DEMAND ANALYSIS WORKING GROUP (DAWG)

AAEE & AAFS Inputs and Assumptions for 2024 IEPR Update

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Acronyms and Initialisms

AAFS – Additional Achievable Fuel Substitution

AC – Air Conditioner

AQMD – Air Quality Management Districts

Btu – British Thermal Unit

CARB – California Air Resources Board

CEC – California Energy Commission

CED/CEDF – California Energy Demand Forecast

DAWG – Demand Analysis Working Group

FSSAT – Fuel Substitution Scenario Analysis Tool

GT – Gradual Transformation (scenario)

IEPR – Integrated Energy Policy Report

MM – Million

NC – New Construction

NOx – Nitrogen Oxides

Q4 – Fourth Quarter in Calendar Year

RASS – Residential Appliance Saturation Study

ROB – Replace on Burnout

ZEAS – Zero-Emission Appliance Standards

Presentation Outline

1. Updates to FSSAT
2. Proposed 2024 AAFS scenario characterizations for statewide and local AQMD building electrification adoption rates

FSSAT Updates

Updated Technology Characterization & Technology Replacement Mapping

Updates to FSSAT

- Incorporation of final 2023 IEPR Baseline Gas and Electric Forecast
- Revised technology characterization with RASS 2019
  - New baseline gas technology assumptions
  - New electric replacement technology assumptions
  - Updated replacement mapping for new and existing buildings
- **CEC staff plans to post technology characterization input files to IEPR docket**
- 2025 IEPR
  - Updated AC penetration rates by climate zone based on AMI data analysis
  - Include the modeling pool heaters
  - Updated module: Agricultural and industrial sector electrification and gas to hydrogen fuel switching potential

Updated Baseline Gas Technologies

Baseline Technology
Res | Furnace (AFUE = 77, HIR = 1.25)
Res | Res Furnace FS (AFUE and HIR at Code Level)
Res | Res Efficient Condensing Furnace (AFUE = 97)
Res | Code HVAC Wall Furnace
Res | Efficient Wall Furnace
Res | Small Gas Storage Water Heater (0.53 EF - 50 Gal)
Res | Res Small Gas Storage Water Heater (0.63 UEF - 50 Gal)
Res | Res Tankless Gas Water Heater (0.81 UEF - High Draw)
Res | Code Level Gas Pool Heater
Res | Efficient Gas Pool Heater
Res | Code Level Res Clothes Dryer (Gas)
Res | Efficient Res Clothes Dryer (Gas)
Res | Gas Cooktop
Res | Gas Oven
Low Income | Furnace (AFUE = 77, HIR = 1.25)
Low Income | Res Furnace FS (AFUE and HIR at Code Level)
Low Income | Res Efficient Condensing Furnace (AFUE = 97)
Low Income | Code HVAC Wall Furnace
Low Income | Efficient Wall Furnace
Low Income | Small Gas Storage Water Heater (0.53 EF - 50 Gal)
Low Income | Res Small Gas Storage Water Heater (0.63 UEF - 50 Gal)
Low Income | Res Tankless Gas Water Heater (0.81 UEF - High Draw)
Low Income | Code Level Gas Pool Heater
Low Income | Efficient Gas Pool Heater
Low Income | Code Level Res Clothes Dryer (Gas)
Low Income | Efficient Res Clothes Dryer (Gas)
Low Income | Gas Cooktop
Low Income | Gas Oven
Res | Small Propane Storage Water Heater (0.64 UEF - 50 Gal)
Res | Propane Furnace (AFUE = 80)
Res | Propane Cooktop
Res | Propane Oven
Res | Wood Stove
Low Income | Small Propane Storage Water Heater (0.64 UEF - 50 Gal)
Low Income | Propane Furnace (AFUE = 80)
Low Income | Propane Cooktop
Low Income | Propane Oven
Low Income | Wood Stove

Source: CEC Staff – FSSAT Model

Baseline Technology
Com | Average Existing Furnace (78 AFUE)
Com | Com Code Furnace (81 AFUE)
Com | Condensing Eff Furnace (98 AFUE)
Com | Average Existing Boiler (78 AFUE)
Com | Code HVAC Boiler (81 AFUE)
Com | Condensing Eff. HVAC Boiler (94 AFUE)
Com | Large Code HVAC System Integrated Furnace and AC
Com | Small Code HVAC System Integrated Furnace and AC
Com | Com Gas Storage Water Heater (0.63 UEF - 50 Gal)
Com | Com Efficient Tankless Gas Water Heater (0.81 UEF - High Draw)
Com | Gas Water Heating Boiler (0.82 EF)
Com | Condensing Eff. Gas Water Heating Boiler (0.92 UEF)
Com | Com Code Large Gas Water Heater (Avg. 0.80 Et 100+ Gal, 0.83 Et 200+ kBtuh)
Com | Standard Convection Oven - Gas
Com | ENERGY STAR Convection Oven - Gas
Com | Standard Fryer - Gas
Com | ENERGY STAR Fryer - Tier 1 Gas
Com | Standard Steamer - Gas
Com | ENERGY STAR Steamer - Gas
Com | Standard Griddle - Gas
Com | ENERGY STAR Griddle - Gas
Com | Standard Combination Oven - Gas
Com | ENERGY STAR Combination Oven - Gas
Com | Average Existing Gas Clothes Dryer
Com | Code Compliant Gas Clothes Dryer
Com | Gas Clothes Dryer - High Efficiency

Source: CEC Staff – FSSAT Model

Link to: Supplemental FSSAT material posted to 19-DECARB-01 Docket (2/15/2022)

