

CARB ON ROAD MOTORCYCLE (ONMC) RULEMAKING



Public Workshop

June 7, 2023

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
 - Please state your name and affiliation before asking a question or making a comment

ONMC RULEMAKING PROJECT TIMELINE



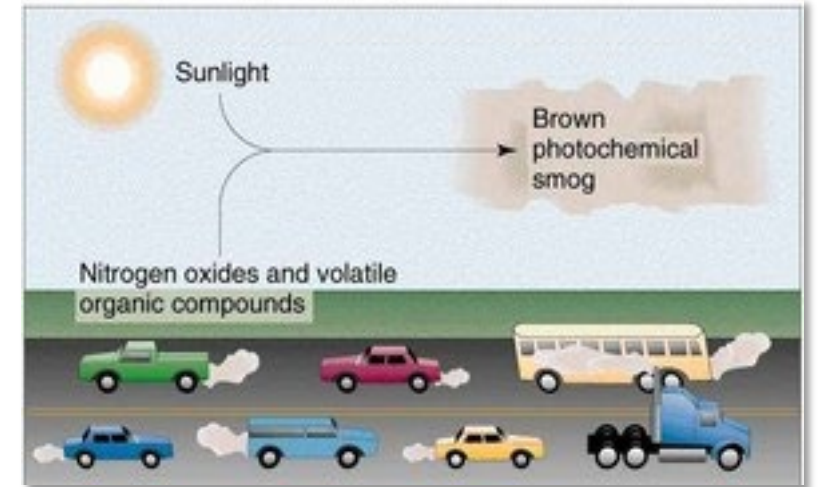
Draft regulatory text and Euro 5 references available at:
<https://ww2.arb.ca.gov/onmc-meetings-workshops>

PRESENTATION OUTLINE

- Background, Need for Updates to ONMC Regulations
- Proposal Overview
 - Exhaust Standards and Procedures
 - Evaporative Standards and Procedures
 - On-Board Diagnostics (OBD)
 - Zero Emission Motorcycles (ZEM)
- Certification Procedure and Administrative Requirements
- Emissions Benefits and Compliance Costs
- Additional Q & A

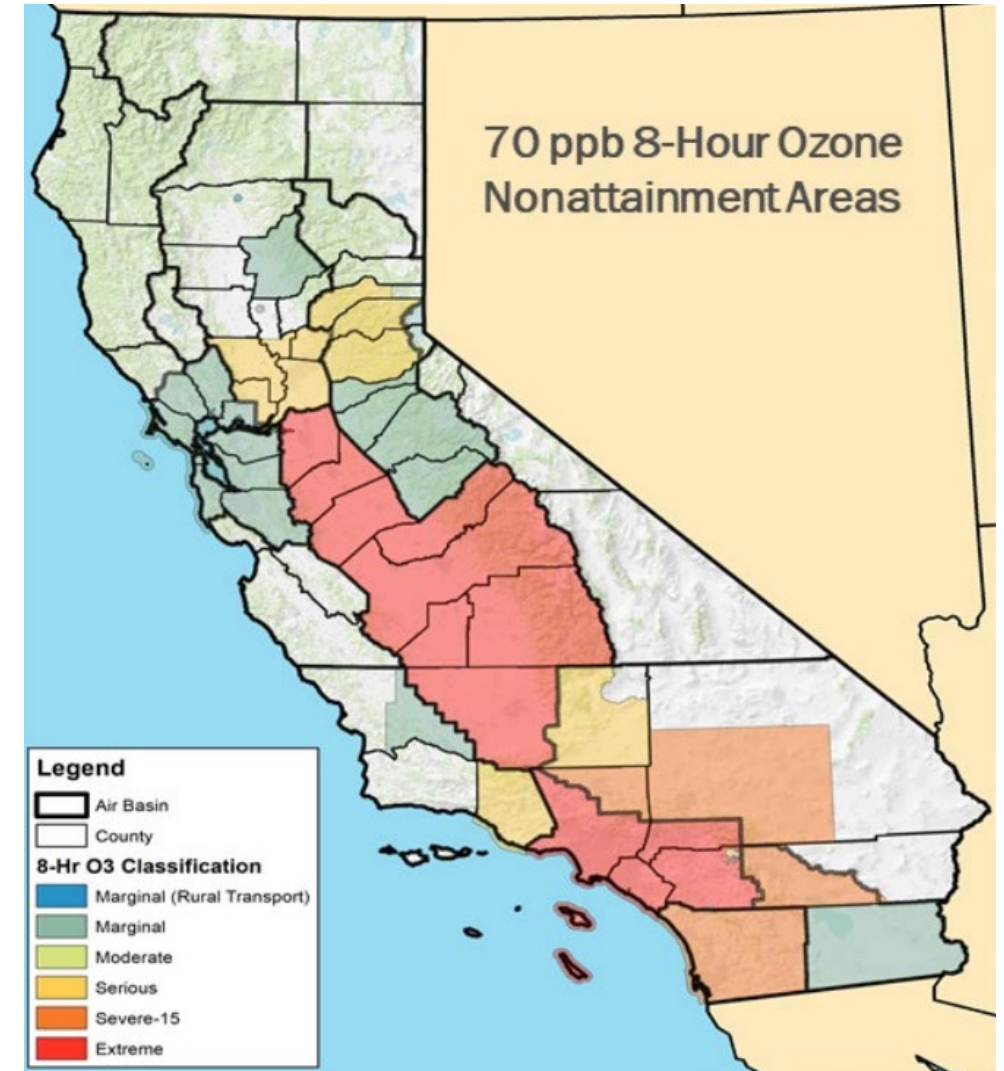
NEED FOR EMISSIONS REDUCTIONS

- Over 90% of Californians breathe unhealthy levels of air pollutants during some part of the year
- A major source of these pollutants is transportation related combustion
 - Nitrogen Oxides (NO_x)
 - Reactive Organic Gases (ROG)
 - Carbon Monoxide (CO)
- Together NO_x and ROG form ozone in sunlight
 - Ground level ozone is a major component of smog
- CARB's mission involves protecting the public health by providing safe clean air to all Californians



70 PPB CHALLENGE ACROSS THE STATE

- EPA set 70 PPB 8-hour ozone standard in 2015
- 19 areas in California are currently classified as non-attainment
 - San Joaquin and Southern California are most challenging
 - Reductions are needed in other areas as well
- State Implementation Plan (SIP) outlines measures to bring CA into attainment
 - Developed by CARB, reviewed and approved by US EPA
- ONMC proposal is included in SIP



TRANSITION TO ZERO EMISSIONS

- CARB is moving aggressively toward zero emissions for all mobile source categories
 - 2016 Zero Emission Vehicle (ZEV) Action Plan
 - Create programs to incentivize zero emission vehicles
 - Executive Order B-48-18
 - 5 million ZEVs in California by 2030
 - 250,000 vehicle chargers installed in California by 2025
 - Executive Order N-17-20
 - Require all passenger cars sold in state to be ZEV by 2035
- CARB's Mobile Source Strategy (MSS) and State Implementation Plan (SIP) both include ZEM targets
 - <https://ww2.arb.ca.gov/resources/documents/2020-mobile-source-strategy>
 - https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf



CARB MOTORCYCLE REGULATION HISTORY

- CARB's first motorcycle emissions standards adopted in 1975
- Most recent CARB ONMC standards amendments in 1998
 - Evaporative emissions effective in 2007
 - Tail pipe emissions effective in 2008
 - Exhaust standards are harmonized with U.S. EPA and ECCC
- Many other countries have adopted more stringent ONMC emission standards
 - Europe, Brazil, China, Japan, South Korea, Chile, Indonesia, India, etc.
 - United Nations Global Technical Regulations (UN GTR) developed based on EU standards

