EE, DR, and DER Potential Study – Draft Results

Entergy Louisiana, LLC. (ELL)

Technical Conference

01/27/2022

Agenda

- Introduction
- Study Overview
- Energy Efficiency Achievable Potential Draft Forecast
- Demand Response Achievable Potential Draft Forecast
- Distributed Energy Resources Achievable Potential Draft Forecast
- Q&A
- Appendix

Introduction

ICF Presentation Team

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ICF Energy Overview

- Recognized energy experts since 1969
- Support all major Federal Government agencies on energy issues
  - DOE, EPA, FERC, DOI, DHS, DOS, USAID, DOD, DOT
- Support all major energy NGOs
  - EEI, API, INGAA, AGA, NEI, NRDC, EDF
- Worked with almost every major energy company in North America, and many overseas
  - 70+ top utility companies in North America
  - Implement 150+ Energy Efficiency Programs
- Approximately 1,100 energy professionals across North America, U.K., India, China, and Ghana

Sectors

- Power and Transmission
- Oil and Gas
- Renewables
- Integrated DER
- Energy Efficiency/DSM
- Electrification
- Climate Change

Study Overview

Study Overview

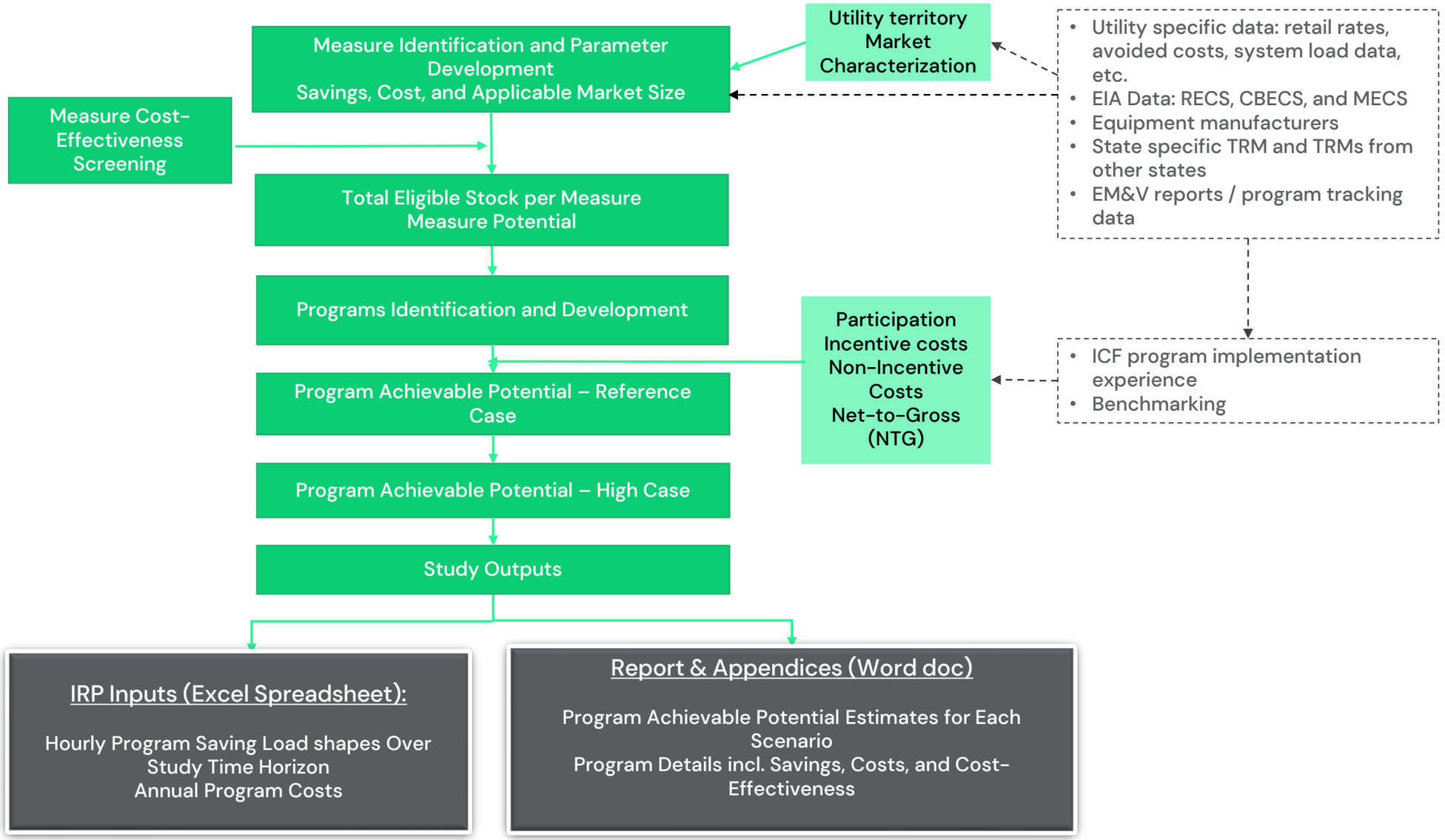
- Objective: Support 2023 ELL's IRP

- Demand side resources covered:
  - Energy Efficiency (EE)
  - Demand Response (DR)
  - Distributed Energy Resources (DER)
    - BTM Solar
    - BTM Storage

- Forecast time horizon: 20 years
  - (2023 - 2042)

- ELL service territory including legacy ELL and EGSL

Bottom-up Market Potential Analysis Modeling Approach



Energy Efficiency Achievable Potential Draft Forecast

Energy Efficiency Potential Scenarios Modeled

Our approach to achievable potential modeling is an evidence-based, data driven approch, which is based on a detailed benchmarking of actual EE program performance.

Two scenarios modelled:

- Reference Case – Current ELL programs were modelled largely based on current program designs and current level of performance, but with additional measures.
- High Case (Expanded Programs) – Includes new programs that ELL does not currently offer and expanded existing ELL programs. Expansion of existing programs is assumed based on benchmarking of comparable programs in South.

Programs Modeled

Current Programs

- Residential
  - A/C Solutions
  - Home Performance with Energy Star
  - Income-Qualified Weatherization
  - Multifamily Solutions
  - Manufacture Homes
  - Retail Lighting & Appliances
  - School Kits and Education
- Commercial & Industrial
  - Large C&I Solutions
  - Small Commercial Solutions

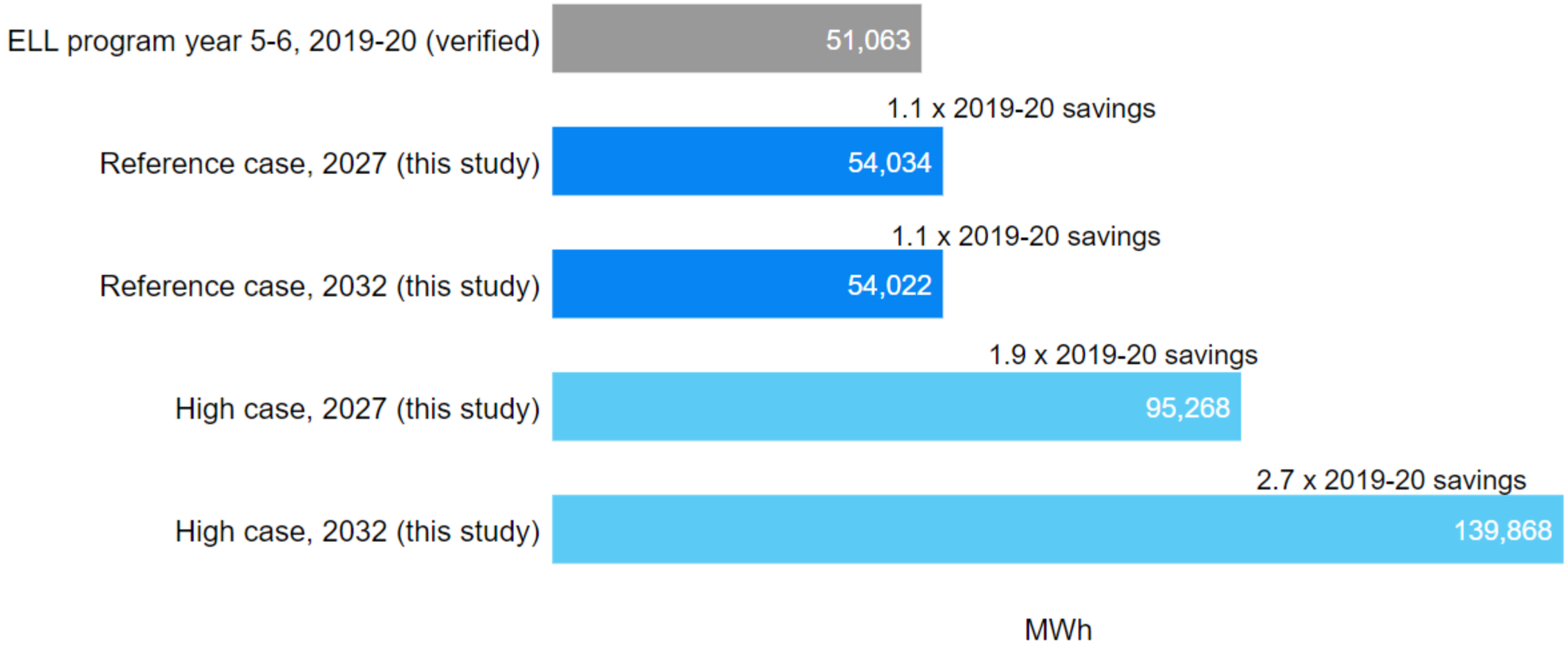
New Programs

- Residential
  - Appliances Recycling
  - Behavioural / Home Energy Report
  - Midstream HVAC
  - Prepay
- Commercial & Industrial
  - Agricultural Pilot*
  - Industrial SEM
  - Midstream Lighting
  - Retro-commissioning
  - Small Business Direct Install

*was not offered in the reference year for the study (2019) but has since been added

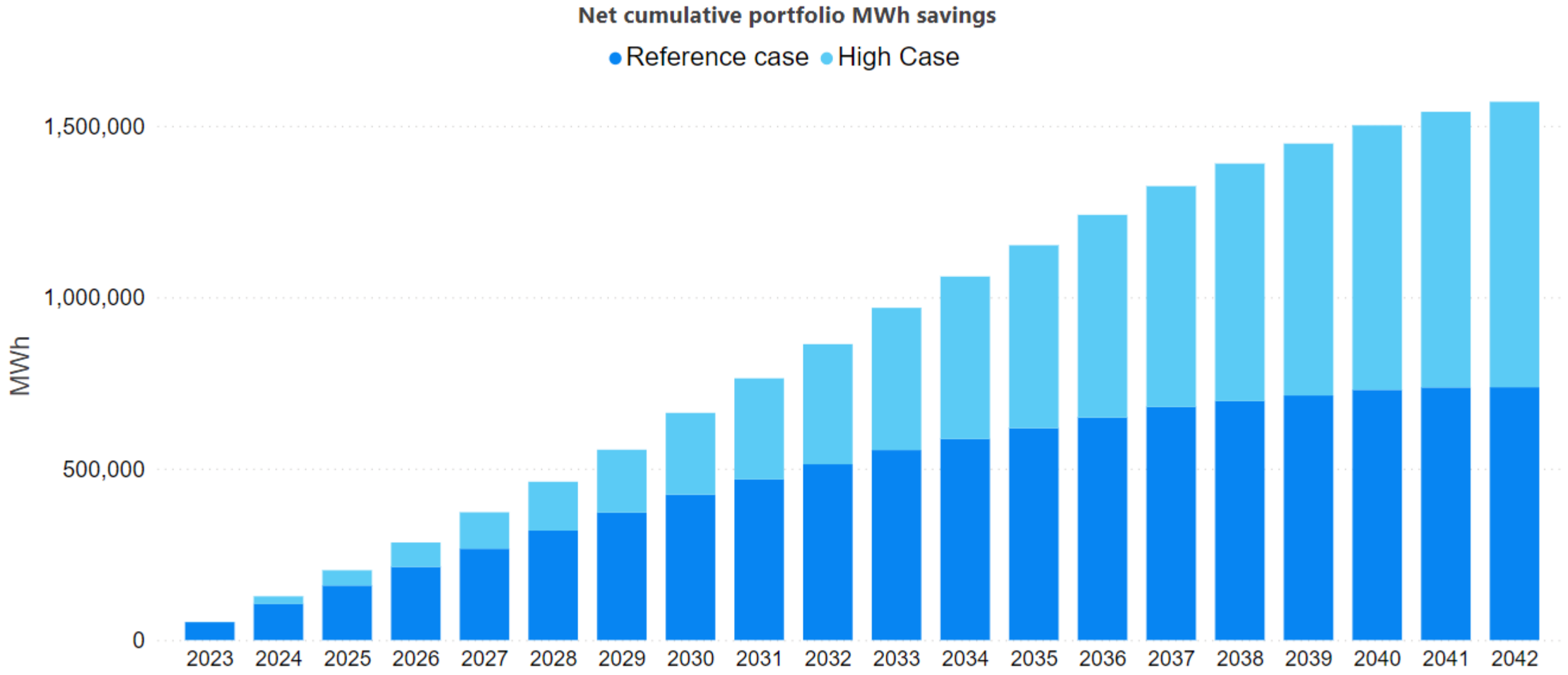
Annual portfolio savings could be more than double by 2032

