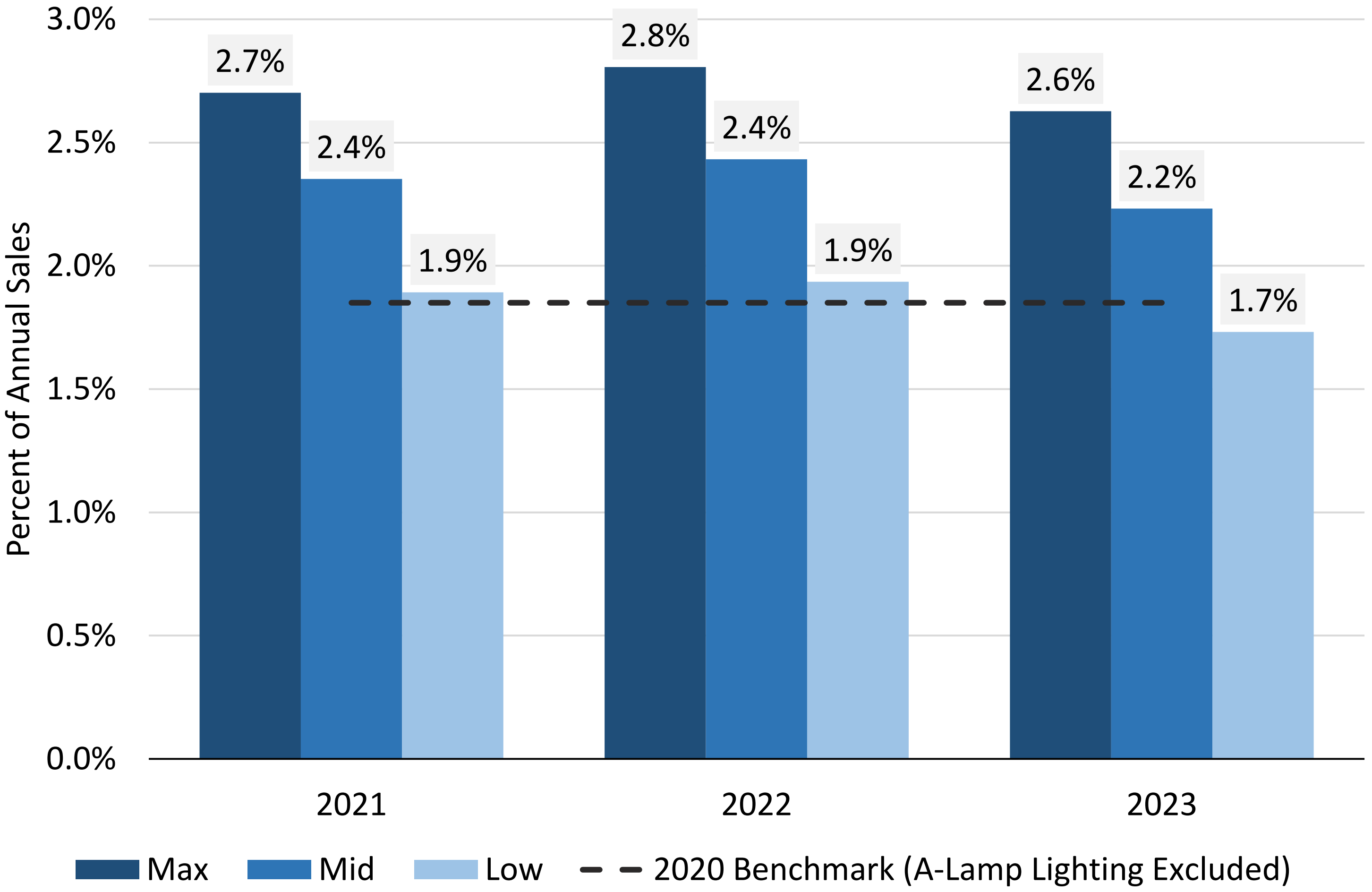
Annual Electric Savings as Percentage of Forecasted Electricity Sales*



- Low Scenario aligns with 2020 Plan savings when A-Lamp savings are excluded.
- Savings decline in 2023 as significant lighting measures leave the programs and saturation of other lighting measures.

Benchmark	Savings
2019 Program Results	2.8%
2020 RI EE Plan	2.6%
2020 RI EE Plan (w/o A Lamps)	1.8%
2021 Potential National Grid (MA)	
BAU	2.1%
MAX	2.7%

*Dunsky treated National Grid's 2021-2026 forecasted electric sales to remove assumed EE savings to estimate percent savings for each year of the study.

EE: Electric Savings Potential

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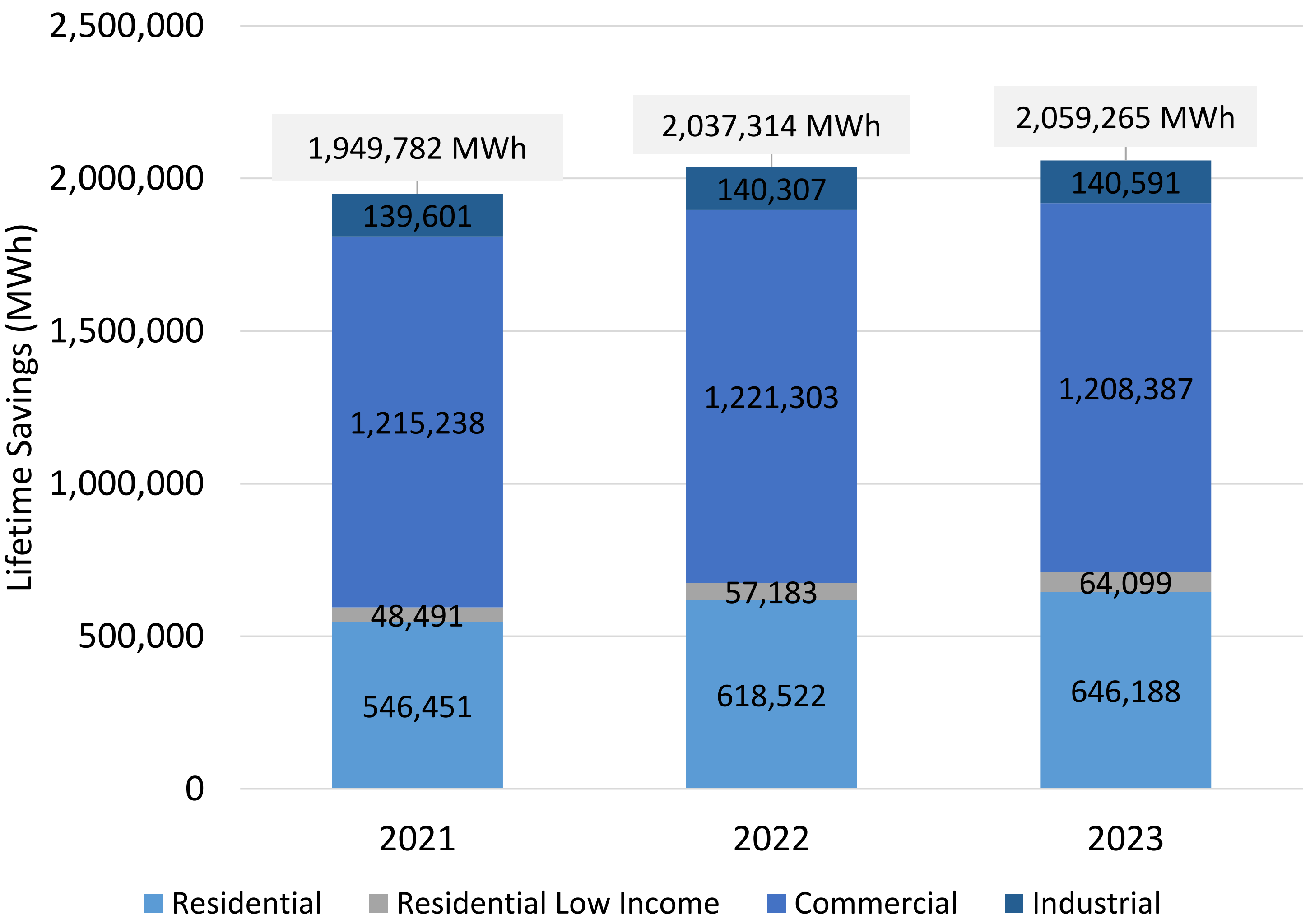
Lifetime Electric Savings by Sector (Max)



- Bulk of electric savings come from residential and commercial sectors
- Lifetime savings increase slightly year-over-year even while annual savings decline in 2023 (previous slide) as longer-lived measures ramp up and replace reduced lighting savings

EE: Electric Savings Potential

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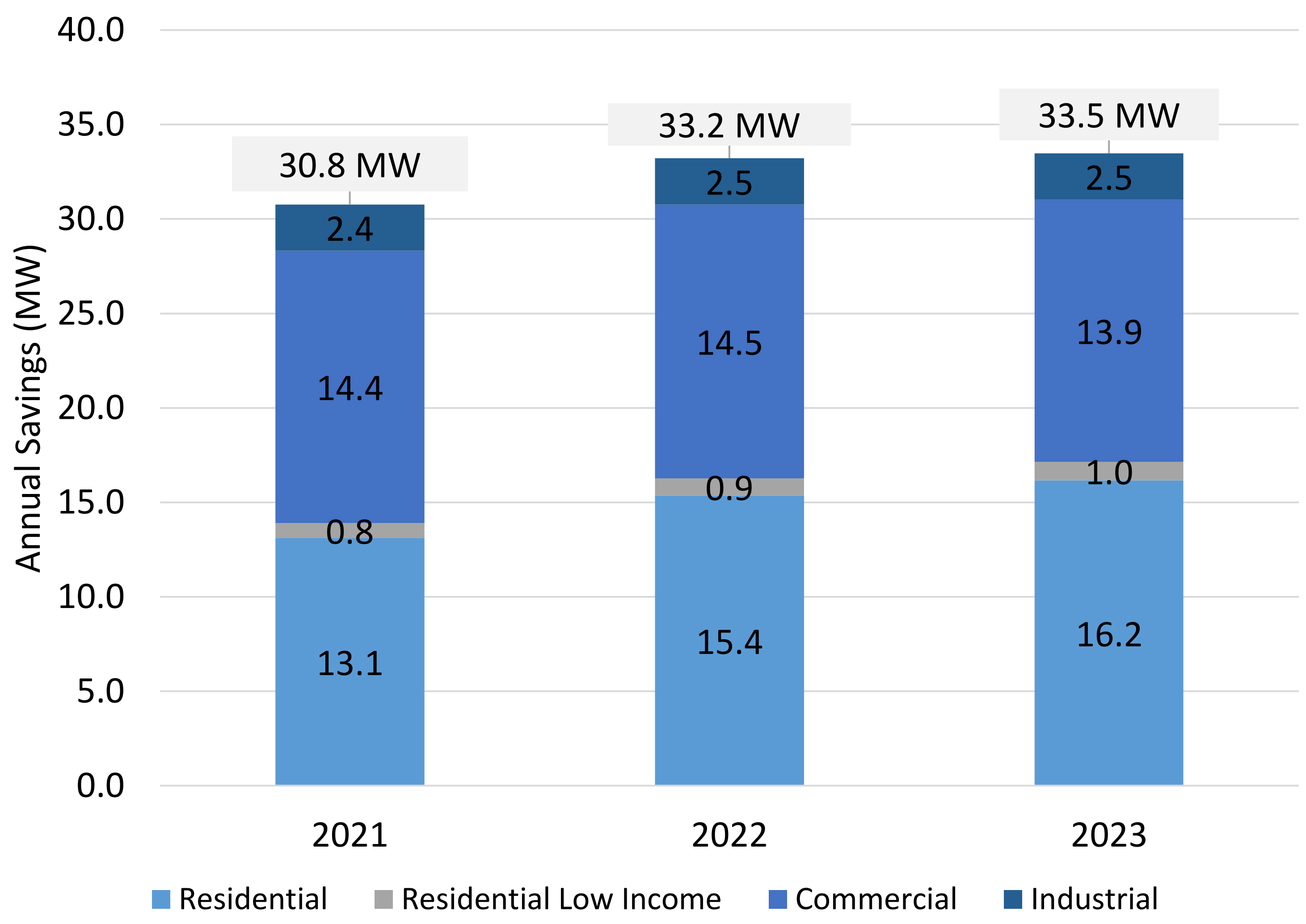
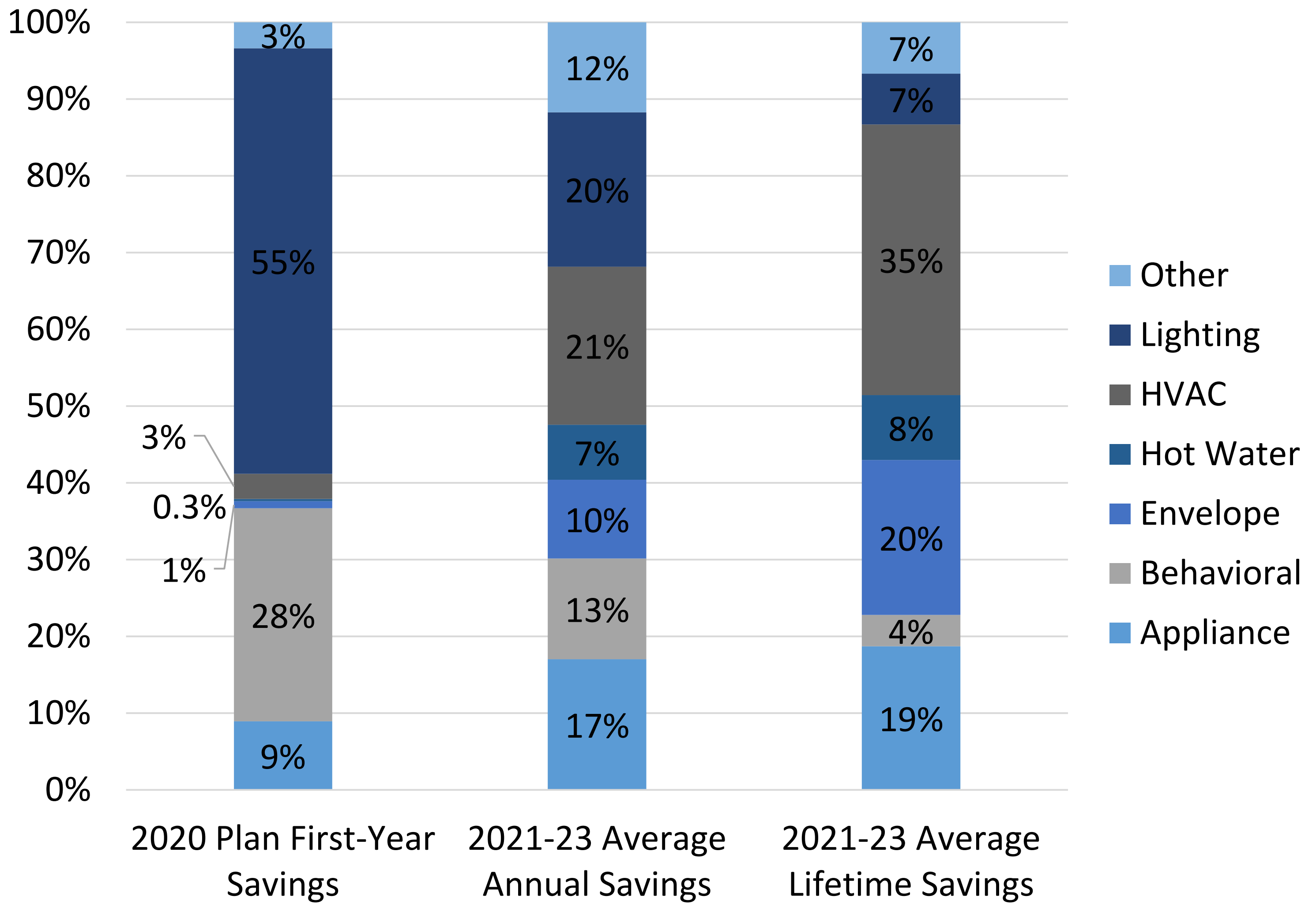
Annual Passive Peak Demand Reduction by Sector (Max)



- Similar to energy savings, bulk of passive demand savings come from residential and commercial sectors

EE: Electric Savings Potential, Residential

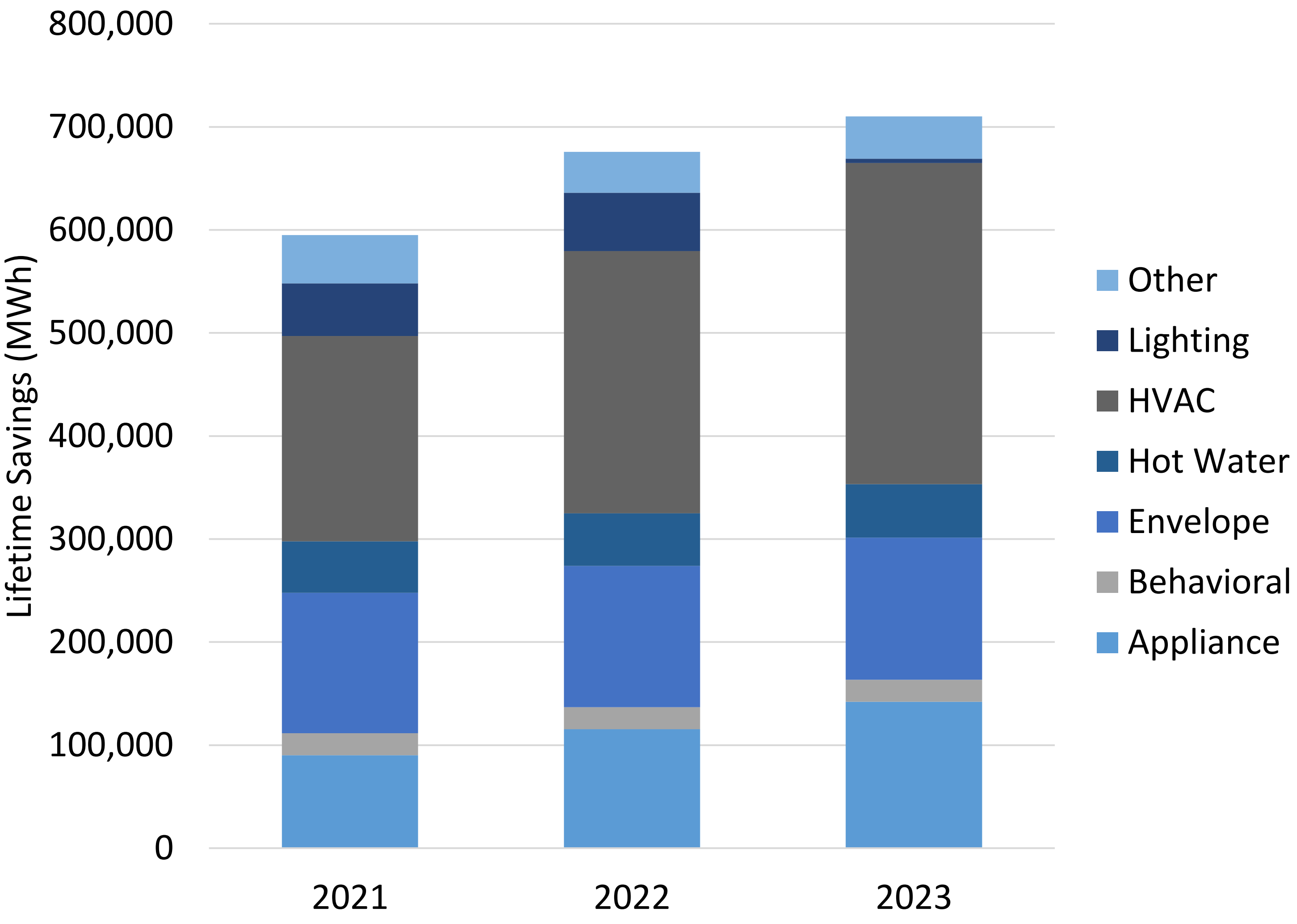
Proportion of Residential Savings by End Use



- Savings move quickly away from lighting and towards other end uses as lighting market transforms to LEDs.
- In terms of annual savings, 2021-2023 residential savings are distributed among end-uses
- From a lifetime perspective, the relative impact of HVAC and envelope measures increase significantly – while lighting, behavioral, and other decrease – when compared to annual savings.

EE: Electric Savings, Residential Lighting

Despite loss of lighting, lifetime residential savings grow



- In the residential sector, increased lifetime savings from long-lived measures (HVAC and appliance) more than make up for reduction of lighting savings in 2023 as the market transforms
- However, in annual terms, savings drop in 2023 as lighting exits the market

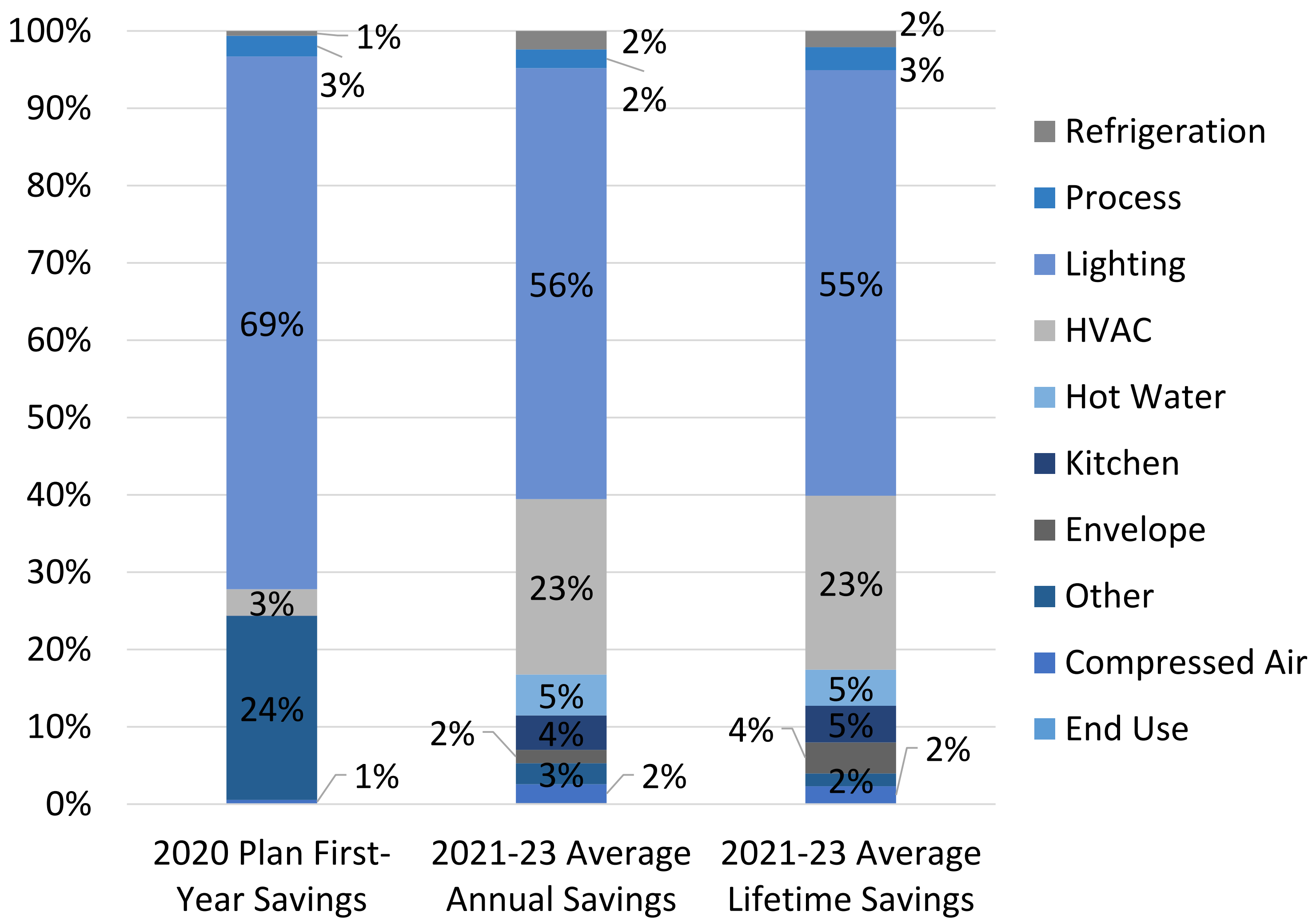
Residential EE Savings, Max Scenario (MWh)

Savings	2021	2022	2023
Annual	78,231	84,722	72,917
Lifetime	594,943	675,705	710,287

*Graph shows combined savings for both residential and low-income residential customers

EE: Electric Savings Potential, Non-Residential

Proportion of Non-Residential Savings by End Use



- Lighting savings drop significantly as compared to 2020 EE Plan as markets transform.
- Still, the majority of non-residential savings are driven by lighting (linear) and lighting controls, with HVAC savings representing a growing and significant opportunity
- There is less difference between average annual savings and lifetime savings compared to residential sector because the spread in measure lives is less.

