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Additional Achievable Energy Efficiency (AAEE) & Additional Achievable Fuel Substitution (AAFS) for the Demand Scenarios Project & SB 100

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Acronyms & Initialisms

AAEE – Additional Achievable Energy Efficiency

AAFS – Additional Achievable Fuel Substitution

EE – Energy efficiency

FS – Fuel substitution

GHG – Greenhouse Gas

AB 3232 – Assembly Bill 3232

CEC – California Energy Commission

DER – Distributed Energy Resource

DF – Demand Flex/Flexibility

FSSAT – Fuel Substitution Scenario Analysis Tool

IEPR – Integrated Energy Policy Report

RASS – Residential Appliance Saturation Study

SB 350 – Senate Bill 350

ZEAS – Zero-Emission Appliance Standard

What are AAEE & AAFS?

- Focus on firm programs and projections
- Shows other possible outcomes given less (or more) effort and ability to realize the potential of existing or proposed EE and FS programs
- AAFS is conceptualized separately from AAEE

How do AAEE & AAFS work?

- Any overlap between these load modifiers as well as the baseline energy demand forecast are accounted for; only achievable EE savings or FS impacts above and beyond that which is already incorporated in the baseline energy consumption forecasts are retained.
- Both AAEE and AAFS reduce gas consumption.
- While AAEE also reduces electricity consumption, AAFS increases it.
  - Thus AAEE “savings” and AAFS “impacts”
  - Both load modifier increments and decrements are relative to baseline electricity and gas consumption on an annual basis
  - Electricity consumption is also modified by both AAEE & AAFS on an hourly basis
- AAFS may contain both programmatic inputs as well as technology-based FS modeled by the FSSAT, this will be described in the later part of this presentation.

2023 AAEE & AAFS Development General approach to Scenarios

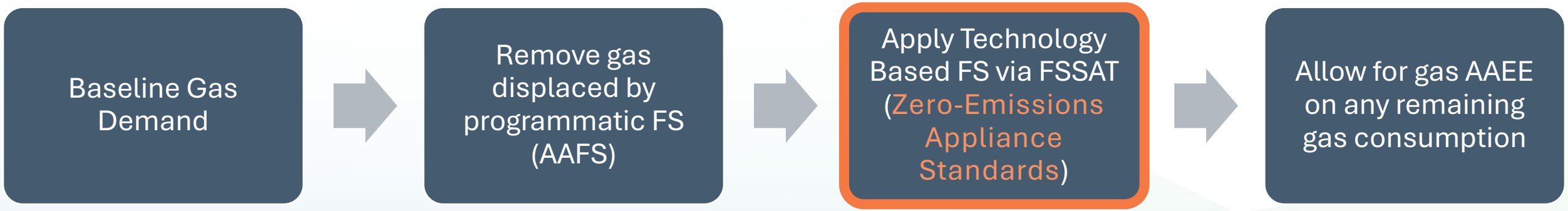
AAEE & Programmatic AAFS in Demand Scenarios

	AAFS 4	AAEE 3	AAEE 4
Policy Scenario	✓	✓	
Policy Scenario (High DER/DF)	✓		✓
Policy Scenario with High Hydrogen Use	✓	✓	

*see https://www.energy.ca.gov/event/2023-11/iepr-commissioner-workshop-load-modifier-scenario-results for AAEE and programmatic AAFS scenarios developed as part of the 2023 IEPR Demand Forecast

Combining AAEE, Programmatic AAFS & FSSAT components in the Demand Scenarios

- AAEE electricity and gas may be separated.
- AAFS electricity and gas are joined.
- **FS is conducted before EE** because the GHG impacts are approximately four times greater for FS than for EE.



