2025 AAEE & AAFS Draft Results

Ingrid Neumann, Ph.D., and Ethan Cooper
Advanced Electrification Analysis Branch, Efficiency Analysis Unit
Demand Analysis Working Group (DAWG) Meeting
October 30, 2025

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

Ingrid Neumann, Ph.D.
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October 30, 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.
- The **additional achievable** scenarios capture a range of incremental market potential 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 *savings* from Programs and Incremental Codes & Standards (PiCS)	1a	PiCS workbooks	**PiCS AAEE** Scenarios 1-6
PiCS AAFS	AAFS gas and electricity *impacts* 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** Scenarios 1-6 **AAFS** Scenarios 1-6

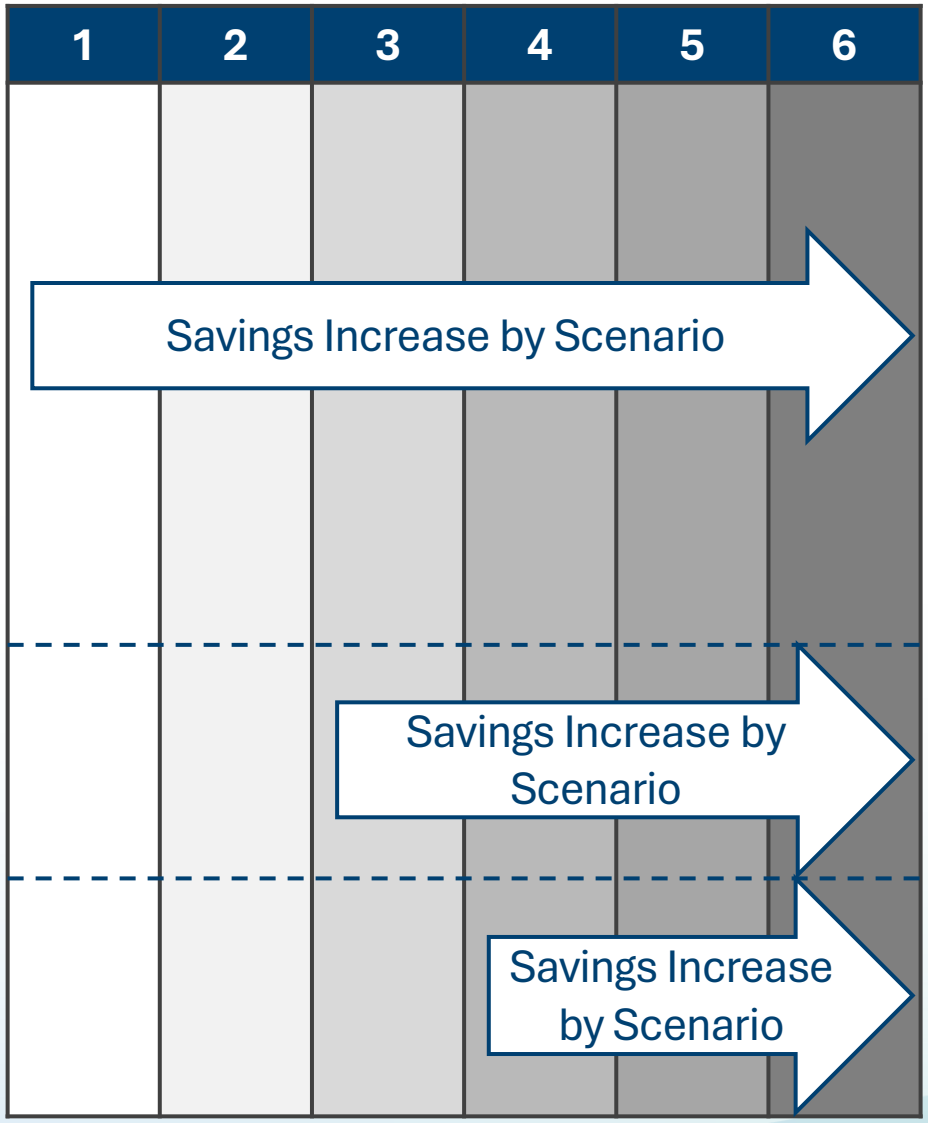
PiCS AAEE & PiCS AAFS Draft Results

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



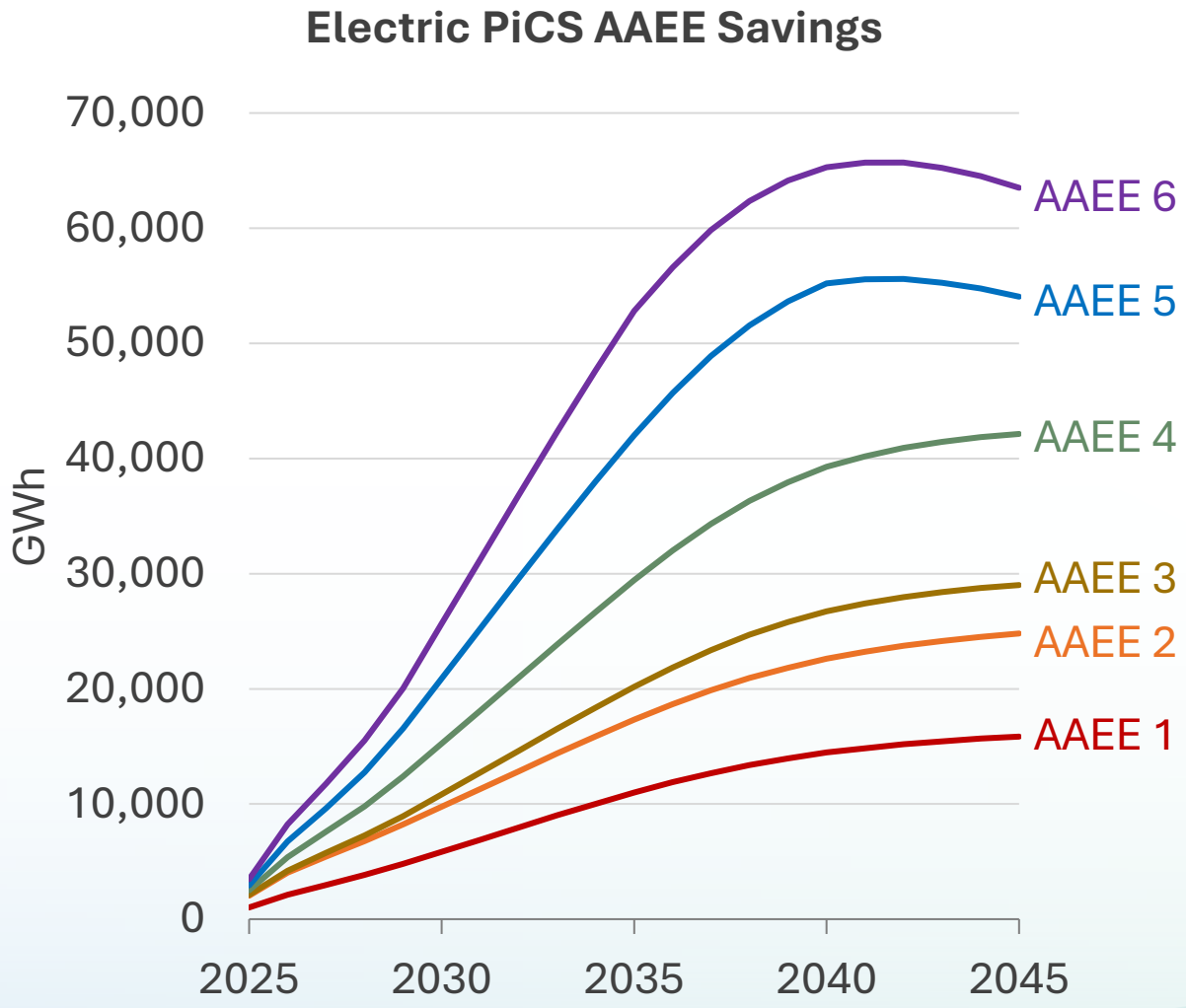
← **PiCS AAEE Scenarios**

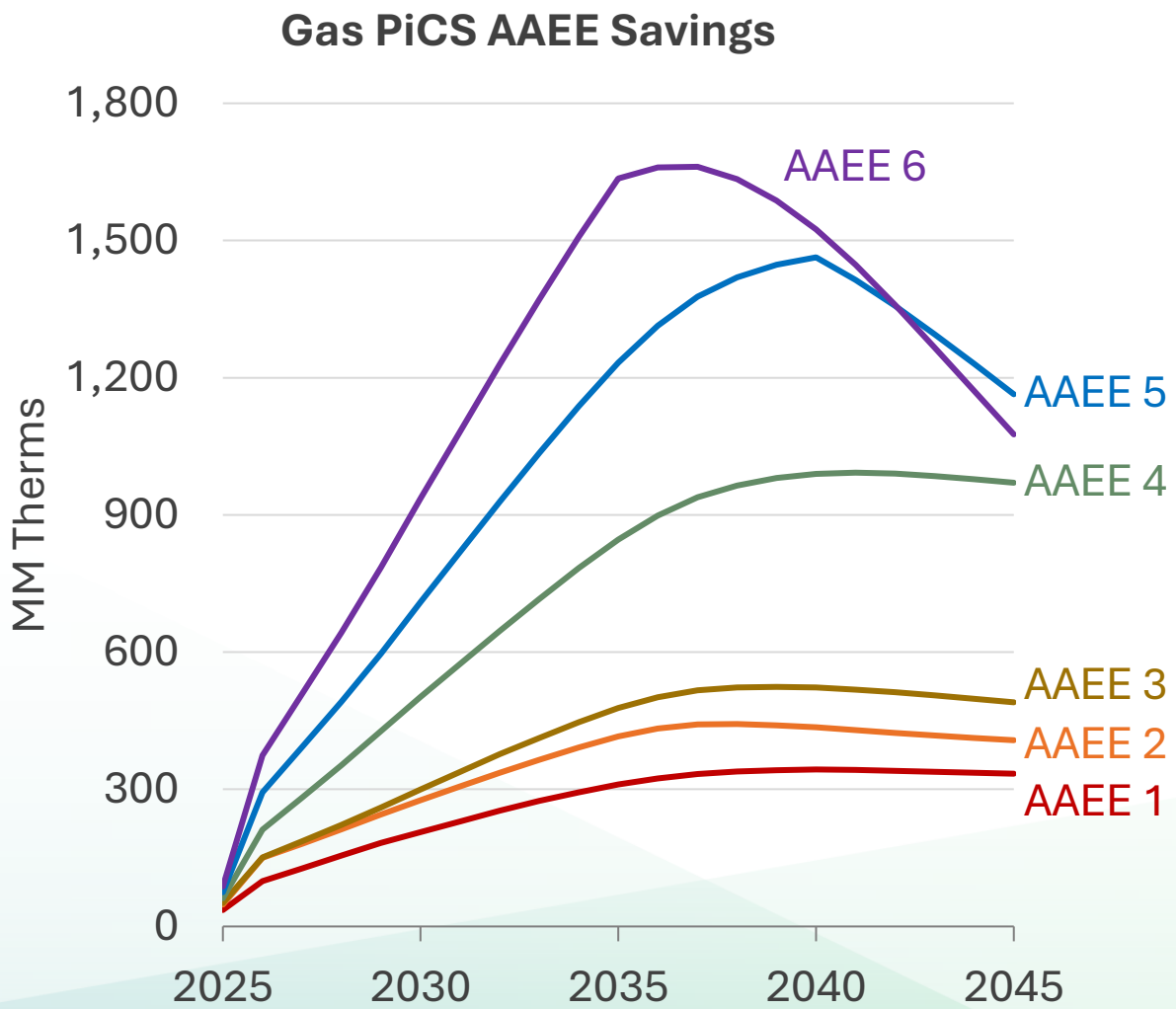
- **IOU energy efficiency programs**
- **POU energy efficiency programs**
- **Title 20 State Appliance Standards**
- **Federal Appliance Standards**
- **Title 24 Res and Non-Res NC and A&A**
- Local Government Ordinances
- **Home Efficiency Rebates (HOMES) IRA Incentive Program**
- Greenhouse Gas Reduction 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

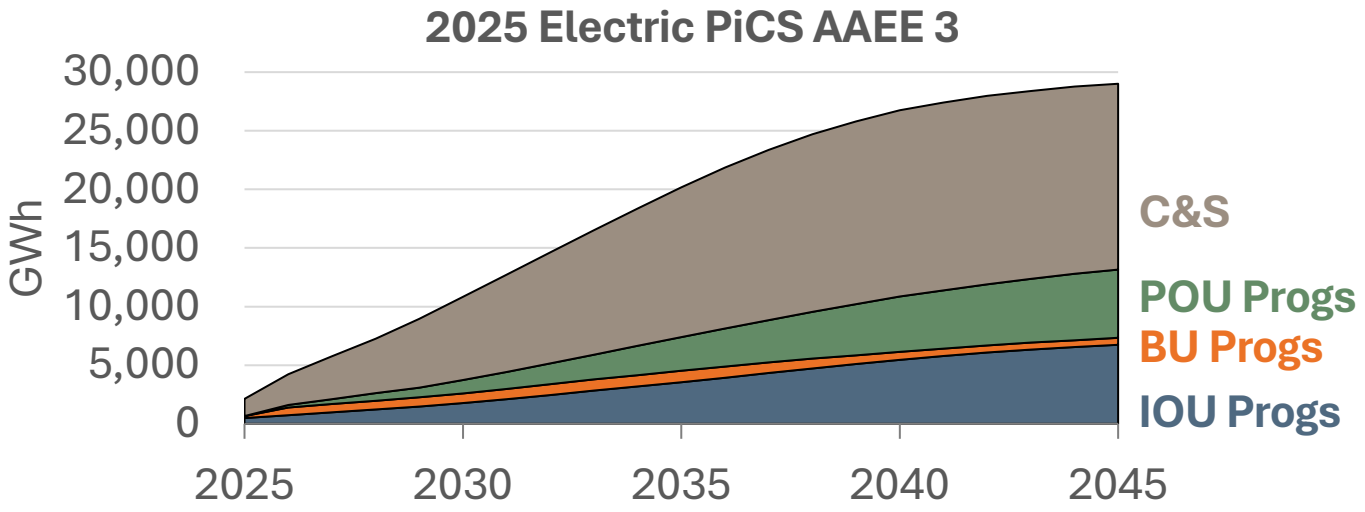
2025 Gas and Electric PiCS AAEE Scenario Savings

