

DOCKETED

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2025 AAEE & AAFS Draft Results

Integrated Energy Policy Report Forecast Commissioner Workshop

Ingrid Neumann, Ph.D., and Ethan Cooper

Energy Assessments Division

November 13, 2025

Introduction to AAEE & AAFS and PiCS AAEE & PiCS AAFS Draft Results



Ingrid Neumann, Ph.D.

Decarbonization Principal, Advanced Electrification Analysis Branch

November 13, 2025



Acronyms, Initialisms, and Abbreviations

AAEE – Additional Achievable Energy Efficiency
AAFS – Additional Achievable Fuel Substitution
AMI – Advanced Metering Infrastructure
AQMD – Air Quality Management District
A&A – Additions and Alterations
BU – Beyond Utility
C&S – Codes and Standards
CARB – California Air Resources Board
CCA – Community Choice Aggregator
CEC – California Energy Commission
CMUA – California Municipal Utility Association
Com – Commercial
DOE – Department of Energy
EBD – Equitable Building Decarbonization
ER – Electric-Resistant Appliance
EUL – Effective Useful Life
Feb - February
FSSAT – Fuel Substitution Scenario Analysis Tool
HH - Household

HPWH – Heat Pump Water Heater
IEPR – Integrated Energy Policy Report
IOU – Investor-Owned Utility
IRA - Inflation Reduction Act
GHG – Greenhouse Gases
LI – Low Income
NC – New Construction
PAR – Proposed Amended Rule
PG&E – Pacific Gas Utility
PiCS – Programs and incremental Codes and Standards
POU – Publicly Owned Utility
Progs - Programs
REN – Regional Energy Network
Res - Residential
ROB – Replace on Burnout
Sc - Scenario
SCE – Southern California Edison



Acronyms, Initialisms, and Abbreviations (Continued)

SDG&E – San Diego Gas and Electric

Sept - September

SH – Space Heating

SIP – State Implementation Plan

T20 – Title 20 California Appliance Standards Code

T24 – Title 24 California Building Standards Code

TECH- Technology and Equipment for Clean
Heating

ZE - Zero-Emission



2025 AAEE & AAFS Draft Results Agenda

#	Topic	Description
1	Introduction to AAEE & AAFS (Ingrid Neumann, Ph.D.)	Background information about CEC's Additional Achievable Energy Efficiency (AAEE) & Additional Achievable Fuel Substitution (AAFS) Framework
2	Draft PiCS AAEE & PiCS AAFS Results (Ingrid Neumann, Ph.D.)	Summarize the Program and Incremental Codes & Standards (PiCS) AAEE & PiCS AAFS Draft Results
3	Draft ZE AAFS and AAEE & AAFS Annual and Hourly Results (Ethan Cooper)	Summarize zero-emission (ZE) AAFS results and summarize the aggregate AAEE & AAFS load modifier combinations
4	Discussion	Questions and Answers



Additional Achievable Framework & Scenarios

- The “**Additional Achievable**” framework is applied to energy efficiency, fuel substitution, and transportation electrification for the IEPR demand forecast.
- **Additional Achievable** scenarios capture a range of incremental potential energy demand impacts beyond what is included in the baseline demand forecast, but they are within the range of what is reasonably expected to occur.

Additional Achievable Scenarios for Efficiency and Fuel Substitution

AAEE 1, AAEE 2, AAEE 3, AAEE 4, AAEE 5, AAEE 6

AAFS 1, AAFS 2, AAFS 3, AAFS 4, AAFS 5, AAFS 6

← *Conservative* *Optimistic* →



AAEE & AAFS Nomenclature Refresher

Load Modifier Label	Description	Modeling Steps	Modeling Component(s)	Set of Scenarios Modeled
PiCS AAEE	AAEE gas and electricity <i>savings</i> from Programs and incremental Codes & Standards (PiCS)	1a	PiCS workbooks	PiCS AAEE Scenarios 1-6
PiCS AAFS	AAFS gas and electricity <i>impacts</i> from PiCS	1b	PiCS workbooks	PiCS AAFS Scenarios 1-6
ZE AAFS	Gas and electricity impacts from zero-emission (ZE) appliance adoption above and beyond those realized in the PiCS AAFS scenarios	2	ZE appliance adoption scenarios modeled using FSSAT and based on AAFS PiCS scenario impacts (Step 1b)	ZE AAFS Scenarios 1-6
(Final) AAEE & AAFS	The realized AAEE and AAFS estimates after accounting for the combined savings and impacts from a set of PiCS AAEE , PiCS AAFS , and ZE AAFS scenarios	3	FSSAT modeled outputs that modify PiCS AAEE (Step 1a), and combine impacts from PiCS AAFS (Steps 1b) and ZE AAFS (Step 2)	AAEE-AAFS Scenarios 1-6



PiCS AAEE & PiCS AAFS Draft Results



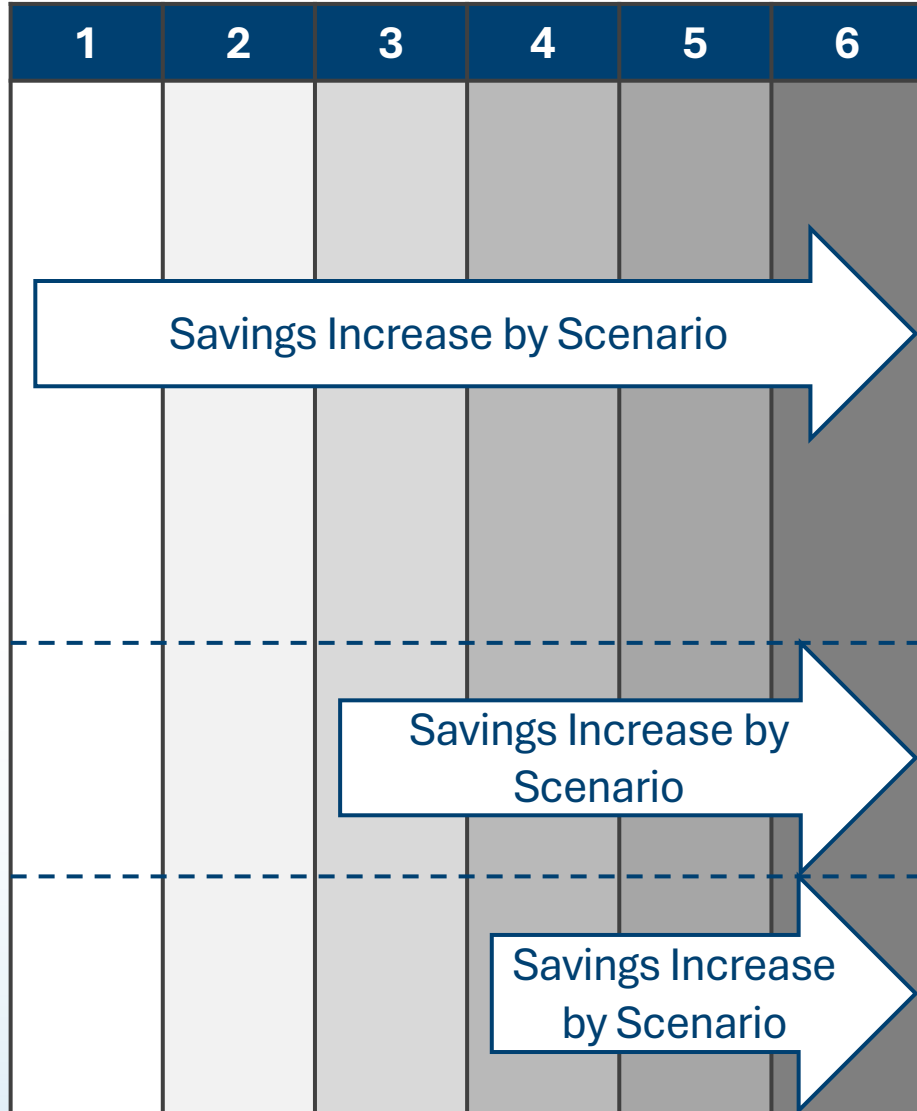
Summary of 2025 PiCS updates since the 2023 IEPR

Significant 2025 updates to the PiCS AAEE & PiCS AAFS since the 2023 IEPR	Impacts PiCS AAEE?	Impacts PiCS AAFS?
New 2025 CMUA Potential Study (includes electrification)	✓	✓
AB 130 Pause on New Residential Standards for 2028 Cycle	✓	✓
Federal appliance standards	✓	✓
IRA funding eliminated end of 2025 rather than 2034	✓	✓
Higher levels of T24 electrification than expected		✓
EBD funding impacts from CA budget adjustments		✓

Note: The PiCS AAEE & PiCS AAFS scenarios are updated every odd year. No changes were made to the planned 2025 updates since the [August 26, 2025, IEPR Commissioner Workshop on Energy Demand Forecast Load Modifier Scenario Updates](#).



Summary of 2025 PiCS AAEE Scenarios



← PiCS AAEE Scenarios

- IOU energy efficiency programs
- POU energy efficiency programs
- Title 20 State Appliance Standards
- Federal Appliance Standards
- Title 24 Res and Non-Res NC and A&A
- Local Government Ordinances
- **Home Efficiency Rebates (HOMES) IRA Incentive Program**
- Greenhouse Gas Reduction Fund LI Weatherization
- Energy Conservation Assistance Act (ECAA) Financing
- Property Assessed Clean Energy (PACE) Financing

- Energy Asset Rating
- Smart Meter Data Analytics

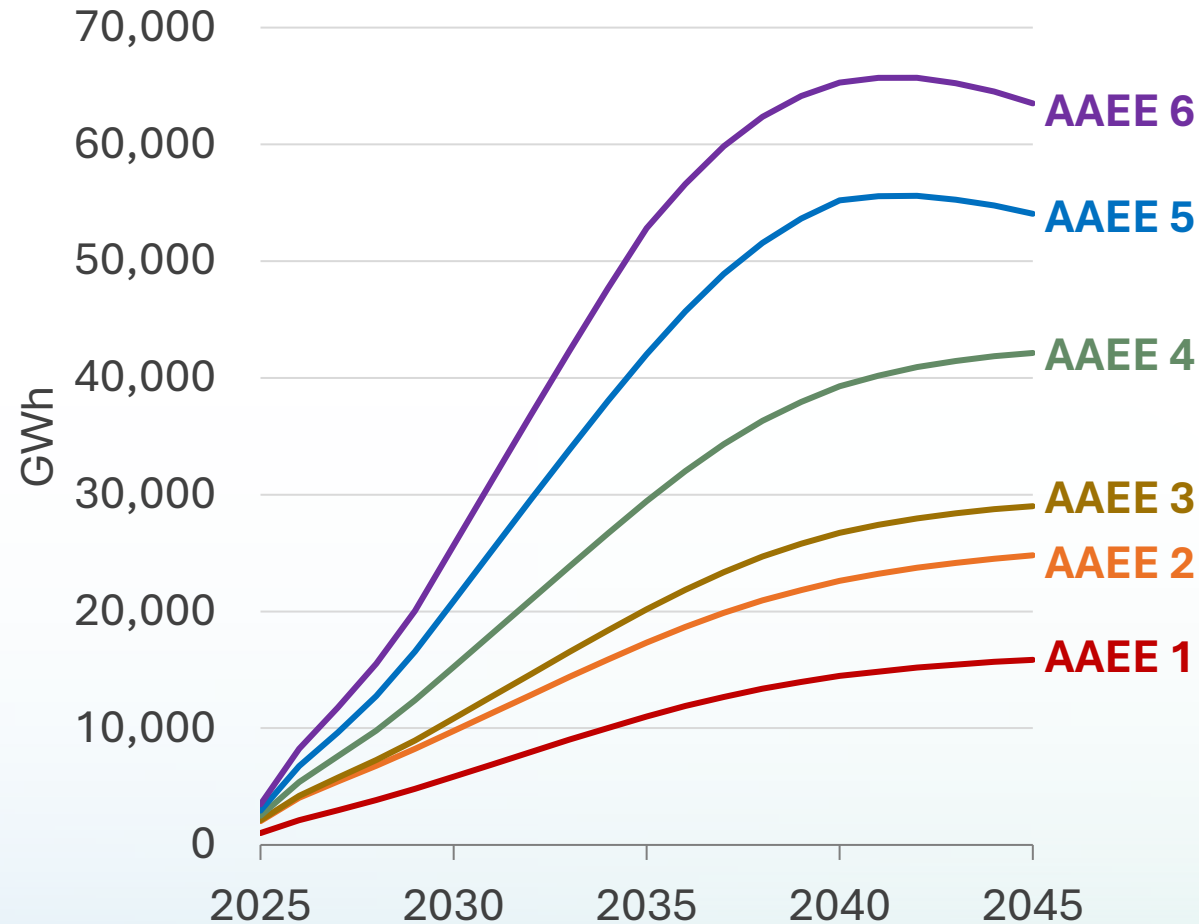
- Industrial and Agricultural Potential
- Conservation Voltage Reduction



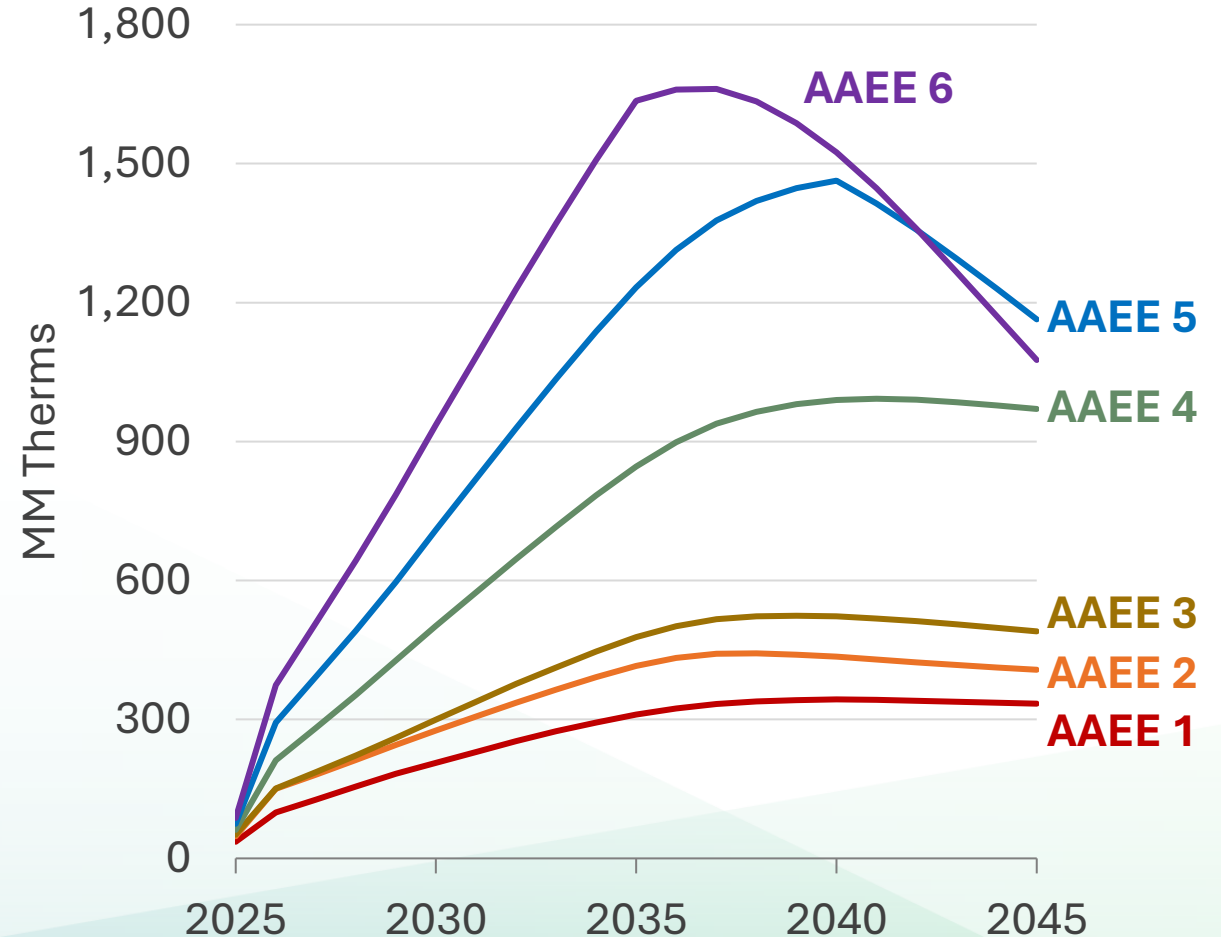
2025 Gas and Electric PiCS AAEE Scenario Savings