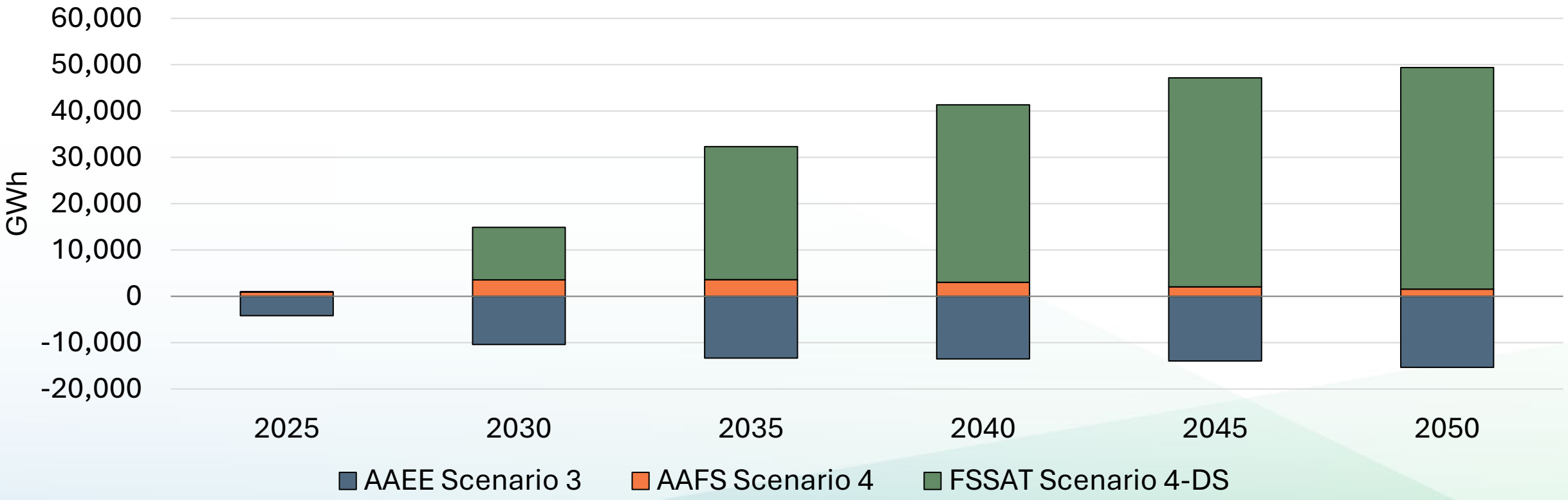
FSSAT Characterization in Demand Scenarios

- FSSAT Scenario 4-DS is used in all SB 100 Demand Scenarios
  - Policy Scenario
  - Policy Scenario (High DER/DF)
  - Policy Scenario with High Hydrogen Use
- FSSAT Scenario 4-DS Scope
  - Models various ZEAS standards for the Residential and Commercial sectors
  - Models fuel switching (electricity and hydrogen) for the Industrial and Agricultural sectors
    - Hydrogen fuel switching is only considered in the Industrial sector
- FSSAT Scenario 4-DS has some minor updates compared to the 2023 IEPR FSSAT Scenario 4
  - Includes RASS 2019
  - Revised local Air Districts' ZEAS
  - Final 2023 IEPR Baseline Gas and Electric Forecast
  - Includes an Agricultural/Industrial fuel switching module

Electricity Impacts – Policy Scenario and Policy Scenario with High Hydrogen Use

All load modifier results are the same for the **Policy Scenario** and the **Policy Scenario with High Hydrogen Use**.

AAEE, Programmatic AAFS, and FSSAT Electricity Impacts - Policy Scenario and Policy Scenario with High Hydrogen Use