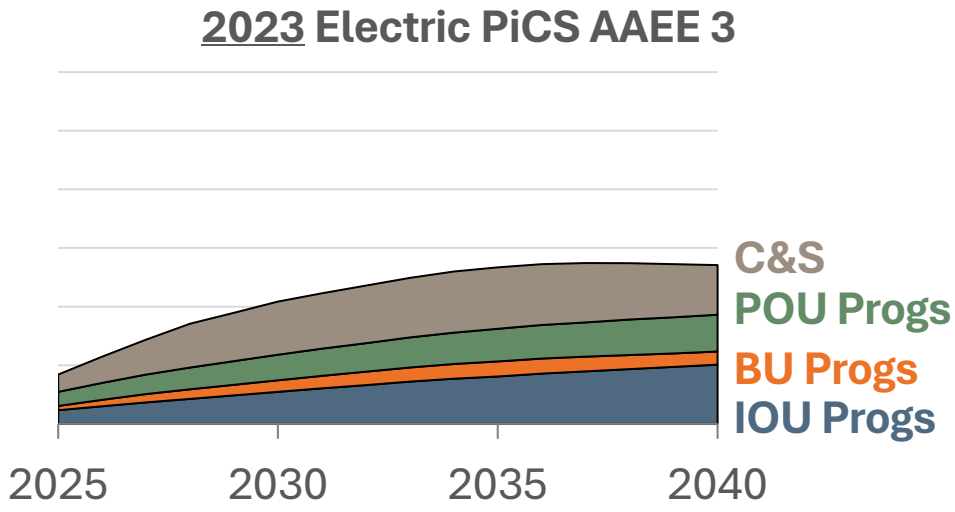


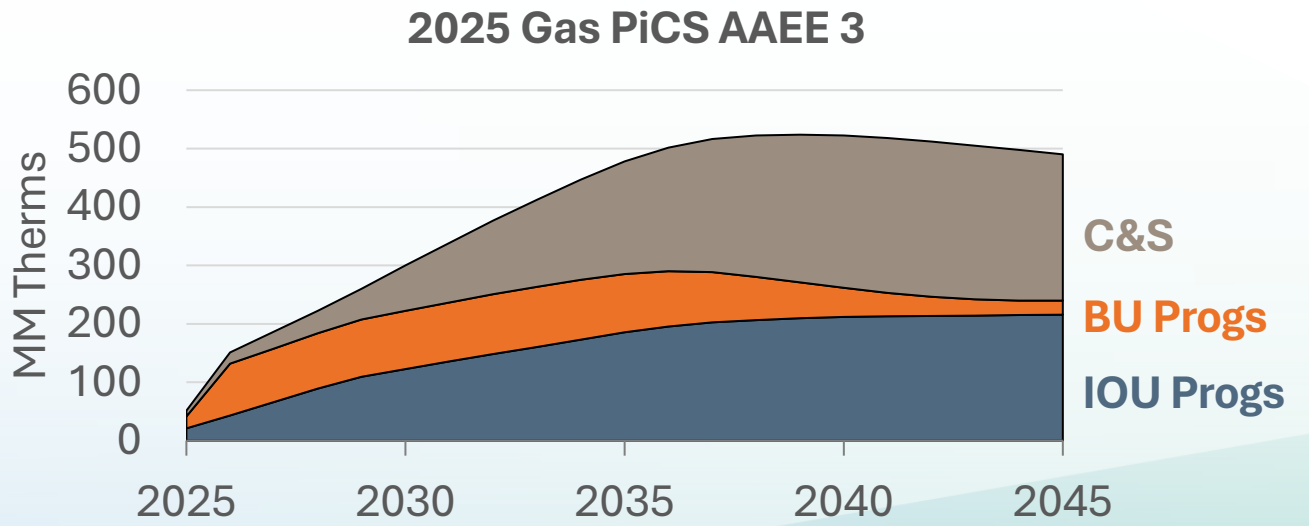


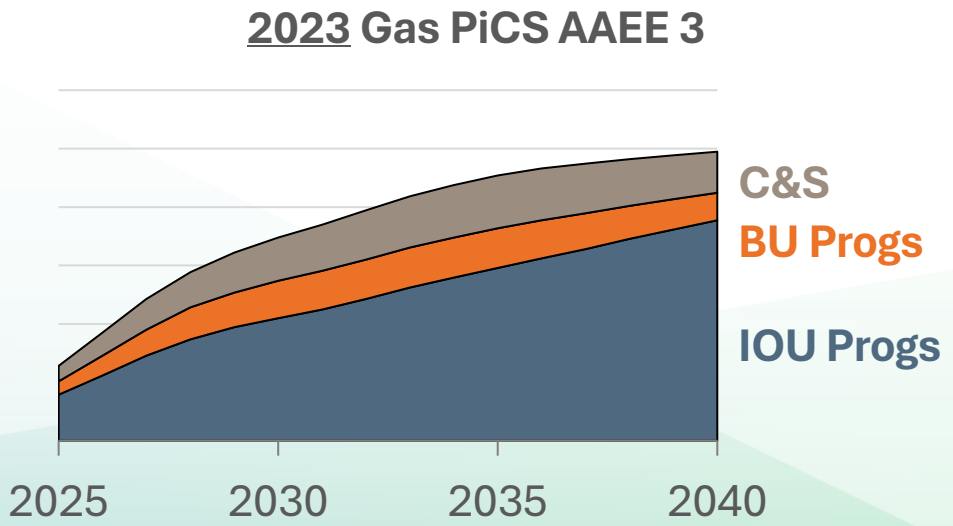
Source: CEC Staff

2025/2023 PiCS AAEE 3 Comparisons









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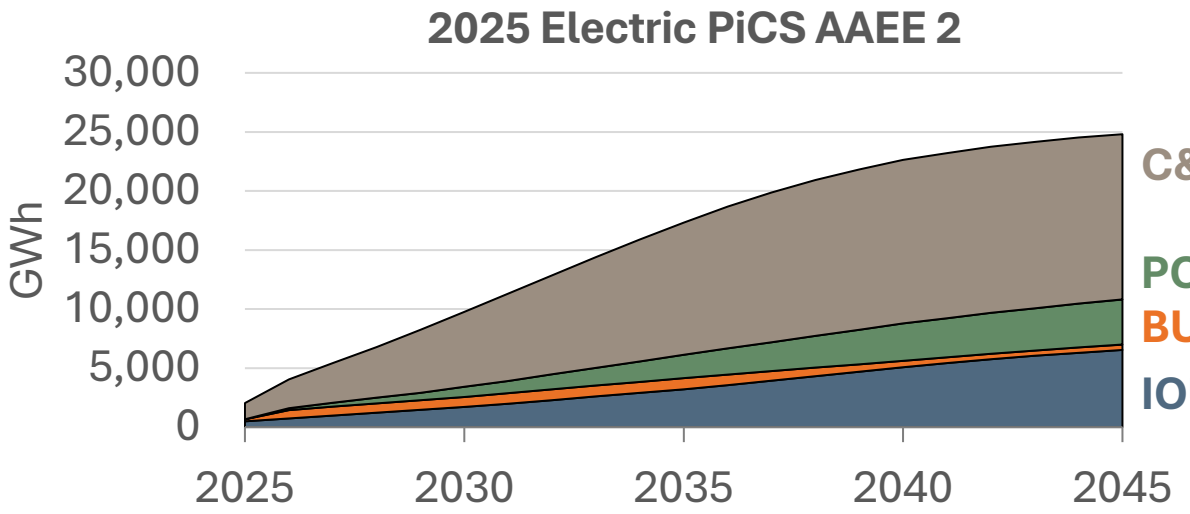
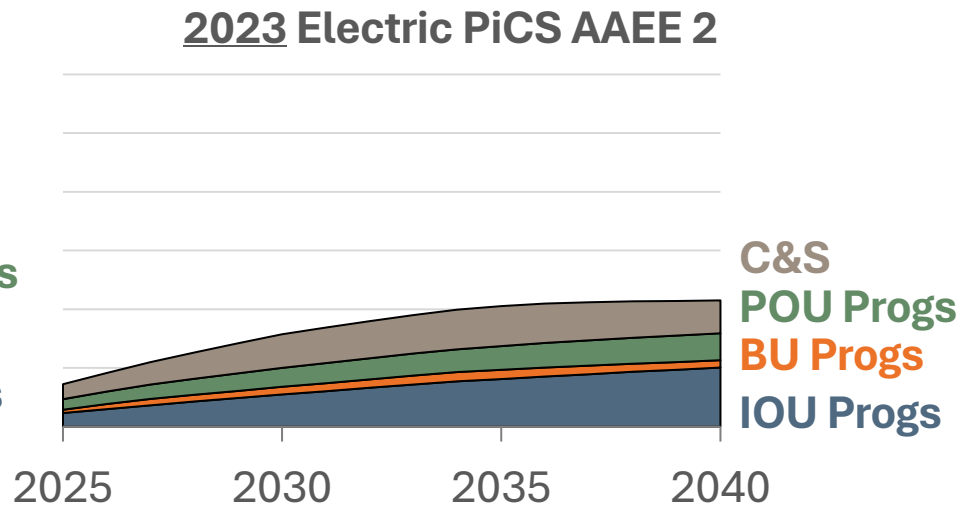
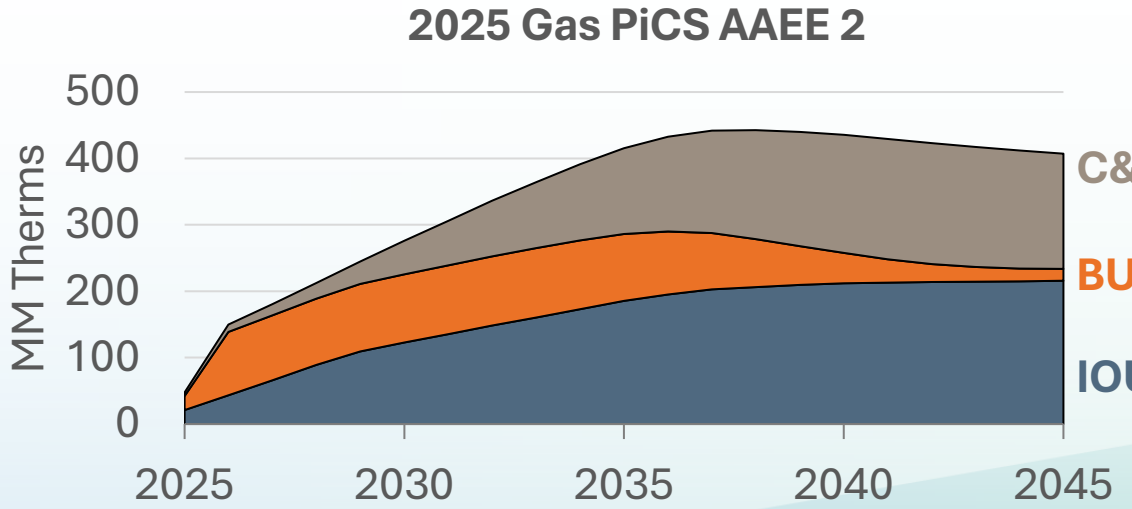
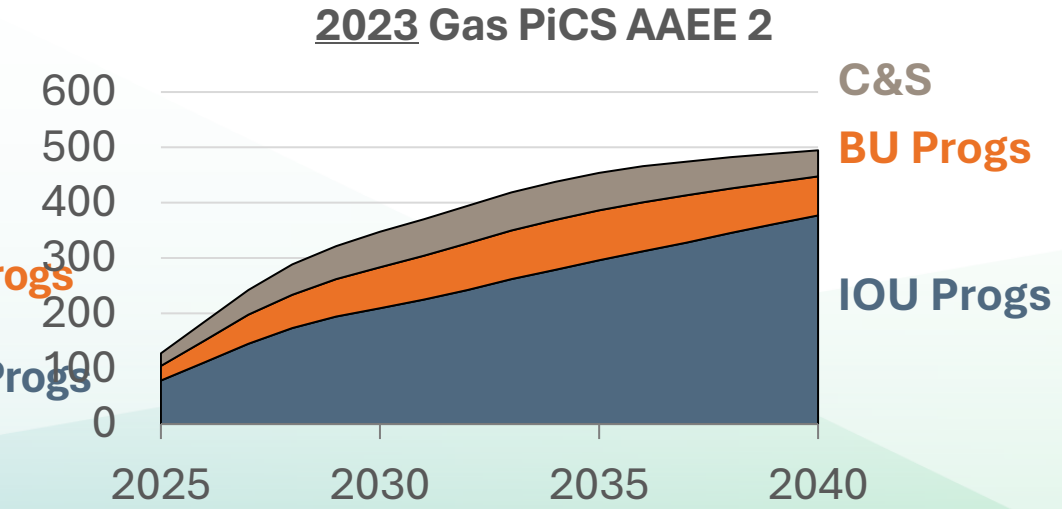
2025/2023 PiCS AAEE 2 Comparisons



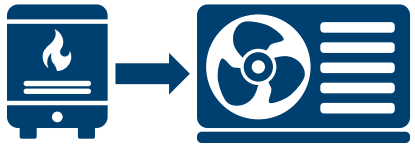






Source: CEC Staff

Summary of 2025 PiCS AAFS Scenarios



1	2	3	4	5	6

Impacts Increase by Scenario

Impacts Increase by Scenario

Increasing Impacts

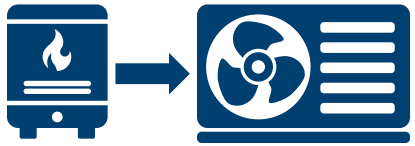
← **PiCS AAFS Scenarios**

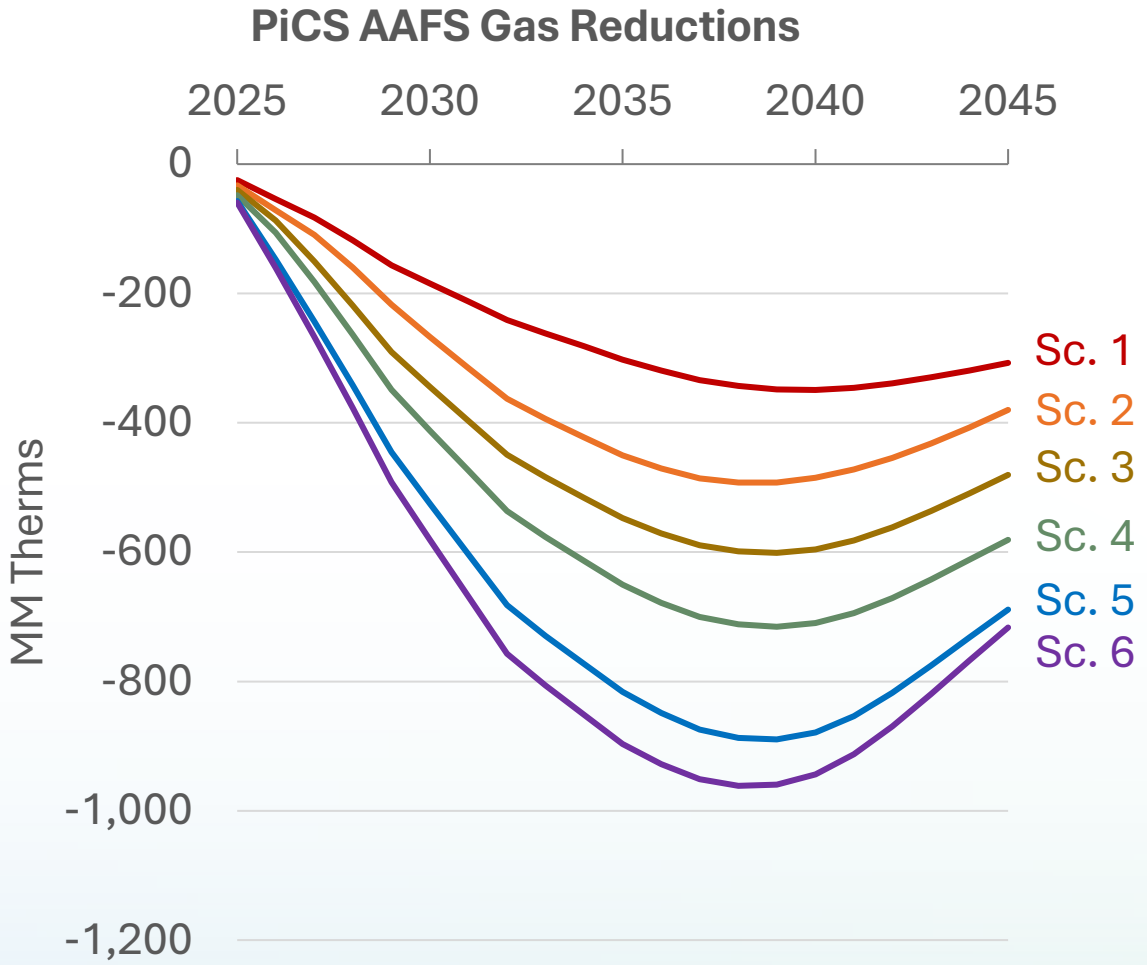
- **IOU & POU fuel substitution programs**
- **Building Initiative for Low-Emissions Development (BUILD)**
- **Home Electrification and Appliance Rebates (HEEHRA) IRA Pay for Performance Program**
- **Title 24 Res and Non-Res NC and A&A**
- **TECH Clean California**
- **EBD Program Direct Install & Tribal 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)

