Project Summary

Air Quality Benefits of a Future National Heavy-Duty Truck Standard

Part 1: MOVES Inventory Modeling of a Potential Cleaner Trucks Initiative Scenario

Part 2: Air Quality Model Analysis of a Potential Cleaner Trucks Initiative Scenario

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Project Summary

The California Air Resources Board identified in their October 2015 Mobile Source Strategy that 80% of ozone forming NOx emissions and 90% of diesel particulate matter emissions come from the transportation sector. Although the strategy addressed NOx reductions from all mobile sectors, heavy-duty trucks make-up over 32% of California's transportation NOx. Therefore, CARB staff's technology assessment identified low-NOx heavy-duty trucks as the most viable approach to help them meet the 75 ppb and 70 ppb ozone goals. The pathway, in turn, assumed internal combustion heavy-duty trucks with NOx emissions 90 percent cleaner than today's standards and equipped with highly efficient particulate filters would be required.

In 2015 CARB initiated a test program at Southwest Research Institute to demonstrate the technical feasibility of meeting a 90% reduction in tailpipe NOx below current standards using advanced engine and aftertreatment controls. The Manufacturers of Emission Controls Association partnered with CARB, U.S. EPA and South Coast Air Quality Management District on this test program by providing all of the hardware and co-funding for screening technology pathways and full useful life aging of hardware. The primary objective of this test program was to demonstrate the technical feasibility of achieving a 90% lower tailpipe NOx without impacting GHG emissions to inform regulatory development.

The January 6, 2020 ANPR from U.S. EPA requested comment on the merit of meeting a 50% to 90% NOx emission reduction below today's truck standards. Based on the technical work at SwRI, which has demonstrated the feasibility of achieving 90% lower NOx emissions, MECA estimated the cost effectiveness of these mobile source NOx reductions to be in the range of $1,000 to $5,000 per ton of NOx reduced. The objective of the emission impact analysis set forth in this project, which includes the MOVES inventory completed by Oak Leaf Environmental, Inc. and the related air quality modeling performed by Alpine Geophysics LLC, was to respond to EPA's request for comment in the ANPR as to the merits of reducing NOx emissions from heavy-duty trucks by 90%.