Electric PiCS AAEE Savings

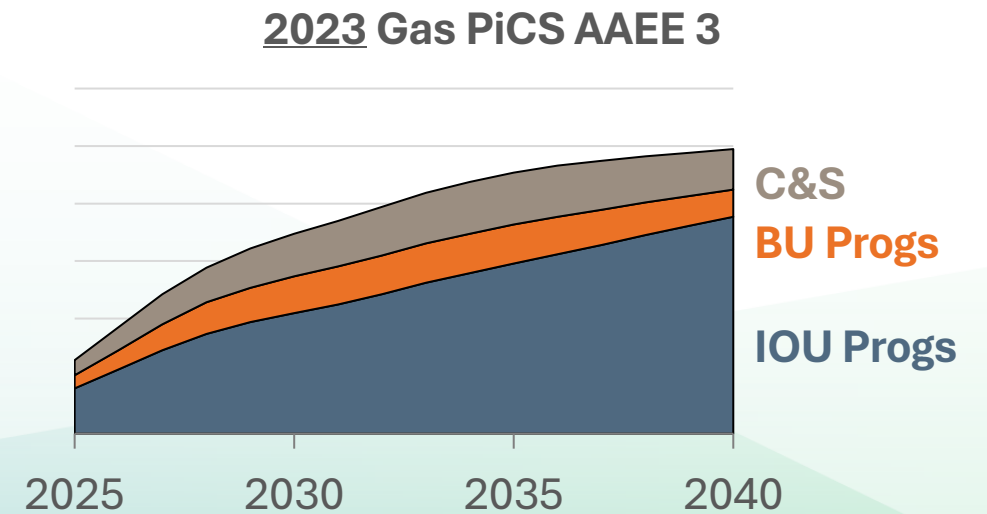
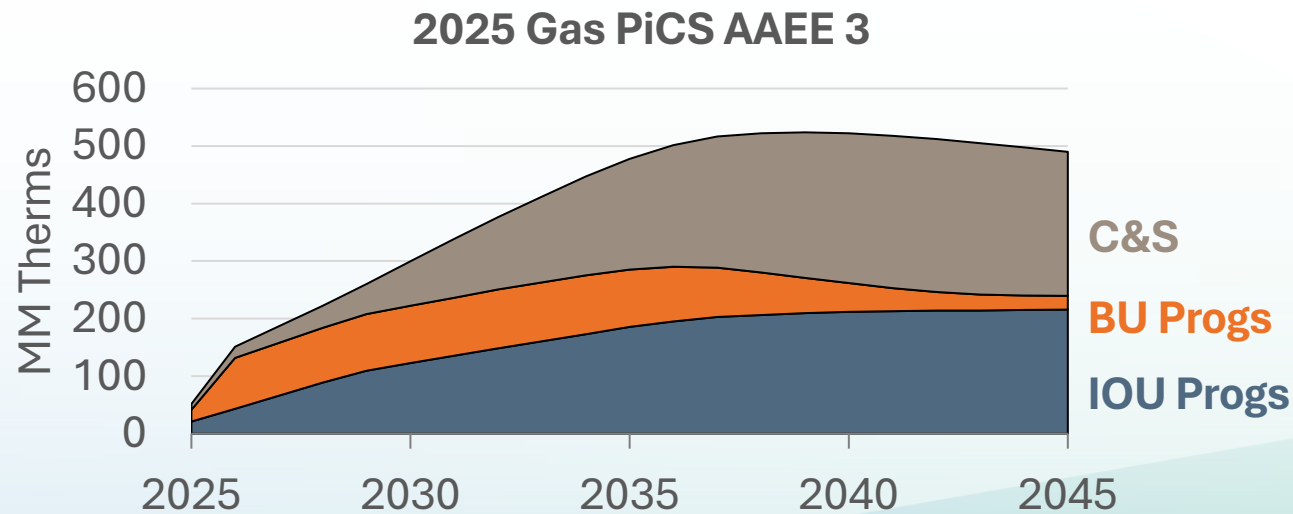
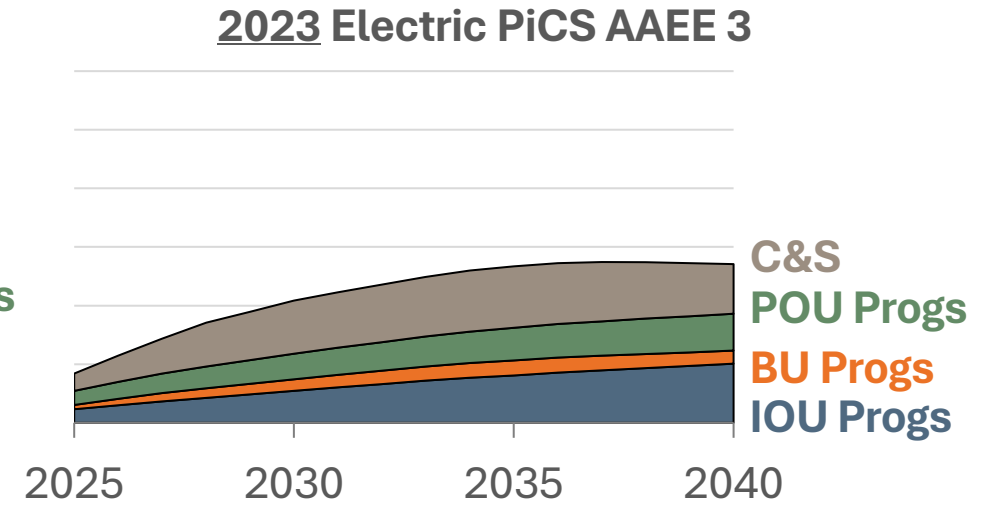
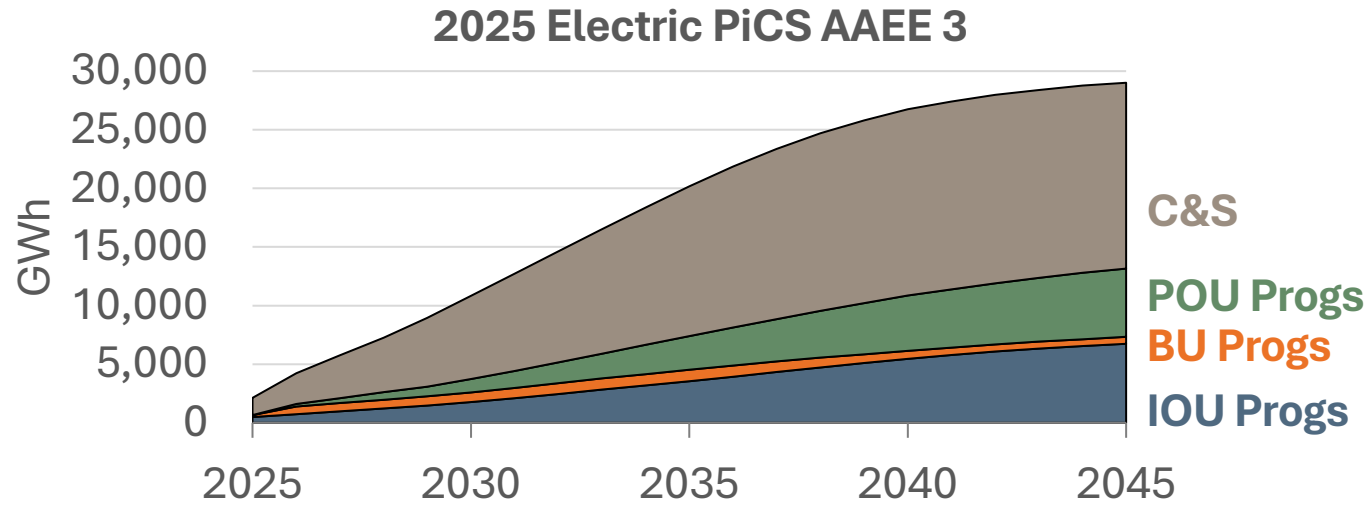


Gas PiCS AAEE Savings



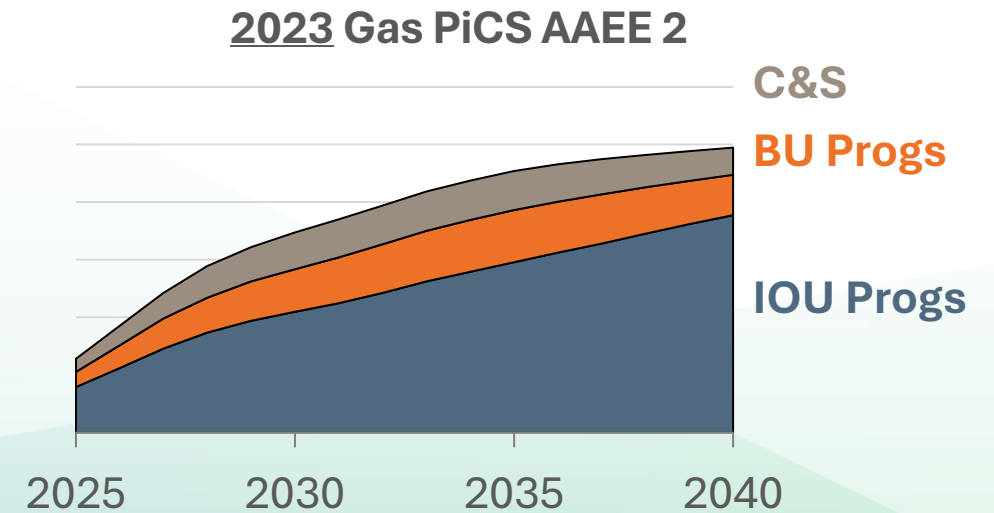
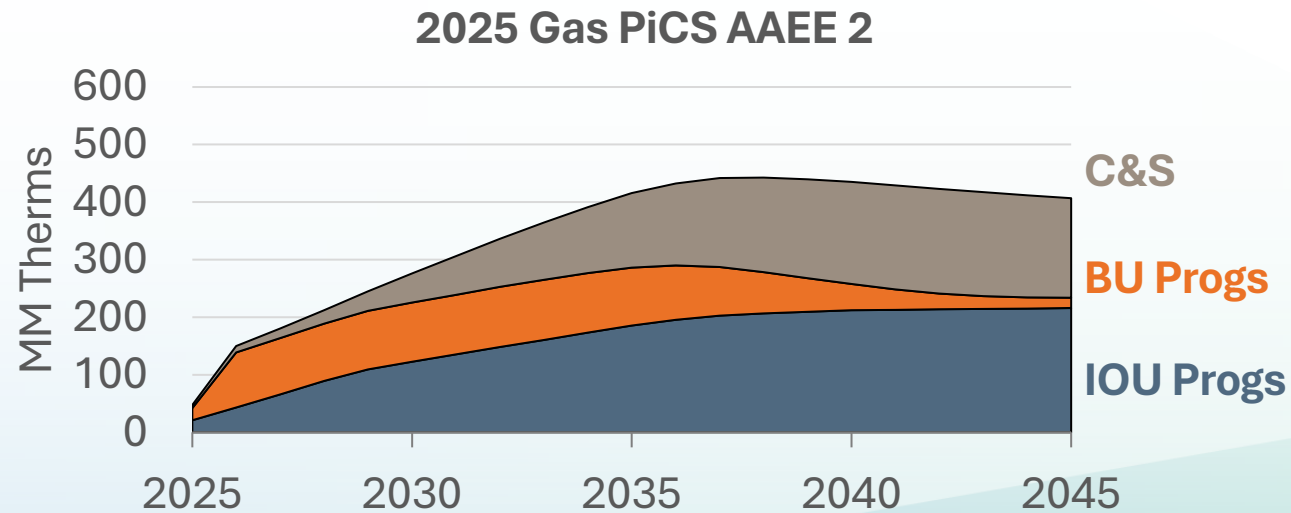
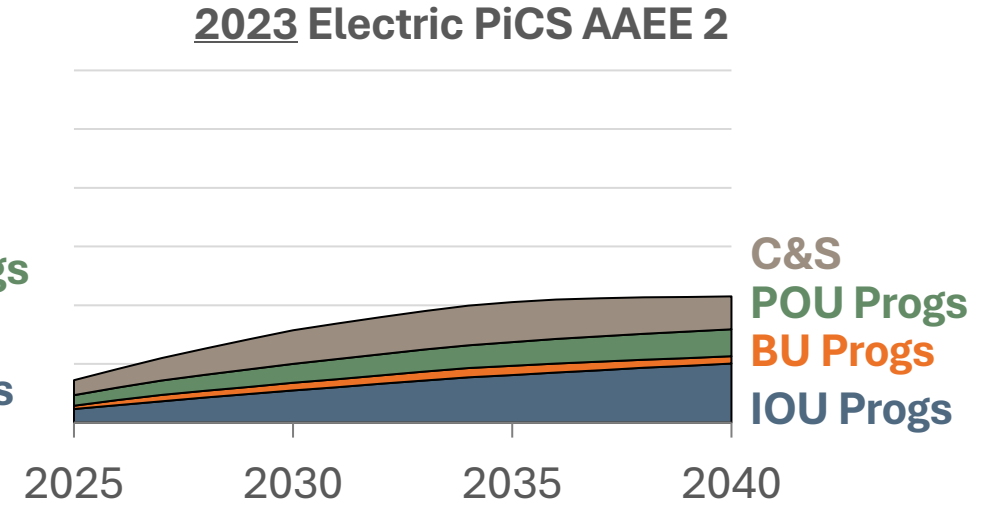
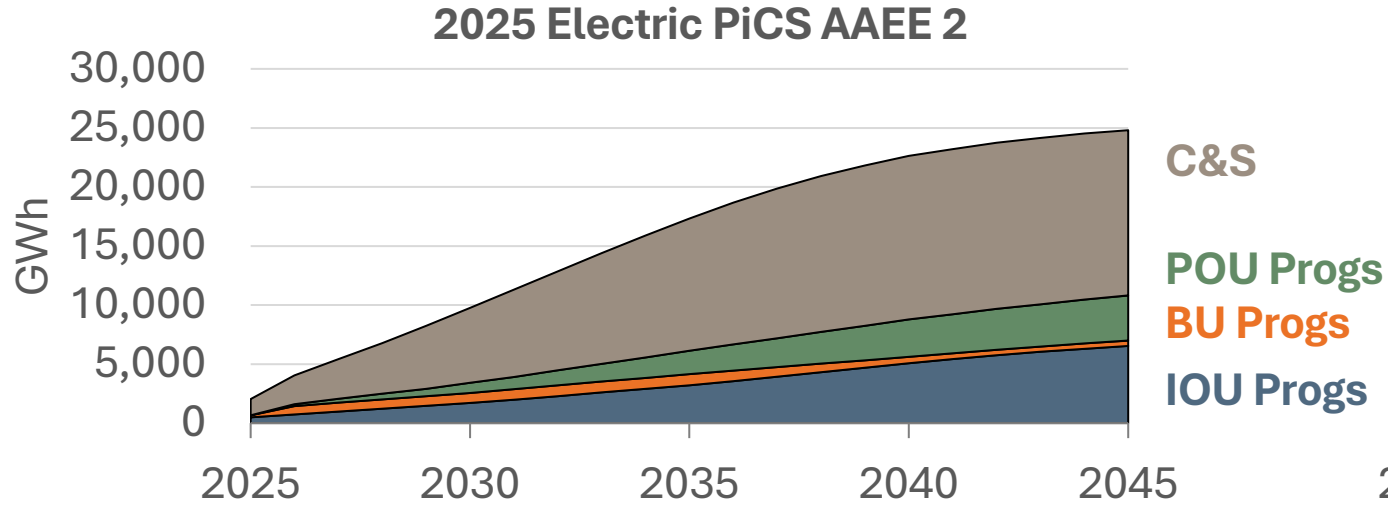