EE: Estimated Electric Program Costs

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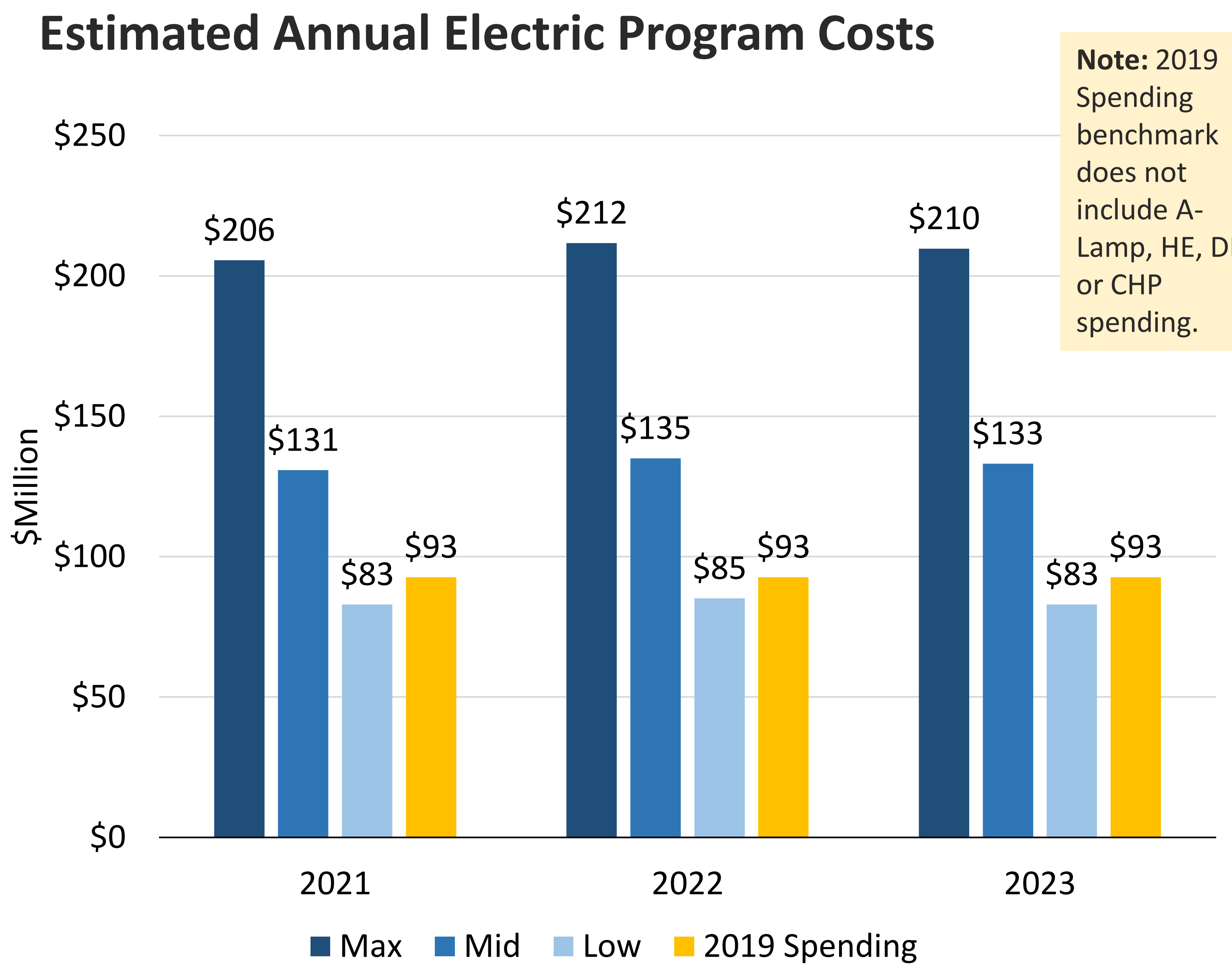


Note: 2019 Spending benchmark does not include A-Lamp, HE, DR, or CHP spending.

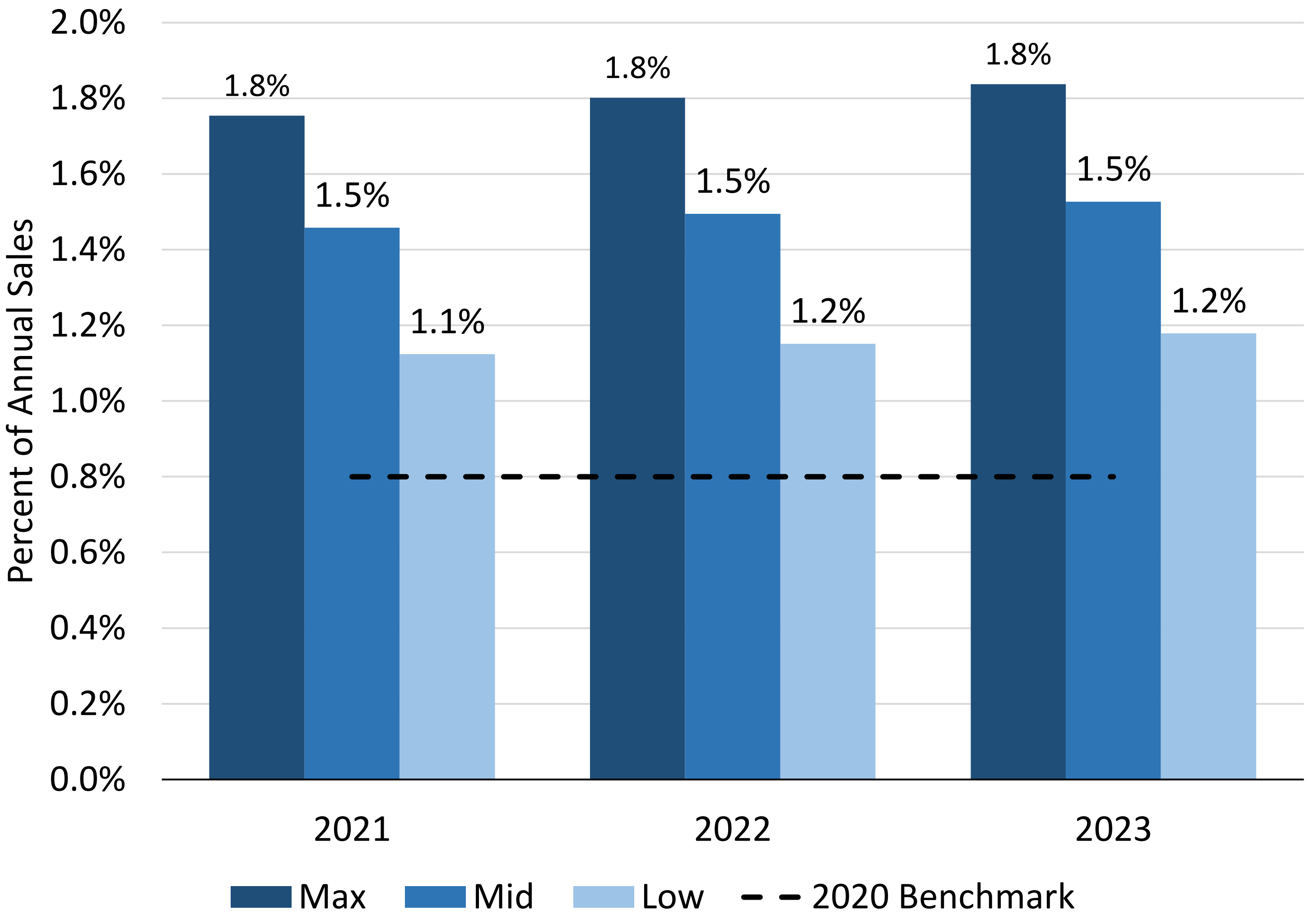
- Total costs and marginal cost per unit savings increase with savings
- Potential study estimated budgets do not account for portfolio optimization and program design improvements

Estimated 2021 Acquisition Costs

Scenario	$ per First-year kWh	$ per Lifetime kWh
Max	$1.09	$0.105
Mid	$0.80	$0.080
Low	$0.63	$0.066
2019 Results	$0.55	$0.065

EE: Natural Gas Savings Potential

Annual Gas Savings as Percentage of Forecasted Gas Sales*



- Low Scenario exceeds 2020 plan, but is similar to 2019 portfolio results
- Mid and Max show notable upside potential

Benchmark	Savings
2019 Programs	1.1%
2020 RI BCR	0.8%
2021 Potential National Grid (MA)	
Low	0.8%
MAX	1.0%

*Dunsky treated National Grid's 2021-2026 forecasted gas sales to remove assumed EE savings to estimate percent savings for each year of the study.

EE: Natural Gas Savings Potential

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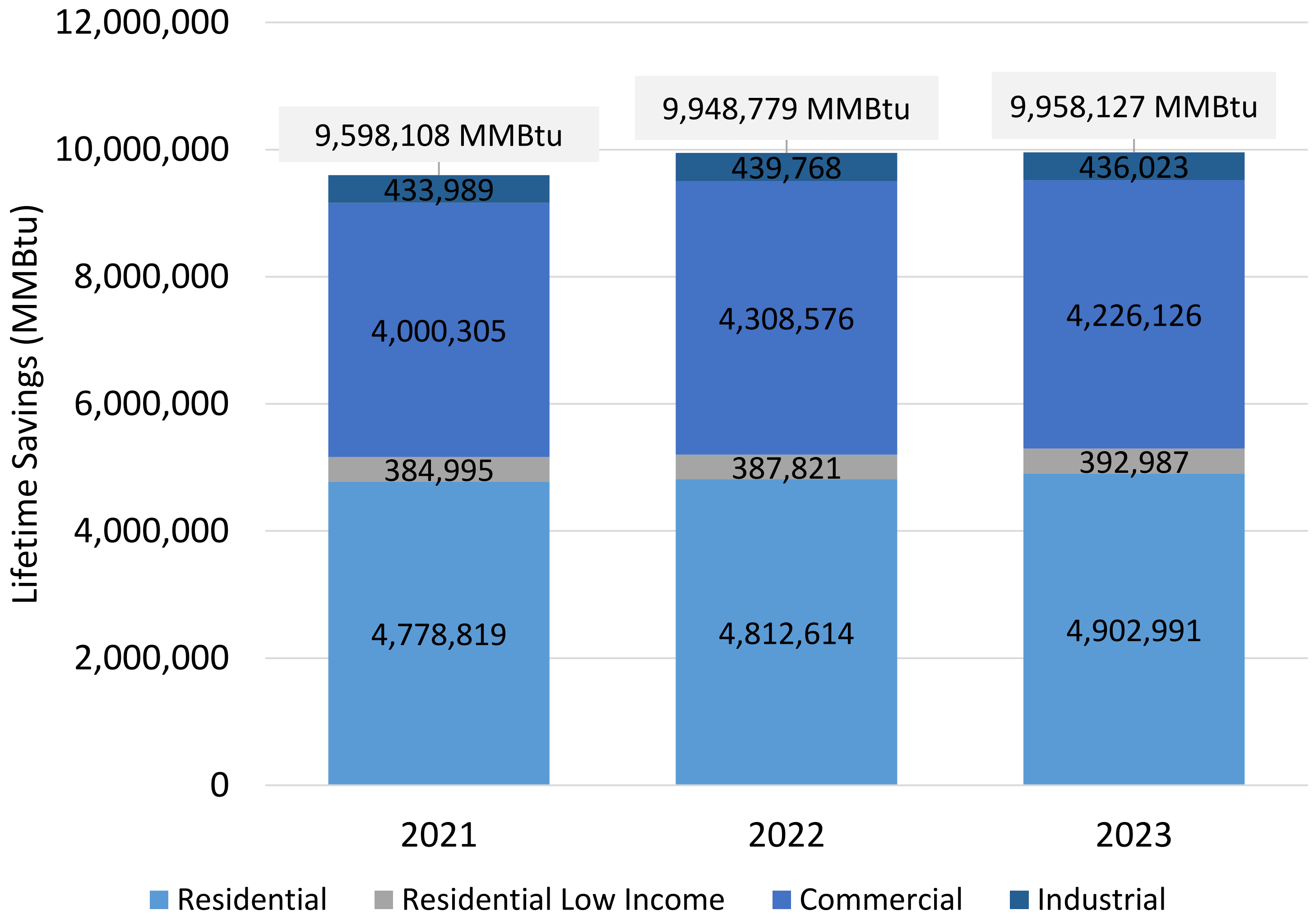
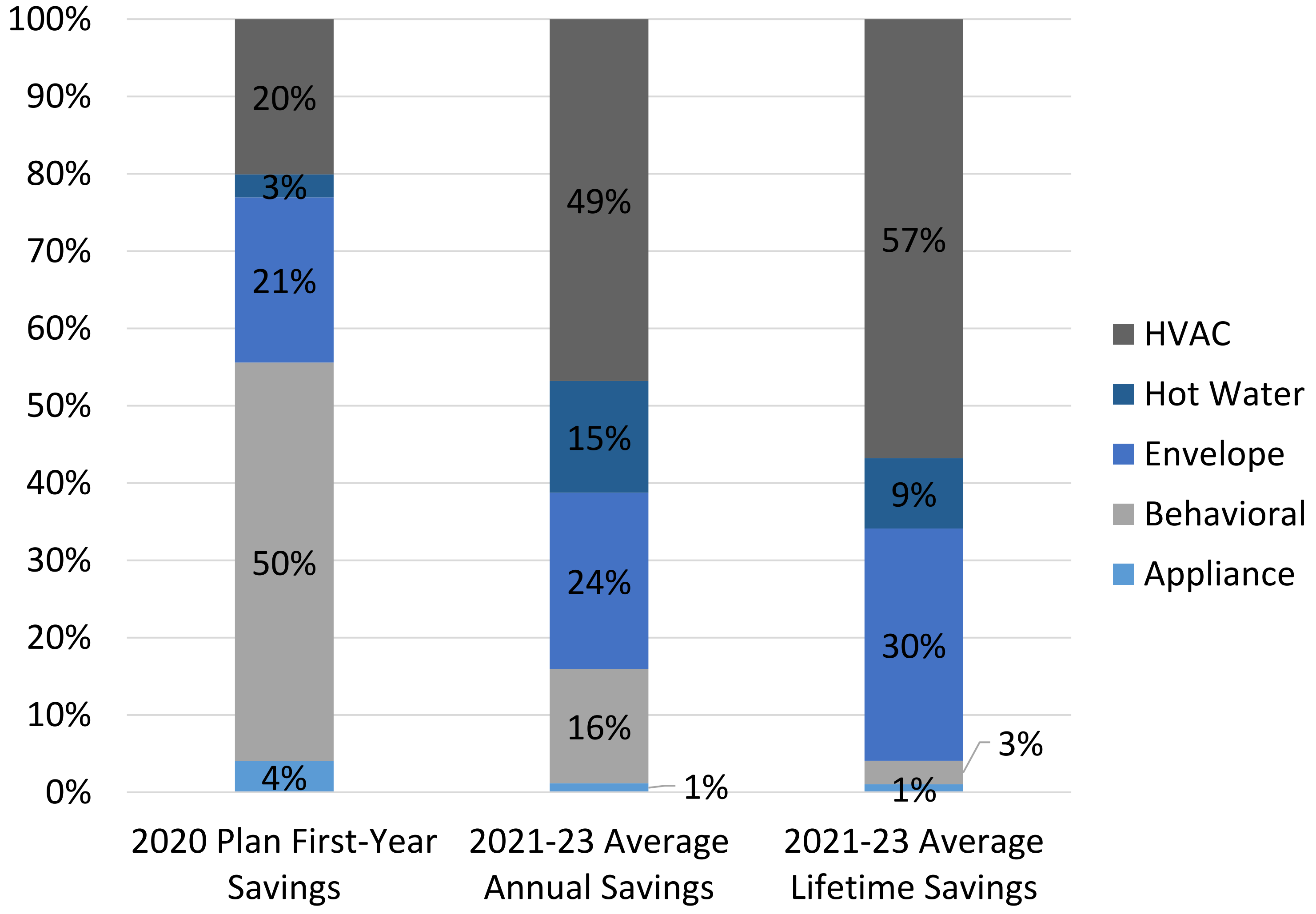
Lifetime Gas Savings by Sector (Max)



- Commercial sector is the slight majority of EE gas savings
  - Residential sector savings driven by single family segment.
  - Commercial sector savings driven office, retail, education/campus and lodging segments.
- Residential sector shows significant upside between Low and Mid scenarios – increasing by 50%

EE: Natural Gas Savings Potential, Residential

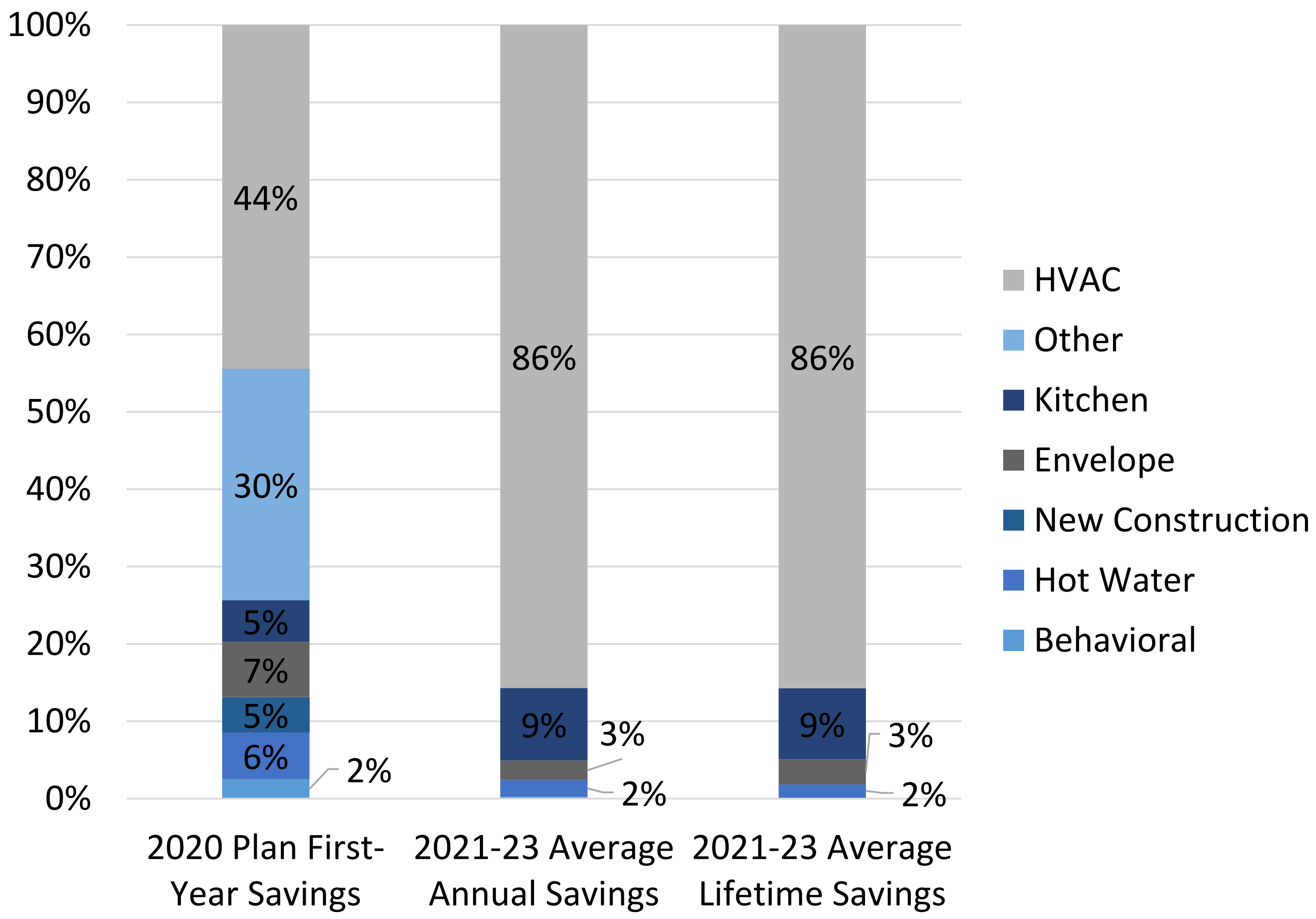
Proportion of Residential Savings by End Use



- On an annual basis, nearly half of residential savings come from HVAC measures
- The impact of HVAC and envelope measures increases when viewed from a lifetime savings perspective, while the behavioral savings portion drops

EE: Natural Gas Savings Potential, Non-Residential

Proportion of Non-Residential Savings by End Use



- Majority of non-residential gas savings are found in HVAC measures
- There is not a significant difference in proportional savings when viewed from annual and lifetime basis

EE: Estimated Gas Program Costs

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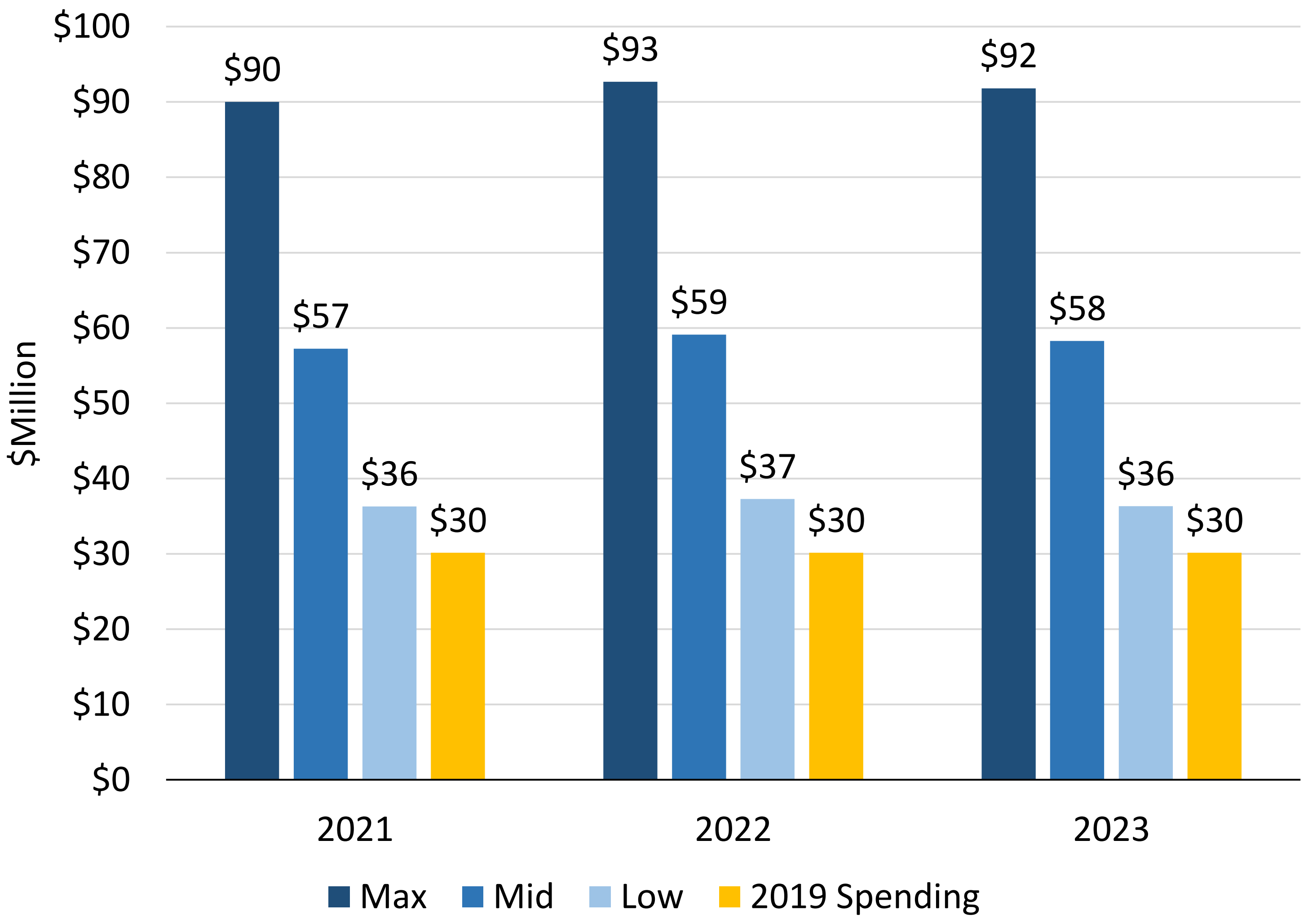
Estimated Annual Gas Program Expenditures