Updated Electric Replacement Technologies

Sector	Electric Technology
Residential	Res Packaged/Split Heat Pump (SEER 14)
Residential	Res Packaged/Split Heat Pump (SEER 15)
Residential	Res Packaged/Split Heat Pump (SEER 16)
Residential	Res Packaged/Split Heat Pump (SEER 17)
Residential	Res Packaged/Split Heat Pump (SEER 18)
Residential	Res Ductless Mini Split Heat Pump (SEER 14)
Residential	Res Ductless Mini Split Heat Pump (SEER 15)
Residential	Res Ductless Mini Split Heat Pump (SEER 16)
Residential	Res Ductless Mini Split Heat Pump (SEER 17)
Residential	Res Ductless Mini Split Heat Pump (SEER 18)
Residential	Res Small Electric Storage Water Heater (0.92 UEF - 50 Gal)
Residential	Res Heat Pump Water Heater (3.30 UEF - 50 Gal)
Residential	Res Central Heat Pump Water Heater (3.00 COP, 150+ kBtuh)
Residential	Res Heat Pump Pool Heater
Residential	Res Electric Resistance Oven
Residential	Res Standard Electric Stove
Residential	Res Induction Cooking Stove
Residential	Res Heat Pump Res Clothes Dryer
Low Income	Low Income Packaged/Split Heat Pump (SEER 14)
Low Income	Low Income Packaged/Split Heat Pump (SEER 15)
Low Income	Low Income Packaged/Split Heat Pump (SEER 16)
Low Income	Low Income Packaged/Split Heat Pump (SEER 17)
Low Income	Low Income Packaged/Split Heat Pump (SEER 18)
Low Income	Low Income Ductless Mini Split Heat Pump (SEER 14)
Low Income	Low Income Ductless Mini Split Heat Pump (SEER 15)
Low Income	Low Income Ductless Mini Split Heat Pump (SEER 16)
Low Income	Low Income Ductless Mini Split Heat Pump (SEER 17)
Low Income	Low Income Ductless Mini Split Heat Pump (SEER 18)
Low Income	Low Income Small Electric Storage Water Heater (0.92 UEF - 50 Gal)
Low Income	Low Income Heat Pump Water Heater (3.30 UEF - 50 Gal)
Low Income	Low Income Central Heat Pump Water Heater (3.00 COP, 150+ kBtuh)
Low Income	Low Income Heat Pump Pool Heater
Low Income	Low Income Electric Resistance Oven
Low Income	Low Income Standard Electric Stove
Low Income	Low Income Induction Cooking Stove
Low Income	Low Income Heat Pump Res Clothes Dryer

Source: CEC Staff – FSSAT Model

Sector	Electric Technology
Commercial	Com Small Unitary Heat Pump (SEER 14)
Commercial	Com Small Unitary Heat Pump (SEER 15)
Commercial	Com Small Unitary Heat Pump (SEER 16)
Commercial	Com Small Unitary Heat Pump (SEER 17)
Commercial	Com Small Unitary Heat Pump (SEER 18)
Commercial	Com Ductless Mini Split Heat Pump (SEER 14)
Commercial	Com Ductless Mini Split Heat Pump (SEER 18)
Commercial	Com Small Packaged Heat Pump (SEER 14)
Commercial	Com Small Packaged Heat Pump (SEER 15)
Commercial	Com Small Packaged Heat Pump (SEER 16)
Commercial	Com Small Packaged Heat Pump (SEER 17)
Commercial	Com Small Packaged Heat Pump (SEER 18)
Commercial	Com Large Packaged Heat Pump (EER 9.3)
Commercial	Com Large Packaged Heat Pump (IEER 14.0)
Commercial	Com High Eff. Split System HP - Air Source
Commercial	Com Electric Storage Water Heater (0.92 UEF - 50 Gal)
Commercial	Com Heat Pump Water Heater (3.30 UEF - 50 Gal)
Commercial	Com Heat Pump Water Heater (4.3 COP - 100+ Gal, 200+ kBtuh)
Commercial	Com Average Existing Electric Clothes Dryer
Commercial	Com Code Compliant Electric Clothes Dryer
Commercial	Com ENERGY STAR Fryer
Commercial	Com ENERGY STAR Combination Oven
Commercial	Com ENERGY STAR Steamer
Commercial	Com ENERGY STAR Griddle