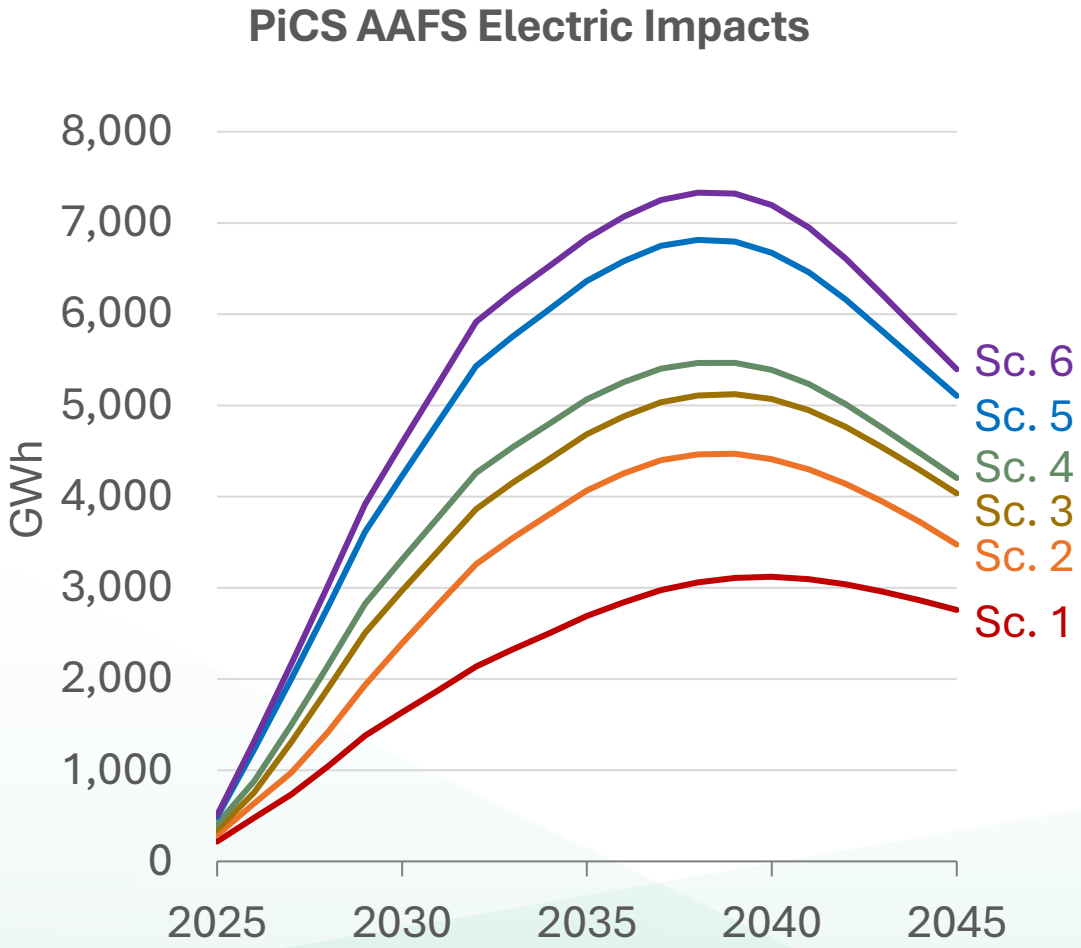
- Self-Generation Incentive Program (SGIP) HPWH
- Food Production Investment Program

- Industrial and Agricultural Potential

2025 Gas and Electric PiCS AAFS Scenario Impacts



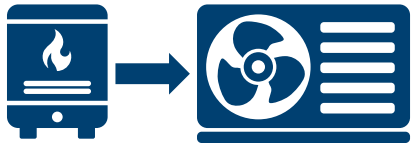


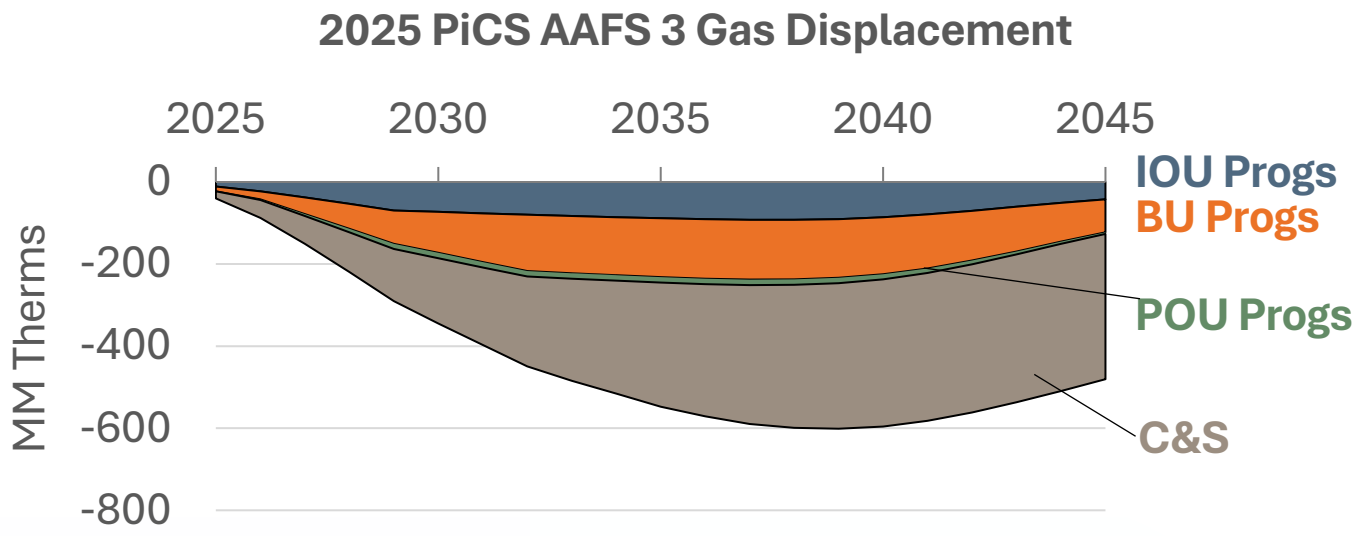


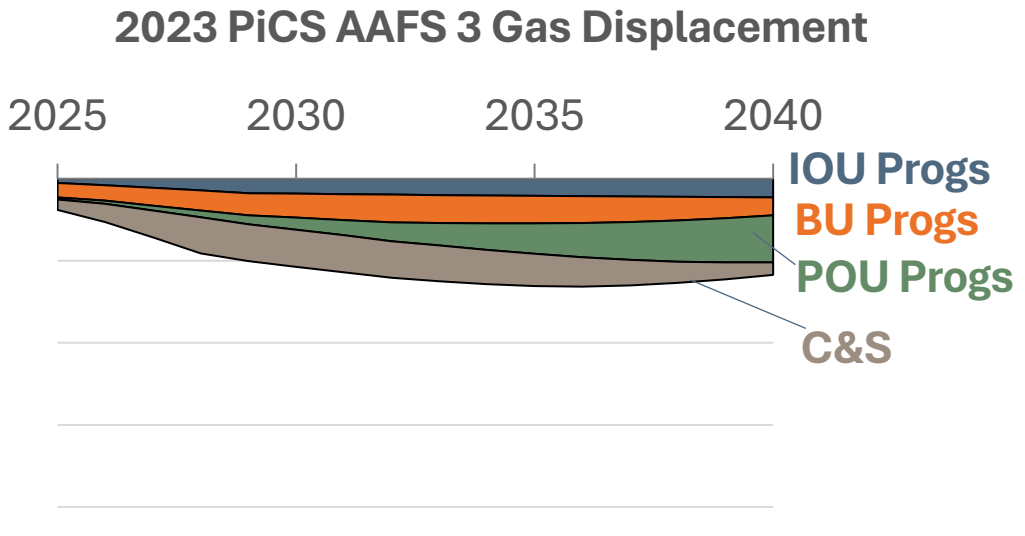
Source: CEC Staff

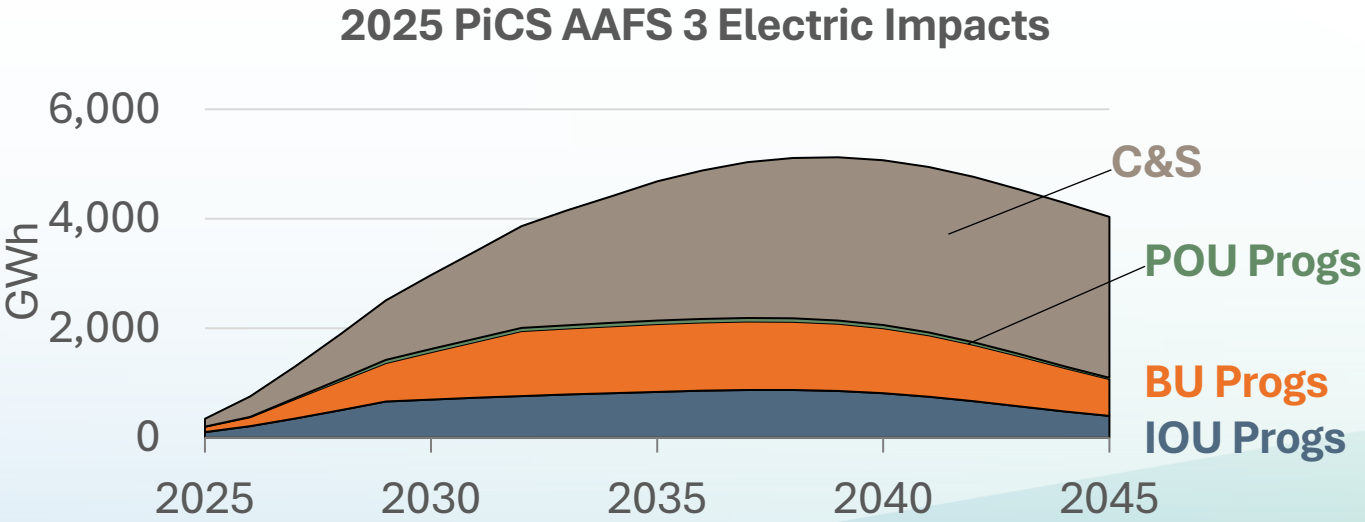
Note: While electric PiCS AAEE Savings reduces electricity consumption, PiCS AAFS adds incremental electric loads.