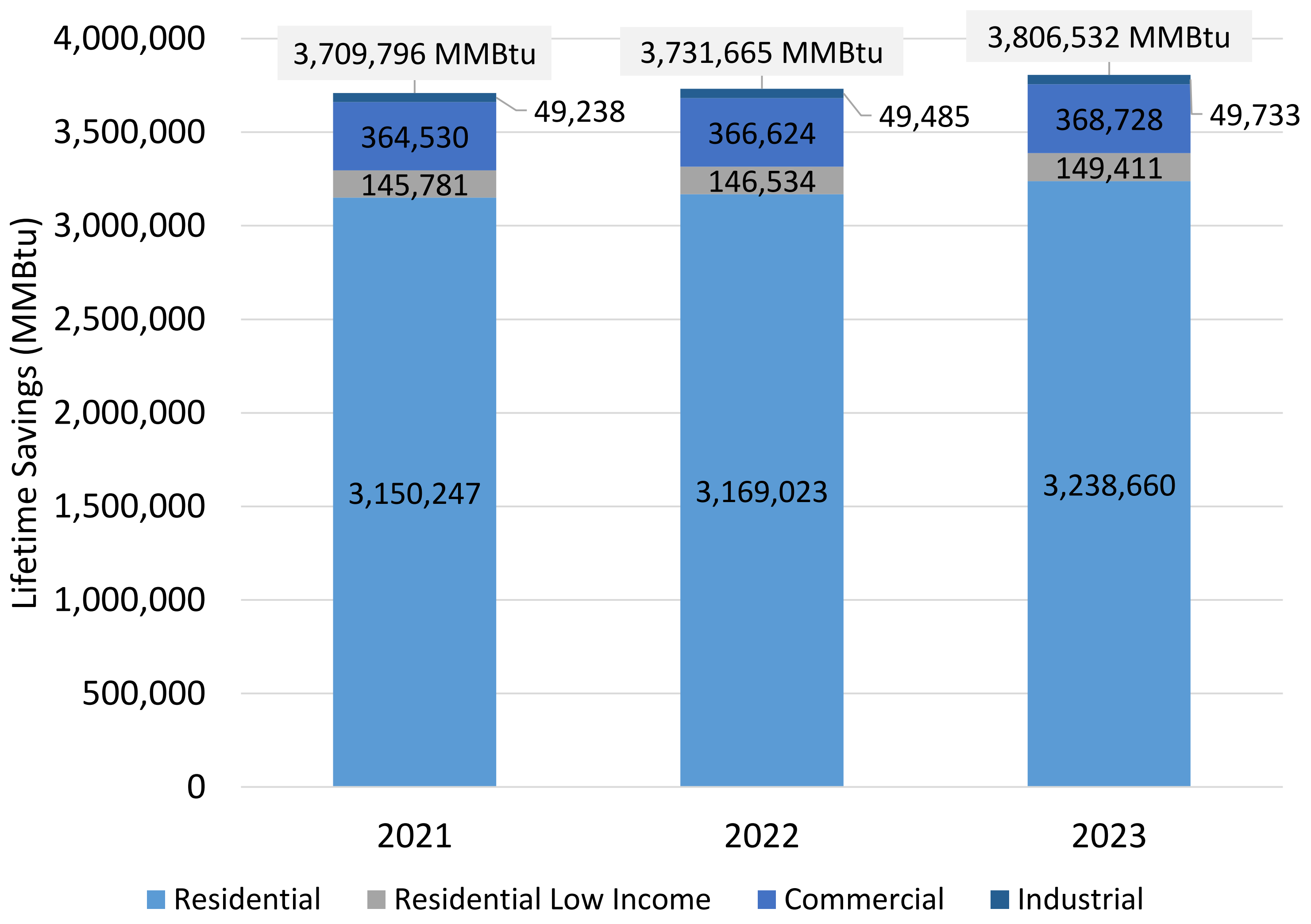
- Estimated total costs and marginal cost per unit savings increase with savings
- Potential study estimated budgets do not account for portfolio optimization and program design improvements.

Estimated 2021 Acquisition Costs

Scenario	$ per Annual MMBtu	$ per Lifetime MMBtu
Max	$120.09	$9.38
Mid	$91.92	$7.65
Low	$75.62	$6.95
2019 Results	$66.79	$6.66

EE: Delivered Fuel Savings Potential

Lifetime Delivered Fuel Savings by Sector (Max)



- The bulk of delivered fuel savings come from the single-family residential customers
- Oil measures account for approximately 94% of delivered fuel savings

EE: Rhode Island Test

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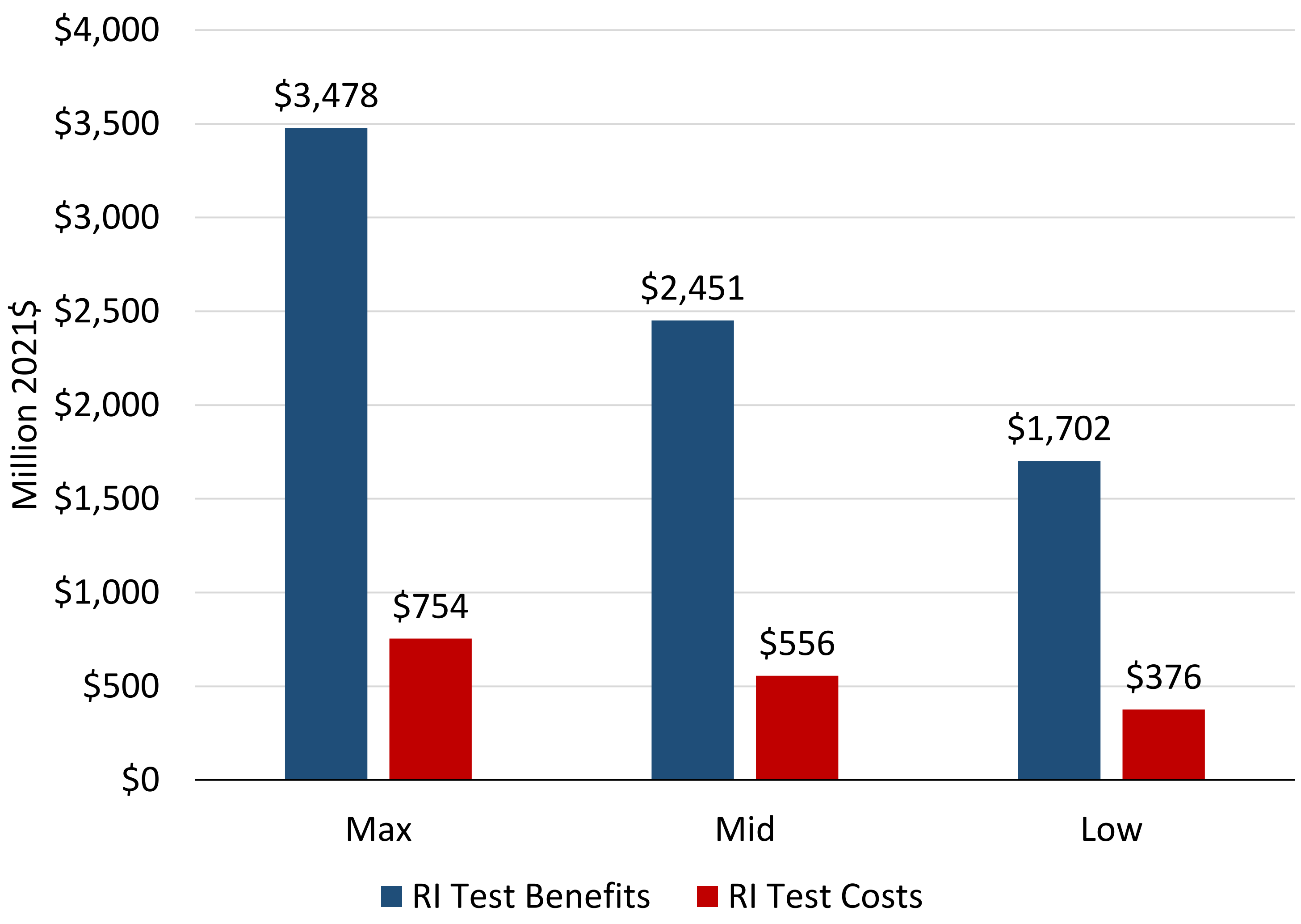
Total Rhode Island Test Benefits and Costs by 2023



- Regardless of program scenario, efficiency programs create significant net benefits under the Rhode Island Test
- BCR ratio decreases slightly under Mid and Max program scenarios, however each scenario is highly cost-effective
- For the first 3 program years, net benefits range from $1.4B to $2.8B

Scenario	Net Benefits	RI Test Ratio	2020 Plan RI Test Ratio
Max	$2,758M	4.63	4.32
Mid	$1,928M	4.42	
Low	$1,361M	4.56	

EE: Customer Benefits

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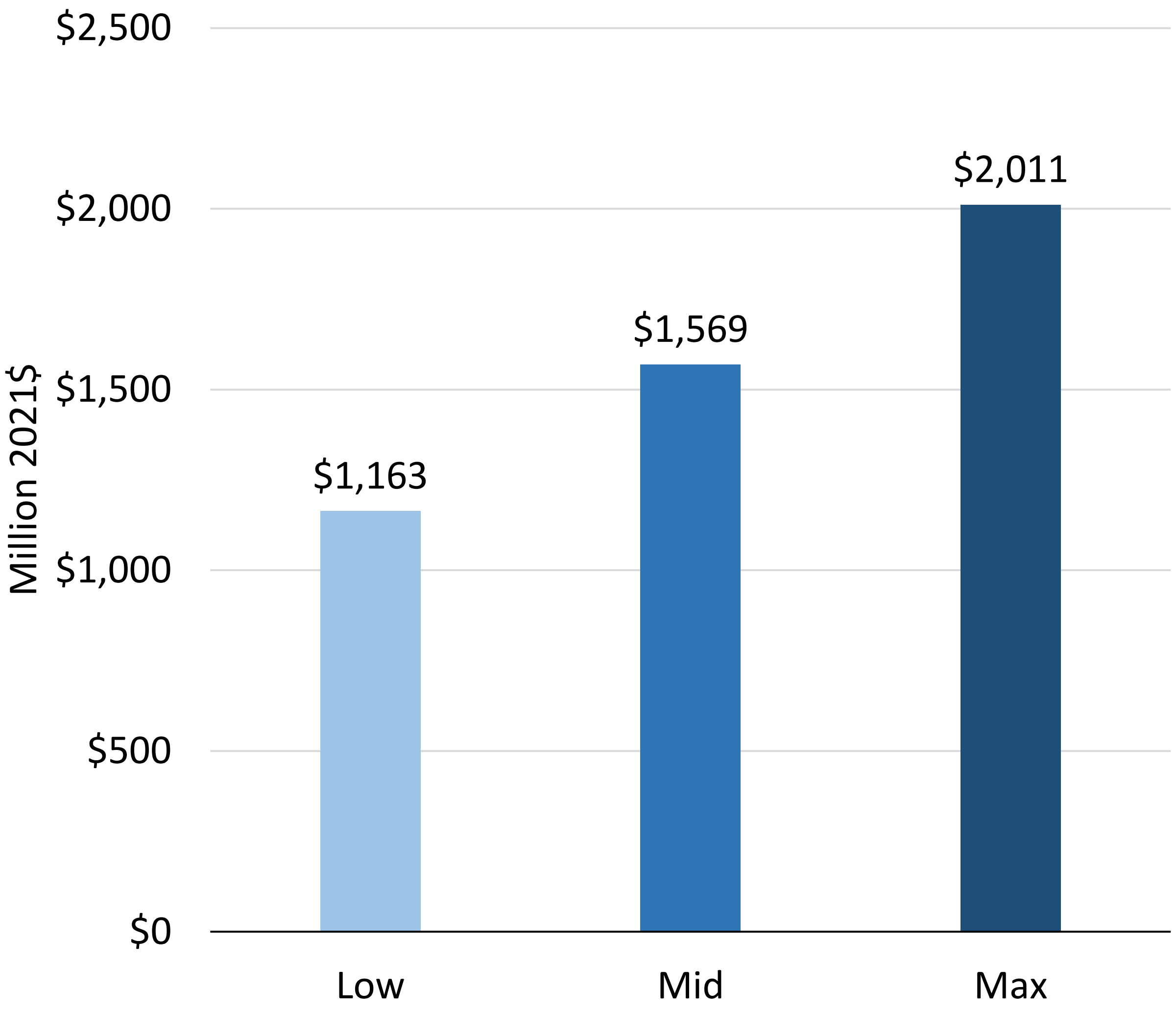
Total Lifetime Customer Net Benefits by 2023



- Efficiency programs create significant customer savings

Low Income Customer Benefits by 2023 (Max Scenario)

Savings	Max Scenario
Electric Savings	25.28 GWh
Gas Savings	80,339 MMBtu
Delivered Fuel Savings	24,262 MMBtu
Customer Savings	$54.3M

EE: Key Takeaways

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1. Electric annual savings are likely to drop as lighting markets become increasingly transformed… *however*, new opportunities exist and can be exploited in a cost-effective manner and savings can continue to increase when considered from a lifetime perspective.

2. Gas savings appear to be growing in importance in the EE portfolio, and the residential sector may offer significant upside potential through higher investments.

3. Program costs to capture non-lighting savings could be somewhat higher that historical program results… *however*, the 3-year portfolio can offer up to $2.8Bn in net benefits to Rhode Islanders.

Demand Response

DR: Achievable Scenarios

Three program scenarios are explored in this study:

Low	Current DR programs and incentives, expanded across the full possible market.
Mid	Expanded DR programs with mid-point incentives (relative to maximum and benchmarked to other jurisdictions)
Max	Expanded DR programs with maximum cost-effective incentives.

DR: Changes since February EERMC Meeting

Integration of other studies:

- Energy efficiency, heating electrification, distributed generation, and EV adoption impacts were integrated into the utility load curve, and the changes to the utility load shape and peak result in an **increase in DR potential.**

Apply National Grid Feedback:

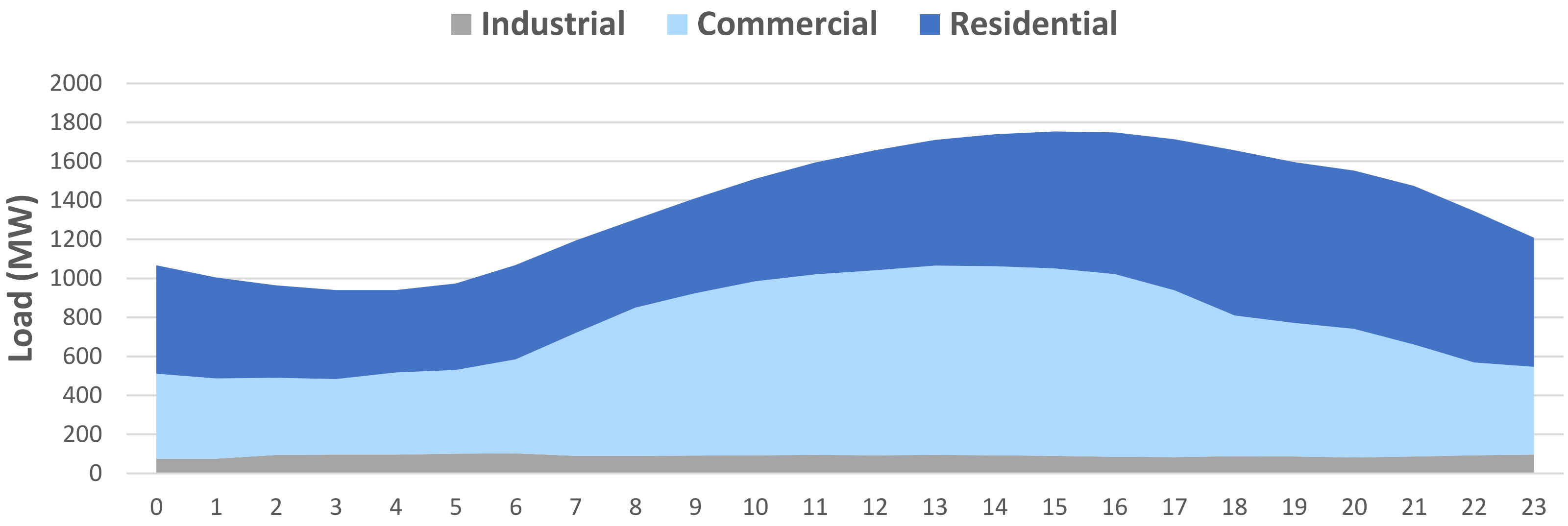
- Updated assumptions for battery energy storage and commercial curtailment leading to **increased potential**

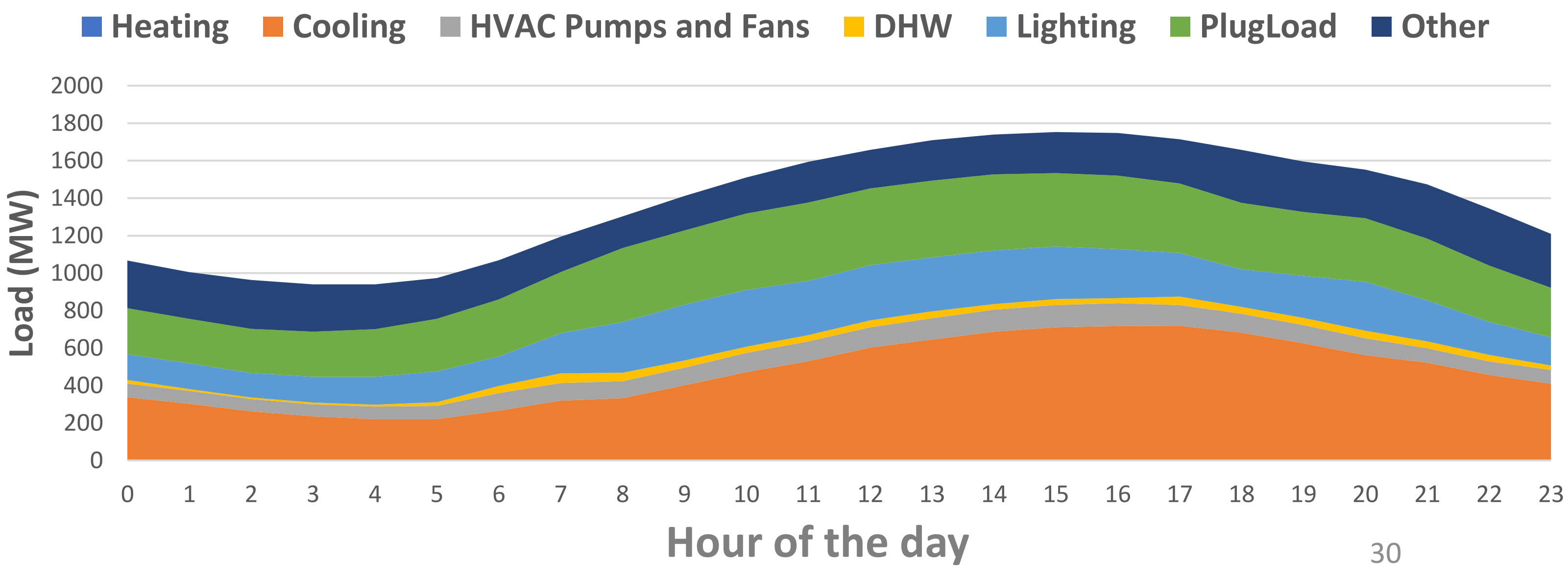
Model Refinement:

- Changes in adoption for large commercial and industrial to better reflect existing programs resulting is a **small decrease** in potential (smaller impact than the changes made by the feedback above)

DR: Peak Load Breakdown

- Cooling driven peak from 12:00 - 18:00
- Limited industrial load relative to peak

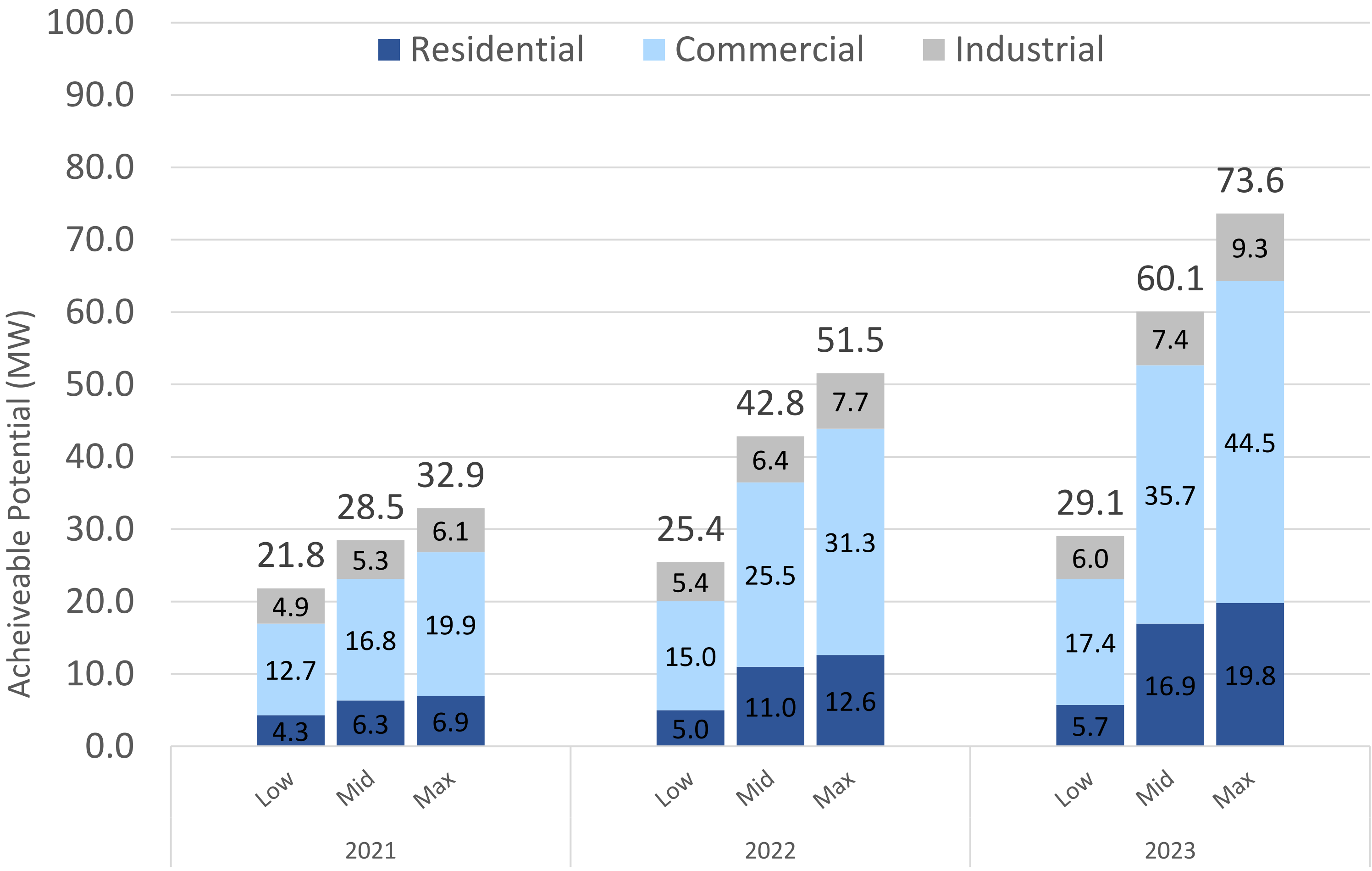




Year	Peak Forecast (MW) (accounting for EE, DG, EVs)
2021	1,753
2022	1,748
2023	1,752
2024	1,750
2025	1,744
2026	1,746

DR: Overview

Achievable Annual Peak Demand Reduction from DR (MW) by Scenario



- Economic potential assessed at: 125 MW*
- Both Residential and Commercial DR have lots of room to grow
- Expanding programs has bigger effect than simply raising incentives
- Budgets range from $2M to $22M per year. Mid scenario appears to offer best savings/cost balance.