Source: CEC Staff – FSSAT Model

Updated Replacement Mapping – Sample for HVAC Replacement

Baseline Technology	End Use	Replacement Type	Repl. Tech. 1	Repl. Tech. 2	Repl. Tech. 3	Repl. Tech. 4	Repl. Tech. 5
Res | Furnace (AFUE = 77, HIR = 1.25)	HVAC	ROB/RET	Res Packaged/Split Heat Pump (SEER 14)	Res Packaged/Split Heat Pump (SEER 15)	Res Packaged/Split Heat Pump (SEER 16)	Res Packaged/Split Heat Pump (SEER 17)	Res Packaged/Split Heat Pump (SEER 18)
Res | Res Furnace FS (AFUE and HIR at Code Level)	HVAC	ROB/RET	Res Packaged/Split Heat Pump (SEER 14)	Res Packaged/Split Heat Pump (SEER 15)	Res Packaged/Split Heat Pump (SEER 16)	Res Packaged/Split Heat Pump (SEER 17)	Res Packaged/Split Heat Pump (SEER 18)
Res | Res Efficient Condensing Furnace (AFUE = 97)	HVAC	ROB/RET	Res Packaged/Split Heat Pump (SEER 14)	Res Packaged/Split Heat Pump (SEER 15)	Res Packaged/Split Heat Pump (SEER 16)	Res Packaged/Split Heat Pump (SEER 17)	Res Packaged/Split Heat Pump (SEER 18)
Res | Code HVAC Wall Furnace	HVAC	ROB/RET	Res Ductless Mini Split Heat Pump (SEER 14)	Res Ductless Mini Split Heat Pump (SEER 15)	Res Ductless Mini Split Heat Pump (SEER 16)	Res Ductless Mini Split Heat Pump (SEER 17)	Res Ductless Mini Split Heat Pump (SEER 18)
Res | Efficient Wall Furnace	HVAC	ROB/RET	Res Ductless Mini Split Heat Pump (SEER 14)	Res Ductless Mini Split Heat Pump (SEER 15)	Res Ductless Mini Split Heat Pump (SEER 16)	Res Ductless Mini Split Heat Pump (SEER 17)	Res Ductless Mini Split Heat Pump (SEER 18)
Low Income | Furnace (AFUE = 77, HIR = 1.25)	HVAC	ROB/RET	Low Income Packaged/Split Heat Pump (SEER 14)	Low Income Packaged/Split Heat Pump (SEER 15)	Low Income Packaged/Split Heat Pump (SEER 16)	Low Income Packaged/Split Heat Pump (SEER 17)	Low Income Packaged/Split Heat Pump (SEER 18)
Low Income | Res Furnace FS (AFUE and HIR at Code Level)	HVAC	ROB/RET	Low Income Packaged/Split Heat Pump (SEER 14)	Low Income Packaged/Split Heat Pump (SEER 15)	Low Income Packaged/Split Heat Pump (SEER 16)	Low Income Packaged/Split Heat Pump (SEER 17)	Low Income Packaged/Split Heat Pump (SEER 18)
Low Income | Res Efficient Condensing Furnace (AFUE = 97)	HVAC	ROB/RET	Low Income Packaged/Split Heat Pump (SEER 14)	Low Income Packaged/Split Heat Pump (SEER 15)	Low Income Packaged/Split Heat Pump (SEER 16)	Low Income Packaged/Split Heat Pump (SEER 17)	Low Income Packaged/Split Heat Pump (SEER 18)
Low Income | Code HVAC Wall Furnace	HVAC	ROB/RET	Low Income Ductless Mini Split Heat Pump (SEER 14)	Low Income Ductless Mini Split Heat Pump (SEER 15)	Low Income Ductless Mini Split Heat Pump (SEER 16)	Low Income Ductless Mini Split Heat Pump (SEER 17)	Low Income Ductless Mini Split Heat Pump (SEER 18)
Low Income | Efficient Wall Furnace	HVAC	ROB/RET	Low Income Ductless Mini Split Heat Pump (SEER 14)	Low Income Ductless Mini Split Heat Pump (SEER 15)	Low Income Ductless Mini Split Heat Pump (SEER 16)	Low Income Ductless Mini Split Heat Pump (SEER 17)	Low Income Ductless Mini Split Heat Pump (SEER 18)
Com | Average Existing Furnace (78 AFUE)	HVAC	ROB/RET	Com Small Unitary Heat Pump (SEER 14)	Com Small Unitary Heat Pump (SEER 15)	Com Small Unitary Heat Pump (SEER 16)	Com Small Unitary Heat Pump (SEER 17)	Com Small Unitary Heat Pump (SEER 18)
Com | Com Code Furnace (81 AFUE)	HVAC	ROB/RET	Com Small Unitary Heat Pump (SEER 14)	Com Small Unitary Heat Pump (SEER 15)	Com Small Unitary Heat Pump (SEER 16)	Com Small Unitary Heat Pump (SEER 17)	Com Small Unitary Heat Pump (SEER 18)
Com | Condensing Eff Furnace (98 AFUE)	HVAC	ROB/RET	Com Small Unitary Heat Pump (SEER 14)	Com Small Unitary Heat Pump (SEER 15)	Com Small Unitary Heat Pump (SEER 16)	Com Small Unitary Heat Pump (SEER 17)	Com Small Unitary Heat Pump (SEER 18)
Com | Average Existing Boiler (78 AFUE)	HVAC	ROB/RET	Com Ductless Mini Split Heat Pump (SEER 14)	Com Ductless Mini Split Heat Pump (SEER 18)			
Com | Code HVAC Boiler (81 AFUE)	HVAC	ROB/RET	Com Ductless Mini Split Heat Pump (SEER 14)	Com Ductless Mini Split Heat Pump (SEER 18)			
