



# **Tier 5 Rulemaking Workshop**

Draft Potential Off-Road Compression-Ignition  
New Engine Regulations

February 27, 2026

*The text is draft, for purposes of discussion, and may be revised and/or reorganized in the future.*

# Agenda

<b>Time</b>	<b>Topic</b>
8:30 am - 8:40 am	Opening Remarks
8:40 am - 9:40 am	Potential Tier 5 (T5) Rulemaking Major Elements and Changes
9:40 am - 10:40 am	Questions / Discussion
10:40 am - 11:15 pm	Off-Road In-Use Testing (ORIUT) Elements and Changes
11:15 am - 12:30 pm	Questions / Discussion
12:30 pm - 1:30 pm	Lunch Break
1:30 pm - 2:30 pm	Off-Road On-Board Diagnostics (OR OBD) Updates
2:30 pm - 3:15 pm	Questions / Discussion
3:15 pm - 3:30 pm	Next Steps / Adjourn

# Zoom Webinar Details

- Telephone Call-in: (216) 706 – 7005
- Access Code: 400363
- How to Ask Questions:
  - In Zoom:
    - Use the “Raise Hand” feature, or
    - Type in “Q&A” box
  - On phone:
    - #2 to “Raise Hand”
    - \*6 to Unmute/Mute

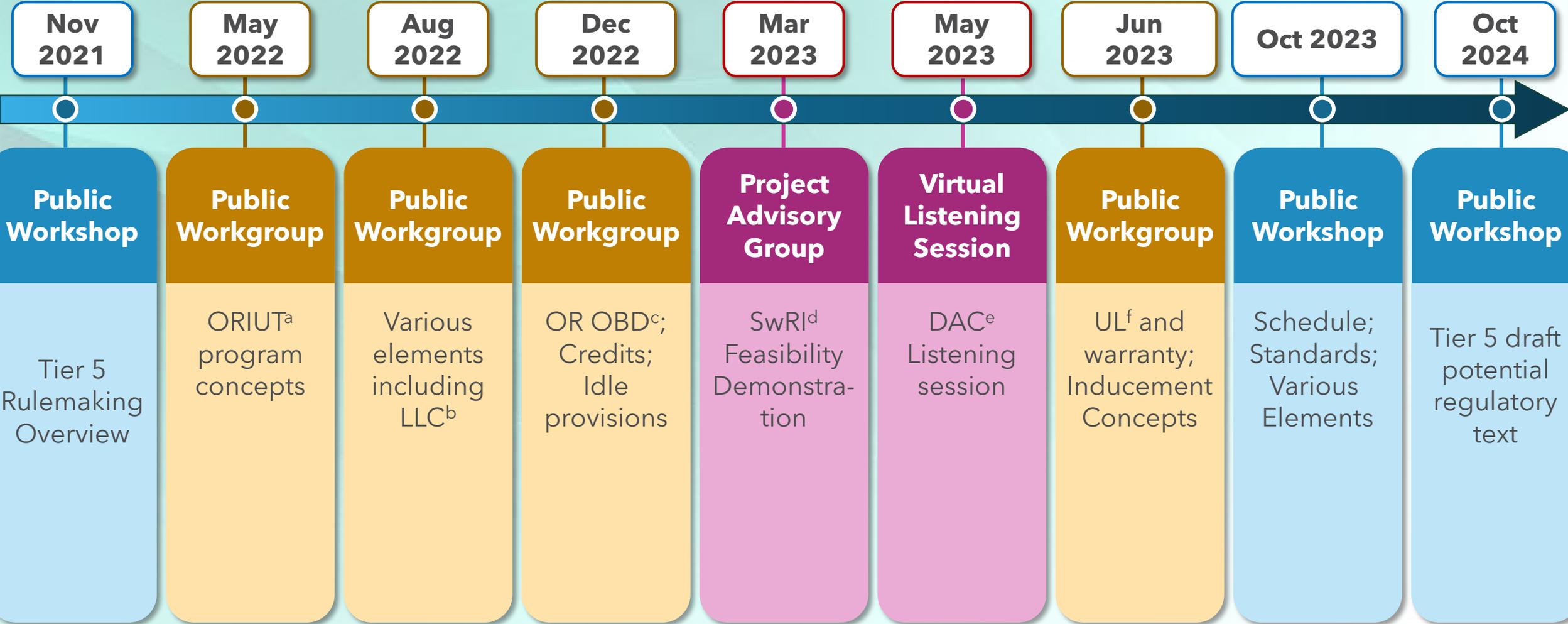
# Outline

- Background and Objectives
- Reorganization of Draft Potential Regulation Order and Draft Potential Test Procedures for Tier 4 and Tier 5
- Elements with Major/Minor/No Substantial Changes
- Tier 5 Interim (T5i)/Tier 5 Final (T5f) Standards and Implementation
- T5i Other Requirements
- Changes in Major Elements
- Potential Exemption from the In-Use Off-Road Regulation
- Request for Feedback
- Next Steps