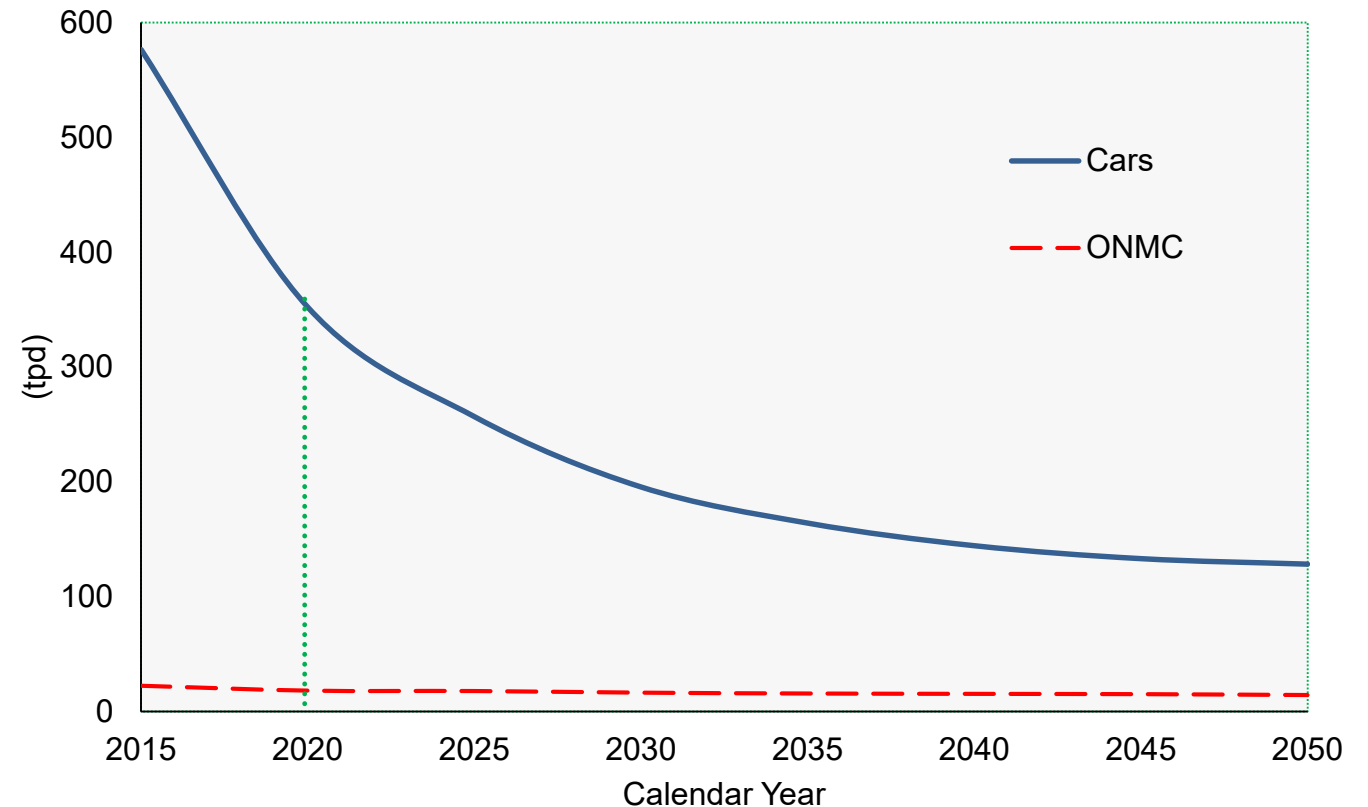


CALIFORNIA ONMC POPULATION AND EMISSIONS

2020 Comparison of Light Duty Vehicles (LDVs) with ONMCs

- 37 times as many LDVs as ONMCs
 - ~ 26 million LDV versus 685K ONMC
- 245 times more miles driven by LDVs
- 19 times as much ROG + NO_x from LDVs

LDV vs ONMC Current Trend for ROG + NO_x



Based on EMFAC 2021 and Staff Off-model ONMC Emissions Factors

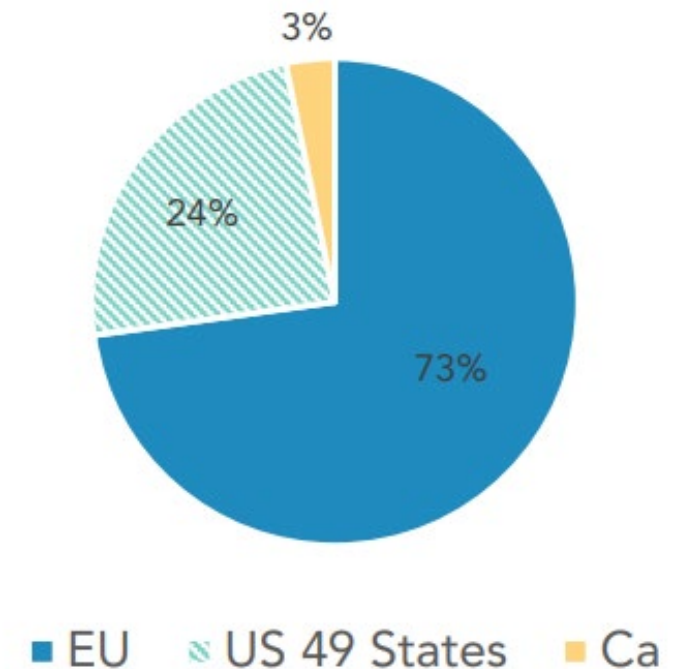
EURO 5 AS BASIS FOR FUTURE CARB EXHAUST STANDARDS

- Euro 5 exhaust standards - effective 2020

Pollutant	Euro 5	Current CARB
HC	0.100 g/km	0.8 g/km HC + NO _x
NO _x	0.060 g/km	
CO	1 g/km	12 g/km
NMHC	0.068 g/km	NA

- Additional benefits of Euro 5 harmonization
 - WMTC drive cycle, based on real world motorcycle riding
 - OBD system required
 - Larger ONMC market, economies of scale
 - Approximately 50,000 ONMC sold annually in CA

Relative ONMC
Market Size

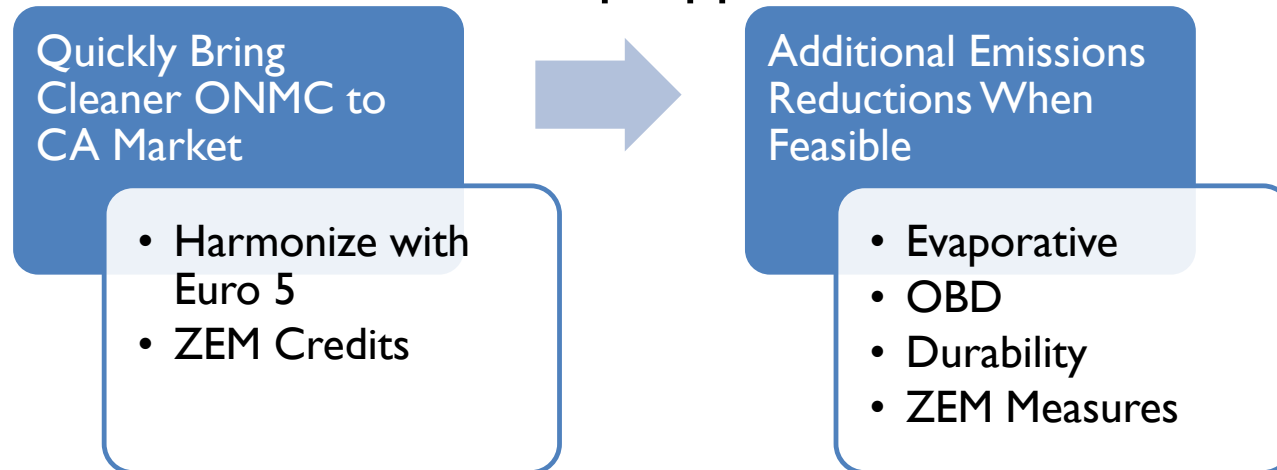


PROPOSAL OVERVIEW

Comprehensive Revisions to ONMC Program



Two-Step Approach





EXHAUST EMISSIONS PROPOSAL

EXHAUST EMISSIONS STANDARDS AND PROCEDURES

- Starting in MY 2026, all ONMC >50cc must meet Euro 5 emissions standards 1958(h)
 - Reference Euro 5 documents 168/2013 and 134/2014
 - Does not apply to manufacturers with sales <100 ONMC/year in California
- Conduct exhaust emissions test (Test Type I) and durability test (Test Type V)
 - Draft regulation incorrectly stated durability as Test Type VI
- Provisions to ease testing burden:
 - Witnessed testing not required 1958(h)(5)(A)
 - Lab equipment must meet either EPA or EU specifications 1958(h)(5)(B)
 - Test fuel is CARB LEV III, but EU-spec fuel can be used as an alternative if emissions are at least 10% below the standard 1958(h)(5)(C)

IMPACT OF FUEL FORMULATION ON EXHAUST EMISSIONS

- CARB, US EPA, ECCC, and an ONMC manufacturer collected exhaust emissions data using various certification fuels
 - Testing included 12 representative ONMCs from MY 2015-2021
 - 9 CARB/EPA certified, 3 EU5 certified

Average Impact of Changing Fuels from EU 5 to LEV III.