2025/2023 PiCS AAEE 3 Comparisons



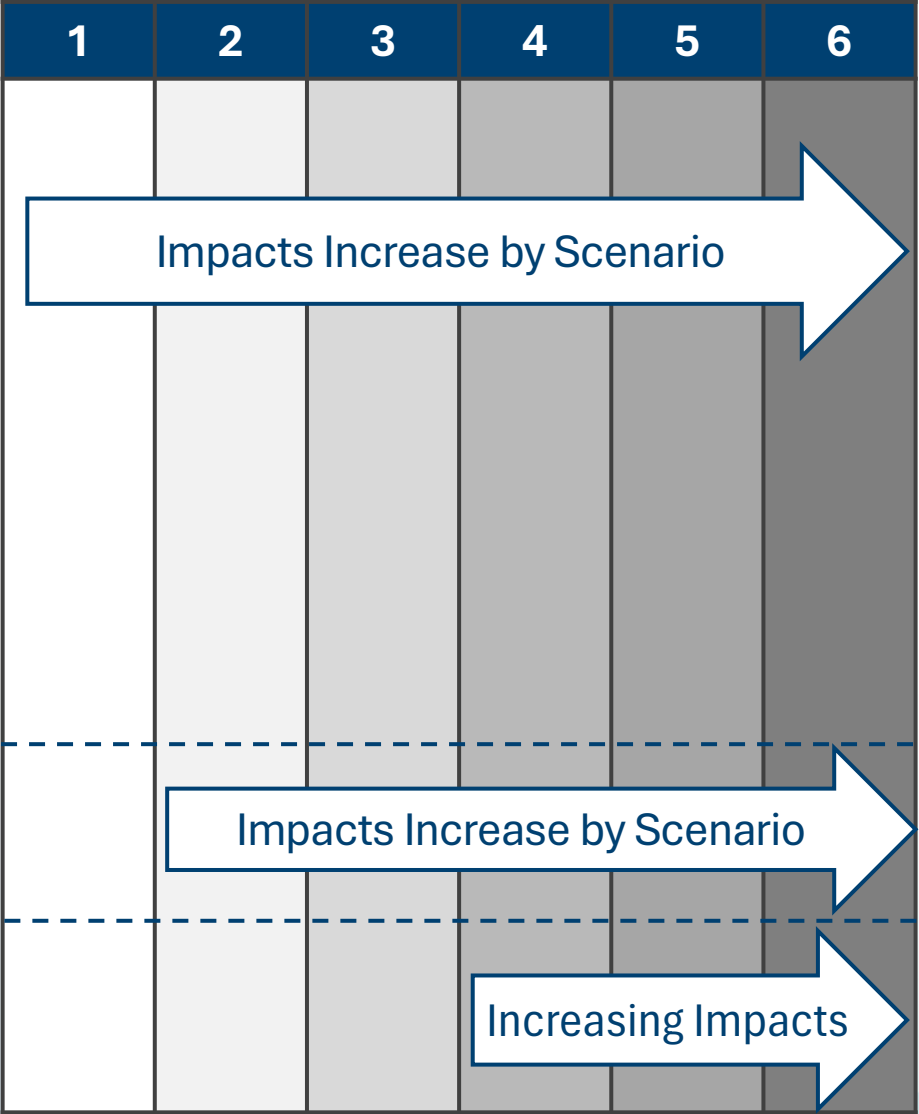
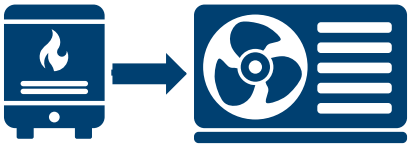


2025/2023 PiCS AAEE 2 Comparisons





Summary of 2025 PiCS AAFS Scenarios

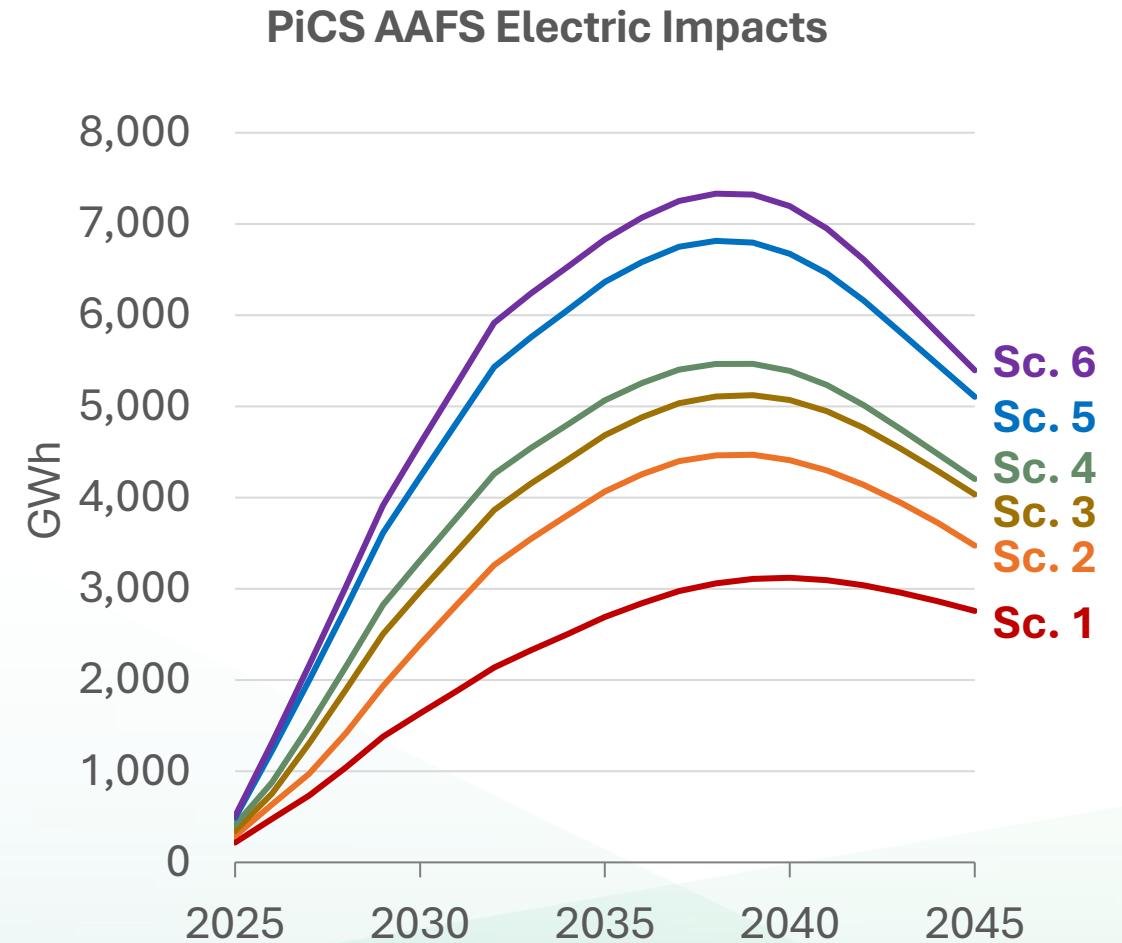
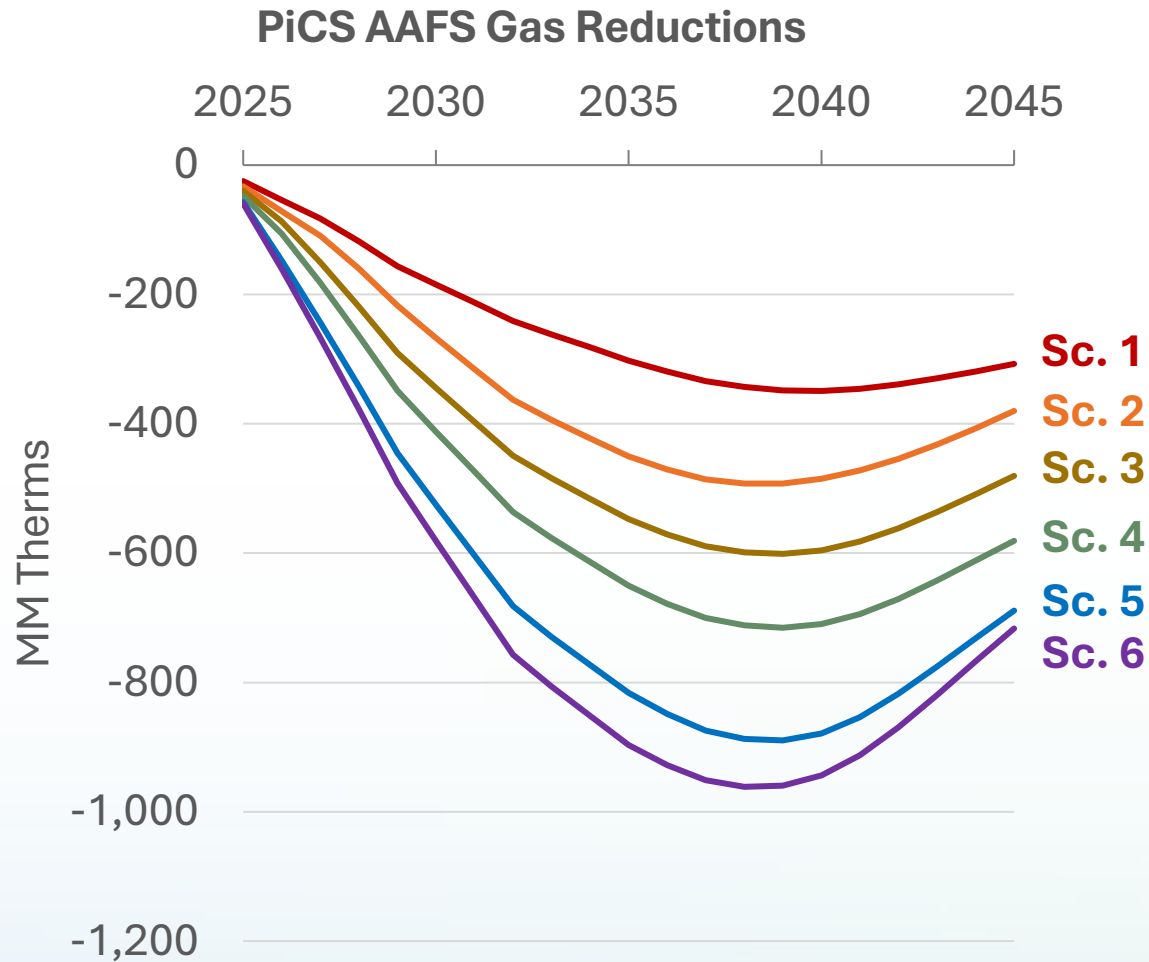
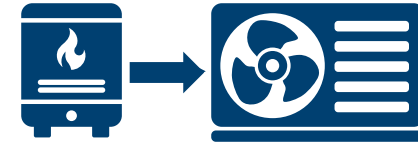


← PiCS AAFS Scenarios

- IOU & POU fuel substitution programs
 - Building Initiative for Low-Emissions Development (BUILD)
 - Home Electrification and Appliance Rebates (HEEHRA) IRA Pay for Performance Program
 - Title 24 Res and Non-Res NC and A&A
 - TECH Clean California
 - EBD Program Direct Install & Tribal Direct Install
 - EBD Go Green Financing
 - California Electric Homes Program (CalEHP)
 - Targeted Electrification
 - Affordable Housing and Sustainable Communities (AHSC)
 - Wildfire and Natural Disaster Resiliency Rebuild (WNDRR)
-
- Self-Generation Incentive Program (SGIP) HPWH
 - Food Production Investment Program
-
- Industrial and Agricultural Potential



2025 Gas and Electric PiCS AAFS Scenario Impacts

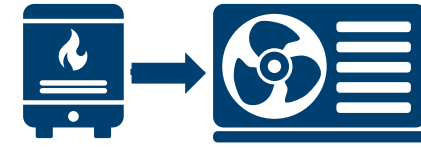


Source: CEC Staff

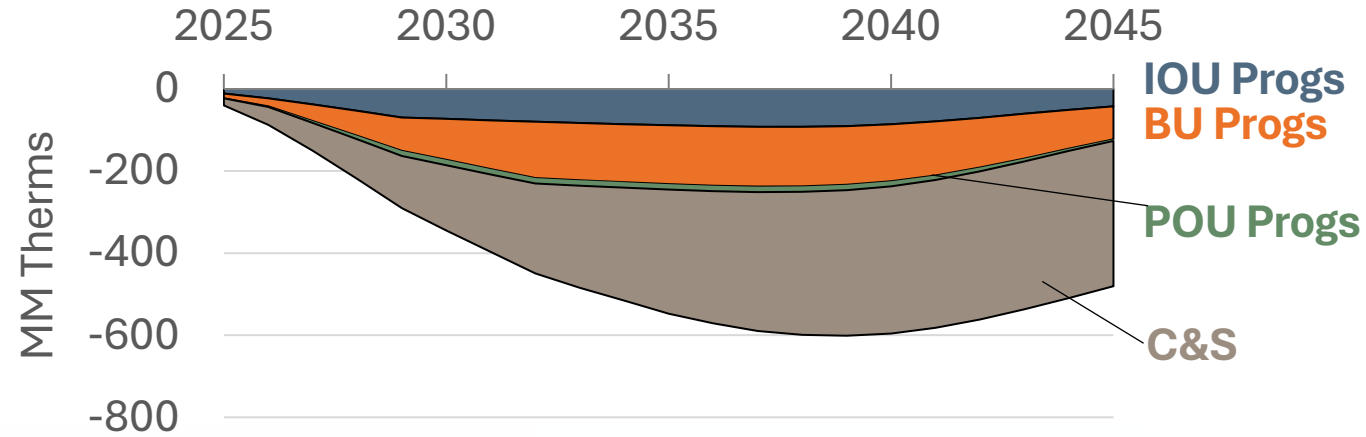
Note: While electric PiCS AAEE Savings reduces electricity consumption, PiCS AAFS adds incremental electric loads.