Com | Condensing Eff. HVAC Boiler (94 AFUE)	HVAC	ROB/RET	Com Ductless Mini Split Heat Pump (SEER 14)	Com Ductless Mini Split Heat Pump (SEER 18)			
Com | Large Code HVAC System Integrated Furnace and AC	HVAC	ROB/RET	Com Large Packaged Heat Pump (EER 9.3)	Com Large Packaged Heat Pump (IEER 14.0)			
Com | Small Code HVAC System Integrated Furnace and AC	HVAC	ROB/RET	Com Small Packaged Heat Pump (SEER 14)	Com Small Packaged Heat Pump (SEER 15)	Com Small Packaged Heat Pump (SEER 16)	Com Small Packaged Heat Pump (SEER 17)	Com Small Packaged Heat Pump (SEER 18)
Res | Res Furnace FS (AFUE and HIR at Code Level)	HVAC	NC	Res Packaged/Split Heat Pump (SEER 14)	Res Packaged/Split Heat Pump (SEER 15)	Res Packaged/Split Heat Pump (SEER 16)	Res Packaged/Split Heat Pump (SEER 17)	Res Packaged/Split Heat Pump (SEER 18)
Low Income | Res Furnace FS (AFUE and HIR at Code Level)	HVAC	NC	Low Income Packaged/Split Heat Pump (SEER 14)	Low Income Packaged/Split Heat Pump (SEER 15)	Low Income Packaged/Split Heat Pump (SEER 16)	Low Income Packaged/Split Heat Pump (SEER 17)	Low Income Packaged/Split Heat Pump (SEER 18)
Com | Condensing Eff Furnace (98 AFUE)	HVAC	NC	Com Small Unitary Heat Pump (SEER 14)	Com Small Unitary Heat Pump (SEER 15)	Com Small Unitary Heat Pump (SEER 16)	Com Small Unitary Heat Pump (SEER 17)	Com Small Unitary Heat Pump (SEER 18)
Com | Condensing Eff. HVAC Boiler (94 AFUE)	HVAC	NC	Com Ductless Mini Split Heat Pump (SEER 14)	Com Ductless Mini Split Heat Pump (SEER 18)			
Com | Large Code HVAC System Integrated Furnace and AC	HVAC	NC	Com Large Packaged Heat Pump (EER 9.3)	Com Large Packaged Heat Pump (IEER 14.0)			
Com | Small Code HVAC System Integrated Furnace and AC	HVAC	NC	Com Small Packaged Heat Pump (SEER 14)	Com Small Packaged Heat Pump (SEER 15)	Com Small Packaged Heat Pump (SEER 16)	Com Small Packaged Heat Pump (SEER 17)	Com Small Packaged Heat Pump (SEER 18)
Res | Propane Furnace (AFUE = 80)	HVAC	ROB/RET	Res Packaged/Split Heat Pump (SEER 14)	Res Packaged/Split Heat Pump (SEER 15)	Res Packaged/Split Heat Pump (SEER 16)	Res Packaged/Split Heat Pump (SEER 17)	Res Packaged/Split Heat Pump (SEER 18)
Res | Wood Stove	HVAC	ROB/RET	Res Packaged/Split Heat Pump (SEER 14)	Res Packaged/Split Heat Pump (SEER 15)	Res Packaged/Split Heat Pump (SEER 16)	Res Packaged/Split Heat Pump (SEER 17)	Res Packaged/Split Heat Pump (SEER 18)
Low Income | Propane Furnace (AFUE = 80)	HVAC	ROB/RET	Low Income Packaged/Split Heat Pump (SEER 14)	Low Income Packaged/Split Heat Pump (SEER 15)	Low Income Packaged/Split Heat Pump (SEER 16)	Low Income Packaged/Split Heat Pump (SEER 17)	Low Income Packaged/Split Heat Pump (SEER 18)
Low Income | Wood Stove	HVAC	ROB/RET	Low Income Packaged/Split Heat Pump (SEER 14)	Low Income Packaged/Split Heat Pump (SEER 15)	Low Income Packaged/Split Heat Pump (SEER 16)	Low Income Packaged/Split Heat Pump (SEER 17)	Low Income Packaged/Split Heat Pump (SEER 18)
Res | Propane Furnace (AFUE = 80)	HVAC	NC	Res Packaged/Split Heat Pump (SEER 14)	Res Packaged/Split Heat Pump (SEER 15)	Res Packaged/Split Heat Pump (SEER 16)	Res Packaged/Split Heat Pump (SEER 17)	Res Packaged/Split Heat Pump (SEER 18)
Res | Wood Stove	HVAC	NC	Res Packaged/Split Heat Pump (SEER 14)	Res Packaged/Split Heat Pump (SEER 15)	Res Packaged/Split Heat Pump (SEER 16)	Res Packaged/Split Heat Pump (SEER 17)	Res Packaged/Split Heat Pump (SEER 18)
Low Income | Propane Furnace (AFUE = 80)	HVAC	NC	Low Income Packaged/Split Heat Pump (SEER 14)	Low Income Packaged/Split Heat Pump (SEER 15)	Low Income Packaged/Split Heat Pump (SEER 16)	Low Income Packaged/Split Heat Pump (SEER 17)	Low Income Packaged/Split Heat Pump (SEER 18)
Low Income | Wood Stove	HVAC	NC	Low Income Packaged/Split Heat Pump (SEER 14)	Low Income Packaged/Split Heat Pump (SEER 15)	Low Income Packaged/Split Heat Pump (SEER 16)	Low Income Packaged/Split Heat Pump (SEER 17)	Low Income Packaged/Split Heat Pump (SEER 18)