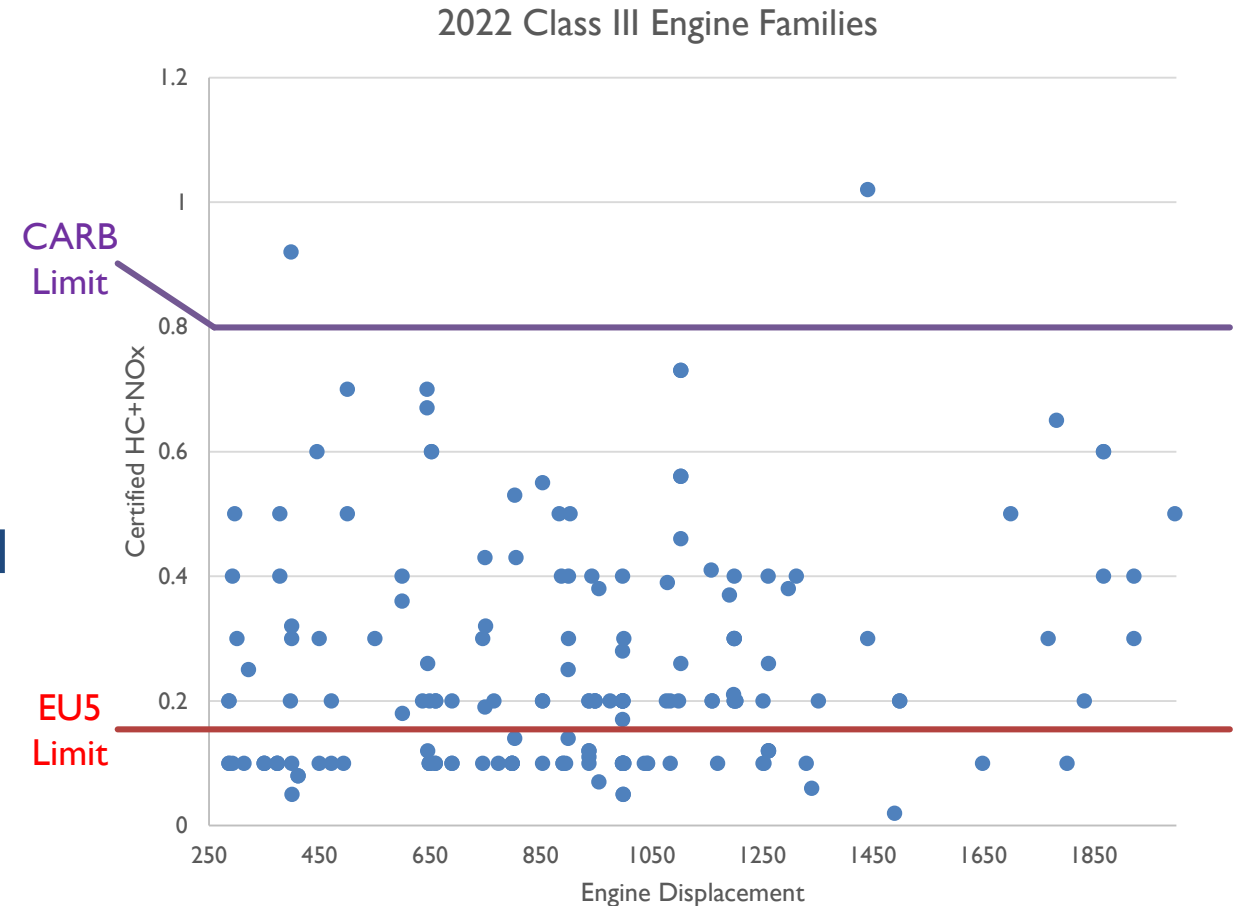
All Bikes EU 5 to LEV III	HC	NOx	HC + NOx**	CO	NMHC
% Δ Emissions	3.8%	9.1%	4.9%	-8.1%	1.0%
% Δ of EU Emissions Limit	1.0%	1.8%	1.3%	-6.6%	-1.1%

**EU has separate ONMC limits for HC and NOx. They are combined into an effective limit for comparison purposes.

- Full results of this test program will be presented in Staff Report

FEASIBILITY FOR MEETING EURO 5 EXHAUST IN MY2026+

- Many CARB-certified models are at or near Euro 5 limits and fitted with OBD
- European versions can be brought to the California market
 - Changes needed to meet federal noise, lighting, labeling, and safety requirements
- Some high-emitting “legacy” models would require redesign to meet new standards
 - Closed loop EFI, three-way catalyst, low emissions engine architecture, OBD components



EXHAUST REQUIREMENTS FOR MY 2028+

- Increased durability distance

CARB/EPA Class	Most Common Comparable EU Class	Current EPA/CARB Distance (kilometers)	Current Euro 5 Distance (kilometers)	Proposed CARB Distance for MY 2028+ (kilometers)	% Increase over current CARB/EPA Distance
IB (50-169 cc)	L3e-A1	12,000	11,000	15,000	25%
II (170-279 cc)	L3e-A2	18,000	20,000	25,000	38.8%
III (279+ cc)	L3e-A3	30,000	35,000	50,000	66.6%

- Full mileage, partial mileage (w/extrapolation) or bench aging are acceptable
 - Add mileage and final test point to Euro5 testing or spread tests out evenly over the required distance
 - AMA (US EPA) or SRC-LeCV (EU) mileage accumulation cycles are acceptable
- ONMC with engines <150cc and top speed >100 kph must run WMTC subclass 2-2
 - Higher speed than required under Euro5, ensures equal or greater stringency than comparable EPA requirements



QUESTIONS ON EXHAUST EMISSIONS PROPOSAL



EVAPORATIVE EMISSIONS PROPOSAL

PROPOSED ONMC EVAPORATIVE STANDARDS

- For MY 2026-2027, all motorcycles must meet either Euro 5 or current CARB evaporative system requirements (two-hour heat blanket test)
 - CCR, Title 13, section 1976(b)(2)
- For MY2028 and later, ONMCs must meet multi-day diurnal performance and hot soak standards 1976(c), TP-934

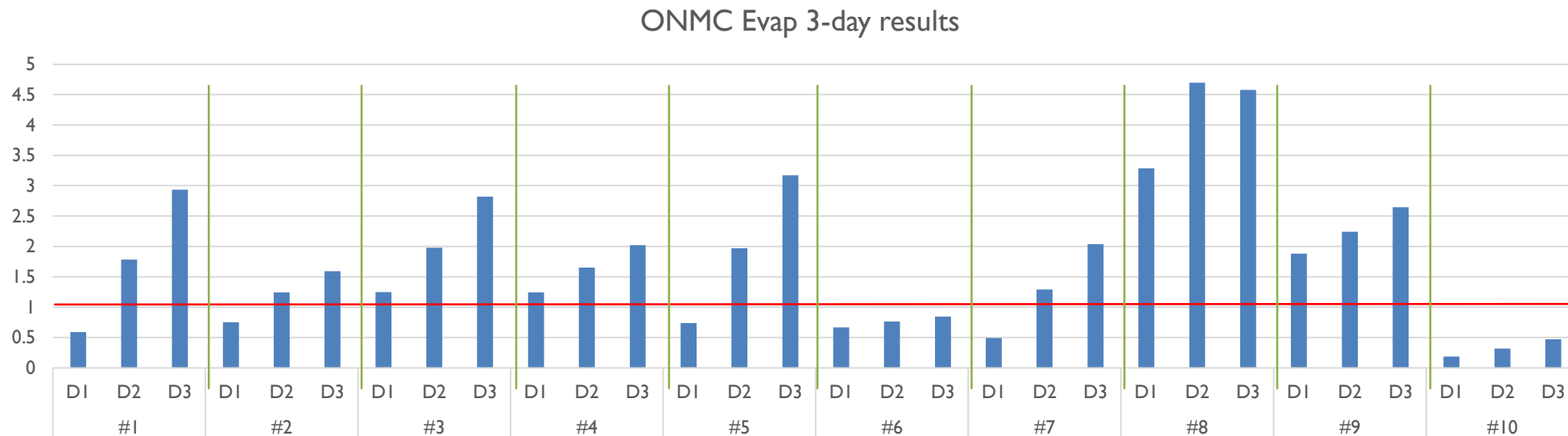
Model Year Effective Date	Diurnal Standard*	Hot Soak Standard	Test Procedure
2028 and later	1.0 grams HC/day	0.2 grams HC	TP-934 3-day diurnal SHED test

*- Highest 24-hour diurnal test result over three consecutive 24-hour diurnal test periods

- For MY 2028 and later, small volume manufacturers (<300 CA sales/year) may continue using the 2-hour heat blanket test 1976(f)(1), 1976(b)(2)

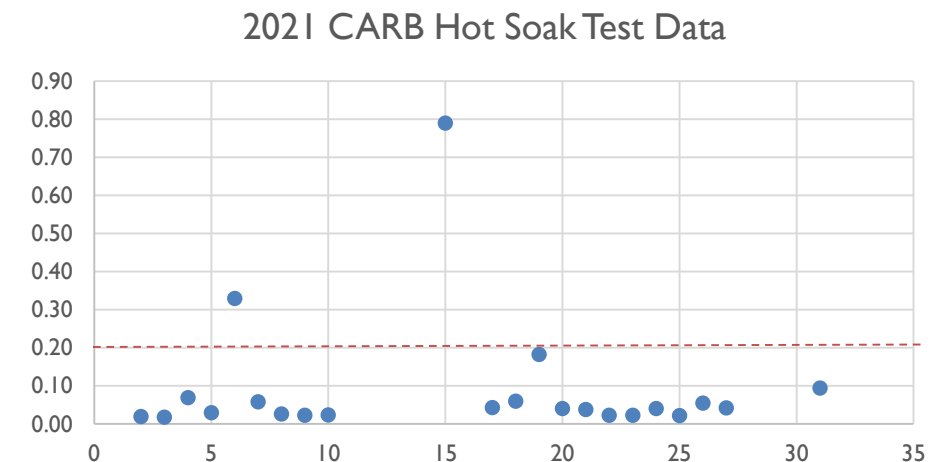
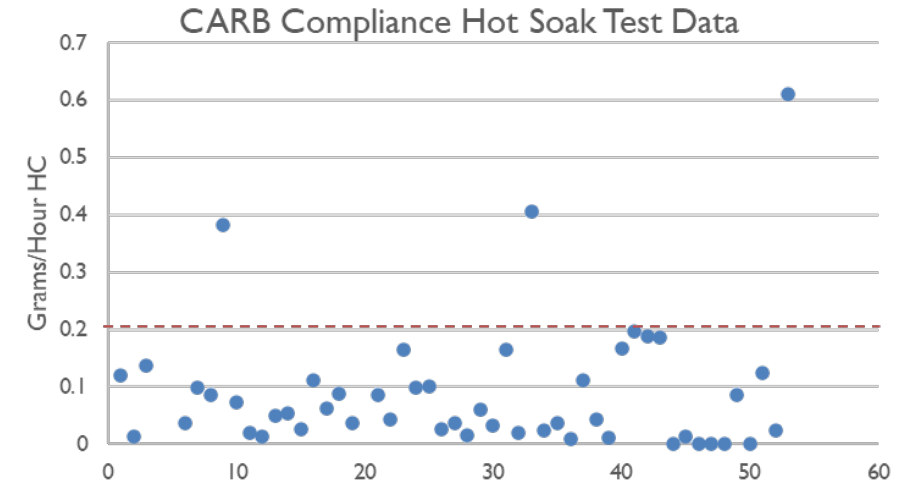
WHY IS A 3-DAY SHED TEST NEEDED?