Average incremental (annual) verified MWh savings in ELL Program Year 5 & 6 compared to forecasts for this study in 2027 and 2032



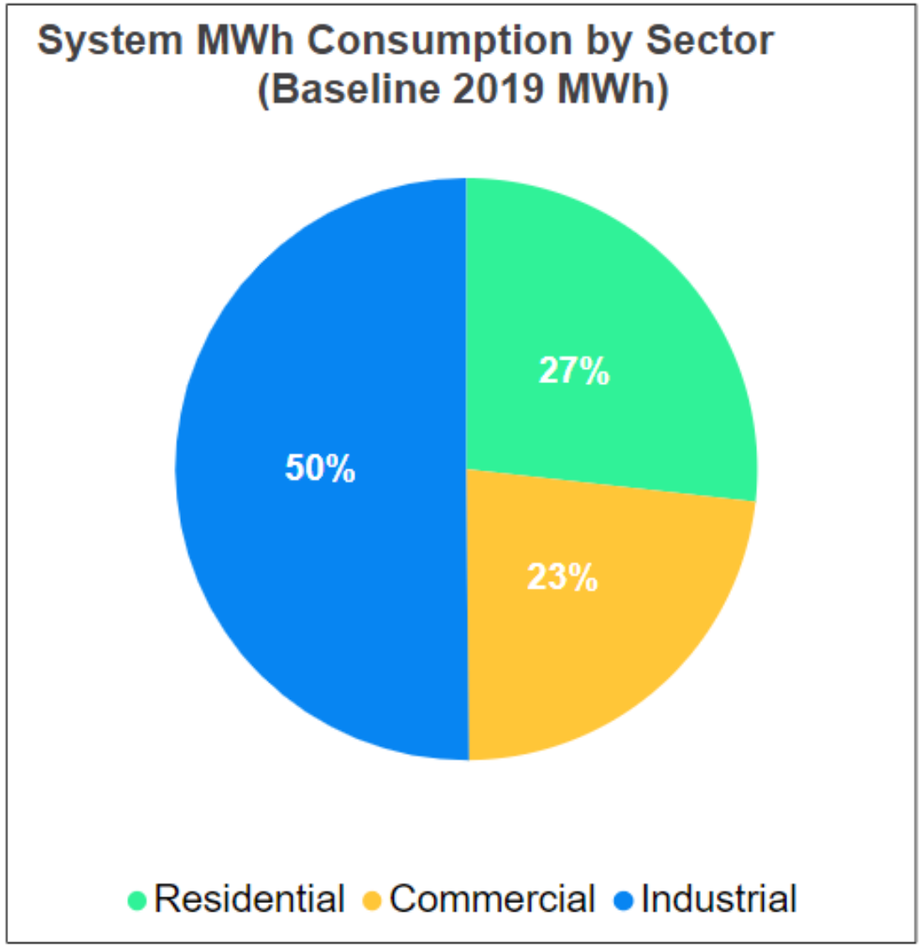
Cumulative MWh Savings over 20 years

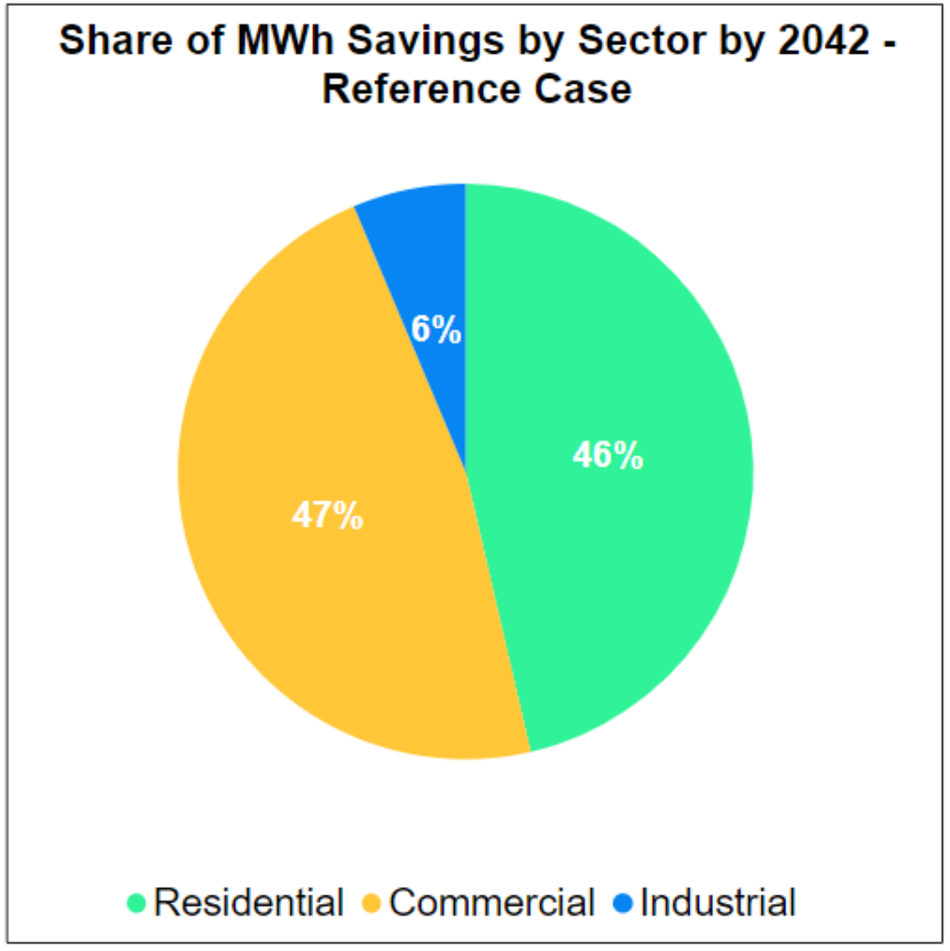
Total portfolio (cumulative) savings could grow from ~49 GWh in 2023 to nearly 1500 GWh by 2042