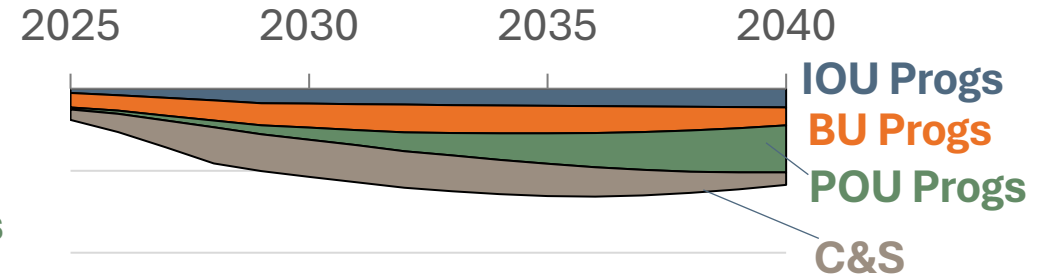
2025/2023 PiCS AAFS 3 Comparisons



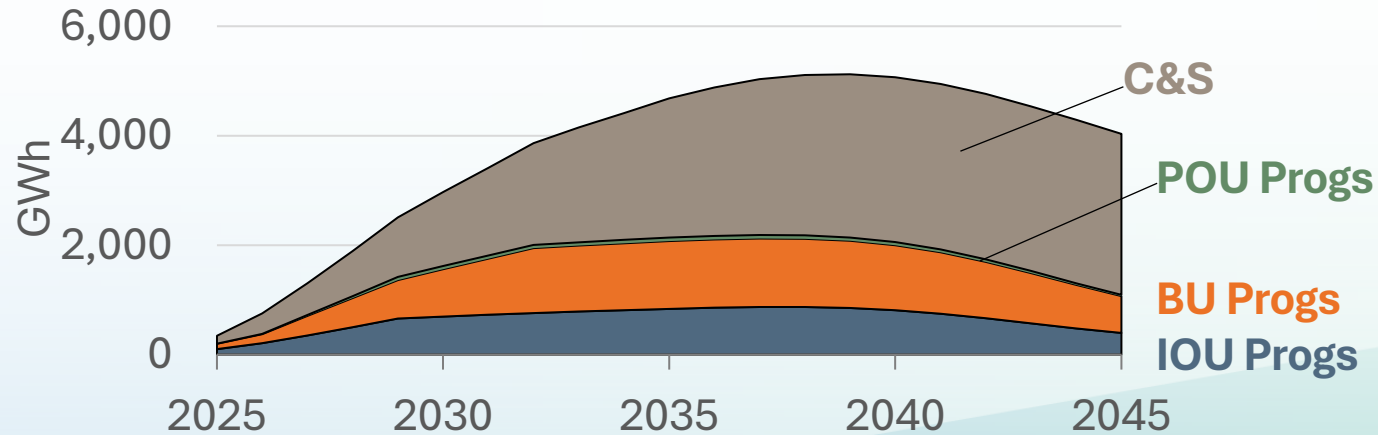
2025 PiCS AAFS 3 Gas Displacement



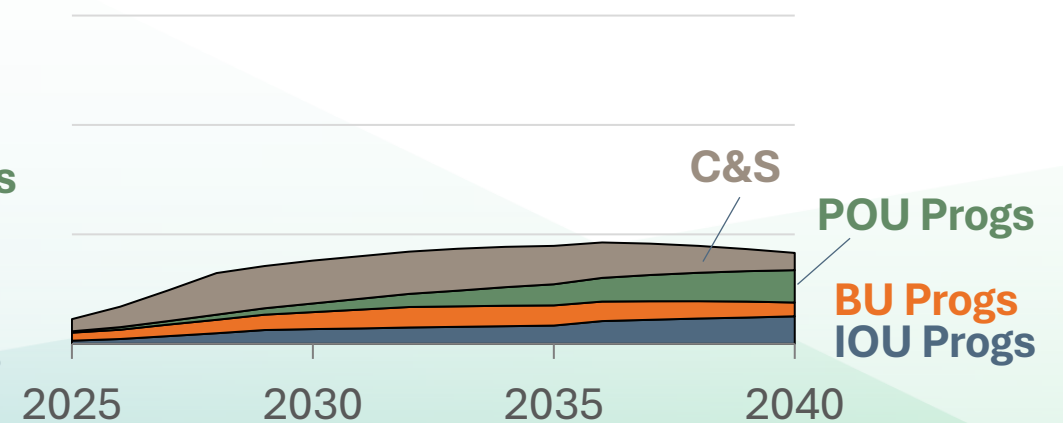
2023 PiCS AAFS 3 Gas Displacement



2025 PiCS AAFS 3 Electric Impacts

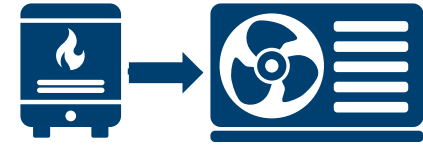


2023 PiCS AAFS 3 Electric Impacts

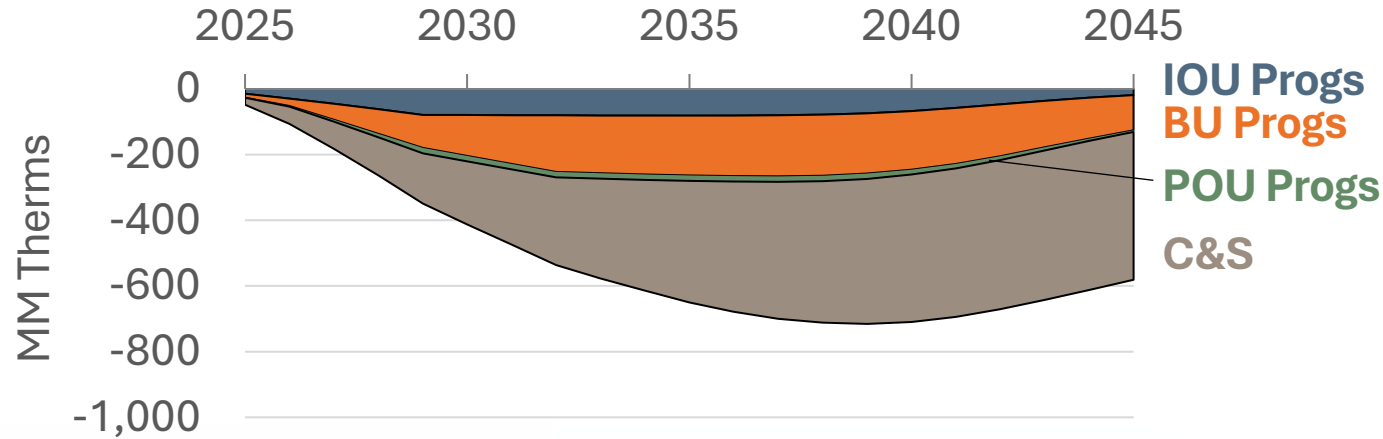




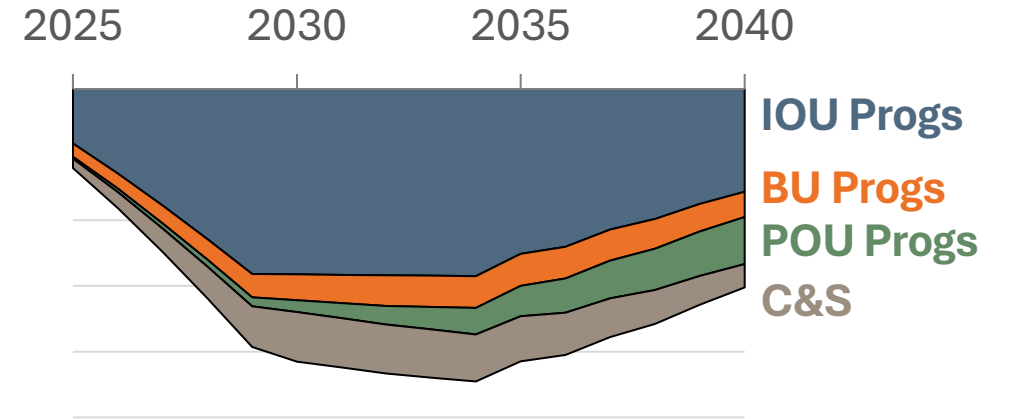
2025/2023 PiCS AAFS 4 Comparisons



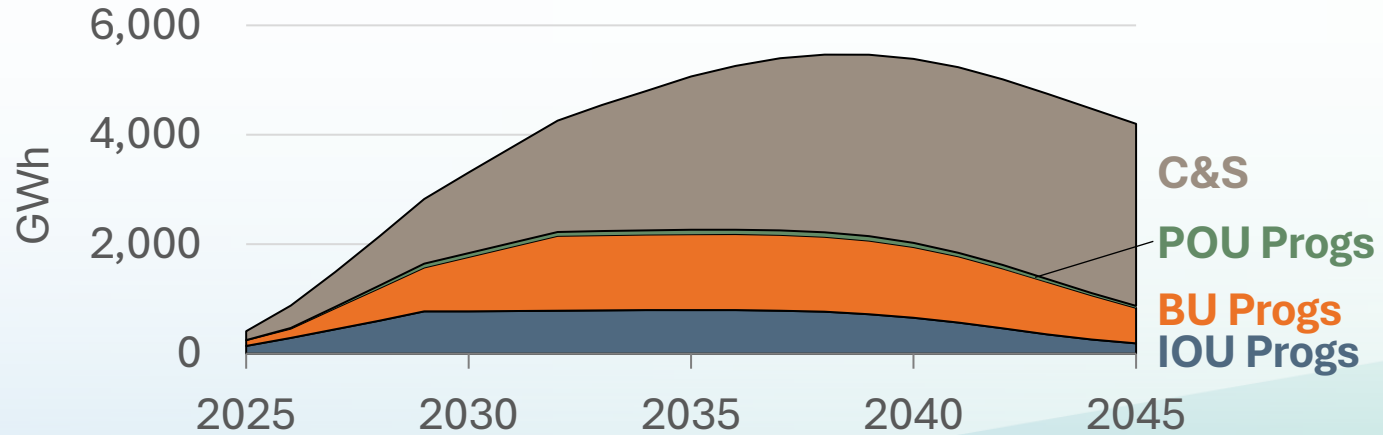
2025 PiCS AAFS 4 Gas Displacement



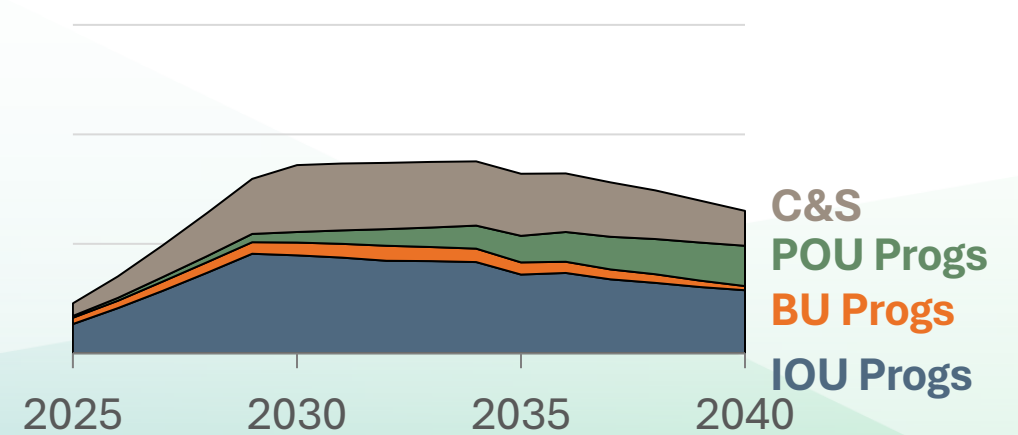
2023 PiCS AAFS 4 Gas Displacement



2025 PiCS AAFS 4 Electric Impacts

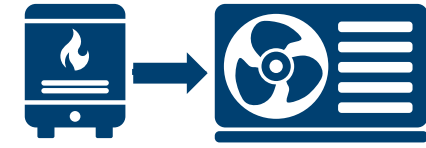


2023 PiCS AAFS 4 Electric Impacts

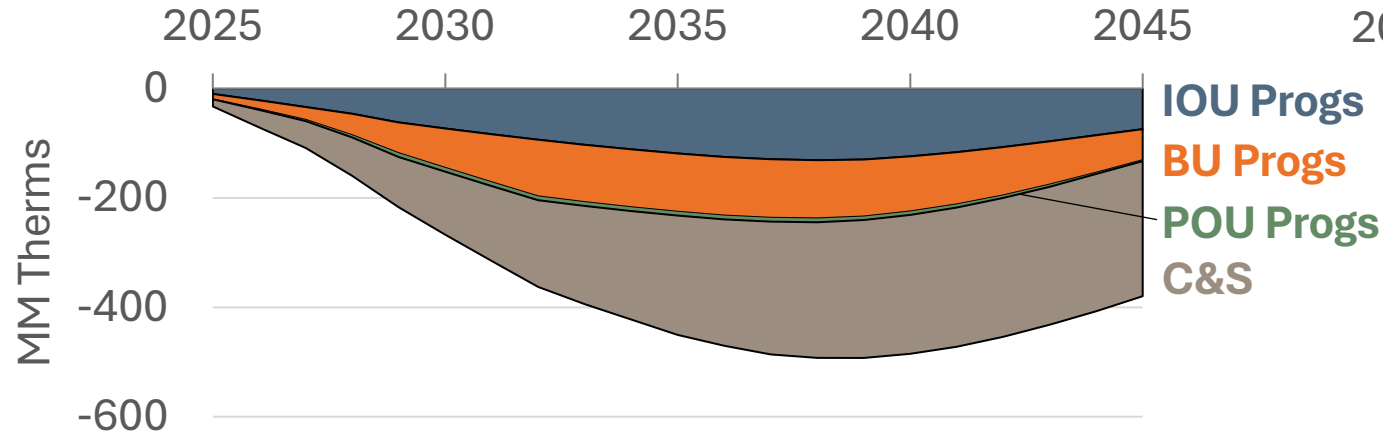




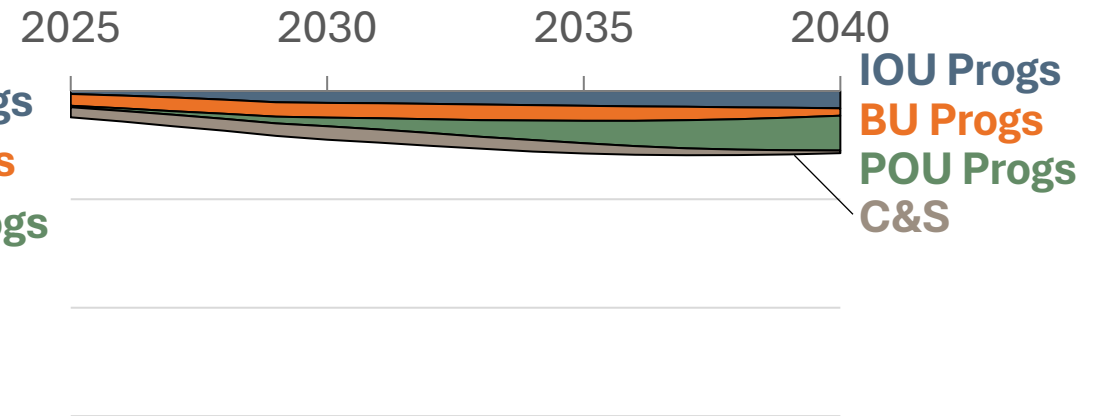
2025/2023 PiCS AAFS 2 Comparisons



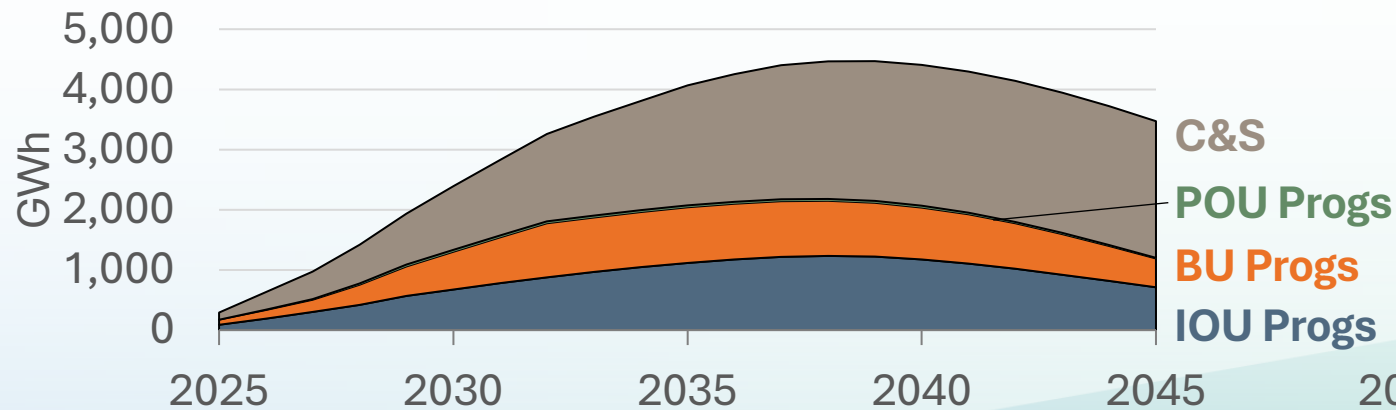
2025 PiCS AAFS 2 Gas Displacement



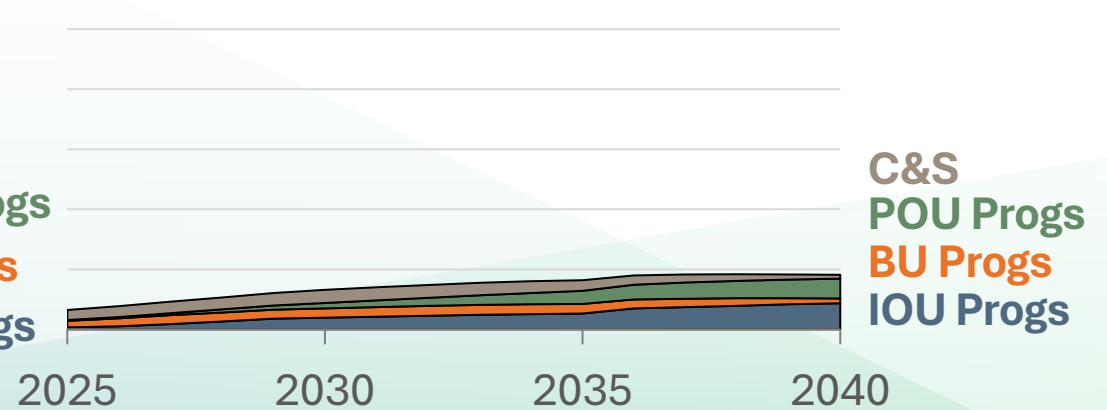
2023 PiCS AAFS 2 Gas Displacement



2025 PiCS AAFS 2 Electric Impacts



2023 PiCS AAFS 2 Electric Impacts





Observations from Draft Results

Notable Observations	Why or What Changed Since 2023?
Increased savings and impacts from C&S for both PiCS AAEE and PiCS AAFS	▪ More future new appliance standards measures modeled in 2025 ▪ Improved 2025 modeling preserves the impacts from T24 post 2030
Increased 2025 PiCS AAFS impacts relative to 2023	▪ Greater assumed T24 electrification impacts in 2025 ▪ Improved data on existing BU Programs yields greater FS impacts than EE ▪ BU Programs with existing impacts included in more scenarios
Lower PiCS AAFS potential from POU Programs in 2025	▪ POU impacts based on the 2025 CMUA Potential Study rather than data from selected participating POUs in 2021 ▪ 2025 Potential Study data show a prioritization of EE over FS
Lower PiCS AAFS potential from IOU Programs in 2025	Elimination of IRA incentives, changes to EULs and incorporation of electrification adders change the cost effectiveness of FS measures, which must compete against EE measures
Crossing of gas PiCS AAEE 5 & AAEE 6	BU Programs with a finite lifetime or potential start first-year savings earlier and exhaust them at a more rapid rate in Sc. 6 than in Sc. 5 (shifts peak savings year earlier in the forecast)

Thank You!