- CARB tested 10 ONMCs over 3 days
 - FTP prep cycle, 65-105-65 summertime temperature profile, LEV III fuel
- Results indicated that single day testing does not reflect emissions on days 2 and 3
 - Gradient varied between manufacturers and bikes (different canister sizes, fuel tank size, etc)
 - Third day emissions are more representative of storage emissions over longer periods



WHY IS HOT SOAK TESTING NEEDED?

- Review of hot soak data from compliance testing
 - Data from fuel injected motorcycles tested 2010-2019
 - Hot soak conducted at 68-86F
 - High hot soak emissions from some motorcycles that meet current evaporative standard
- 2021 CARB hot soak testing
 - Most tests passed the proposed hot soak standard
 - Leakage from fuel caps was distinct
 - Change in temperature affects leakage
 - Conducted smoke test to determine leaks
 - Could not find leak until gas cap was hot



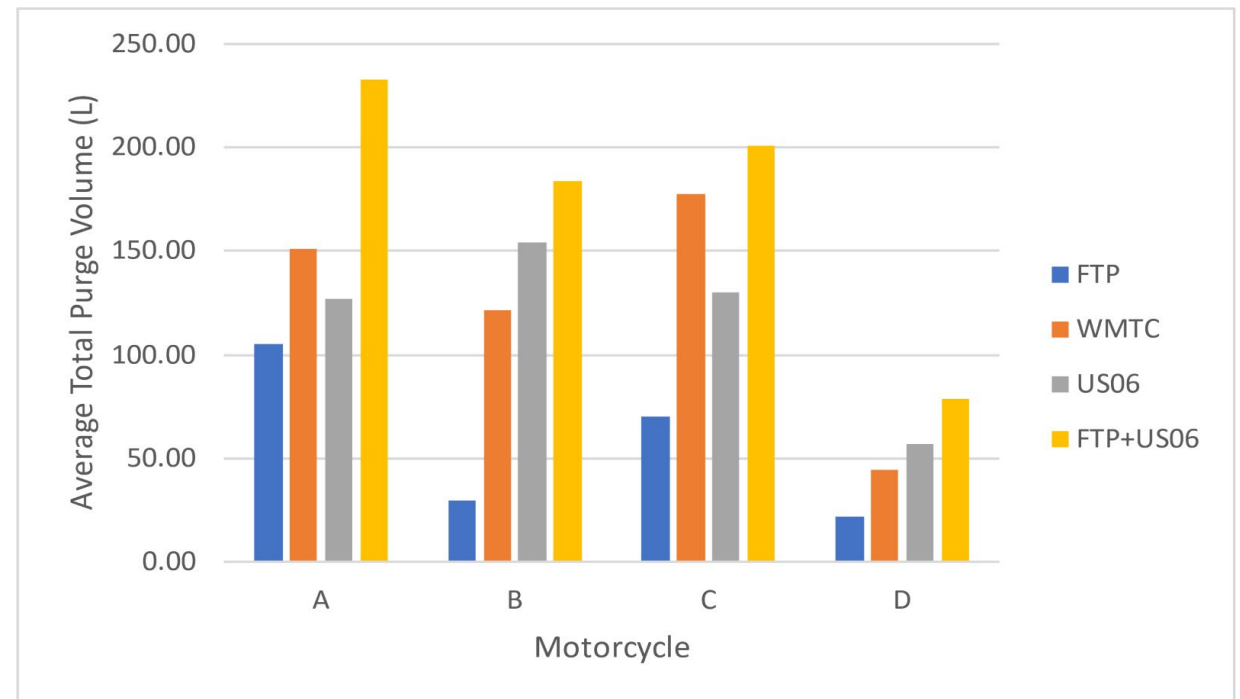
COMPLIANCE ACTIONS FOR EVAP, MY 2028+

- Some ONMC are already meeting the standard, no action required
- ONMC above the standard will need to reduce evaporative emissions
 - Eliminate leakage in fuel system (fill cap, connections and fittings)
 - Increased canister working capacity within existing canister volume
 - Install a larger carbon canister
 - Improve canister efficiency using better carbon, increased carbon volume in existing canister volume, increase l/d ratio
 - Manage thermal load on fuel system (insulation, component location)
 - Hybrid evaporative system with pressure relief valve and carbon canister
 - Revise engine management strategy to maximize carbon canister purge

CANISTER PURGE ON VARIOUS DRIVE CYCLES

- Studied canister purge of 4 low emitting ONMC on WMTC, FTP, and US06
- WMTC consistently provided more purge than FTP
- CARB staff is proposing WMTC as prep cycle for 3-day SHED test
 - More representative of real-world riding
- Full results of purge study included in Staff Report

Canister Purge Volume of Four ONMC on Various Drive Cycles





QUESTIONS ON EVAPORATIVE EMISSIONS PROPOSAL



ON-BOARD DIAGNOSTICS (OBD) PROPOSAL

GENERAL OBD REQUIREMENTS

- OBD required for Class III motorcycles beginning in model year 2026 1958.2
- Reference Euro 5 documents 168/2013 and 44/2014
 - Euro 5 OBD stage II including catalyst monitoring and misfire detection
- Small volume exemption
 - Manufacturers producing fewer than 100 class III motorcycles per year eligible for exemption from requirements of section 1958.2
 - Exemption based on three-year average of annual street-use motorcycle sales of class III motorcycles as defined in section 1958.1
 - Exemption based on projected sales for the upcoming year for new manufacturers, or a combination of available sales data and projected sales if fewer than three years average sales data available
 - See sections 1958.2(a)(2) and (a)(3)

OBD REQUIREMENTS FOR MY 2026-2027

- Fully harmonized with Euro 5 OBD Stage II
- Key OBD monitors and system requirements include:
 - Catalytic converter monitoring
 - Exhaust gas recirculation (EGR) monitoring
 - In-use monitor performance ratio (IUMPR)
 - Misfire detection
 - Oxygen sensor deterioration monitoring
 - Comprehensive component monitoring
- Manufacturers to perform type VIII test specified in EU 134/2014 1958.2(c)(1)
 - CA cert fuel to be used for testing
 - Fuels accepted under EU 134/2014, Annex VIII, Section 5.3 accepted as an alternative test fuel

ADDITIONAL OBD REQUIREMENTS FOR MY 2028+

- CARB staff initially proposed several additional OBD monitors for MY 2028+. After reviewing technical feasibility, costs, and benefits, staff is now proposing only one additional monitor for CARB Step II OBD: Fuel System Monitoring
 - Refer to draft regulatory text subsection 1958.2(b)(1)
 - Proposed OBD malfunction threshold of **3x** the applicable emissions standard
- Fuel System Monitoring requirement can be met using existing sensors and hardware
 - Software/calibration changes may be necessary to enable this as a MIL – relevant monitor
- Readiness status indication
 - See subsection 1958.2(b)(2)
- Additional testing needed to demonstrate compliance with Fuel System Monitoring requirements
 - See Subsection 1958.2(c)(1)(B)
 - FSM testing to be conducted with CA cert fuel



OBD DATA COMMUNICATION PROTOCOLS

- For 2026-2027 MY, manufacturers may use any of the communications protocols specified in EU 44/2014
- For MY 2028 and beyond, CARB is sunsetting some of the older communications protocols, manufacturers will be required to use one of the following communications protocols moving forward:
 - ISO 14229-3:2012: 'Road vehicles — Unified diagnostic services(UDS) — Part 3: Unified diagnostic services on CAN implementation.'
 - ISO 15765-4:2011: 'Road vehicles — Diagnostics on Controller Area Network (CAN) — Part 4: Requirements for emission-related systems', dated 1 November 2001.'