# 2022 State SIP Commitment for Tier 5

- Off-road NO<sub>x</sub> emissions are significant
- Tier 5 is one of the 2022 SIP measures
- Staff committed to investigating a rule designed to reduce NO<sub>x</sub>, particulate matter (PM), and carbon dioxide (CO<sub>2</sub>) emissions from new off-road compression-ignition (CI) engines
- Target statewide NO<sub>x</sub> emission reduction: 10.4 tpd

# Tier 5 Public Process to Date



<sup>a</sup> ORIUT: off-road in-use testing

<sup>b</sup> LLC: low-load cycle

<sup>c</sup> OR OBD: off-road on-board diagnostics

<sup>d</sup> SwRI: Southwest Research Institute

<sup>e</sup> DAC: disadvantaged communities

<sup>f</sup> UL: useful life

# Tier 5 Background and Objectives

- Major elements of T5f considered in the 2024 workshop:
  - Up to 90% cleaner NOx standard than Tier 4 Final (T4f)
  - Up to 75% cleaner PM standard than T4f
  - Greenhouse gas (GHG) standards
  - LLC
  - ORIUT program
  - OR OBD program
- Tier 5 would bring off-road engines to a similar stringency as Heavy-Duty on-road standards and provide health benefits, despite additional challenges due to greater diversity in off-road applications
- 5+ years of demonstration projects\* support the technical feasibility of the potential T5f standards\*\*

\* Conducted by the Southwest Research Institute

\*\* 90% reduction in NOx emissions for 56-560-kilowatt (kW) power category

# Reorganization of the Draft Potential Regulation Order and Release of Two Test Procedures

- Documents released on Feb. 5, 2026, for this workshop:
  - Draft Potential Regulation Order
  - Draft Potential California Tier 4 In-Use Compliance Test Procedures
  - Draft Potential Tier 5 and Marine CI < 37 kW Test Procedures
- General approach for Title 13
  - Staff developed draft potential California Code of Regulations (CCR) sections with sub-numbering, while maintaining the current T4 sections unchanged
  - Example:

Topics in Title 13	Title 13, CCR*, section
T4f standards and test procedures	2423 (no change)
Draft Potential supplemental T4f standards and test procedures	2423.05
Draft Potential T5 standards and test procedures	2423.1
Draft Potential standards and test procedures for marine CI engines < 37 kW	2423.2

# Draft Major Changes Since the 2024 Workshop

(1 of 2)

- Staff is considering *optional*/T5i standards for model year (MY) 2031-2035; T4f would be the standard through MY 2035 for all power categories
- T5i optional standard would be comparable to the European standard (Stage V)
- T5i optional would not include T5f elements such as the idle reductions, LLC, OR OBD, ORIUT, extended warranty, or extended UL
- Staff is considering pushing out the implementation date of T5f from MY 2031-2034 (depending on power categories and compliance options) to MY 2036 for all power categories and removed former options 1-4

# Draft Major Changes Since the 2024 Workshop

## (2 of 2)

- Staff is considering removing:
  - GHG standards for potential T5i and T5f
  - Zero-emission credits and certification requirements
- Staff is considering introducing the 2-Bin Moving Average Window for ORIUT (more details on ORIUT to be presented in the next presentation)
- Selective catalytic reduction (SCR) inducement requirements are To Be Determined and will be revisited later
- Staff is considering maintaining the current minimum engine dynamometer aging hours in California
- Restructured the draft potential Tier 5 Regulation Order
- Released draft potential Test Procedures for T5 and T4 In-Use

# Tier 5 Elements with Minor/No Substantial Changes from 2023-2024 Workshops

## Minor changes

- Useful life/warranty/defect reporting
- OR OBD
- California Transition Program for Equipment Manufacturers (CA-TPEM)
- CI Marine
- In-Use Fleet Regulation

## No substantial changes

- Selective Enforcement Audit
- New Replacement Engine and Rebuilt Engine Reporting
- Idling Provisions
- LLC
- Labeling