Source: CEC Staff – FSSAT Model

Proposed 2024 AAFS scenario characterizations

Status of State and Local Appliance Standards

Zero-Emission Appliance Standards: Uncertainties

Regulatory Uncertainty

- Regional regulatory differences
- Regulatory timelines
- Scope of sectors and fuel type

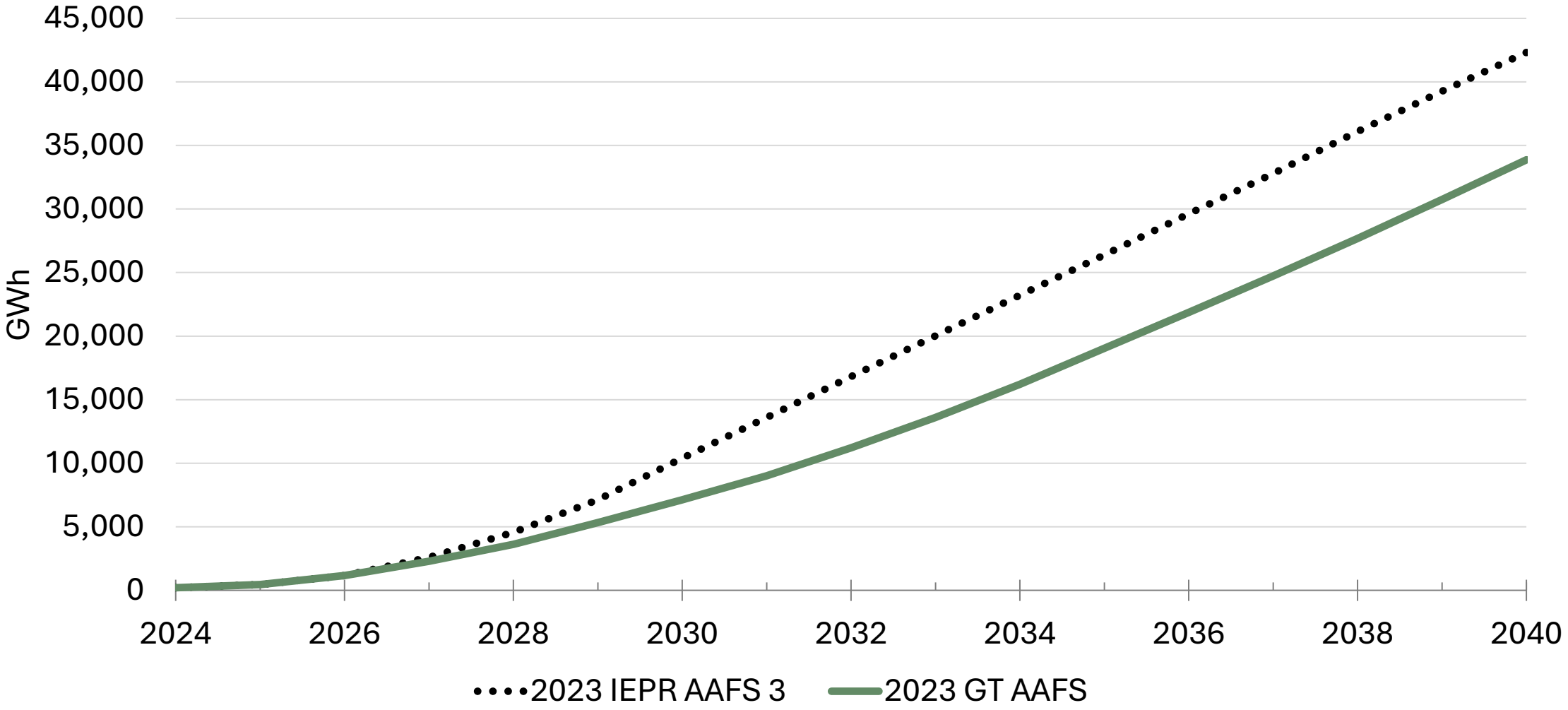
Adoption and Compliance Uncertainty

- Adoption rate and behavioral responses
- Compliance rate
- Readiness
  - Manufacturer capacity
  - Grid capacity
  - Impacts to the gas and electric systems

Updates since the 2023 IEPR

- 2023 IEPR CED Forecast: Six AAFS scenarios, with four including the zero-emission appliance standard scenarios
  - ➢ Adopted an additional GT AAFS Scenario at the May 2024 Business Meeting
- California Air Resources Board has revised the compliance schedules of proposed statewide zero-emission appliance standards to follow the local air quality management districts' zero-NOx emissions standard compliance dates
- On June 7th, South Coast AQMD amended Rule 1146.2 (large water heaters, small boilers, and process heaters)
  - ➢ Plan to amend Rule 1111 (gas-fired furnaces) and Rule 1121 (water heaters) by end of 2024
- CEC staff challenged with modeling standards by different equipment sizes; must resort to modeling standards by sector and not equipment type

Electricity Impacts for 2023 AAFS Scenarios



Source: CEC Staff

CARB's revised proposed ZEAS compliance schedule (Board vote expected in 2025)

Effective Date	Equipment Type	Capacity/Size Limits
2027	Boilers and water heaters	< 75,000 Btu/hr
2029	~~Central~~ Furnaces	< 175,000 Btu/hr
2029	Boilers and water heaters	≤ 400,000 Btu/hr
2029	Instantaneous water heaters	≤ 200,000 Btu/hr
2029 ~~TBD~~	~~Central~~ Furnaces	≤ 2MM Btu/hr
2031	Boilers and water heaters	≤ 2MM Btu/hr
2031	Instantaneous water heaters	≤ 2MM Btu/hr
2031	Pool heaters	≤ ~~400,000~~ 2MM Btu/hr
2033	High temperature (>180°F) boilers and water heaters	≤ 2MM Btu/hr

CARB

Source: CARB (May 29, 2024 Workshop, Slide 13)

Bay Area AQMD (Rule 9-4)

Amendments adopted March 2023

Rule 9-4: Applicable to any person who sells, installs, or offers for sale a natural gas-fired furnace for use within the District and any manufacturer who intends to sell or distribute for sale or installation a gas-fired furnace for use within the District.

Equipment	Sector	New Buildings ZEAS Compliance Date	Existing Buildings ZEAS Compliance Date
Furnace (< 175k Btu/hr)	Residential & Commercial	2029	2029

Source: Bay Area AQMD

→ **FSSAT Electric Replacement Characterization**: Bay Area AQMD's residential and commercial space heater ROB ramps to 100% adoption by 2029.

Bay Area AQMD (Rule 9-6)
Amendments adopted March 2023

Rule 9-6: Applicable to any person who sells, installs, or offers for sale a natural gas-fired water heater for use within the District and any manufacturer who intends to sell or distribute for sale or installation a gas-fired water heater for use within the District. *Mobile homes are exempt.*

Equipment	Sector	New Buildings ZEAS Compliance Date	Existing Buildings ZEAS Compliance Date
Water Heater (75,000 Btu/hr or less)	Residential & Commercial	2027	2027
Water Heater (75,000 – 2MM Btu/hr)	Residential & Commercial	2031	2031

Source: Bay Area AQMD

→ **FSSAT Electric Replacement Characterization**: Bay Area AQMD's residential water heater ROB ramps to 100% adoption by 2027. Bay Area AQMD commercial water heaters ROB ramps to 100% adoption by 2031.

