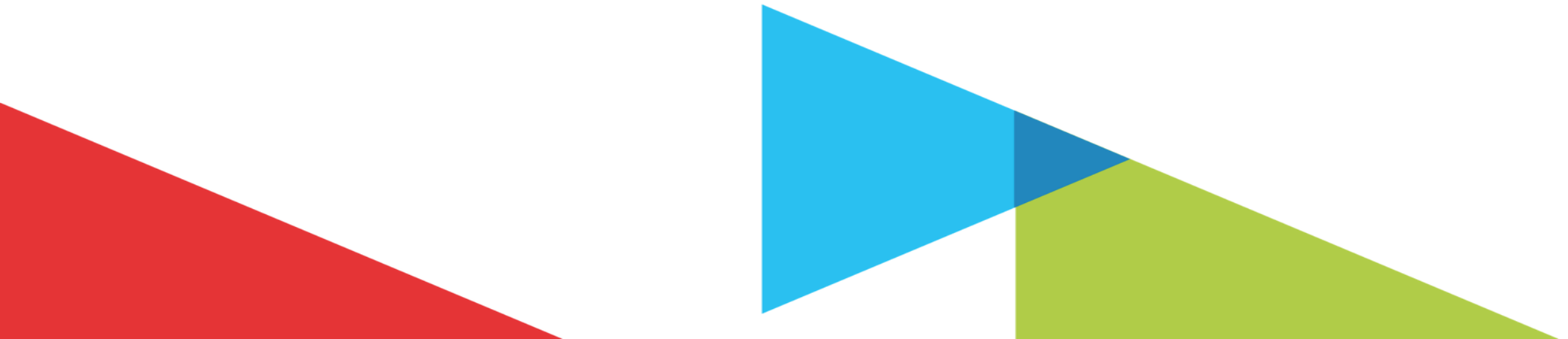
Nicor Gas

Nicor Gas Energy Efficiency Potential Assessment

Prepared for Illinois Energy Efficiency SAG

November 10, 2020



AGENDA

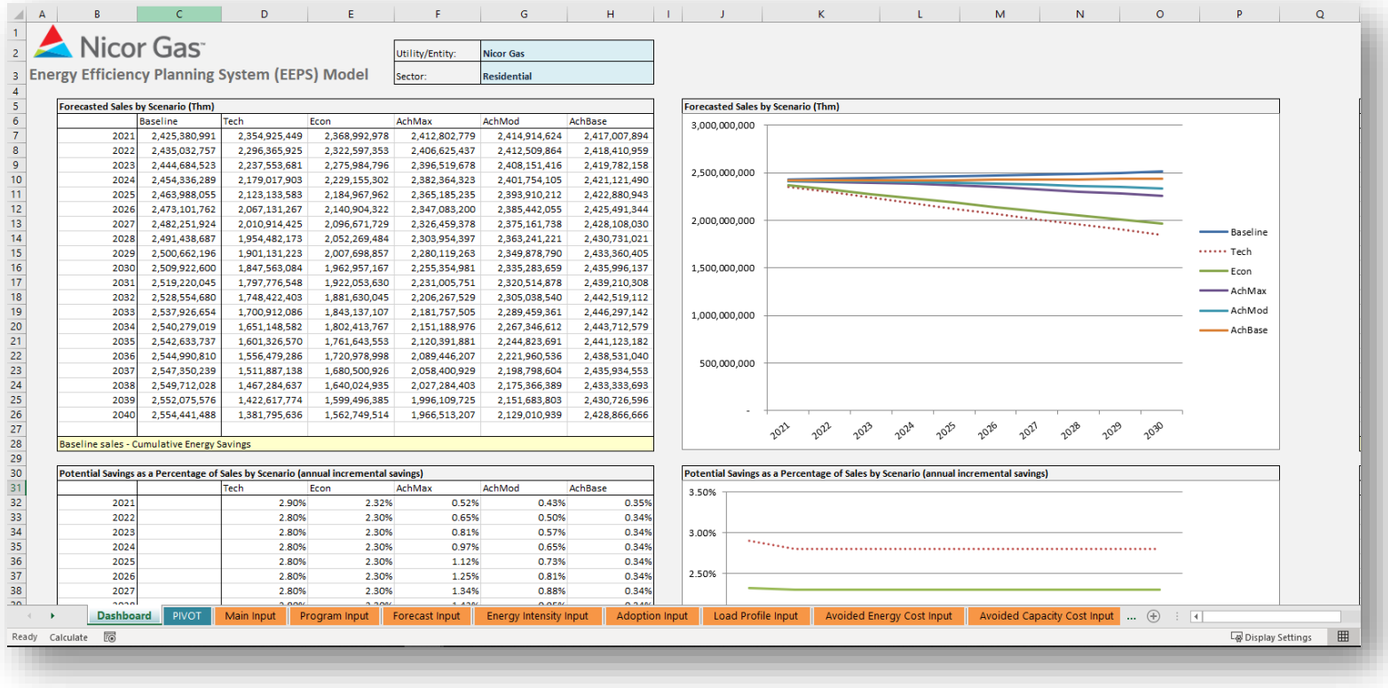
- Study Approach
- Market Characterization Findings
- Adoption Curves
- EE Potential Findings

Study Approach

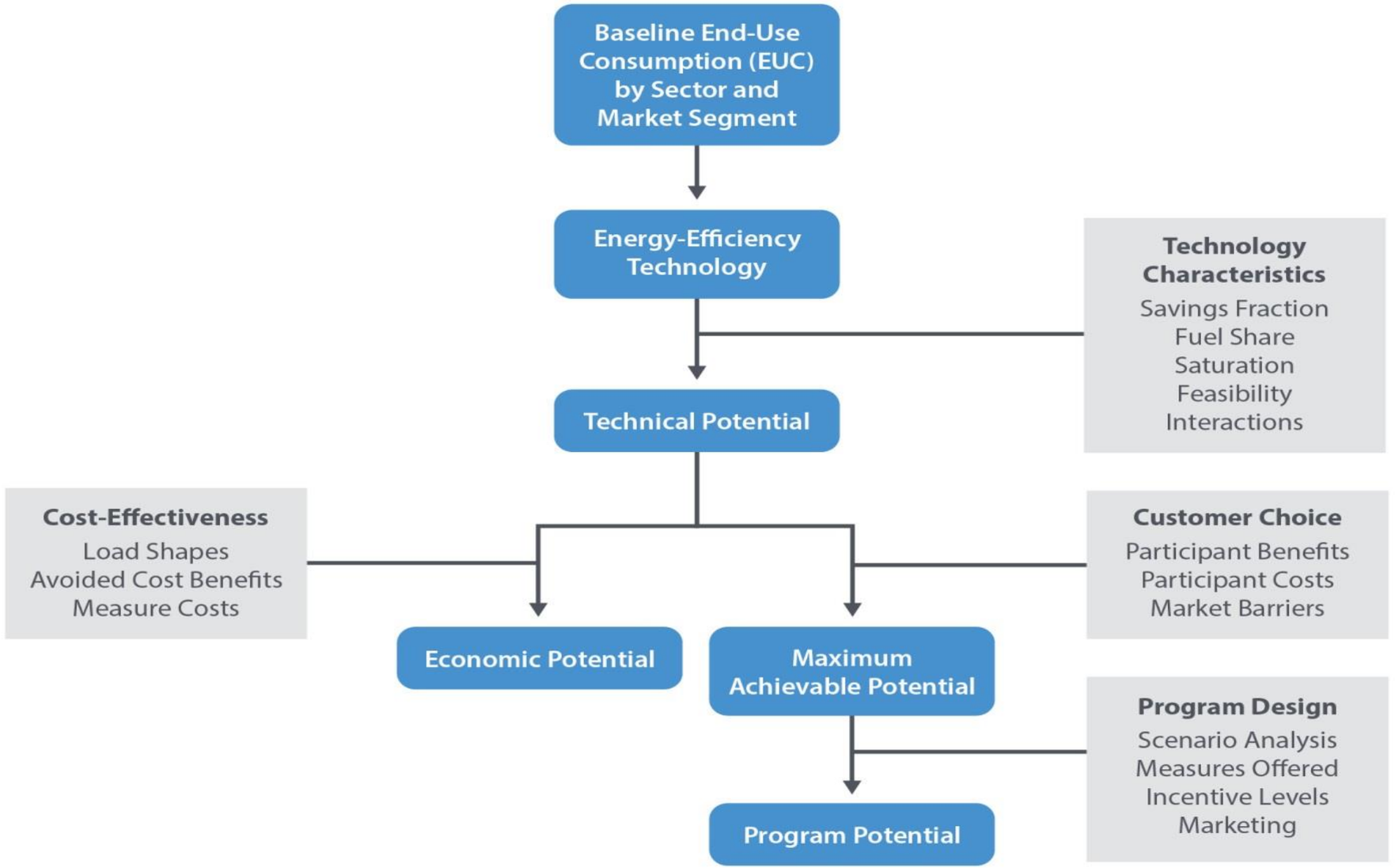
Study Team

- **Nicor Gas staff**
  - Randy Opdyke – project oversight
  - Charles Parilla, Bruce Liu – analysts
- **KBH Consulting**
  - Tyler Hammer – project manager / subject matter expert
- **First Tracks Consulting Service**
  - Ted Weaver – subject matter expert

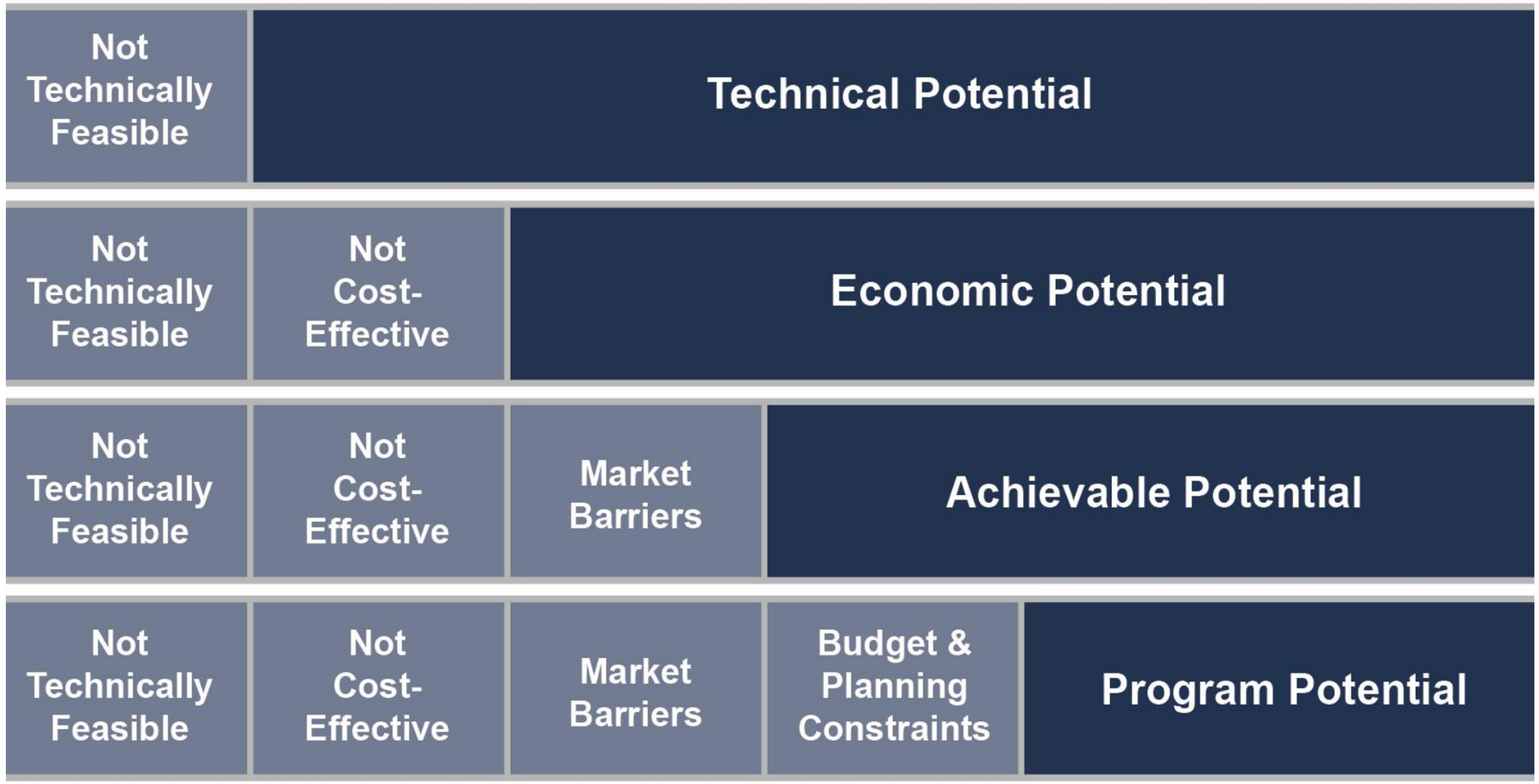
Nicor Gas' TEAPot Tool used for stock forecast and potential modeling



General Methodology



Potential Assessment - Types



Study Data Sources

Model Parameter	Key Data Sources
Measure Parameters	IL TRM v9
Forecast Disaggregation	Nicor Gas customer billing database
	EIA Energy Consumption Surveys (RECS, CBECS, MECS)
Market Characterization	Nicor Gas Appliance Saturation Survey
	ComEd Baseline Study
Adoption Curves	Nicor Gas program participation data
	Customer Willingness to Pay benchmark data
Economic Inputs	Nicor Gas administrative costs, measure rebates
	Avoided energy forecasts, discount rates

* Primary data collection not part of this study

TEAPot Tool

End Use model developed in MS Excel that calculates savings potential via “bottom-up”, % of end use load.