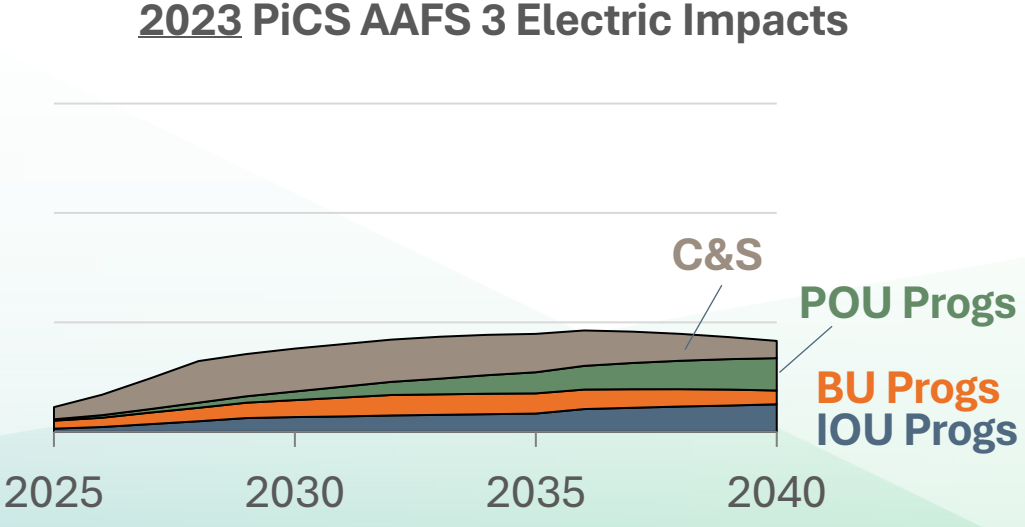
2025/2023 PiCS AAFS 3 Comparisons





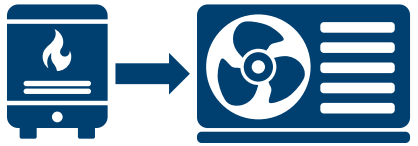




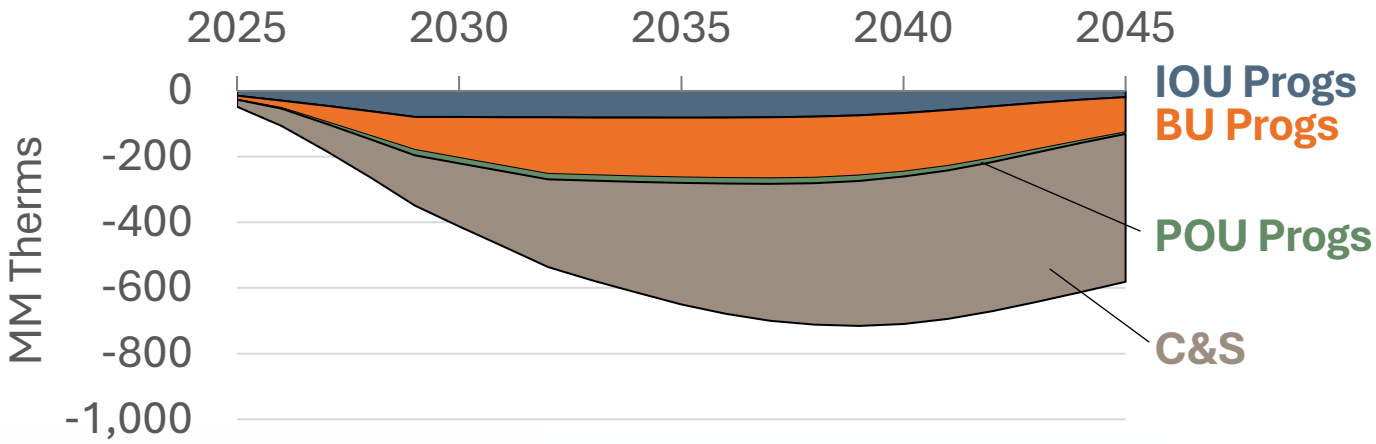


Source: CEC Staff

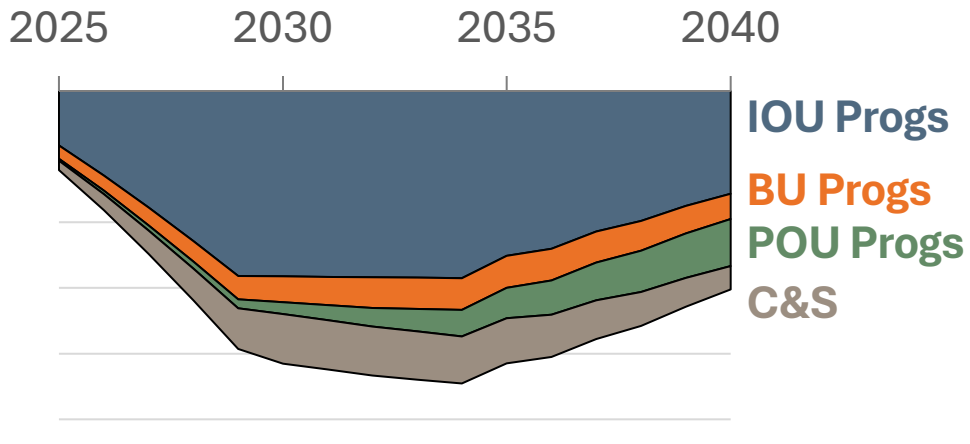
2025/2023 PiCS AAFS 4 Comparisons



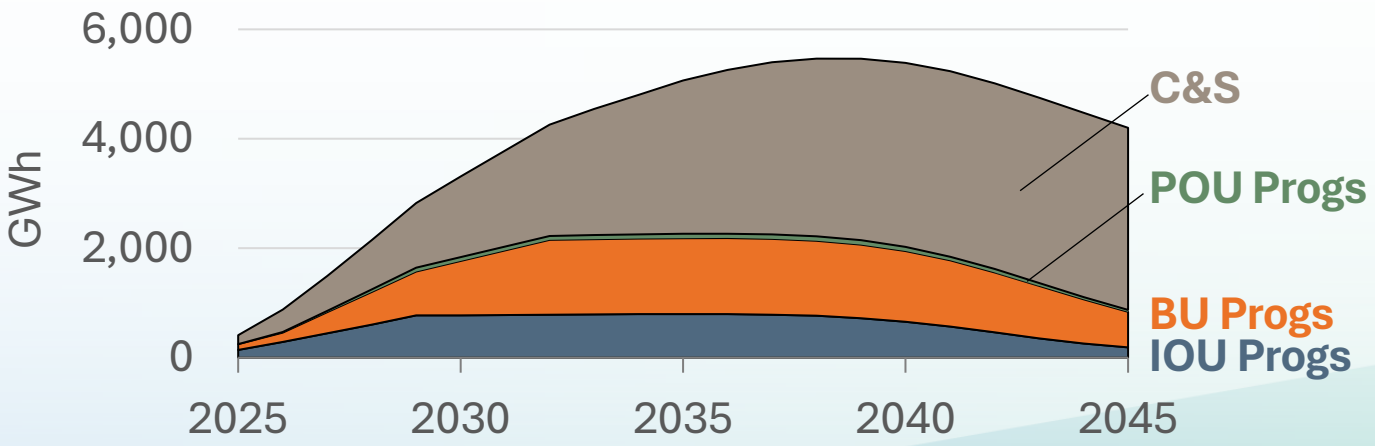
2025 PiCS AAFS 4 Gas Displacement



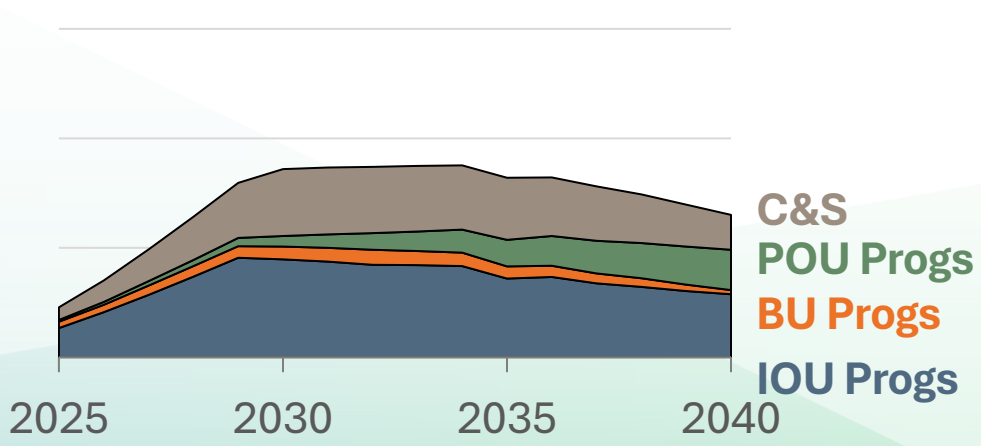
2023 PiCS AAFS 4 Gas Displacement



2025 PiCS AAFS 4 Electric Impacts

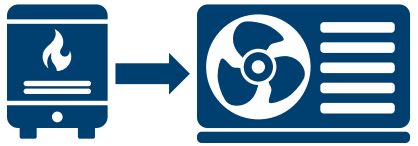


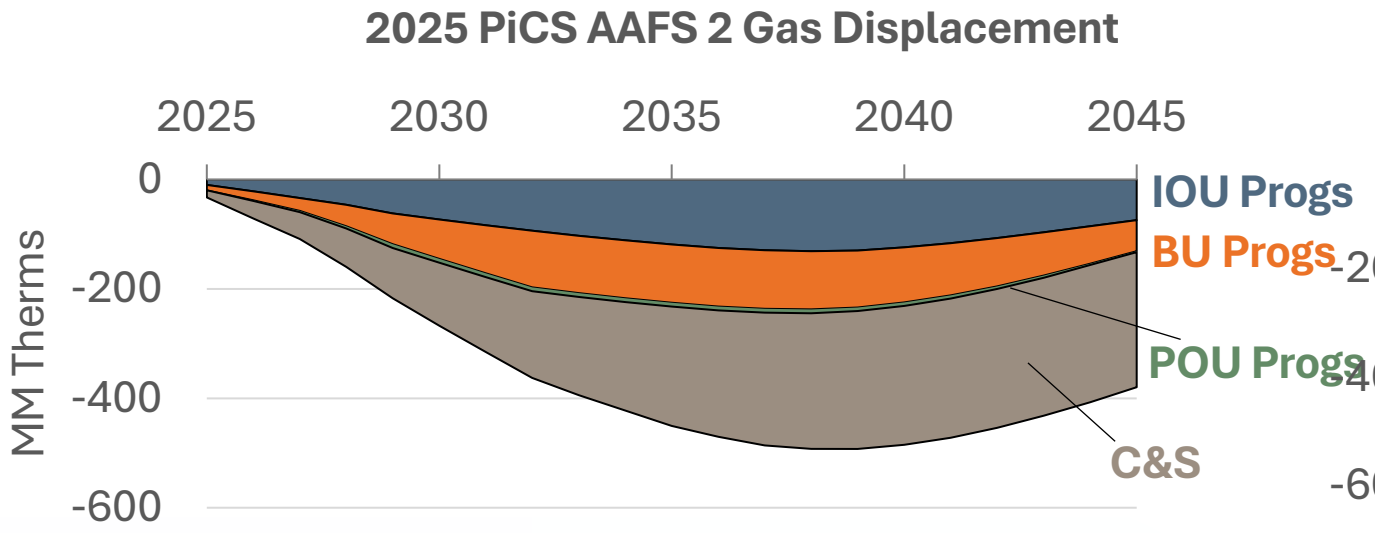
2023 PiCS AAFS 4 Electric Impacts

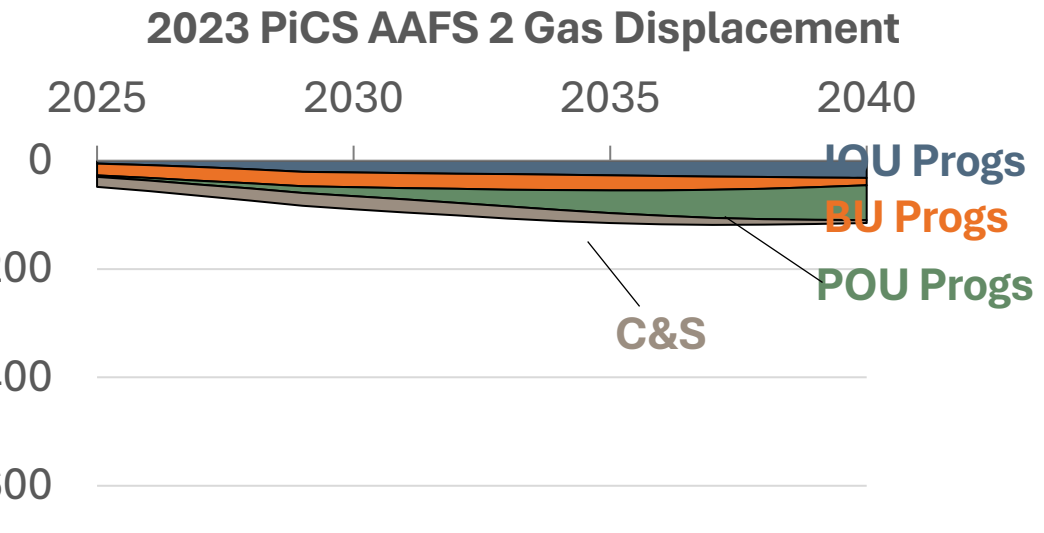


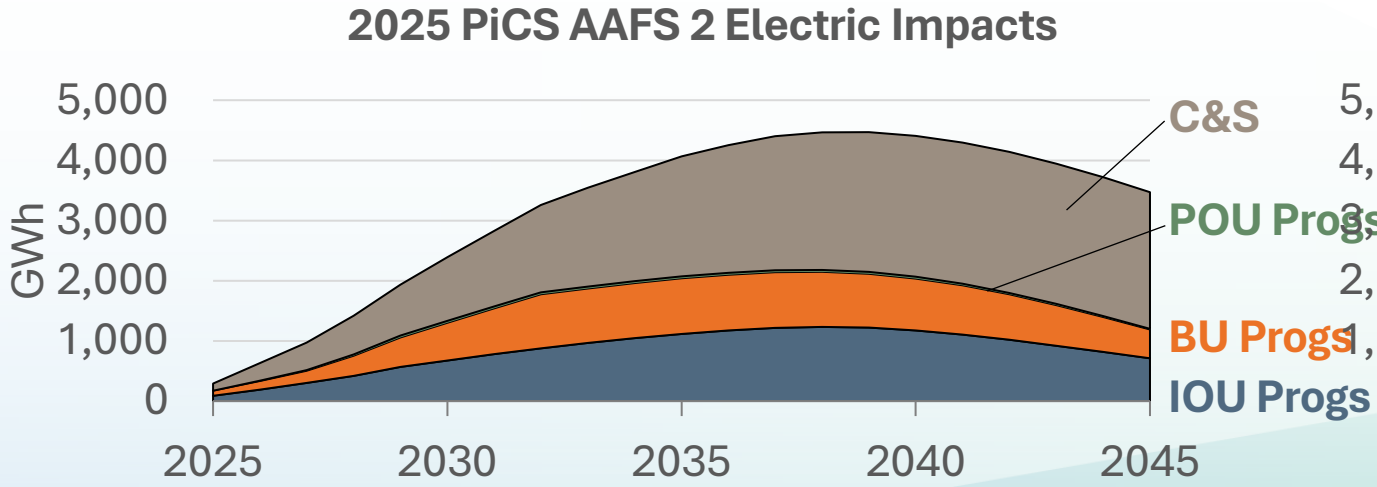
Source: CEC Staff

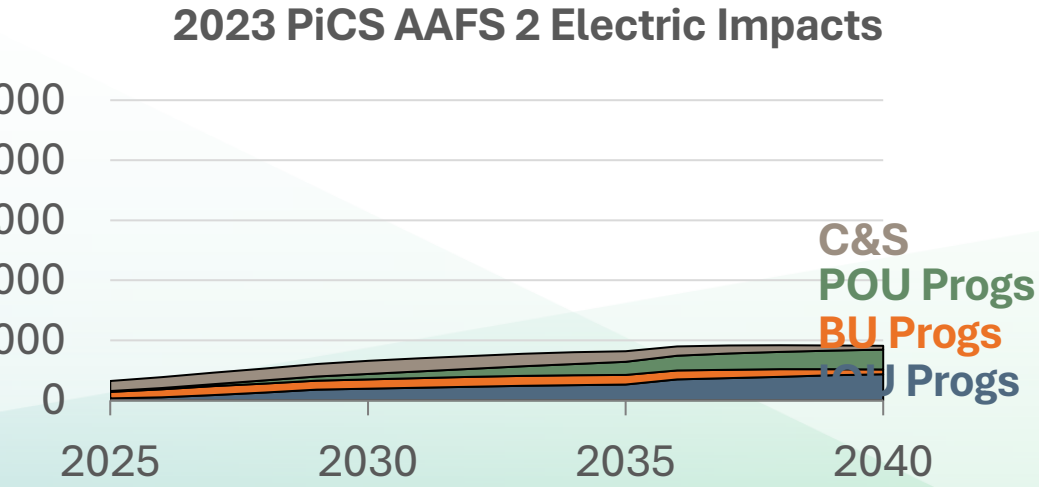
2025/2023 PiCS AAFS 2 Comparisons











Source: CEC Staff

Summary of Observations from 2025 PiCS AAEE & PiCS AAFS 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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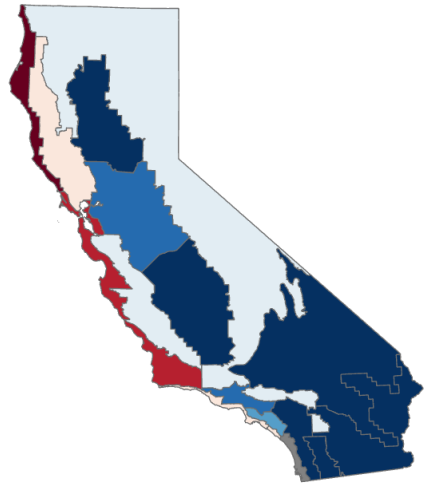
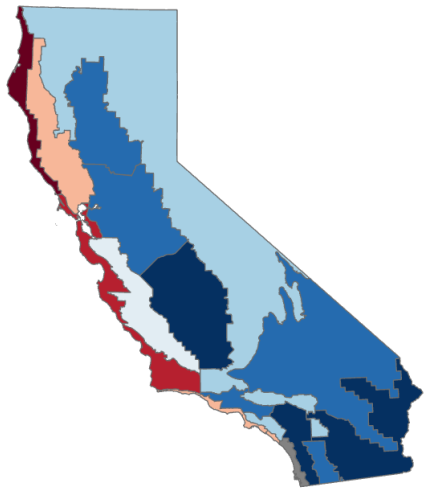
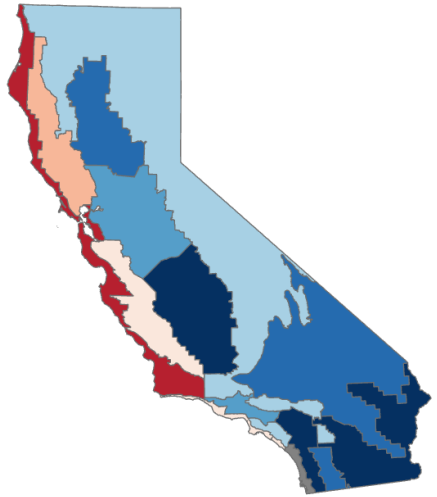
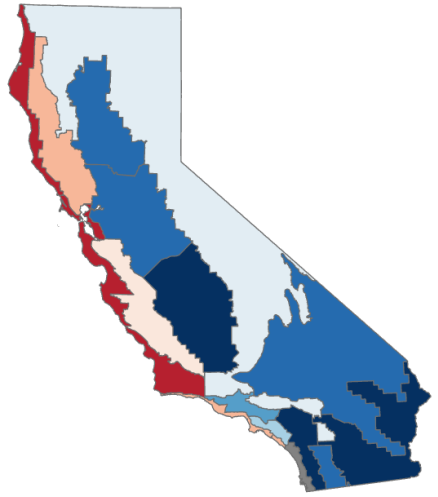
October 30, 2025

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 from ZE AAFS ▪ Begin modeling AQMD impacts with ZE AAFS Sc. 3
CARB's SH and WH ZE Appliance Standards	CARB memo to EJAC members (August 28, 2025) states that they are exploring alternative regulatory concept approaches to a 100% new sales requirement	Revised ZE AAFS Scenarios ▪ ZE AAFS 3: CARB SP ▪ ZE AAFS 4: CARB SIP with compliance starting in '30 ▪ Added a ZE AAFS Sc. 1
Federal Standards	DOE energy efficiency standards for residential water heaters (Compliance required starting in 2029)	Updated the efficiency weighting for residential water heaters in FSSAT
