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# **Characterizing the Incorporation of the Zero-Emission Appliance Standards to AAFS**

IEPR Commissioner Workshop on Load Modifier Scenario Results

November 15, 2023

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Energy Assessments Division, Advanced Electrification Analysis Branch



# Fuel Substitution Scenario Analysis Tool (FSSAT)

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FSSAT is a “what if” policy analysis tool examining the cost, energy, and greenhouse gas impacts of different fuel substitution scenarios given different levels of additional achievable energy efficiency (AAEE) and fuel substitution (AAFS) assumptions.

- FSSAT previously used for:
  - AB 3232 California Building Decarbonization Assessment
  - Demand Scenarios Project
  - 2022 IEPR Demand Forecast Update



# Recent history

- Climate goals since the 2021 adoption of the AB 3232 (Friedman, Chapter 373, Statutes of 2018) [California Building Decarbonization Report](#)
  - **6 million heat pumps** installed by 2030 (Recommended in [2021 IEPR](#))
  - **3 million climate-ready and climate-friendly homes by 2030 and 7 million by 2035** ([Governor's July 2022 letter to CARB](#))
    - [October 10, 2023](#): Top global building appliance manufacturers and distributors commit to help California achieve six million heat pump goal
- Zero- and low- NOx emission appliance standard proceedings occurring at the state and local level
- [2022 IEPR Update](#)
  - Incorporated zero-emission appliance standards in the Local Reliability Scenario CARB SIP Strategy



# Statewide and Local Emission Standards/Rules/Measures

- Statewide:
  - CARB's 2030 zero-emission space and water heating appliance standard from the 2022 State SIP Strategy<sup>1</sup>.
    - Rulemaking process started in 2023 (first workshop on May 10<sup>th</sup>).
    - Expected regulatory board hearing date of 2025.
- Local:
  - BAAQMD<sup>2</sup> Regulation 9, Rules 4 and 6 for space and water heating appliances:
    - Adopted by the air district in March 2023.
  - SCAQMD<sup>3</sup> low- and zero-emission control measures for multiple end uses:
    - Rulemaking process for residential measures starting date – Anticipated early 2024.

<sup>1</sup>[2022 State Strategy for the State Implementation Plan](#), adopted on September 22, 2022

<sup>2</sup>Bay Area Air Quality Management District - [Final Staff Report on Proposed Amendments to Regulation 9, Rule 4 and Rule 6](#)

<sup>3</sup>South Coast Air Quality Management District - [2022 Air Quality Management Plan](#) and [Public Consultation Meeting Presentation on Amended Rule 1111](#)



# 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





# 2025 check-in on progress and readiness

As stated in their [March 2023 Final Staff Report](#), Bay Area AQMD requires interim reports and implementation working groups (first interim report due January 1, 2025, for water heaters and boilers below 75,000 BTU/hr):

*“The proposed amendments include the addition of an interim report to be brought to the Board of Directors by the Air Pollution Control Officer (APCO) **two years prior to the compliance date for the zero NOx standard.** Staff intends for this report to provide information to the Board and the public about the accessibility of zero NOx appliances to Bay Area residents and to allow the Board of Directors an opportunity to take any necessary action in response to this information. **Contents of this report would include information on technology development, market availability of zero NOx space heating appliances, potential costs of compliance, infrastructure readiness, and availability of incentive programs to decrease these costs.**”*



# AAFS Levers for the Modeling of the Zero-Emission (ZE) Appliance Standard in FSSAT

	AAFS Levers	AAFS 3	AAFS 4	AAFS 5	AAFS 6
Programmatic Characterization	AAEE Gas/Elec Scenario	Scenario 3	Scenario 2	Scenario 2	Scenario 2
	Programmatic AAFS	Scenario 3	Scenario 4	Scenario 5	Scenario 6
ZE Appliance Technology Characterization (modeled via FSSAT)					





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	Programmatic AAFS	Scenario 3	Scenario 4	Scenario 5	Scenario 6
ZE Appliance Technology Characterization (modeled via FSSAT)	Water Heater and Space Heating	Yes	Yes	Yes	Yes
	Other FSSAT end uses	No	No	Yes	Yes
	Residential Propane	No	No	Yes	Yes
	AQMDs	BAAQMD	BAAQMD	BAAQMD	BAAQMD & SCAQMD



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	Residential Propane	No	No	Yes	Yes
	AQMDs	BAAQMD	BAAQMD	BAAQMD	BAAQMD & SCAQMD
	Technology Set	Mixed	Mixed	Mixed	<b>Mixed*</b>
	Technology Efficiency Weighting	Even	Even	Even	<b>High**</b>
	Ramp Adoption Rate	Linear Ramp (10% reduction in interim years)	Linear Ramp	Linear Ramp	Linear Ramp

\*Revised from “single-best technology”    \*\*Revised from “NA”



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	AQMDs	BAAQMD	BAAQMD	BAAQMD	BAAQMD & SCAQMD
	Technology Set	Mixed	Mixed	Mixed	<i>Mixed</i> *
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	AAFS Levers	AAFS 3	AAFS 4	AAFS 5	AAFS 6
Programmatic Characterization	AAEE Gas/Elec Scenario	Scenario 3	Scenario 2	Scenario 2	Scenario 2
	Programmatic AAFS	Scenario 3	Scenario 4		
ZE Appliance Technology Characterization (modeled via FSSAT)	Water Heater and Space Heating	Yes	Yes		
	Other FSSAT end uses	No	No		
	Residential Propane	No	No		
	AQMDs	BAAQMD	BAAQMD		
	Technology Set	Mixed	Mixed		
	Technology Efficiency Weighting	Even	Even	Even	<i>High**</i>
	Ramp Adoption Rate	Linear Ramp (10% reduction in interim years)	Linear Ramp	Linear Ramp	Linear Ramp