South Coast AQMD (Rule 1146.2)
Amendments adopted June 2024

Rule 1146.2: Applicable large water heaters, small boilers, and process heaters to meet a zero-emission NOx standard for new equipment installations. Implementation and compliance schedule varies by categories of equipment and end-user.

Phase	Equipment	New Buildings ZEAS Compliance Date	Existing Buildings ZEAS Compliance Date
Phase I	Smaller units (≤ 400k Btu/hr)	2026	2029
Phase II	Larger units and pool heaters (> 400k Btu/hr)	2028	2031
Phase III	High temperature units (>180 degrees F)	2029	2033

Source: South Coast AQMD

→ **FSSAT Modeling Characterization**: South Coast AQMD's commercial water heater ROB ramps to 100% adoption by 2031. [Revised from 2029 used in '23 GT AAFS Scenario]

South Coast AQMD (Rule 1111)

Initial proposal (subject to change)

Rule 1111: Applicable to manufacturers, distributors, retailers, Resellers, and Installers of natural gas-fired Furnaces used for comfort heating with a Rated Heat Input Capacity less than or equal to 2,000,000 British thermal units (Btu) per hour.

Equipment	Sector	New Buildings ZEAS Compliance Date	Existing Buildings ZEAS Compliance Date
Fan-type central furnace (< 175k Btu/hr)	Residential	2026	2028
Fan-type central furnace (175k-2MM Btu/hr)	Commercial	2026	2028
Mobile home furnace	Residential	2026	2030
Wall furnaces, floor furnaces, and others	Residential & Commercial	2026	2028

Source: South Coast AQMD

→ **FSSAT Electric Replacement Characterization**: South Coast AQMD's residential and commercial furnace ROB ramps to 100% adoption by 2028.

South Coast AQMD (Rule 1121)

Initial proposal (subject to change)

Rule 1121: The provisions of this rule are applicable to manufacturers, distributors, Resellers, and Installers of natural gas-fired water heaters, with a Rated Heat Input Capacity rates less than 75,000 British thermal units (Btu) per hour. (Stricter than Bay Area's Rule 9-6)

Equipment	Sector	New Buildings ZEAS Compliance Date	Existing Buildings ZEAS Compliance Date
Water Heater (capacity less than 75,000 Btu/hr)	Residential & Commercial	2026	2027
Mobile home water heater	Residential	2026	2030

Source: South Coast AQMD

→ **FSSAT Electric Replacement Characterization**: South Coast AQMD's Residential water heater ROB ramps to 100% adoption by 2027.

Summary: "Commercial" ROB Water Heaters (> 75k Btu/hr)--2029 or 2031?

	Board Vote or Amendments Adoption Date	Equipment Size	Compliance Date
Statewide CARB ZEAS	Expected 2025	Boilers and water heaters (≤ 400k BTU/hr)	**2029**
Statewide CARB ZEAS	Expected 2025	Instantaneous water heaters (≤ 200k Btu/hr)	**2029**
Statewide CARB ZEAS	Expected 2025	Boilers, water heaters, and instantaneous water heaters (≤ 2MM Btu/hr)	**2031**
Bay Area AQMD (Rule 9-6)	March 15, 2023	Water Heaters (75,000 – 2MM Btu/hr)	**2031**
South Coast AQMD (Rule 1146.2)	June 7, 2024	**Phase I:** Smaller units (≤ 400k Btu/hr)	NC: 2026; Existing: **2029**
South Coast AQMD (Rule 1146.2)	June 7, 2024	**Phase II:** Larger units and pool heaters (> 400k Btu/hr)	NC: 2028; Existing: **2031**
South Coast AQMD (Rule 1146.2)	June 7, 2024	**Phase III:** High temperature units (> 180 degrees F)	NC: 2029; Existing: **2033**

Summary: "Residential and Commercial" ROB Furnaces

	Board Vote or Amendments Adoption Date	Equipment Size	Compliance Date
Statewide CARB ZEAS	Expected 2025	Furnaces (< 175k Btu/hr & 2MM ≤ Btu/hr)	**2029**
Bay Area AQMD (Rule 9-4)	March 15, 2023	Furnaces (< 175k Btu/hr)	**2029**
South Coast AQMD (Rule 1111)	Expected Q4 2024	Residential Fan-type central furnace (< 175k Btu/hr)	NC: 2026; Existing: **2028**
South Coast AQMD (Rule 1111)	Expected Q4 2024	Commercial Fan-type central furnace (175k-2MM Btu/hr)	NC: 2026; Existing: **2028**
South Coast AQMD (Rule 1111)	Expected Q4 2024	Mobile home furnace	NC: 2026; Existing: **2028**
South Coast AQMD (Rule 1111)	Expected Q4 2024	Wall furnaces, floor furnaces, and others	NC: 2026; Existing: **2028**

→ **South Coast AQMD's proposed amendment to Rule 1111** is more aggressive than CARB's proposed ZEAS and Bay Area's AQMD's Amended Rule 9-4.

