

EPA's Heavy-Duty 2027 Final Rule: An Overview for NACAA MSF Committee

MARCH 3, 2023

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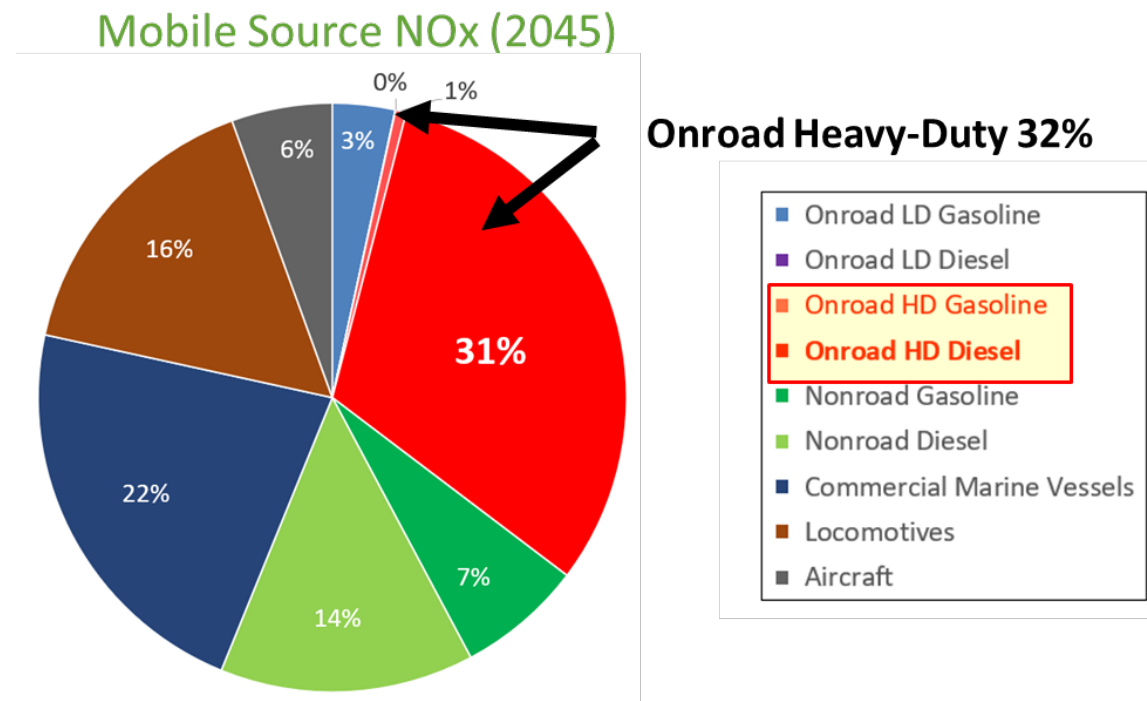
EPA's Heavy-Duty 2027 Final Rule

Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards

- EPA Administrator signed the FRM on December 20, 2022
- FRM published in the Federal Register on January 24, 2023
 - 88 FR 4296, January 24, 2023
 - <https://www.govinfo.gov/content/pkg/FR-2023-01-24/pdf/2022-27957.pdf>
- See our FRM webpage for more information
 - <https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-and-related-materials-control-air-pollution>

Context for EPA's Heavy-Duty 2027 Rule

- The heavy-duty industry is diverse, spanning delivery trucks, tractor-trailers, school buses, and other types of vocational vehicles
- Heavy-duty vehicles contribute significantly to local, regional, and global air pollution
- The Clean Air Act gives EPA authority to set standards for HC, CO, NOx, and PM for heavy-duty
 - These standards must “achieve the greatest degree of emission reduction achievable ...”, and provide a **minimum of 4 years lead-time**, and 3 years of stability between new standards
 - EPA's last heavy-duty rulemaking for these pollutants was over 20 years ago, with standards that phased in through 2010.



