



Tier 5 Rulemaking Workshop II

Incentives and Equipment Flexibility Provisions

October 30-31, 2023

Outline

- Update on Off-Road Hybrid Powertrain Credits
- Off-Road Zero Emission (ZE) Credits
- Tier 5 Transition Program for Equipment Manufacturers (CA-TPEM)



Not Proposing Credit for Hybrid Powertrains

- Credit for Hybrid Powertrains is not recommended because:
 - Off-road diesel hybrid powertrain test cycles and standardized certification procedures for the various off-road diesel equipment types and applications are not available
 - Hybrid systems, if not designed properly, can cause oxides of nitrogen (NOx) increases
 - Executive Order (EO) N-79-20 requires ZE off-road equipment operations by 2035 so additional resources should be focused on ZE, not hybrids
- Staff is proposing other provisions in place of diesel hybrid credits to ease the transition to Tier 5 standards and other off-road engine requirements
 - Compliance phase-in options
 - Less stringent interim standards
 - ZE credit provisions

Tier 5 Zero Emission Credit Program



Off-Road Tier 5 ZE Credit Program

- Incentivizes cleaner propulsion technology
 - Lower emissions
 - Early ZE adoption lays groundwork for compliance with EO N-79-20
- Provides compliance flexibility options
 - Extends Tier 5 phase-in periods
 - Possible alternative to Tier 5 for some power categories
- Reduces costs
 - Use credits instead of redesigning engines to meet Tier 5

Definition of Zero-Emission Equipment

What are “Zero-Emission Equipment”?

- Off-road vehicles or equipment with a drivetrain that produces zero exhaust emissions of any regulated criteria pollutant, precursor pollutant, or greenhouse gas under any possible operational modes or conditions
 - Adjusted definition of a “Zero-Emission Vehicle” from 13 CCR 2449 (c)(74) of the In-Use Off-Road Diesel-Fueled Fleets Regulation and from the California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles

Tier 5 ZE Credit Program Approach

- Applicable to new equipment traditionally powered by off-road diesel engines
 - Assigns credits to incentivize the production and sale of new ZE equipment
 - Increases the turn-over rate of diesel equipment to cleaner ZE equipment
 - Minimizes potential over-crediting from regulated non-diesel categories
- Exclusions
 - Credits cannot be generated from ZE powered equipment including the following:
 - Transport Refrigeration Units and Cargo Handling Equipment
 - Other equipment for which ZE powertrains are mandatory
- Five Year Expiration

Crediting Philosophy

- Credit = (CF) x (Std) x (ZE Sales) x (PWR Bin) x (CI UL)
- Early introduction (MY 2026-2028)
 - NO_x and PM only
 - CF = 90% of the Tier 4 standard ≥ 130 kW
 - CF = 80% of the Tier 4 standard < 130 kW
- Concurrent implementation with Tier 5
 - NO_x, PM, and GHG
 - CF = 75% of the Tier 5 standard ≥ 130 kW
 - CF = 50% of the Tier 5 standard < 130 kW

CF = credit factor, Std = standard, ZE Sales = number of zero emission sales in California, PWR Bin = power bin, CI UL = useful life of compression-ignition engines, MY = model year
NO_x = oxides of nitrogen, PM = particulate matter, GHG = greenhouse gas, kW = kilowatt

Equation Parameters

- Power variable (PWR Bin) value would be assigned based on the maximum power of the diesel engine replaced by the ZE powertrain:

BIN #	CI Max Power Equivalency Range (kW)	PWR Bin	BIN #	CI Max Power Equivalency Range (kW)	PWR Bin
1	130-172	130	6	345-387	345
2	173-215	175	7	388-430	390
3	216-258	220	8	431-473	435
4	259-301	260	9	474-516	475
5	302-344	305	10	517-560	520

- If the ZE powertrain is not replacing a diesel engine, the powertrain manufacturer may request to use a PWR Bin based on typical diesel engines in similar equipment types
- Useful life variable (CI UL) would be the useful life of the diesel engine being replaced by the ZE powertrain or equivalent to a diesel engine used to power similar equipment types

Crediting Examples

$$\text{Credit} = (\text{CF}) \times (\text{Std}) \times (\text{ZE Sales}) \times (\text{PWR Bin}) \times (\text{CI UL})$$

Early Intro: If ≥ 130 kW, then CF = 90% of the Tier 4 standard for NO_x or PM
 Credit = 90% x 0.4 g/kW-hr x 100 units x 260 kW x 8,000 hours
 74,880,000 grams or 74,880 kg of NO_x credit

If < 130 kW, then CF = 80% of the Tier 4 standard for NO_x or PM
 Credit = 80% x 0.4 g/kW-hr x 100 units x 30 kW x 5,000 hours
 4,800,000 grams or 4,800 kg of NO_x credit

With Tier 5: If ≥ 130 kW, then CF = 75% of the Tier 5 standard for NO_x, PM, or GHG
 Credit = 75% x 0.04 g/kW-hr x 100 units x 260 kW x 8,000 hours
 6,240,000 grams or 6,240 kg of NO_x credit

If < 130 kW, then CF = 50% of the Tier 5 standard for NO_x, PM, or GHG
 Credit = 50% x 0.04 g/kW-hr x 100 units x 30 kW x 5,000 hours
 300,000 grams or 300 kg of NO_x credit