Proposed 2024 AAFS scenario characterizations

For electric system planning

Statewide characterization of electrification adoption

	AAFS 2	Planning Forecast (AAFS 3)	Local Reliability (AAFS 4)
Programmatic AAEE			
Programmatic AAFS			
Statewide Residential NC			
Statewide Commercial NC			
Statewide Residential ROB			
Statewide Commercial ROB			
Statewide CARB ZEAS (Board Vote Expected 2025)			

Statewide characterization of electrification adoption

--	AAFS 2	Planning Forecast (AAFS 3)	Local Reliability (AAFS 4)
Programmatic AAEE	Scenario 2 (2023)	Scenario 3 (2023)	Scenario 2 (2023)
Programmatic AAFS	Scenario 2 (2023)	Scenario 3 (2023)	Scenario 4 (2023)
Statewide Residential NC			
Statewide Commercial NC			
Statewide Residential ROB			
Statewide Commercial ROB	Revised GT AAFS (6.67% linear annual growth rate)	--	--
Statewide CARB ZEAS (Board Vote Expected 2025)	--	CARB's ZEAS Updated Compliance Schedules	CARB's ZEAS Updated Compliance Schedules

Programmatic AAEE and AAFS

- Programmatic scenarios not updated for 2024
- Uses same combinations as 2023 IEPR

Statewide characterization of electrification adoption

--	AAFS 2	Planning Forecast (AAFS 3)	Local Reliability (AAFS 4)
Programmatic AAEE	Scenario 2 (2023)	Scenario 3 (2023)	Scenario 2 (2023)
Programmatic AAFS	Scenario 2 (2023)	Scenario 3 (2023)	Scenario 4 (2023)
Statewide Residential NC	100% starting in 2026	100% starting in 2026	100% starting in 2026
Statewide Commercial NC	100% starting in 2029	100% starting in 2029	100% starting in 2029
Statewide Residential ROB	R… In…		
Statewide Commercial ROB	R… linear annual growth rate)		
Statewide CARB ZEAS (Board Vote Expected 2025)	--	CARB's ZEAS Updated Compliance Schedules	CARB's ZEAS Updated Compliance Schedules

Statewide New Construction

- Same assumptions as used in 2023 IEPR and GT AAFS Scenarios

Statewide characterization of electrification adoption

--	AAFS 2	Planning Forecast (AAFS 3)	Local Reliability (AAFS 4)
Programmatic AAEE	Scenario 2 (2023)	Scenario 3 (2023)	Scenario 2 (2023)
Programmatic AAFS	Scenario 2 (2023)	Scenario 3 (2023)	Scenario 4 (2023)
Statewide Residential NC	100% starting in 2026	100% starting in 2026	100% starting in 2026
Statewide Commercial NC	100% starting in 2029	100% starting in 2029	100% starting in 2029
Statewide Residential ROB	Revised GT AAFS (6.67% linear annual growth rate)	--	--
Statewide Commercial ROB	Revised GT AAFS (6.67% linear annual growth rate)	--	--
Statewide CARB ZEAS (Board Vote Expected 2025)	--	CARB's ZEAS Updated Compliance Schedules	CARB's ZEAS Updated Compliance Schedules

AAFS ROB characterizations of local zero-NOx standards

Measure (✓ – included in scenario)	Amendments Adoption Date	Zero-NOx Standard Compliance Date and FSSAT Impacted Sector	AAFS 2	Planning Scenario (AAFS 3)	Local Reliability (AAFS 4)
Statewide characterization		*See slide 12 for proposed ZEAS schedule*	Revised GT AAFS	CARB ZEAS	CARB ZEAS
Bay Area AQMD (Rule 9-4)	March 15, 2023	2029: ROB Residential & Commercial Space Heating	✓	✓ *	✓ *
Bay Area AQMD (Rule 9-6)	March 15, 2023	2027: ROB Residential Water Heating; **2031: ROB Commercial Water Heating**	✓	✓ *	✓ *
South Coast AQMD (Rule 1146.2)	June 7, 2024	~~**2029**~~ **2031**: ROB Commercial Water Heating	✓	✓ *	✓ *
South Coast AQMD (Rule 1111)	Expected Q4 2024	2028: ROB Residential and Commercial Space Heating			✓
South Coast AQMD (Rule 1121)	Expected Q4 2024	2027: ROB Residential Water Heating		*	✓ *

* Indicates non-binding for a given scenario (i.e., CARB's ZEAS aligns with local zero-NOx standard).

Questions from CEC staff

1. Do you have any feedback on the proposed AAFS scenarios for 2024?
   - CARB's updated zero-emission appliance standards
   - Local AQMD's zero-NOx emission standards
   - **Proposed FSSAT modeling of commercial water heaters**

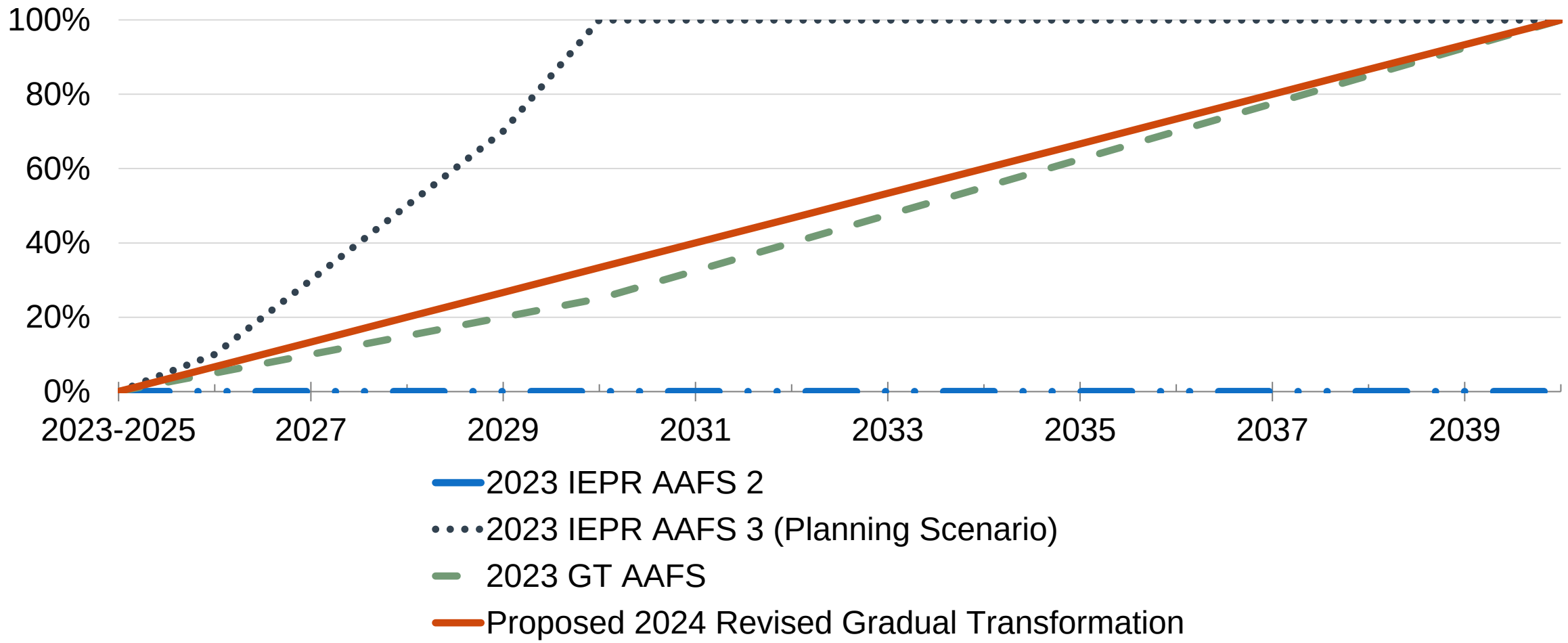
2. Do you have any comments or questions about the recent updates to FSSAT?