MOVES3 for onroad and nonroad and 2016 Emissions Modeling Platform for all other mobile sectors

Summary of the Heavy-Duty 2027 Proposal

- EPA proposed two options for new criteria pollutant standards, test procedures, useful life, and warranty, with other requirements for highway heavy-duty engines and vehicles
- Proposal included targeted updates to the existing GHG Phase 2 program to further reduce GHG emissions in the MY 2027 timeframe
- NPRM published in the Federal Register on March 28, 2022 (87 FR 17414)
 - 46-day comment period + virtual public hearing over 3 days: April 12-14, 2022
 - Docket: <https://www.regulations.gov/docket/EPA-HQ-OAR-2019-0055>
- High levels of public interest and engagement in this rulemaking (200,000+ public comments)
 - Over 250 testifiers over three days of public hearings in April
 - Written comments from more than 300 organizations
- See our NPRM webpage for more information
 - <https://www.epa.gov/regulations-emissions-vehicles-and-engines/proposed-rule-and-related-materials-control-air-1>

Overview of Final Rule

- Holistic program to further reduce NOx and other criteria pollutant emissions from Heavy-Duty Engines and Vehicles
 - New, much more stringent numeric emissions standards cover a wider range of heavy-duty engine operating conditions compared to today's standards
 - Longer useful life periods cover more of the time when the engines operate on the road
 - Broader rule elements ensure long-term in-use emissions control (emission-related warranty, serviceability, OBD, and engine derating)
- The single-step final program will begin in MY2027, the earliest year criteria pollutant standards can begin under EPA's Clean Air Act authority
- No final action on the proposed targeted updates to the existing Heavy-Duty GHG Phase 2 program; also, did not finalize NOx credits for EVs

Longer Regulatory Useful Life Periods

- Longer useful life periods ensure engines are designed to meet emission standards through more of their operational lives
- Our final useful life periods are generally based on average mileage at time of rebuild or replacement
- For the smaller engine categories, we finalized the longest useful life mileage proposed; for the largest category, we finalized the longest useful life proposed for MY 2027 (Option 2)

Primary Intended Service Class	Current			MY 2027+		
	Miles	Years	Hours	Miles	Years	Hours
Spark-ignition HDE	110,000	10	-	200,000	15	10,000
Light HDE	110,000	10	-	270,000	15	13,000
Medium HDE	185,000	10	-	350,000	12	17,000
Heavy HDE	435,000	10	22,000	650,000 [750,000*]	11	32,000

*Heavy HDE standards must be demonstrated at the time of certification to 750,000 miles

New Laboratory Test Procedures and Standards

- For all engine categories, the final standards are a **single-step, beginning in MY 2027**
 - Lower standards over laboratory current duty cycles
 - New **“low-load” cycle and standards for compression-ignition engines** covering stop-and-go and idle operation to help address emissions from urban driving conditions that could impact communities already overburdened with pollution
 - New **“supplemental emission test” cycle and standards for spark-ignition engines** covering sustained higher speed and higher load operation to help reduce fuel enrichment under highway driving conditions

- For Medium HDE and Heavy HDE, we finalized a in-use compliance allowance (of 15 mg NO_x/hp-hr) that applies when engines are tested after these engines have entered commerce (in-use testing)

Compression-ignition HDE NO_x Standards (mg NO_x /hp-hr)

	Current	MY 2027+	Medium and Heavy HDE MY 2027+ w/In-Use Compliance Allowance
Federal Test Procedure (cold start, transient mid/high load conditions)	200	35	50
Supplemental Emission Test (steady-state conditions)	200	35	50
Low Load Cycle (low-load conditions)	N/A	50	65

Spark-ignition HDE NO_x Standards (mg NO_x /hp-hr)

	Current	MY 2027+
Federal Test Procedure (cold start, transient mid/high load conditions)	200	35
Supplemental Emission Test (steady-state conditions)	N/A	35