* % savings are based on 2019 MWh consumptions

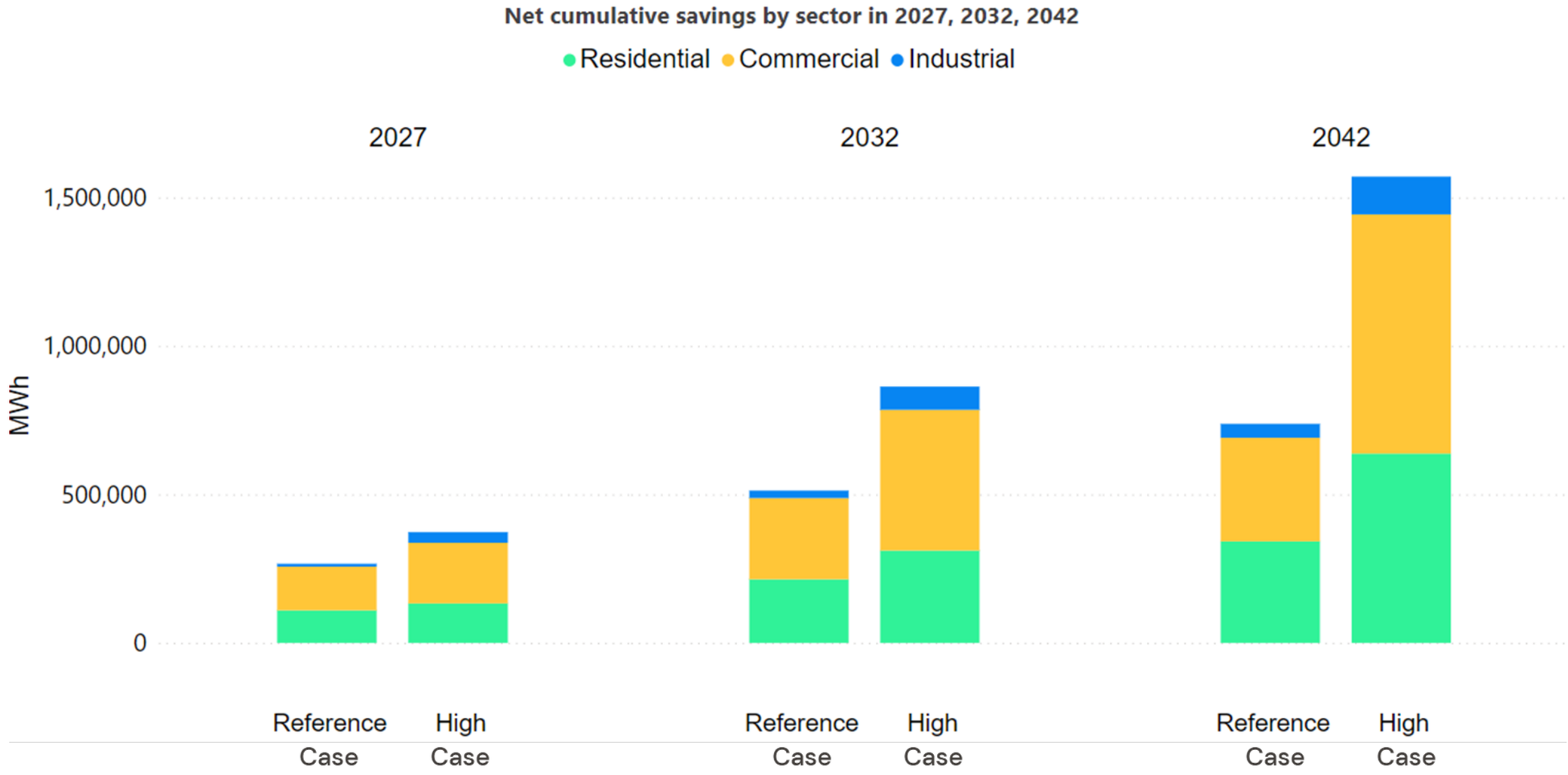
Share of MWh Savings by 2042





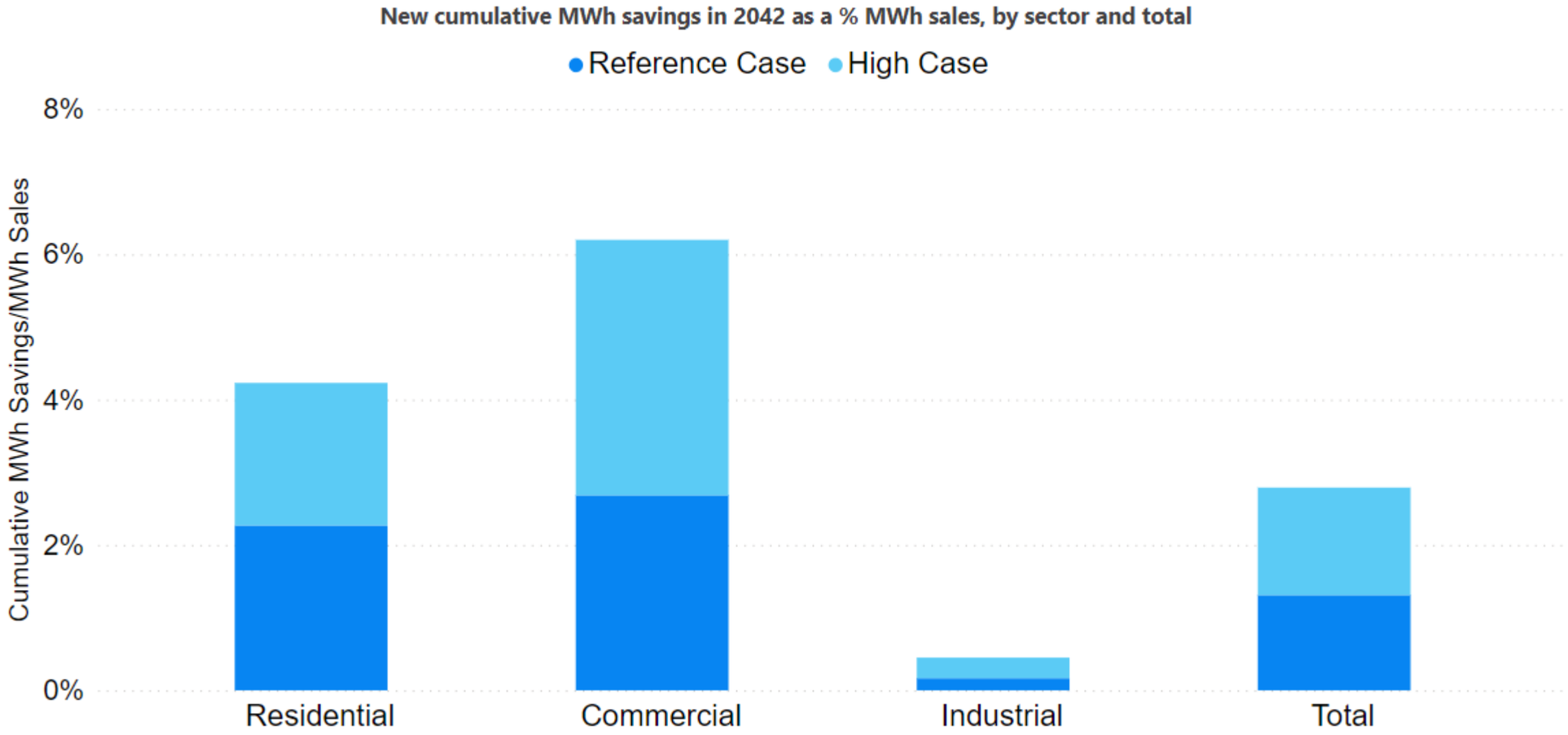
Cumulative Savings by Sector

In the Expanded scenario residential and commercial sector level savings are about equal and together comprise 90% of total savings



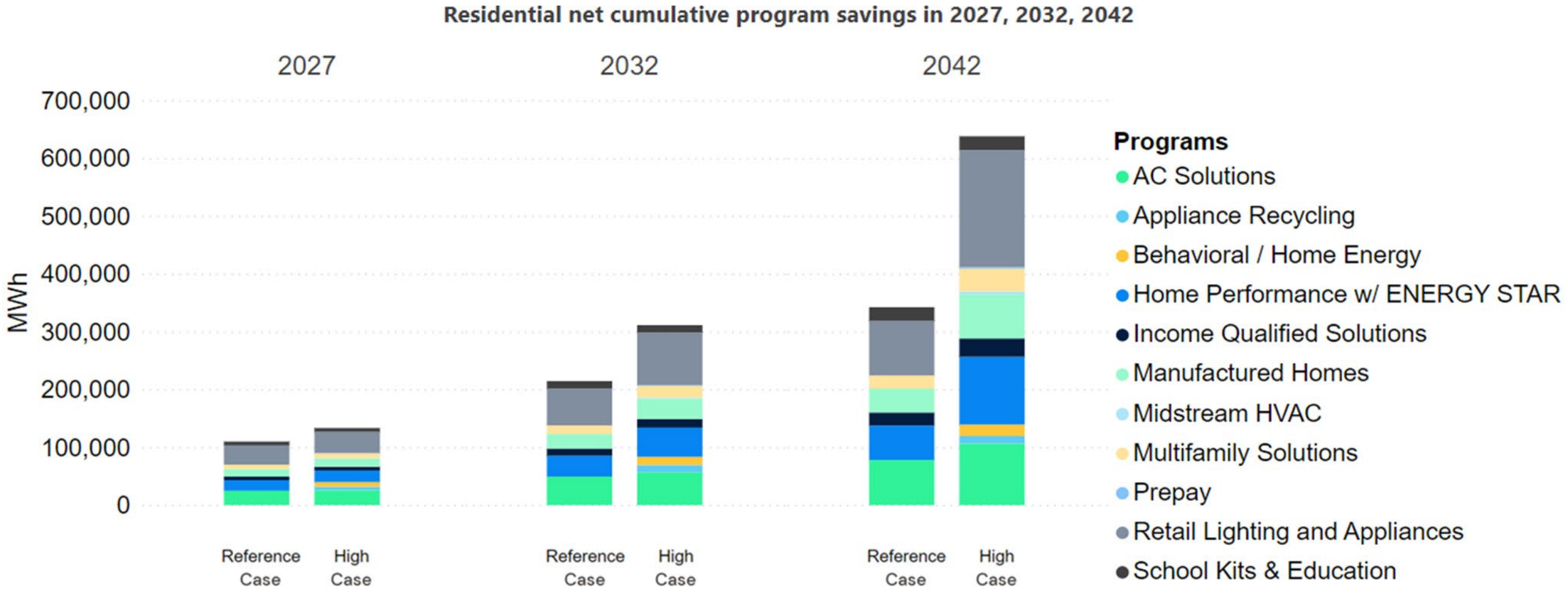
Cumulative Savings by Sector

Residential and commercial savings levels could reach up to 4.1% and 6.3% of sector sales, respectively, by 2042



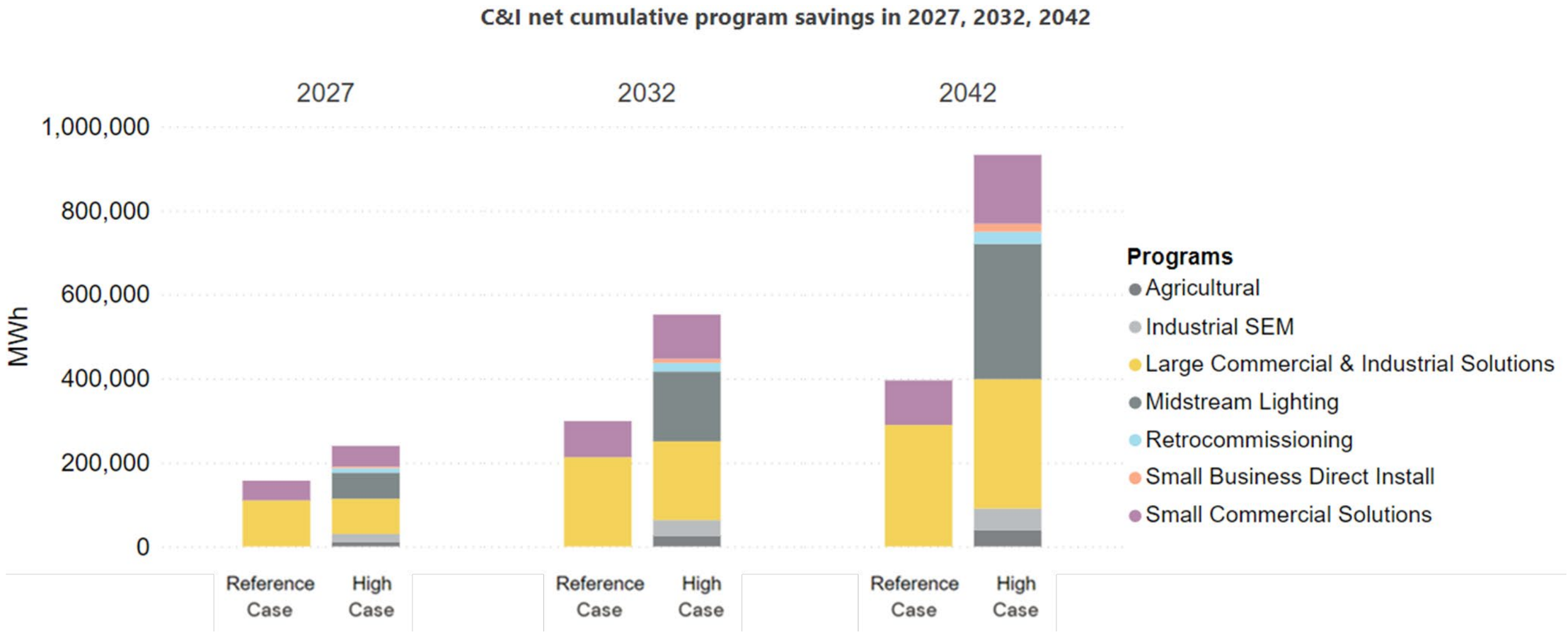
Cumulative Savings by Program – Residential

Retail lighting and appliance is the biggest residential savings opportunity Expanded programs could double residential savings by 2042



Cumulative Savings by Program – C&I

Expanded programs could increase C&I savings by 791 GWh by 2042



Cost and Cost-effectiveness Metrics – Residential Programs

Reference Case	Actual Cost ($ mil)	Annual Program Costs (2022 $ mil)				CE Metrics	
Program	**PY6**	**2027**	**2032**	**2037**	**2042**	**TRC**	**Levelized Cost ($/kWh)**
AC Solutions	$0.9	$0.8	$0.8	$0.8	$0.8	3.59	$0.01
Home Performance w/ ENERGY STAR	$1.0	$1.0	$1.0	$1.0	$1.0	2.70	$0.02
Income Qualified Solutions	$0.6	$0.6	$0.7	$0.7	$0.7	2.01	$0.04
Manufactured Homes	$0.8	$0.6	$0.6	$0.6	$0.6	3.62	$0.02
Multifamily Solutions	$0.4	$0.6	$0.5	$0.5	$0.5	1.76	$0.04
Retail Lighting and Appliances	$1.0	$0.7	$0.7	$0.7	$0.7	3.20	$0.01
School Kits & Education	$0.3	$0.3	$0.3	$0.3	$0.3	3.20	$0.02
Total	**$4.9**	**$4.7**	**$4.5**	**$4.5**	**$4.5**	**2.93**	**$0.02**

High Case	Actual Cost ($ mil)	Annual Program Costs (2022 $ mil)				CE Metrics	
Program	**PY6**	**2027**	**2032**	**2037**	**2042**	**TRC**	**Levelized Cost ($/kWh)**
AC Solutions	$0.9	$0.9	$1.1	$1.2	$1.2	3.62	$0.01
Appliance Recycling	NA	$0.3	$0.6	$0.6	$0.6	1.51	$0.05
Behavioral / Home Energy	NA	$0.3	$0.4	$0.6	$0.6	1.83	$0.03
Home Performance w/ ENERGY STAR	$1.0	$1.2	$2.0	$2.3	$2.3	2.73	$0.02
Income Qualified Solutions	$0.6	$0.7	$0.9	$1.0	$1.1	1.99	$0.04
Manufactured Homes	$0.8	$0.8	$1.2	$1.3	$1.2	3.65	$0.02
Midstream HVAC	NA	$0.0	$0.0	$0.1	$0.1	1.47	$0.01
Multifamily Solutions	$0.4	$0.7	$1.1	$1.0	$0.9	1.79	$0.04
Prepay	NA	$0.0	$0.0	$0.1	$0.1	2.13	$0.03
Retail Lighting and Appliances	$1.0	$0.8	$1.5	$1.7	$1.7	3.22	$0.01
School Kits & Education	$0.3	$0.3	$0.3	$0.3	$0.3	3.20	$0.02
Total	**$4.9**	**$6.1**	**$9.2**	**$10.1**	**$9.9**	**2.82**	**$0.02**