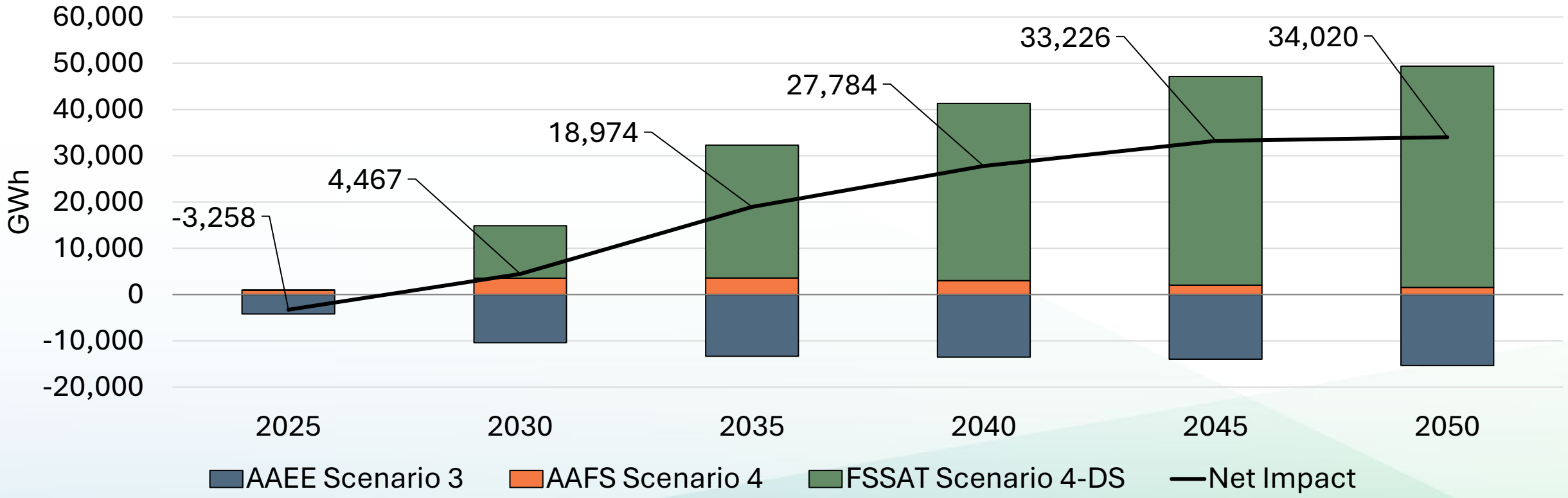


Source: CEC Staff

Electricity Impacts – Policy Scenario and Policy Scenario with High Hydrogen Use [+ Net Impact]

All load modifier results are the same for the **Policy Scenario** and the **Policy Scenario with High Hydrogen Use**.

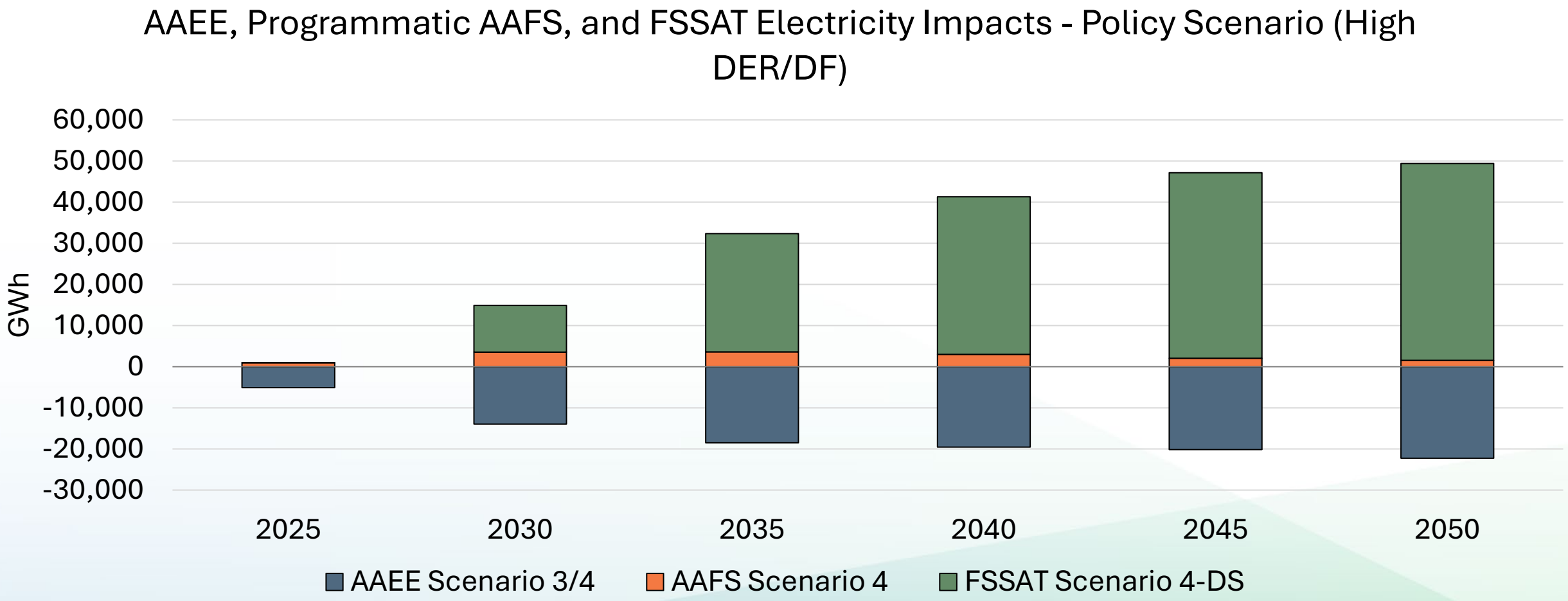
AAEE, Programmatic AAFS, and FSSAT Electricity Impacts - Policy Scenario and Policy Scenario with High Hydrogen Use