New Off-cycle Test Procedure and Standards

- Updated test procedure and standards for vehicles on-the-road to cover all driving conditions
 - Changes make urban driving conditions and other low-load conditions which were excluded from the current Not-to-Exceed (NTE) standards, subject to the off-cycle standards
 - Helps ensure emission reductions occur in the real-world over a broad range of operation
 - Test procedure characterizes on-the-road operation using moving average windows
- Standards were set at the most stringent level justified by demonstration data for MY 2027 engines, which includes the standards at lower ambient conditions

Off-cycle Bin	Light HDE	Medium HDE & Heavy HDE	
	At Certification and In-Use	At Certification	In-Use
Bin 1 (idle operation)	10 g/hr @ $\geq 25\text{ }^{\circ}\text{C}$ 15 g/hr @ $5\text{ }^{\circ}\text{C}$ Linear between 25 and $5\text{ }^{\circ}\text{C}$	10 g/hr @ $\geq 25\text{ }^{\circ}\text{C}$ 15 g/hr @ $5\text{ }^{\circ}\text{C}$ Linear between 25 and $5\text{ }^{\circ}\text{C}$	
Bin 2 (non-idle operation)	58 mg @ $\geq 25\text{ }^{\circ}\text{C}$ 102 mg @ $5\text{ }^{\circ}\text{C}$ Linear between 25 and $5\text{ }^{\circ}\text{C}$	58 mg @ $\geq 25\text{ }^{\circ}\text{C}$ 102 mg @ $5\text{ }^{\circ}\text{C}$ Linear between 25 and $5\text{ }^{\circ}\text{C}$	73 mg @ $\geq 25\text{ }^{\circ}\text{C}$ 117 mg @ $5\text{ }^{\circ}\text{C}$ Linear between 25 and $5\text{ }^{\circ}\text{C}$

Longer Emission-Related Warranty Periods

- Warranty ensures end-users don't bear all the risk of emission technologies that fail prematurely
- We lengthened warranty, in part, because owners are more likely to repair and maintain their emission controls, and less likely to tamper, if emission controls are covered by warranty
- For the smaller engine categories, we finalized the longest warranty mileages proposed; for the largest category, we finalized the longest warranty proposed for MY 2027 (Option 1, 2027)

Primary intended Service Class	Current			MY 2027+		
	Mileage	Years	Hours	Mileage	Years	Hours
Spark-ignition HDE	50,000	5	-	160,000	10	8,000
Light HDE	50,000	5	-	210,000	10	10,000
Medium HDE	100,000	5	-	280,000	10	14,000
Heavy HDE	100,000	5	-	450,000	10	22,000

Broader Rule Elements

- Updated ABT program
 - Including four pathways to encourage the introduction of lower NOx engines in MYs 2022 – 2026
- New maintenance, serviceability, and OBD requirements to help owners:
 - Access more maintenance information to facilitate repairs
 - Quickly identify failed emissions control parts
 - Limit frustration, cost, and downtime due to repairs
- New regulations for engine derating related to SCR-based aftertreatment systems
 - Final derate speeds slow enough to ensure use of high-quality DEF, prevent tampering, and encourage repair of components
 - Derate schedule provides sufficient notice and enough time for operators to get home safely to address the issue
 - Three possible derate speed schedules based on average vehicle speed