# Changes in T5i/T5f Standards and Implementation

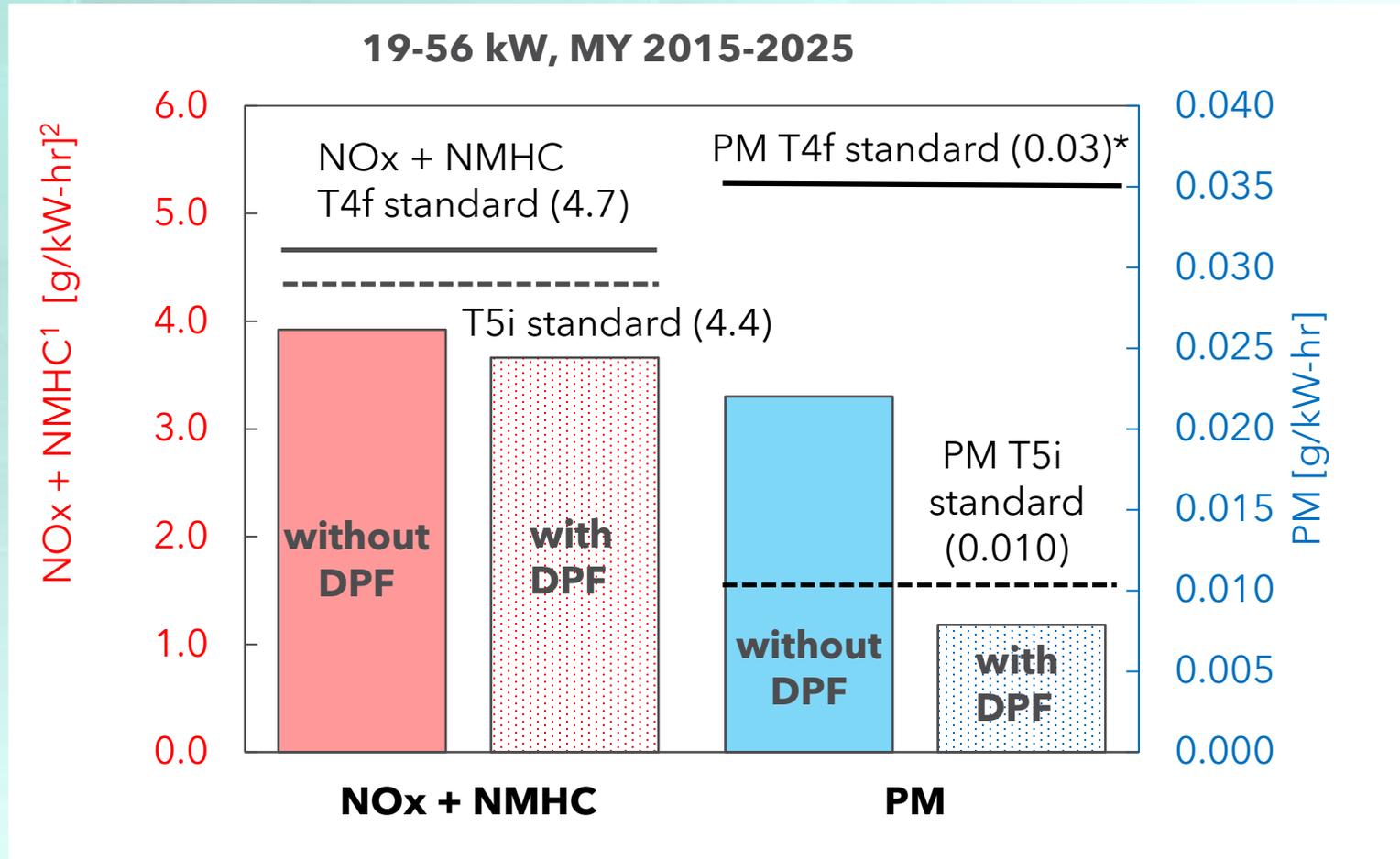
- T5f implementation would shift from MY 2031-2034 (depending on power categories and compliance options) to MY 2036+
- For MY 2031-2035, optional T5i standards are being considered for 19-560 kW power categories
  - Staff is evaluating tying incentive funding guidelines (Carl Moyer) and the California Clean Construction program to T4f plus diesel particulate filters (DPF) and T5i optional

Power Category	MY								
	2030	2031	2032	2033	2034	2035	2036	2037	2038
kW < 19	T5f Standards						T5f Standards		
19 ≤ kW ≤ 560	T5f Standards	Optional T5i Standards				T5f Standards			
kW > 560	T5f Standards						T5f Standards		

Request for feedback: Is there any alternative approach for incentivizing optional T5i?

# Analysis of T4f Certification Data (19-56 kW)

- Staff analyzed T4f Executive Orders in 19-56 kW power category
- Engine families with DPFs have lower average NOx and PM emissions
- Staff is considering potential T5i NOx and PM standards based on the analysis