3. Are there are any analyses or results you would like CEC staff to present at the October DAWG?
   - Annual electric equipment projections
   - Annual AC electric load impacts from fuel substitution

Thank you

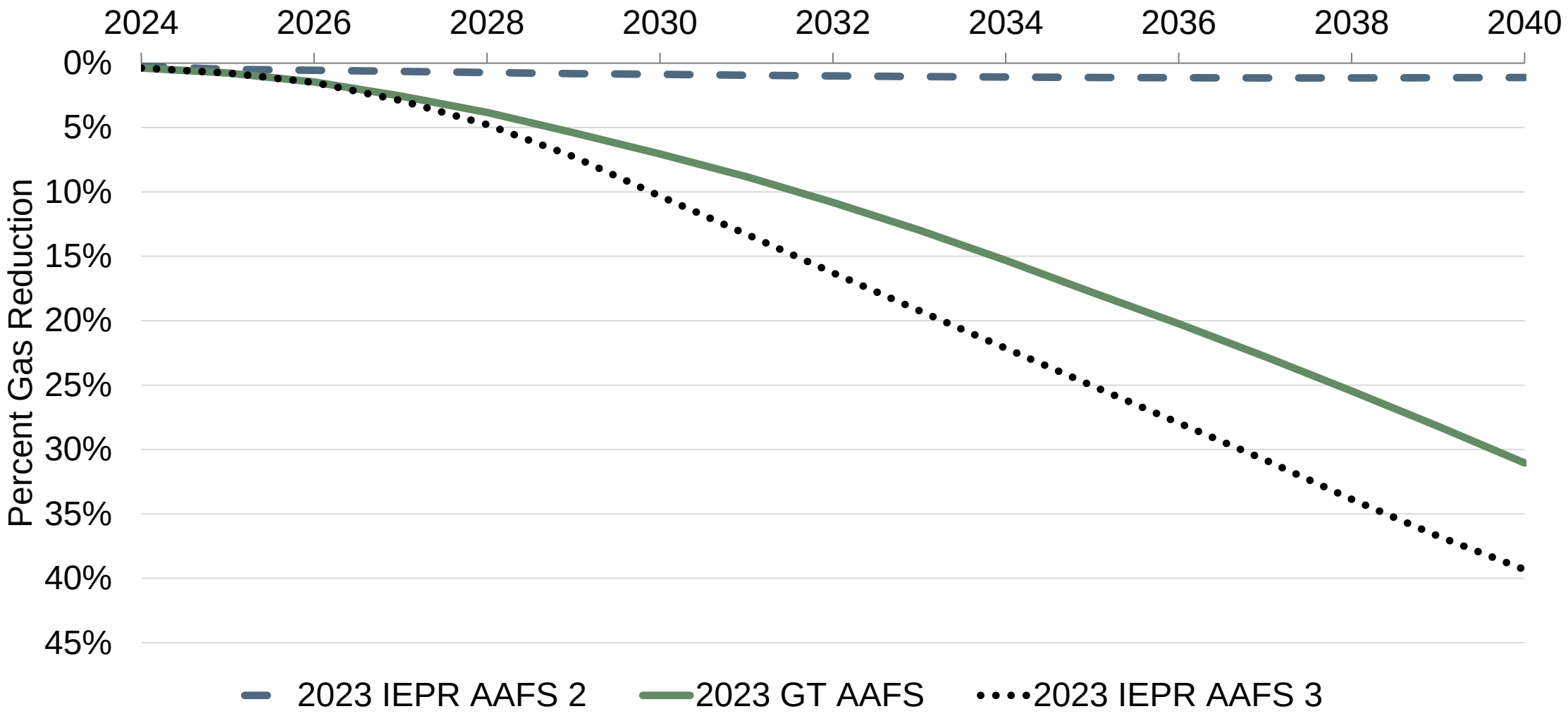
Please send any written comments or questions to
Nicholas Janusch (nicholas.janusch@energy.ca.gov)

Differences in statewide replace-on-burnout (ROB) adoption rates



Source: CEC Staff

Baseline Gas Forecast Percent Reduction for 2023 AAFS Scenarios



Source: CEC Staff