Summary of Final Rule Analyses

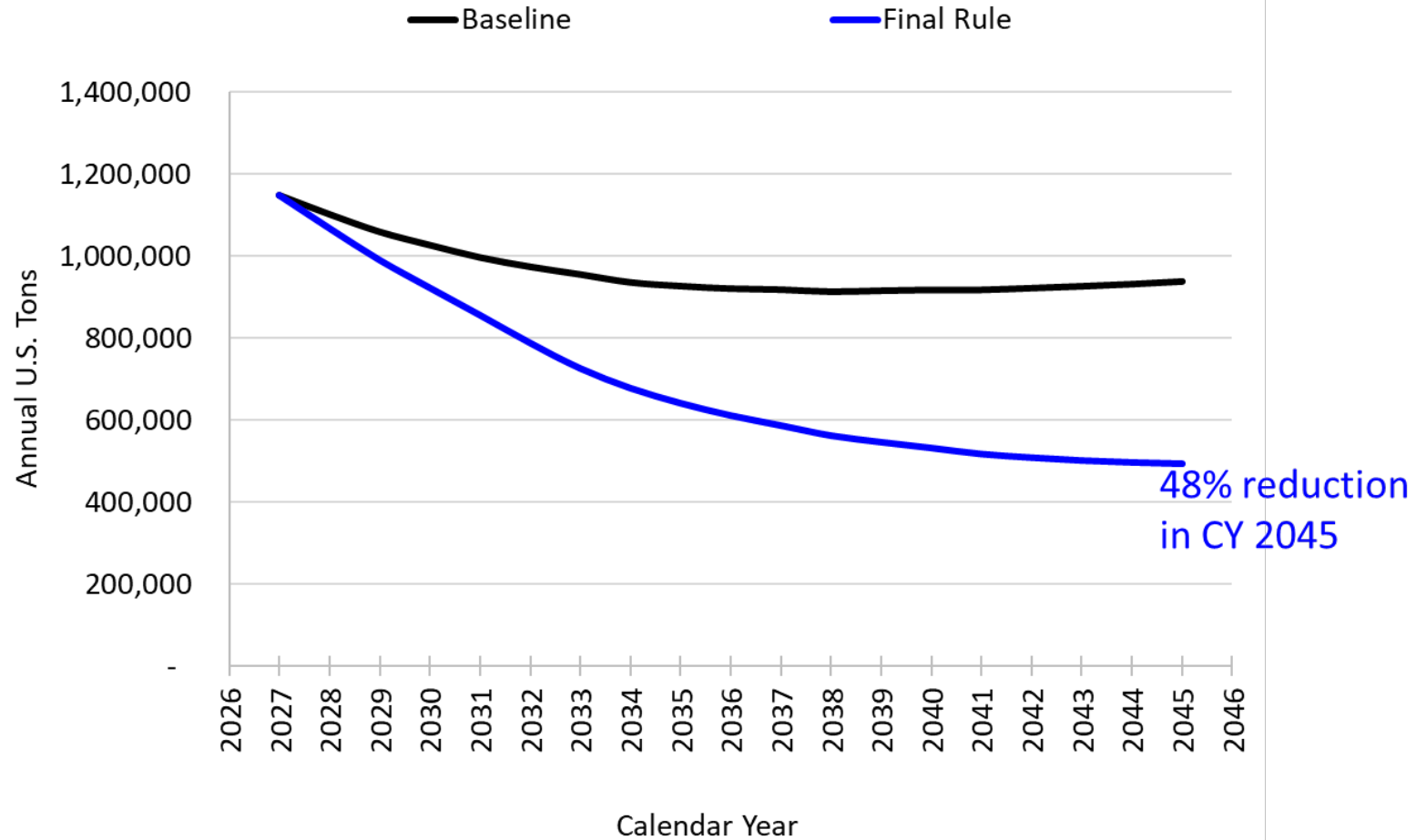
Cost per Engine: Heavy Heavy-duty Diesel in a Long-Haul Tractor

- Cost per heavy-duty engine vary across fuel type, engine size, vehicle types
- Costs per engine reflect manufacturers' costs
 - Includes: new emission control technologies, improved durability due to longer useful life periods, warranty liability during longer warranty periods
 - Increases in costs may differ from how manufacturers choose to price products
- Additional operating costs and savings for the owner
 - Some operating costs for additional DEF used in diesel aftertreatment systems
 - Some savings in repair of emission-related components due to longer useful life and warranty periods

% Reduction in City Cycle Standard	Useful Life (miles)	Emissions Warranty (miles)	Total Incremental Cost per MY 2027 Engine	Increase in Initial Cost*
80%	650K	450K	\$4,800	4%