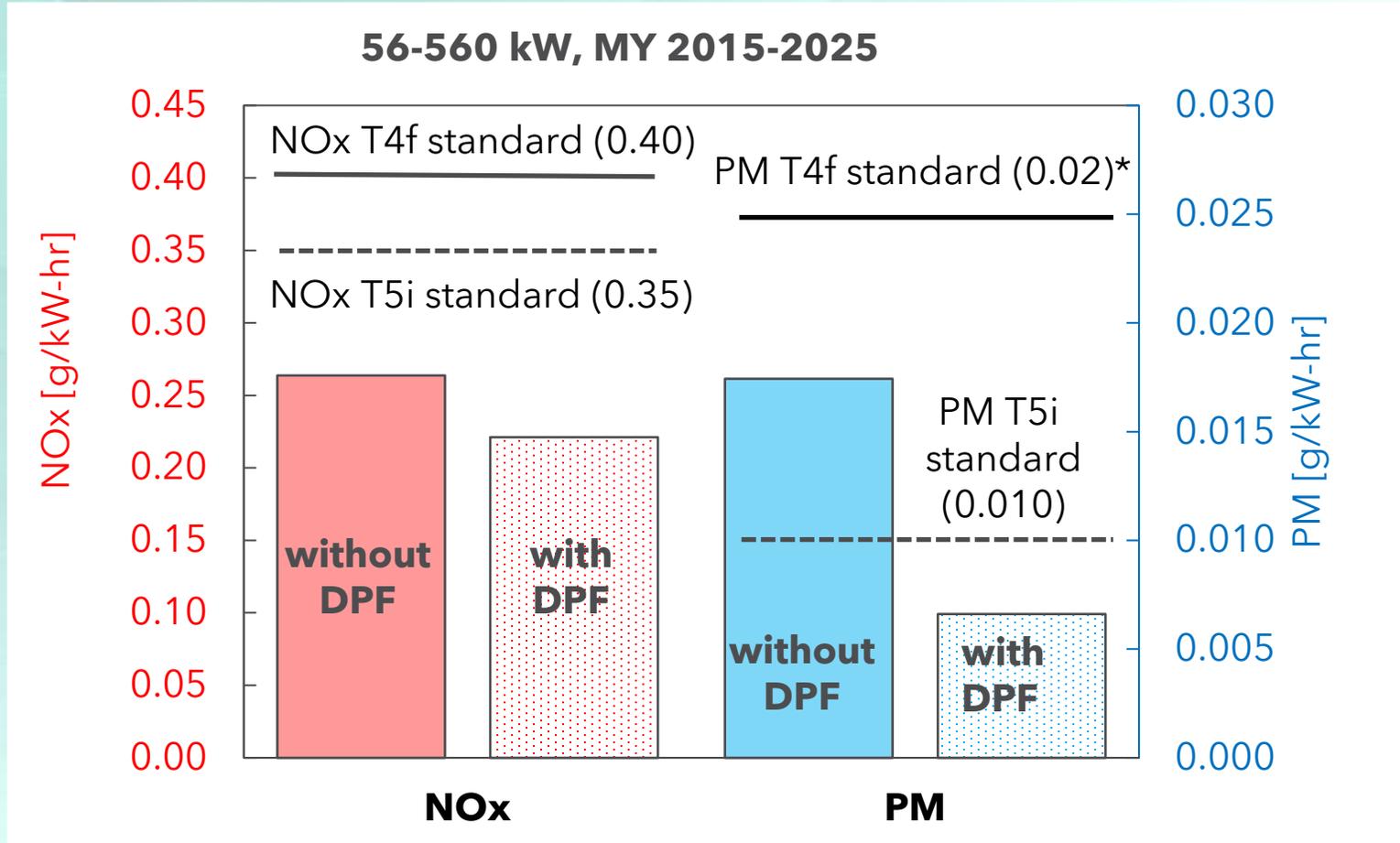


<sup>1</sup> NMHC: non-methane hydrocarbons  
<sup>2</sup> g/kW-hr: gram per kw · hour

\* PM T4f standard is 0.03 g/kW-hr with rounding (e.g., 0.0349 → 0.03)