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Draft ZE AAFS and AAEE & AAFS Annual and Hourly Results



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Advanced Electrification Analysis Branch
November 13, 2025

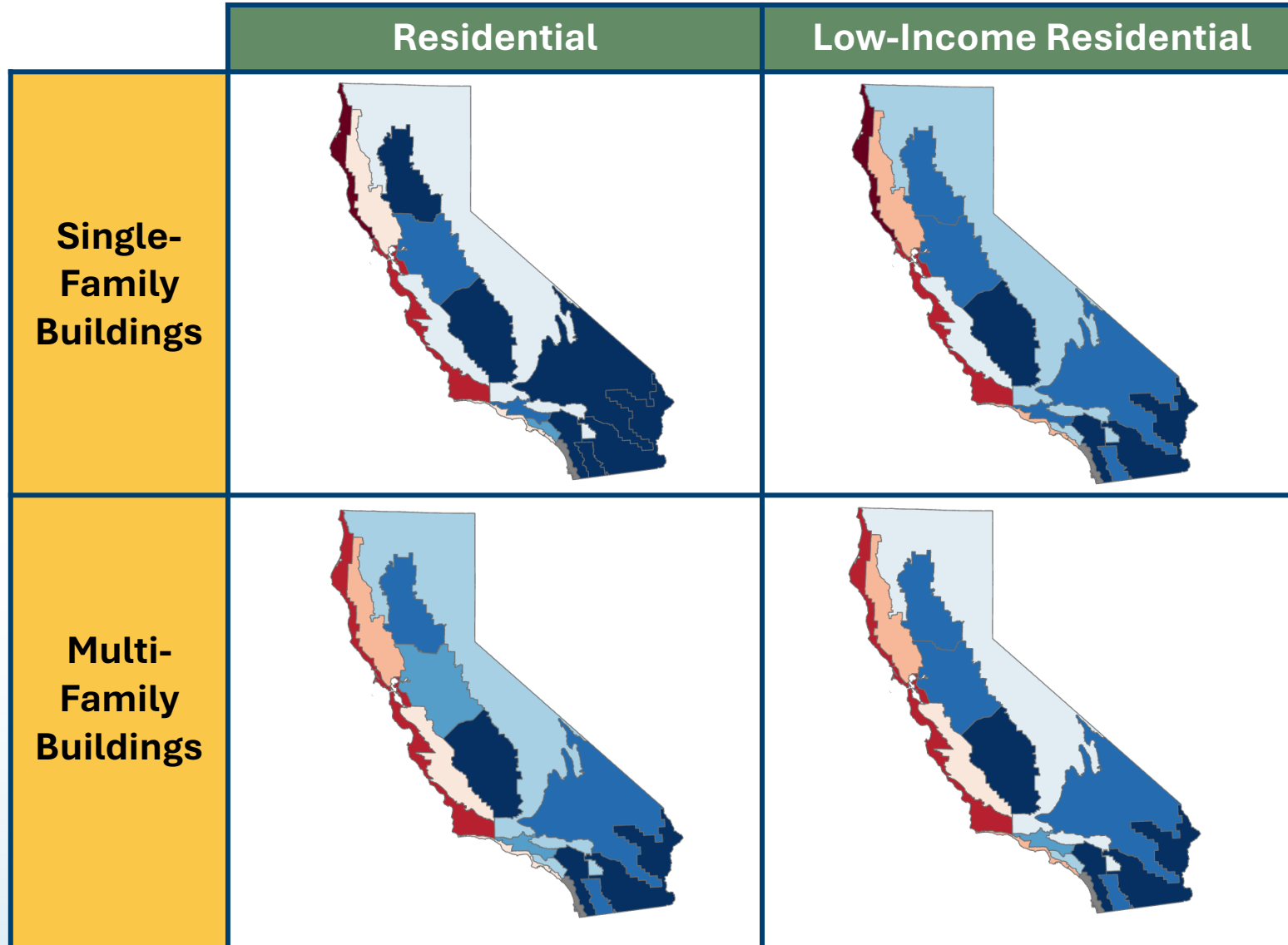


Summary of 2025 ZE AAFS Modeling Differences Compared to 2024

Topic	Update	2025 AAFS Changes
Air Districts' Zero-NOx Appliance Regulations	▪ South Coast: June 2025 rejection of PAR 1111 (Res & Comm SH) and 1121 (Res WH). In July 2025, the federal court upheld PAR 1146.2 (large WHs, small boilers, and process heaters) ▪ Bay Area: Exploring amendments to Rule 9-6 (Res & Com WH)	Revised ZE AAFS scenarios ▪ Removed PAR 1111 and 1121 ▪ Begin modeling AQMD impacts with ZE AAFS 3
CARB's SH and WH ZE Appliance Standards	CARB memo to EJAC members (August 28, 2025) : Exploring alternative regulatory concepts other than a 100% new sales requirement for ZE appliances	Revised ZE AAFS Scenarios ▪ ZE AAFS 3: CARB SP ▪ ZE AAFS 4: CARB SIP with compliance starting in '30 ▪ Added a ZE AAFS 1
Federal Standards	DOE energy efficiency standards for residential water heaters (Compliance required starting in 2029)	Updated the efficiency weighting for Res WHs in FSSAT
Other Updates	▪ AC penetration rates based on AMI data analysis ▪ Commercial HVAC space heating load shapes ▪ General debugging and process improvements	Updated data inputs and assumptions



FSSAT Inputs: AC Penetration Rates



Symbol	Upper Value
	≤ 10%
	≤ 20%
	≤ 30%
	≤ 40%
	≤ 50%
	≤ 60%
	≤ 70%
	≤ 80%
	≤ 90%
	≤ 100%
	<NULL>

Source: Recurve & CEC Staff
Maps display the 16
California Climate Zones



2025 AAFS & AAEE Forecast Scenario Combinations



The presented draft results will highlight these **AAFS & AAEE** forecast scenario combinations

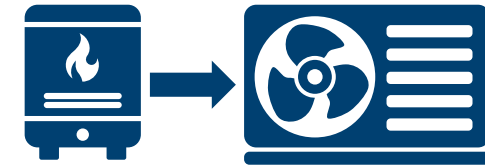
AAFS (PiCS + ZE)	AAEE
1	3
2	3
3	3
4	2
5	2
6	2

For each AAFS & AAEE combination...

- Electric AAEE savings are independent of AAFS impacts
- Realized AAEE gas savings depend on AAFS electrification modeled in FSSAT
- FSSAT also conducts a final alignment of the realized AAEE gas dynamic



AAFS 2025 Characterizations



	AAFS 1	AAFS 2	AAFS 3	AAFS 4	AAFS 5	AAFS 6
PiCS AAFS	1	2	3	4	5	6
ZE AAFS	1	2	3	4	5	6
End Uses	SH & WH	SH & WH	SH & WH	SH & WH	SH, WH, C, CD	SH, WH, C, CD
Substituted Fuel Types	Gas	Gas	Gas	Gas	Gas	Gas & RP
NC (Beyond PiCS T24)				100% in 2029	100% in 2029	100% in 2029
Statewide EB	GT 50% by 2040	GT 100% by 2040	CARB SP 100% Targets	SIP linear to 100% by 2030	SIP linear to 100% by 2030	SIP linear to 100% by 2030
Bay Area PAR 9-4 & 9-6			✓	✓	✓	✓
South Coast PAR 1146.2			✓	✓	✓	✓

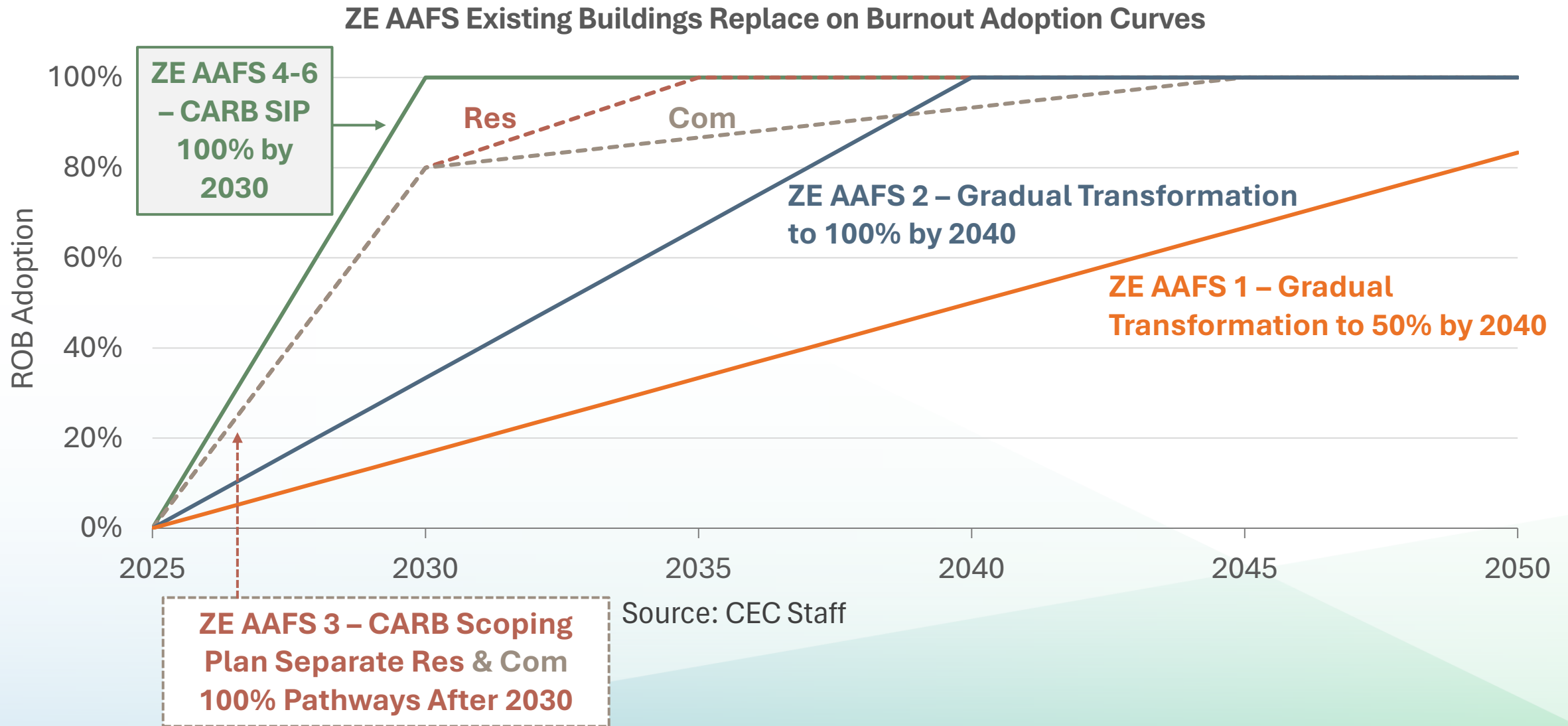
Table Abbreviations

C Cooking	GT Gradual Transformation Scenario	RP Residential Propane	SP Scoping Plan
CD Clothes Drying	NC New Construction	SH Space Heating	T24 Title 24
EB Existing Buildings	PAR Proposed Amended Rule	SIP State Implementation Plan	WH Water Heating

Note: AAFS scenario impacts are the sum of the PiCS AAFS and ZE AAFS Scenario impacts modeled by FSSAT. FSSAT finalizes gas AAEE savings based on the AAFS effect on available gas in AAEE.