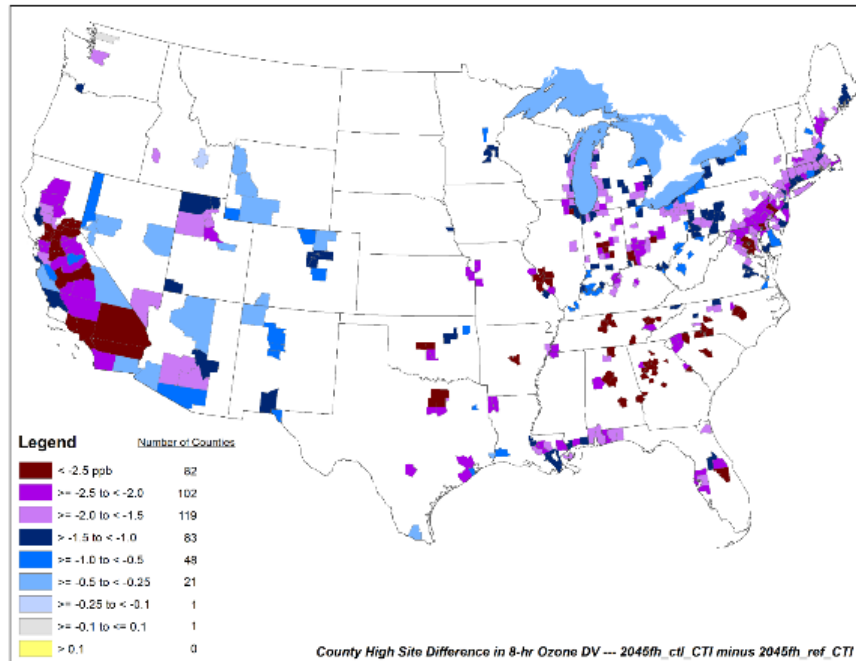
* Undiscounted, 2017 dollars, applying an estimated price of \$119,000 for a Class 8 tractor

Final Rule Reductions in Heavy-Duty Highway NOx Emissions Inventory

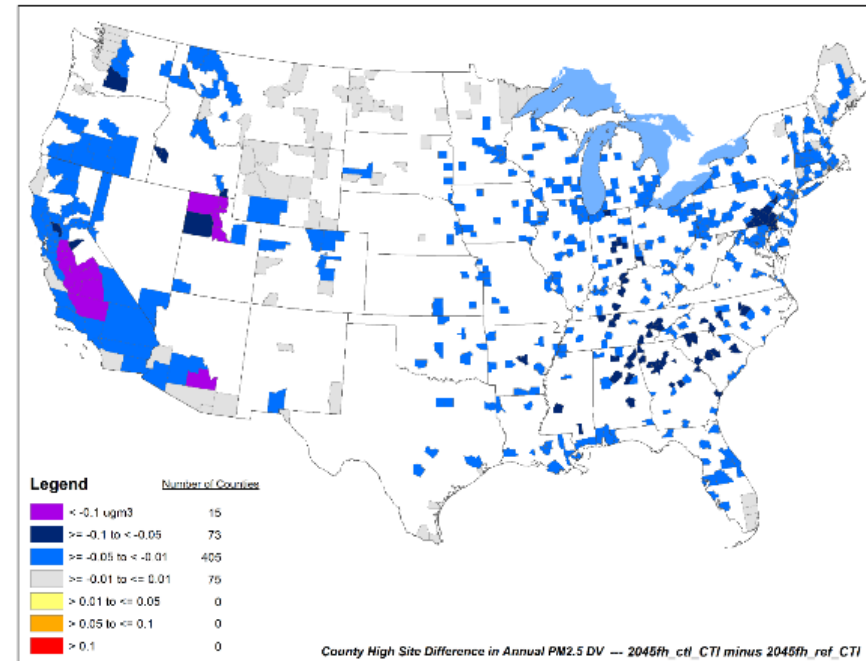


Air Quality Benefits

- Significant reductions in ambient ozone
 - PM_{2.5}, NO₂, and CO also reduced
 - AQ modeling for proposal reasonably represents impacts of final rule



Projected Change in 8-hour Ozone Design Values in 2045



Projected Change in Annual PM_{2.5} Design Values in 2045

Health Benefits

- Environmental justice considerations
 - Detailed demographic analysis of population near major truck routes
 - Analysis of distribution of ozone and PM_{2.5} impacts
- Monetized health benefits from reductions in ozone and PM_{2.5}
 - Upper and lower estimates of benefits reflect combinations of alternative PM_{2.5} and ozone mortality studies that yield more and less conservative benefits totals.