OBD FAMILY GROUPING

- Multiple engine families can be grouped into a single “OBD family” and testing need only be performed on a single representative engine family within the OBD family
 - See subsection 1958.2(d)(1)(A)
- Criteria for grouping OBD families is defined in EU 44/2014, Annex XII, Appendix 5
 - Engine combustion process, fueling method, fuel type
 - Emission control components and types (catalyst, EGR, air injection)
 - Methods of OBD functional monitoring, malfunction detection and malfunction indication
- Single OBD application can cover the entire OBD family
 - Testing conducted on the “worst case” within the OBD family

IN-USE PERFORMANCE MONITORING (IUMPR)

- MY 2026+, manufacturers must meet functional IUMPR requirements
 - Minimum ratio of 0.100 required for all monitors as specified in EU 44/2014
- MY 2028+, manufacturers must also include IUMPR for the fuel system monitor
 - Minimum ratio of 0.100 for fuel system monitor and all other monitors as specified in EU 44/2014
- MY 2026-2027 not subject to enforcement action for IUMPR below 0.100
 - See section 1958.3(b)(6)(B)
 - Allows verification that EU OBD systems are functioning as expected under CA operating conditions
- Manufacturers required to collect and report IUMPR data for every OBD family as defined in 1958.2(d)(1)(A)
 - Twelve-month data submittal window

IUMPR SAMPLE SIZE

Annual Sale*	Minimum IUMPR Sample Size
<100	No IUMPR data submittal required
100-199	2 motorcycles
200-299	4 motorcycles
300-399	6 motorcycles
400-499	8 motorcycles
500+	10 motorcycles

*For this requirement, total annual sales means the total number of street-use motorcycles offered for sale in California in a given model year that are part of the same certified OBD family as defined in subsection 1958.2(d)(1)(A)

- **Manufacturers shall submit a plan for sampling and data collection**
 - Plan subject to EO review and approval
 - Include as many engine families within the OBD family as possible
 - Collect data likely to be representative of California driving conditions and usage patterns

OBD - PRODUCTION MOTORCYCLE EVALUATION

- For MY 2028+, manufacturers must conduct a complete evaluation of the OBD system within 6 months of the start of normal production
 - Manufacturer to notify EO of the OBD families planned for that year
 - EO selects which engine families within the OBD families to test
 - Manufacturer to test one motorcycle per selected engine family and submit results to CARB
- Evaluation requirements specified in 1958.2(g)(1)(C)
 - Properly detect malfunctions, illuminate MIL, and store confirmed fault code
 - Verify proper incrementation of numerators and denominators for IUMPR
 - Manufacturers to submit test plan prior to testing
 - Testing to be conducted on-road where feasible

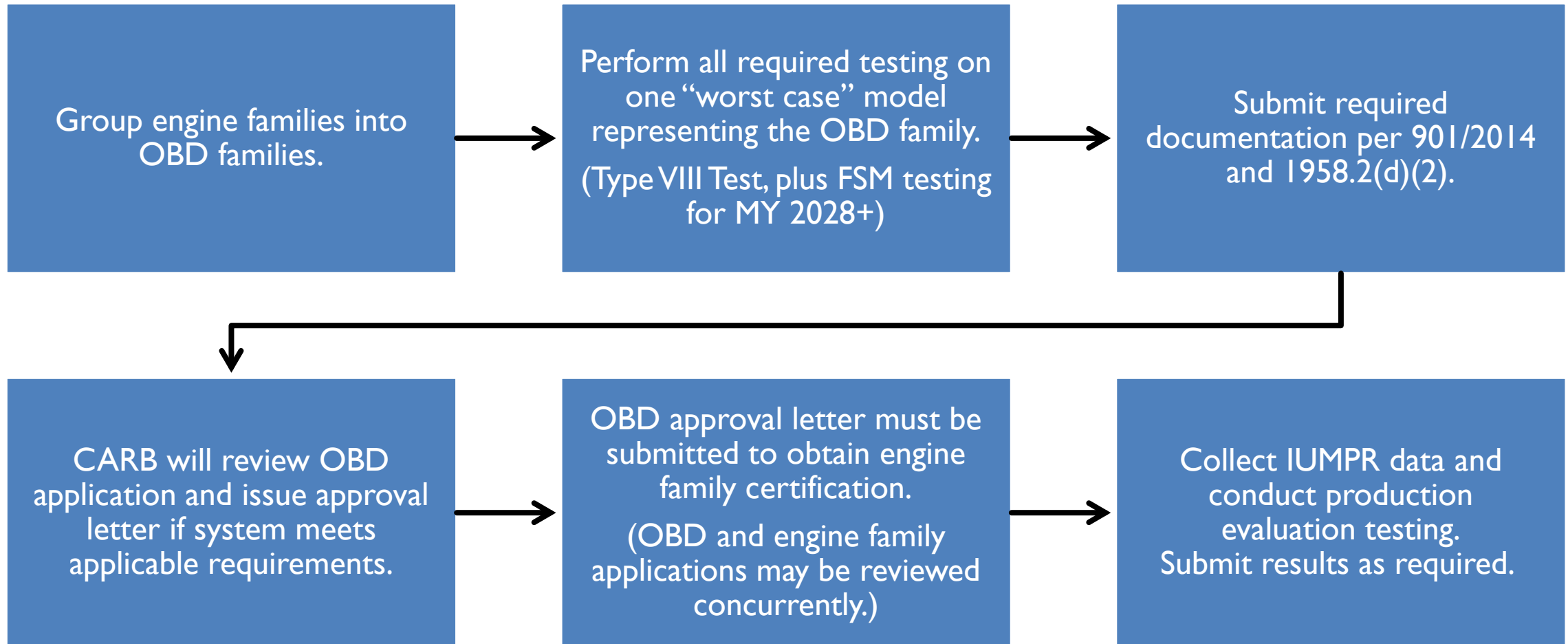
ODB SYSTEM DEFICIENCIES

- For 2026-2027 MY, deficiency requirements are as specified in EU 44/2014
- For 2028 and subsequent MY, deficiency requirements are modeled after CARB LDV deficiency requirements
 - First two deficiencies are “free”
 - Subsequent deficiencies subject to fines of \$30 per major monitor, \$15 per minor monitor
- Deficiencies limited to two years
 - Must re-apply each year for carry-over deficiencies
 - Can be extended to three years if major hardware changes and lead time are needed, with Executive Officer approval

OBD DOCUMENTATION REQUIREMENTS

- For all MY2026+ ONMCs with OBD, the OBD certification documentation requirements (and template) are provided in EU 901/2014
 - Annex I, Appendix 3, Item No. 7.6
- For MY2028+, documentation must also include the same information for the OBD Fuel System Monitor
 - General working principles, list of all OBD output codes, etc.
 - Emission test data, description of testing sequence, fault codes stored, etc.
 - See subsection 1958.2(d)(2)(A)

OBD CERTIFICATION PROCESS



OBD NONCONFORMANCE

- Section 1958.3 outlines process for motorcycle selection and procurement, testing procedures, and criteria for determination of nonconformance of the OBD requirements set forth in 1958.2
 - Nonconforming OBD systems can lead to remedial action and possible ordered recall
- Section 1958.3 also outlines manufacturer's obligations in cases of nonconformance
 - Remedial action plans
 - Notifications to owners and labeling requirements
 - Recordkeeping and reporting requirements



QUESTIONS ON THE ON-BOARD DIAGNOSTICS (OBD) PROPOSAL



ZERO EMISSIONS MOTORCYCLE (ZEM) PROPOSAL

PURPOSE OF ZEM CREDIT PROGRAM

- Accelerate growth in the Zero-Emission Motorcycle (ZEM) industry
- Establish a credit trading program that will incentivize ZEMs
- Reward early ZEM manufacturers by adding value (credits) to current ZEMs
- Provide flexibility for manufacturers to comply with proposed requirements by using ZEM credits

ZEM PROGRAM FRAMEWORK

Early Stage (MY 2024-27)

- Credits awarded for CA ZEM Sales
- No requirements for ZEM sales
- Large early adoption credit multipliers promote early entry into ZEM market
- Build a credit surplus to be used for later compliance

Mid Stage (MY 2028-2035)

- ZEM credits required based on sales (10% to 50%)
- Credit trading provides flexibility for compliance
- ZEM quality assurance measures (CARB certification, labeling, warranty, and state-of-health)
- Reduced credit multipliers
- Increased ZEM products

Late Stage (MY 2036+)

- 50% ZEMs industry wide
- No credit multipliers or bonuses
- Wide range of ZEM products available
- Credit trading continues to provide manufacturers flexibility

EARLY STAGE MY 2024 – MY 2027

- To earn ZEM credits, all ZEMs to be sold in California must meet US EPA certificate of conformity
 - Title 40, Part 86, subpart E
- No ZEM sales requirement for any manufacturer
- Credits generated can be traded and/or banked to be used for future compliance
- Base ZEM credits generated will have early adoption multipliers and bonus credits awarded where applicable
- Credits generated during this time will have a 5-year expiration date starting from MY2028