Misc. Data Updates	▪ Updated AC penetration rates based on AMI data analysis ▪ Updated Commercial HVAC space heating load shapes ▪ Misc. FSSAT debugging and process improvements	Updated FSSAT's data inputs and assumptions

FSSAT Inputs: AC Penetration Rates By Climate Zone, Building Type, and Low-Income

	Residential	Low-Income Residential
Single-Family Buildings		
Multi-Family Buildings		

Symbol	Upper Value
	≤ 10%
	≤ 20%
	≤ 30%
	≤ 40%
	≤ 50%
	≤ 60%
	≤ 70%
	≤ 80%
	≤ 90%
	≤ 100%
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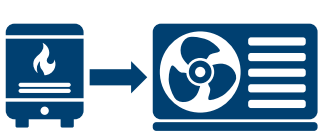
Source: Recurve & CEC Staff

2025 AAFS & AAEE Forecast Scenario Combinations

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

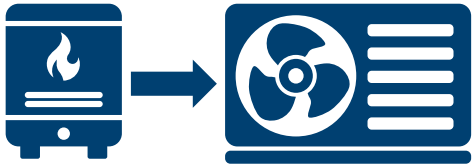


AAFS (PiCS + ZE)	AAEE
1	3
2	**3**
3	**3**
4	**2**
5	2
6	2

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



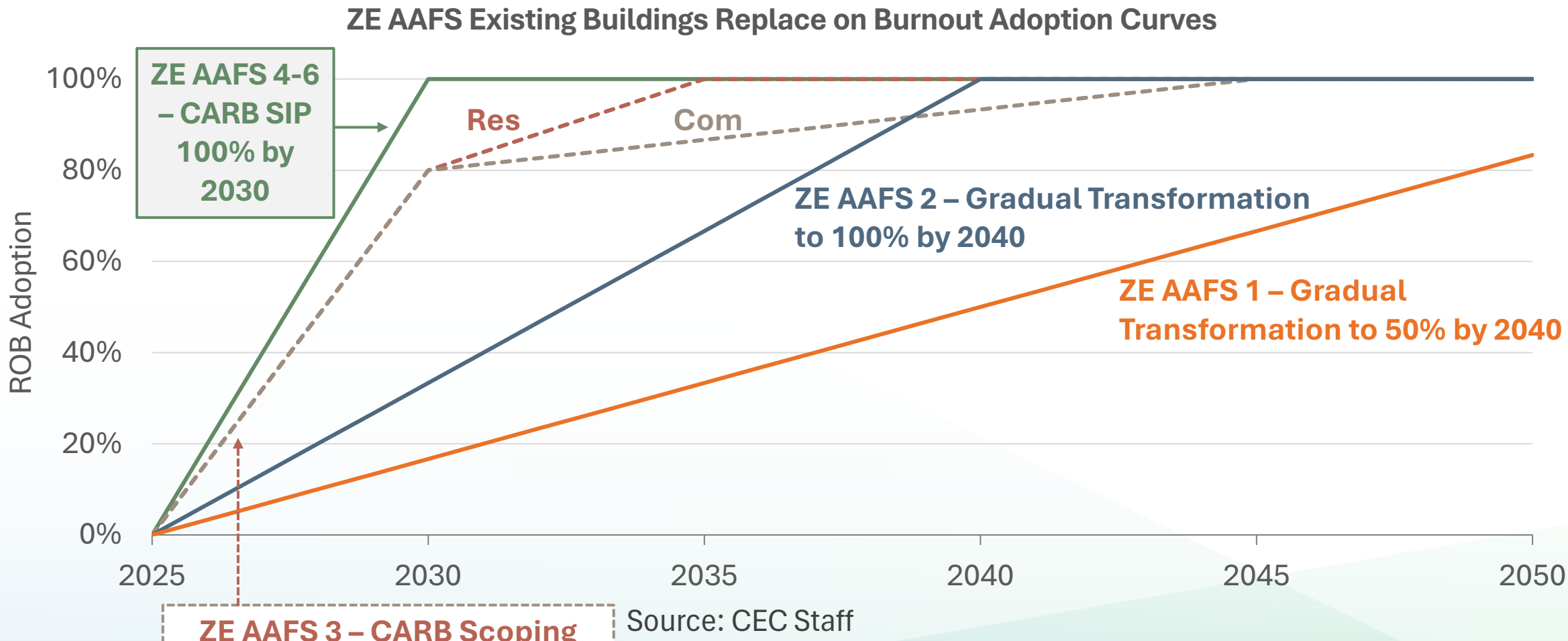
	AAFS 1	AAFS 2	AAFS 3	AAFS 4	AAFS 5	AAFS 6
PiCS AAFS	1	2	3	4	5	6
ZE AAFS	1	2	3	4	5	6
End Uses	SH & WH	SH & WH	SH & WH	SH & WH	SH, WH, C, CD	SH, WH, C, CD
Substituted Fuel Types	Gas	Gas	Gas	Gas	Gas	Gas & RP
NC (Beyond PiCS T24)				100% in 2029	100% in 2029	100% in 2029
Statewide EB	GT **50%** by 2040	GT **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

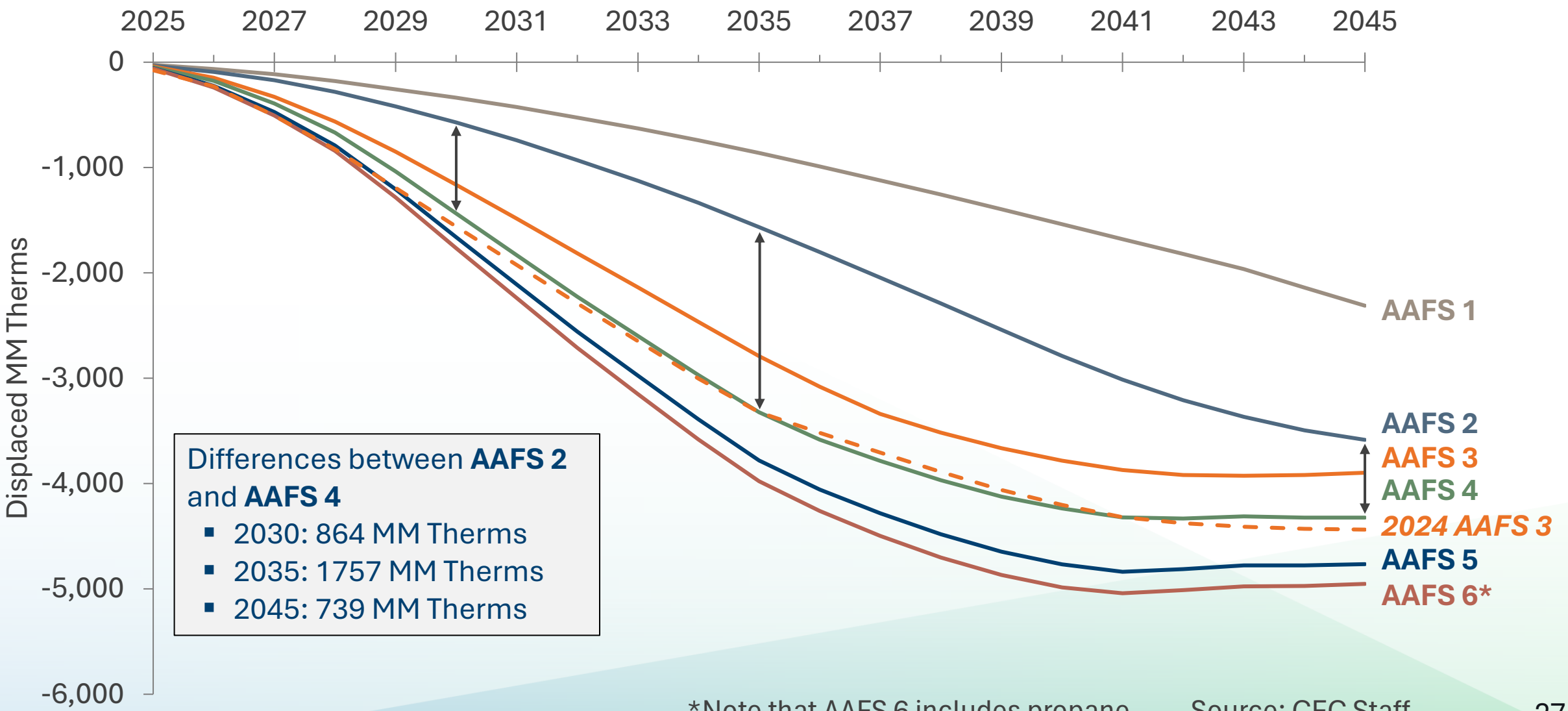
Note: AAFS scenario impacts are the sum of the PiCS AAFS and ZE AAFS Scenario impacts modeled by FSSAT. FSSAT finalizes gas AAEE savings based on the AAFS effect on available gas in AAEE.

2025 ZE AAFS Scenario Replace-on-Burnout Adoption Curves



Source: CEC Staff

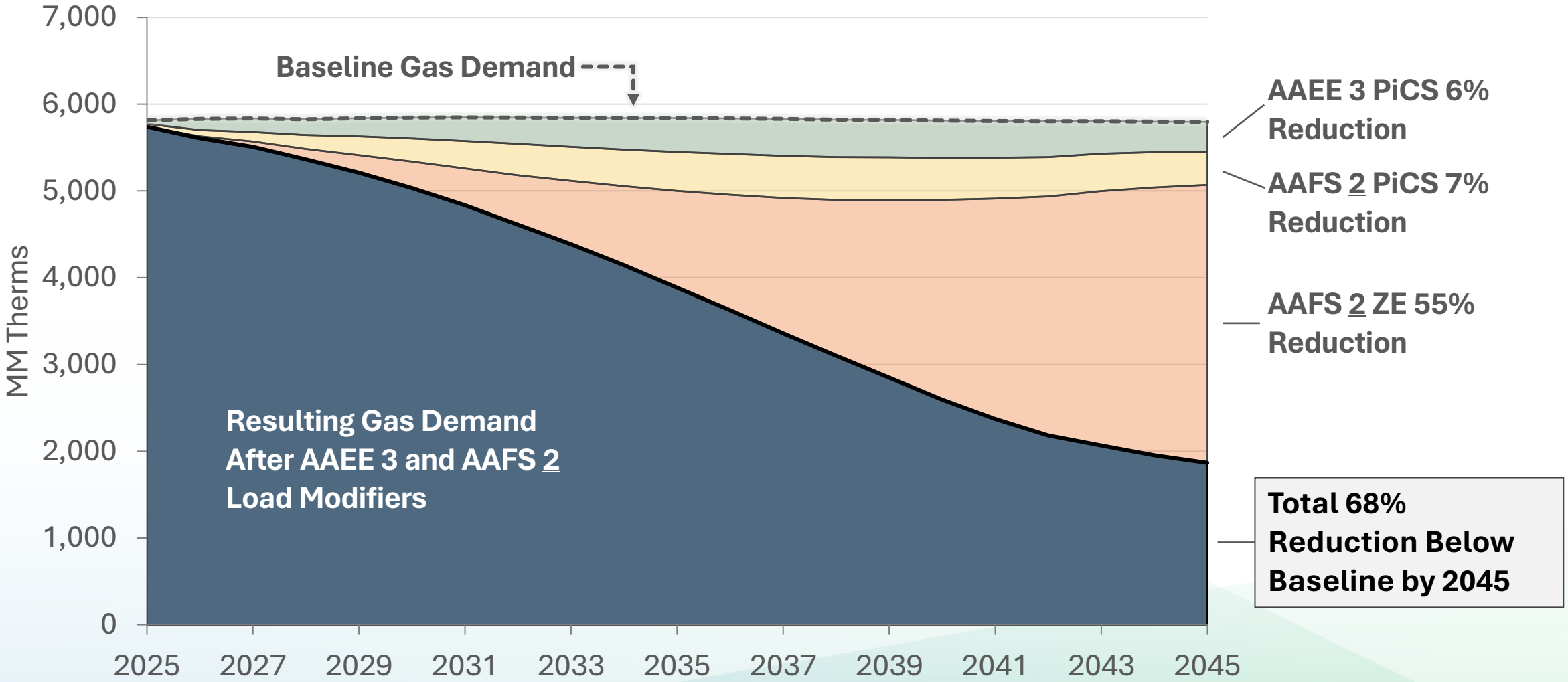
2025 AAFS Gas Displacement Draft Results