- Disaggregated energy and stock forecast by sector, segment, end use, equipment type
- Comprehensive measure list and parameters using Illinois TRM v9 inputs and algorithms
- Nicor Gas-specific economic indices – avoided costs (inclusive of NEBs), discount rate
- Adoption Curves by scenario, by sector by equipment type – 66 residential, 81 nonresidential

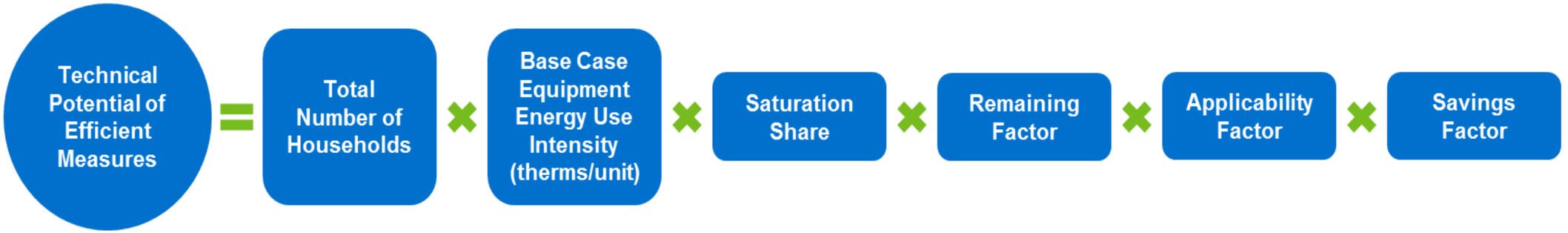
Thousands of Model Outputs by

- Sector
- Segment
- Scenario
- Measure Type
- End Use
- Building Type
- Vintage

Model Set Up

- **Developed 5 model inputs by sector**
  - Residential
  - Small Commercial
  - Large Commercial
  - Public Sector
  - Industrial
- **5 Scenarios run per sector**
  - Technical Potential
  - Economic Potential
  - Achievable/Program Potential
    - Max (100% incremental measure cost incentivized, aggressive program delivery)
    - Moderate (50% incremental measure cost incentivized, moderate program delivery)
    - Base (Program potential, business as usual)
- **Measure Screening**
  - Measures screened individually at a TRC>0.7 threshold without administrative costs included
- **Study Horizon**
  - 20-year horizon (2021 – 2040), with focus on EEP period of 2022 to 2025

Savings Algorithm



- **Total Number of Households** = total number of eligible households determined by the stock forecast, turnover rate (for replace on burnout equipment measures) and rate of adoption.
- **Base Case Equipment Energy Use Intensity** = the gas used per customer per year by each base-case technology in each market segment. In other words, the base-case equipment EUI is the consumption of the natural gas energy using equipment that the efficient technology replaces or affects.
- **Saturation Share** = the fraction of the end-use natural gas energy that is applicable for the efficient technology in a given market segment. As an example, for residential water heating, the saturation share would be the fraction of all residential customers that have gas water heating in their household.
- **Remaining Factor** = the fraction of equipment that is not considered to already be energy efficient. To extend the example above, the fraction of gas water heaters that is not already energy efficient.
- **Applicability Factor** = the fraction of the applicable units that is technically feasible for conversion to the most efficient available technology from an engineering perspective (i.e., it may not be possible to install tankless water heaters in a home).
- **Savings Factor** = the percentage reduction in natural gas consumption resulting from the application of the efficient technology.

Model Set up - Taxonomy

List of Segments by Sector				
Residential	**Small Commercial**	**Large Commercial**	**Public Sector**	**Industrial**
SF Low Income	Assembly	Assembly	College	Small Mfg
SF Reg Income	Assisted Living	Assisted Living	Public Elementary and High School	Large Mfg
MF Low Income	College	College	Hospital	Small Agriculture
MF Reg Income	Dry Cleaners	Hospital	Public Service/Gov't	Large Agriculture
Public Housing Authority	Grocery	Large Office	Misc. Commercial	Small Misc. Industrial
Other	Healthcare Clinic	Retail		Large Misc. Industrial
	Hotel/Motel	Warehouse		
	Small Office			
	Religious Building			
	Restaurant			
	Retail			
	Warehouse			
	Misc. Commercial			
	Private Education			

List of End Uses by Sector				
Residential	**Small Commercial**	**Large Commercial**	**Public Sector**	**Industrial**
Space Heat	Space Heat	Space Heat	Space Heat	Space Heat
Water Heat	Water Heat	Water Heat	Water Heat	Water Heat
Cooking	Cooking	Cooking	Cooking	Cooking
Dryers	Process Heat	Process Heat	Process Heat	Process Heat
Fireplace	RNG	RNG	RNG	RNG
Other	Other	Other	Other	Other

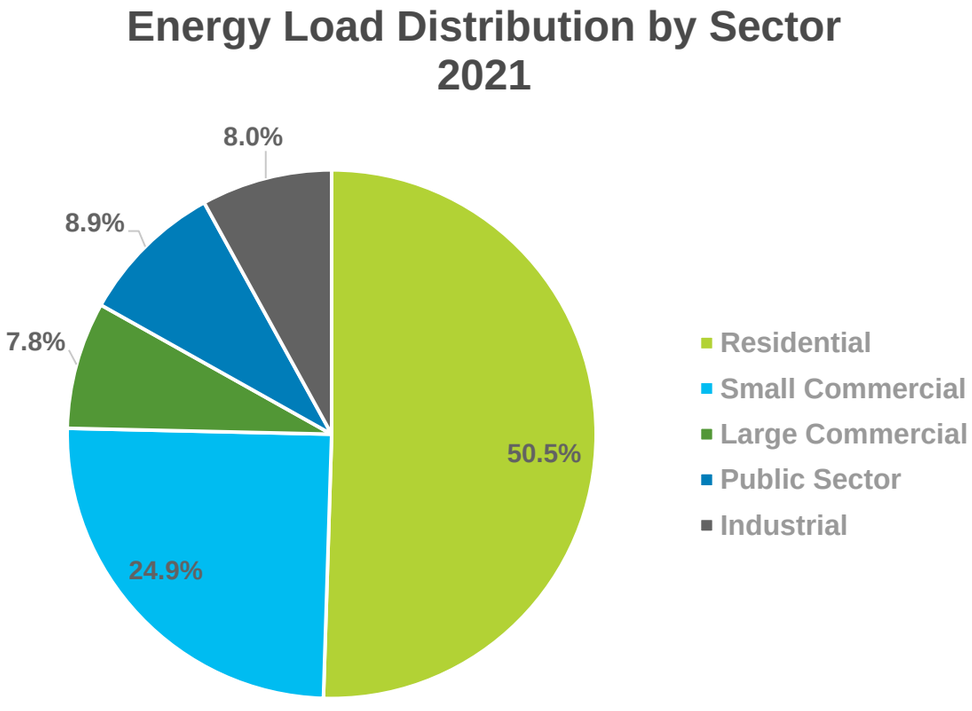
Model Set up - Taxonomy

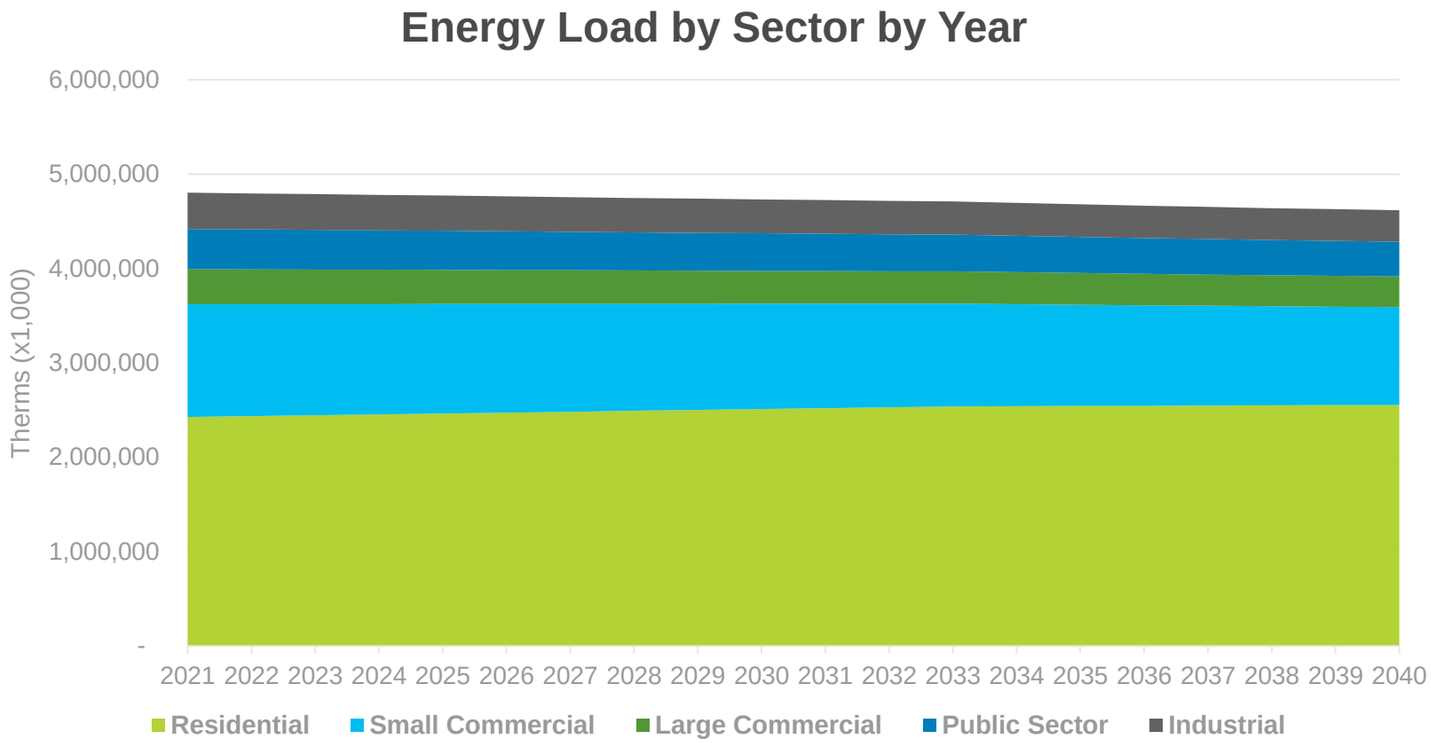
List of Equipment Types by End Use – Residential					
Space Heat	**Water Heat**	**Cooking**	**Dryers**	**Fireplace**	**Other**
Furnace	Conventional Tank	Cooking Equip	Dryers Equip	Fireplace Equip	Other
Boiler	Central Hot Water System				
Space Heat Other	Tankless on Demand				
	Water Heat Other				

List of Equipment Types by End Use – Non-Residential					
Space Heat	**Water Heat**	**Cooking**	**Process Heat**	**Other**	**RNG**
Indoor Gas Forced Air Furnace/S.D.	Conventional	Cooking Equip	Process Heat Equip	Other	RNG Equip
Rooftop or Outdoor Package Unit	Indirect Fired Storage Tank				
Indoor Unit Heater	Tankless, on demand				
Hot Water Boiler	Water Heat Other				
Combined Boiler and Water Heater					