MID STAGE MY 2028 – MY 2035

- All ZEMs will need to be certified through CARB's Executive Office
 - Title 40, Part 86, subpart E plus additional CARB required information
- Manufacturers classified as large will have a ZEM credit obligation
- Credit multipliers and bonuses will start phasing out
- A ZEM battery warranty is required
- All ZEMs must begin to be able to report battery state of health to the owner

MINIMUM CRITERIA TO QUALIFY FOR ZEM CREDITS

- Must be a registerable motorcycle under CA DMV
 - no electric bicycles, stand-up scooters, etc.
- Must be pure zero emissions
 - Battery-electric, hydrogen fuel cell, or other technology that generates zero criteria pollutants or greenhouse gas under any operating mode or condition
- Minimum capability of at least 25mph for 10min and a range of at least 25 miles
 - UDDS drive cycle
- MY 2024-2027: EPA Certificate of Conformity
- MY 2028+: CARB Certification for ZEMs

ZEM TIERS

Excluded

Tier I

- Range \geq 25 miles
- Top Speed \geq 25 mph
- Range protocol: UDDS
- Flat credit rate of 0.25



Tier II

- Range \geq 25 miles
- Top Speed \geq 55 mph
- Range protocol: Constant 55 mph + UDDS
- Credit Value: 0.25 – 1.00



Tier III

- Range \geq 50 miles
- Top Speed \geq 70 mph
- Range protocol: Constant 70mph + UDDS or WMTC 3-2
- Credit Value: 1.00-2.50



RANGE TEST PROCEDURES – BATTERY ELECTRIC ZEMS

- **Test Procedure:** SAE J2982_202210 - *Riding Range Test Procedure for On-Highway Electric Motorcycles, revised 10-13-2022*
 - Charge to full, drive until battery is fully discharged
- **Drive Cycle:**
 - Tier I - UDDS drive cycle
 - Tier II – Combination of UDDS and 55mph constant (defined in SAE J2982)
 - Tier III – Combination of UDDS and 70 mph constant (defined in SAE J2982) – OR - WMTC 3-2
- **Dyno Coefficients:**
 - UDDS and Constant Speed Tests – EPA defined
 - WMTC – Euro 5 defined
 - Optional – Use values derived from real world coast down testing

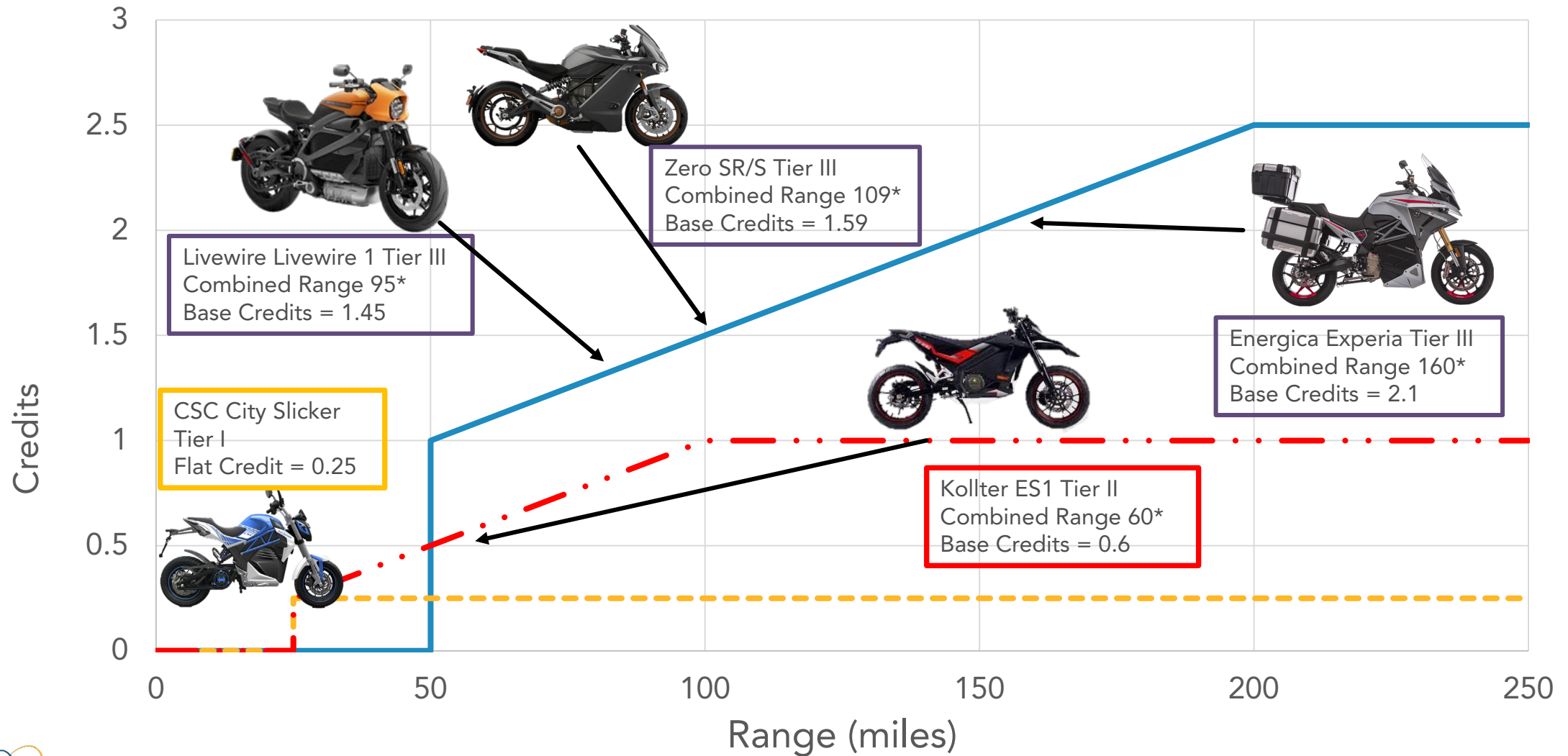
RANGE TEST PROCEDURES – HYDROGEN FUEL CELL AND OTHERS

- **Hydrogen Fuel Cell Test Procedure:** SAE J2572_201410 - *Recommended Practice for Measuring Fuel Consumption and Range of Fuel Cell and Hybrid Fuel Cell Vehicles Fueled by Compressed Gaseous Hydrogen*, revised 10-16-2014
- **Drive Cycle:**
 - Tier I and Tier II: UDDS drive cycle to determine range
 - Tier III: ZEMs will use a combination of UDDS plus the highway fuel economy driving schedules (HFEDS) drive cycle (as described in SAE J2572)
- **Other ZEM Technologies:**
 - Manufacturers will use one of the test procedures (SAE J2982 or J2572) with modifications necessary for the specific technology and as approved by CARB Executive Office

BASE CREDIT FORMULA COMPARISON



ZEM RANGE BASE CREDIT COMPARISON



FAST CHARGE BONUS CREDIT

- Tier II and Tier III ZEMs can qualify for an additional fast charge bonus
- Level 1 and 2 SAE J1772 coupler required
- Tier III ZEMs must also have on-board charger that meets:
 - Minimum rating of 3.3 kW, or
 - Capable of going from state of discharge to full in less than 4 hours
- Exchangeable batteries not owned or leased by ZEM owner
- Powered by compressed gaseous hydrogen as part of a fuel cell

Tier II Fast Charge Credit	Tier III Fast Charge Credit
0.25	0.50

EARLY ADOPTION MULTIPLIERS

- Tier II and Tier III ZEMs qualify for Early Adoption Multipliers
- Credit multipliers will decrease over time and are phased out with MY 2031
- Applies only to base credits and is not applied to additional fast charge credits

TIER	MY 2024-2027	MY 2028-2030	MY 2031 +
I	N/A	N/A	N/A
II	3x	1.5x	N/A
III	6x	3x	N/A

CREDIT OBLIGATION

Beginning in MY 2028, all manufacturers classified as large will have an annual ZEM credit obligation

- Large Manufacturers = ≥ 750 annual sales in CA
 - two consecutive years of a 3-year rolling average California annual street-use motorcycle sales equal to or greater than 750 per year. 1958.6(e)
- ZEM credit obligations for a given model year will be based on the previous year's three-year rolling average of the manufacturer's volume of street-use motorcycles produced and delivered for sale in California 1958.6(b)-(d)
- The credits may be earned by producing ZEMs for sale in California (generating credits) or obtaining credits from another ZEM manufacturer

ZEM Credit
Obligations by Year

Year	%
2028	10
2029	15
2030	20
2031	25
2032	31
2033	37
2034	43
2035 +	50

CALCULATING ANNUAL SALES (MY 2028+)

Annual sales includes conventional motorcycles and ZEMs

- All conventional motorcycles have a value of one
- Tier level dictates how a ZEM is counted towards manufacturer's total sales volume
- Multi-brand companies will be combined under one parent company per section 1958.1(e)

Motorcycle Type	Sales Volume Value
Tier I ZEM	0.25
Tier II ZEM	0.50
Tier III ZEM	1.0
All internal combustion ONMCs	1.0

ZEM BATTERY WARRANTY REQUIREMENTS (MY 2028+)

- For MY2028+, ZEMs must include a battery warranty 1958.4(f)(7)
- “... traction battery is free from defects in materials and workmanship which cause deterioration such that the battery state of health falls below 70% for, at minimum, the distance and time (whichever occurs first) shown in the following table.”