*Note that AAFS 6 includes propane

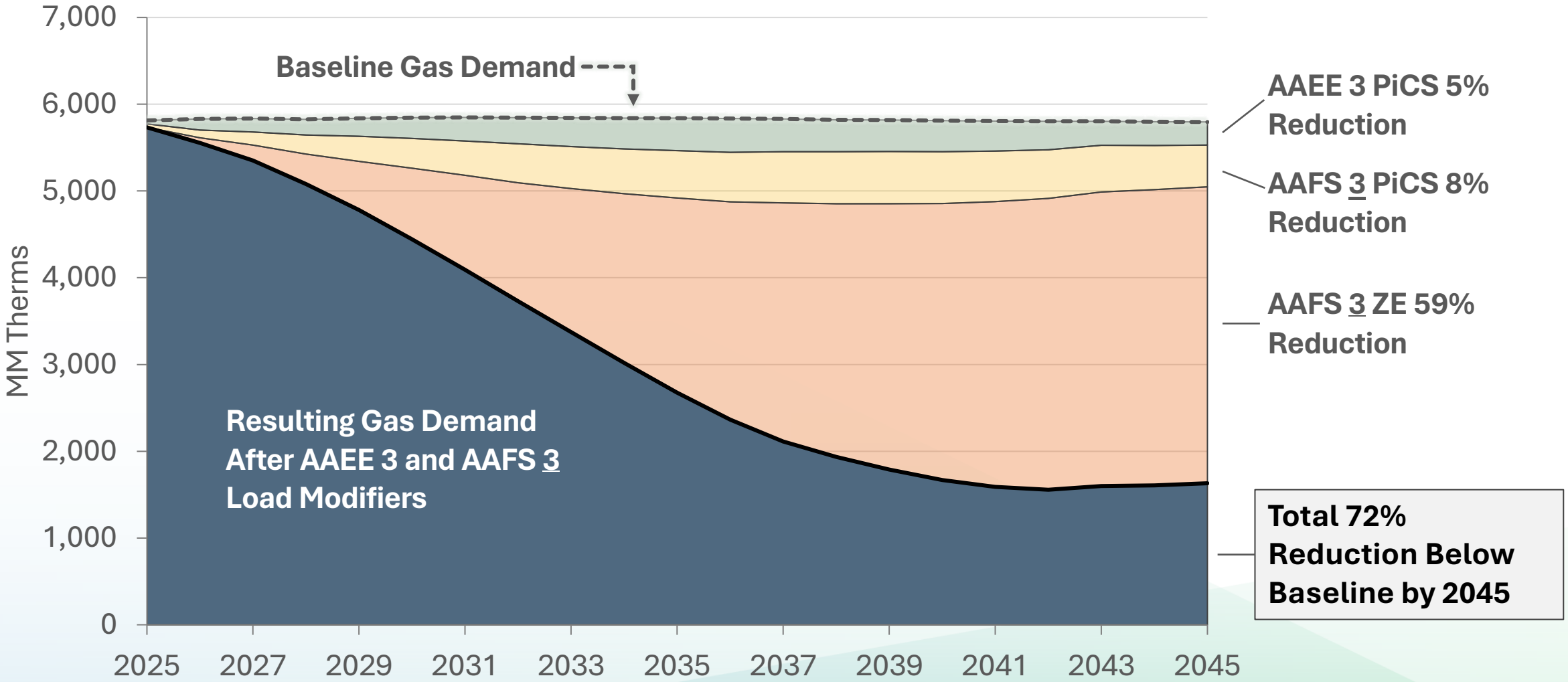
Source: CEC Staff

AAFS 2 + AAEE 3 Gas Displacement



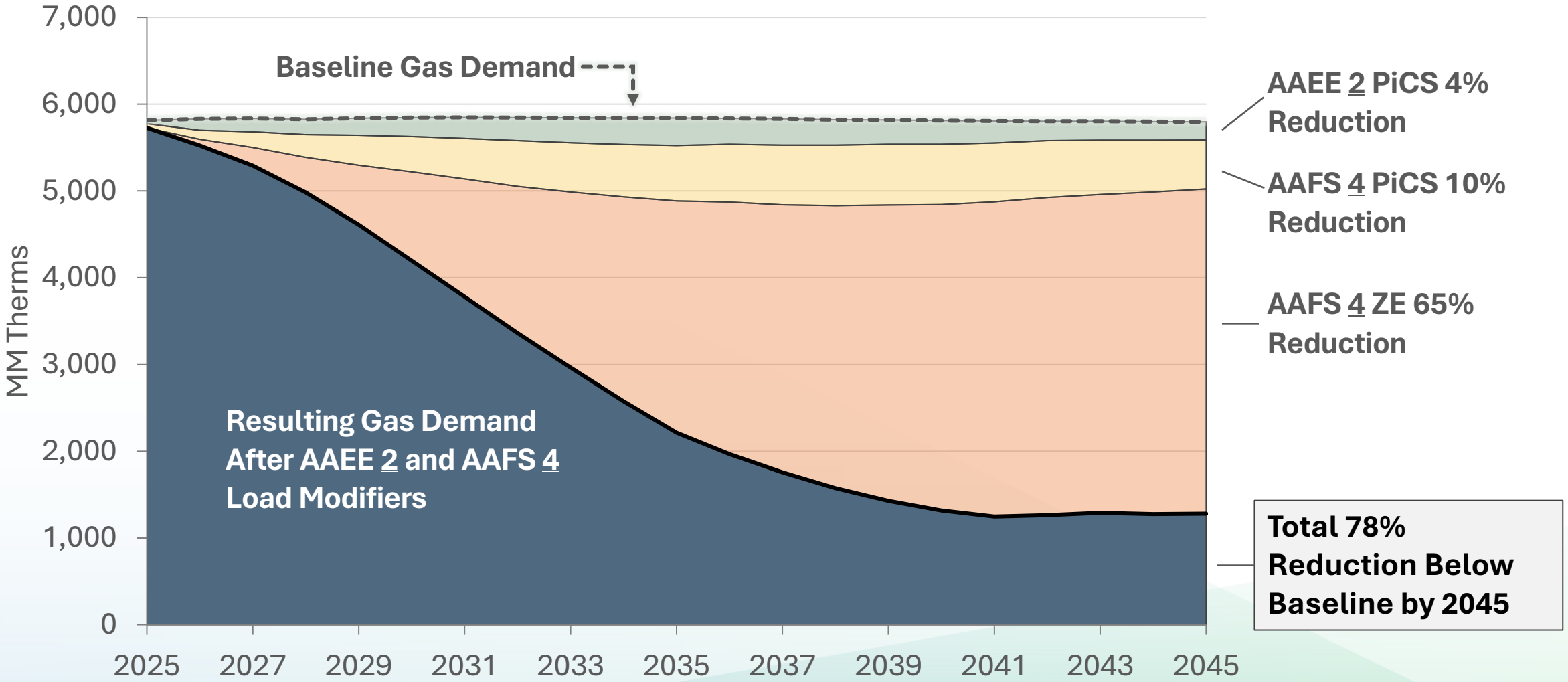
Source: CEC Staff Note: Gas displacement displayed is only for Residential and Commercial sectors

AAFS 3 + AAEE 3 Gas Displacement



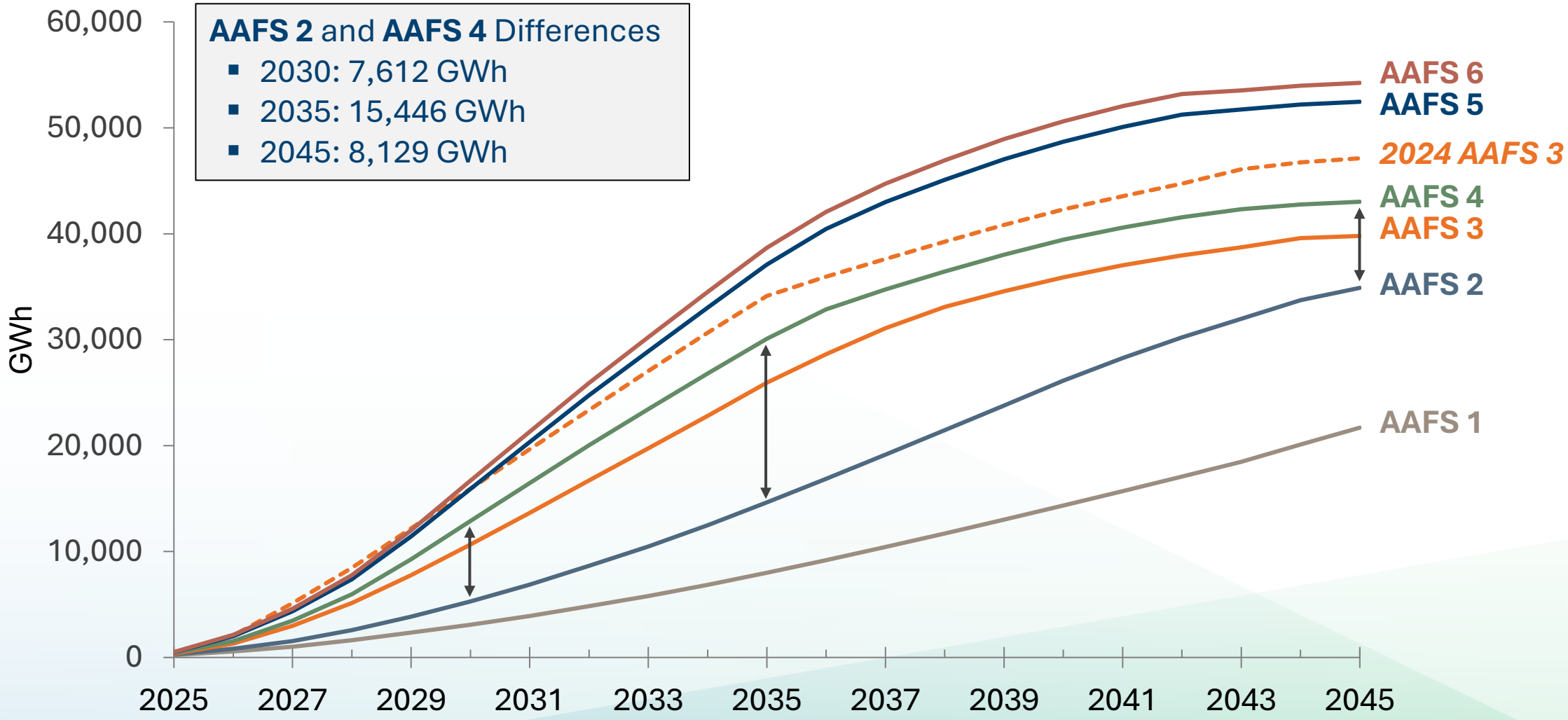
Source: CEC Staff Note: Gas displacement displayed is only for Residential and Commercial sectors

AAFS 4 + AAEE 2 Gas Displacement



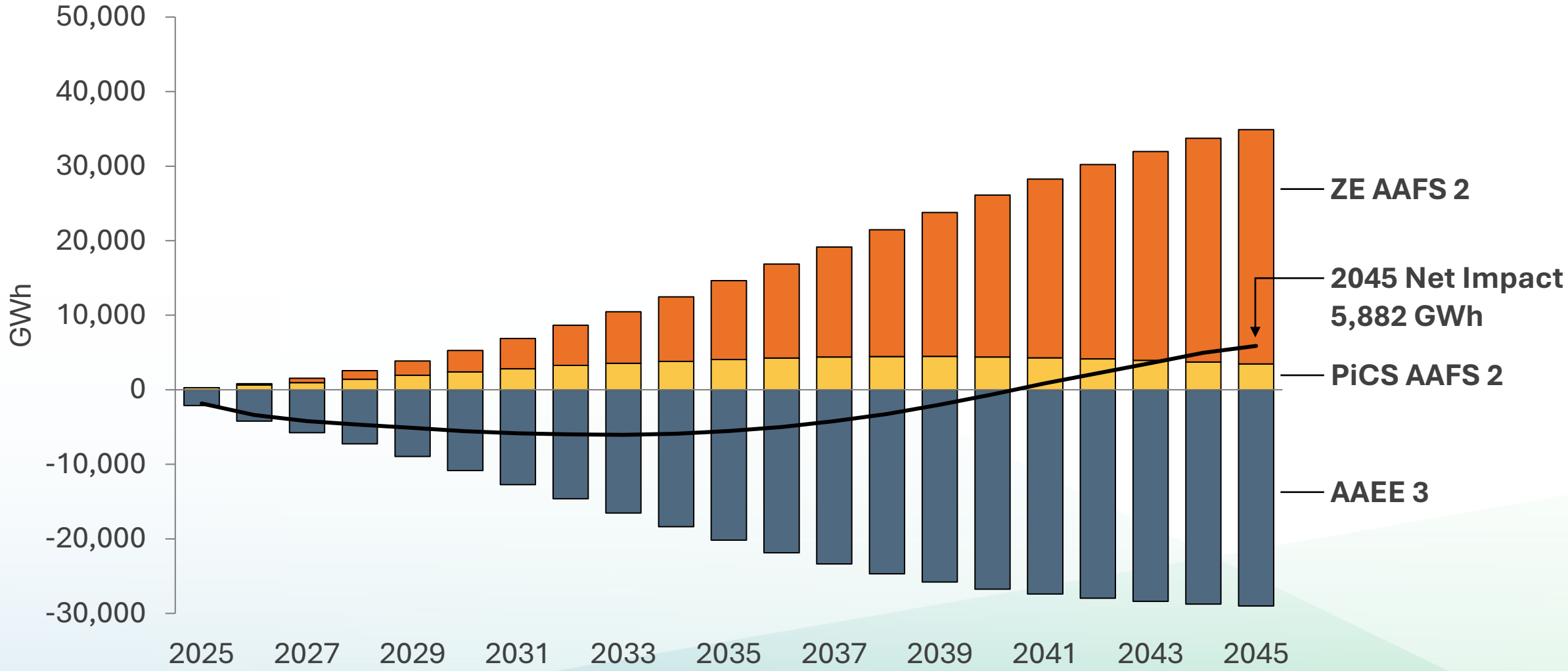
Source: CEC Staff Note: Gas displacement displayed is only for Residential and Commercial sectors