# Analysis of T4f Certification Data (56-560 kW)

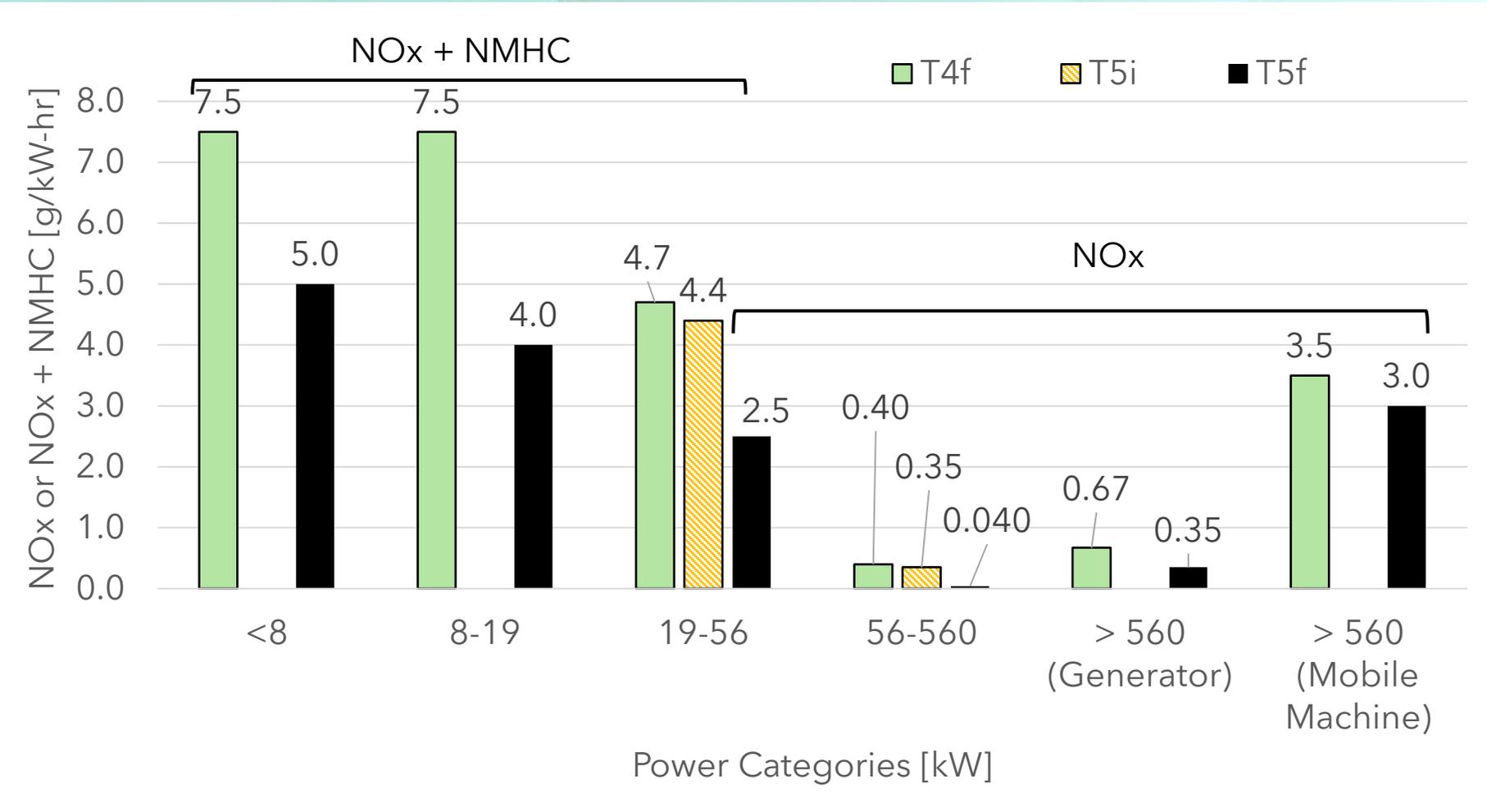
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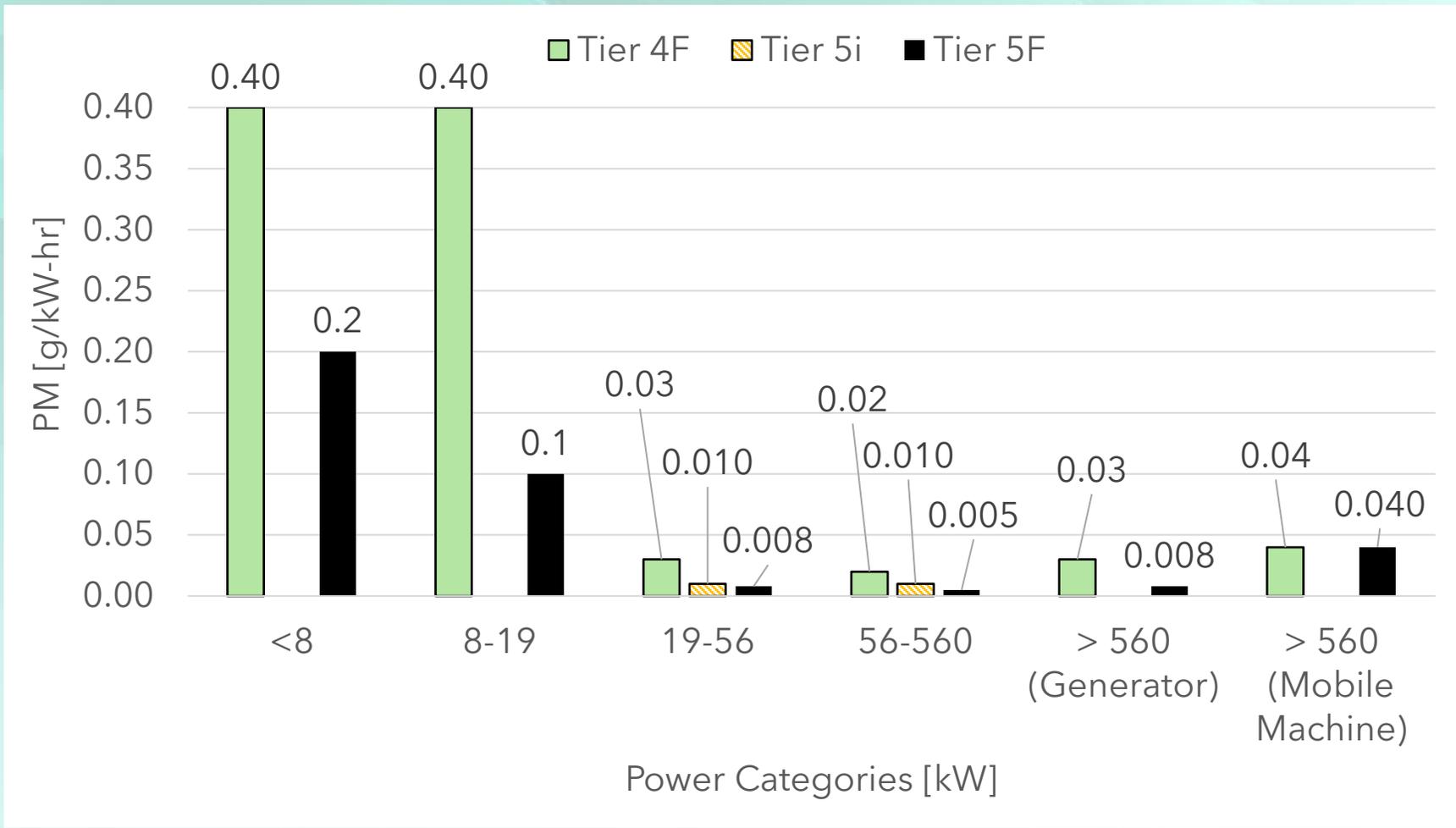
Request for feedback: Any concern about the stringency of T5i, considering that it is optional?