ZEM Tier	Distance	Duration
Tier I	20,000 km	2 years
Tier II	30,000 km	3 years
Tier III	50,000 km	5 years

- Does not apply to exchangeable batteries not owned/leased by the ZEM owner 1958.4(f)(8)

BATTERY STATE OF HEALTH (SOH) (MY 2028+)

- For MY 2028+, ZEMs with traction batteries must monitor and report battery state of health
- State of health is the maximum amount of usable energy currently able to be stored in the battery, divided by the maximum amount initially able to be stored
- The ZEM must be able to display battery SOH percentage to the ZEM owner without any tools and no more than five selectable screens or submenus from the home screen
- State of health calculation and display is not required for exchangeable batteries not owned or leased by ZEM owner
 - 1958.4(f)(8) language will be amended to cover warranty and state of health requirements

$$\text{State of Health \%} = \frac{\text{Current Maximum Available Capacity}}{\text{Initial Maximum Available Capacity}}$$

SWAPPABLE BATTERY CRITERIA



Photo source <https://global.yamaha-motor.com/news/2018/0911/collaboration.html>

- Traction batteries used by the ZEM are part of a battery swapping network.
- Traction batteries are not owned or leased by the ultimate purchaser
- Customer removable batteries that are owned by the ultimate purchaser are not considered to be swappable
- Exempt from battery warranty and state of health requirements

ZEM CERTIFICATION PROCEDURE

- CARB ZEM certification is required for MY 2028+
- ZEM models may be grouped into ZEM test groups 1958.4(g)
 - Battery/fuel cell configuration, motor configuration, and expected degradation in usable battery energy
 - Range test on “worst-case” model in the ZEM test group applies to the number of credits generated by the group
 - A manufacturer can test other models to earn additional credits on individual ZEMs within that group
- Application must include all information specified in 1958.4(h)
- ZEM certification fee is required per section 2904(c)(3)
 - Fee is $\frac{1}{4}$ the standard ONMC certification fee, as with other zero emission categories

LATE STAGE MY 2036 AND BEYOND

- The classification of a large manufacturer will change to include manufacturers with two consecutive years of a 3-year rolling average CA annual ONMC sales ≥ 100 units/year.
 - Manufacturers that fall into the new large category must immediately meet the ZEM credit obligation starting in MY 2036
 - Manufacturers with <100 CA ONMC sales per year will still be exempt from ZEM credit obligations
- All ZEMs will earn a flat rate based on their tier status. (No bonuses or multipliers will apply.)
 - Tier I - 0.25 credit
 - Tier II – 0.50 credit
 - Tier III – 1.00 credit
- Individual manufacturers can still comply using credits acquired from another manufacturer, and credits can still be banked.



QUESTIONS ON THE ZERO EMISSIONS MOTORCYCLE (ZEM) PROPOSAL



CERTIFICATION AND ADMINISTRATIVE

TESTING REQUIREMENTS

- CARB's proposed regulations will be significantly more stringent than EPA standards, *and* CARB / EU certification protocols differ from EPA
- EPA Certificate of Conformity is required before a motorcycle can be offered for sale in CA
 - Manufacturers must demonstrate compliance with both EPA and CARB regulations
- Different mileage accumulation protocols for EU and EPA
 - EU will not accept a fixed DF or EPA's mileage accumulation protocol beyond 2024MY
 - Two EDVs will be needed in order to meet EU and EPA requirements: one aged w/ EU/CARB protocol, one aged w/ EPA protocol
 - CARB test data can be generated using either mileage accumulation protocol (AMA or SRC-LeCV)

A NEW CERTIFICATION PROCESS WILL BE NEEDED

- Staff proposal includes new elements not found in current EPA/CARB regulations.
 - Drive cycle, test fuel, durability procedures, measured pollutants, emissions limits, OBD, warranty, diurnal SHED test, etc.
- EPA may eventually harmonize fully or partially with new CARB requirements
 - EPA staff currently focused on other priorities
- EPA's application process (EV-CIS) does not accommodate CARB's new data elements
- EPA may not make significant modification to EV-CIS to meet CARB's needs
 - A new certification application process may be needed

CERTIFICATION PROCESS

- All applications will be submitted into EV-CIS (49-state, 50-state, CA-only)
 1. All bikes: Submit data that meets EPA standards in the traditional way
 2. 50-state and CA-only: Submit additional data that meets CARB standards as supplemental files (attachments) within EV-CIS
- CARB staff will prepare templates to capture CARB-required certification data in a standardized format
 - Templates will include all unique data for CARB's new exhaust, evap, and OBD requirements
 - Templates will be updated prior to MY2028 to include all new "Step 2" and ZEM requirements
 - CARB staff will work with manufacturers to ensure templates meet their needs
- EU Type approval documents may be accepted (EU Regulation 901/2014)
- Process may be streamlined in the future when EPA / CARB have resources

EU TYPE APPROVAL VERSUS CARB CERTIFICATION

- Standards and procedures are generally harmonized with Euro 5, however:
 1. **EU Type Approval is not required for CARB certification**
 2. **EU Type Approval does not guarantee CARB certification**
- CARB staff will evaluate each application for compliance with applicable requirements
- CARB may ask for additional information beyond EU Type Approval documents, as needed, to determine compliance
- CARB staff may identify errors, omissions, or other issues and concerns not found during EU Type Approval

ANNUAL ONMC SALES REPORT

- New section 1958.1 outlines annual sales reporting requirements
- Consolidates existing sales reporting requirements
 - Fleet emissions averaging, certification fee production report, EPA etc.
- Includes additional information needed to implement ZEM program
 - Breakdown of conventional ONMC sales and ZEM sales by class and tier
- CARB staff will prepare a template that manufacturers can use to submit required annual sales report information



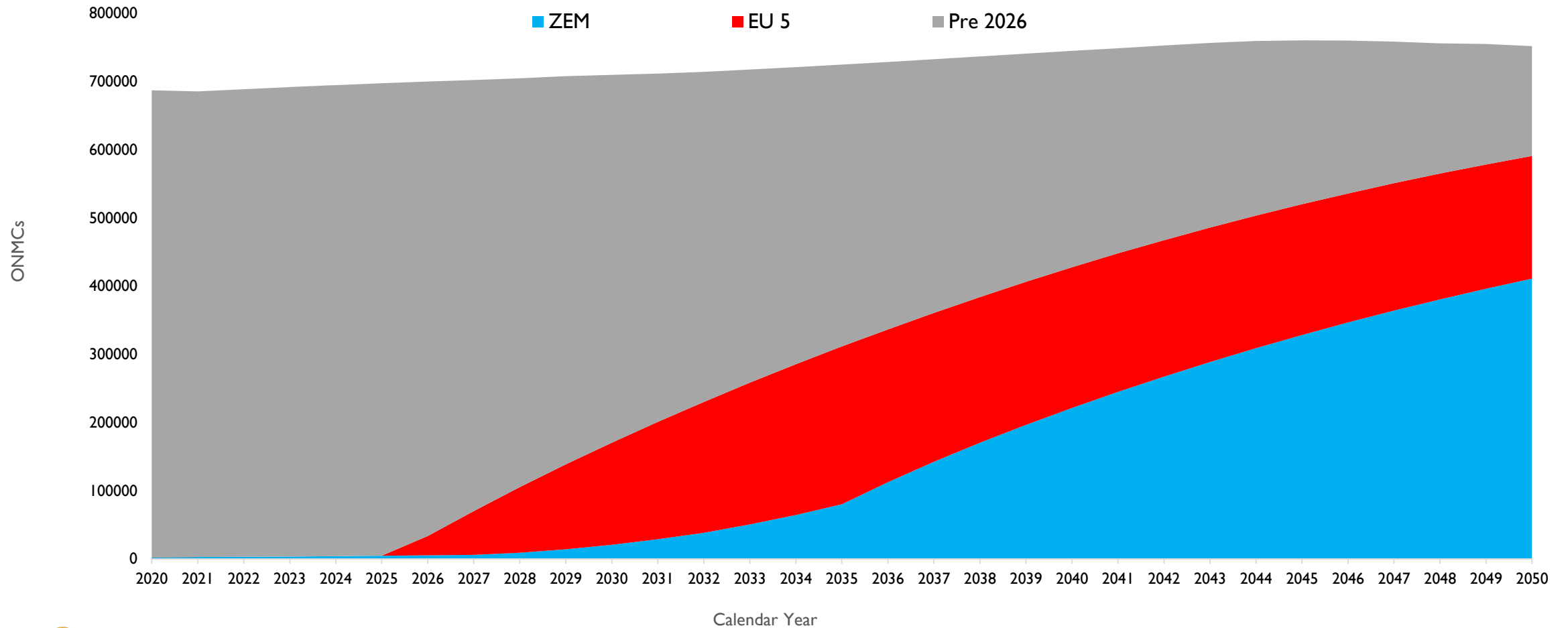
QUESTIONS ON CERTIFICATION AND ADMINISTRATIVE REQUIREMENTS