Market Characterization Findings

Energy Load by Sector

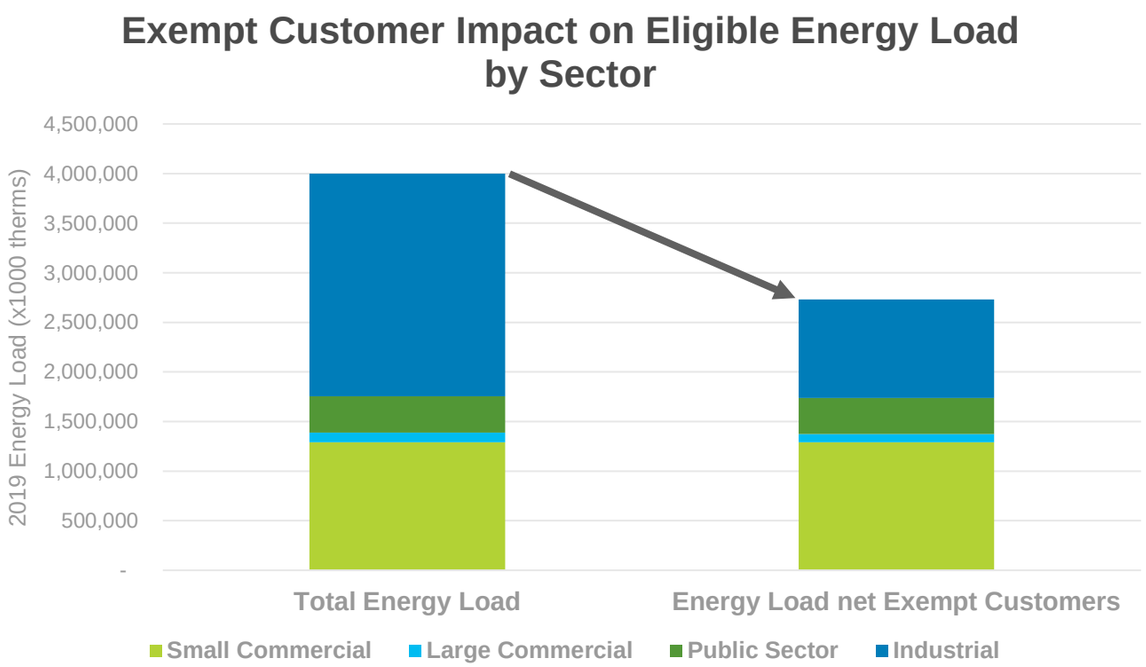


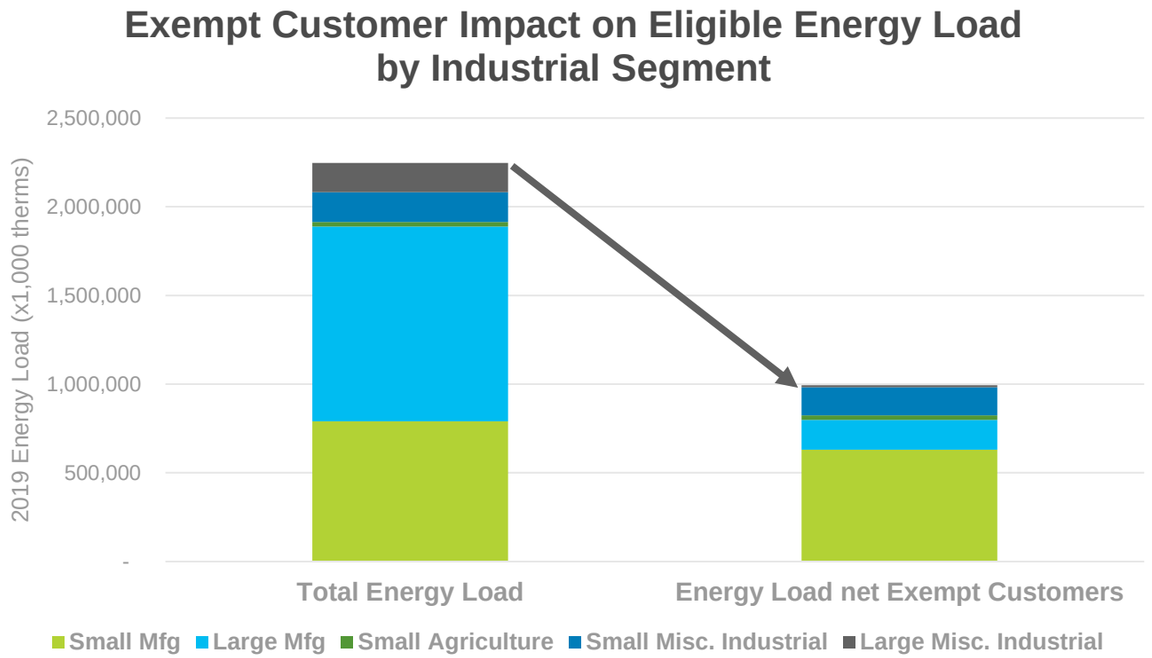


- Findings do not include exempt customers
- Majority (50.5%) of available energy load in residential sector
- Increasing residential forecast
- Declining nonresidential forecast & overall forecast

Nicor Gas | Energy Efficiency Program

Impact of Exempt Customers on Energy Load Eligible for DSM





- Across the portfolio, 32% reduction of energy load eligible for DSM programs due to exempt customers
- 98.6% of exempt customers in the Industrial sector
- 56% reduction in energy load eligible for DSM programs due to exempt customer in Industrial sector
  - Primarily in the Large Mfg. and Large Misc. Industrial segment

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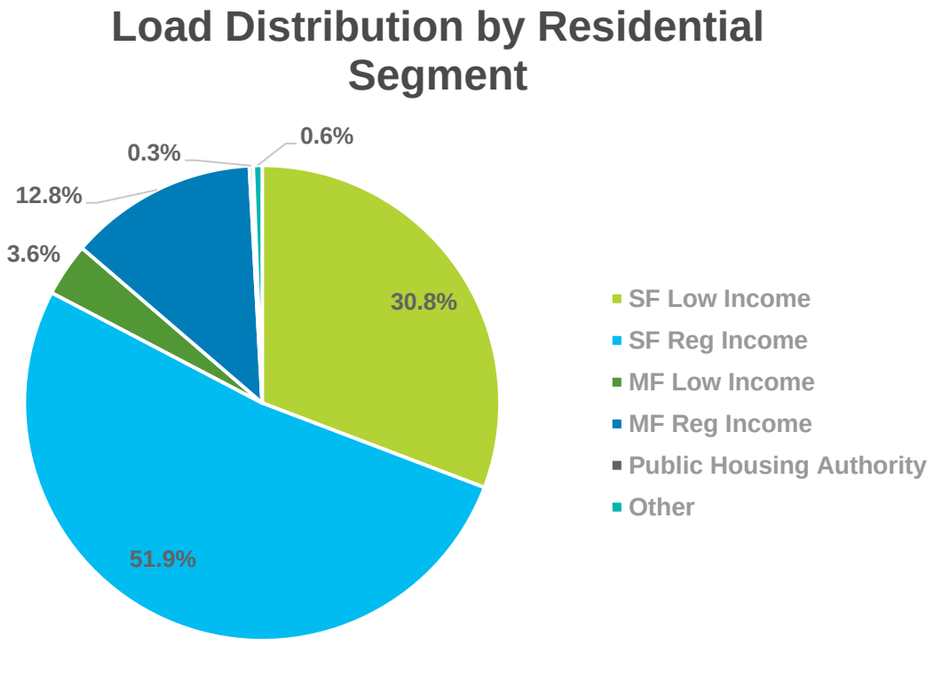
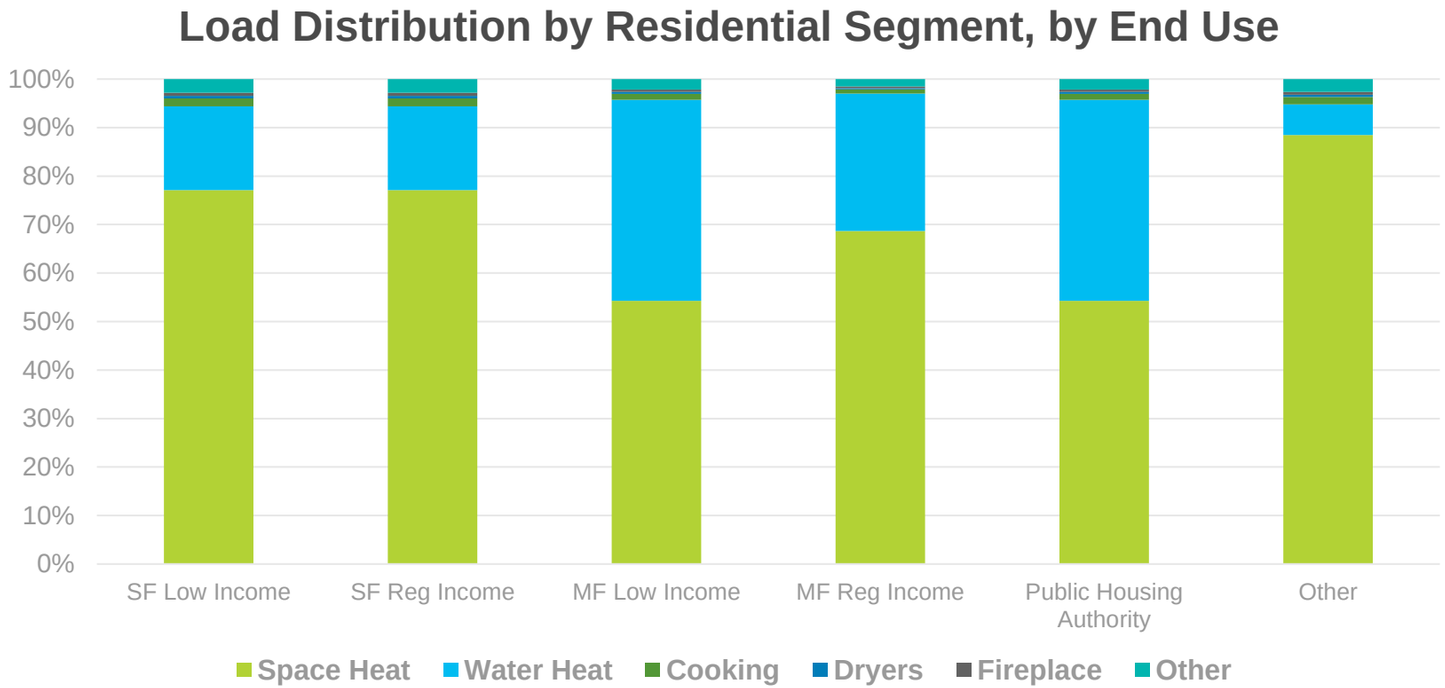
Residential Sector



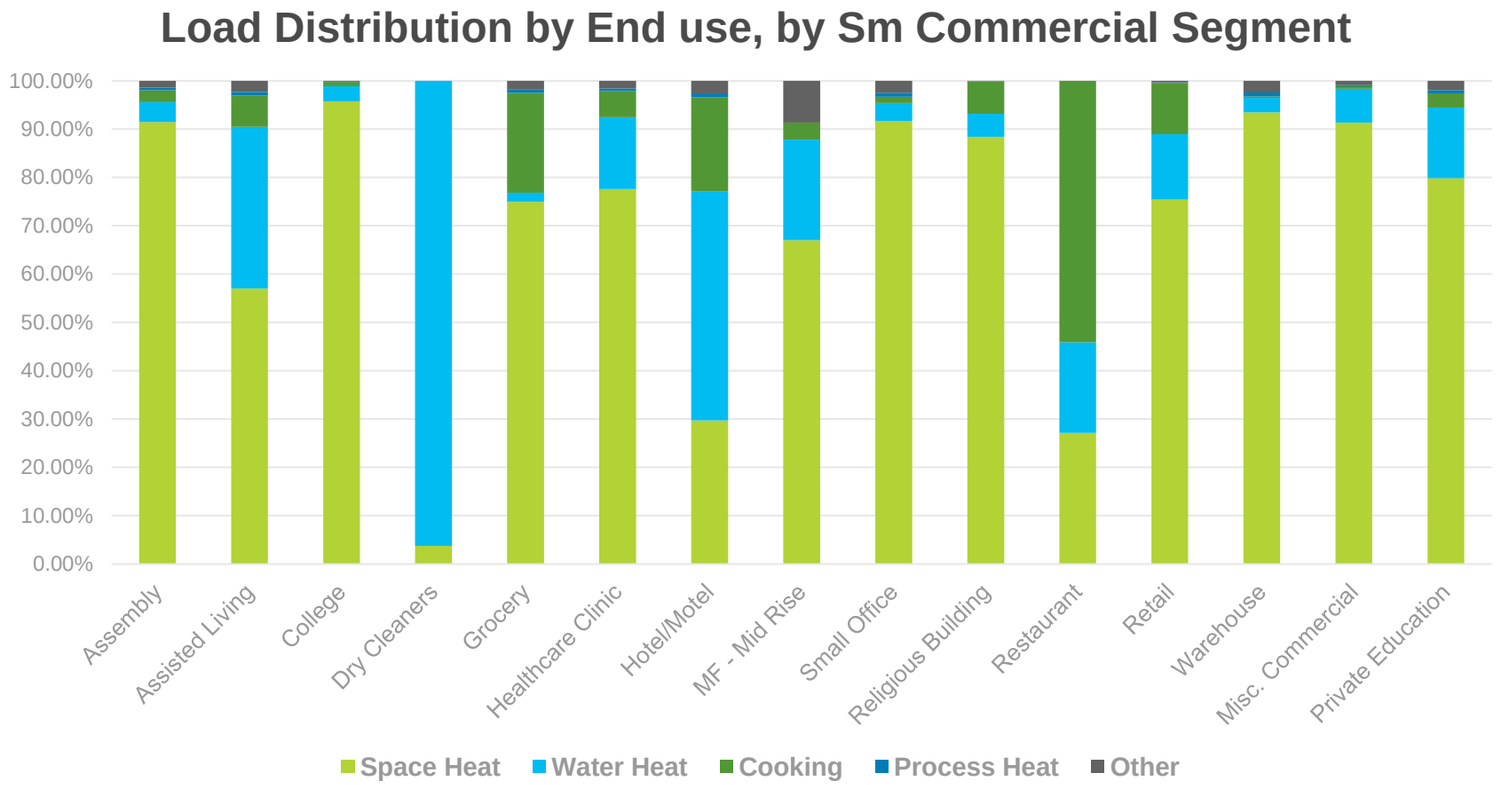


- 83% of energy load in Single Family households
- 35% of energy load in low income households
- Space Heat dominant end use in Single Family
  - Water Heat larger load share in Multifamily