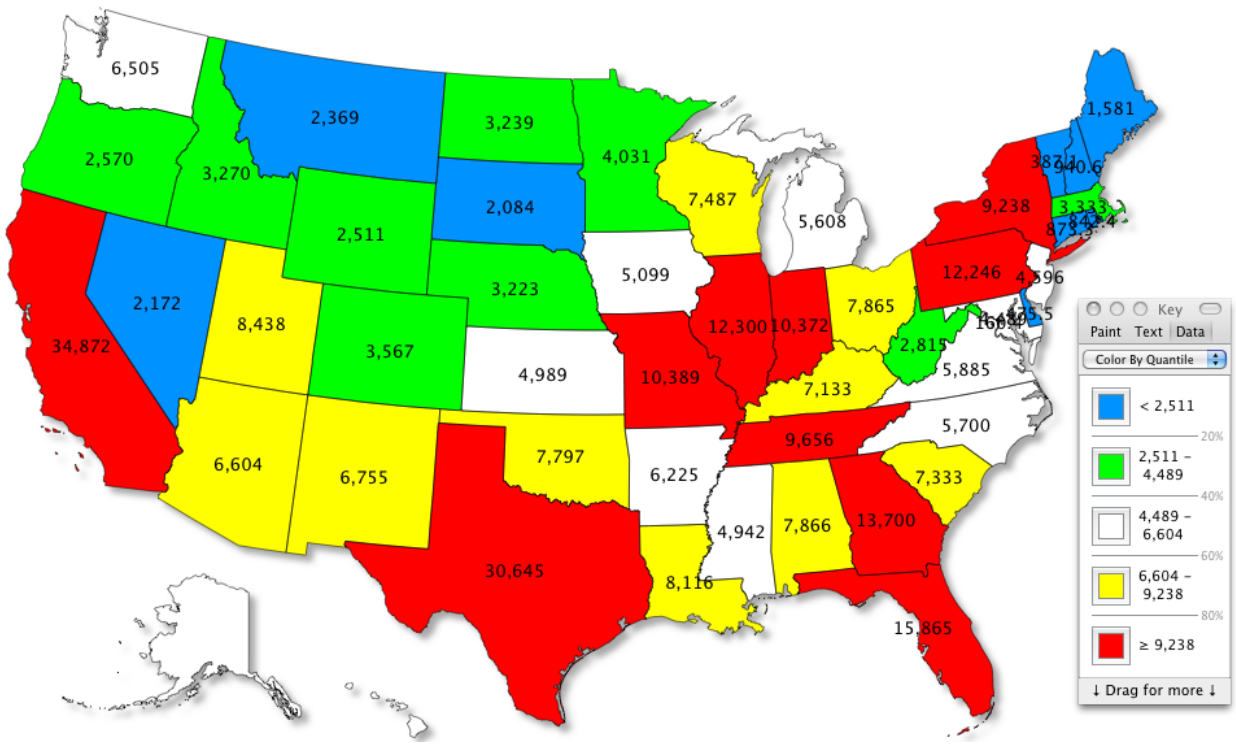
On March 6, 2020, CARB proposed to set an intermediate FTP limit of 50 mg/bhp-hr in 2024-2026 and a final FTP standard of 20 mg/bhp-hr in 2027, which represents a 90% reduction below today's standard of 200 mg/bhp-hr. In addition to FTP limits, CARB proposed to introduce a new low load certification cycle, revised in-use compliance program, longer useful life and emission control warranty requirements. These emission limit values and durability requirements proposed by CARB served as the basis of our assumptions for developing an emissions inventory and performing the modeling set-out to quantify the air quality benefits if a national standard were set by U.S. EPA under the CTI to align with the CARB proposed limits and implementation dates. We were not able to incorporate the compliance program changes or warranty revisions into our model assumptions.

The modelled year of 2035 was chosen to allow as much phase-in of low NOx trucks meeting the future modelled CTI emission limits while still providing adequate confidence from the air

quality perspective. Given that the new truck regulations begin implementation in 2024 and heavy-duty trucks last 20-30 years on the road, the 2035 timeframe represents an intermediate level of CTI truck penetration. It is expected that further NOx reductions will be realized beyond the 2035 modelled year as the heavy-duty truck fleet continues to turn over to the cleanest technology vehicles. It was felt that a full-implementation air quality projection, including mobile and stationary sources, was beyond the scope of this analysis and we therefore kept stationary sources constant beyond the 2028 base year.

The emissions impact analysis of the modelled, federal CTI scenario, set at the limits proposed by CARB, has demonstrated to provide substantial NOx reductions nationally (Figure 1). The 2035 inventory impact analysis, representing only the first 11 model years of more stringent standards (eight of which are at the 20 mg/bhp-hr final standard), yields an average estimated 36.2 percent reduction in on-road NOx emissions nationally or about 330,000 tons of NOx in the year 2035. At the county level, NOx emissions were reduced by 3.7 to 60.1 percent – when expressed as a percent reduction in on-road emissions.