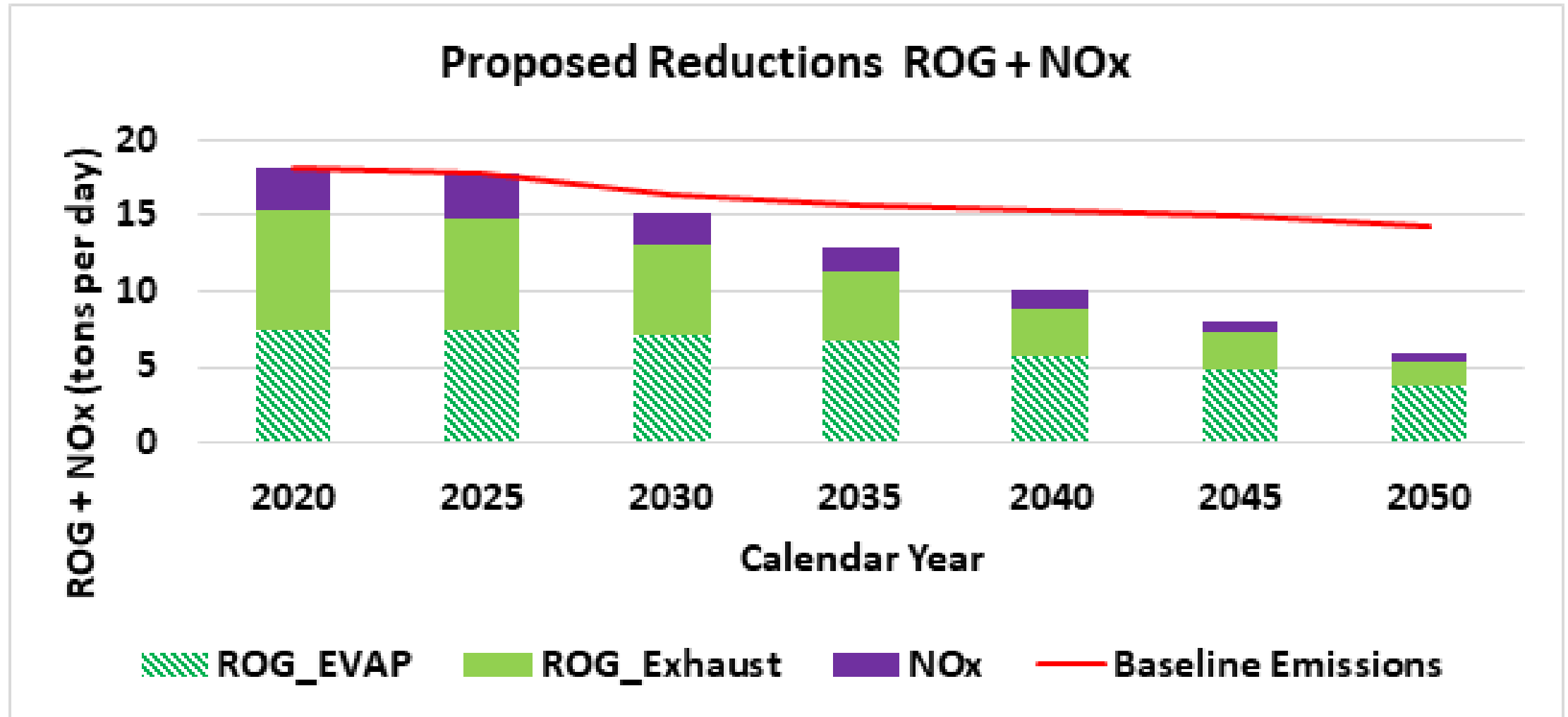
EMISSIONS BENEFITS

CA ONMC FLEET PROJECTION

California ONMC Population Projection

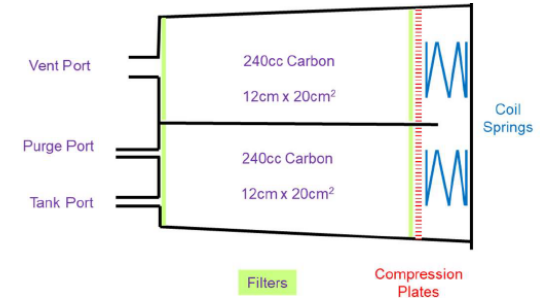


PROJECTED EMISSIONS BENEFITS



COST DRIVERS (COSTS IN 2020 \$)

- Primary ICE costs factors
 - Upgraded carbon canister design
 - ~ \$30/ONMC
 - Upgraded catalytic converter
 - ~ \$191/ONMC
 - Access to SHED testing facilities
 - ~ \$16M across industry

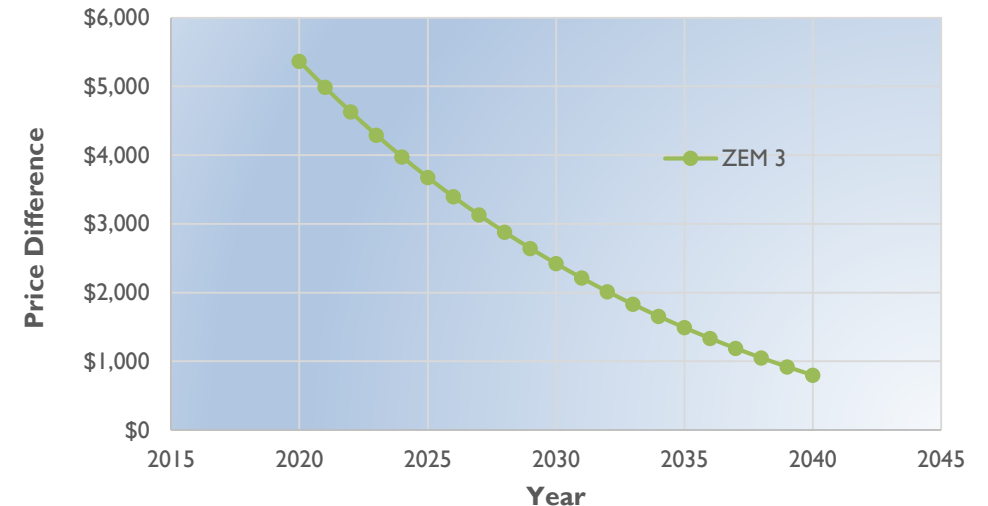


COST SAVING DRIVERS (COSTS IN 2020 \$)

- Primary ZEM costs are driven by retail price differentials that will decrease over time
 - Retail cost differential (ZEM Tier III to Class III) ~ \$5,365
 - Increased Insurance and Registration costs (assumed 1st year owned, decreasing after) ~ \$303
 - Costs decrease significantly due falling battery prices and are substantially lower when regulation becomes effective
- Primary ZEM cost savings
 - Maintenance annual ~ \$108
 - Net fuel annual savings ~ \$143
 - Based on current prices CPI adjusted to 2020 \$
 - Fuel savings subject to market price fluctuations

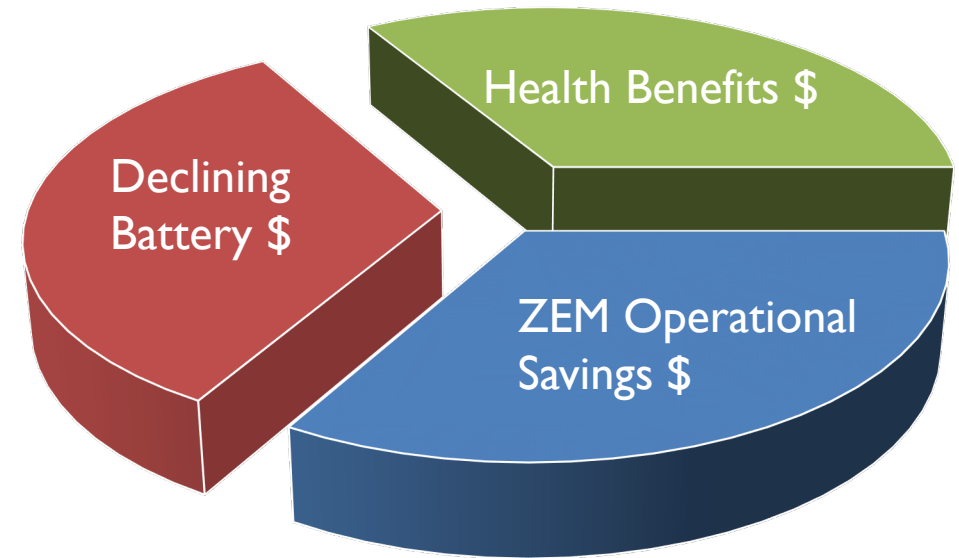


Declining ZEM-ICE Price Differential



COST/BENEFIT DRIVERS

- Proposal results in a net annual benefit by 2036 and beyond
 - Cumulative benefits outweigh costs by 2039
 - Includes health benefits such as avoided hospitalization and reduced mortality
- Factors driving net cost saving
 - ZEM operational cost savings
 - Declining ZEM battery costs
- Complete economic analysis will be included in the Staff Report



QUESTIONS AND ANSWERS

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