Cost and Cost-effectiveness Metrics – C&I Programs

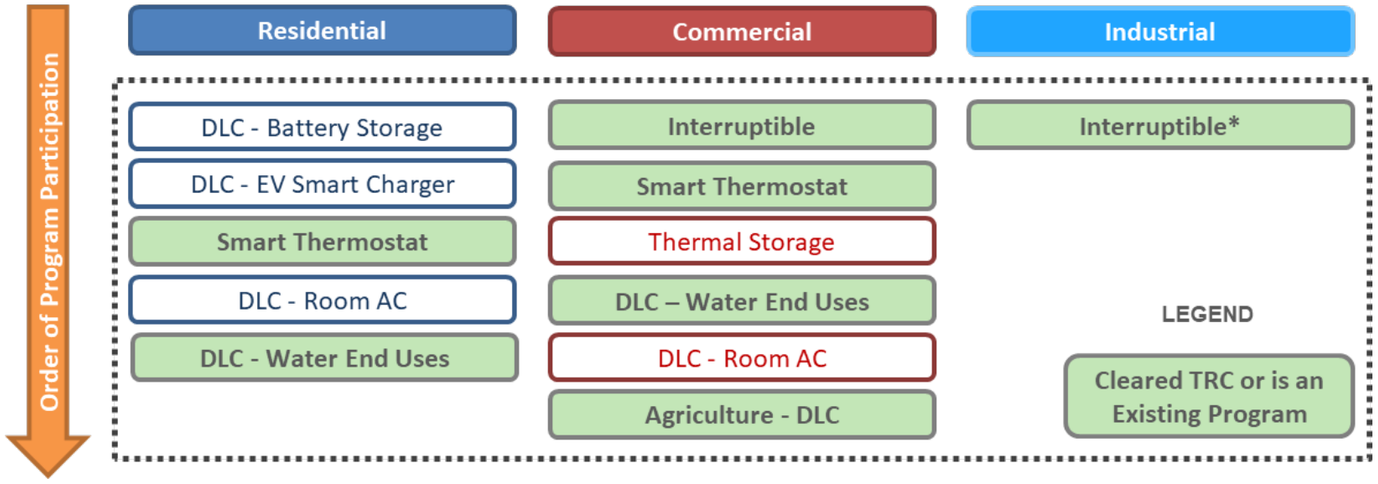
Reference Case	Actual Cost ($ mil)	Annual Program Costs (2022 $ mil)				CE Metrics	
Program	**PY6**	**2027**	**2032**	**2037**	**2042**	**TRC**	**Levelized Cost ($/kWh)**
Large Commercial & Industrial Solutions	$2.3	$2.8	$2.9	$3.0	$3.0	3.55	$0.01
Small Commercial Solutions	$1.6	$1.7	$1.6	$1.6	$1.6	2.38	$0.02
Total	**$3.9**	**$4.5**	**$4.6**	**$4.5**	**$4.6**	**3.12**	**$0.02**

High Case	Actual Cost ($ mil)	Annual Program Costs (2022 $ mil)				CE Metrics	
Program	**PY6**	**2027**	**2032**	**2037**	**2042**	**TRC**	**Levelized Cost ($/kWh)**
Agriculture	NA	$0.3	$0.3	$0.3	$0.4	2.57	$0.03
Industrial SEM	NA	$1.3	$1.4	$1.4	$1.4	1.15	$0.03
Large Commercial & Industrial Solutions	$2.3	$2.3	$3.6	$4.0	$4.0	2.40	$0.02
Midstream Lighting	NA	$2.3	$3.4	$3.8	$3.7	2.77	$0.02
Retrocommissioning	NA	$0.4	$0.7	$0.8	$0.8	2.95	$0.01
Small Business Direct Install	NA	$0.1	$0.2	$0.2	$0.2	1.48	$0.01
Small Commercial Solutions	$1.6	$1.9	$2.5	$2.5	$2.5	1.90	$0.01
Total	**$3.9**	**$8.7**	**$12.1**	**$13.0**	**$13.0**	**2.54**	**$0.02**

Demand Response Achievable Potential Draft Forecast

Programs and Scenarios

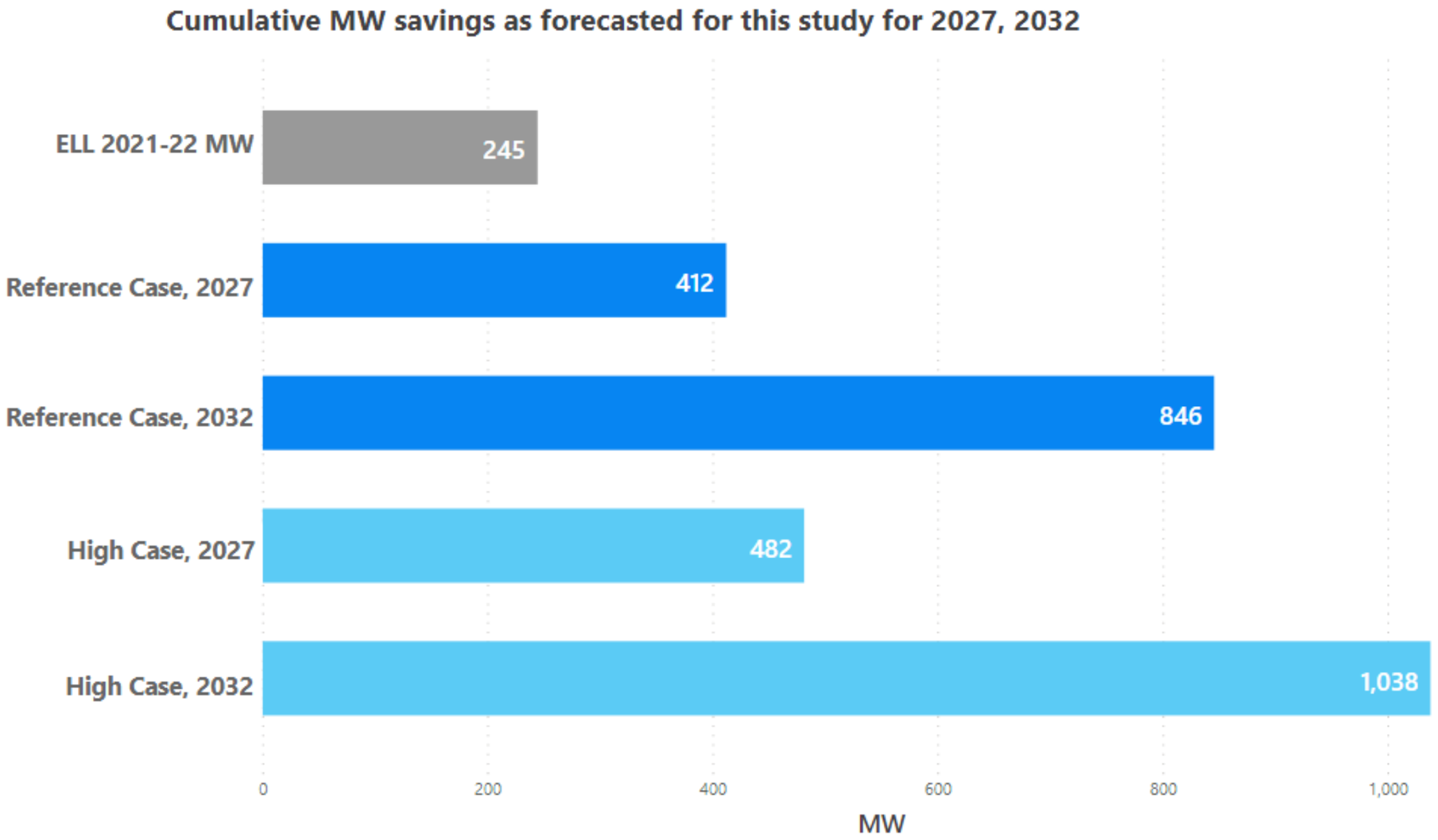
- Two scenarios –
  - Reference Case – Levels of participation corresponding to an expected level of maximum market share, with a Bass diffusion curve taking the participation from existing levels to the maximum market share level
  - High Case – Higher participation rates, with the maximum market share usually set to about 50% higher than the maximum market share of the reference case
- All programs are opt-in.



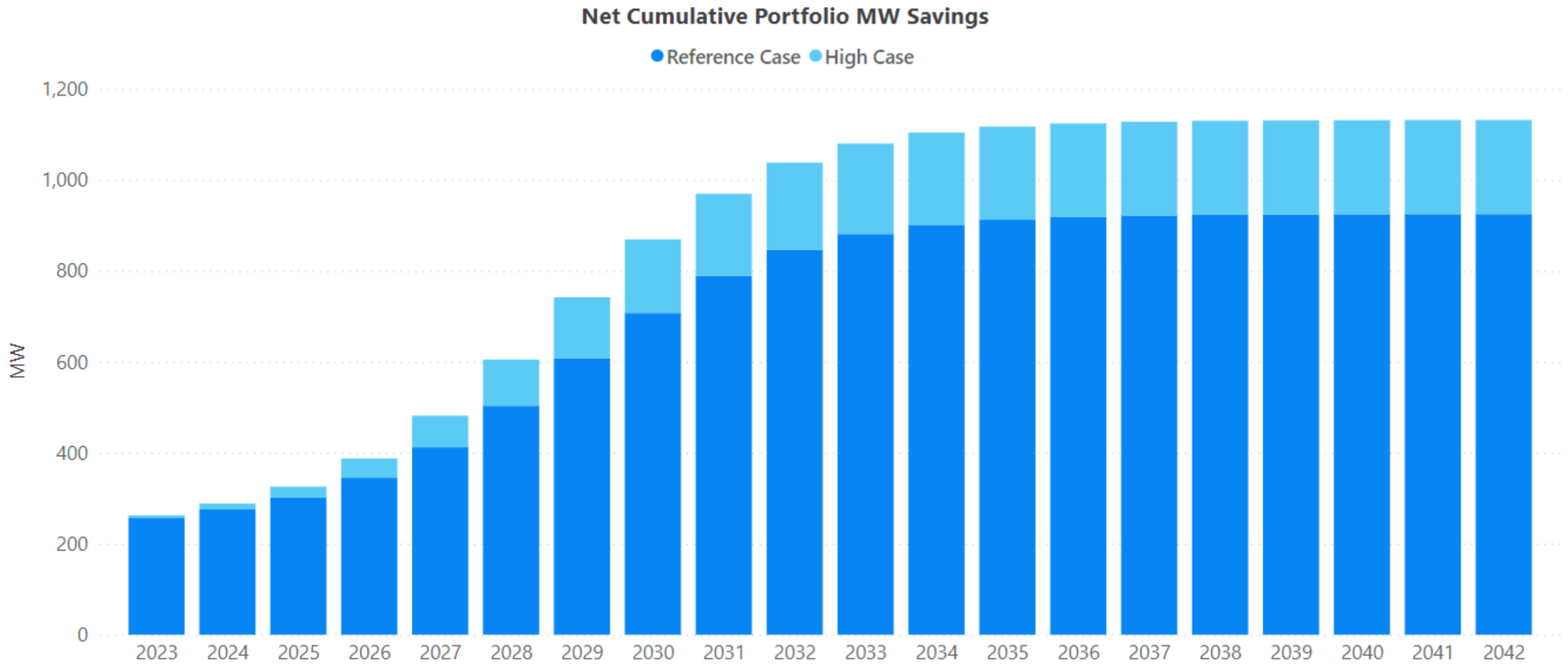
Programs highlighted in green shade clear a program TRC of 1 (or, as in the case of industrial interruptible program, have been included since it is an existing program as well) and show up with non-zero savings in the achievable potential

- Smart Thermostat Program was modeled with two modes of delivery
  - Bring your own thermostat (BYOT)
  - Direct Install (DI)
- Interruptible Load program comprises of
  - existing participants expected to continue at legacy rates,
  - new participants to be enrolled in the new LPSC-approved interruptible riders
  - New participants to be enrolled in a separate, new program for smaller commercial customers not eligible for the new, LPSC-approved interruptible riders