Source: CEC Staff

Electricity Impacts – Policy Scenario (High DER/DF)

Uses AAEE Scenario 4 for the Residential and Commercial sectors ("AAEE Scenario 3/4").



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Electricity Impacts – Policy Scenario (High DER/DF) [+ Net Impact]

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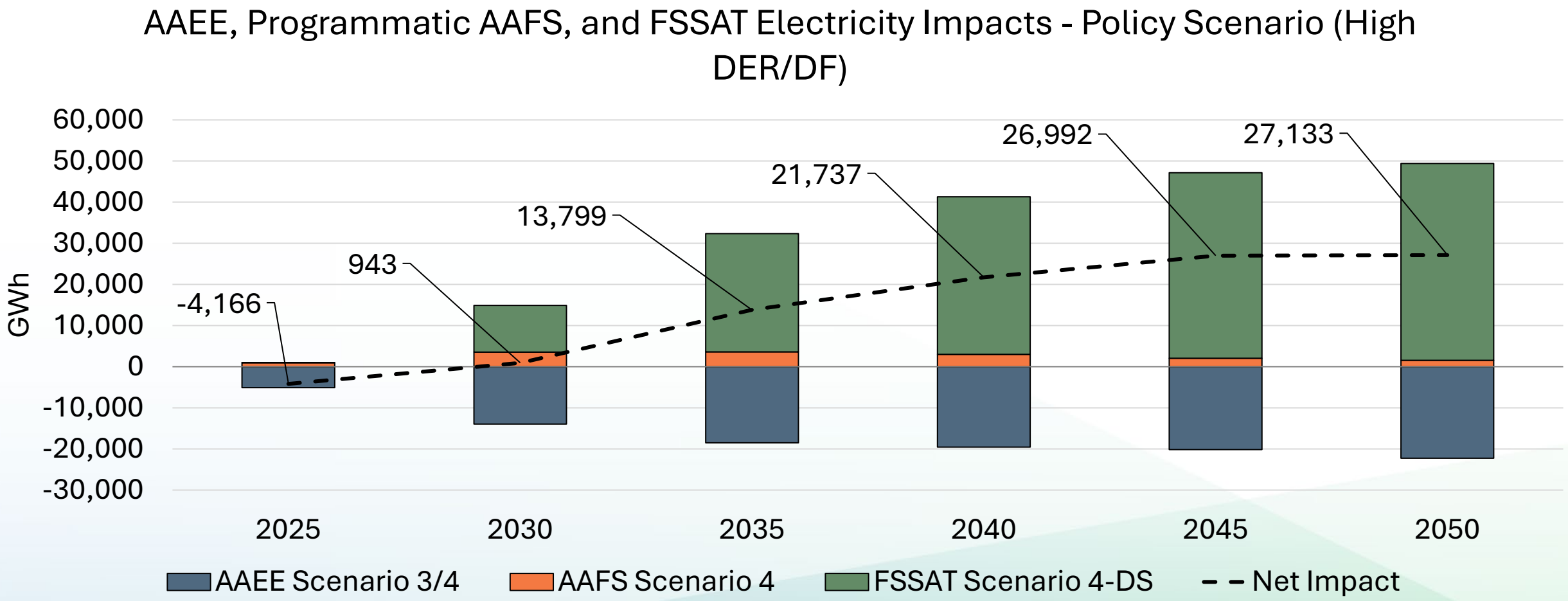