Present Value* through Calendar Year 2045 (3% DR, Billions 2017\$)	
Health Benefits	Net Benefits
\$91 - \$260	\$36 - \$200

*Present Values reflect the stream of rule-related costs and benefits between 2027-2045

Final Rule Summary

- Final rule will change key aspects of the heavy-duty criteria pollutant program elements, including:
 - New numeric standards, as well as new and revised test procedures, useful life, warranty, and other requirements
- Longer useful life and warranty periods, combined with serviceability and maintenance provisions in the final rule, will provide a comprehensive approach to ensure that the new, much more stringent emissions standards are met during in-use operations
- Final rule is supported by EPA's technical analyses, including engine demonstration data, and further informed by additional data and information provided through public comments
- Final rule will provide meaningful, nationwide reductions in ozone and PM_{2.5}

Questions

Appendix

Transitional Credit Program: 4 pathways to generate NOx credits

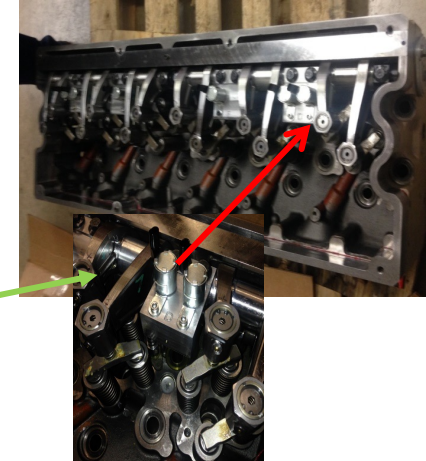
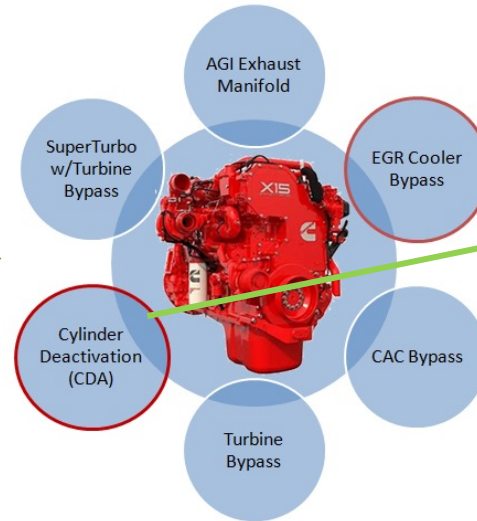
- **Pathway 1: Discounted credits**
 - MY 2022-2026 engine family that meets all the requirement of 40 CFR 86
 - 40% discount when credits are used
 - Credits can be used through MY 2029
- **Pathway 2: Partial credits**
 - MY 2024-2026 engine family
 - Certify to LLC and off-cycle test procedures
 - Useful life mileage from 40 CFR 86.004-2
 - Credits can be used through MY 2031
- **Pathway 3: Full credits**
 - MY 2024-2026 engine family that meets all the requirement of 40 CFR 1036
 - Credits can be used through MY 2031
- **Pathway 4: 2026 service class pull-ahead credits**
 - Available to manufacturers that certify all their diesel fueled Heavy HDE families to 40 CFR 1036
 - 50 mg/hp-hr FEL cap
 - Can be used for Medium HDE with 10% discount
 - Credits can only be used for engine families with an FEL at or below 50 mg/hp-hr
 - Credits can be used through MY 2034
 - Not applicable for natural gas engines

EPA Stage 3 Low NO_x Engine

2017 Cummins X15 Engine



Additional Engine Hardware (Cylinder Deactivation)



Advanced Low Aftertreatment (Dual SCR-Dual Dosing)