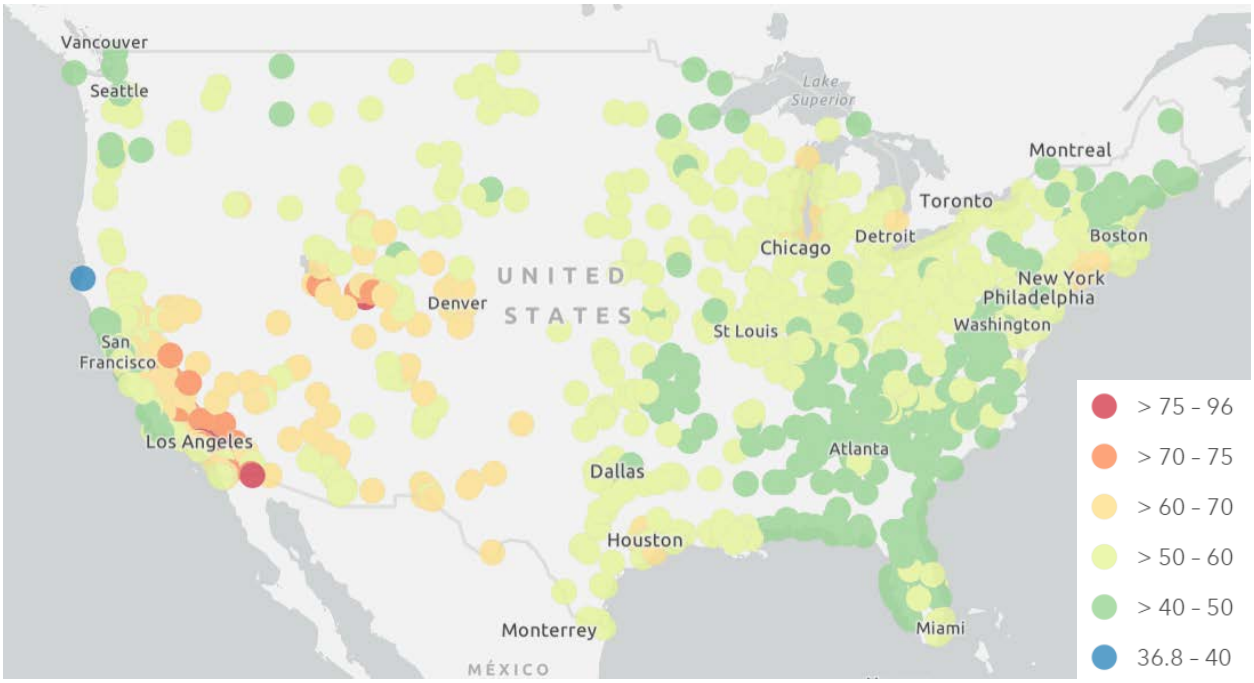
Figure 1. State-Level Annual Tons of NOx Reduced in 2035 from Modelled CTI



The modelled 2028 base year 8-hour ozone design values were found to be above the 70 ppb NAAQS for 75 monitoring locations. Applying the potential CTI strategy to the 2028 base year eliminates ozone nonattainment everywhere east of the Rockies, while several monitoring sites (mostly in California) are projected to have reduced ozone levels yet remain in nonattainment

(Figure 2). The greatest ozone reduction impact of the strategy is seen in urban areas and along highway corridors with reductions of up to 6.5 ppb seen in the west (San Bernardino) and 4.9 ppb seen in the east (Atlanta). It is important to note that even though the 2015 ozone NAAQS was finalized at 70 ppb, EPA's Clean Air Scientific Advisory Committee (CASAC) in 2015 supported a range of 60-70 ppb for the 8-hour primary ozone standard. Prior to applying the projected CTI strategy, nearly 300 monitoring sites are projected to have 8-hour ozone design values between 60 and 70 ppb, and the proposed CTI strategy will reduce these by an average of 2.35 ppb and up to a max of 5 ppb.

Figure 2. 2028/2035 Modelled CTI Case – Ozone Design Values (ppb)



Furthermore, the modeled CTI strategy demonstrates noted impact on the annual $PM_{2.5}$ design value nationwide. The greatest annual $PM_{2.5}$ impacts are reductions of 0.64 $\mu g/m^3$ (4.1%) seen in the west (Kern County, CA) and 0.21 $\mu g/m^3$ (2.3%) reduction in the east (Chicago). As with the annual $PM_{2.5}$ modeling, impact is seen on daily $PM_{2.5}$ design values nationwide. The greatest daily $PM_{2.5}$ impacts are reductions of 4.5 $\mu g/m^3$ (9.8%) seen in the west (Tulare County, CA) and 0.9 $\mu g/m^3$ (4.5%) reduction in the east (Chicago).