Focus for today:

AAFS 3 → Planning Forecast

AAFS 4 → Local Reliability Scenario

\*Revised from “single-best technology”    \*\*Revised from “NA”



# Appendix: Zero-Emission Appliance Standards Replacement Assumptions

Table 2: FSSAT Zero-Emission Appliance Standards Replacement Assumptions for the 2023 IEPR

Territory	Replacement Type	AAFS Scenario	2020-25	2026	2027	2028	2029	2030-40
All Air Districts	Comm. New Construction	All	0%	0%	0%	0%	<b>100%</b>	100%
All Air Districts	Res. New Construction	All	0%	<b>100%</b>	100%	100%	100%	100%
BAAQMD	Replace on Burnout: Space Heating	All	0%	25%	50%	75%	<b>100%</b>	100%
BAAQMD	Replace on Burnout: Water Heating	All	0%	50%	<b>100%</b>	100%	100%	100%
Rest of State	Replace on Burnout	AAFS 3						
Rest of State	Replace on Burnout	AAFS 4-6						
SCAQMD	Replace on Burnout: Residential	AAFS 6						
All Air Districts	Res. Propane Replace on Burnout*	AAFS 6						
All Air Districts	Res. Propane New Construction*	AAFS 6						

\*Propane replacement is solely for water heating and space heating end uses in the Residential sector.



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All Air Districts	Res. New Construction	All	0%	<b>100%</b>	100%	100%	100%	100%
BAAQMD	Replace on Burnout: Space Heating	All	0%	25%	50%	75%	<b>100%</b>	100%
BAAQMD	Replace on Burnout: Water Heating	All	0%	50%	<b>100%</b>	100%	100%	100%
Rest of State	Replace on Burnout	AAFS 3	0	10%	30%	50%	70%	<b>100%</b>
Rest of State	Replace on Burnout	AAFS 4-6	0%	20%	40%	60%	80%	<b>100%</b>
SCAQMD	Replace on Burnout: Residential	AAFS 6	0%	25%	50%	75%	<b>100%</b>	100%
All Air Districts	Res. Propane Replace on Burnout*	AAFS 6	0%	20%	40%	60%	80%	<b>100%</b>
All Air Districts	Res. Propane New Construction*	AAFS 6	0%	<b>100%</b>	100%	100%	100%	100%

\*Propane replacement is solely for water heating and space heating end uses in the Residential sector.



# 2023 IEPR FSSAT Analysis Changes from 2022 IEPR Update

- Incorporates the impacts from the zero-emission appliance standards for both the planning forecast and local reliability scenario.
- Characterized four scenarios of the zero-emission appliance standards for AAFS Scenarios 3 through 6.
  - Changed the technology efficiency weighting from highly to evenly weighted for the local reliability forecast (and for the planning forecast).
  - Revised adoption rates for commercial new construction.
  - Addition of new SCAQMD and updated BAAQMD proposed measures/rules.
  - AAFS Scenarios 5 and 6 considers propane and other end uses.
- Updated Commercial and Residential buildings and energy forecast data.
- Updated air conditioning penetration rate assumptions for PG&E territory



# Thank you

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# Appendix: State Zero-Emission Appliance Standards Table for CARB

Table 3: Statewide Zero-Emission Appliance Standards from CARB

Implementer	CARB
Regulation/Rule/Measures	Zero-Emission Appliance Standard
Description	Measure stating that, beginning in 2030, 100 percent of new space and water heaters (for either new construction or existing buildings) sold in California would need to meet the zero-emission standard.
Jurisdiction	Statewide
Data Source Links	<a href="#">CARB 2022 State SIP Strategy</a>



# Appendix: Local Zero-Emission Appliance Standards and Rules Table for BAAQMD

Table 4: Local Zero-Emission Standards and Rules from BAAQMD

Implementer	BAAQMD
Regulation/Rule/Measures	Regulation 9, Rule 4 and 6 for Building Appliances
Description	<p>Rule 9-4: Zero NOx emission standard starting in 2029 for gas-fired space heaters.</p> <p>Rule 9-6 (small water heaters): Zero NOx emission standard starting in 2027 for gas-fired water heaters below 75,000 BTU/hour.</p> <p>Rule 9-6 (large water heaters): Zero NOx emission standard starting in 2031 for gas-fired water heaters between 75,000 - 2,000,000 BTU/hour.</p>
Jurisdiction	Bay Area air district
Data Source Links	<a href="#">BAAQMD Final Staff Report on Proposed Amendments to Regulation 9, Rule 4 and Rule 6</a>



# Appendix: Local Low- and Zero-Emission Control Measures Table for SCAQMD

Table 5: Local Low- and Zero-Emission Control Measures from SCAQMD

Implementer	SCAQMD
Regulation/Rule/Measures	Control Measures R-CMB-01, R-CMB-02, R-CMB-03, R-CMB-04
Description	<p>R-CMB-01: Control measure proposing a rule to require the installation of only zero or low NOx water heaters in the residential sector starting in 2029.</p> <p>R-CMB-02: Control measure proposing a rule to require the installation of only zero or low NOx space heaters in the residential sector starting in 2029.</p> <p>R-CMB-03: Control measure proposing a regulatory and incentive approach to switch residential gas cooking equipment with zero or low NOx emission appliances starting in 2029.</p> <p>R-CMB-04: Control measure proposing a rule to require the installation of only zero or low NOx appliances for other/miscellaneous end uses in the residential sector starting in 2029.</p>
Jurisdiction	South Coast air district
Data Source Links	<a href="#">SCAQMD 2022 Air Quality Management Plan</a>