Small Commercial Sector

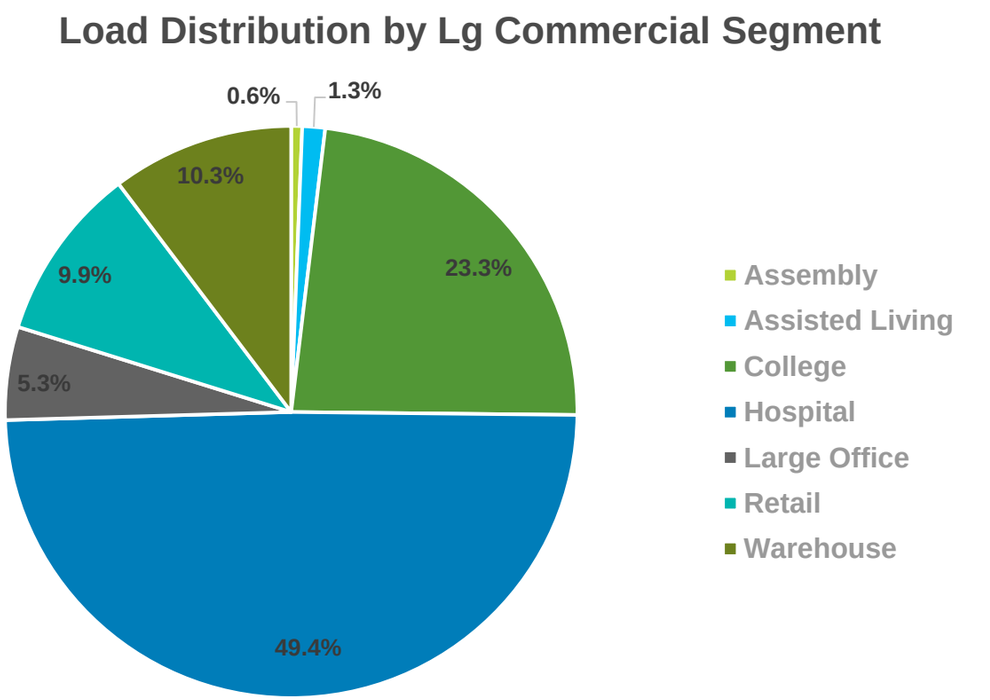
Load Distribution by Sm Commercial Segment

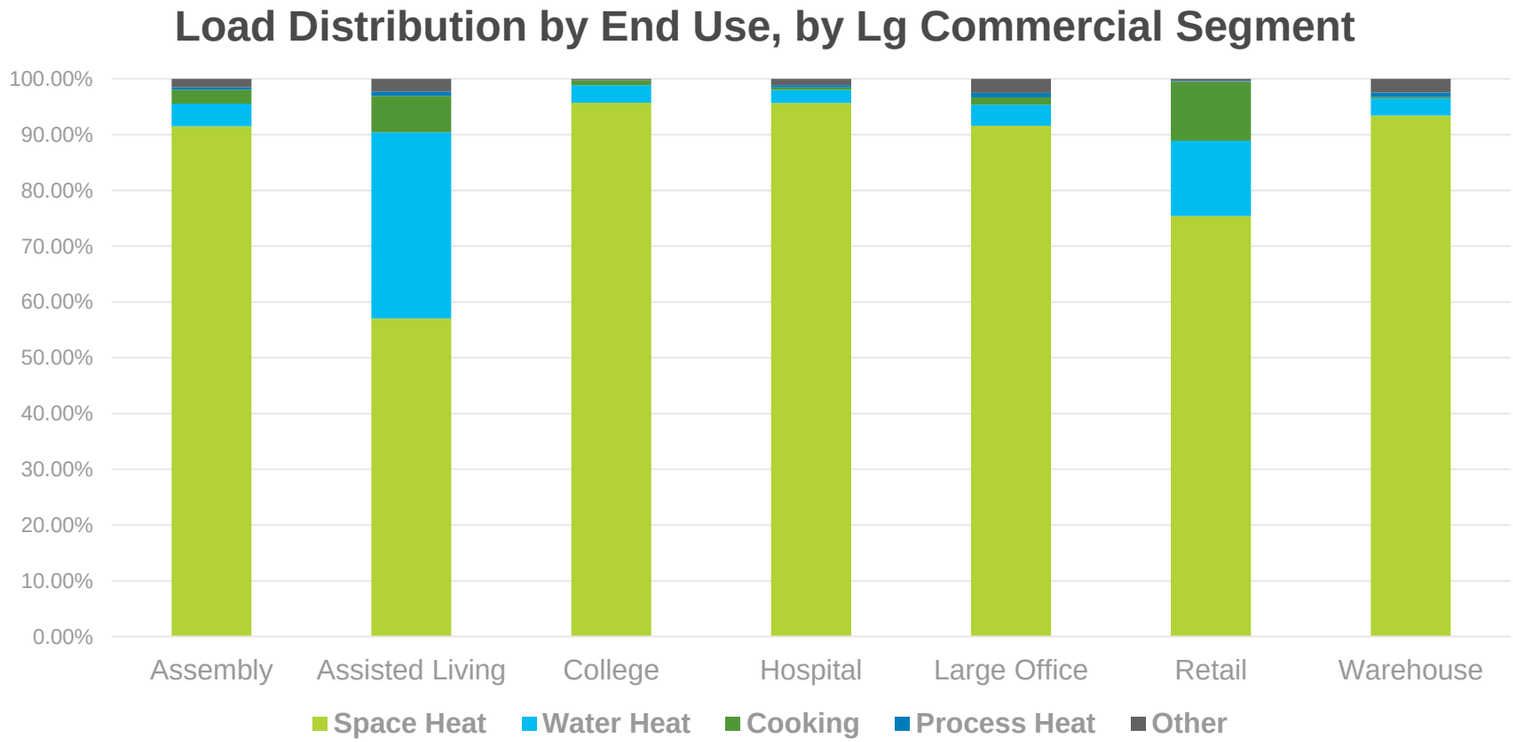
Segment	% of Start Yr Sales
Assembly	2.7%
Assisted Living	3.0%
College	1.6%
Dry Cleaners	1.4%
Grocery	4.5%
Healthcare Clinic	3.7%
Hotel/Motel	3.4%
Small Office	22.9%
Religious Building	4.6%
Restaurant	9.0%
Retail	15.5%
Warehouse	18.8%
Misc. Commercial	6.5%
Private Education	2.4%



- Small Office largest segment, followed by Warehouse and Retail
- Large variation in end use consumption among segments

Large Commercial Sector

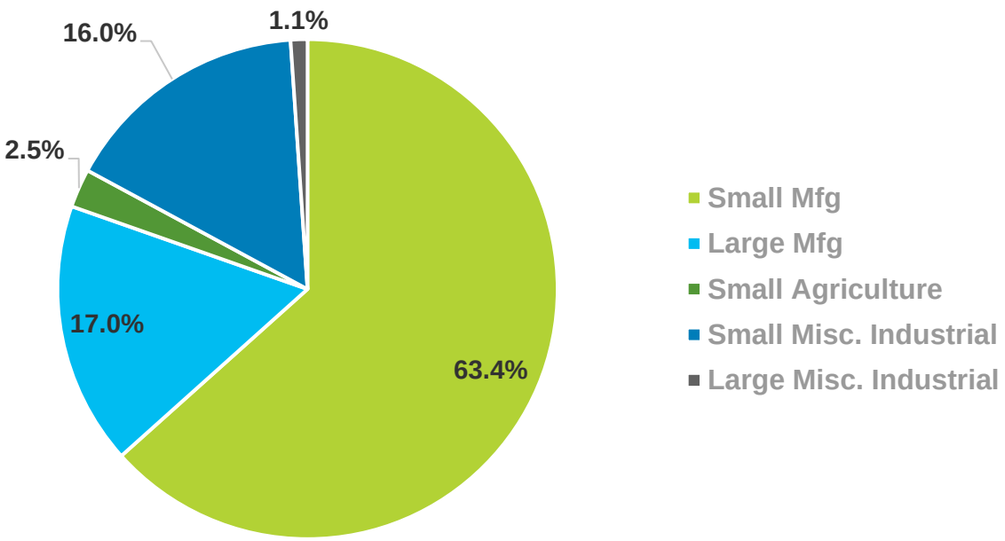




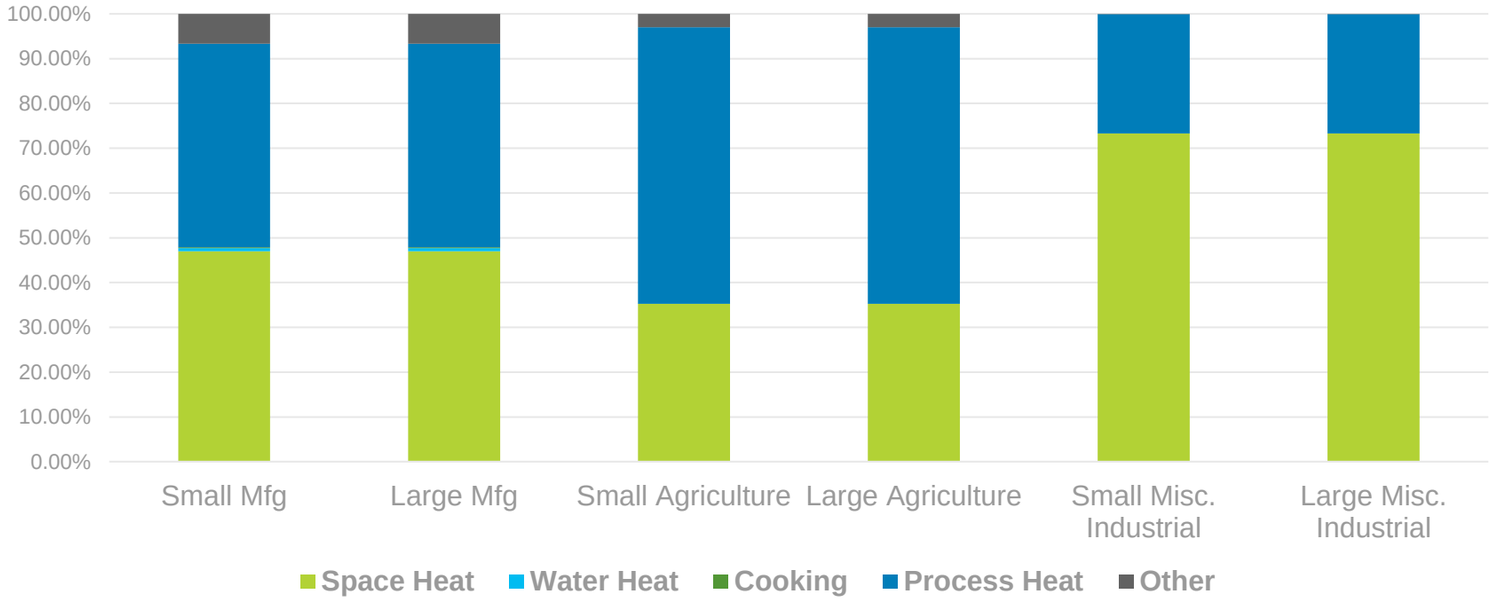
- 32 Accounts – based on Nicor Gas Rate Classification
- Hospital represent majority of accounts and 49% of energy load
- Space Heat dominant end use load

Industrial Sector

Load Distribution by Industrial Segment



Load Distribution by End Use, by Industrial Segment



- 79% of energy load in small industrial facilities
- Process Heat dominant end use load