ZE NO_x Equivalency in the Tier 5 Timeframe

ZE to Tier 4 Ratios

Power Category	Early ZE Credits Prior to Tier 5	ZE Credits Concurrent with Tier 5
ZE Needed to Offset One Tier 4 Engine in the Tier 5 Timeframe		
< 8 kW	0.3 ZE units	1 ZE unit
8 ≤ kW < 19	0.6 ZE units	1.8 ZE units
19 ≤ kW < 56	0.4 ZE units	1 ZE unit
56 ≤ kW ≤ 560	1 ZE units	12 ZE units
> 560 kW Gen Sets	0.4 ZE units	1.2 ZE units
> 560 kW Mobile Machines	0.1 ZE units	0.2 ZE units

Power ratios are the same for both credit generating and consuming engines and powertrains

Reporting Requirements

- Prior to the production of engines to be certified using ZE credits, the engine manufacturer would submit in its application for certification:
 - Name and contact information of the credit-supplying ZE equipment manufacturer
 - Number of credits obtained from the credit-supplying ZE equipment manufacturer
 - All credit-using calculations required under the California averaging, banking and trading (CA-ABT) program
- The ZE equipment manufacturer would provide CARB with:
 - A valid California equipment identification number (EIN) dating back at least three years, or other proof of prior California sales presence and operations
 - Actual number of ZE equipment sold in California via End-of-Year Reporting by equipment type, model year, power category, and diesel equivalent engine family
 - An accounting of the ZE equipment credits generated, banked, transferred, or used
 - Attestation to the accuracy of ZE equipment credit numbers and credit calculations via a signed letter of accountability by the ZE equipment manufacturer

Tier 5 Transition Program for Equipment Manufacturers



Transition Program for Equipment Manufacturers - Background

- The Transition Program for Equipment Manufacturers (TPEM) was an optional compliance provision that granted equipment manufacturers additional lead time to incorporate new engines after the last change in off-road diesel engine standards
- TPEM allowances under Tier 4 ended in 2021
- TPEM is a cost-effective way for equipment manufacturers to transition to newly designed engines, but slows the propagation of those newly designed engines into the marketplace, thus diluting the short-term emission benefits of the standards
- Some equipment manufacturers need additional lead time to modify their chasses under Tier 5 to accommodate newly designed engines with differing packaging and performance characteristics

Proposed Tier 5 CA-TPEM Methodology

- CA-TPEM allowances would apply to all power categories individually
- Each equipment manufacturer would be given a fixed number of CA-TPEM allowances based on an average of 2026-2028 MY historical CA sales volumes in each power category
- The same methodology would apply to small-volume manufacturers
- Allowances would be based on reported actual CA equipment sales volumes
- Equipment manufacturers must report actual CA equipment sales volumes starting with the 2026 MY in order to receive CA-TPEM allowances
- CA-TPEM allowances and duration would vary according to power category
 - 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

Tier 4 TPEM Provisions

- Under Tier 4, equipment manufacturers were allowed to continue selling new equipment with previous-tier engines for:
 - All power categories
 - Up to 7 years
 - A cumulative total of up to 80% of annual production within each power category
 - Up to 700 total / 200 units annually for small-volume manufacturers for a single engine family
 - Up to 525 total / 150 units annually for small-volume manufacturers for multiple engine families < 130 kW
 - Up to 350 total / 100 units annually for small-volume manufacturers for multiple engine families \geq 130 kW

Proposed CA-TPEM Implementation

GENERAL AVAILABILITY OF ALLOWANCES (TIER 5 INTERIM CA-TPEM START)

POWER CATEGORY	CALENDAR YEARS	CA-TPEM ENGINE STANDARD
kW < 19	2031 - 2034	Tier 4 Final
19 ≤ kW < 56	2031 - 2034	Tier 4 Final
56 ≤ kW < 130	2031 - 2033	Tier 4 Final
130 ≤ kW ≤ 560	2029 - 2031	Tier 4 Final
kW > 560	2030 - 2032	Tier 4 Final

DELAYED AVAILABILITY OF ALLOWANCES (TIER 5 FINAL CA-TPEM START)

POWER CATEGORY	CALENDAR YEARS	CA-TPEM ENGINE STANDARD
kW < 19	2034 - 2037	Tier 5 Interim
19 ≤ kW < 56	2034 - 2037	Tier 5 Interim
56 ≤ kW < 130	2034 - 2036	Tier 5 Interim
130 ≤ kW ≤ 560	2033 - 2035	Tier 5 Interim
kW > 560	2034 - 2036	Tier 5 Interim

Other Tier 5 CA-TPEM Considerations

- Record keeping and reporting requirements would remain largely unchanged from Tier 4 TPEM requirements except that they would be based on CA-directed sales
- All equipment manufacturers would be required to report California equipment sales beginning in 2026
- CA Executive Orders would continue to be required for all engines produced under these Tier 5 CA-TPEM provisions
- CA specific bonds or registration may be required to prevent Tier 5 circumvention for new equipment manufacturers without a historical record of sales in California requesting Tier 5 CA-TPEM allowances
- Equipment manufacturers must consider all CA-directed equipment sales when calculating Tier 5 CA-TPEM allowances, including those from parent or subsidiary companies and any other companies licensed by the manufacturer