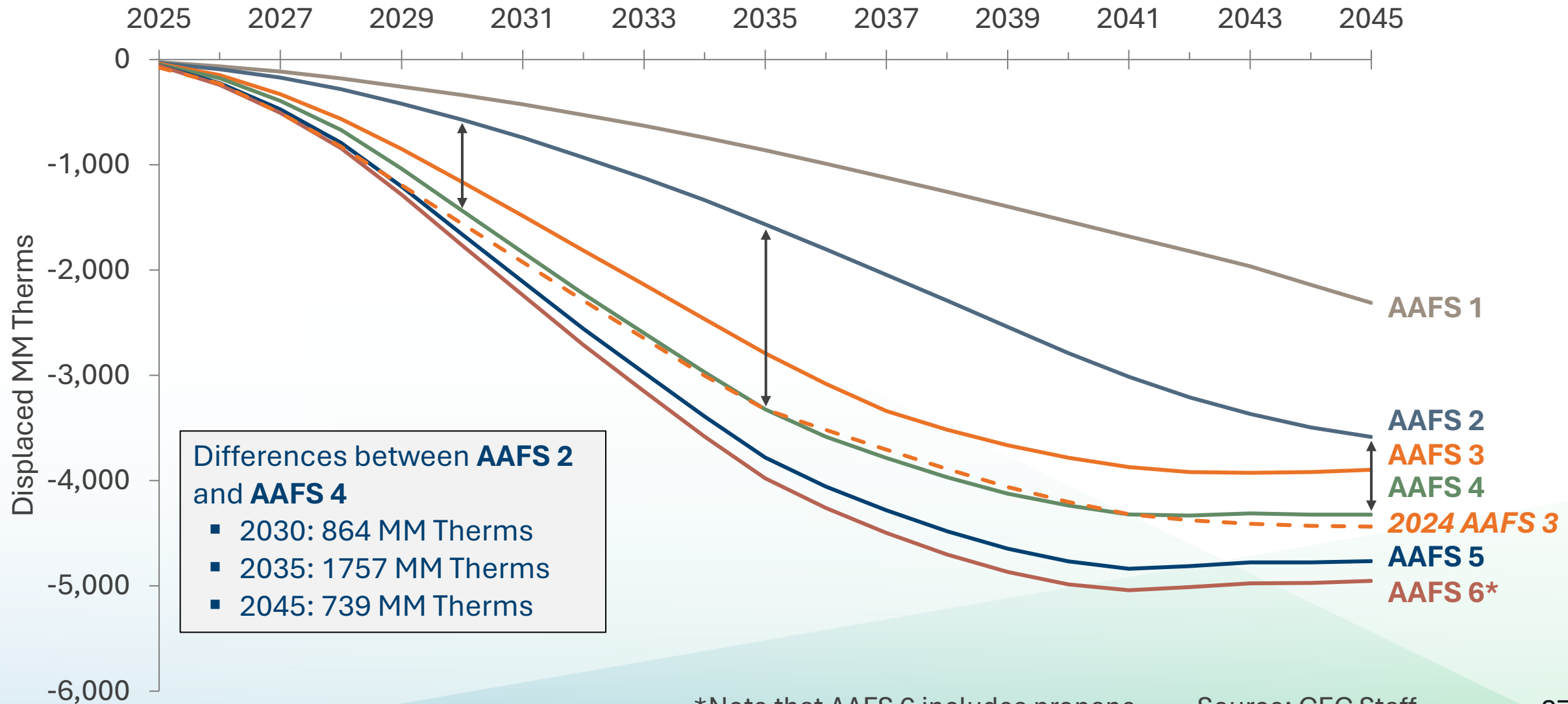


2025 ZE AAFS Scenario Replace-on-Burnout Adoption Curves



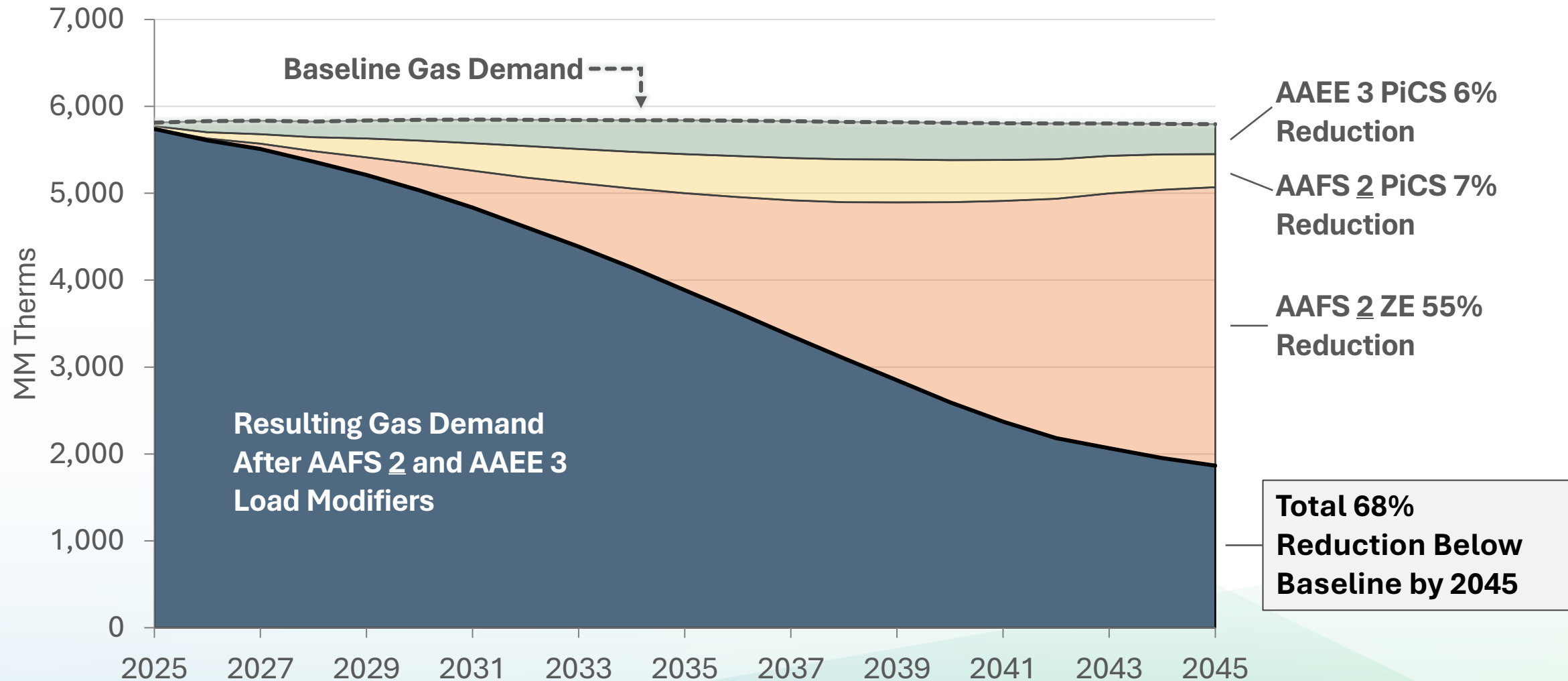


2025 AAFS Gas Displacement Draft Results





AAFS 2 + AAEE 3 Gas Displacement

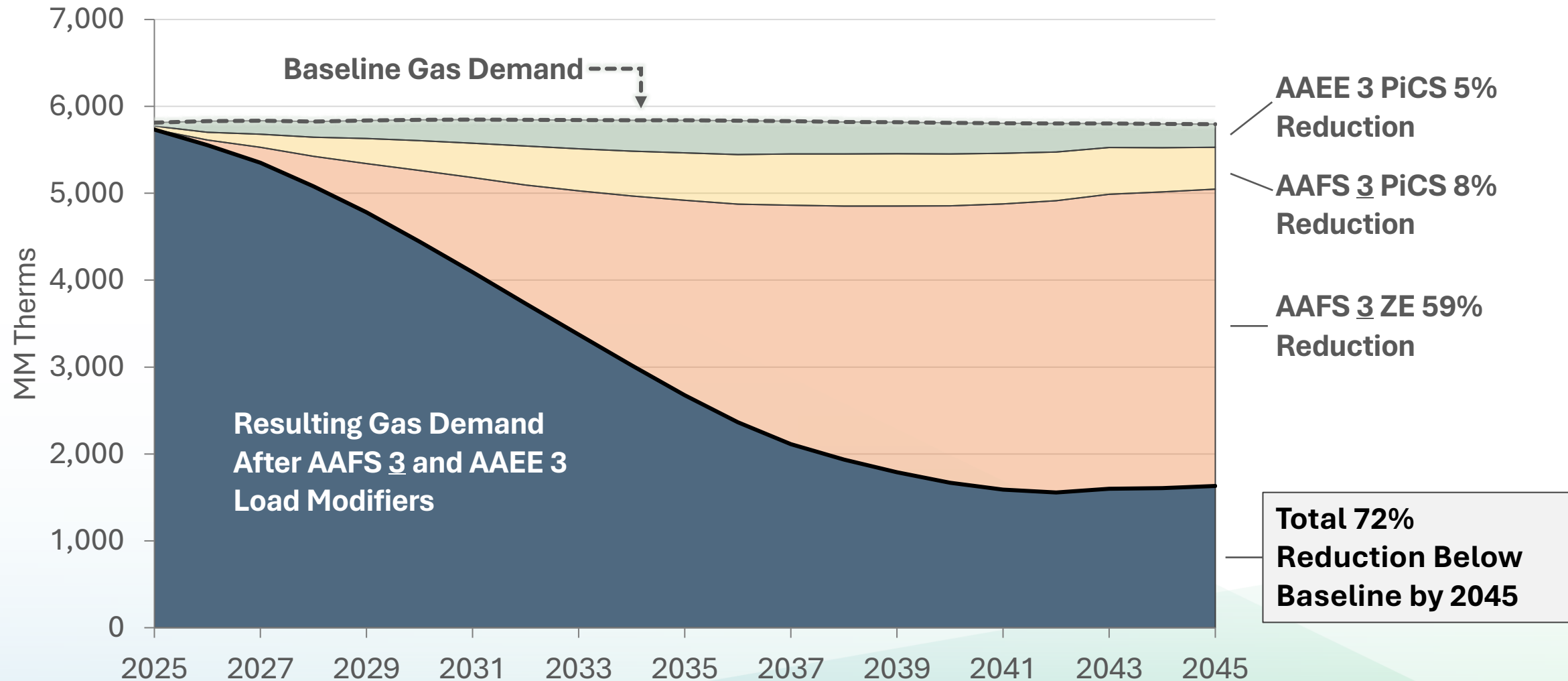


Source: CEC Staff

Note: Gas displacement displayed is only for the Residential and Commercial sectors



AAFS 3 + AAEE 3 Gas Displacement

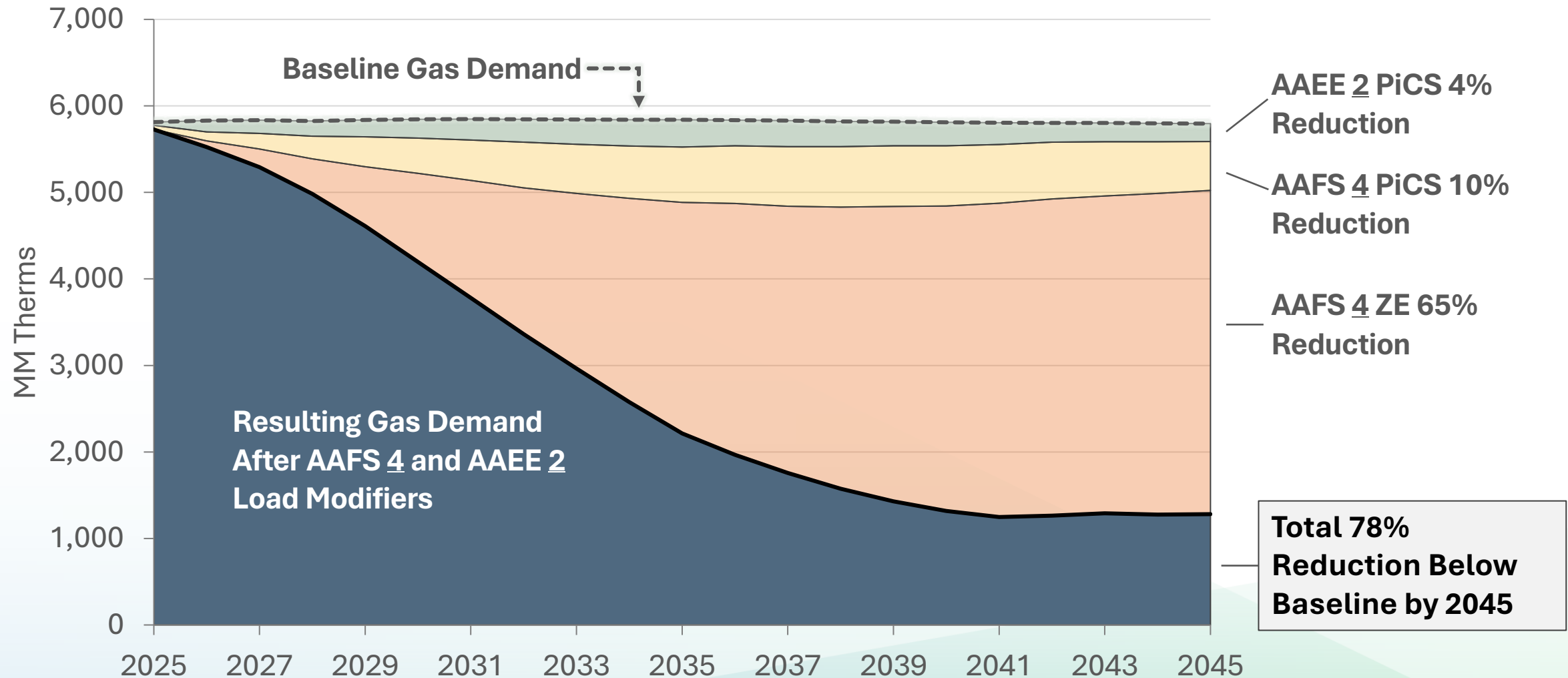


Source: CEC Staff

Note: Gas displacement displayed is only for the Residential and Commercial sectors



AAFS 4 + AAEE 2 Gas Displacement

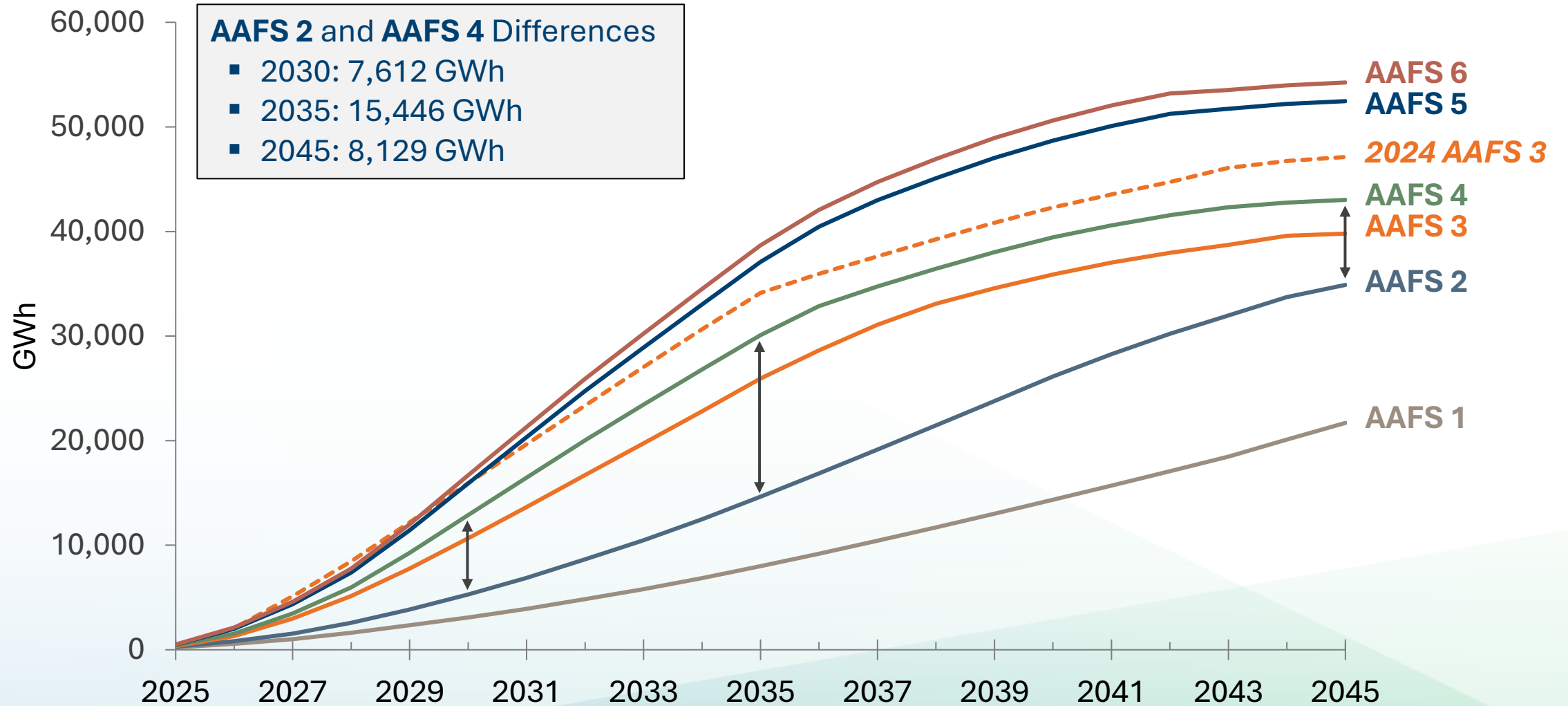


Source: CEC Staff

Note: Gas displacement displayed is only for the Residential and Commercial sectors