\* PM T4f standard is 0.02 with rounding (e.g., 0.0249 → 0.02)

# Summary of Potential NOx or NOx + NMHC Tier 5 Standards



# Summary of Potential Tier 5 PM Standards



# Potential T5i Optional Standards (g/kW-hr)

Nonroad Transient Test Cycle and Discrete Mode Cycle/Ramped Modal Cycles, MY 2031-2035

Power Category	NO <sub>x</sub>	PM	NO <sub>x</sub> + NMHC	NMHC	CO <sup>a</sup>
< 8 kW ( < 11 HP) <sup>b</sup>	-	-	-	-	-
8 ≤ kW < 19 (11 ≤ HP < 25)	-	-	-	-	-
19 ≤ kW < 56 (25 ≤ HP < 75)	-	<b>0.010</b>	<b>4.4</b>	-	5.0
56 ≤ kW < 130 (75 ≤ HP < 175)	<b>0.35</b>	<b>0.010</b>	-	0.19	5.0
130 ≤ kW ≤ 560 (175 ≤ HP ≤ 750)	<b>0.35</b>	<b>0.010</b>	-	0.19	3.5
> 560 kW (Gen Sets) ( > 750 HP)	-	-	-	-	-
> 560 kW (Mobile Machines) ( > 750 HP)	-	-	-	-	-

- Not applicable

**Bolded values are different from Tier 4 Final standards**

<sup>a</sup> CO: carbon monoxide

<sup>b</sup> HP: horsepower

# Potential T5f Standards (g/kW-hr)

Nonroad Transient Test Cycle and Discrete Mode Cycle/Ramped Modal Cycles, MY 2036+  
 (No change from 2024 workshop except for the implementation timing)

Power Category	NOx	PM	NOx + NMHC	NMHC	CO
< 8 kW ( < 11 HP)	-	<b>0.2</b>	<b>5.0</b>	-	8.0
8 ≤ kW < 19 (11 ≤ HP < 25)	-	<b>0.1</b>	<b>4.0</b>	-	6.6
19 ≤ kW < 56 (25 ≤ HP < 75)	<b>2.5</b>	<b>0.008</b>	-	0.19	5.0
56 ≤ kW < 130 <sup>a</sup> (75 ≤ HP < 175)	<b>0.040</b>	<b>0.005</b>	-	<b>0.080<sup>b</sup></b>	5.0
130 ≤ kW ≤ 560 <sup>a</sup> (175 ≤ HP ≤ 750)	<b>0.040</b>	<b>0.005</b>	-	<b>0.080<sup>b</sup></b>	3.5
> 560 kW (Gen Sets) ( > 750 HP)	<b>0.35</b>	<b>0.008</b>	-	<b>0.080<sup>b</sup></b>	3.5
> 560 kW (Mobile Machines) ( > 750 HP)	<b>3.0</b>	<b>0.040</b>	-	0.19	3.5

- Not applicable

**Bolded values are different from Tier 4 Final standards**

<sup>a</sup> LLC NOx limit is 0.060 g/kW-hr for 56 ≤ kW ≤ 560 power category except for constant-speed engines

<sup>b</sup> The NMHC standard for lean-burn natural gas engine families would be 0.19 g/kW-hr

# Optional T5i - Other Requirements

- T5i engines would not generate California-averaging, banking, and trading (CA-ABT) credits to avoid earning both federal and CA-ABT credits
- Use of federal ABT credits would not be allowed for certifying T5i engines during the interim period (MY 2031-2035)
- Manufacturers certifying T4f/T5i after MY 2036, using the 5% limited production allowance, must offset the difference between T4f/T5i and T5f standards using CA-ABT credits\*
- T5i engines would need to comply with in-use “not-to-exceed” emission limits and test procedures for the California Air Resources Board-Run Off-Road In-Use Compliance program
- Lower thresholds for defect reporting and corrective action apply due to smaller sales volume

Request for feedback: How can staff better incentivize optional T5i?

\*discounted by 70%

# Zero-Emission Credits

- Staff is proposing removing zero-emission credits
- Potential Phased Advanced Clean Equipment Regulation may pursue zero-emission credits with the development of hybrid electric and zero-emission technology strategies for manufacturers and/or fleets

# Minimum Engine Dynamometer Aging Hours: *Current Requirements*

Changes in  
Major Elements

## California requirements<sup>a</sup> - Manufacturers may choose to:

1. Ask CARB to approve deterioration factors (DF) for established technology based on engineering analysis, **or**
2. Ask CARB to approve DF based on emission measurements from similar highway or off-road engines, **or**
3. Establish DF based on engine aging and extrapolate the trend to full UL
  - Example: 2,800 hours of engine dynamometer aging for an 8,000-hour UL engine (i.e., 35%)<sup>b</sup>

## Federal requirements<sup>c</sup>:

1. The same options as California (option 1-3), **or**
2. Bench-age the aftertreatment to full UL with a minimum of 1,500 hours of engine aging

<sup>a</sup> California Exhaust Emission Standards and Test Procedures for New 2011 and Later Tier 4 Off-Road Compression-Ignition Engines, Part I-D, section 1039.245