Adoption Curves

Adoption Curves

Scenario	Adoption Approach
Achievable Maximum	Bass diffusion curve, 100% incentive rate & aggressive program delivery expenditures
Achievable Moderate	Bass diffusion curve, 50% incentive rate & moderate program delivery expenditures
Achievable Base	Flat adoption, calibrated to current program participation

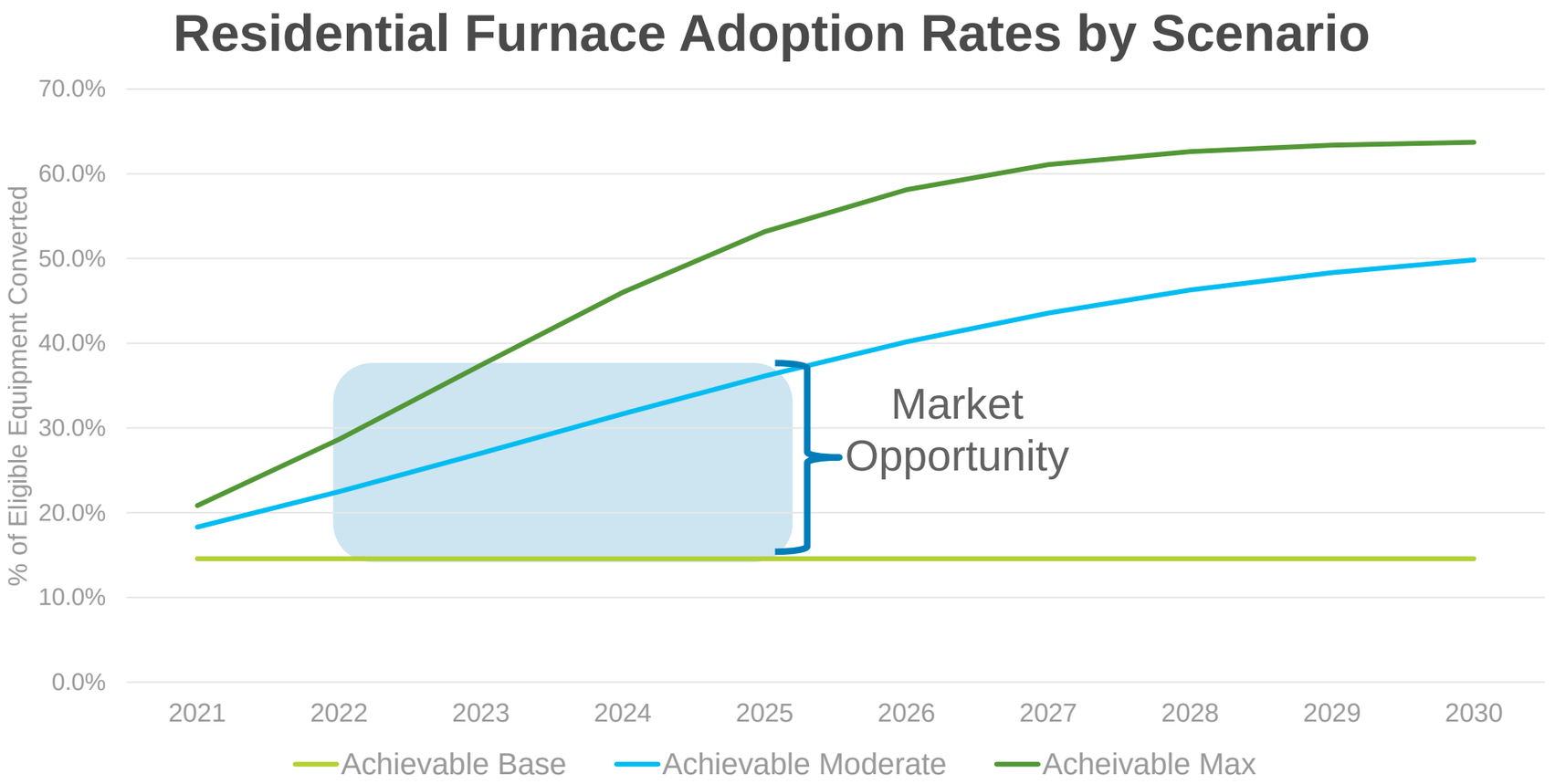
Capture unique characteristics of varying equipment types

✓ 68 Residential curves
✓ 81 Nonresidential curves

- **Achievable Base**
  - Adoption Rate = Current participation / eligible market
  - Used to calibrate model to current program performance
  - Determine starting share (y-intercept) on bass diffusion curve (for Achievable Mod/Max)

- **Achievable Moderate/Maximum**
  - Utilize bass diffusion theory to identify market opportunities and available potential with more aggressive program delivery
  - Max shares based on benchmark willingness to participate research

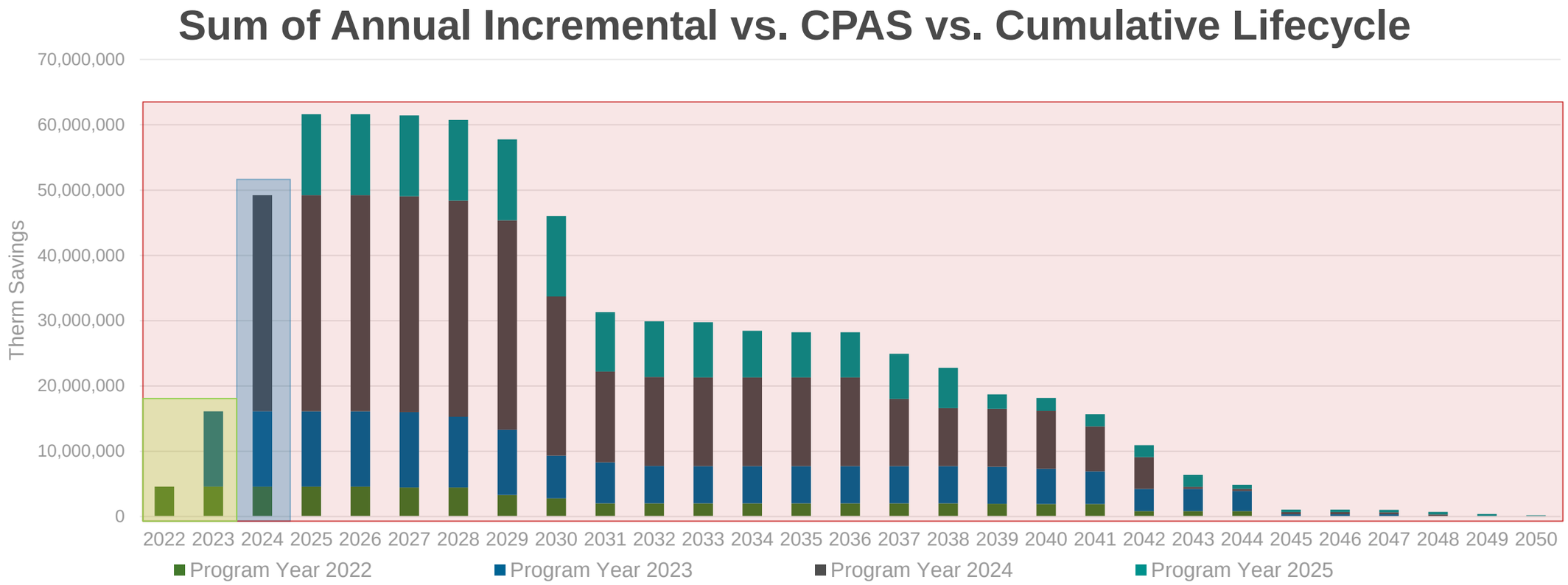
Adoption Curves



Achievable Mod/Max scenarios enable program staff to identify market opportunities in comparison to business as usual program delivery (Ach Base)

Study Findings

Savings – Accounting Methods



= 2023 Sum of Annual Incremental Savings (no decay)

= 2024 Cumulative Persisting Annual Savings (CPAS)

= 2025 Cumulative Lifecycle Savings

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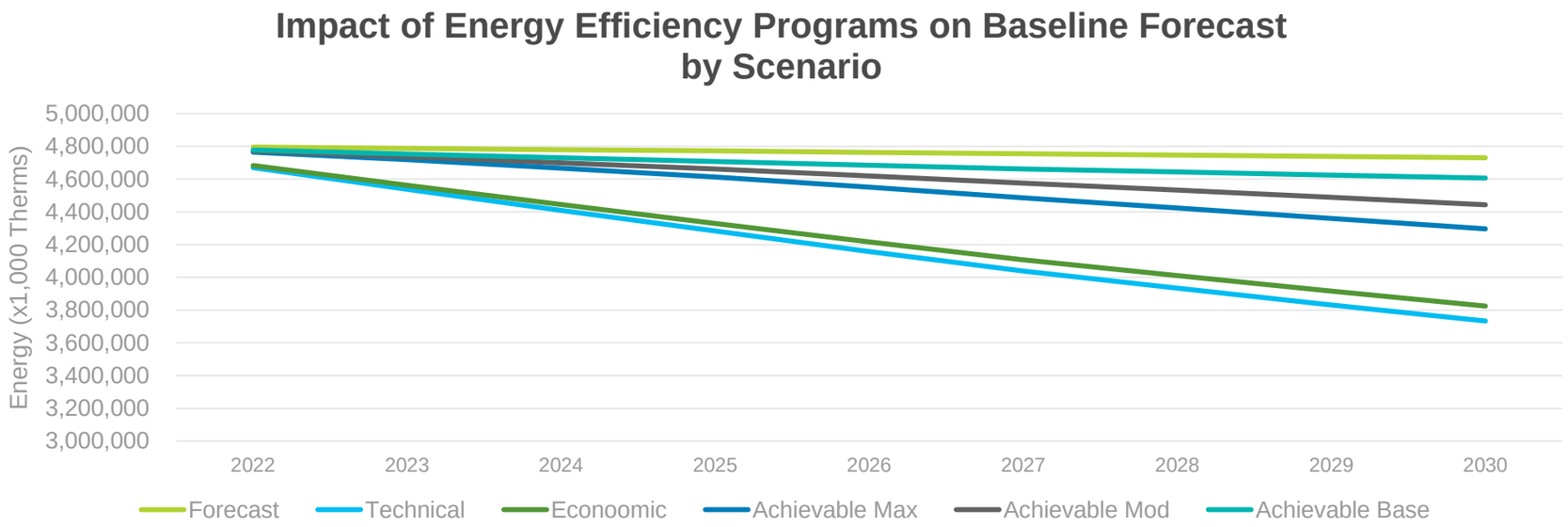
Portfolio Results – Cumulative Persisting Annual Savings (CPAS)

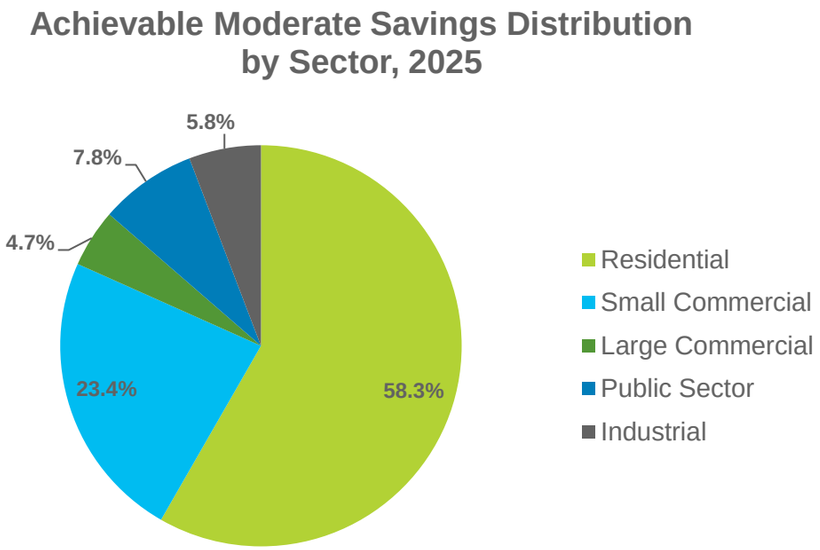


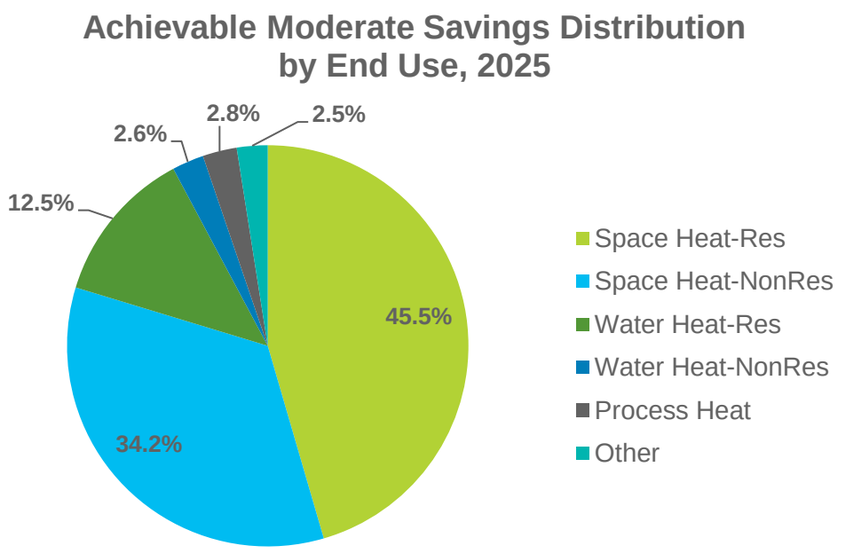
Portfolio Net Energy (x1,000 therms) Savings Potential by Scenario, by Year - CPAS