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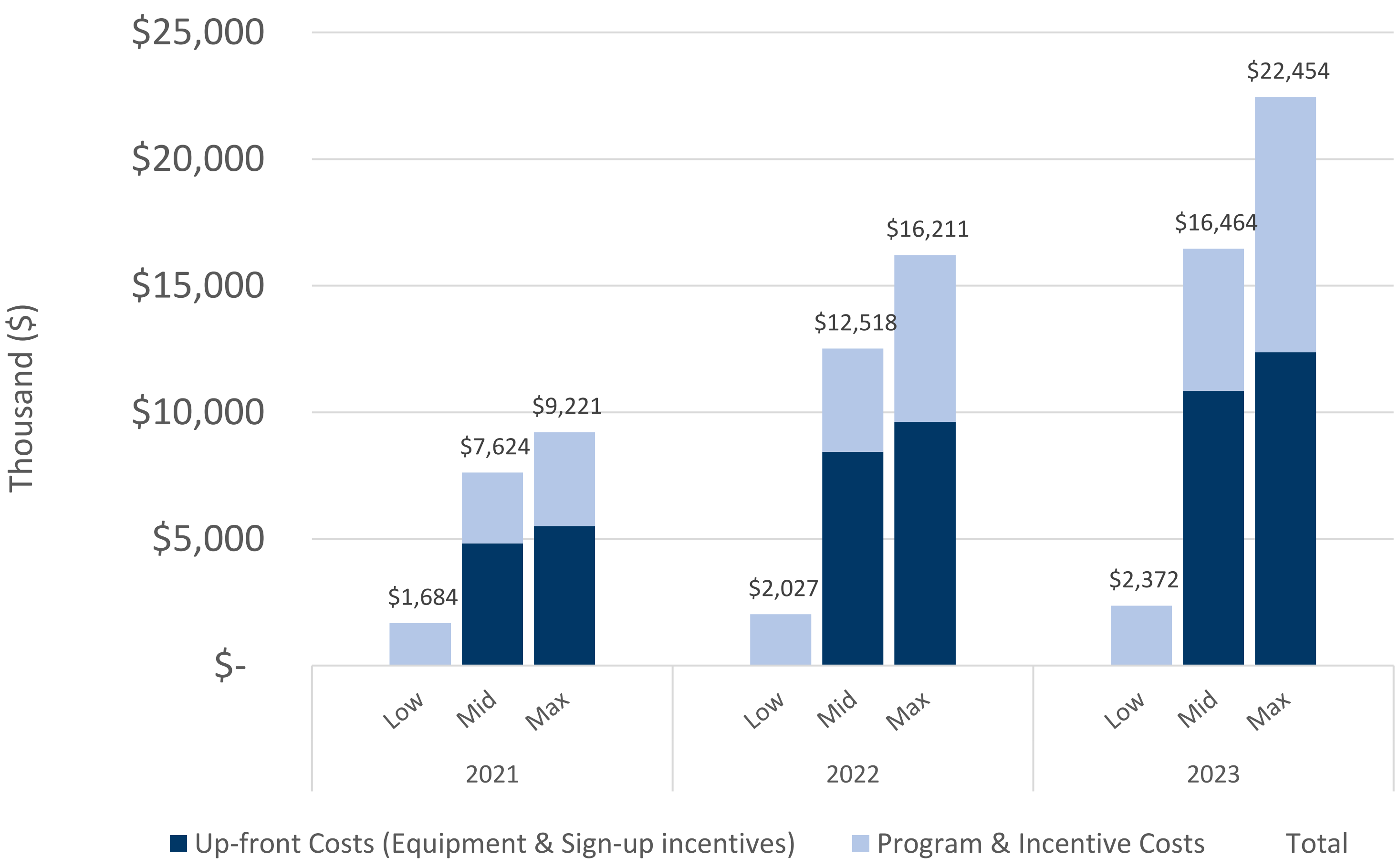
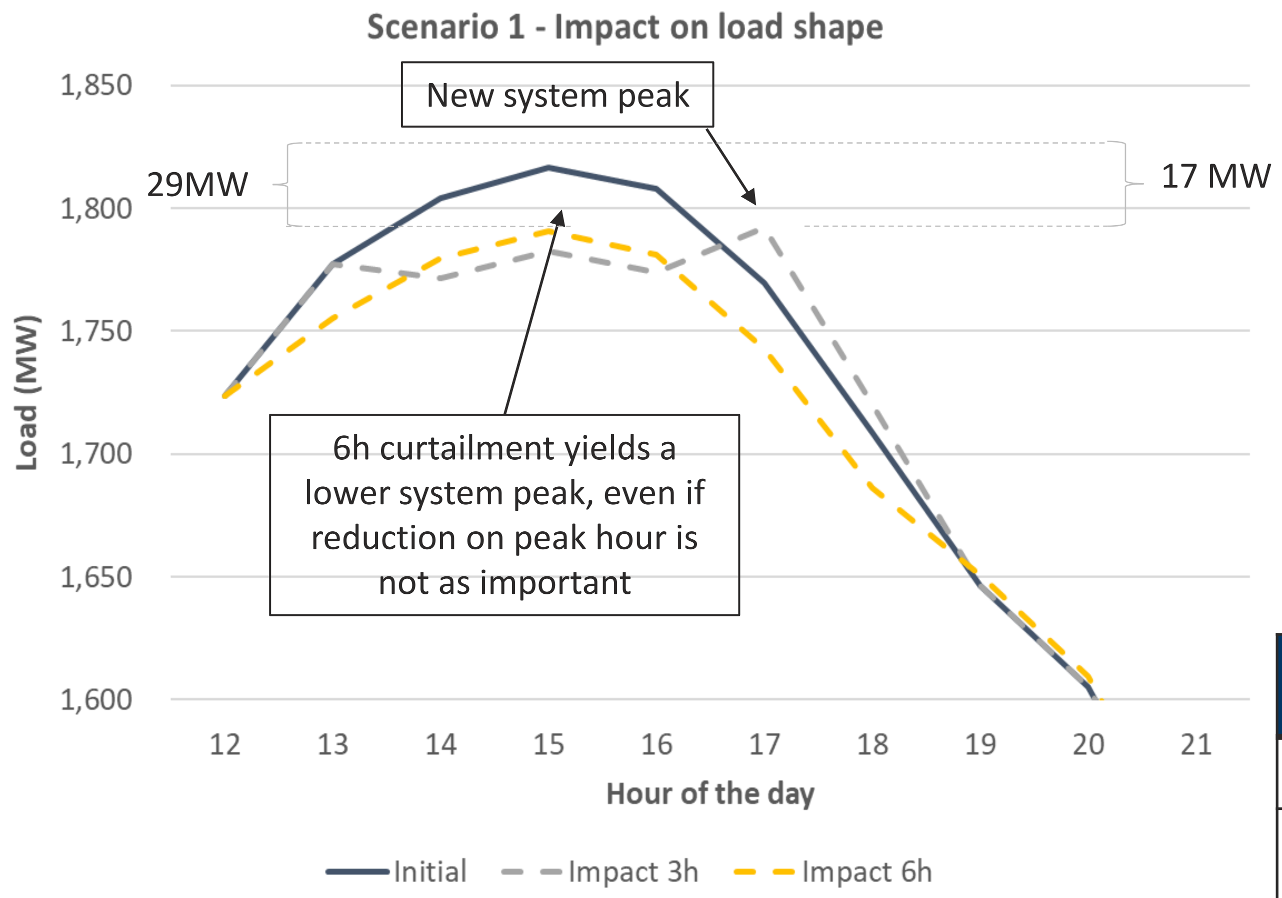
DR Portfolio Costs ($1000) by scenario



- Increasing impact come at significantly increased cost
- Mid and Max scenarios involve notable investment in early years to install equipment (controls, battery storage, etc
- The Max scenario is more focused on high curtailment incentives, which need to be paid each year to drive peak reductions.
- Keep in mind: DR savings only persist for as long as the programs are active (study assumed that measures deliver savings for a 10 year program life)

DR: Low Scenario (net impacts)



- Assessed net commercial impacts are lower than what is measured on an hourly basis
- Interactions among measures can further deteriorate net impact
- 3-hour window is limiting: Expanding the duration of DR measures could improve potential for new measures
- DR potential is evaluated using RI load curve. DR potential on the NE ISO peak will be in the main report appendices.

Programs	Current Program	Potential (NE ISO)	Potential (RI load)
Residential	5.5	5.8	3.3
Commercial and Industrial Curtailment	29.3	28.6	13.6

DR: Low Scenario

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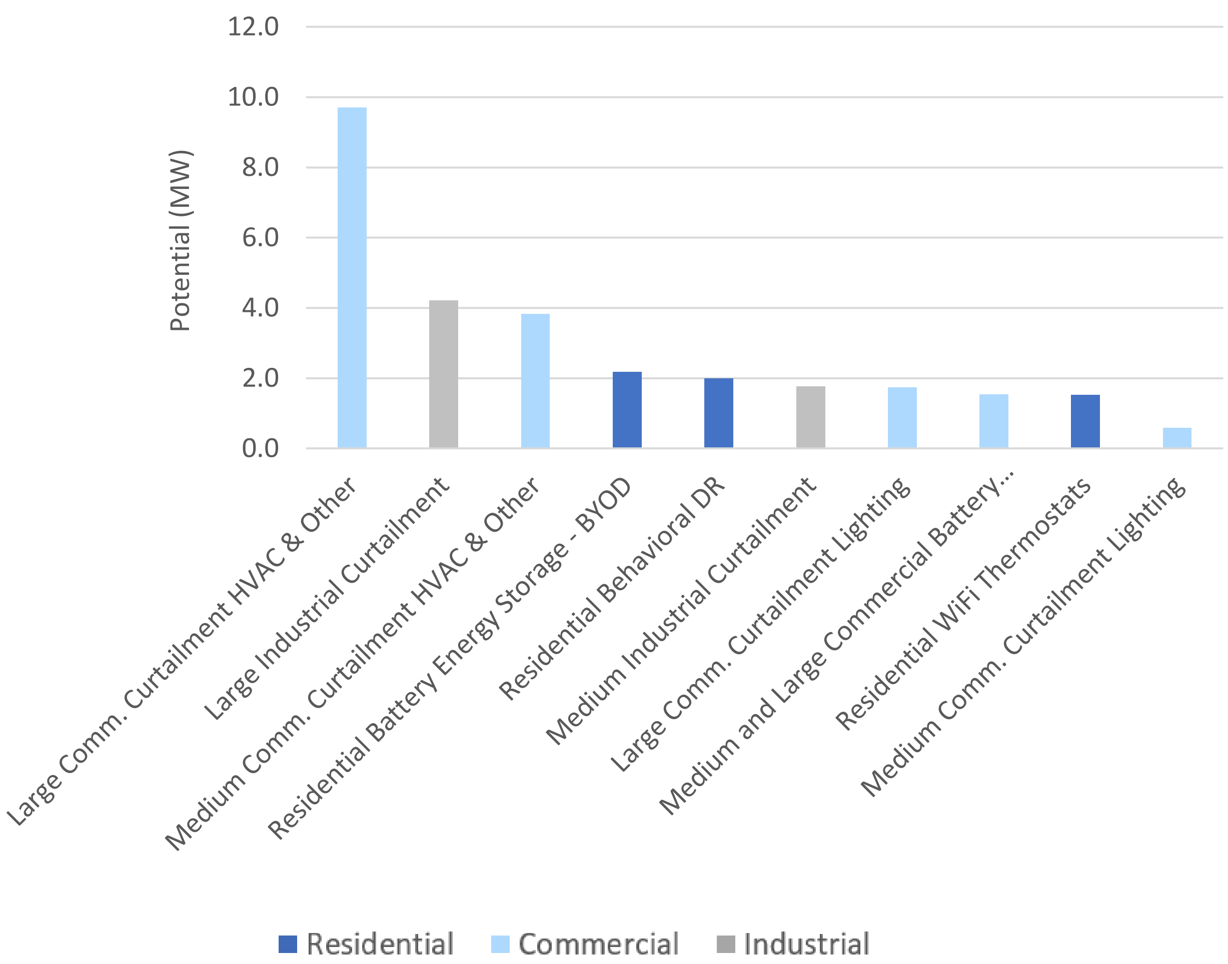
Top 10 Measures: 2023 Achievable Potential (MW)

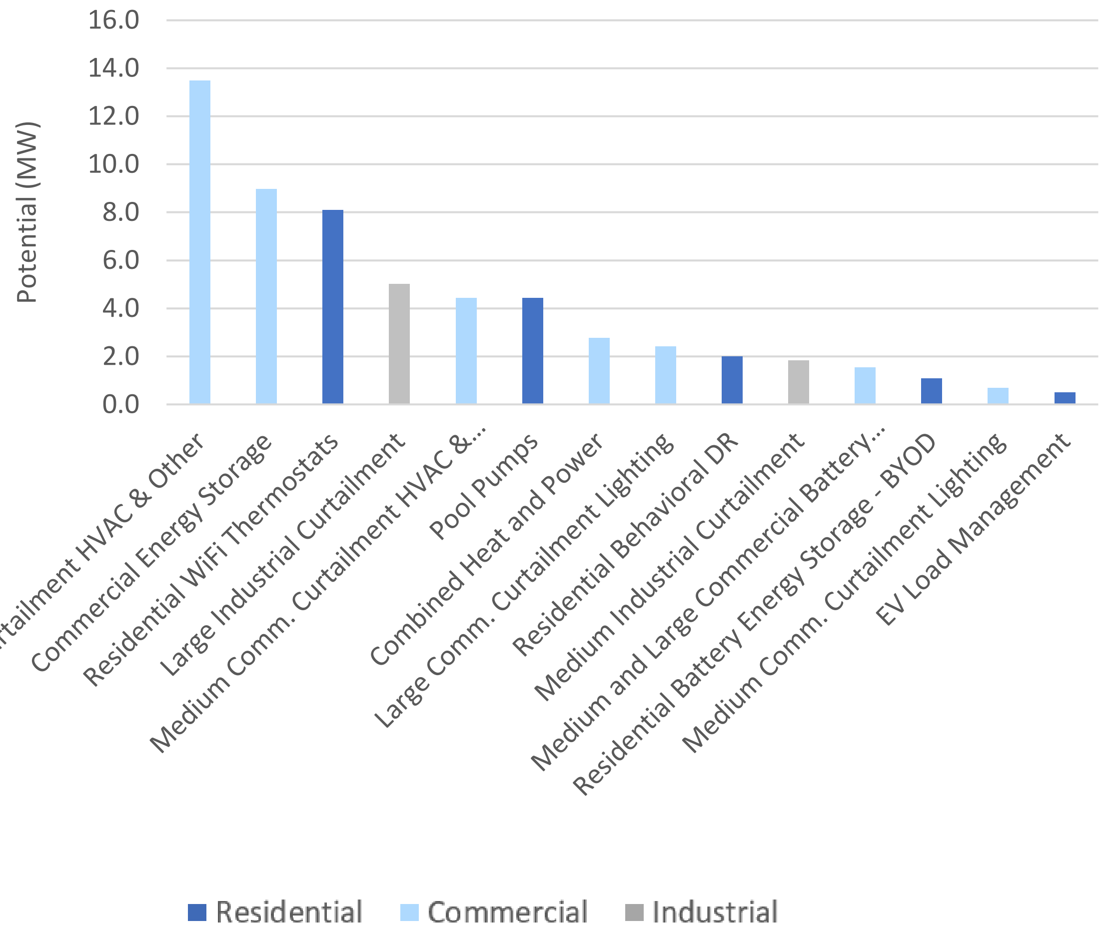


- Central AC and C&I Curtailment show notable potential for current program expansion, could integrate with efficient AC incentives
- Did not apply any growth to Behavioral DR

Program (2023)	RI Test	Savings (MW)
Residential BYOD	1.5	3.7
Medium & Large Commercial Curtailment	7.3	17.4
Medium & Large Industrial Curtailment	7.3	6.0
Res. Behavioral DR	41.7	2.0

DR: Mid-Scenario

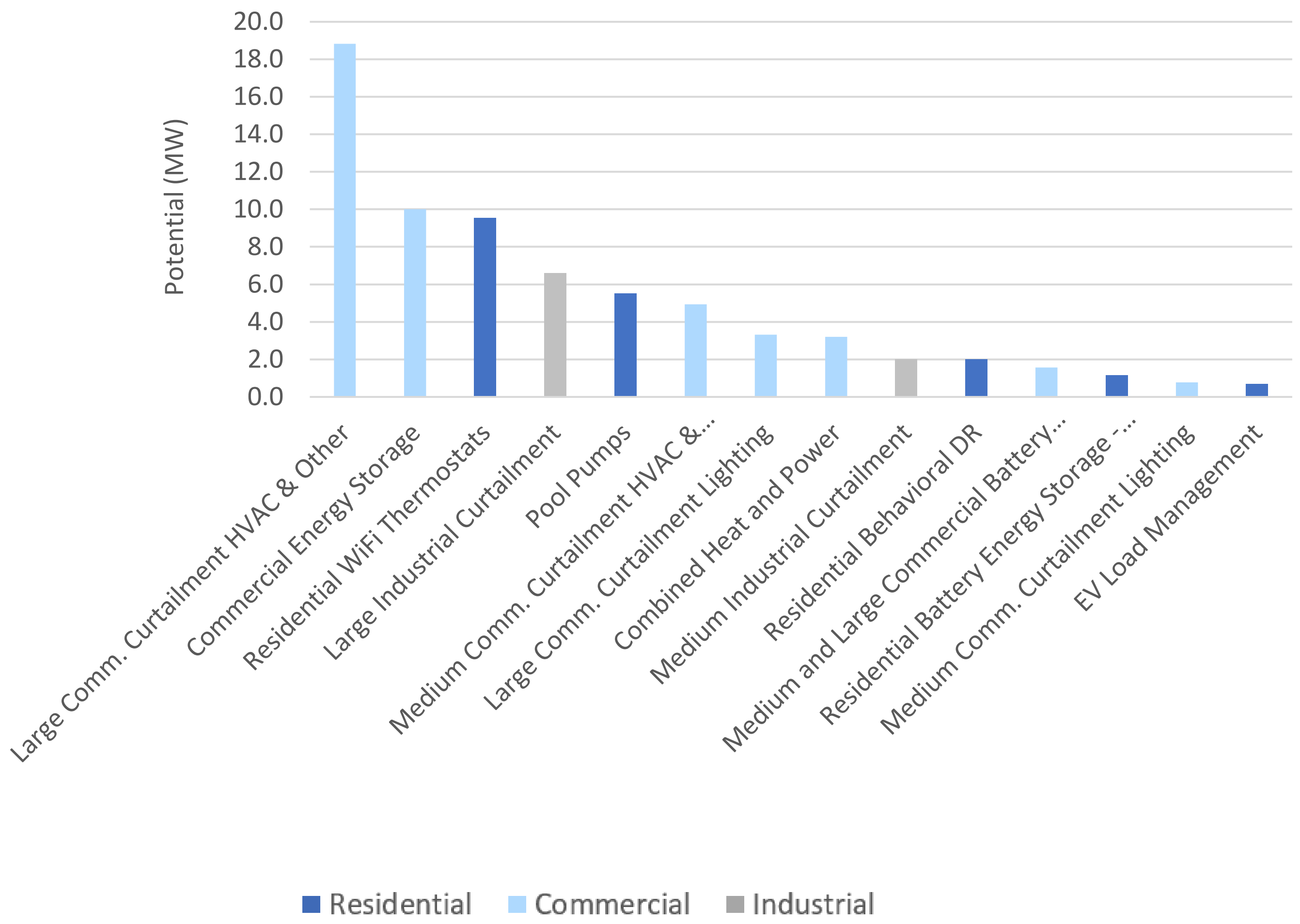
Top Measures: 2023 Achievable Potential (MW)



- Commercial curtailment and residential program expansion are driving the savings
- Commercial energy storage plays a key role in this scenario.
  - Note: Commercial energy storage is excluded from the Low Scenario as this technology is not currently participating in existing programs

Program (2023)	RI Test	Savings (MW)
Res. DLC	2.0	14.4
Res. BYOD	1.5	4.8
Small Comm. BYOD	3.1	0.4
Small Comm. DLC	1.3	10.1
Med. & Large Comm. Curtailment	4.1	25.5
Med. & Large Industrial Curtailment	4.5	7.4
Res. Behavioral DR	41.7	2.0

Top Measures: 2023 Achievable Potential (MW)



- Results in a notable change in top measure mix to be more focussed on C&I curtailment, compared to Mid scenario

Program (2023)	RI Test	Savings (MW)
Res. DLC	0.8	5.4
Res. BYOD	0.8	18.4
Small Comm. BYOD	0.9	0.5
Small Comm. DLC	1.0	11.5
Med. & Large Comm. Curtailment	5.3	36.6
Med. & Large Industrial Curtailment	3.4	9.3
Res. Behavioral DR	41.7	2.0

DR: Key Takeaways

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1. There is significant opportunity to expand DR programs in RI in a cost-effective manner, both through growing the market for existing programs, and introducing new programs and measures.