<sup>b</sup> United States Environmental Protection Agency (U.S. EPA), CD-2020-19 (HD Highway and Nonroad), November 17, 2020

<sup>c</sup> 40 CFR 1039.245

# Minimum Engine Dynamometer Aging Hours for Draft Potential T5f

Changes in  
Major Elements

- Manufacturers may choose one of the two options:
  - Option 1: Same as the current requirement in California (e.g., 35% engine aging), or
  - Option 2: Same as the federal requirement, except that the minimum hours of engine-dynamometer aging are:
    - 2,800 hours for an 8,000-hour UL engine
    - 1,750 hours for a 5,000-hour UL engine
    - 1,500 hours for a 3,000-hour UL engine
- Rationale for maintaining the 35% engine aging
  - The currently implemented engine dynamometer aging would be maintained because the potential Tier 5 would not lengthen the UL hours (only longer year limits are considered)

Request for feedback: If alignment with the current federal minimum requirement of 1,500 hours (40 CFR 1039.245(e)(1)) is desired, please share feedback on why shorter engine dynamometer aging might be considered beneficial.

# CA-ABT

- CA-ABT credit use or generation would not be allowed for T5i engines
- Engine families meeting T5f in the MY 2033-2035 may generate CA-ABT credits with early-introduction NOx multipliers
- The CA-ABT program would begin with MY 2036
  - One-time transfer of a manufacturer's California portion of existing federal Tier 4 ABT credits earned through 2035
  - Transferred federal Tier 4 ABT credits must be discounted by 70% to compensate for the difference between Tier 4 and Tier 5f requirements (e.g., LLC, OR OBD)

# CA-TPEM

- The start of CA-TPEM would be shifted to the 2036 calendar year; no CA-TPEM for T5i
- Total available CA-TPEM allowances would be based on a manufacturer's historical three-year average of California equipment sales for calendar years 2033 through 2035 for each power category
- Staff has kept the same CA-TPEM allowances and duration
  - Up to 4 years and 80% for each power category < 56 kW
  - Up to 3 years and 50% for each power category  $\geq$  56 kW

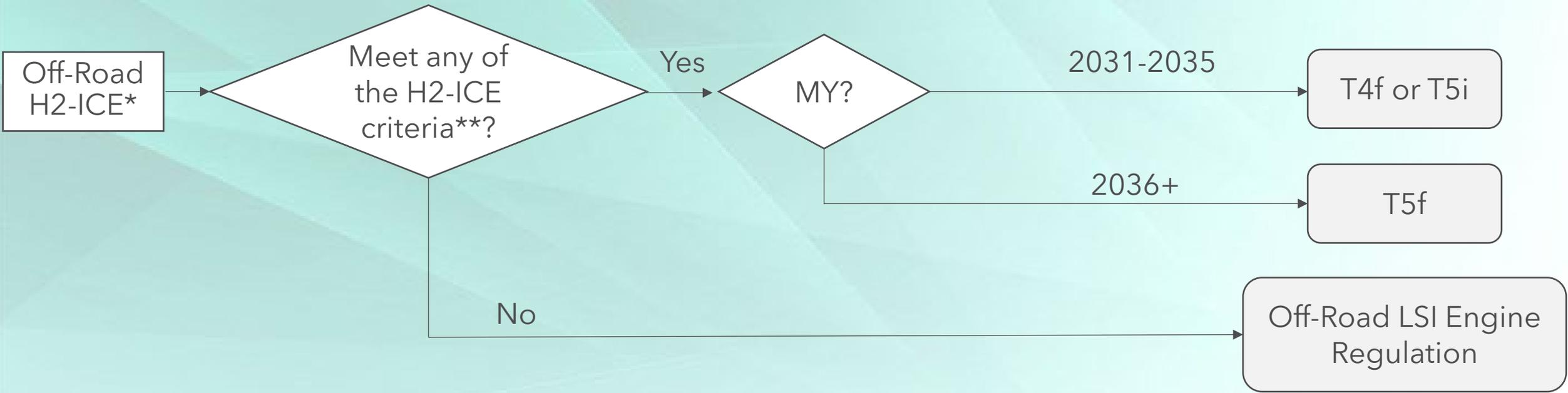
# Hydrogen-Fueled Internal Combustion Engines

- Currently, for certification purposes, for any engine that is not distinctly a CI engine nor derived from such, the Executive Officer determines whether engines are subject to off-road CI engine regulation
- Staff is considering clarifying the applicability of Hydrogen-Fueled Internal Combustion Engines (H2-ICE)
- Staff is considering adding the following clarifications:
  - Prior to T5f implementation, H2-ICEs designed to operate like diesel engines\* would meet T4f or T5i standards
  - Amend the Off-Road Large Spark-Ignition (LSI) Engine Regulation to provide consistency and exclude H2-ICEs from its applicability

\* Criteria shown in the next slide

# Applicable Regulation for Off-Road H2-ICE

Changes in Major Elements



**\*\* H2-ICE Criteria:**

- a. Employs boosted air induction
- b. Designed to operate in equipment previously powered with CI engines
- c. Derived from CI engines