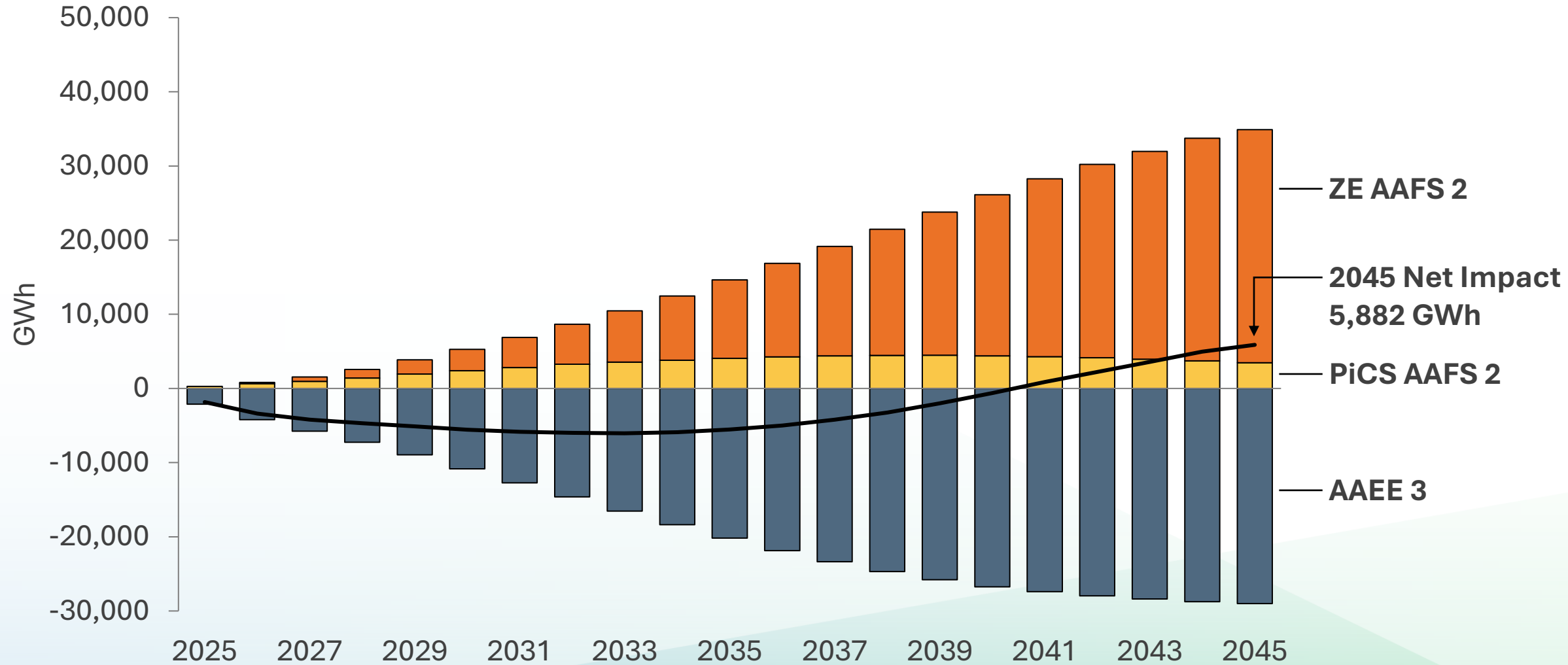


2025 AAFS Electricity Impacts



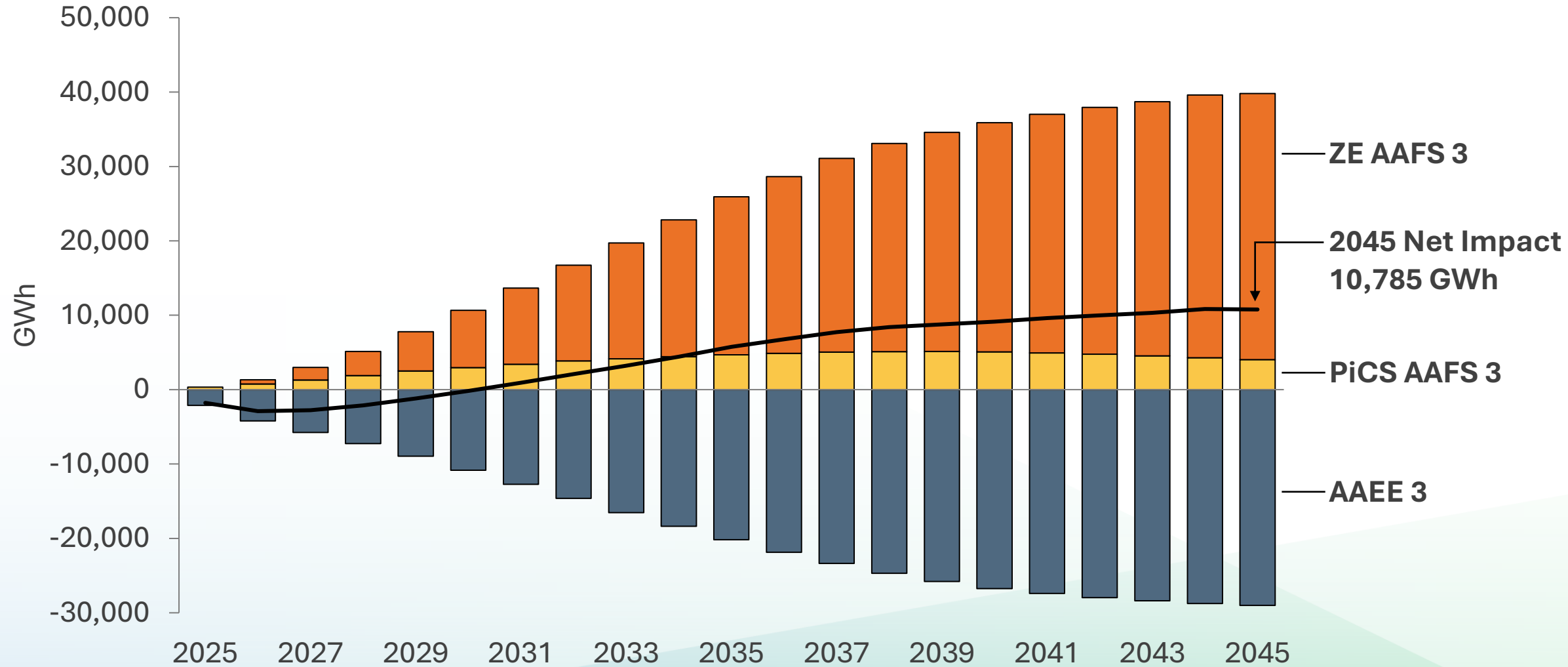


AAFS 2 + AAEE 3 Electricity Impacts



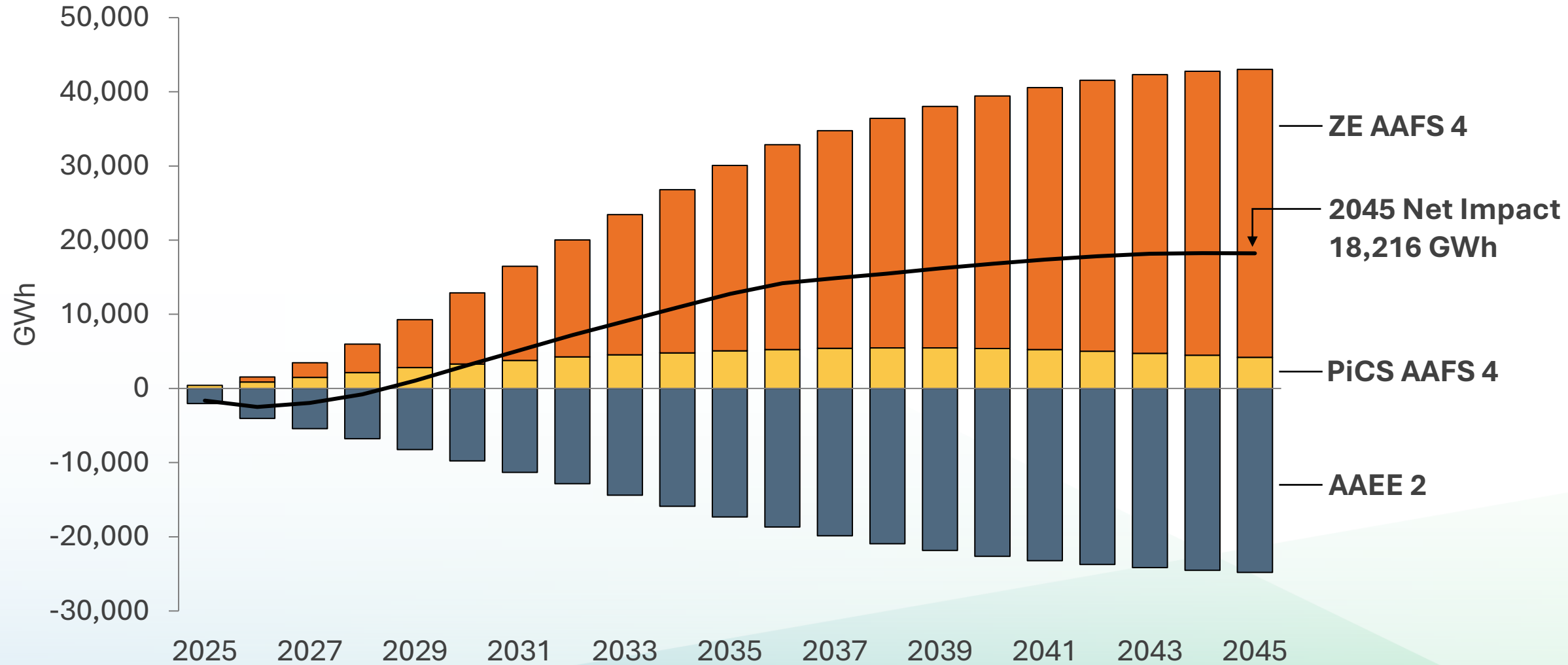


AAFS 3 + AAEE 3 Electricity Impacts





AAFS 4 + AAEE 2 Electricity Impacts



ZE AAFS 4

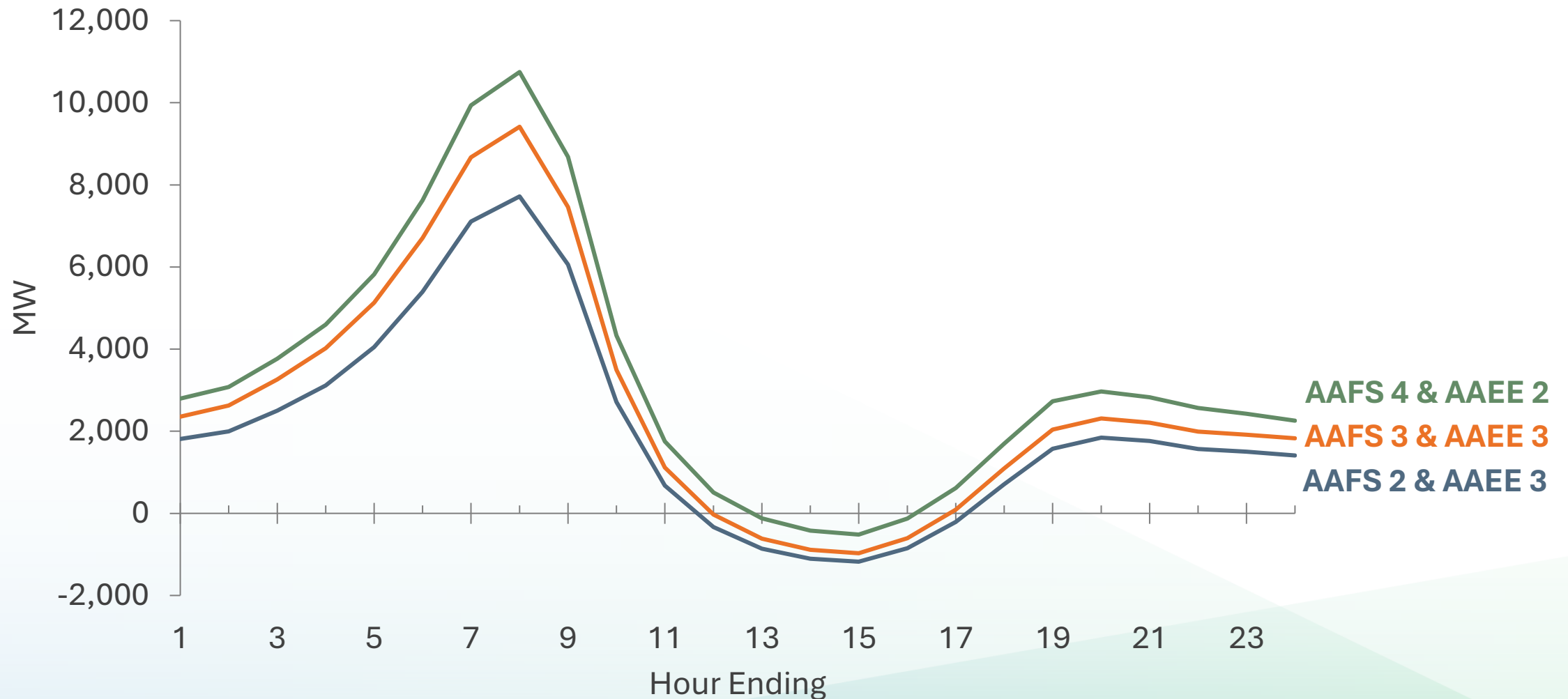
2045 Net Impact
18,216 GWh

PiCS AAFS 4

AAEE 2



February 2045 Average Hourly Profile Scenario Comparisons

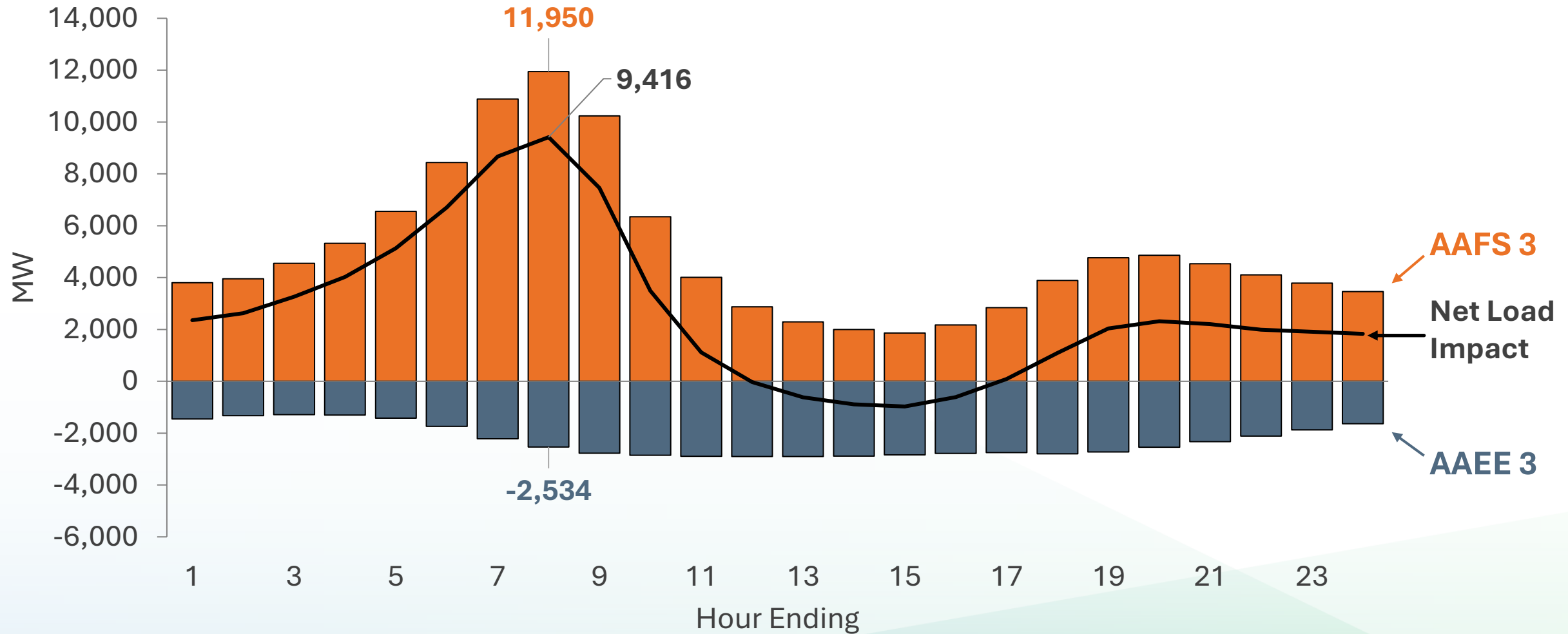


Source: CEC Staff

Note: The figure reports only CAISO system hourly load.