2. Expanding programs to new measures (low to mid) has bigger effect than raising incentives (mid to max)

3. Overall, estimated potential aligns with other recent DR studies:

	Rhode Island (2020)	Massachusetts (2018)	Michigan (2017)	Northwest Power (2014)
Portion of Peak Load	3.6% - 4.4% (2026)	3.5% - 4.0% (10-year outlook)	4.4%-7.7% (3-year outlook)	8.2% (15-year outlook)
Avoided Costs	$200 / kW	$290 / kW	$140 / kW	n/a

Combined Heat and Power (CHP)

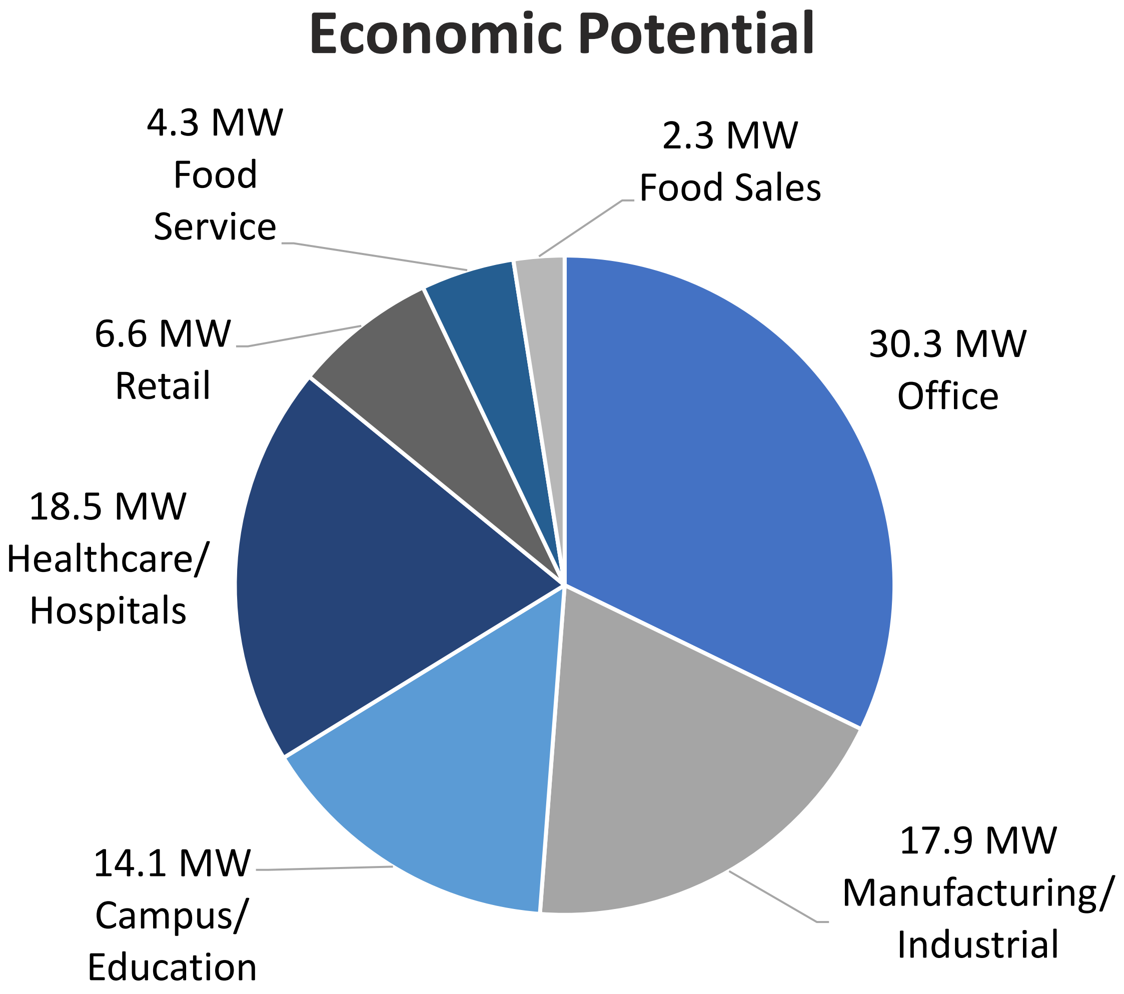
CHP: Achievable Scenarios

Three program scenarios are explored in this study:

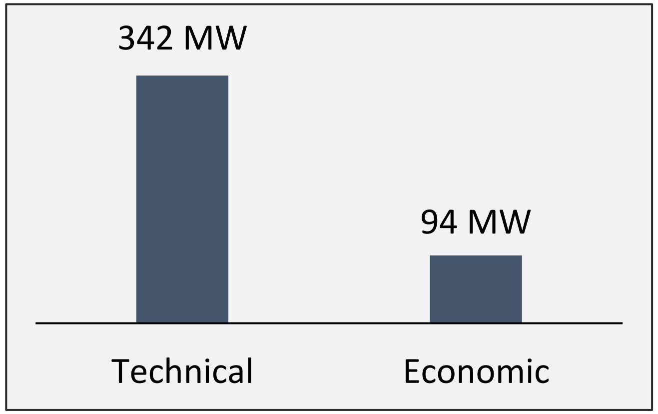
Scenario	Description
Low	Incentive levels set at **maximum allowable incentive (70%)**
Mid	Incentive levels set at maximum allowable incentive (70%) with **additional barrier level decrease**
Max	Incentive levels set at **100%** with same barrier level decrease as mid scenario

CHP: Economic Potential

CHP Economic Potential Installed Capacity Potential by Segment (MW)



- Significant technical potential exists, but the majority does not pass economic screening
- Office, Healthcare, Campus/Education and Industrial segments have greatest potential



CHP: Installed Capacity

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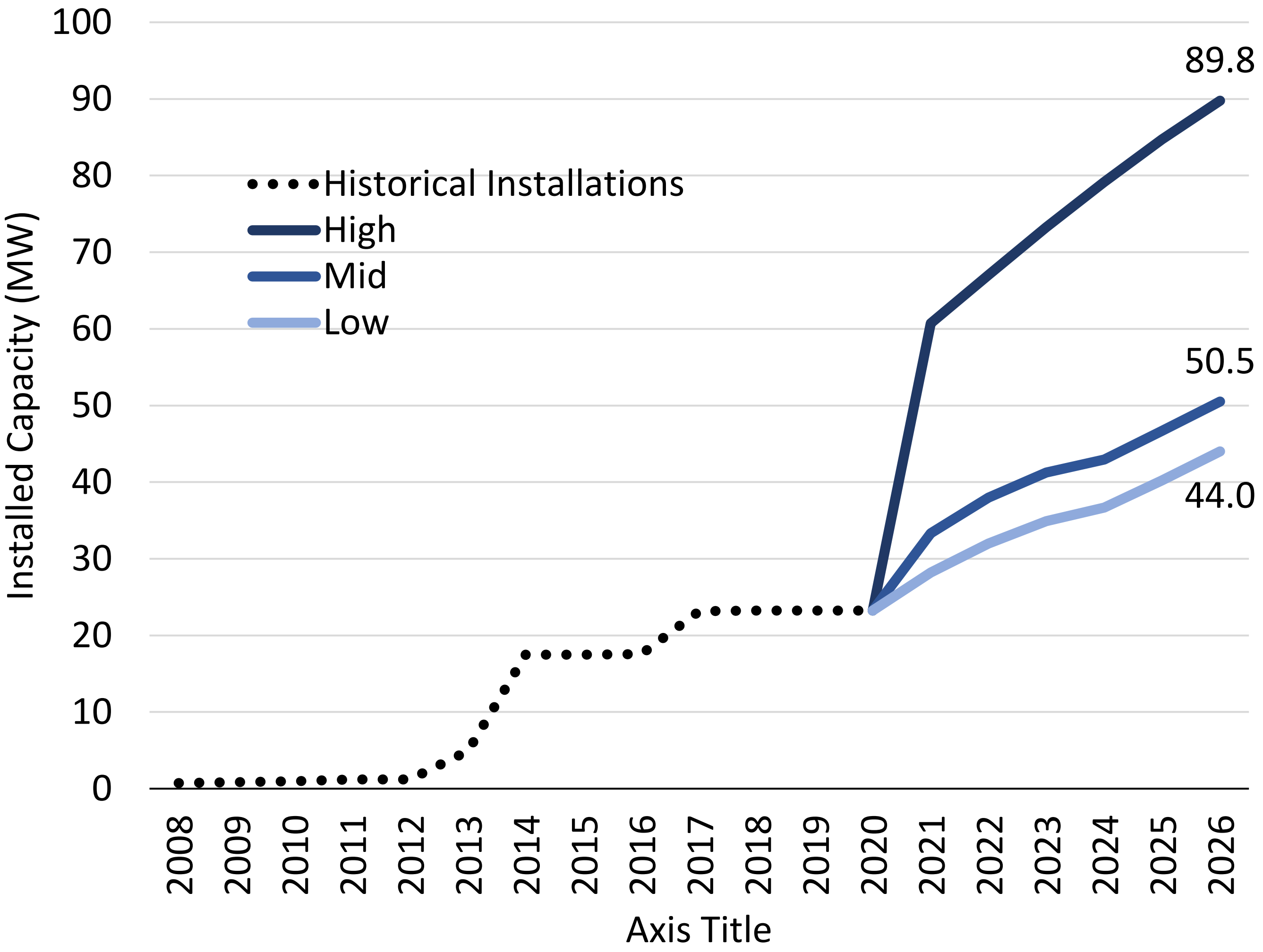
Historical Installed Capacity and Achievable Adoption Projections



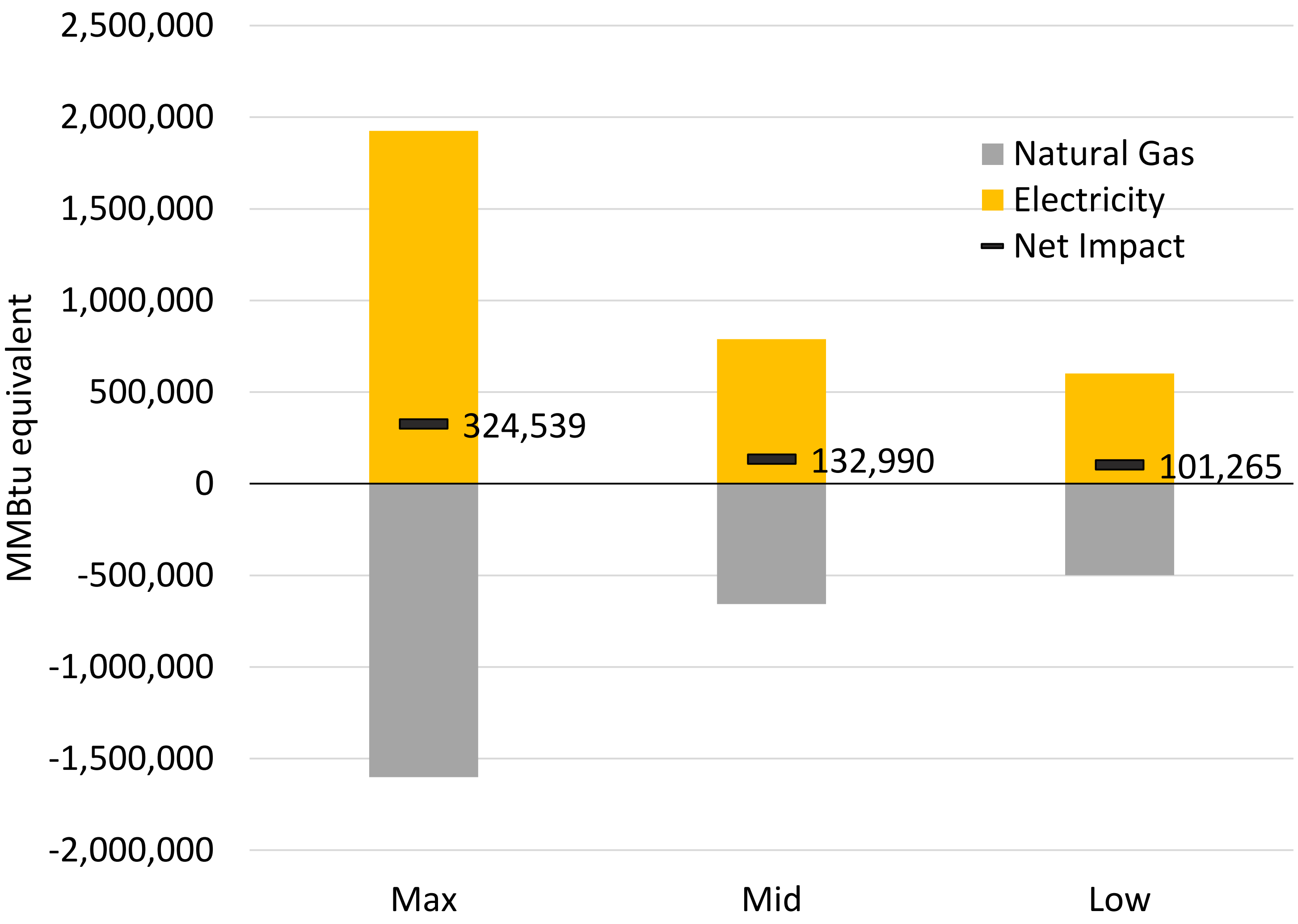
Average impacts (2021-2026)

Impact	Max	Mid	Low
Annual Capacity Additions (MW)	11.1	4.5	3.5
Annual Electric Savings (MWh)	45,209	18,526	14,106
Lifetime Electric Savings (MWh)	723,337	296,409	225,700
Peak Demand Reduction (MW)	4.12	1.69	1.28
Annual Gas Consumption Increase (MMBtu)	266,891	109,366	83,277
Annual Program Spending (Million $2021)	$29.6M	$9.0M	$6.7M

- Adoption estimates are best interpreted by study period averages
- **Benchmark:** 3.6MW installed annually between 2014 and 2018

CHP: Net Savings

Total Net Energy Savings Including Grid Electricity Embedded Energy by 2026



- When the embedded energy of grid electricity production is considered, CHP adoption results in net energy savings
- Note: Analysis assumes marginal heat rate of 7,100 Btu/kWh (AESC 2018)

CHP: Key Takeaways

1. Additional CHP potential exists and current incentive levels can encourage additional adoption commensurate with recent years.

2. The biggest opportunities are in the Office, Healthcare, Education & Campus, and Industrial segments.

3. Reducing non-financial barriers through enabling activities may move the market a little, but overall impact is small compared to increasing customer payback (e.g. increased incentives).

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Heating Electrification (HE)

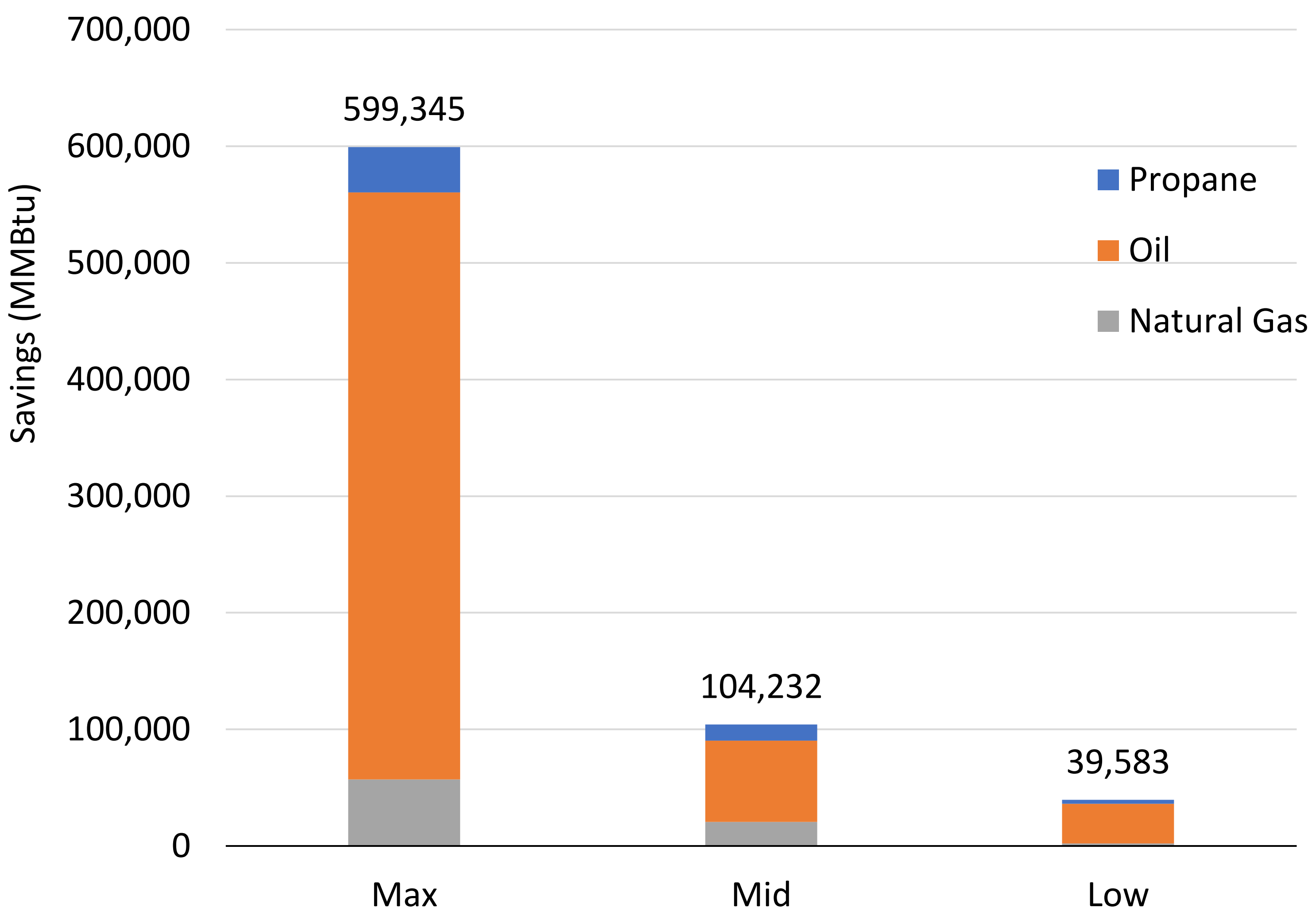
HE: Achievable Scenarios

Three program scenarios are explored in this study:

Low	Applies **25%** incentives and enabling activities (half-step barrier reduction) in line with National Grid's 2020 Energy Efficiency Plan
Mid	Applies **50%** incentives and additional enabling strategies (full-step barrier reduction)
Max	Incentives set at **100%** to completely eliminates customer costs and applies enabling strategies (full-step barrier reduction)

HE: Fuel Savings

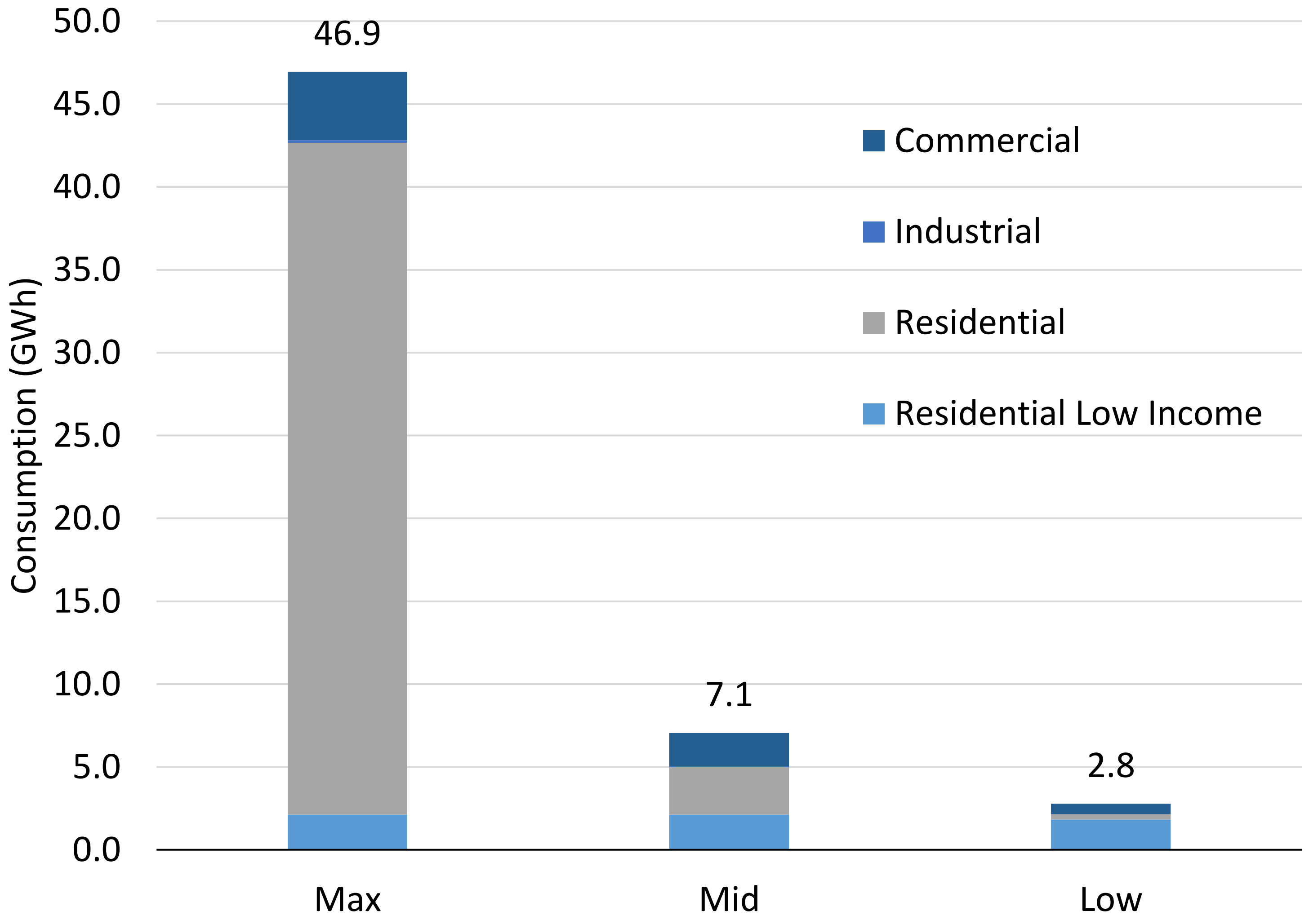
Average Annual Combustible Fuel <u>First-Year Savings</u> (2021-2023)



- There is significant technical potential for heating electrification in Rhode Island – particularly when natural gas is included.
- Propane and oil fuel switching are largely cost-effective, but most natural gas electrification does not pass the RI Test
- Increasing incentives and reducing barriers drives significantly more adoption compared to the Low Scenario (mostly oil savings)

HE: Electricity Consumption

Average Annual Electricity Consumption Increase (2021-2023)



- Heating electrification has the potential to significantly increase electricity consumption
- The majority of potential is in the residential sector
- The commercial sector is constrained by economics (high cost, and limited sizing)
- Space heating dominates fuel-switching savings when compared to hot water savings

HE: Rhode Island Test

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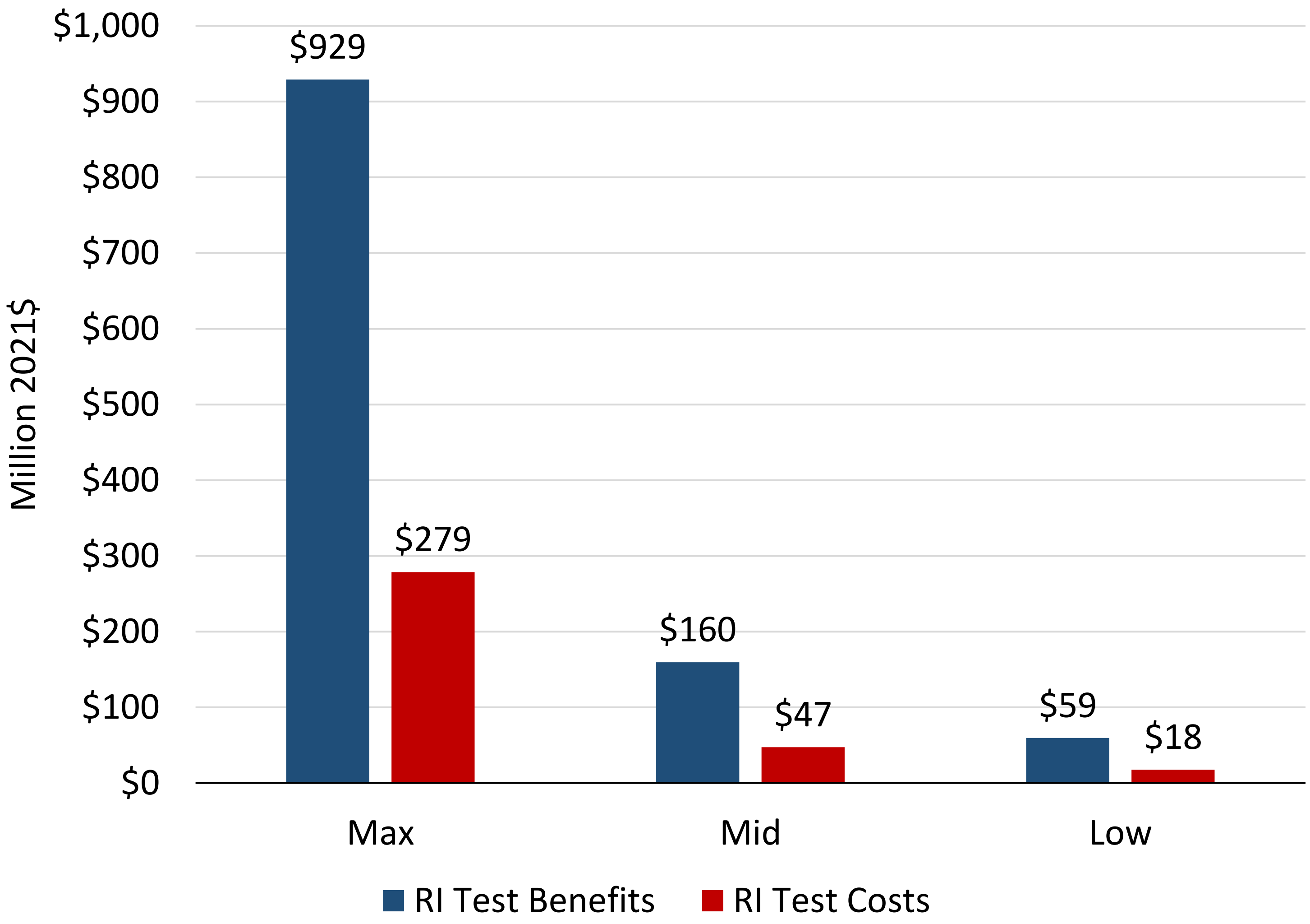
Total Rhode Island Test Benefits and Costs by 2023



- Annual estimated costs range from $6.4M (Low) to $115M (Max) per year
  - National Grid's 2019 HE spending totaled $1.8M
- Lifetime customer net benefits are significant.
  - $35.2M customer lifetime benefits by 2023 under Low Scenario over a third accruing to the residential low income sector.