2025 AAFS Electricity Impacts



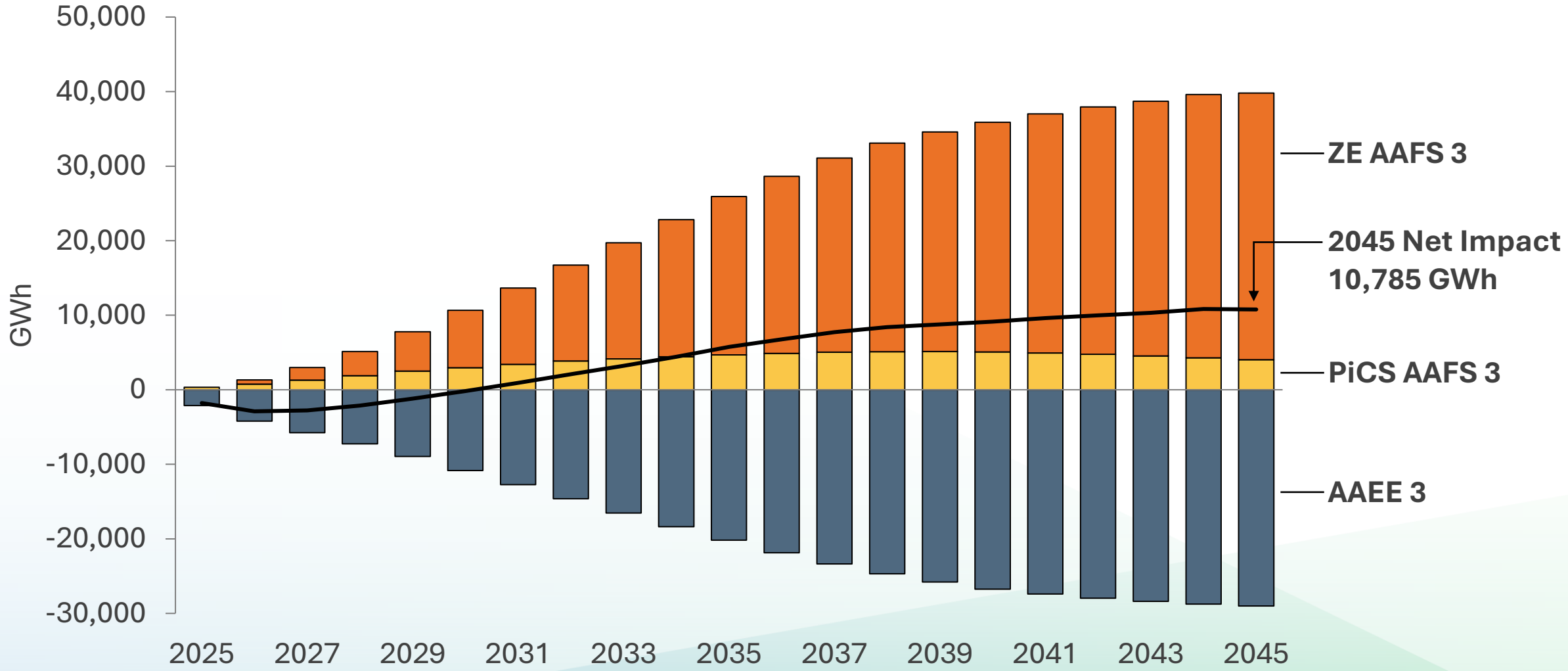
Source: CEC Staff

AAFS 2 + AAEE 3 Electricity Impacts



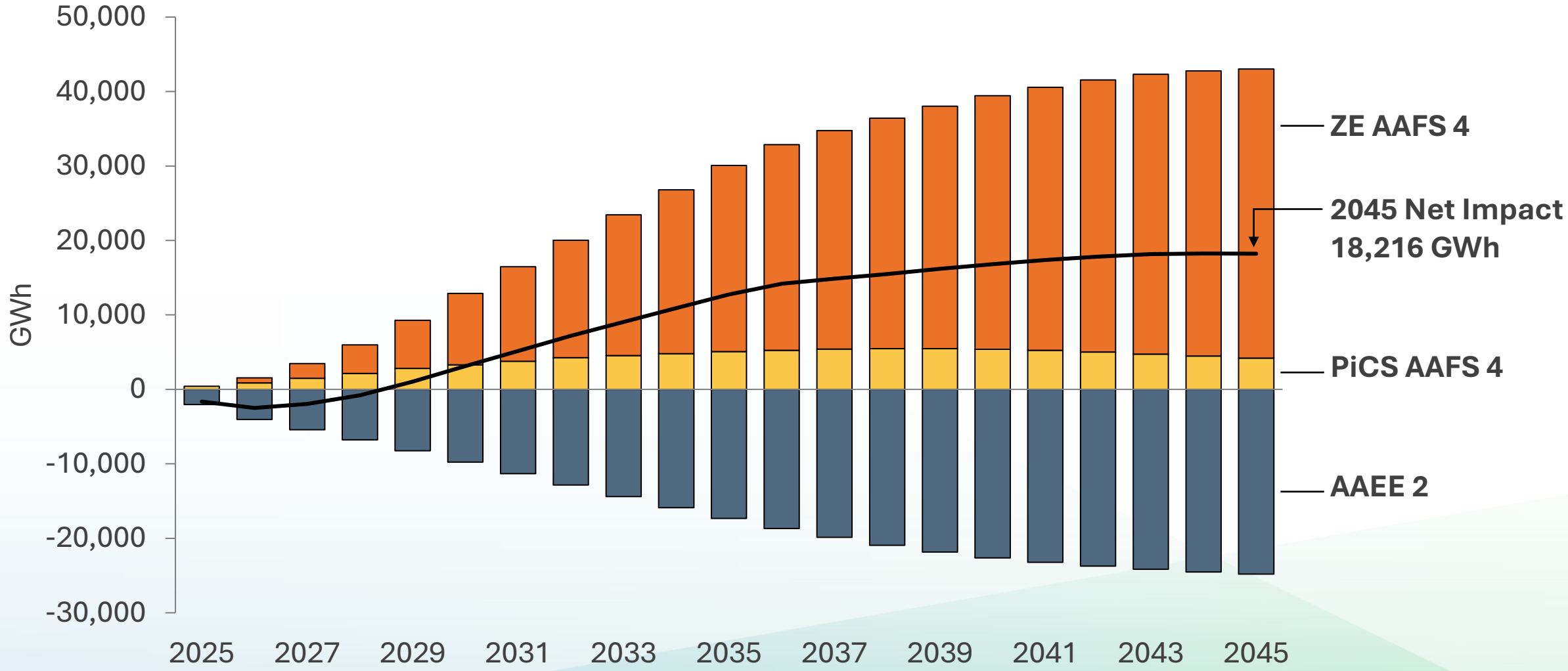
Source: CEC Staff

AAFS 3 + AAEE 3 Electricity Impacts



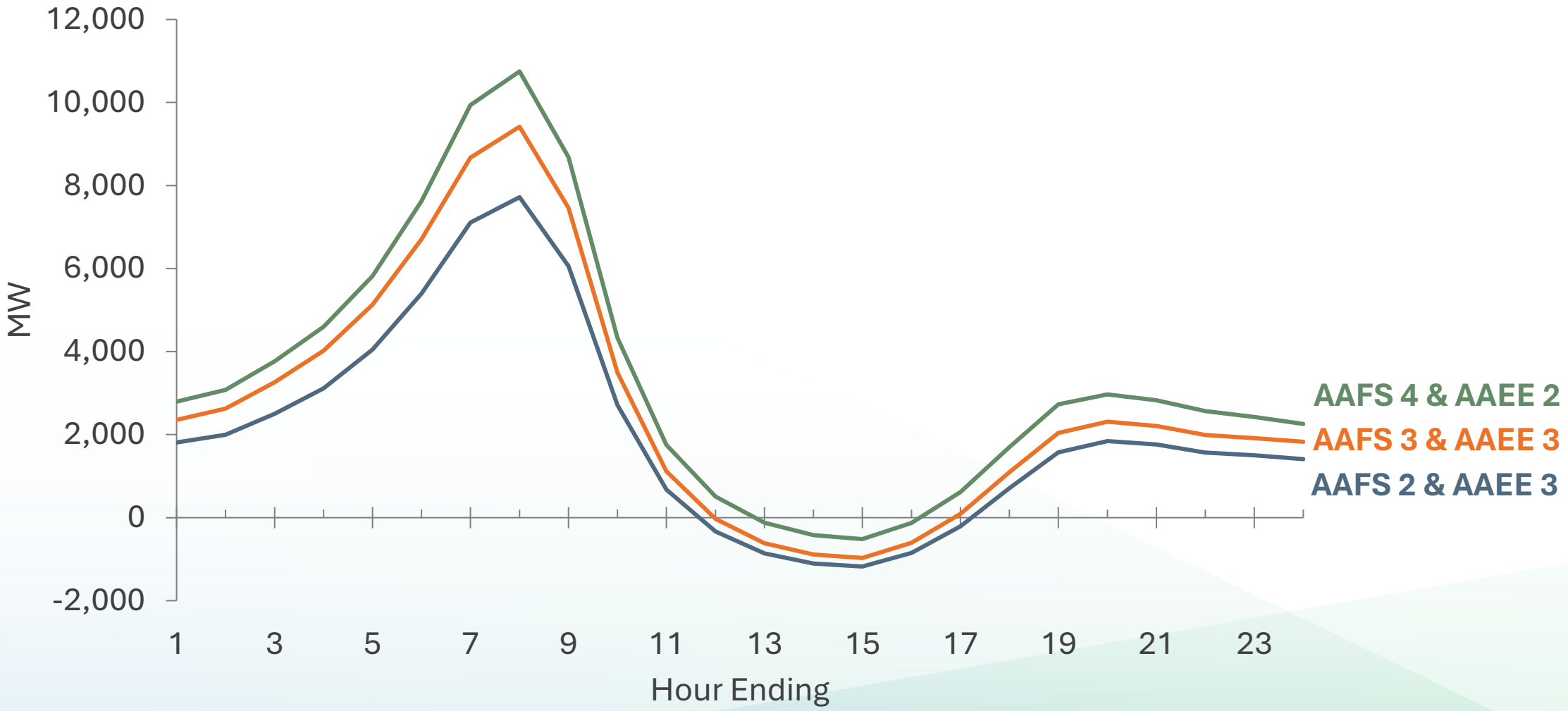
Source: CEC Staff

AAFS 4 + AAEE 2 Electricity Impacts



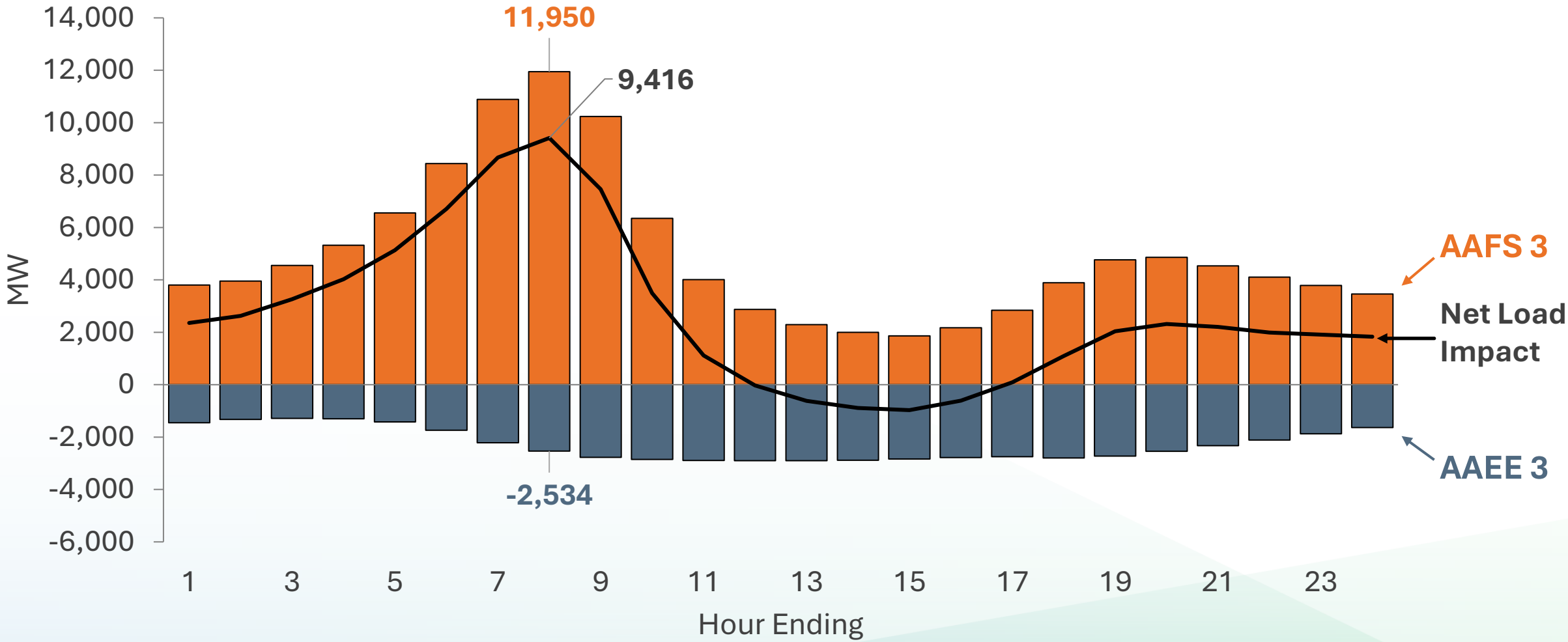
Source: CEC Staff

February 2045 Average Hourly Profile Scenario Comparisons



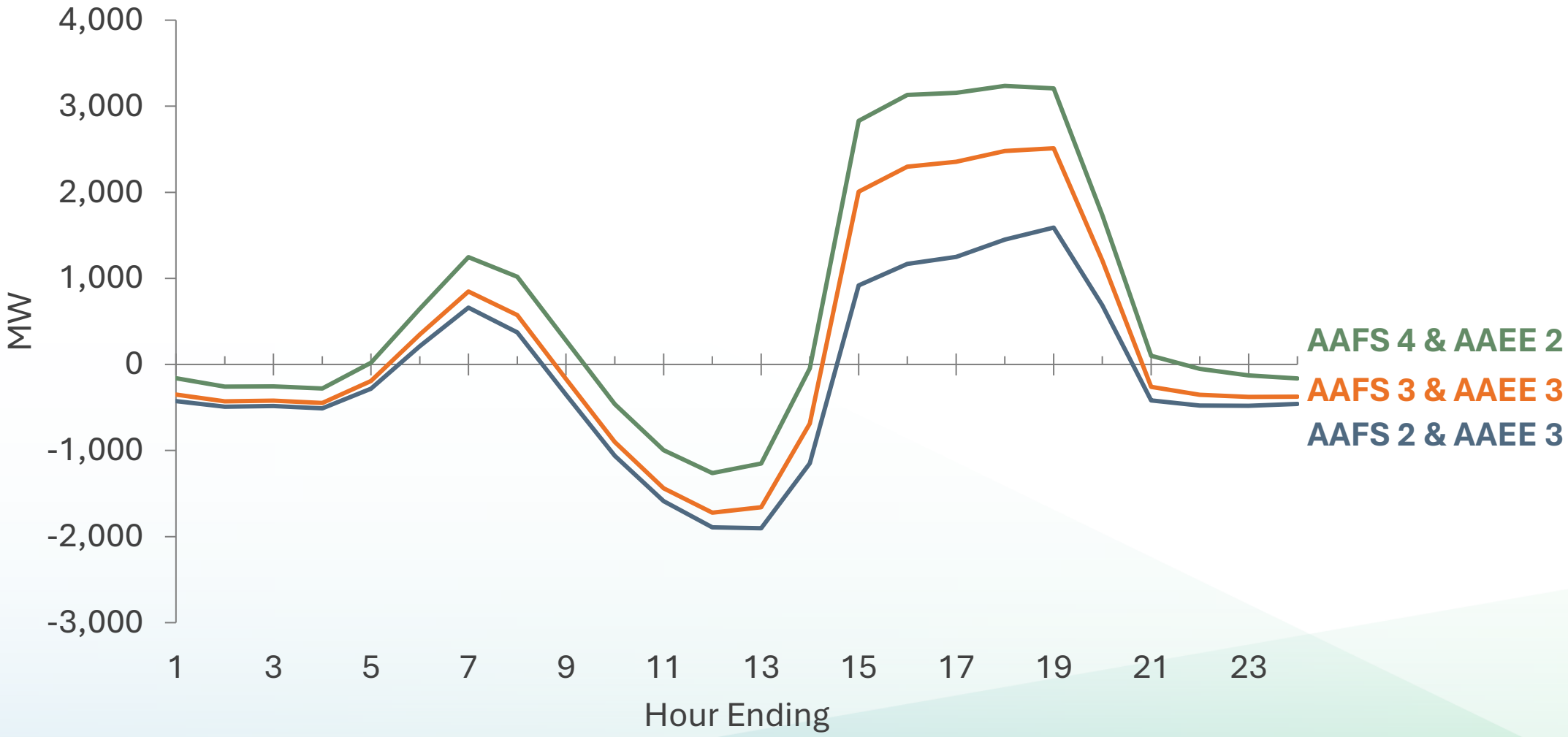
Source: CEC Staff

February 2045 Average Hourly Impacts for AAFS 3 & AAEE 3



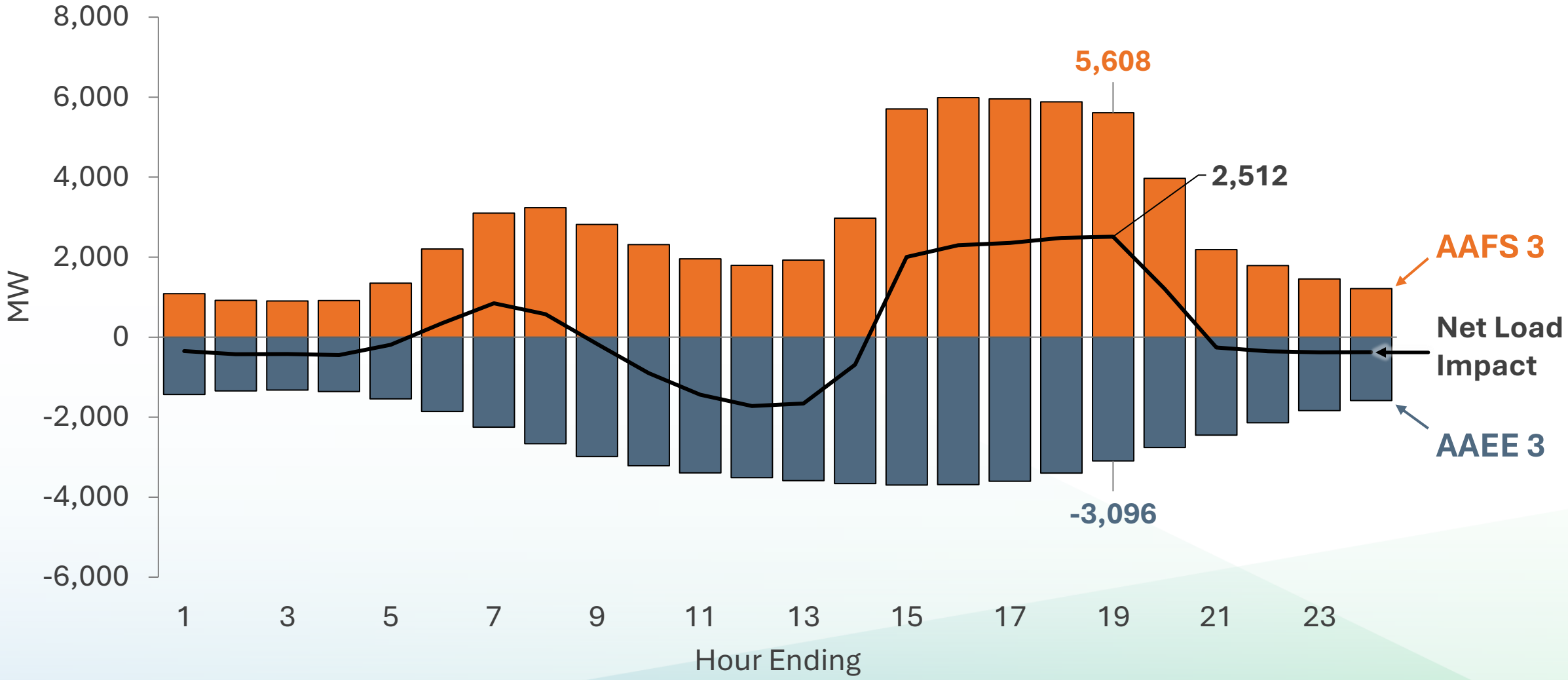
Source: CEC Staff

September 2045 Average Hourly Profile Scenario Comparisons



Source: CEC Staff

September 2045 Average Hourly Profile for AAFS 3 & AAEE 3



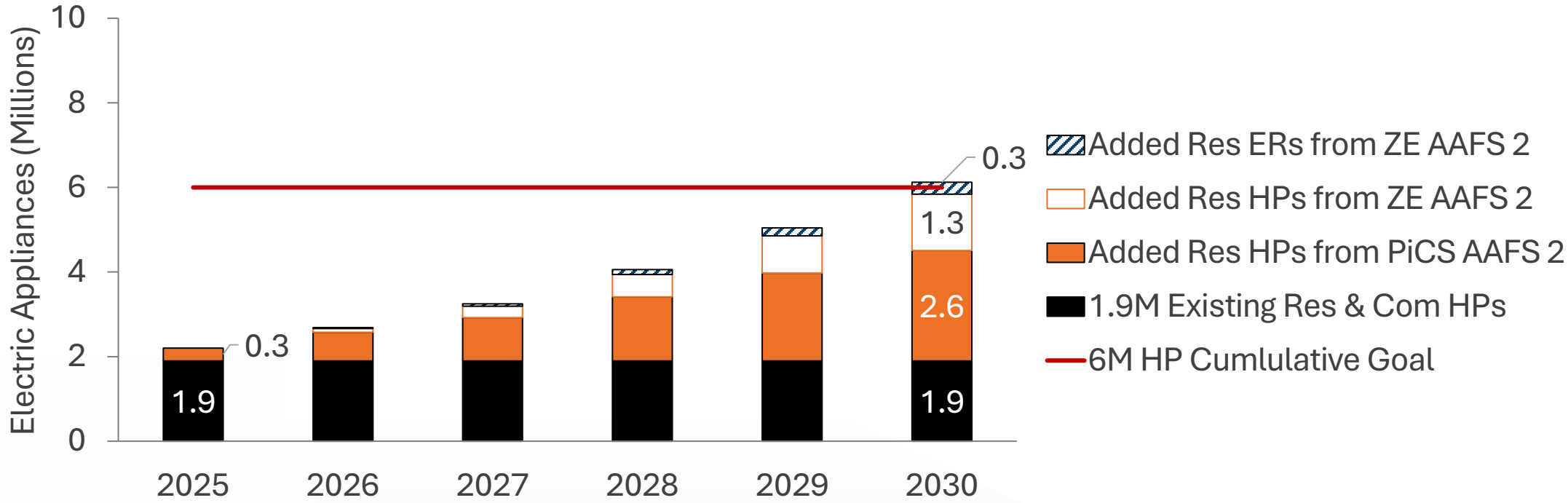
Source: CEC Staff

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

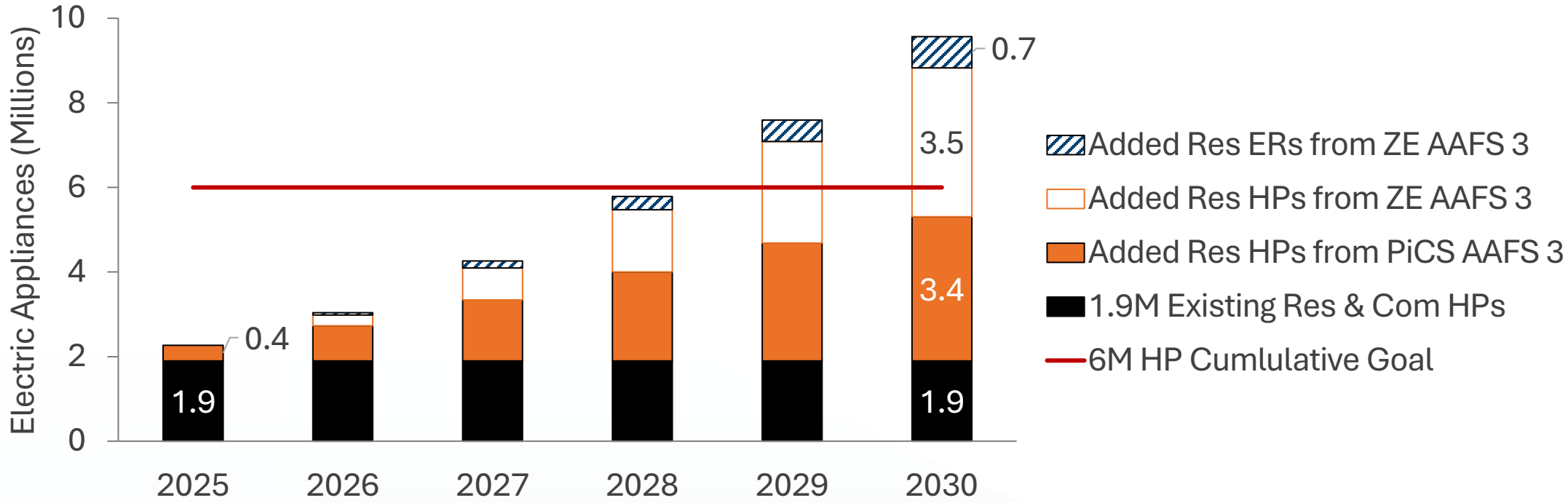