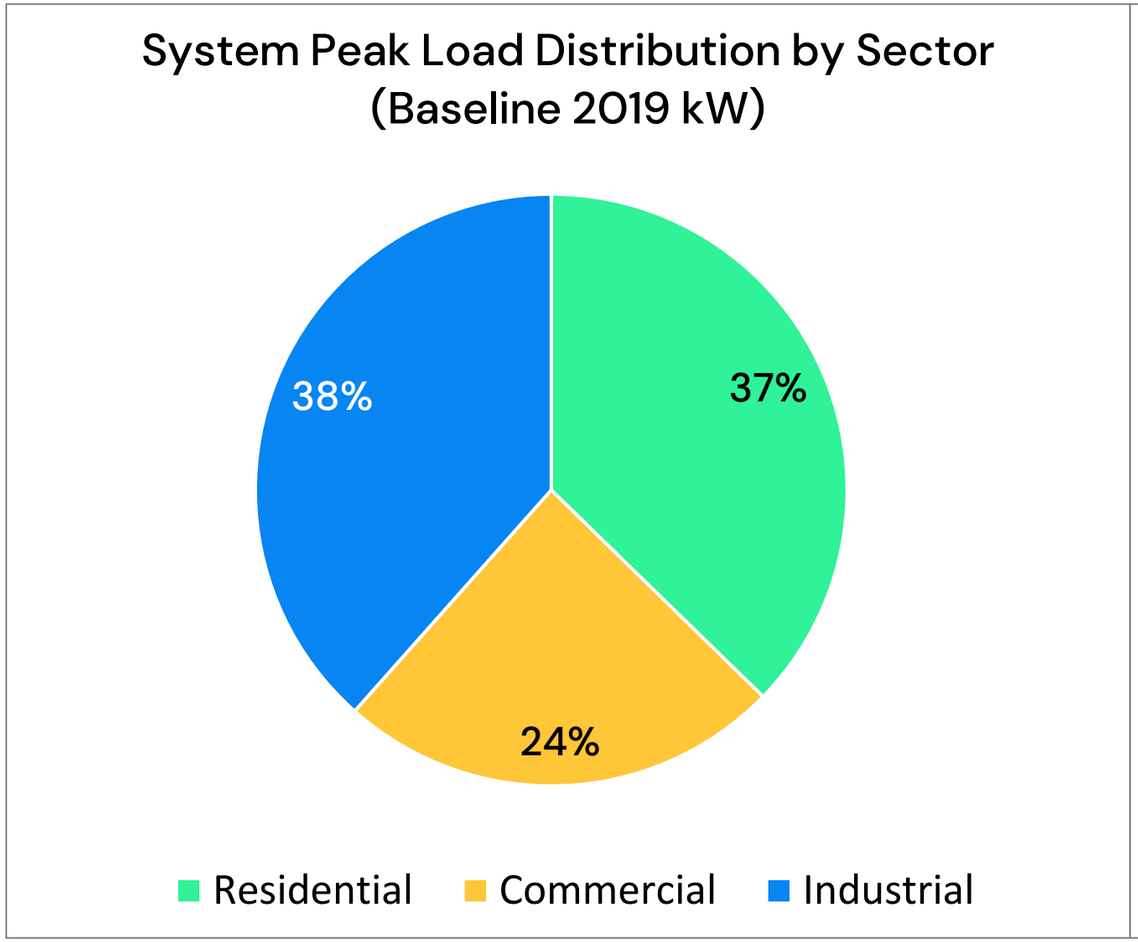
Summer MW Savings – All sectors for 2027, 2032