Scenario	Net Benefits	BCR Ratio
Max	$650M	3.33
Mid	$112M	3.36
Low	$42M	3.36

HE: Key Takeaways

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1. There is significant potential for heating electrification in Rhode Island that can create significant net benefits for the state.

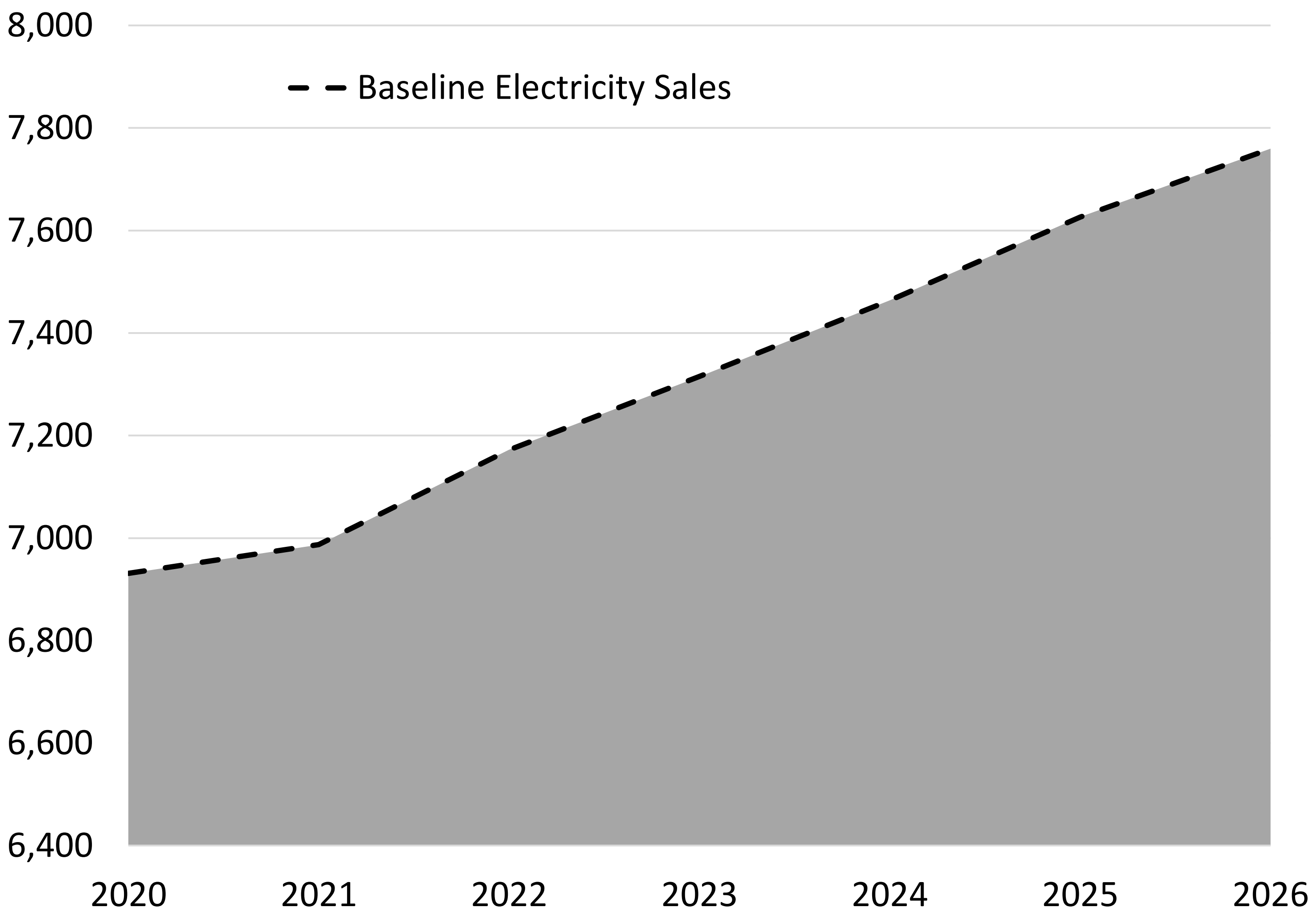
2. Savings come primarily from switching away from oil and propane heating. Most natural gas heating electrification does not pass economic screening.

3. Increasing incentives drives significantly more heating electrification, particularly between the Mid and Max scenarios.

Impacts on Sales

Cumulative Savings: Electricity Sales

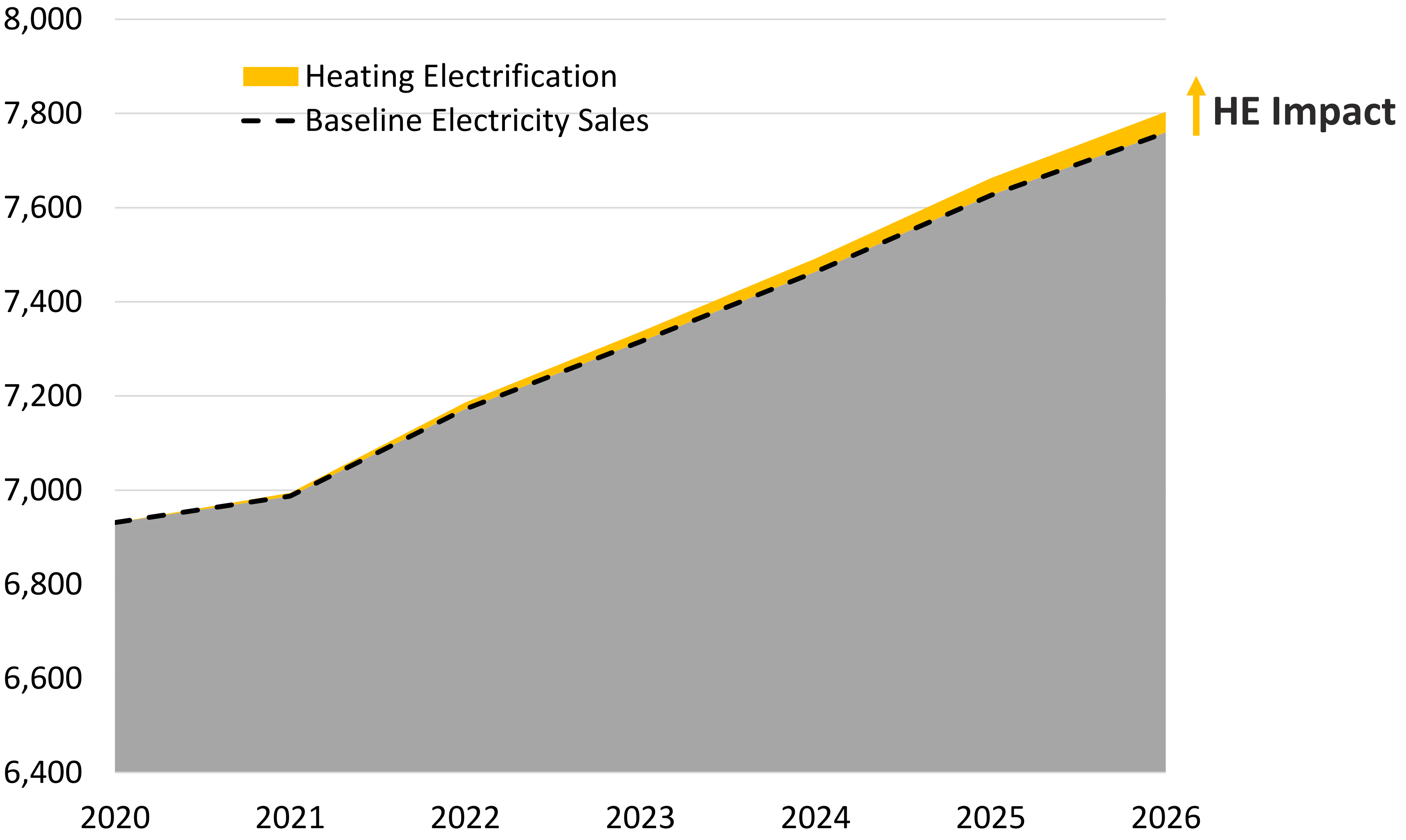
Baseline Electricity Sales (GWh)



- Without additional energy efficiency programming, electricity sales are forecasted to increase by approximately **12%** during the study period

Cumulative Savings : Electricity Sales

Mid Scenario: Electricity Sales + HE (GWh)

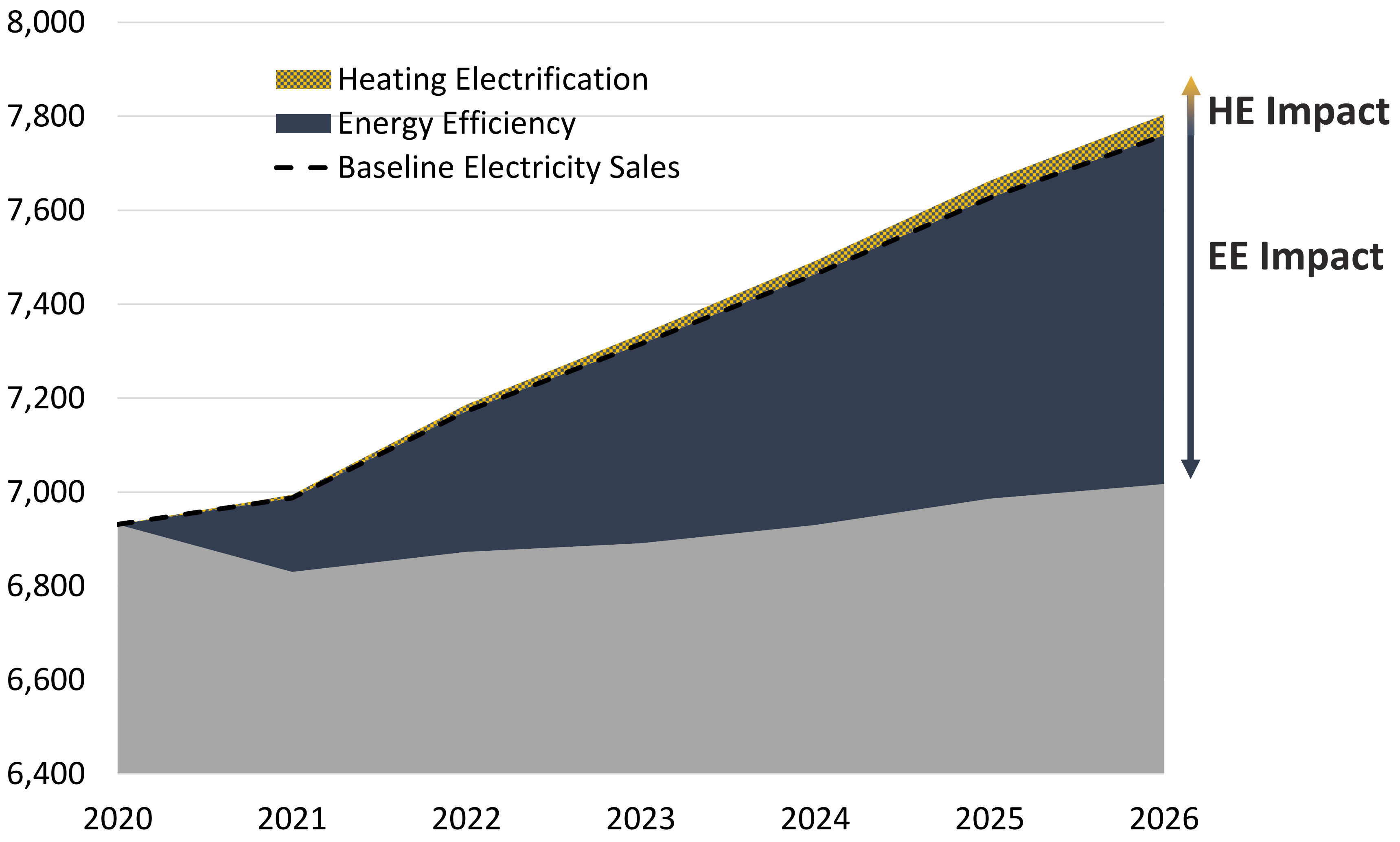


- **Heating electrification** will slightly increase annual consumption (net of reduction for more efficiency air conditioning)

Cumulative Impact on 2026 Baseline	
HE	+0.6%

Cumulative Savings: Electricity Sales

Mid Scenario: Electricity Sales + HE + EE (GWh)

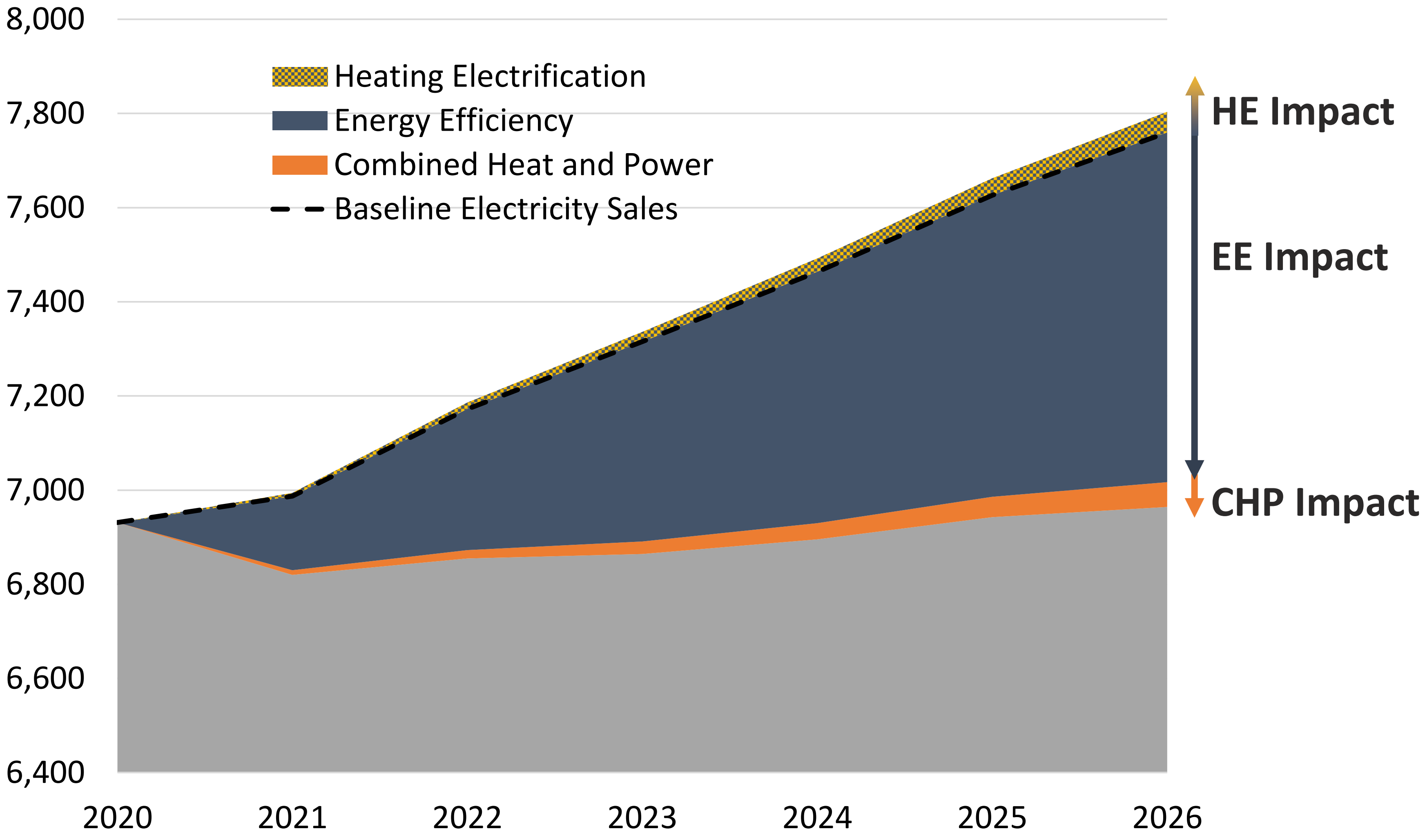


- **Energy efficiency** mitigates heating electrification impact and delivers substantial sales curtailment.

Cumulative Impact on 2026 Baseline	
HE	+0.6%
EE	-10.1%

Cumulative Savings: Electricity Sales

Mid Scenario: Electricity Sales + HE + EE + CHP (GWh)

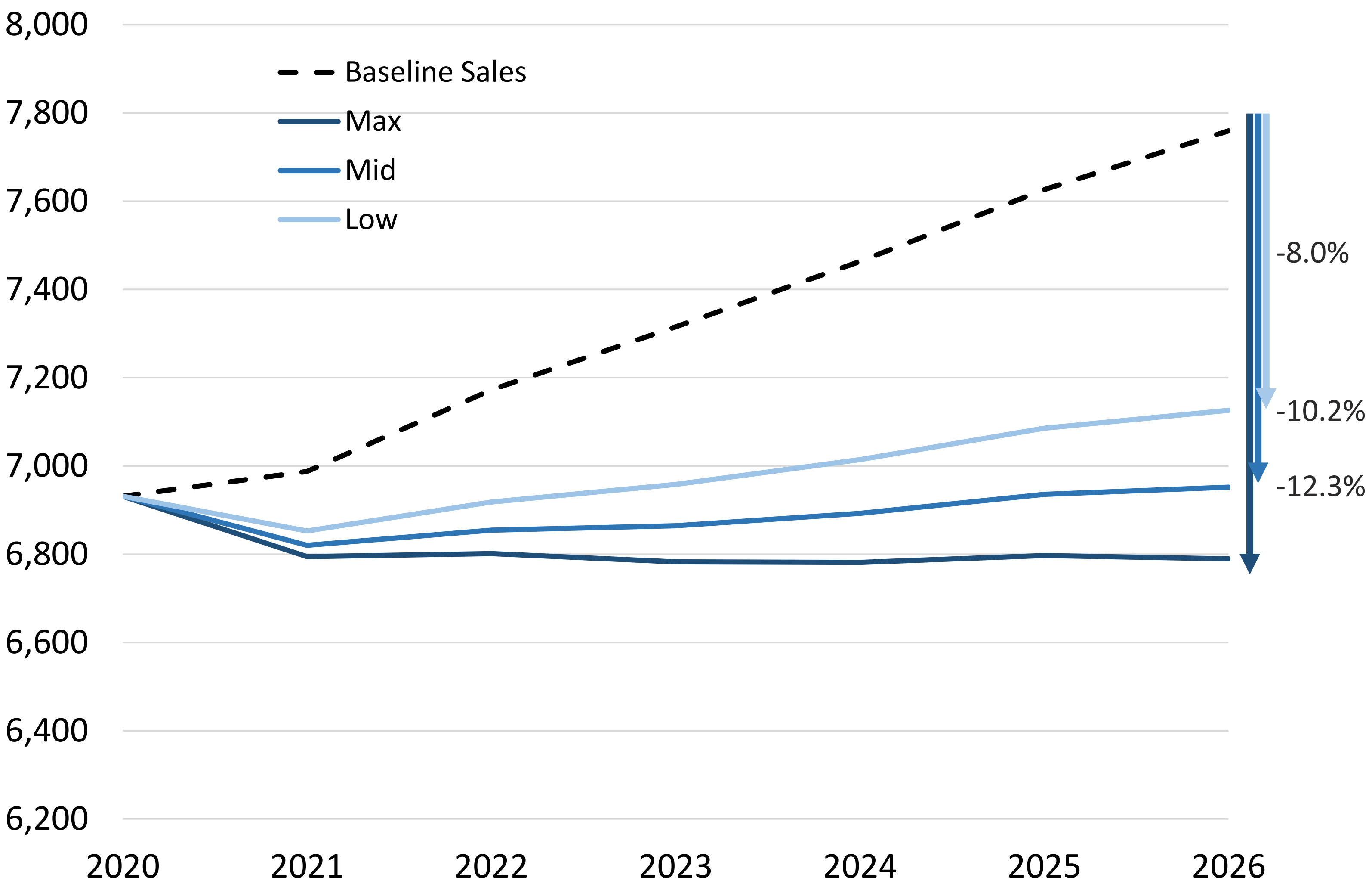


- **Combined heat and power** then further reduced electricity consumption (from the grid)

Cumulative Impact on 2026 Baseline	
HE	+0.6%
EE	-10.1%
CHP	-0.7%

Cumulative Savings: Electricity Sales

Cumulative Impact on Electric Sales (GWh)



- All scenarios are successful in curtailing RI electric consumption growth
- Max scenario leads to a slight reduction in overall consumption
- Solar PV (DG) when added will further reduce overall electricity consumption

Cumulative Savings : Electric Demand

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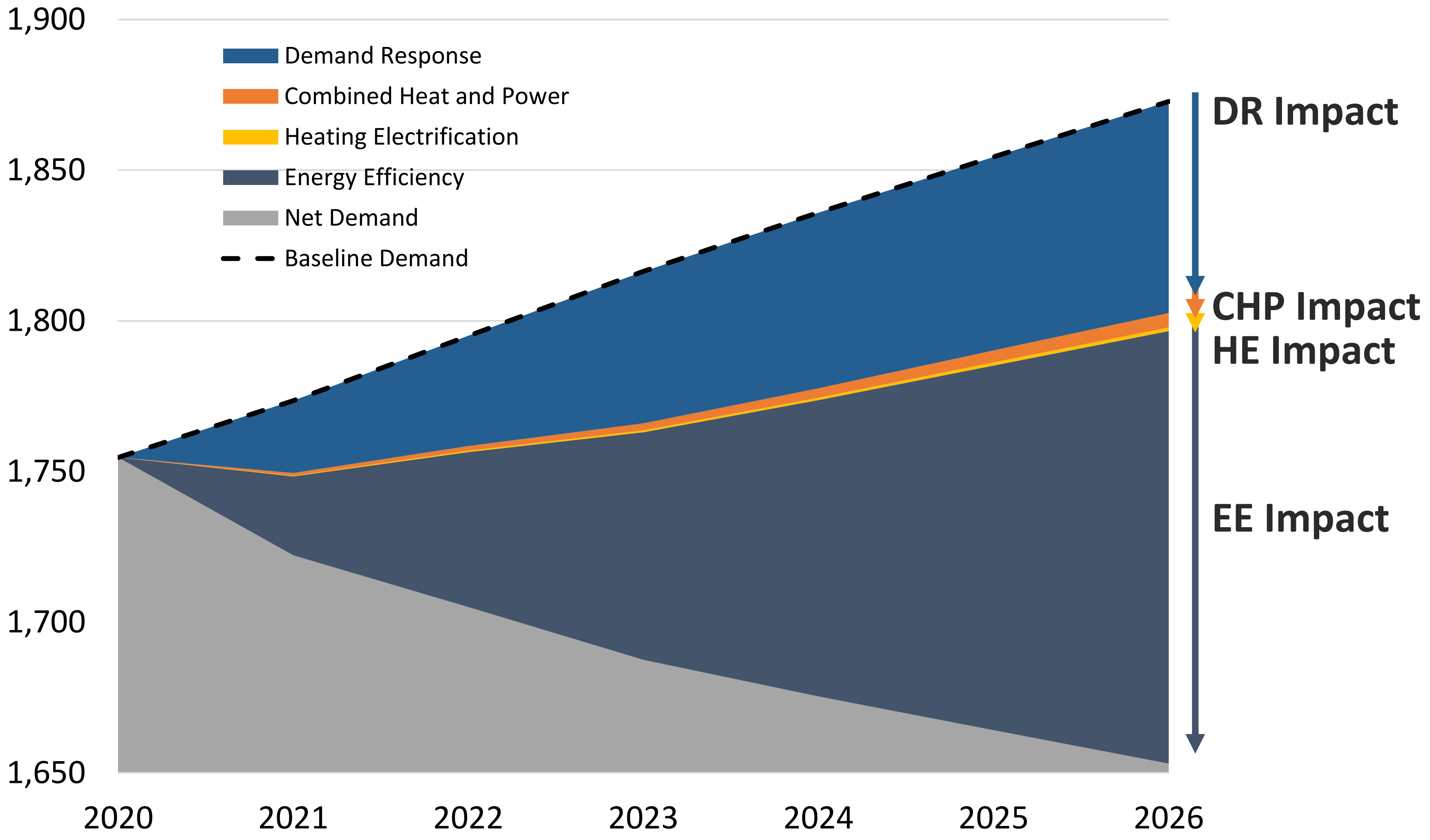
Mid Scenario: Electric Demand (MW)