	2022	2023	2024	2025	4-year Avg.
CPAS Net Energy Savings Potential (x1,000 Therms)					
Technical	125,268	249,760	370,944	489,137	122,284
Economic	113,163	226,200	336,012	442,974	110,743
Achievable Max	30,888	69,017	113,219	160,110	40,028
Achievable Moderate	23,704	50,757	80,278	110,452	27,613
Achievable Base	15,368	30,723	45,467	58,524	14,631
CPAS Net Energy Savings Potential - % of Current Year Portfolio Load					
Technical	2.6%	5.2%	7.8%	10.2%	2.6%
Economic	2.4%	4.7%	7.0%	9.3%	2.3%
Achievable Max	0.6%	1.4%	2.4%	3.4%	0.8%
Achievable Moderate	0.5%	1.1%	1.7%	2.3%	0.6%
Achievable Base	0.3%	0.7%	1.0%	1.2%	0.3%

- Tech/Econ savings acquired over time
- An additional 13M therms savings per year feasible with Achievable Mod scenario, absent budget constraints
- Average annual baseline forecast reduction of 0.3% to 0.6% feasible

Portfolio Results – Cumulative Persisting Annual Savings (CPAS)





- 82% of potential in Residential and Small Commercial sectors
- 80% of potential in space heat end use
- $182M budget to acquire 61.5M therms in Achievable base ($2.97/therm)
- Additional $315M ($79M/year) to acquire Achievable mod savings (115M therms)

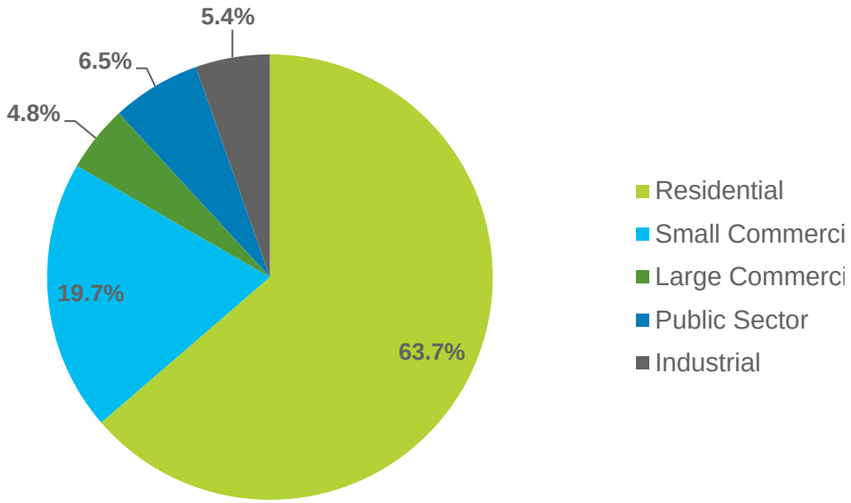
Portfolio Acquisition Cost and TRC by Scenario

Scenario	2022-2025 Program Costs ($Million)	2022-2025 Net Savings* (x1,000 Therms)	Acquisition Costs ($/Therms)	TRC
Achievable Max	$1,133	166,914	$6.79	2.0
Achievable Moderate	$497	115,170	$4.31	1.9
Achievable Base	$182	61,452	$2.97	1.9

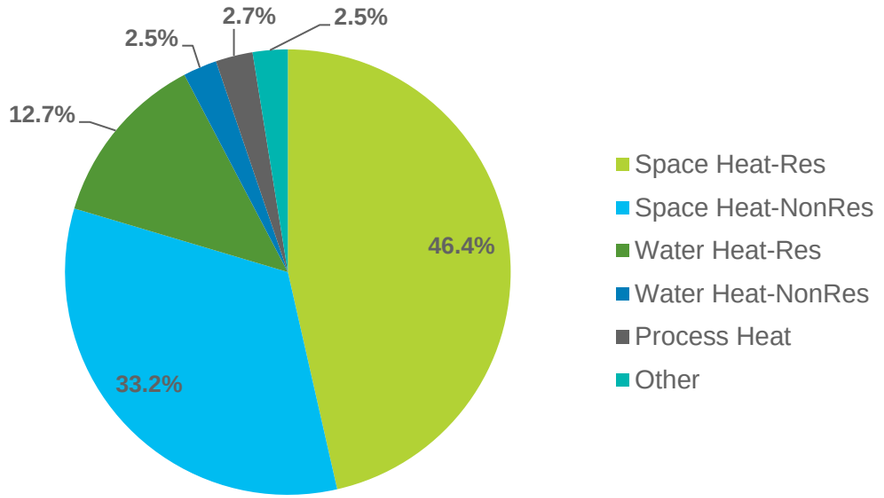
* Sum of annual incremental savings

Portfolio Results – Cumulative Lifecycle

Achievable Moderate Savings Distribution by Sector, 2025



Achievable Moderate Savings Distribution by End Use, 2025

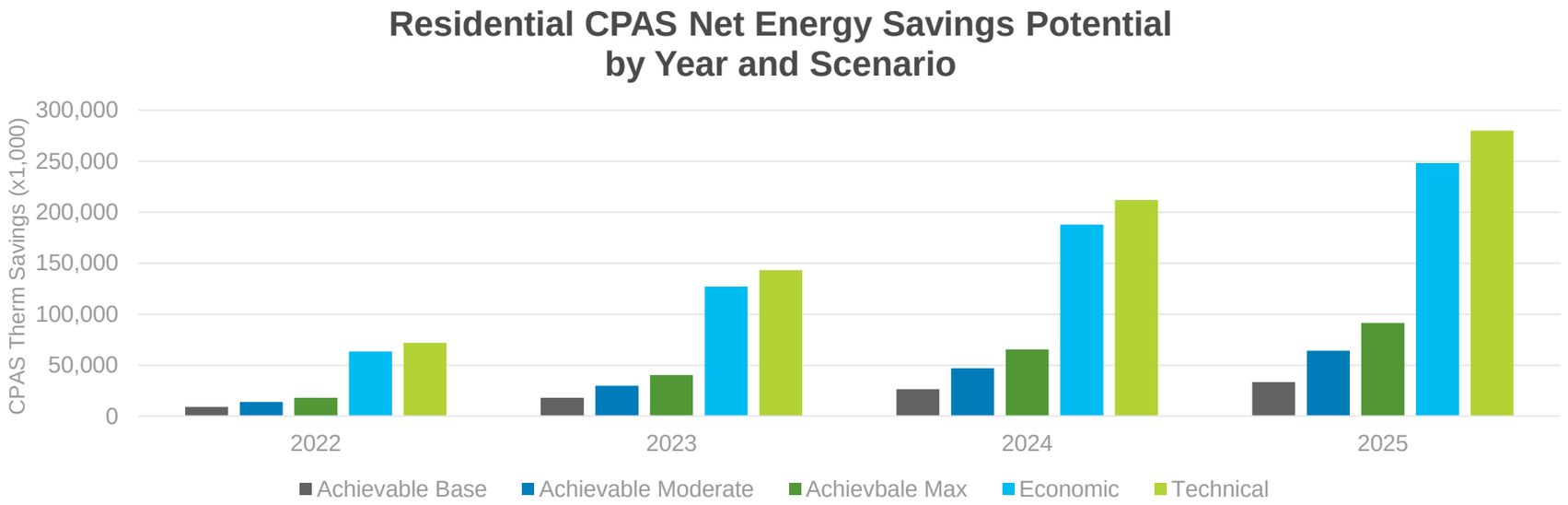


- Proportionally, more cumulative lifecycle savings in Residential sector
- Minimal difference in end use savings

Portfolio Net Energy (x1,000 therms) Savings Potential by Scenario, by Year – Cumulative Lifecyle

	2022	2023	2024	2025	4-year Avg.
Cumulative Lifecycle Net Energy Savings Potential (x1,000 Therms)					
Technical	1,735,840	3,471,295	5,206,356	6,941,015	1,735,254
Economic	1,593,570	3,186,642	4,779,209	6,371,263	1,592,816
Achievable Max	380,800	868,759	1,468,280	2,174,529	543,632
Achievable Moderate	294,478	639,359	1,036,688	1,486,912	371,728
Achievable Base	184,114	368,146	552,095	735,960	183,990

Residential Results – Cumulative Persisting Annual Savings (CPAS)

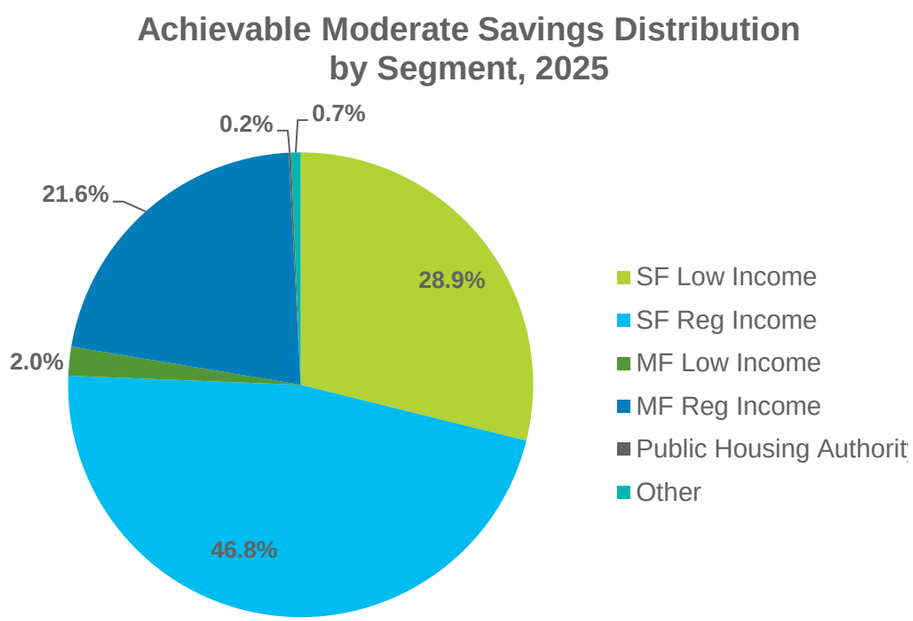


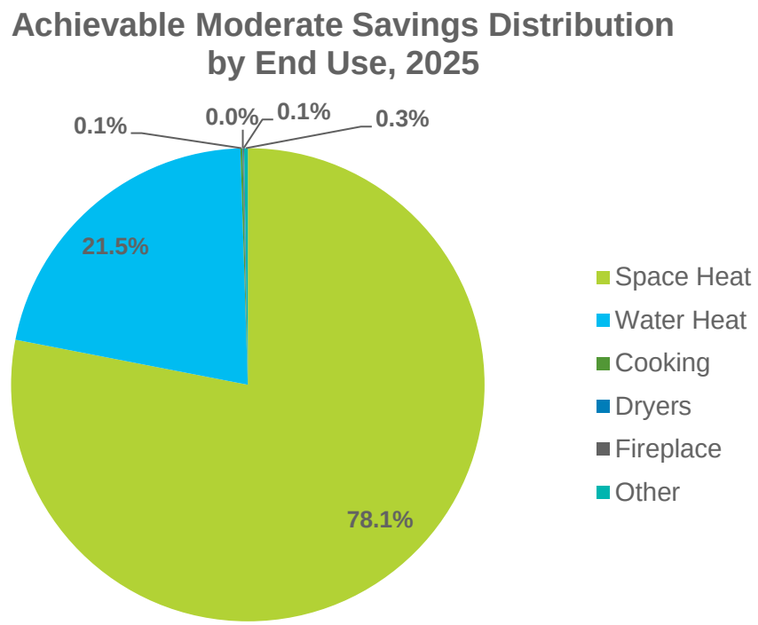
Residential Net Energy (x1,000 therms) Savings Potential by Scenario, by Year - CPAS