February 2045 Average Hourly Impacts for AAFS 3 & AAEE 3

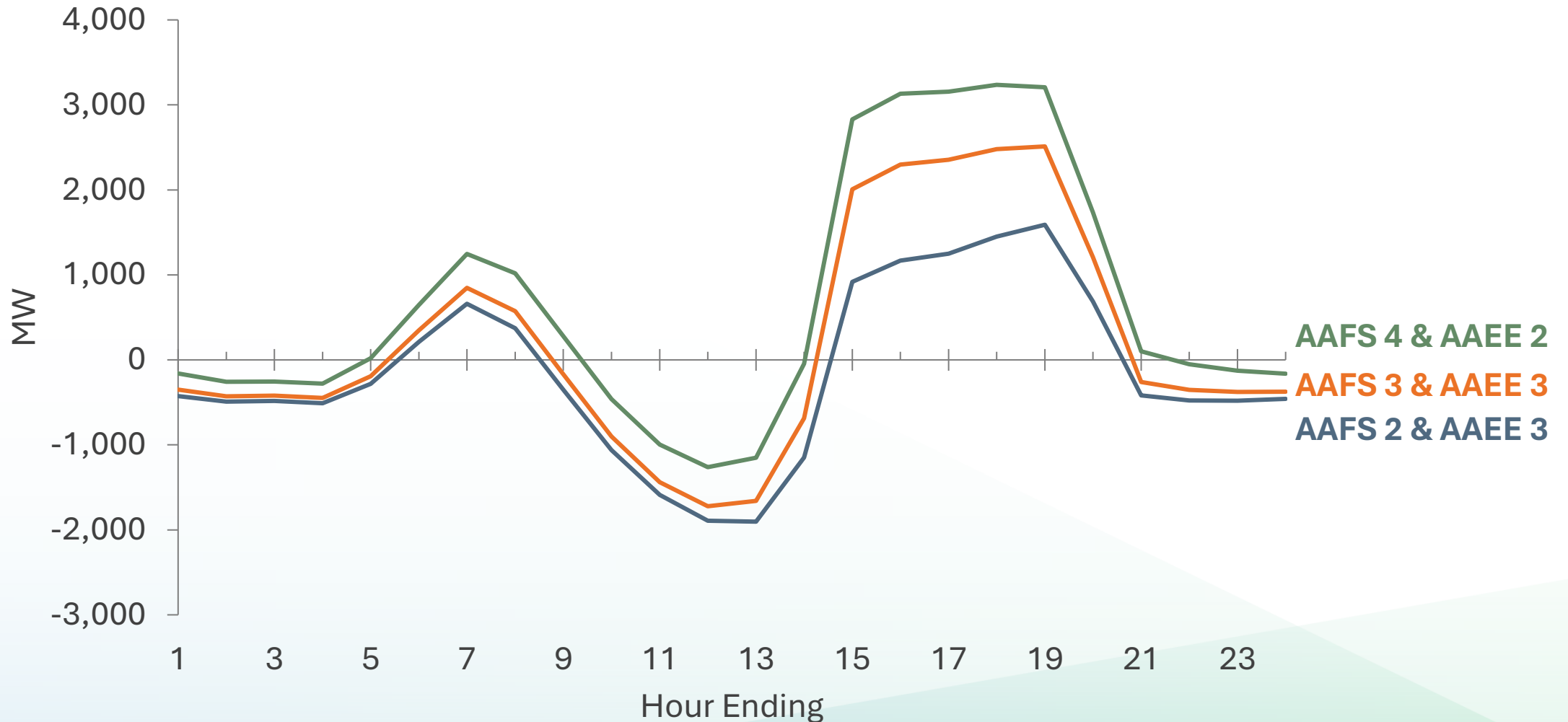


Source: CEC Staff

Note: The figure reports only CAISO system hourly load.



September 2045 Average Hourly Profile Scenario Comparisons

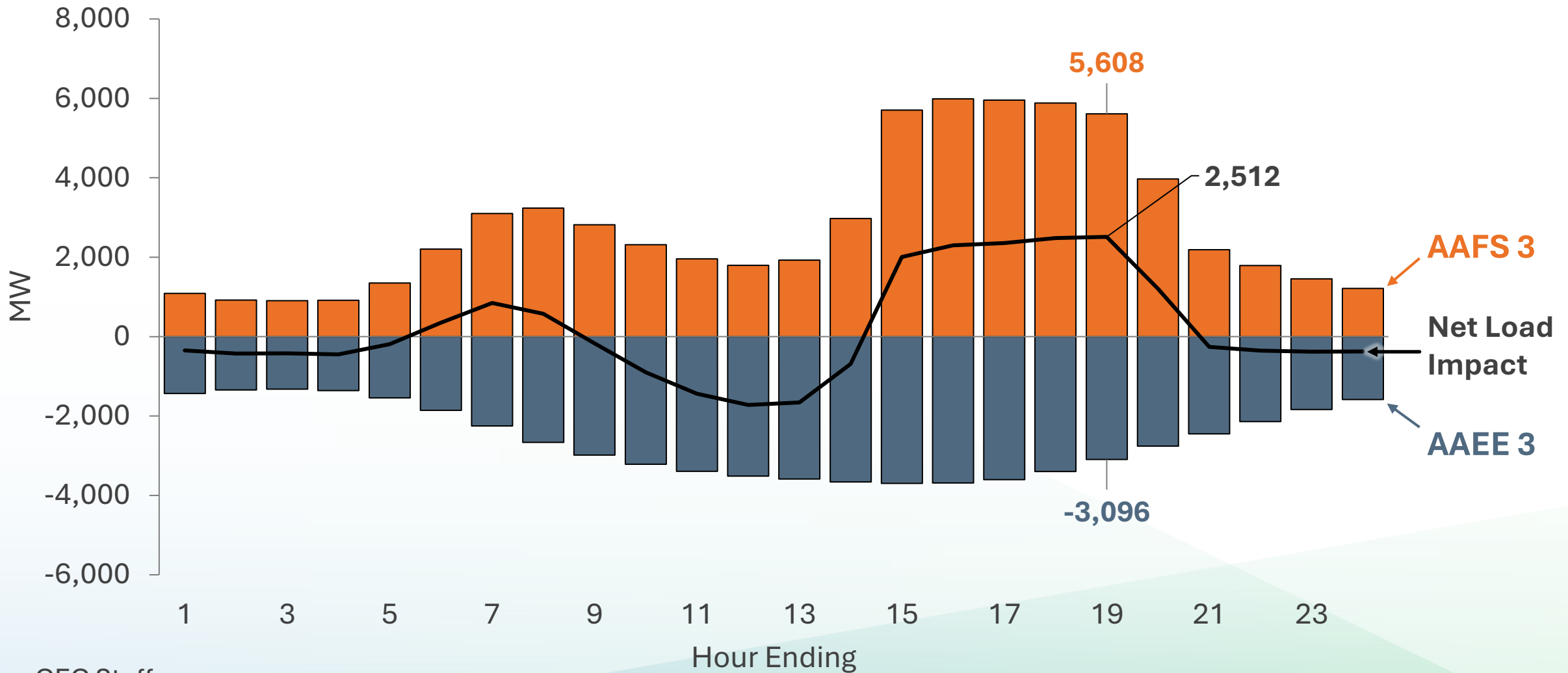


Source: CEC Staff

Note: The figure reports only CAISO system hourly load.



September 2045 Average Hourly Profile for AAFS 3 & AAEE 3



Source: CEC Staff

Note: The figure reports only CAISO system hourly load.



Draft AAFS Electric Appliance Stock Projections



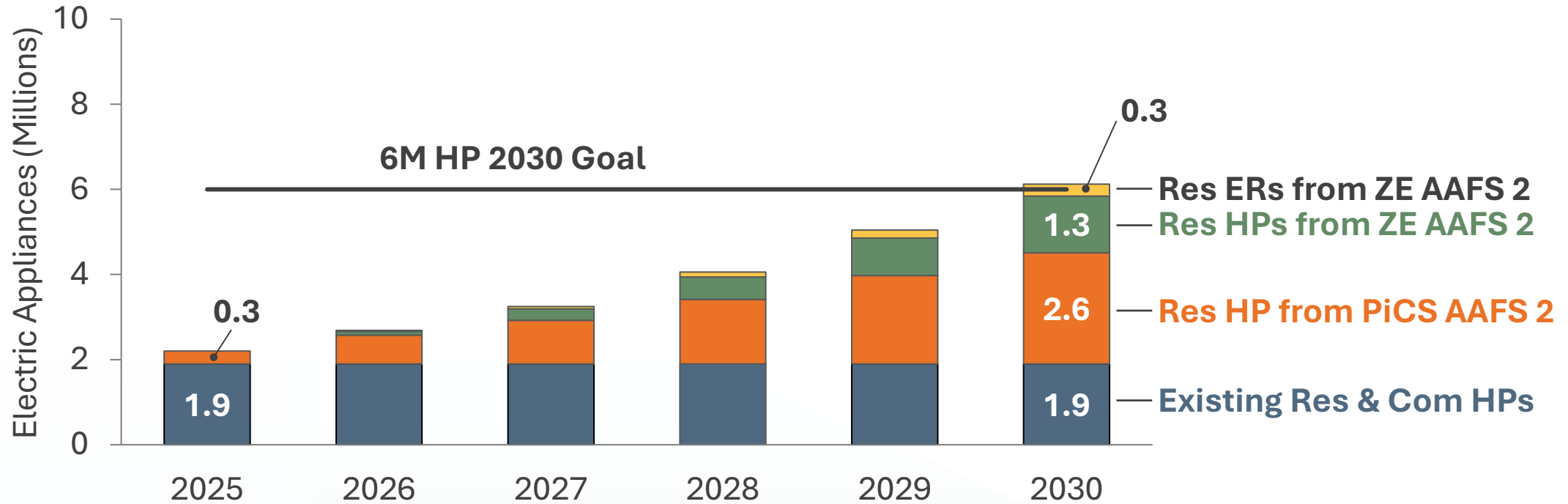
Update on CEC's Heat Pump Tracking Efforts

- CEC staff currently has an unofficial estimate as of **Q4 2024 (1.9M)** and **Q2 2025 (2.1M)**
- Increasing agency-wide efforts in tracking equipment, particularly heat pumps
 - Existing available data sources
 - Energy Data Collection Phase 3 – Space Conditioning And Water Heating Equipment Data Tracking
 - AMI data
- Dashboard in development with planned quarterly updates
- Plan to use Q4 2024 estimate of 1.9M HPs for 2025 IEPR analysis





Estimated Cumulative New Electric Appliances in 2030 – AAFS 2

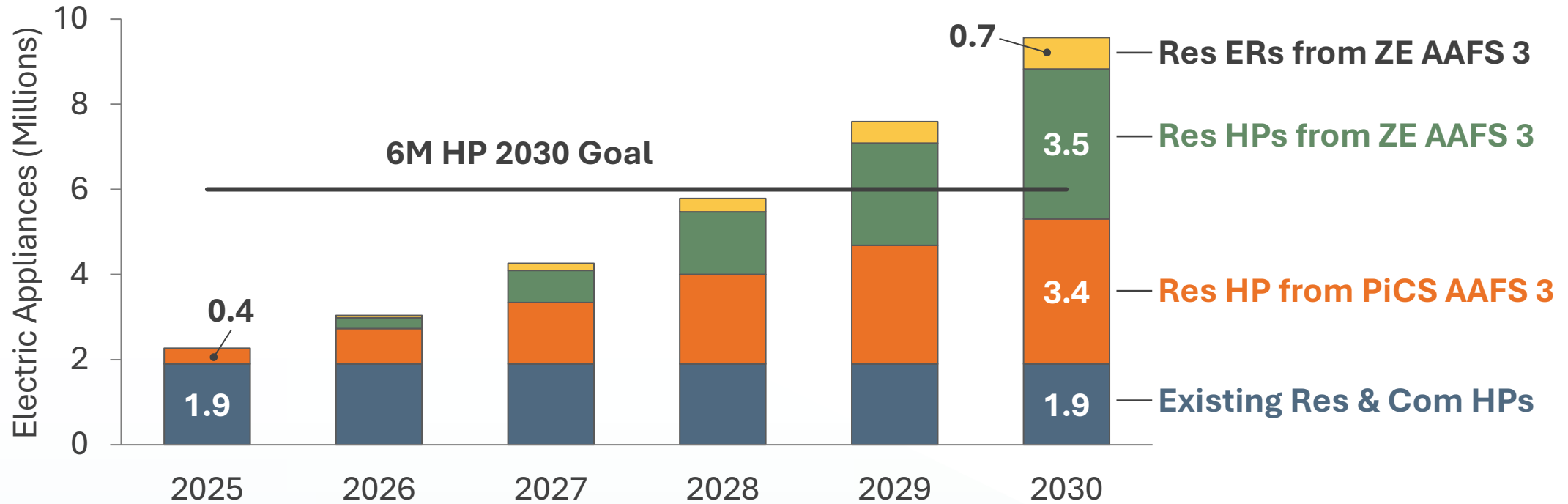


Caveats

- Based on an existing cumulative **2024 1.9M Res and Com HP estimate**
- The added appliances are only from Res sector, as FSSAT currently does not estimate Com stock
- ZE AAFS ERs (electric-resistant appliances) could potentially be HPs
- CEC staff will continue to improve HP tracking and projection mechanisms



Estimated Cumulative New Electric Appliances in 2030 – AAFS 3



Caveats

- Based on an existing cumulative **2024 1.9M Res and Com HP estimate**
- The added appliances are only from Res sector, as FSSAT currently does not estimate Com stock
- ZE AAFS ERs (electric-resistant appliances) could potentially be HPs
- CEC staff will continue to improve HP tracking and projection mechanisms

Thank You, Again!



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Appendix



2023 AAEE and PiCS AAFS Workbooks

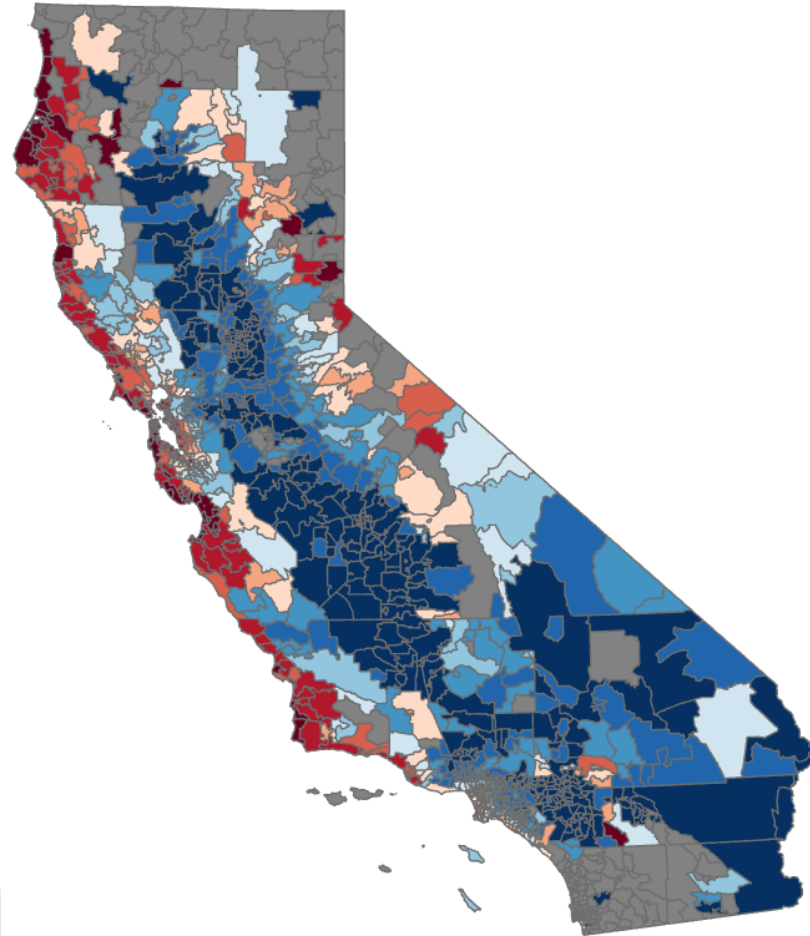
A detailed workbook of AAEE and AAFS PiCS characterizations is available here: [2023 AAEE & PiCS AAFS Scenario Characterization Workbook](#). TN# 262297. Docket Number 24-IEPR-03. March 21, 2025.

See slides “AAEE Modeled in 2023” and “PiCS AAFS Modeled in 2023”

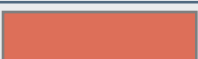
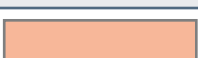
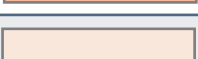
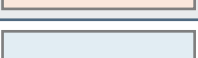


AC Penetration Rates: Zip Code

All Households by Zip Code



1:8,000,000 ▼

Symbol	Upper Value
	≤ 0.1
	≤ 0.2
	≤ 0.3
	≤ 0.4
	≤ 0.5
	≤ 0.6
	≤ 0.7
	≤ 0.8
	≤ 0.9
	≤ 1.0
	<NULL>

Source:
Recurve & CEC Staff