Estimated cumulative new electric appliances in 2030 – AAFS 2



Caveats	1) Based on an existing cumulative **2024 1.9M Res and Com HP estimate** 2) The added appliances are only from Res sector and exclude added Com appliances; FSSAT currently does not provide Com stock estimates 3) The dashed ZE AAFS ERs (electric-resistant appliances) reports added appliances that could have potentially been converted to a HP 4) CEC staff will continue to improve HP tracking and projection mechanisms

Source: CEC Staff

Estimated cumulative new electric appliances in 2030 – AAFS 3



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Source: CEC Staff

Thank You, Again!

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Advanced Electrification Analysis Branch
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Appendix

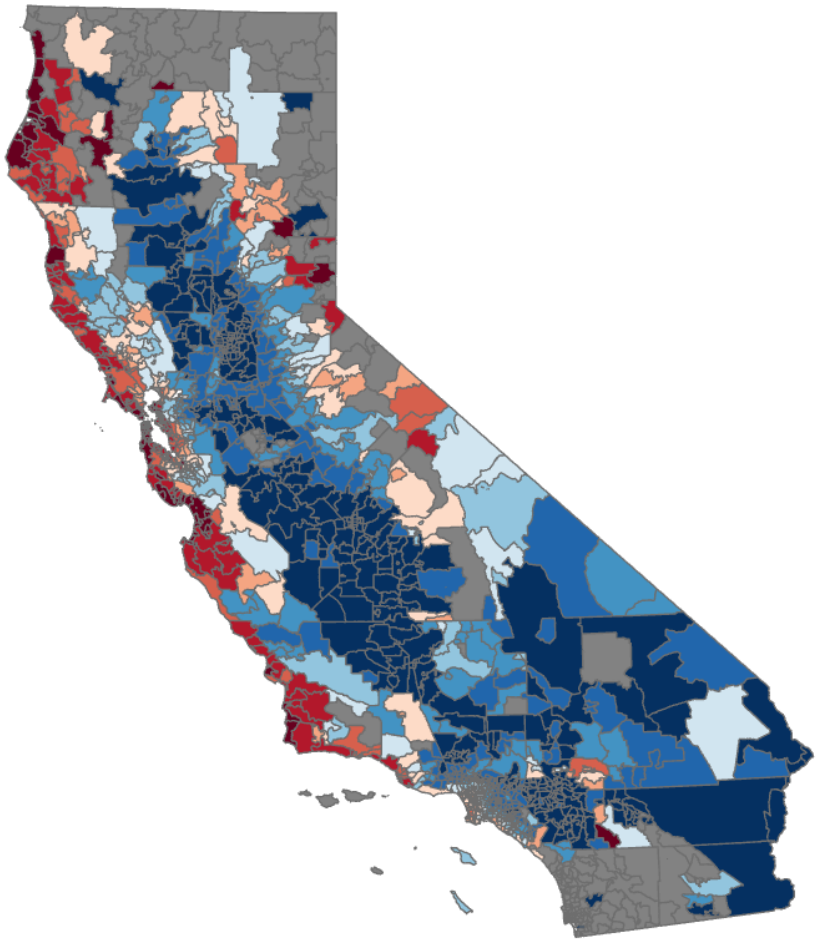
2023 AAEE and PiCS AAFS Workbooks

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