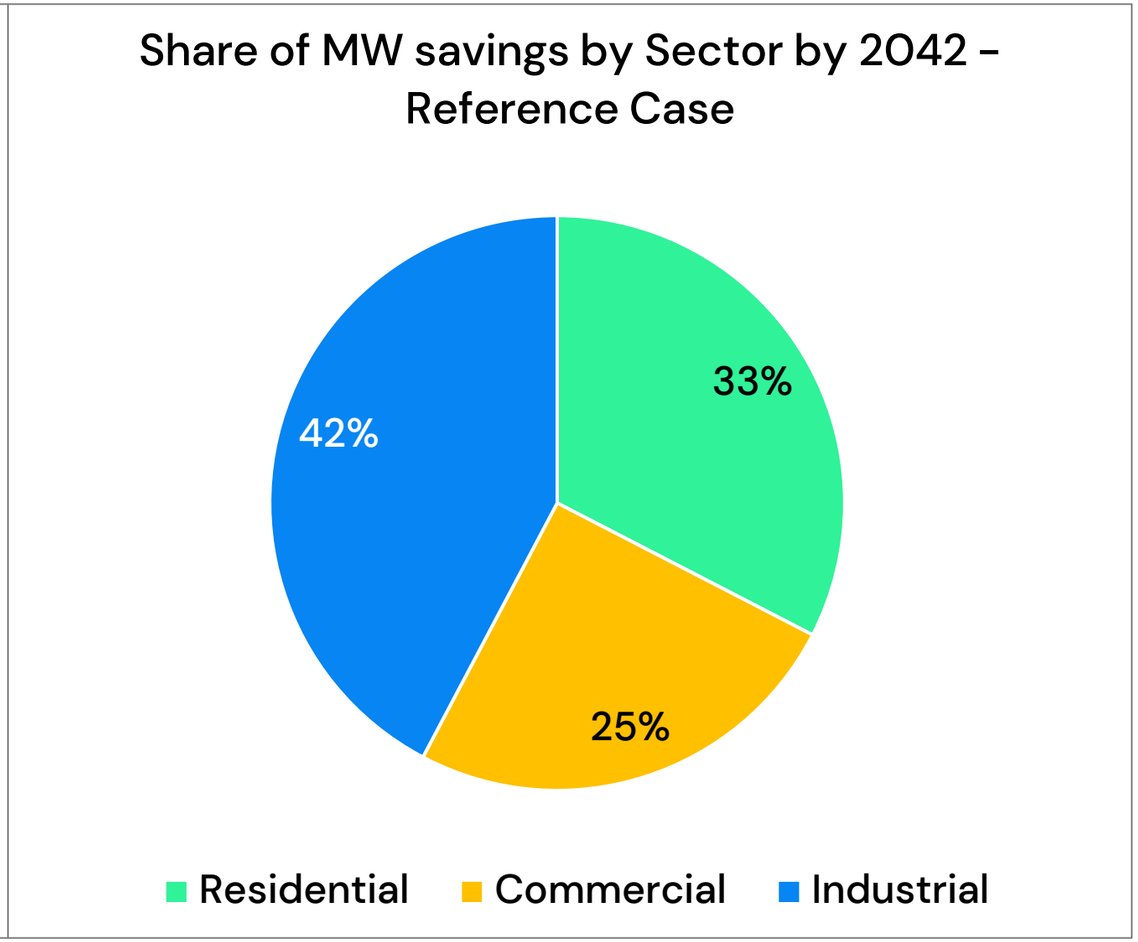


Summer MW Savings – All sectors

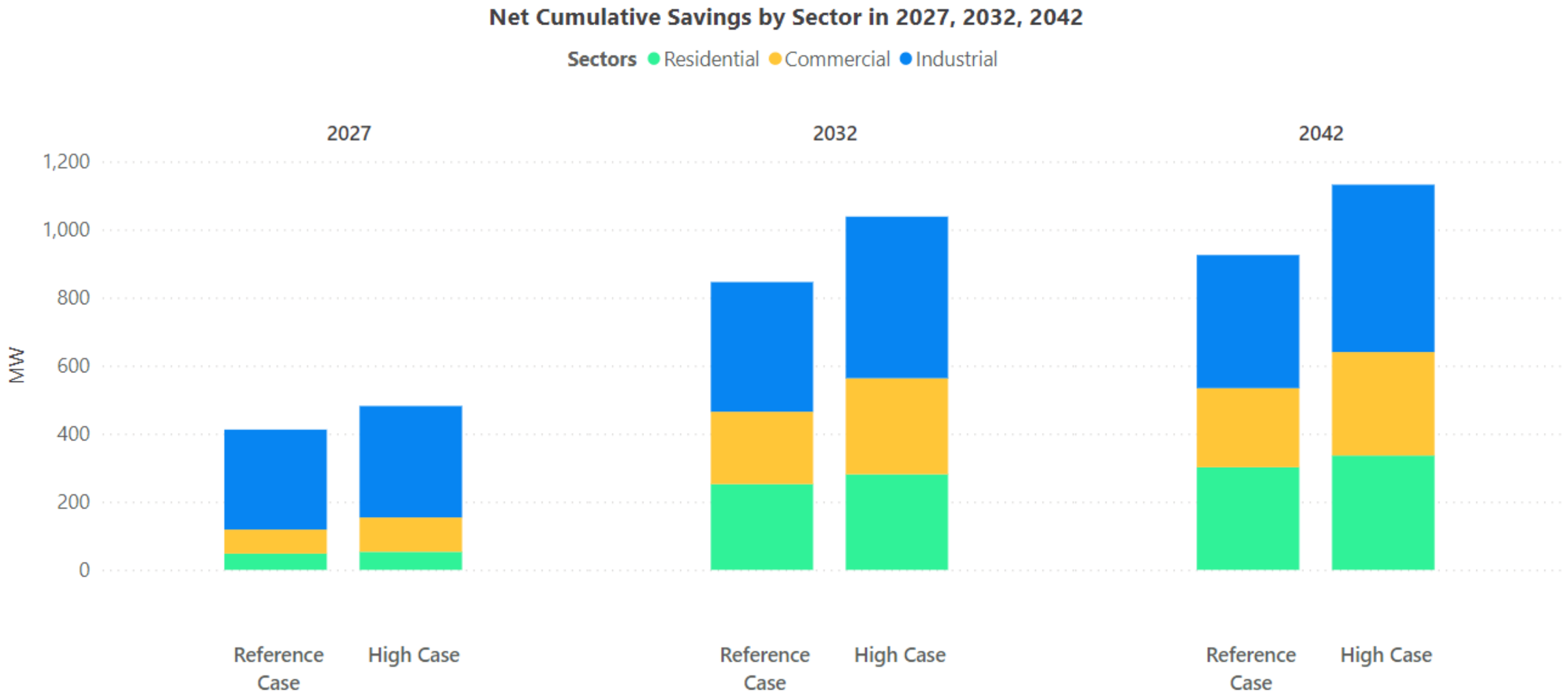


Share of MW Savings by 2042



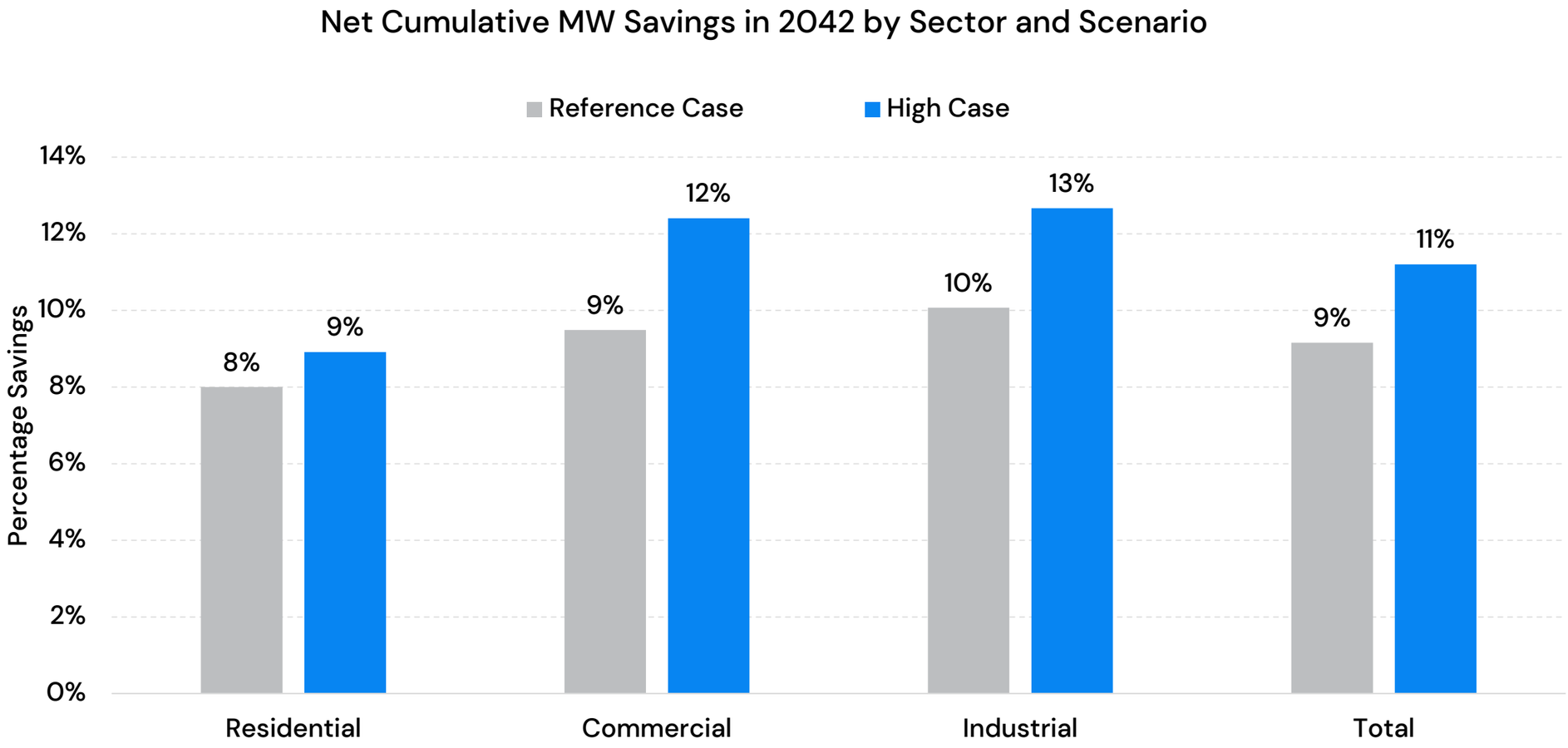


Summer MW Savings by Sector

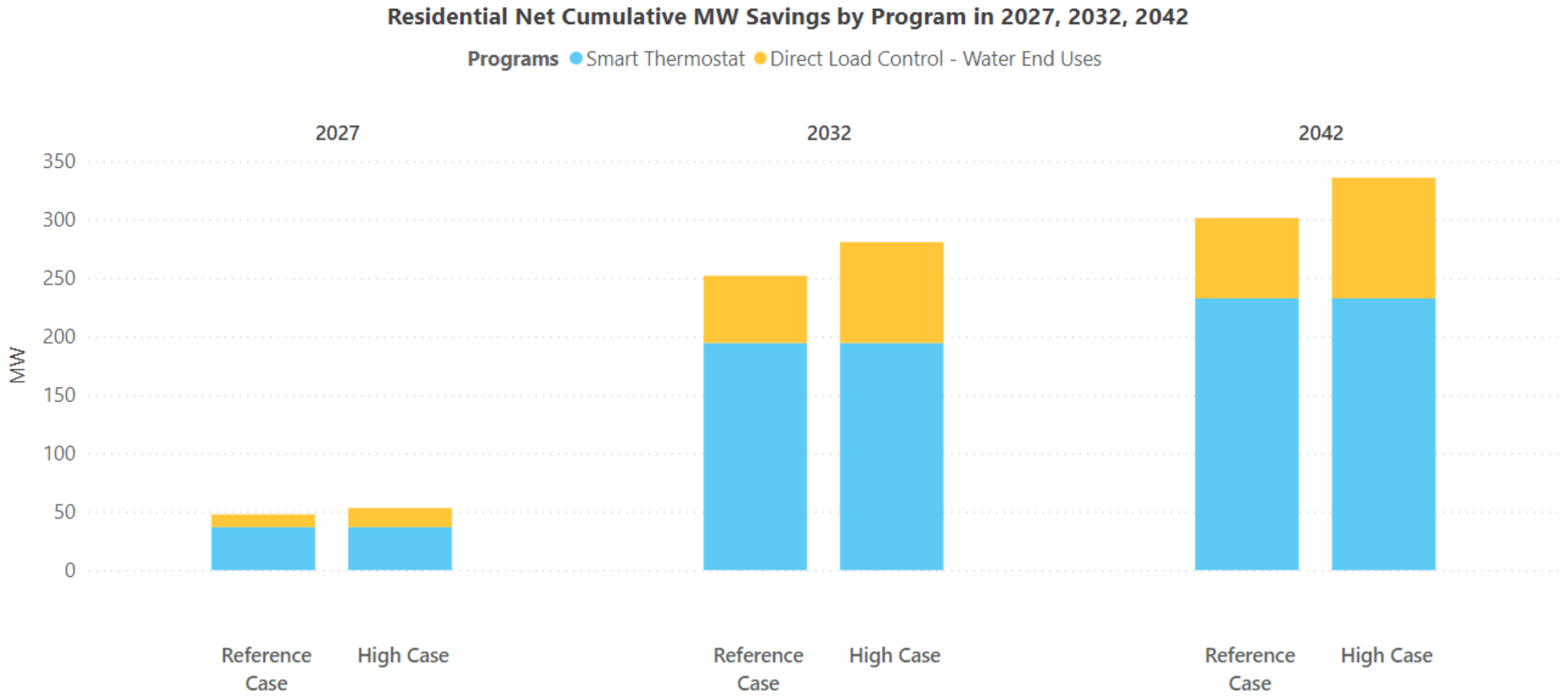


MW % Savings by 2042

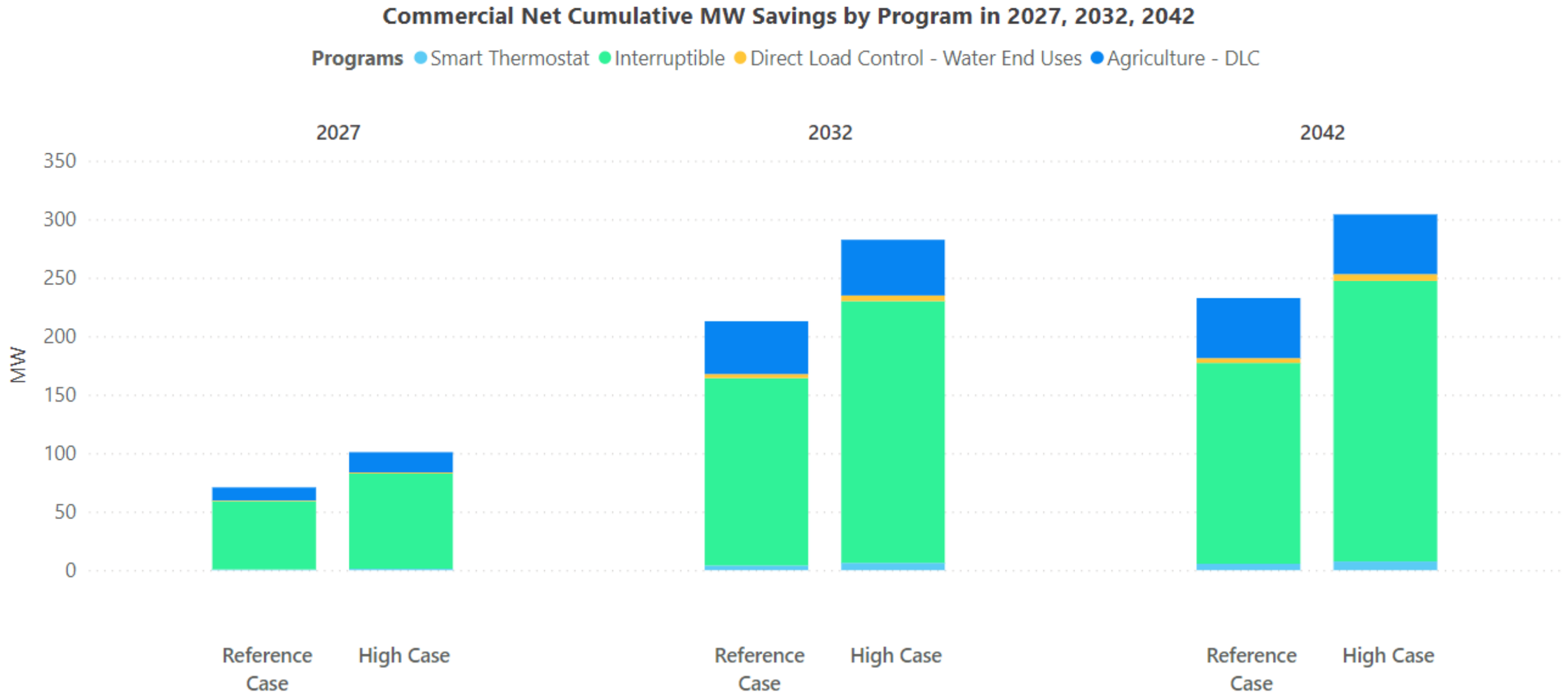
NOTE: The % savings are calculated using 2019 peak as the baseline