	2022	2023	2024	2025	4-year Avg.
CPAS Savings Potential (x1,000 Therms)					
Technical	71,875	143,377	211,971	280,061	70,015
Economic	63,478	127,203	188,078	248,201	62,050
Achievable Max	18,155	40,411	65,597	91,392	22,848
Achievable Moderate	13,982	30,005	47,195	64,300	16,075
Achievable Base	8,985	18,005	26,462	33,488	8,372
CPAS Net Energy Savings Potential - % of Current Year Residential Sector Load					
Technical	3.0%	5.9%	8.6%	11.4%	2.8%
Economic	2.6%	5.2%	7.7%	10.1%	2.5%
Achievable Max	0.7%	1.7%	2.7%	3.7%	0.9%
Achievable Moderate	0.6%	1.2%	1.9%	2.6%	0.7%
Achievable Base	0.4%	0.8%	1.2%	1.5%	0.4%

- An additional 7.7M therms savings per year feasible under Achievable Mod scenario, absent budget constraints
- Average annual baseline forecast reduction of 0.4% (Ach Base) to 0.7% (Ach Mod) feasible

Residential Results – Cumulative Persisting Annual Savings (CPAS)





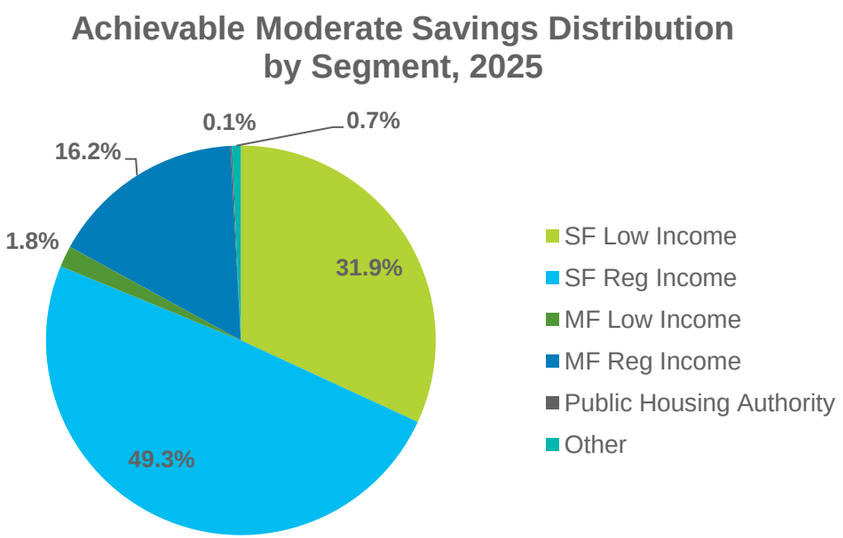
- Acquisition cost of $2.92/therm (Ach Base) to $4.89/therm (Ach Mod)
- Additional $218M ($54M per year) needed to acquire entire Achievable mod opportunity

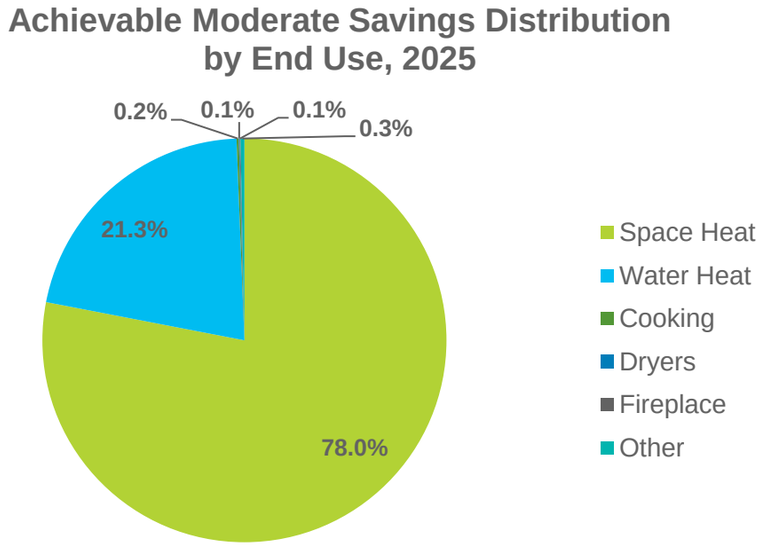
Residential Acquisition Cost and TRC by Scenario

Scenario	2022-2025 Program Costs ($Million)**	2022-2025 Net Savings* (x1,000 Therms)	Acquisition Costs ($/Therms)	TRC
Achievable Max	$761	97,249	$7.83	1.8
Achievable Moderate	$335	68,4218	$4.89	1.7
Achievable Base	$106	36,157	$2.92	1.7

* Sum of annual incremental savings
** Does not include portfolio level fixed costs

Residential Results – Cumulative Lifecycle





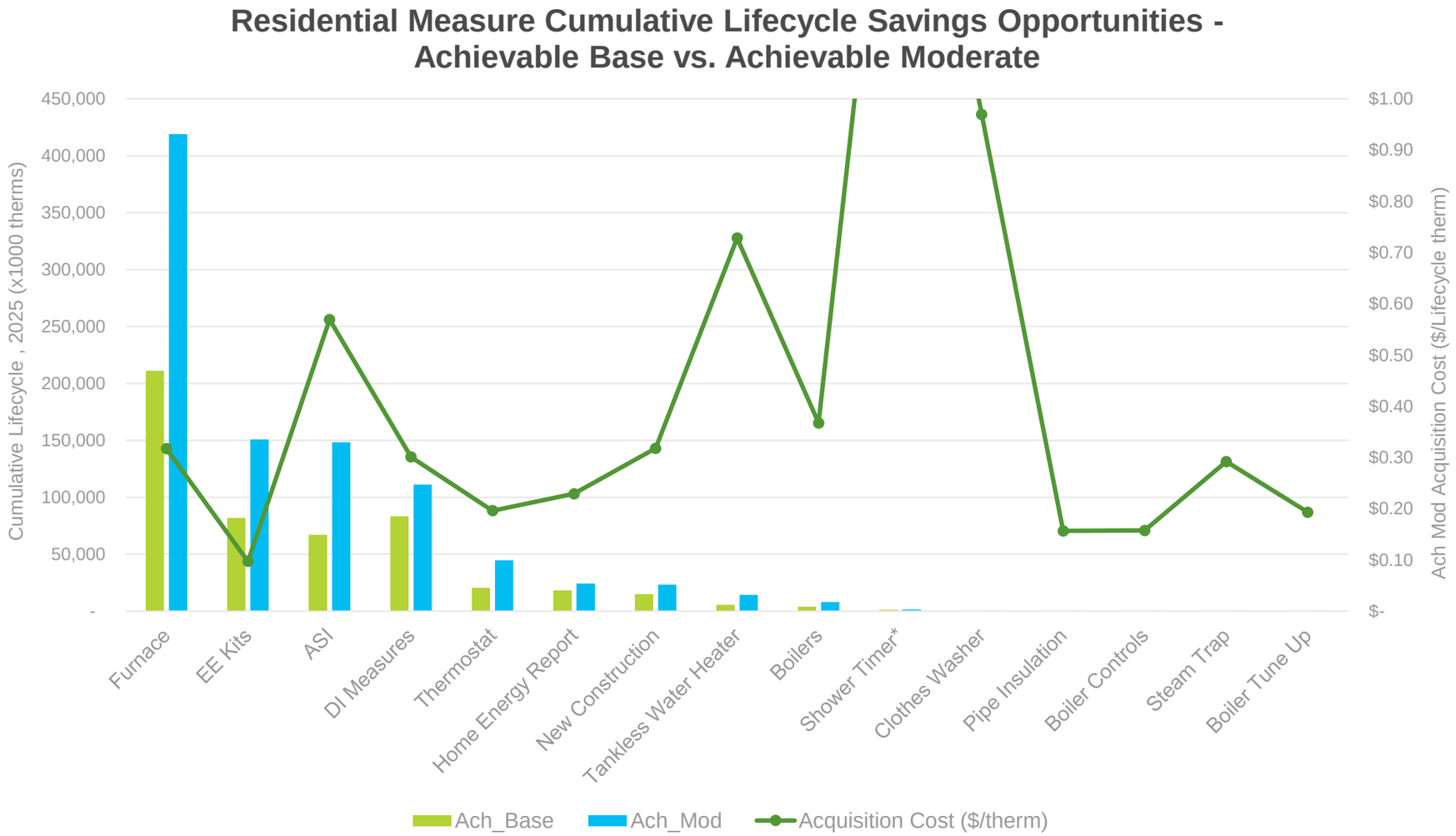
- More savings opportunity in Single Family segments
- Furnace measure represent 44% of savings potential, followed by Kits and Air Sealing / Insulation measures
- EE Kits, DI Measures, Thermostats and HER least expensive measures

Top 10 Residential Measures, Achievable Mod – 2025 Cumulative Lifecycle Net Energy Savings

Measure Category	Cumulative Lifecycle Net Energy Savings (therms)	% of Total	Acquisition Cost ($/Lifecycle therm)	Acquisition Cost ($/therm*)
Furnace	419,139,157	44.3%	$0.32	$6.34
EE Kits	150,901,209	15.9%	$0.10	$1.45
Air Sealing & Insulation	148,438,900	15.7%	$0.57	$11.39
Direct Install Measures	111,114,553	11.7%	$0.30	$2.48
Thermostat	44,673,746	4.7%	$0.20	$1.98
Home Energy Report	24,269,020	2.6%	$0.23	$0.64
New Construction	23,129,029	2.4%	$0.32	$6.18
Tankless Water Heater	14,256,311	1.5%	$0.73	$9.47
Boilers	8,136,797	0.9%	$0.37	$8.59
Shower Timer	1,404,072	0.2%	$1.80	$3.70

* Sum of annual incremental savings

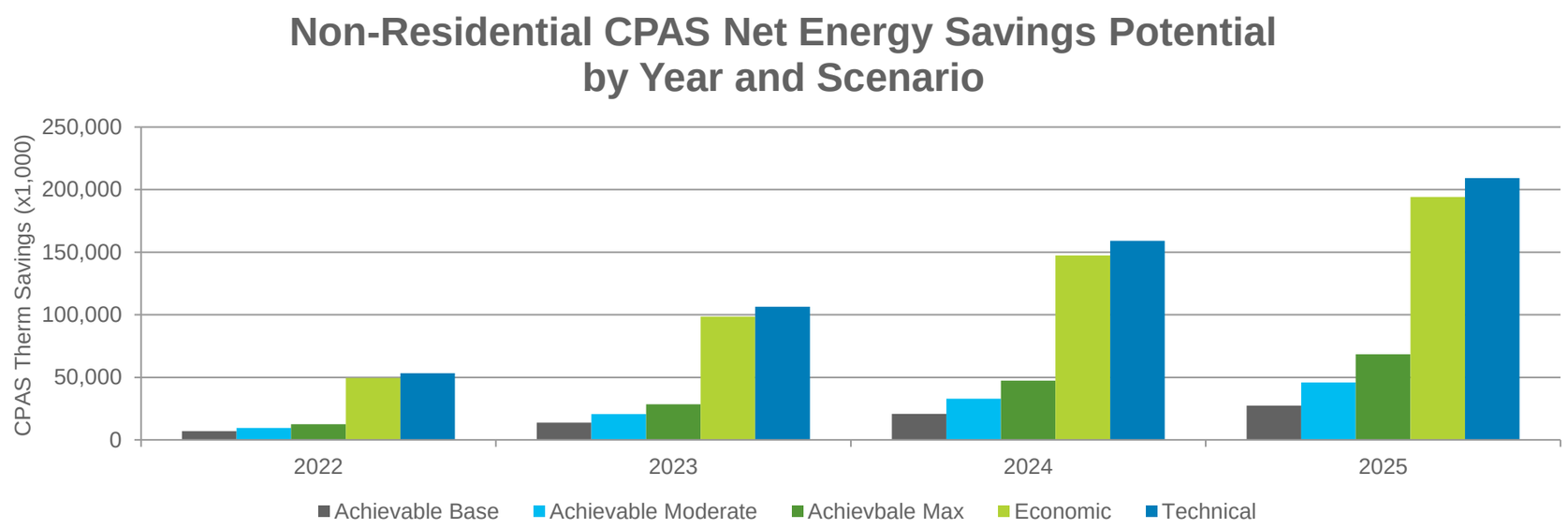
Residential Results – Cumulative Lifecycle



- Furnace represents largest opportunity in savings, but moderately expensive
- EE Kits show largest opportunity for increased savings at lowest acquisition cost

* Shower Timer = $1.80/lifecycle therm

Non-Residential Results – Cumulative Persisting Annual Savings (CPAS)