\* This flow chart does not apply to marine engines < 37 kW

# Amendments in Off-Road LSI Engine Regulation Applicability for H2-ICE

- Staff is considering amending the applicability\* of Off-Road LSI Engine Regulation to exclude H2-ICE
- Off-Road H2-ICE meeting any one of H2-ICE criteria (previous slide) would certify to CI engine standards as applicable
  - MY 2031-2035: T4f or T5i
  - MY 2036+: T5f

\*Title 13, CCR, Section 2430

# Potential Requirements for H2-ICE Certifying to T4f/T5i/T5f

Changes in  
Major Elements

- H2-ICE certifying to T4f, T5i, or T5f would meet all the requirements of T4f, T5i, or T5f, with the following modifications:

No fuel-related sulfur exposure requirement in durability demonstration

**Rationale:** H2 fuel has extremely low sulfur levels

Standardized H2 fuel specifications\* for emission testing & service accumulation

**Rationale:** Same as H2 fuel cell to enable use of the same infrastructure and avoid contamination issues

For the ORIUT program, adopting a work-based procedure for calculating emissions

**Rationale:** Since H2 fuel is carbon free, alternate method is needed

\* Title 4, CCR, Section 4181 - Specifications - Hydrogen Fuel Used in Internal Combustion Engines and Fuel Cells

\*\* Title 40, Code of Federal Regulations (CFR), 1036.530(j)

Request for feedback: If low-purity H2 fuel is desired, please provide feedback on how it does not result in additional need for fueling infrastructure and cross-contamination

# SCR Inducement

To be determined. Potential strategies include

- Alignment with U.S. EPA's guidance (released August 2025), or
- Alignment with E.U. Stage V SCR inducement schedule, or
- Other?

Request for feedback: Staff is requesting feedback on potential strategies for SCR inducement

# Useful life/Warranty/Defect Reporting

- Lengthened year periods in UL and warranty would apply for T5f only
- Defect reporting and corrective action thresholds would be based on California production volume for T5i and T5f to account for low sales volume

# Marine CI Engines < 37 kW

- Tier 2 standards for propulsion marine compression-ignition engines below 37 kW remain in effect in California,\* while Tier 3 standards are in effect for the federal standards\*\*
  - Staff is considering solving the inconsistency
- The requirements for 2031+ MY marine CI engines with a power rating below 37 kW largely would align with the federal requirements\*\*
- Marine engines include propulsion marine engines and integrated auxiliary marine engines\*\*\*
- Credits may be generated or used according to the federal requirements\*\*\*\*

\*Title 13, CCR, Section 2423 (b)(1)

\*\* Federal requirements in Title 40, CFR, Part 1042 apply to marine CI engines > 37 kW

\*\*\* Portable auxiliary marine engine is considered integrated if it's fueling, cooling, or exhaust system is an integral part of the vessel (Title 40, CFR, 1042.901 "Marine engine")

\*\*\*\* Title 40, CFR, Part 1042, subpart H

# In-Use Off-Road Regulation: Exemption Concept

- Staff is exploring ways to provide more flexible compliance options for off-road in-use diesel fleet non-profit training organizations
  - Non-profit organizations are not exempt; they are classified as "small fleets," which provides the least stringent requirements.
- Staff is exploring several relief options

# Request for Feedback (1 of 2)

- Staff request feedback on all sections of the draft Regulation Order and the draft Test Procedures
- T5i optional
  - Is there any concern about the stringency of T5i, considering that it is optional?
  - Staff is considering tying T5i to incentive funding guidelines. What concerns are there? How best can manufacturers be incentivized to bring T5i engines to market?
- Engine dynamometer aging hours
  - If alignment with the current federal requirements (40 CFR 1039.245) is desired, please share feedback on why shorter engine dynamometer aging might be considered beneficial

Staff requests feedback on the draft Regulation Order and draft Test Procedures (T4 and T5) by May 4, 2026.

# Request for Feedback (2 of 2)

- H2-ICE
  - If manufacturers prefer to use low-purity H2 fuel for H2-ICE, please provide feedback on how it does not result in additional need for fueling infrastructure (that cannot be used for fuel cells) and cross-contamination between low-purity and fuel-cell grade H2 fuel
- SCR Inducement
  - Staff is requesting feedback on potential alignment with the U.S EPA or the E.U. Stage V options for the inducement schedule

Staff requests feedback on the draft Regulation Order and draft Test Procedures by May 4, 2026.

# Request for Alternatives

- Pursuant to California Senate Bill 617, staff welcomes public input on alternatives to the regulatory concept discussed in this workshop
- Please include data and data-supported justifications with your alternative
- Please ensure the submission discusses the alternative's ability to fulfill the purpose of the regulatory concept as staff has presented it
- Please submit the associated cost and benefit information and data sources to enable comparison of economic impacts, and also submit a clear description of the basis for any cost calculations
- The deadline for submission of alternatives relating to economic impacts is March 31, 2026
- Alternatives may be submitted via email to **[tier5@arb.ca.gov](mailto:tier5@arb.ca.gov)**

# Potential Tier 5 Timeline/Next Steps

- Release of draft potential Regulation Order and Test Procedures: February 5, 2026
- Release of Initial Statement of Reasons: Early 2027
- 45-day public notice: Early 2027
- Board hearing date: 2027