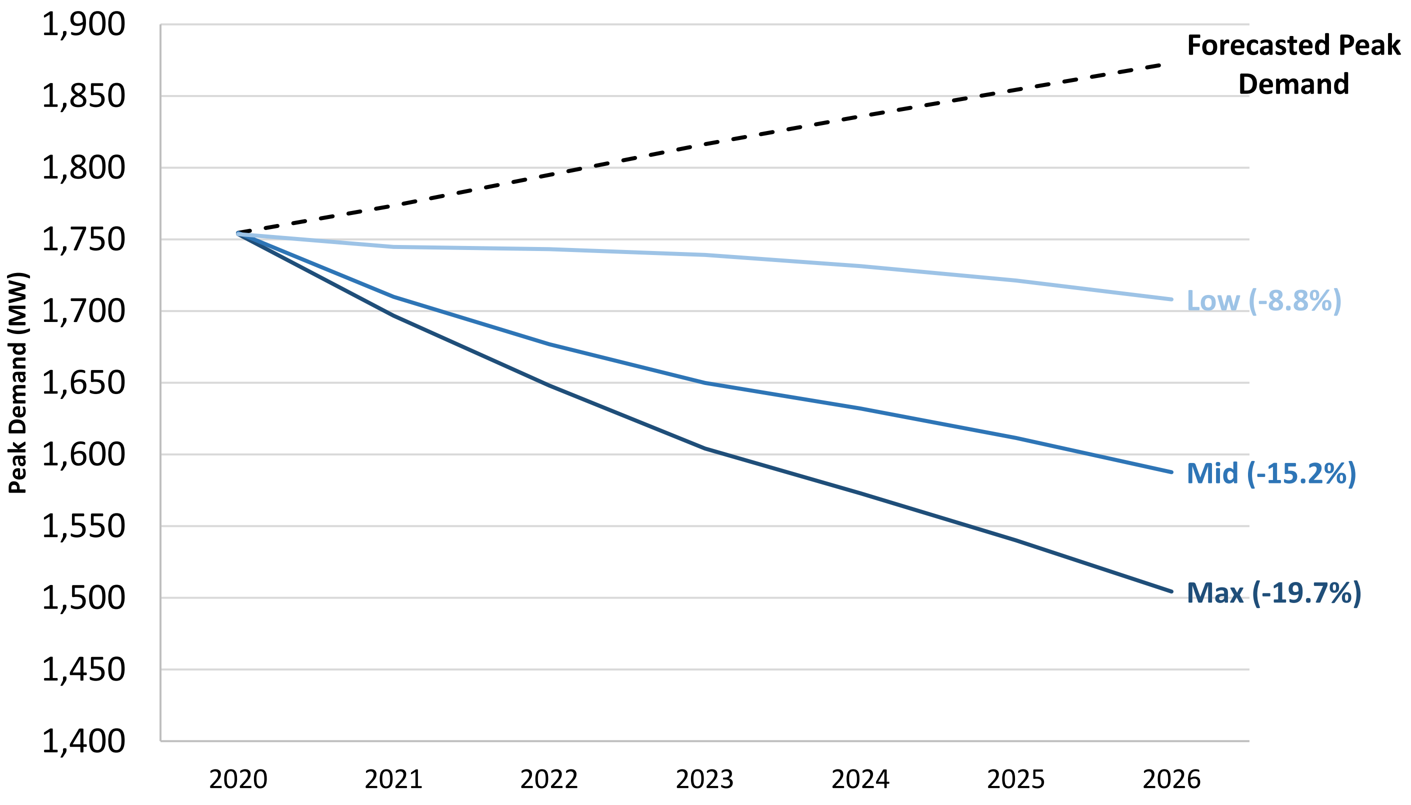


- Efficiency offers the greatest peak load reduction
- DR programs offer second-most, if expanded significantly (new measures, higher incentives)

Cumulative Impact on 2026 Baseline	
DR	-3.7%
CHP	-0.3%
HE	-0.1%
EE	-7.8%

Cumulative Savings : Electric Demand

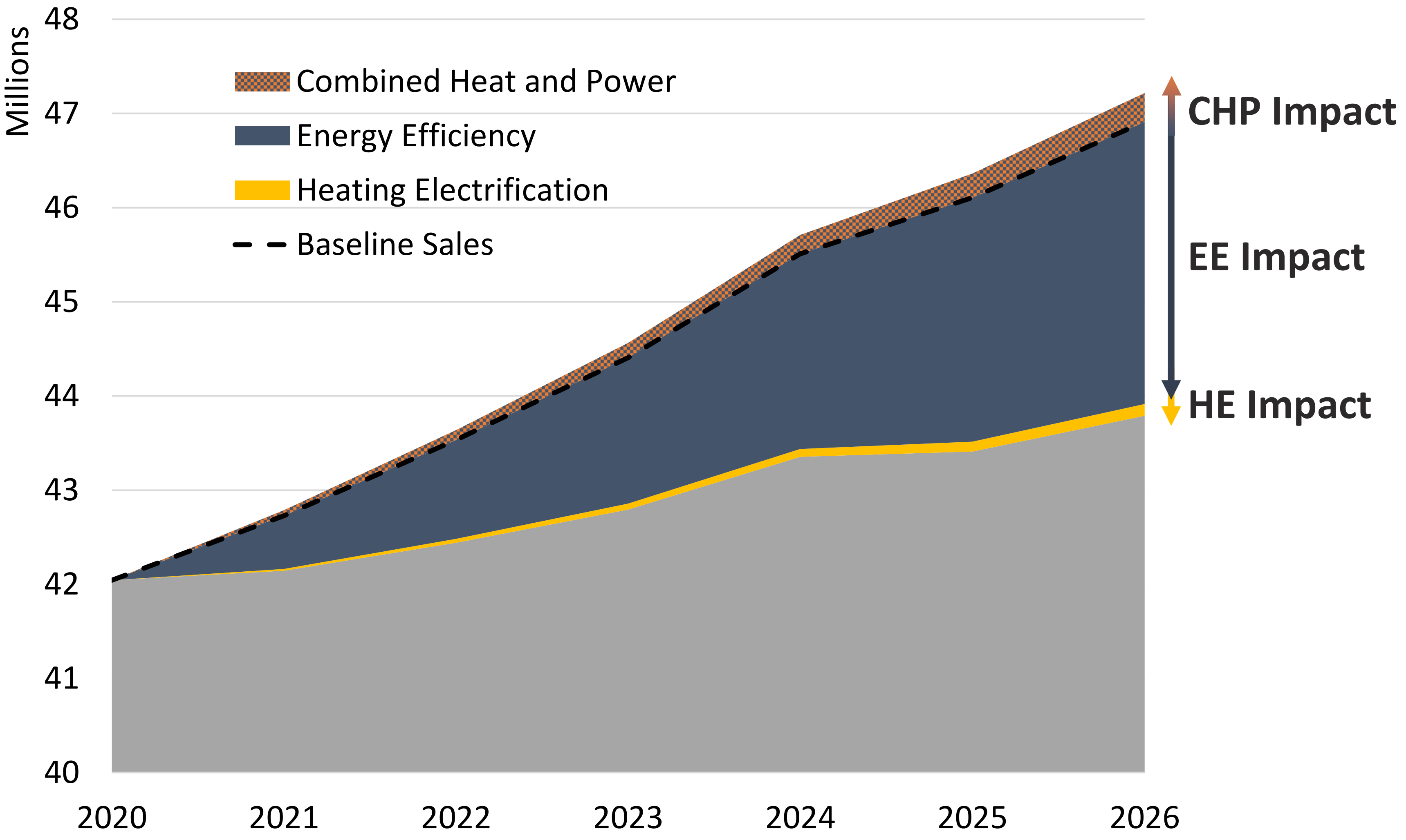
Cumulative Impact on Peak Demand (MW)



- Low Scenario nearly avoids any growth in peak demand over the study period
- Increase in DR is most significant jump in peak load reduction between Low to Mid scenarios
- Solar PV (DG) will further reduce peak load when added.

Cumulative Savings : Natural Gas Sales

Mid Scenario Natural Gas Sales + CHP + EE + HE (MMBtu)

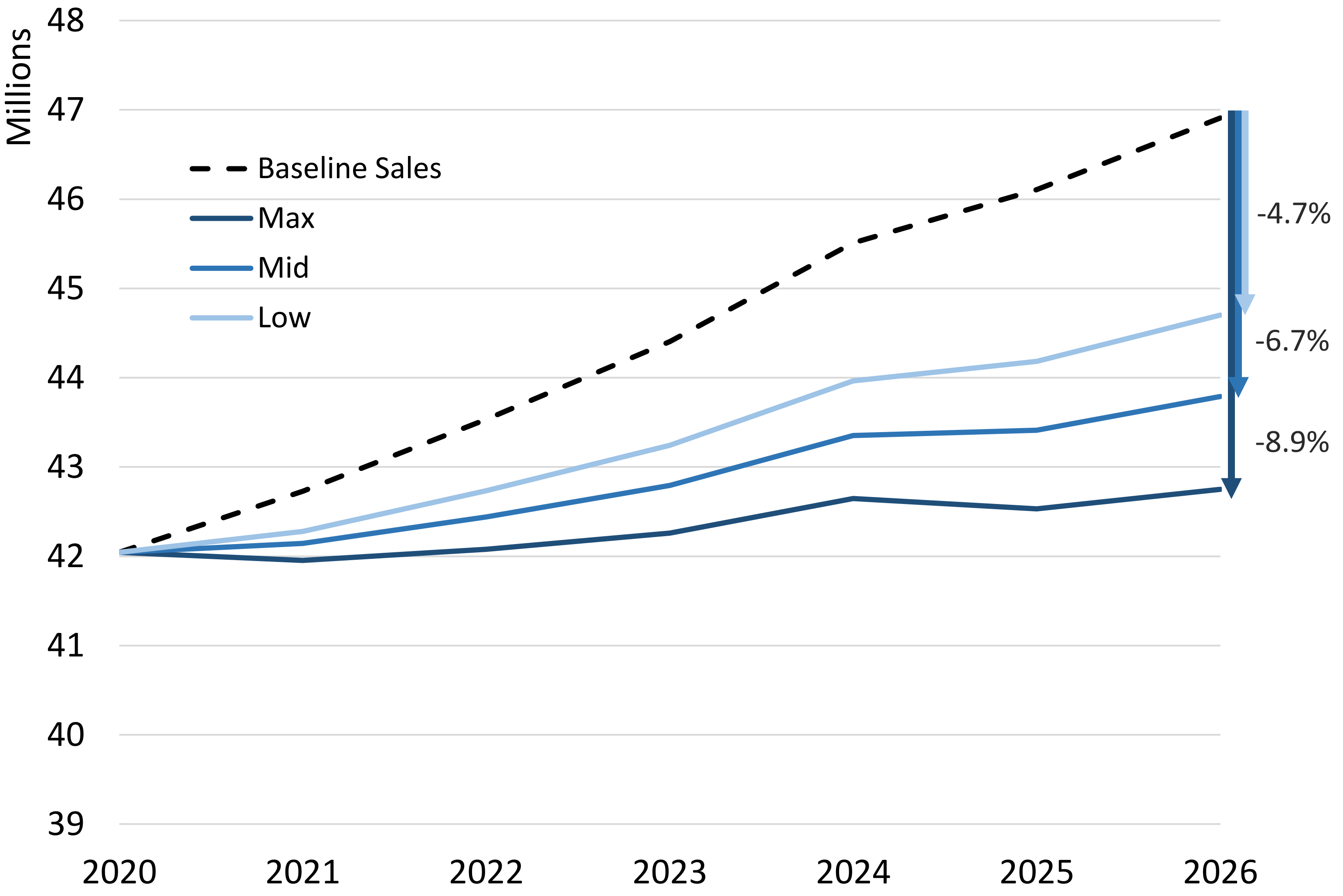


- CHP will increase on-site consumption of natural gas
- EE offers greatest opportunity to reduce natural gas sales

Cumulative Impact on 2026 Baseline	
CHP	+0.7%
EE	-7.0%
HE	-0.3%

Cumulative Savings : Natural Gas Sales

Cumulative Impact on Natural Gas Sales (MMBtu)

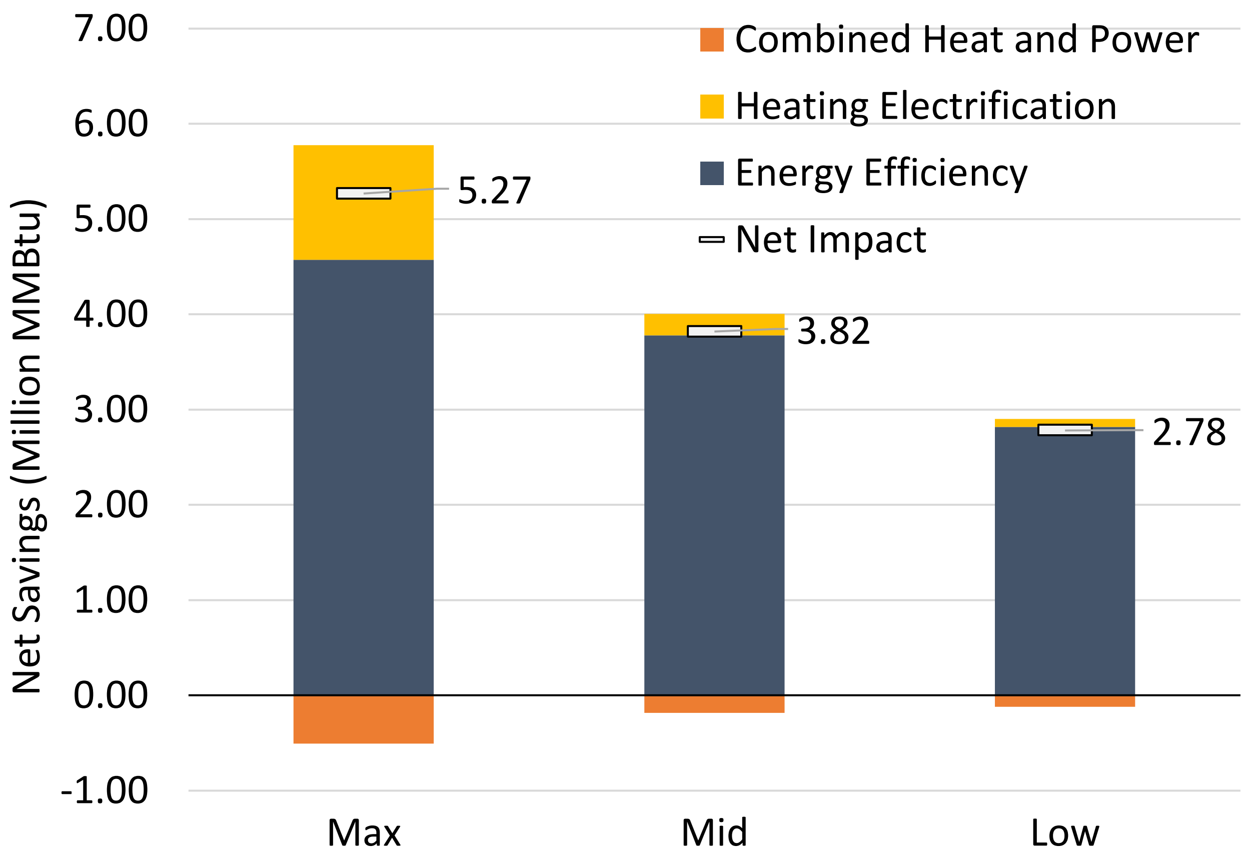


- Under all scenarios, an increase in gas consumption is projected to increase over the study period
- Max scenario comes near to keeping gas consumption flat over study period

Conclusions

Cumulative Savings: Overall Energy Impacts

Total Net Customer Energy Savings by 2023



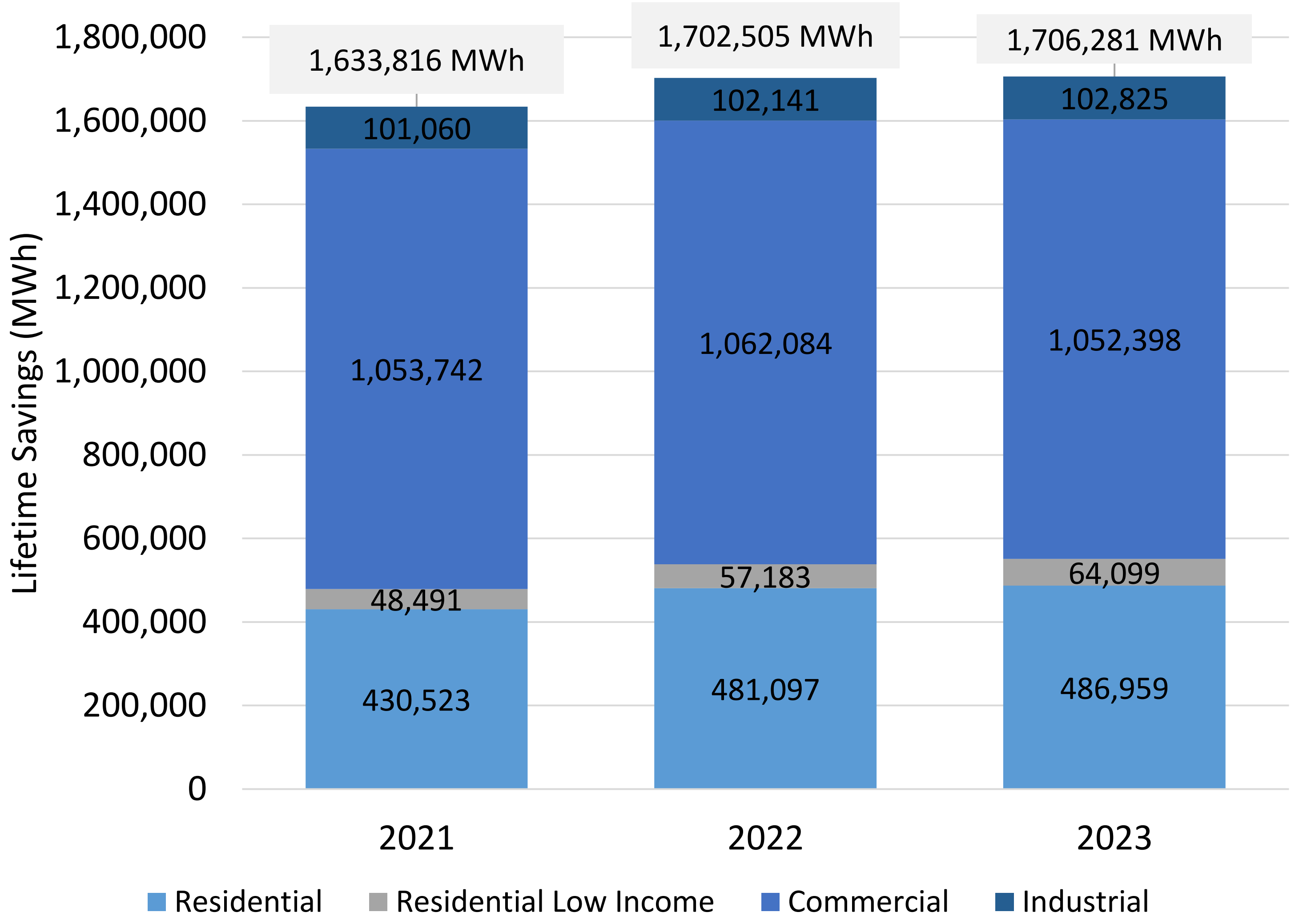
- Efficiency continues to have the largest overall impact
  - Electric savings lower than in past, but still substantial
  - Gas savings growing in importance
- CHP contributes to a slight increase in total site energy use
- HE could have notable impact, with further investments
- DR (not shown) shows room to grow with increased budgets
- Overall, the results show great potential for GHG reductions via all savings streams. In the future, GHGs may provide a useful basis for combined target setting.

Note: This graph does not consider savings at the generator, which would show CHP as a net positive energy savings.

Appendix

EE: Electric Savings Potential

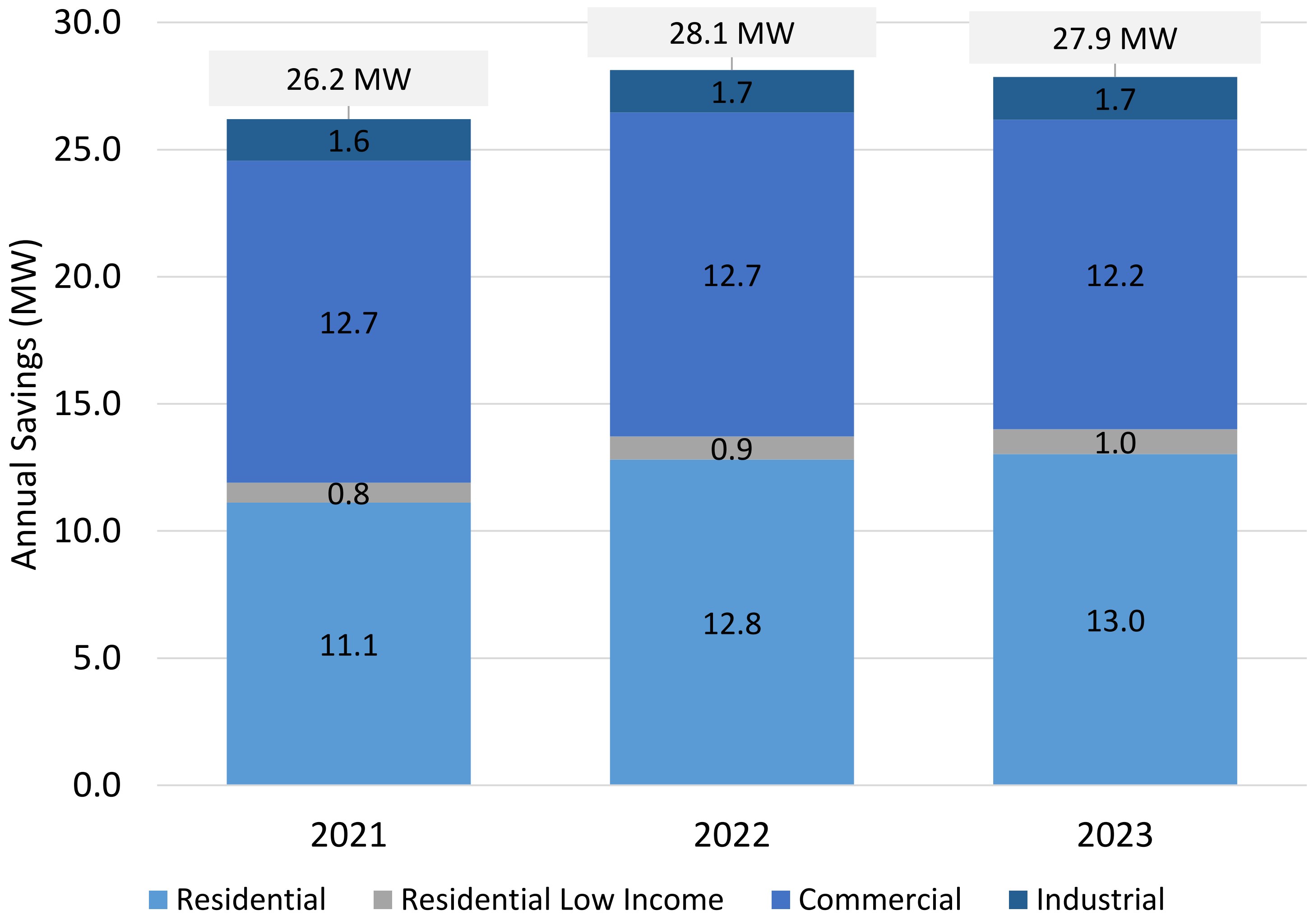
Lifetime Electric Savings by Sector (Mid)



- Bulk of electric savings come from residential and commercial sectors
  - Within residential sector, savings are driven by the single family segment
  - Within commercial sector, savings are driven by office, retail, and education/campus segments.