Source: CEC Staff

Thank you

Appendix

Modeling Electrification: FSSAT Main Processes Flow Chart

0 Integrated Energy Policy Report (IEPR)
- **Gas Demand Forecast**

1 Programmatic **Additional Achievable Fuel Substitution (AAFS)**
- Reduces consumption of gas

2 **FSSAT Technology Substitution**
- Gas for various electric technologies

3 **Additional Achievable Energy Efficiency (AAEE)**
- Further reduces consumption of gas

4 **Hourly Calculation**
- End use consumption load curves

Annual Outputs
- "Final" demand forecast
- Technology stock
- Cost of substitution
- Incremental electricity added
- **Net GHG emissions**

Hourly Outputs
- Hourly electric consumption increase
- Hourly GHG emissions

Source: Based on Kenney, Michael, Nicholas Janusch, Ingrid Neumann, and Mike Jaske. 2021. California Building Decarbonization Assessment. California Energy Commission. Publication Number: CEC-400-2021-006-CMF. Page A-41.

ZEAS Characterization – FSSAT Scenario 4-DS

Agency	Board Hearing Date	Zero Emission Appliance Standard	Characterization in FSSAT
Bay Area AQMD[1]	March 16, 2023	Amendments to Rule 9-4 and Rule 9-6: Space Heaters	ZEAS for replace on burnout (ROB) beginning in 2029 for residential & commercial space heaters
Bay Area AQMD[1]	March 16, 2023	Amendments to Rule 9-4 and Rule 9-6: Water Heaters	**Revised** - ZEAS beginning in 2027 for ROB for residential water heaters
South Coast AQMD[2]	June 7, 2024	Rule 1146.2 – Large Water Heaters and Small Boilers and Process Heaters	**Added** - ZEAS beginning in 2029 for ROB for commercial water heaters
Statewide		New Construction	100% adoption of electric space and water heaters for residential in 2026, and 2029 for commercial
CARB[3]	2025	Existing Buildings	Statewide ZEAS for ROB beginning in 2030 for residential & commercial space and water heaters

[1]Bay Area Air Quality Management District - BAAQMD's Building Appliance Rules 9-4 and 9-6 webpage
[2]South Coast Air Quality Management District - SCAQMD's Proposed Amended Rule 1146.2 webpage
[3]California Air Resources Board - CARB's Zero-Emission Appliance Standards proceeding webpage

ZEAS Characterization – FSSAT Scenario 4-DS

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South Coast AQMD[2]	June 7, 2024	Rule 1146.2 – Large Water Heaters and Small Boilers and Process Heaters	
Statewide		New Construction	100% adoption of electric space and water heaters for residential in 2026, and 2029 for commercial
CARB[3]	2025	Existing Buildings	Statewide ZEAS for ROB beginning in 2030 for residential & commercial space and water heaters

Disclaimer: 2023 IEPR CARB ZEAS characterization is outdated. CARB presented their updated proposal at a May 29th, 2024 public workshop (Source: https://ww2.arb.ca.gov/our-work/programs/building-decarbonization/zero-emission-space-and-water-heater-standards/meetings-workshops).

[1]Bay Area Air Quality Management District - BAAQMD's Building Appliance Rules 9-4 and 9-6 webpage
[2]South Coast Air Quality Management District - SCAQMD's Proposed Amended Rule 1146.2 webpage
[3]California Air Resources Board - CARB's Zero-Emission Appliance Standards proceeding webpage

ZEAS Replacement Assumptions – FSSAT Scenario 4-DS

Territory	Replacement Type	FSSAT Scenario	2020-25	2026	2027	2028	2029	2030-50
Statewide	Comm. New Construction	Scenario 4-DS	0%	0%	0%	0%	**100%**	100%
Statewide	Res. New Construction	Scenario 4-DS	0%	**100%**	100%	100%	100%	100%
BAAQMD	Replace on Burnout: Space Heating	Scenario 4-DS	0%	25%	50%	75%	**100%**	100%
BAAQMD	Replace on Burnout: Res. Water Heating	Scenario 4-DS	0%	50%	**100%**	100%	100%	100%
SCAQMD	Replace on Burnout: Comm. Water Heating	Scenario 4-DS	0%	25%	50%	75%	**100%**	100%
Rest of State	Replace on Burnout	Scenario 4-DS	0%	20%	40%	60%	80%	**100%**