Manufacturers of Emission Controls Association

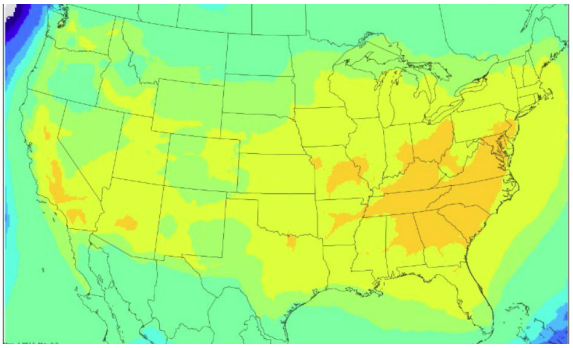
ACHIEVING ULTRA-LOW NOx EMISSIONS FROM HEAVY-DUTY TRUCKS

April 2019

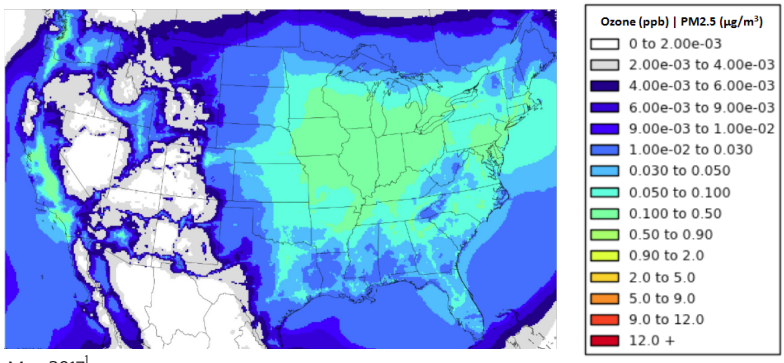
BENEFITS OF A TIGHTER HEAVY-DUTY NOx STANDARD

Under the existing U.S. heavy-duty NOx standards, emissions from heavy-duty trucks are projected to have a large impact on air pollution in 2025.

On-Road Heavy-Duty Diesel NOx Contribution to Ambient Ozone in 2025



On-Road Heavy-Duty Diesel Secondary PM2.5 Concentration in 2025



Source: U.S. EPA, Impact of Mobile Source Emissions on Air Quality presentation, May 2017[1]

Year	NOx Emission Reductions (tons per day)*				
	Continental U.S. (excluding CA)	OTC	SESARM	LADCO	CenSARA
2025	139	22	33	25	38
2030	355	57	99	68	90
2040	604	98	162	110	159
2050	728	119	195	134	195

* Projected reductions based on modeled assumption of a 90% tighter heavy-duty NOx standard starting in MY 2021.

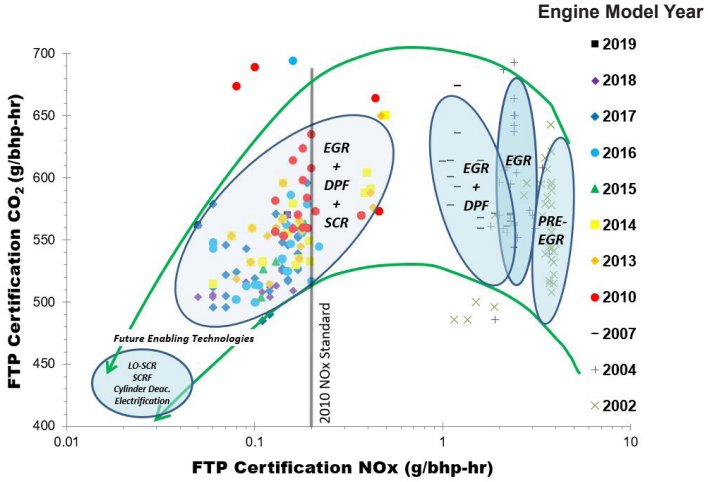
Source: MECA, NOx Emission Reduction Benefits of Future Potential U.S. Mobile Source Regulations, June 2018[2]

Strengthening the current standards by 90% will deliver significant NOx reductions across the U.S.

ADVANCED POWERTRAINS DELIVER BOTH NOx AND GHG EMISSION REDUCTIONS

History has shown that setting stringent, achievable, and aligned standards for both NOx and CO_2 drives innovation and allows industry to achieve cleaner and more efficient engines simultaneously.

U.S. EPA Heavy-Duty Engine Certification Levels



For the past 18 years, several generations of advanced engines and emission control technologies have simultaneously reduced NOx and CO_2

EVOLUTION OF HD EMISSION CONTROL TECHNOLOGY

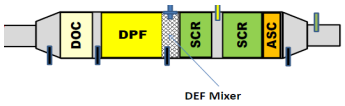
Through a natural evolution in emission control technology, today's systems are **60%** smaller, **40%** lighter, and significantly less expensive than nine years ago.

The cost of emission controls on a future ultra-low NOx truck is estimated to be ***similar*** to the cost of emission controls on a MY 2010 truck.

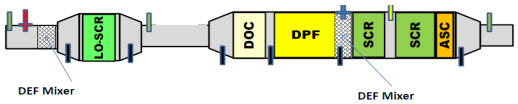
2010 **2013** **2019**

An ongoing California ARB-funded test program is demonstrating the feasibility of meeting a 0.02 g/bhp-hr NOx standard on a modern heavy-duty truck engine with smart deployment of currently available advanced technologies. The test program has already shown that emission control systems on today's trucks can be optimized to meet a 0.05 g/bhp-hr NOx standard.

Today's Emission Control System



Potential Low NOx Emission Control System



Source: SAE Paper Nos. 2017-01-0954, 2017-01-0956, and 2017-01-0958, March 2017.[3]

The emission control technologies that will deliver **90%** lower NOx emissions in the future will incorporate advancements in substrates, catalysts, and engine technologies already found on passenger cars.

COST-EFFECTIVE PATH FOR STATES TO MEET NAAQS

Nonattainment areas in the U.S. continue to need strategies that reduce NOx emissions to meet ozone NAAQS deadlines. Strategies for heavy-duty trucks can deliver these reductions more cost effectively than strategies for stationary sources.

Heavy-duty trucks can deliver NOx reductions at a cost in the range of **$1,000–5,000 PER TON**

Controls for **stationary sources** can deliver reductions at a cost of about **$2,000–21,000 PER TON**

Source: U.S. EPA, Menu of Control Measures for NAAQS Implementation, April 2012[4]

[1] https://www.epa.gov/sites/production/files/2017-06/documents/05312017-epa-presentation.pdf
[2] http://www.meca.org/resources/MECA_NOx_Modeling_Report_0618.pdf
[3] https://www.arb.ca.gov/research/veh-emissions/low-nox/low-nox.htm
[4] https://www.epa.gov/air-quality-implementation-plans/menu-control-measures-naaqs-implementation