EE: Electric Savings Potential

Annual Passive Peak Demand Reduction by Sector (Mid)



- Similar to energy savings, bulk of passive demand savings come from residential and commercial sectors

EE: Natural Gas Savings Potential

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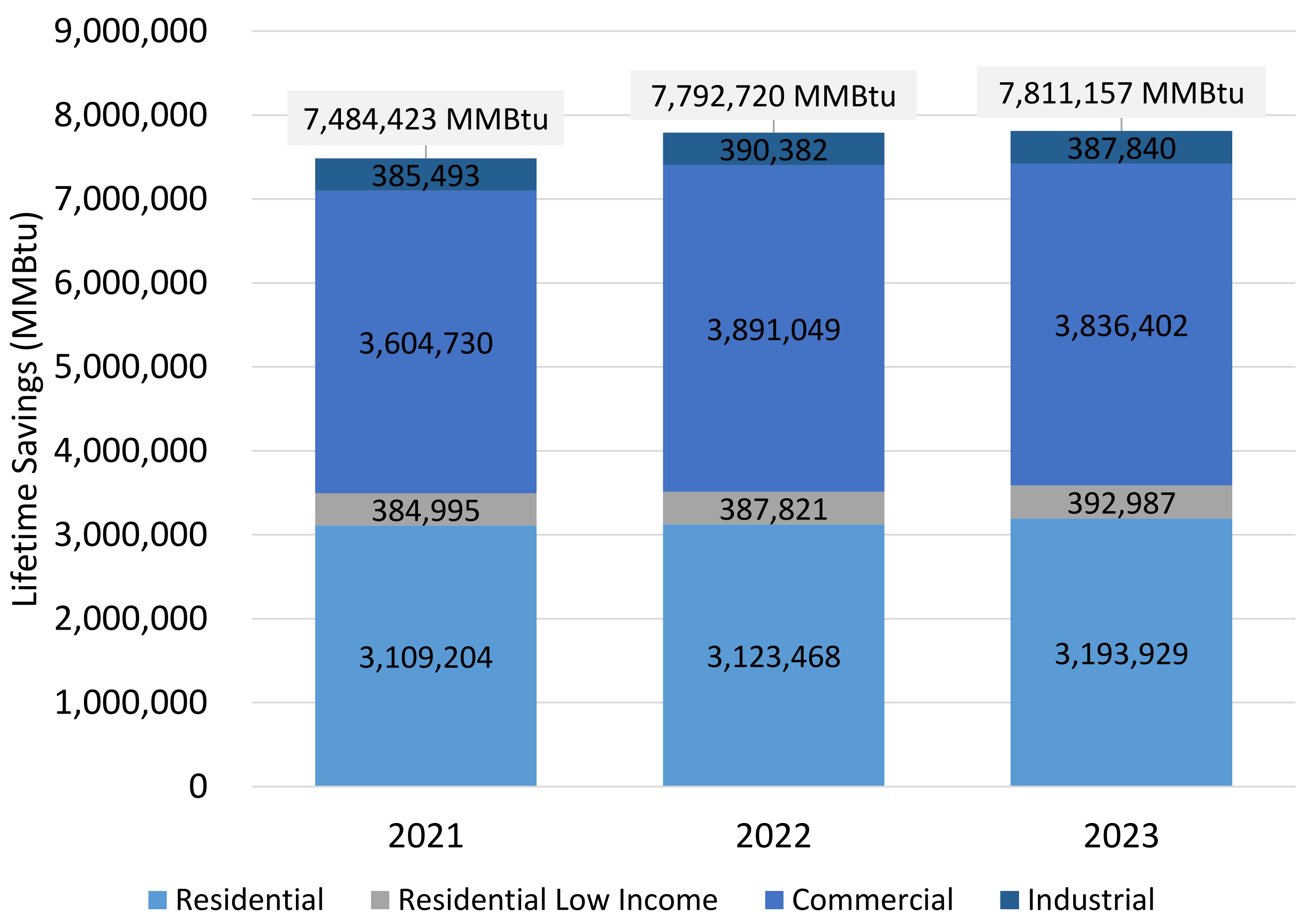
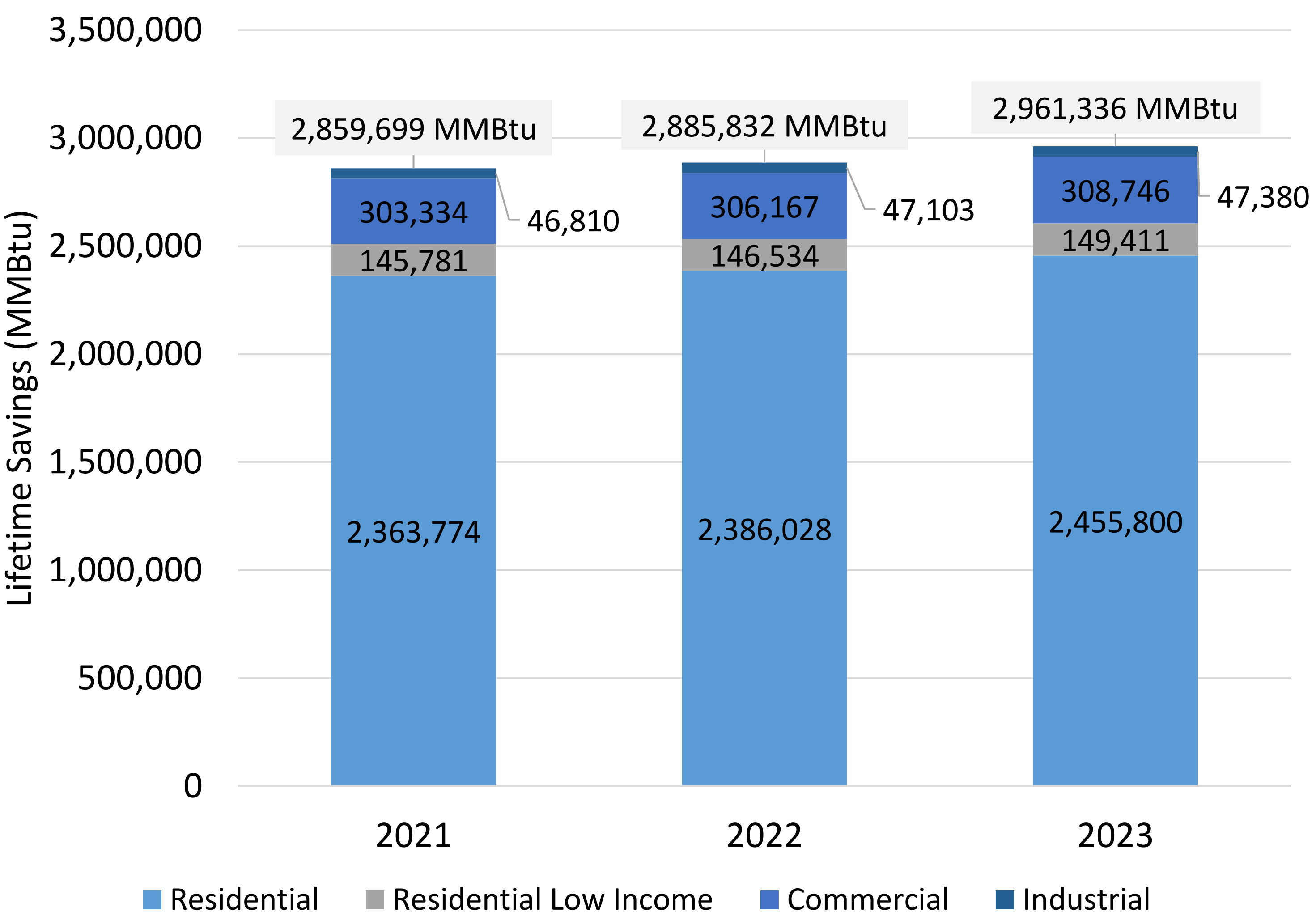
Lifetime Gas Savings by Sector (Mid)



- Commercial sector is the slight majority of EE gas savings under mid scenario
    - Residential sector savings driven by single family segment.
    - Commercial sector savings driven office, retail, education/campus and lodging segments.
- Residential sector shows significant upside between Low and Mid scenarios – increasing by nearly 50%

EE: Delivered Fuel Savings Potential

Lifetime Delivered Fuel Savings by Sector (Mid)



- The bulk of delivered fuel savings come from the single-family residential customers
- Oil measures account for approximately 94% of delivered fuel savings

EE: Electric Savings Potential

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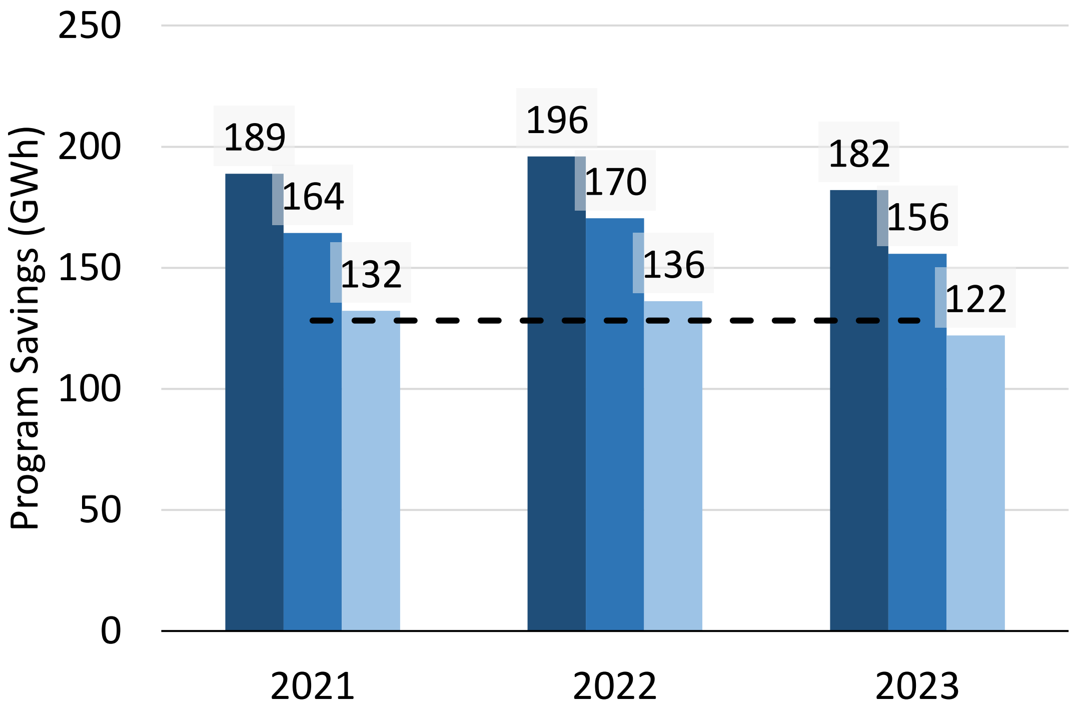
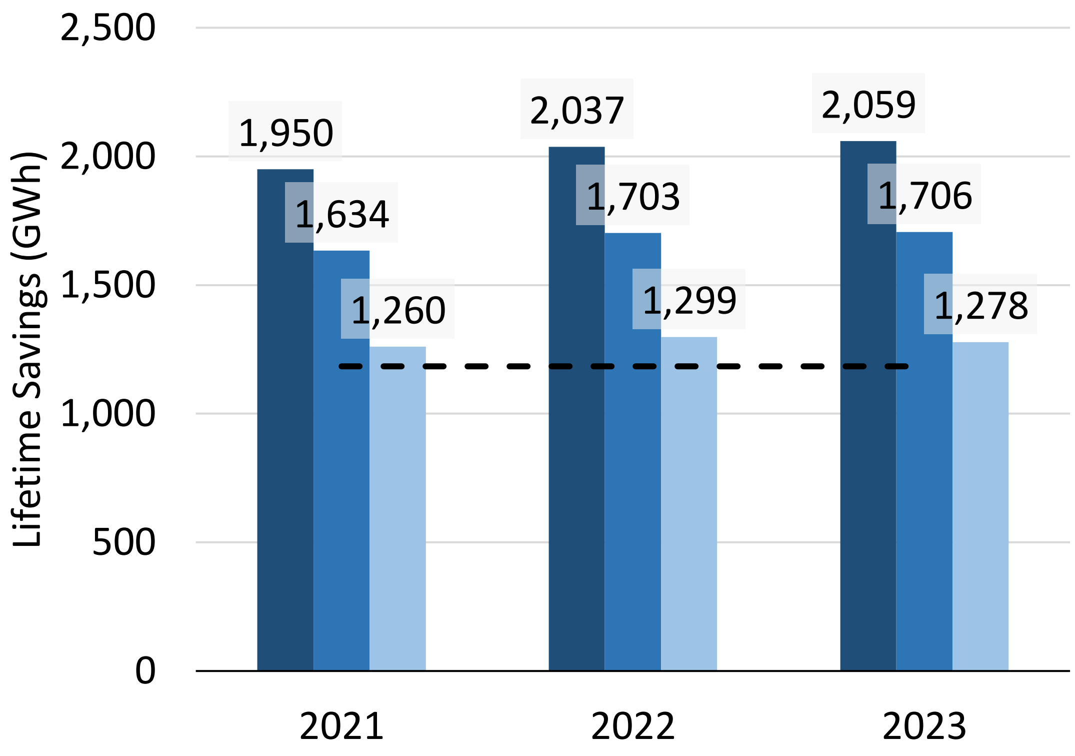
Annual Electric Program Savings



Note: 2020 Plan Benchmark savings do not include A-Lamp savings.

Lifetime Electric Program Savings



Max Mid Low Benchmark: 2020 Plan

Annual Savings: The amount of energy savings achieved in the first-year of the measure's installation.
Lifetime Savings: The amount of energy savings achieved over the entire measure's lifetime.

EE: Gas Savings Potential

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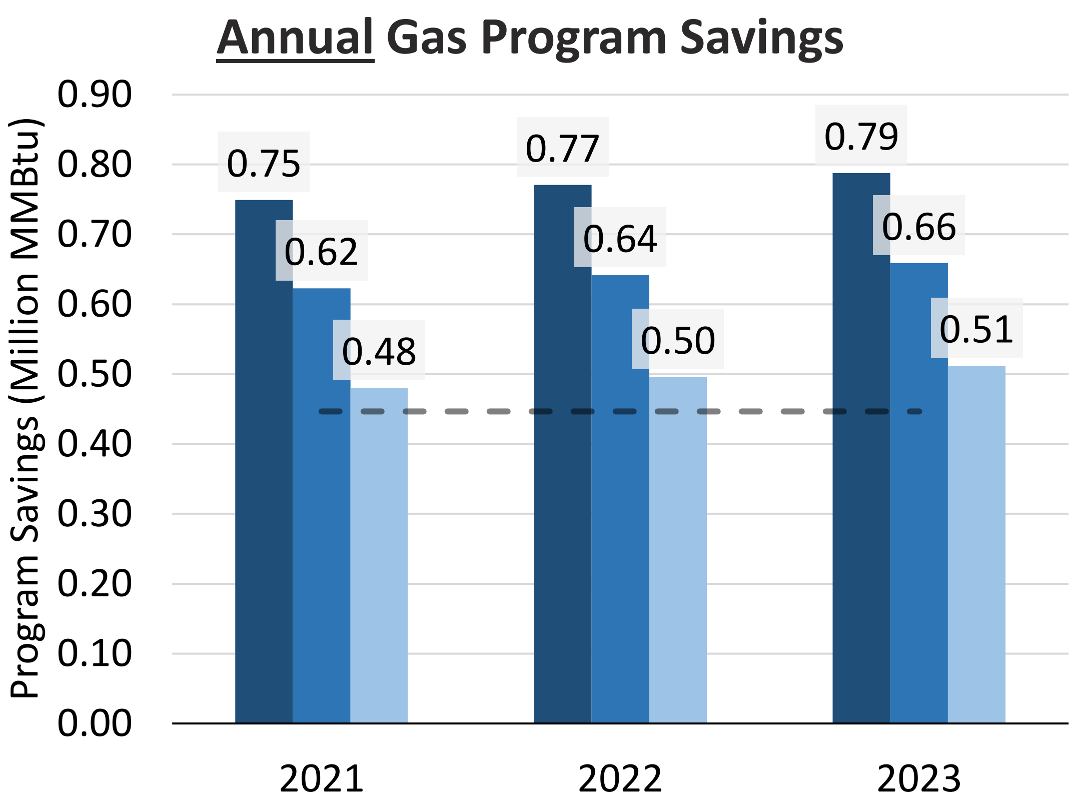
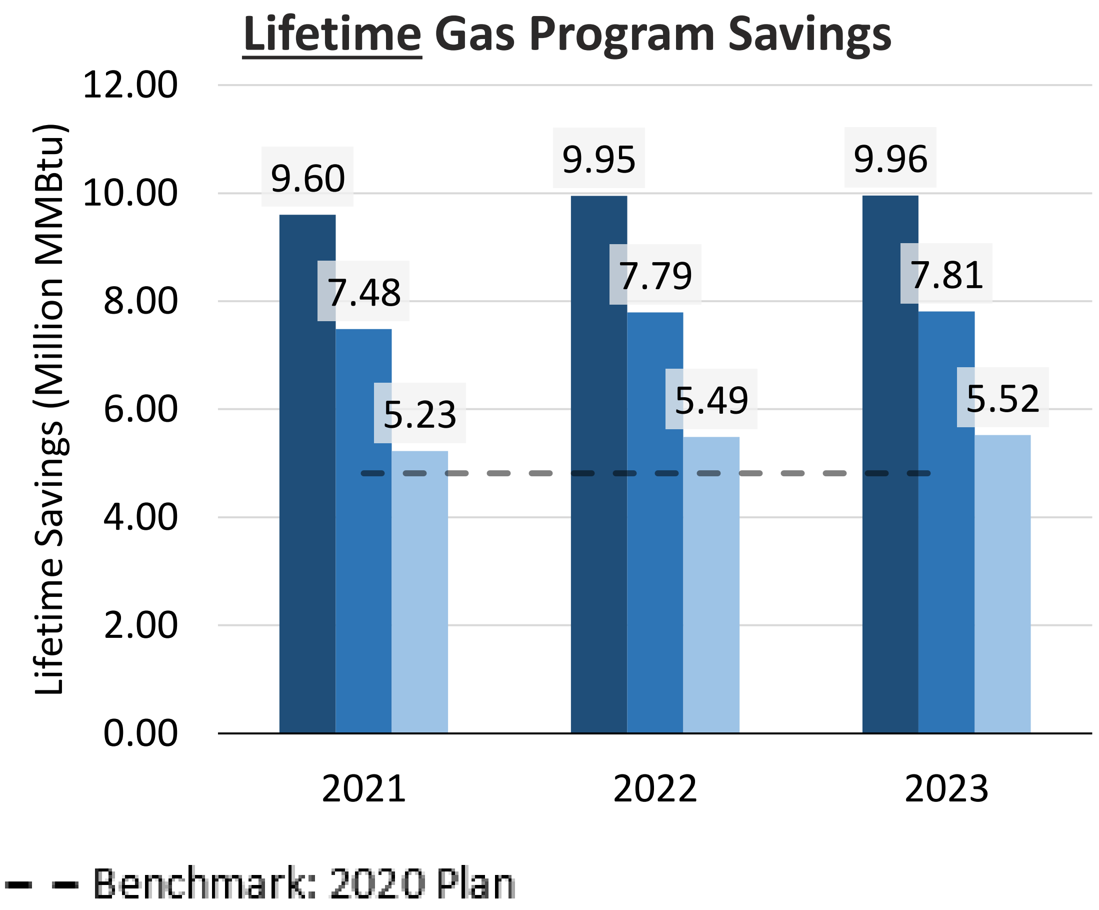


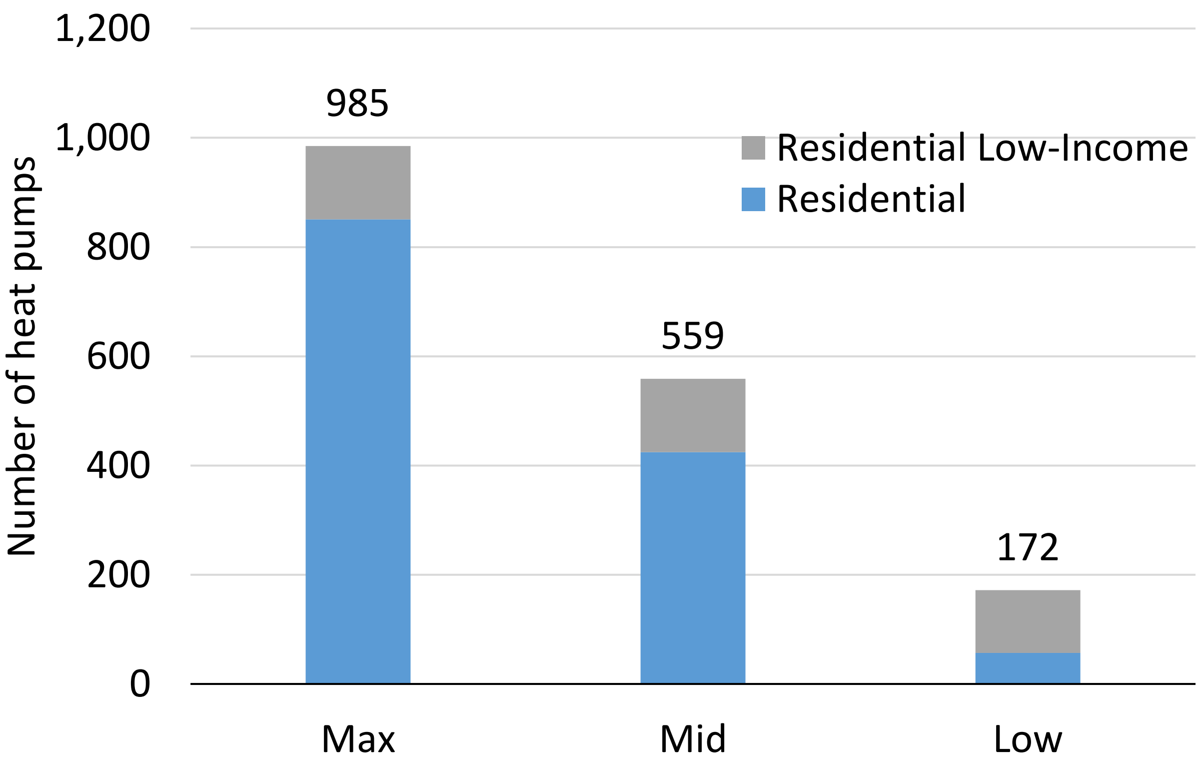


Annual Savings: The amount of energy savings achieved in the first-year of the measure's installation.
Lifetime Savings: The amount of energy savings achieved over the entire measure's lifetime.

EE: Electric Savings Potential, Residential

Measure Example: Ductless Mini-split Heat Pumps (DMSHP) for Electric Resistance Heating

Average Number of DMSHP adopted by residential customers per year (2021-2023)



- Under the Mid Scenario, over 2,000 customers adopt mini-split heat pumps to displace electric resistance heating – including 450 Low Income customers – by 2023.
- Benchmarks:
  - 2019 results: 181 heat pumps
  - 2020 plan: 325 heat pumps

Average Annual GWh Savings (2021-2023)

	Max	Mid	Low
Residential	5.4	3.6	1.1
Residential Low-Income	0.9	0.9	0.7
Total	**6.2**	**4.5**	**1.8**

All Saving Streams: Estimated Combined Costs

Estimated Combined Costs (EE, CHP, and DR only)

Note: 2019 Benchmark does not include Heating Electrification or A-Lamp spending.