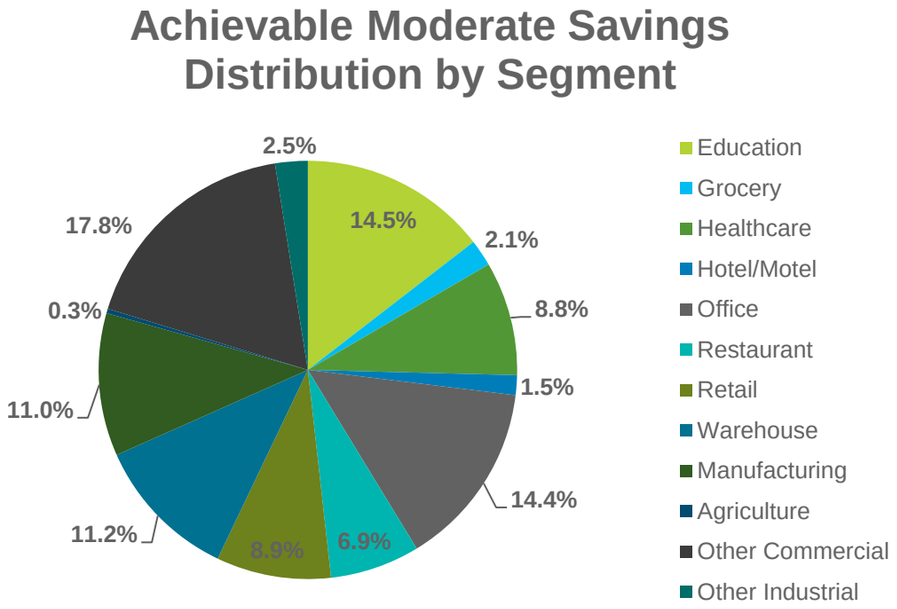


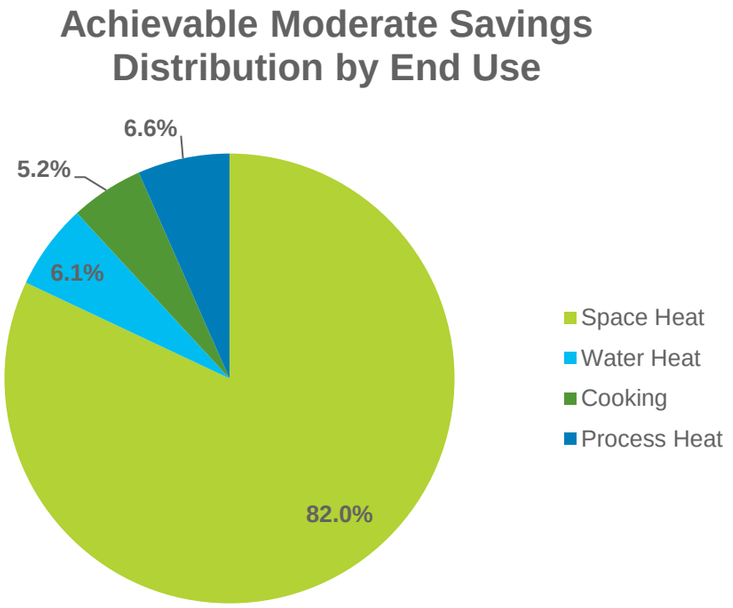
Non-Residential Net Energy (x1,000 therms) Savings Potential by Scenario, by Year - CPAS

	2022	2023	2024	2025	4-year Avg.
CPAS Net Energy Savings Potential (x1,000 Therms)					
Technical	53,392	106,383	158,972	209,076	52,269
Economic	49,685	98,996	147,934	194,773	48,693
Achievable Max	12,734	28,607	47,622	68,718	17,179
Achievable Moderate	9,721	20,751	33,083	46,152	11,538
Achievable Base	6,383	12,718	19,005	25,036	6,259
CPAS Net Energy Savings Potential - % of Current Year Portfolio Load					
Technical	2.3%	4.5%	6.8%	9.1%	2.3%
Economic	2.1%	4.2%	6.4%	8.4%	2.1%
Achievable Max	0.5%	1.2%	2.0%	3.0%	0.7%
Achievable Moderate	0.4%	0.9%	1.4%	2.0%	0.5%
Achievable Base	0.3%	0.5%	0.9%	1.1%	0.3%

- An additional 5.2M therms savings per year feasible under Achievable Mod scenario, absent budget constraints
- Average annual baseline forecast reduction of 0.3% (Ach Base) to 0.5% (Ach Mod) feasible

Non-Residential Results – Cumulative Persisting Annual Savings (CPAS)





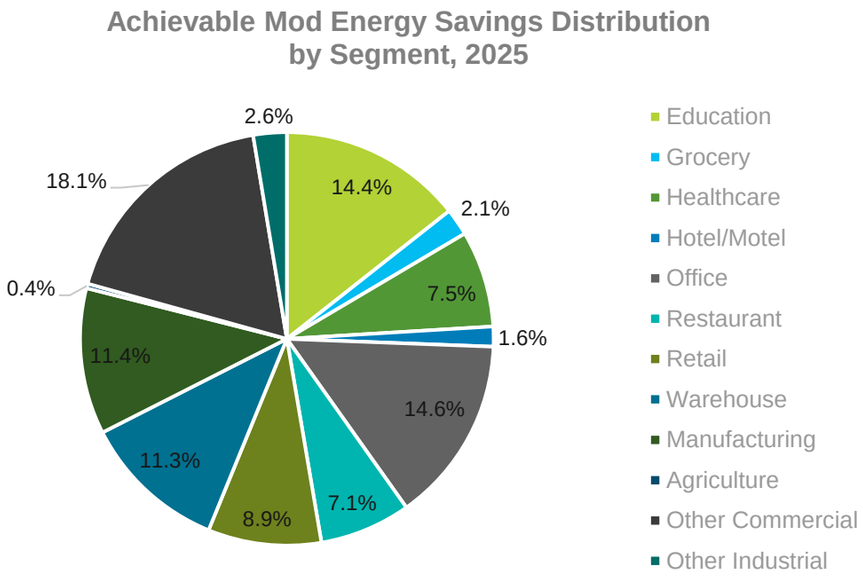
- Non-Res acquisition cost less expensive than residential portfolio
- Additional $74M ($18.5M per year) needed to acquire entire Achievable mod opportunity

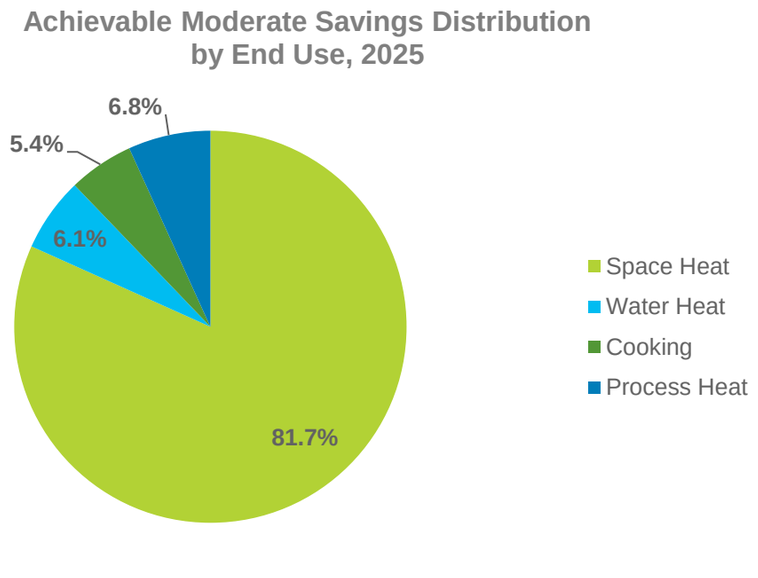
Residential Acquisition Cost and TRC by Scenario

Measure Category	2022-2025 Program Costs ($Million)**	2022-2025 Net Savings* (x1,000 Therms)	Acquisition Costs ($/Therms)	TRC
Achievable Max	$317	69,665	$4.55	2.5
Achievable Moderate	$121	46,753	$2.58	2.5
Achievable Base	$47	25,296	$1.84	2.4

* Sum of annual incremental savings
** Does not include portfolio level fixed costs

Non-Residential Results – Cumulative Lifecycle





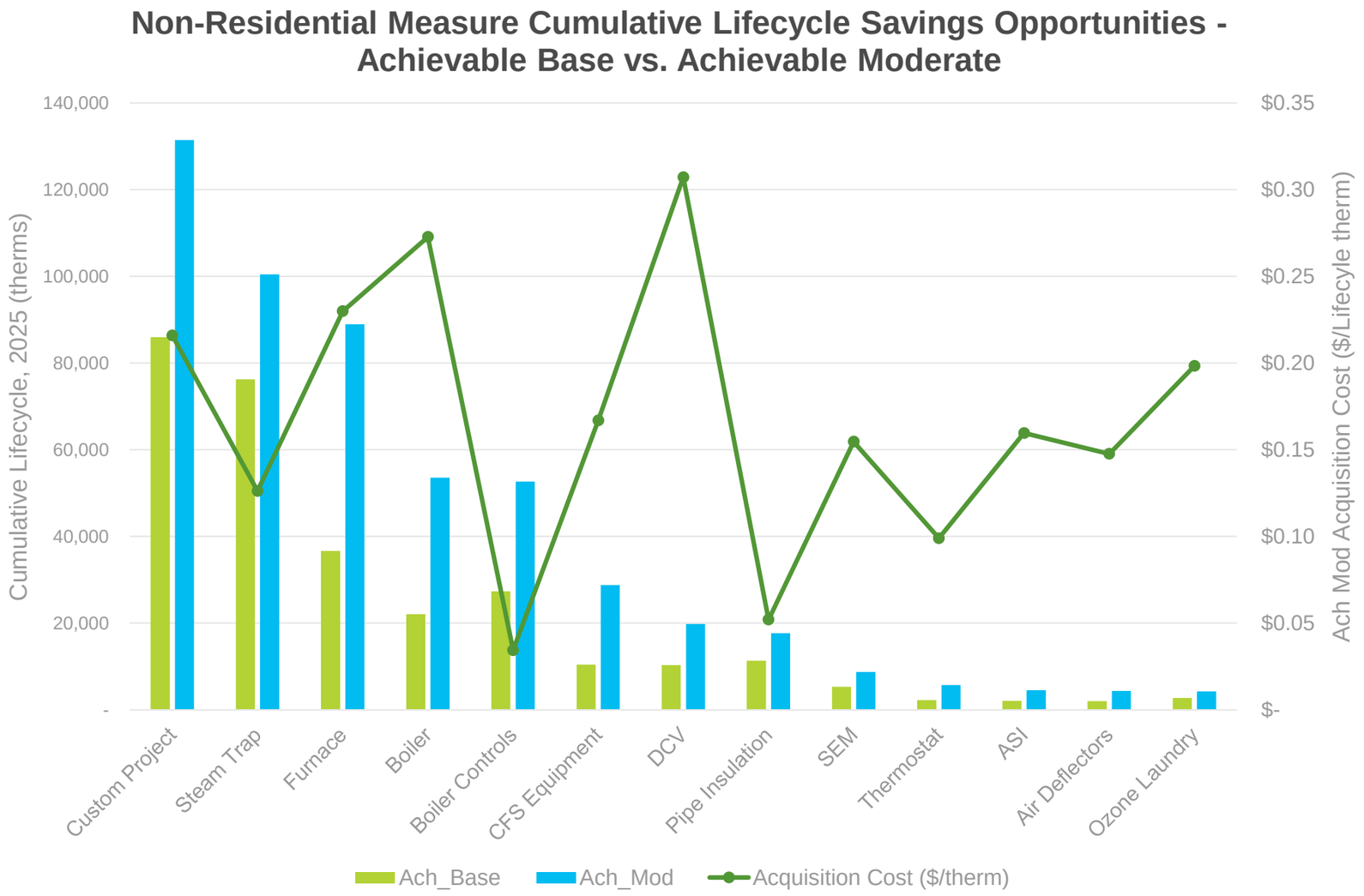
- Savings opportunity evenly distributed among segments
- Custom Projects represent largest opportunity (24%), followed by Steam Traps and Furnaces
- Steam Traps and Boiler controls least expensive measures with large opportunity

Top 10 Non-Residential Measures, Achievable Mod – 2025 Cumulative Lifecycle Net Energy Savings

Measure Category	Cumulative Lifecycle Net Savings (therms)	% of Total	Acquisition Cost ($/Lifecycle therm)	Acquisition Cost ($/therm*)
Custom Project	131,448,567	24.3%	$0.22	$4.42
Steam Trap	100,431,441	18.6%	$0.13	$0.76
Furnace	88,969,511	16.5%	$0.23	$3.25
Boiler	53,563,999	9.9%	$0.27	$6.82
Boiler Controls	52,664,929	9.8%	$0.03	$0.69
CFS Equipment	28,811,227	5.3%	$0.17	$1.99
DCV	19,813,808	3.7%	$0.31	$3.07
Pipe Insulation	17,684,307	3.3%	$0.05	$0.78
SEM	8,718,279	1.6%	$0.15	$0.75
Thermostat	5,711,142	1.1%	$0.10	$0.72

* Sum of annual incremental savings

Non-Residential Results – Cumulative Lifecycle



- Furnace represents largest opportunity in savings
- Boiler Controls show largest opportunity for increased savings at lowest acquisition cost