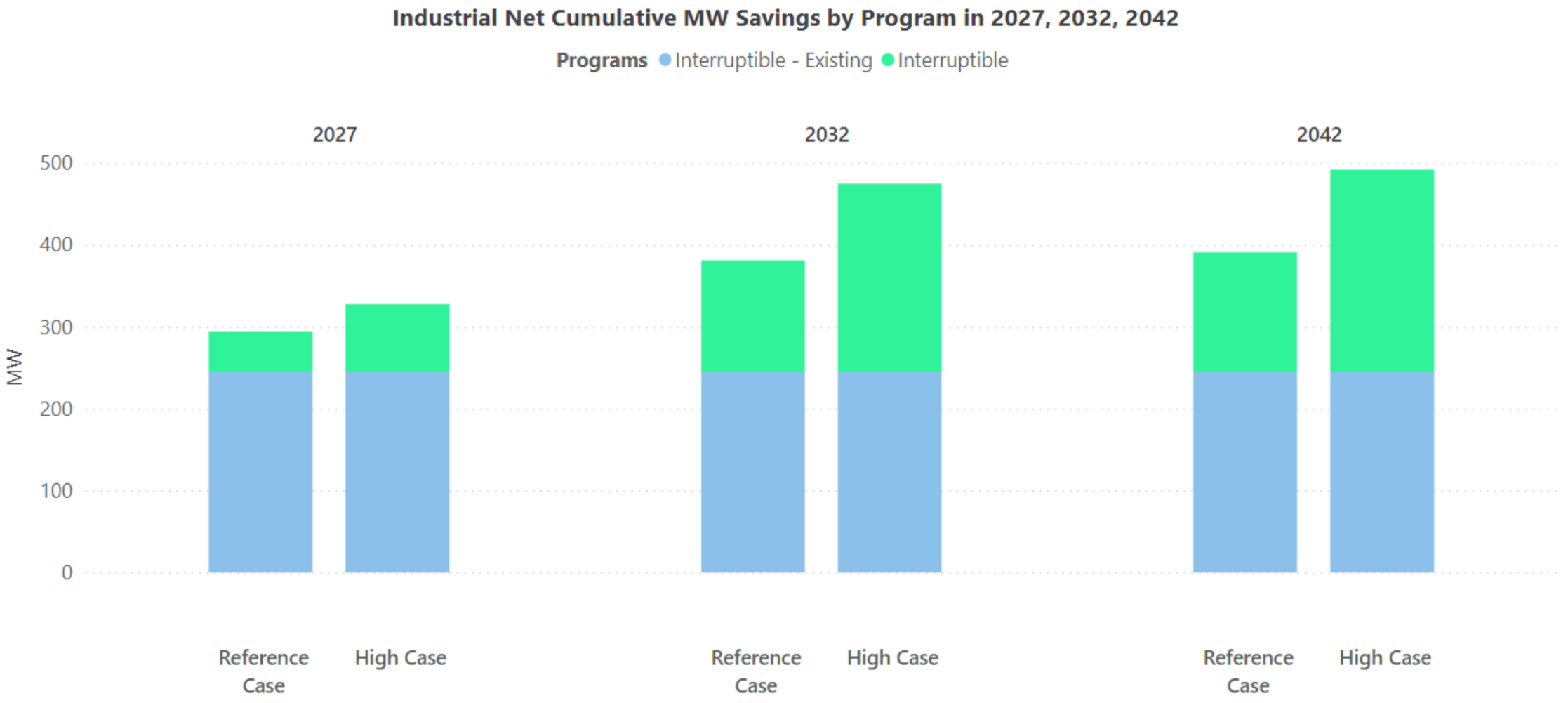
Residential Summer MW Savings



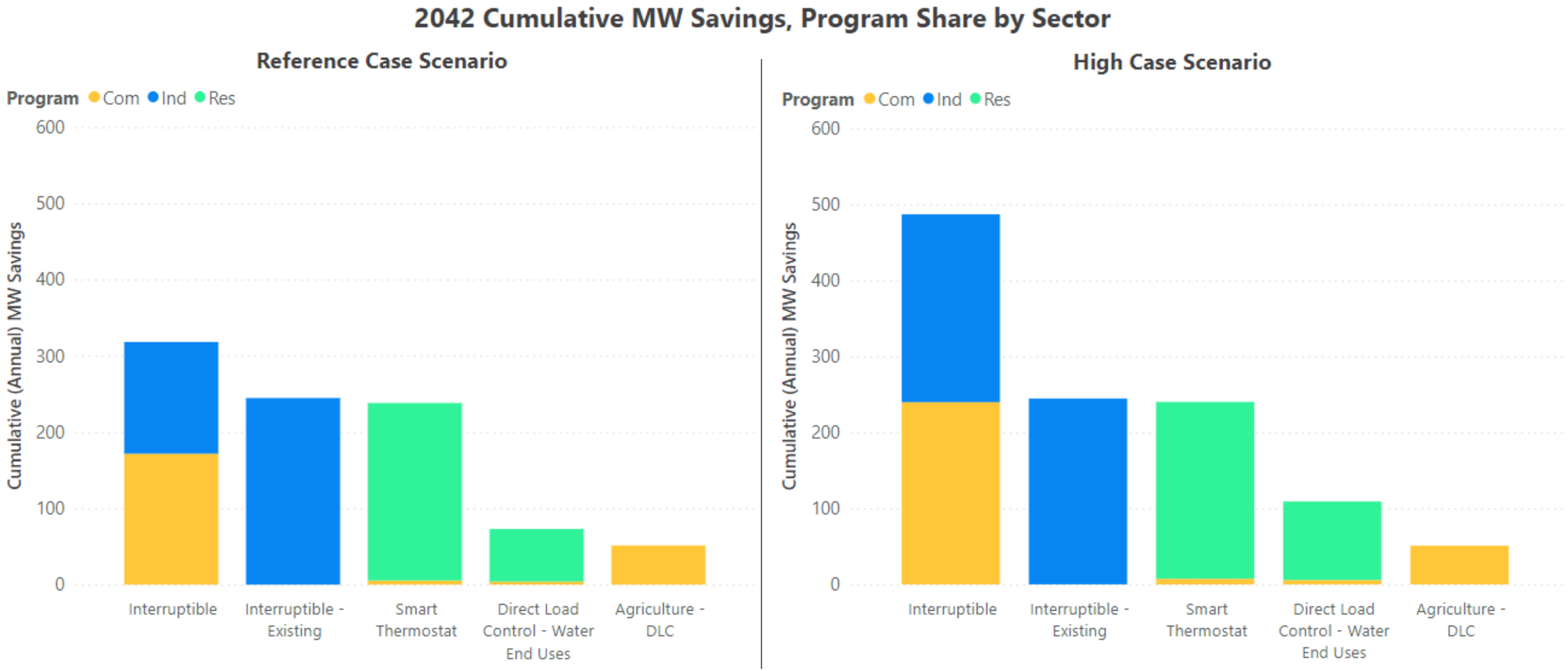
Commercial Summer MW Savings



Industrial Summer MW Savings



Program composition, by sector, in 2042, Cumulative Demand Savings MW



DR Cost & Cost-effectiveness metrics – All Sectors

Reference Case

Sector	Program	Annual Program Costs (2022 $ Mil.)				Cost Effective (CE) Metrics		
		2027	2032	2037	2042	Applicable Ratio	Benefit-Cost Ratio	Levelized Cost ($/kW)
Residential	Direct Load Control – Water End Uses	$ 3.7	$ 8.4	$ 7.1	$ 7.9	TRC	1.2	$ 149.2
	Smart Thermostat	$ 4.1	$ 10.8	$ 10.2	$ 11.0	TRC	4.4	$ 56.6
	Sector Total	$ 7.8	$ 19.2	$ 17.3	$ 18.9	TRC	2.8	$ 77.7
Commercial	Agriculture - DLC	$ 0.6	$ 1.9	$ 2.0	$ 2.0	TRC	3.6	$ 42.7
	Direct Load Control – Water End Uses	$ 0.2	$ 0.5	$ 0.4	$ 0.4	TRC	1.2	$ 140.5
	Interruptible - New	$ 3.2	$ 8.6	$ 9.2	$ 9.3	UCT	1.6	$ 54.1
	Smart Thermostat	$ 0.1	$ 0.3	$ 0.3	$ 0.3	TRC	2.6	$ 70.5
	Sector Total	$ 4.1	$ 11.3	$ 11.9	$ 12.0	UCT*	1.6	$ 53.4
Industrial	Interruptible - New	$ 1.6	$ 4.4	$ 4.8	$ 4.8	UCT	2.6	$ 32.7
	Interruptible - Existing	$ 37.5	$ 37.5	$ 37.5	$ 37.5	UCT	0.5	$ 153.3
	Sector Total	$ 39.1	$ 41.9	$ 42.3	$ 42.3	UCT	0.7	$ 119.8
Portfolio Total**		$ 13.5	$ 35.0	$34.0	$35.7	TRC	3.1	$ 58.6

* Commercial sector level UCT is reported since Interruptible is the largest contributor to costs and savings
** Portfolio total includes TRC for 'Interruptible – New' for C&I; 'Interruptible – Existing' is not included in this calculation.

DR Cost & Cost-effectiveness metrics – All Sectors

High Case

Sector	Program	Annual Program Costs (2022 $ Mil.)				Cost Effective (CE) Metrics		
		2027	2032	2037	2042	Applicable Ratio	Benefit-Cost Ratio	Levelized Cost ($/kW)
Residential	Direct Load Control – Water End Uses	$ 5.5	$ 12.5	$ 10.5	$ 11.8	TRC	1.3	$ 147.9
	Smart Thermostat	$ 4.1	$ 10.8	$ 10.2	$ 11.0	TRC	4.5	$ 56.6
	Sector Total	$ 9.6	$ 23.4	$ 20.7	$ 22.8	TRC	2.5	$ 84.7
Commercial	Agriculture - DLC	$ 0.8	$ 1.9	$ 2.0	$ 2.0	TRC	3.9	$ 40.9
	Direct Load Control – Water End Uses	$ 0.3	$ 0.6	$ 0.5	$ 0.6	TRC	1.3	$ 133.9
	Interruptible - New	$ 3.8	$ 10.4	$ 11.1	$ 11.1	UCT	1.9	$ 46.6
	Smart Thermostat	$ 0.1	$ 0.4	$ 0.4	$ 0.4	TRC	3.2	$ 64.4
	Sector Total	$ 5.0	$ 13.3	$ 14.0	$ 14.1	UCT*	1.8	$ 47.5
Industrial	Interruptible - New	$ 1.8	$ 5.0	$ 5.3	$ 5.3	UCT	4.0	$ 21.6
	Interruptible - Existing	$ 37.5	$ 37.5	$ 37.5	$ 37.5	UCT	0.5	$ 153.3
	Sector Total	$ 39.3	$ 42.5	$ 42.8	$42.8	UCT	0.9	$ 101.4
Portfolio Total**		$ 16.4	$ 41.7	$ 40.0	$ 42.2	TRC	3.69	$ 52.8

* Commercial sector level UCT is reported since Interruptible is the largest contributor to costs and savings
** Portfolio total includes TRC for 'Interruptible – New' for C&I; 'Interruptible – Existing' is not included in this calculation.

Distributed Energy Resources (DER) Achievable Potential Draft Forecast

Behind-the-Meter (BTM) DER Technology & Customer Combinations Forecasted

Residential PV

Commercial PV

Industrial PV

Residential PV + Battery

Commercial PV + Battery

Industrial PV + Battery

Commercial Standalone Battery

Industrial Standalone Battery

Overview of DER Analytic Approach

1. Baseline Conditions & Cost Effectiveness Screening in ELL Market

Current DER Deployment in ELL Territory

Screening based on Future Utility Rates, DER Cost & Performance, & Other Market/Policy Inputs (reference and high scenarios)

2. Historical Experience from Other Markets:
Relationship b/t Customer DER Deployment & Project Economics Leads to Market Acceptance Curves

3. Annual Capacity and Net Annual Production Forecasts (2023 through 2042)
of Achievable Potential in ELL Market

4. Allocation of C&I Forecast into Separate Commercial & Industrial Results

5. Hourly Net Load Profile Impacts for ELL

DER Cumulative Installed Capacity: Reference Scenario Forecast for Selected Years (data in MW_{AC}; for battery storage, "power" capacity is shown)

Year	Residential PV	C&I PV	Residential Battery (paired with PV)	C&I Battery (paired with PV)	Standalone C&I Battery
2023	80	8	< 1	< 1	< 1
2033	253	46	15	2	< 1
2034	275	51	18	2	< 1
2035	295	56	21	3	< 1
2036	315	60	25	3	< 1
2037	334	65	28	4	< 1
2038	353	70	32	4	< 1
2039	373	75	36	5	1
2040	393	80	40	5	1
2041	413	86	45	6	1
2042	433	91	50	7	1

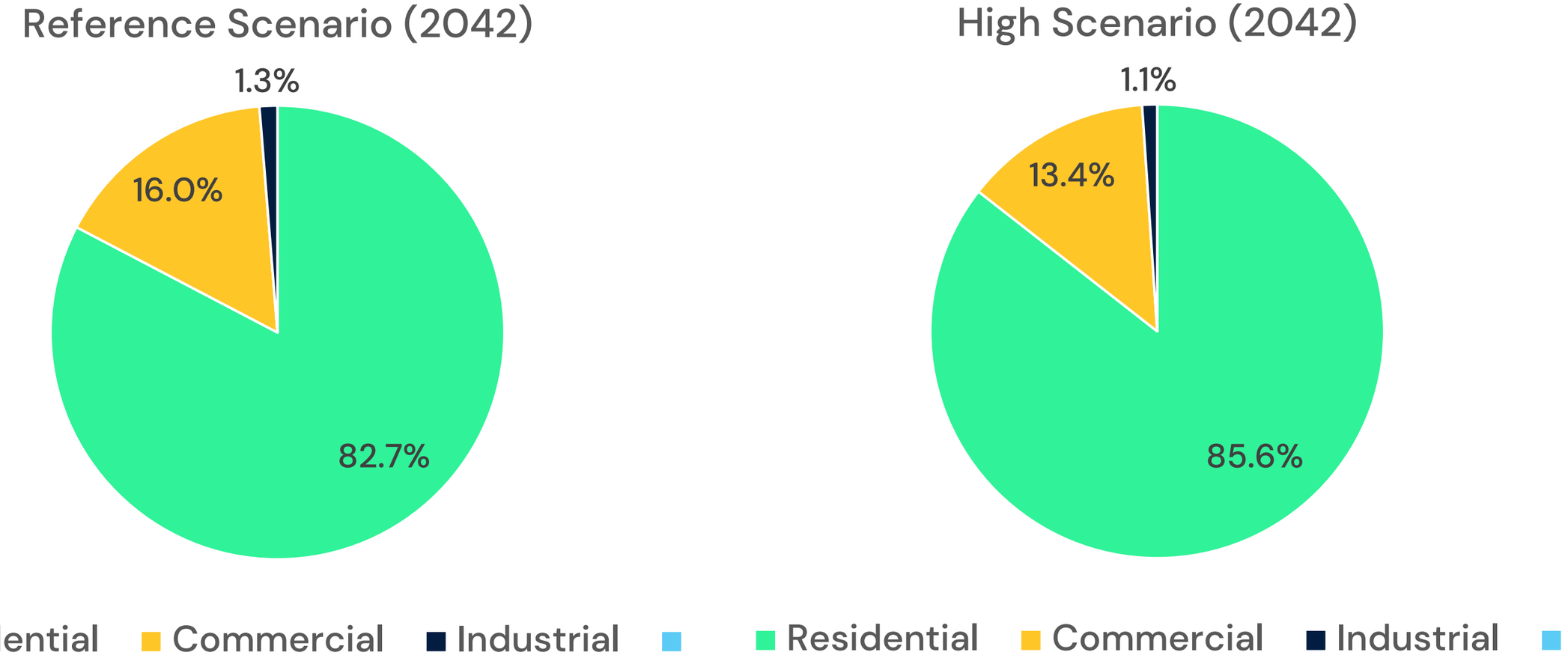
- Capacity forecast data for the years 2024–2032 are displayed later in an Appendix to this presentation.

DER Cumulative Installed Capacity: High Scenario Forecast for Selected Years (data in MW_{AC}; for battery storage, "power" capacity is shown)

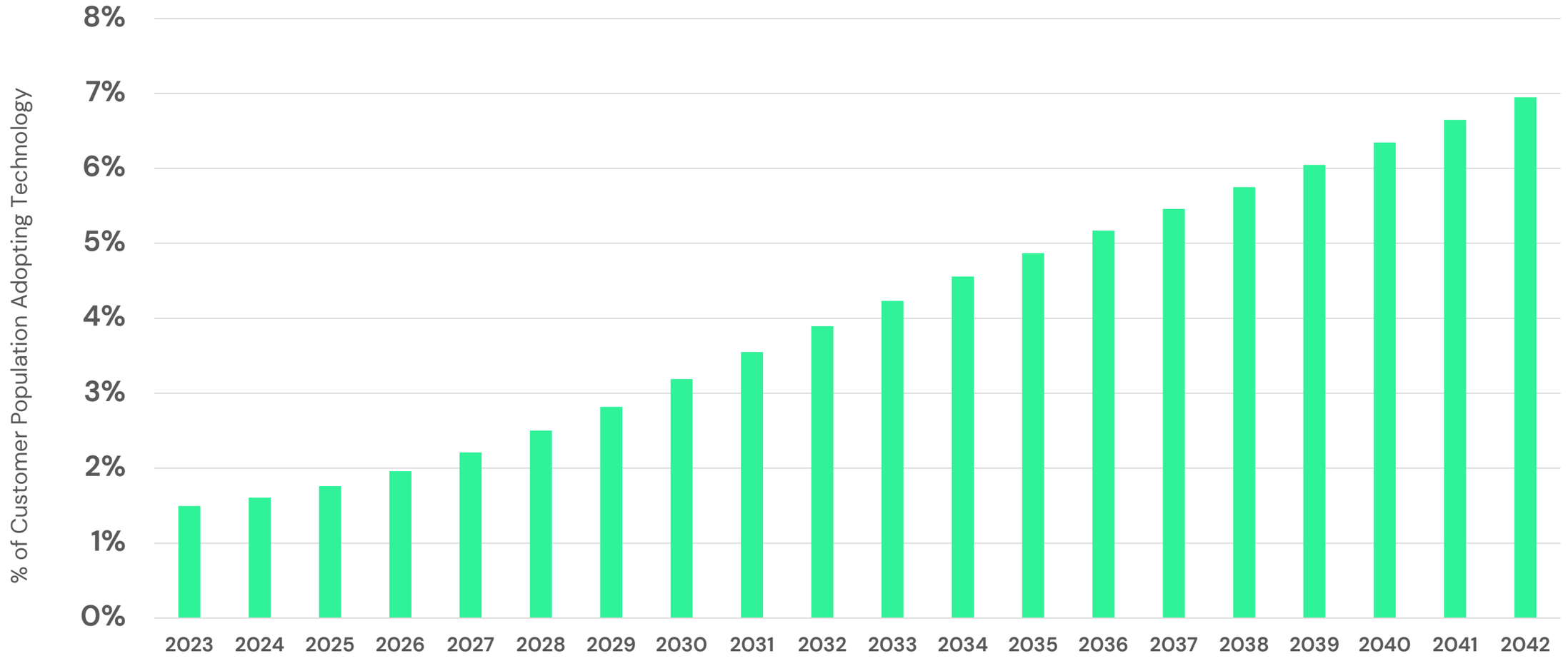
Year	Residential PV	C&I PV	Residential Battery (paired with PV)	C&I Battery (paired with PV)	Standalone C&I Battery
2023	85	8	< 1	< 1	< 1
2033	379	57	52	5	2
2034	415	64	62	6	2
2035	450	70	73	7	3
2036	484	76	84	8	3
2037	516	83	96	9	3
2038	549	89	109	11	4
2039	582	96	122	12	4
2040	615	102	137	14	5
2041	649	109	152	15	5
2042	683	115	169	17	5

- Capacity forecast data for the years 2024-2032 are displayed later in an Appendix to this presentation.

Cumulative Distributed PV Capacity Forecast: Share by Customer Class in 2042



Forecasted Share of ELL Residential Customer Population Adopting PV: Reference Scenario

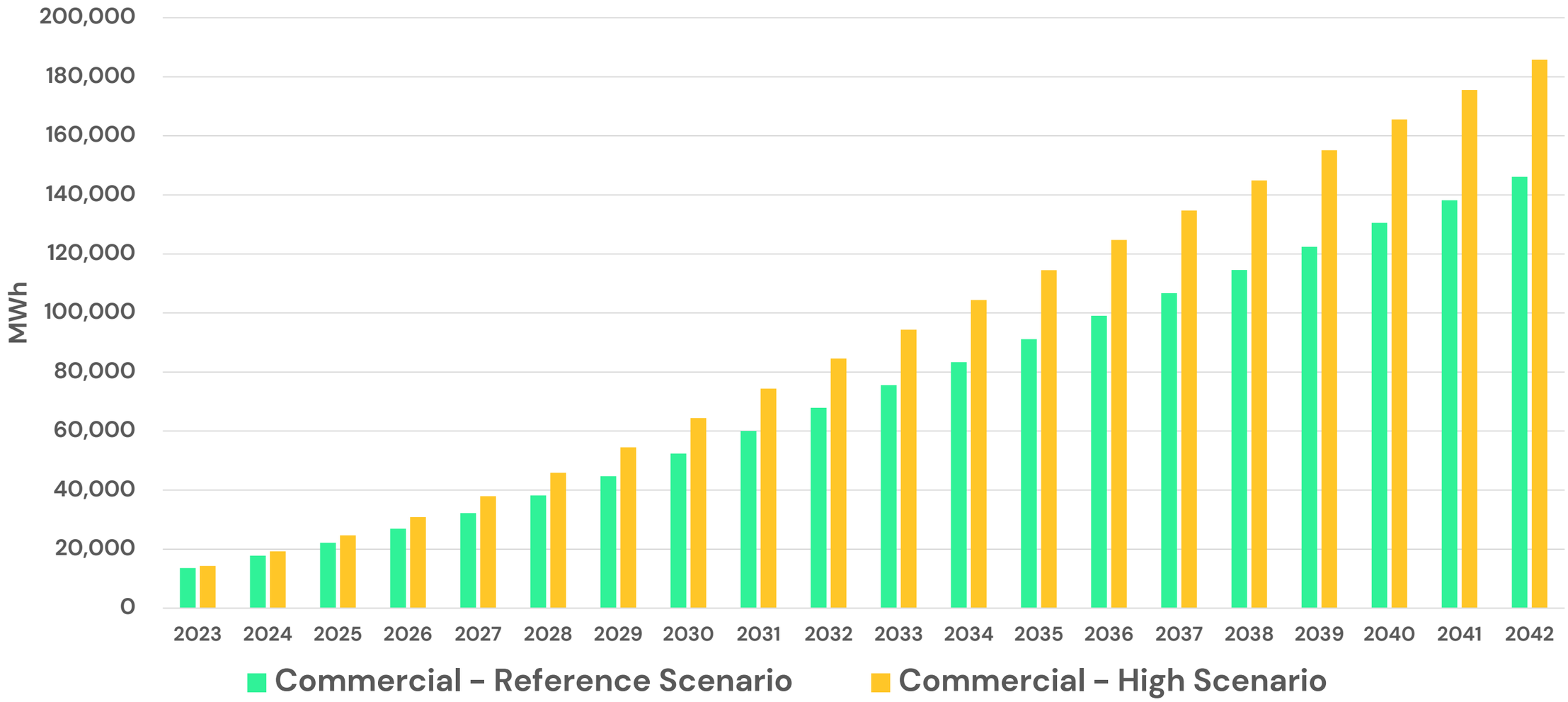


- In mid-2021, about 1% of ELL's residential customers had interconnected PV systems.
- By 2042, the reference scenario forecasts that about 7% (of the bigger residential customer base at that time) will adopt PV. In the high scenario, the corresponding 2042 PV adoption value is 11%.

Forecasted Annual Residential PV Production (in MWh)

- This production includes both PV electricity consumed on-site and PV electricity exported back to the utility. Production data shown are grossed up for transmission and distribution losses.

Forecasted Annual Commercial PV Production (in MWh)



- This production includes both PV electricity consumed on-site and PV electricity exported back to the utility. Production data shown are grossed up for transmission and distribution losses.

Q&A

Appendix

DER Cumulative Installed Capacity: Reference Scenario Forecast for 2023–2032 (data in MW_{AC}; for battery storage, "power" capacity is shown)

Year	Residential PV	C&I PV	Residential Battery (paired with PV)	C&I Battery (paired with PV)	Standalone C&I Battery
2023	80	8	< 1	< 1	< 1
2024	87	10	< 1	< 1	< 1
2025	96	13	1	< 1	< 1
2026	109	16	1	< 1	< 1
2027	125	19	2	< 1	< 1
2028	143	23	3	< 1	< 1
2029	163	27	5	1	< 1
2030	187	32	7	1	< 1
2031	209	36	10	1	< 1
2032	232	41	12	1	< 1

- Capacity forecast data for the years 2033–2042 are displayed earlier in this presentation.

DER Cumulative Installed Capacity: High Scenario Forecast for 2023-2032 (data in MW_{AC}; for battery storage, "power" capacity is shown)

Year	Residential PV	C&I PV	Residential Battery (paired with PV)	C&I Battery (paired with PV)	Standalone C&I Battery
2023	85	8	< 1	< 1	< 1
2024	96	11	1	< 1	< 1
2025	112	15	2	< 1	< 1
2026	132	18	4	< 1	< 1
2027	158	23	7	1	< 1
2028	187	27	10	1	< 1
2029	221	33	16	2	1
2030	262	39	24	2	1
2031	302	45	32	3	1
2032	341	51	42	4	1

- Capacity forecast data for the years 2033-2042 are displayed earlier in this presentation.

DER: Overview of Selected Modeling Assumptions

Input	Value	Source
PV Capacity Factors$_{AC}$ (year 1 of system operation)	19.5%	National Renewable Energy Laboratory (NREL) PV Watts®, using ELL territory weather data, and Lawrence Berkeley National Laboratory inverter loading ratios
PV System Capital Costs (pre-incentive)	Annual residential and commercial values from NREL, *Annual Technology Baseline*	
Standalone Battery System Capital Costs	Initial year (2023) BTM lithium-ion battery system values: California Public Utilities Commission (CPUC) proposed IRP inputs Annual % cost decline rates for 2024 and after: NREL, *Annual Technology Baseline*	
Federal Investment Tax Credit for PV	22% in 2023; 10% (C&I) and 0% (residential) in 2024 & after	U.S. Department of Energy (DOE) summary documents (used values in current law as of December 2021)
Retail Electricity Prices	Rate forecasts by customer class and overall inflation rates provided by ELL. Made adjustments for components not offset by PV (e.g., fixed monthly charges & portions of demand charges).	
Inflation Rate (applicable to annual O&M and other factors)	2%	ELL
Battery Storage Roundtrip Efficiency	86%	DOE, *Energy Storage Technology and Cost Characterization Report*
Annual Performance Degradation (after year 1)	0.5% (PV) 1% (Battery System)	PV: NREL guidance document Battery System: CPUC proposed IRP inputs

Residential Battery Storage: Modest Annual Net Production Impacts

- Assumed that all residential battery storage systems are paired with PV.
  - Due to use cases and system economics.

- Battery storage, unlike PV, increases ELL loads on a net basis.
  - Due to the roundtrip efficiency losses on charging and discharging battery storage.

- Annual sum of residential battery charging in 2042 in high scenario: 55,733 MWh.
- Annual sum of residential battery discharging in 2042 in high scenario: 47,930 MWh.
  - Annual net load impact in residential high scenario: increase of 7,803 MWh.
    - That annual net load impact equals only about 0.05% of total residential load in 2042.
    - In any given hour, the net impact on ELL's loads can be positive or negative, depending on the aggregate battery charging and discharging behavior of ELL customers at that time.

C&I Standalone Battery Storage: Notes on Population and Use Case

- Applicable C&I population for standalone battery storage adoption
  - Evaluated ELL tariffs for best economic opportunities for demand reduction by C&I customers.
  - Less than 150 C&I customers are on tariffs with peak demand charges high enough to potentially justify economic investment in battery storage.
    - Used sample customer load profiles to evaluate battery storage potential for net monthly demand cost reductions.
- Economic use case
  - Customer cost savings are obtained by charging the battery system during times of low customer demand and discharging the battery during times of high customer demand to reduce average demand on a monthly basis.
  - Estimated economic benefits are calculated by summing demand charge savings, net of battery roundtrip efficiency losses, and deducting battery system capital costs and annual O&M costs.

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