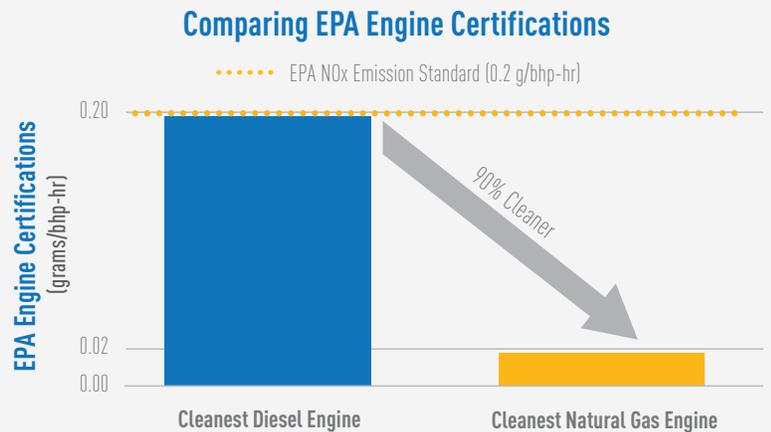


ULTRA-LOW NOx NATURAL GAS VEHICLE EVALUATION FACT SHEET

A report released by the University of California Riverside’s College of Engineering-Center for Environmental Research and Technology (CE-CERT), found that new ultra-low NOx natural gas heavy-duty vehicles met and exceeded their certification standards during a full range of duty cycles. This finding is in stark contrast to previously released CE-CERT data of heavy-duty diesel trucks that emitted higher levels of NOx than their certification standards in the same duty cycles. With the near-zero emission factors demonstrated for natural gas vehicles, it is expected that these vehicles could play an important role in providing much needed emissions reductions required for the South Coast Air Basin and California to reach federal air quality attainment standards.

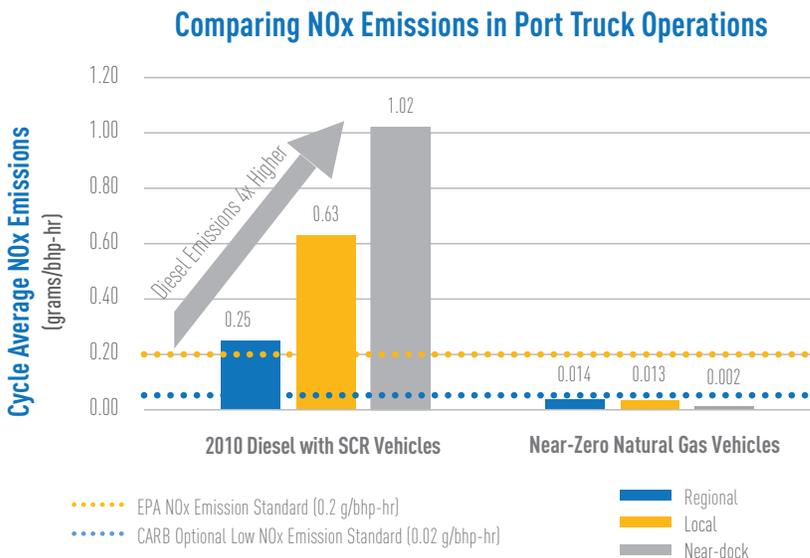
Key Facts:

- » The current EPA NOx emission standard is 0.2 g/bhp-hr¹
- » The cleanest heavy-duty diesel engine available today is certified at 0.2 g/bhp-hr
- » The cleanest heavy-duty natural gas engine available today is certified by CARB at 0.02 g/bhp-hr, **90% cleaner than the EPA NOx emission standard**



In-use testing results of heavy-duty trucks in port applications found:

(The data has been pulled from UCR CE-CERT test results of the Cummins Westport ISL G near-zero natural gas engine and 2010 diesel engines with selective catalytic reduction (SCR) emission control systems.)



- » **Natural gas vehicles emitted lower NOx:** The ISL G natural gas engine emitted lower NOx emissions than its EPA certification standard. Emissions decreased as the duty cycles decreased (i.e., slower speeds, idling, stop-and-go traffic, etc.).
- » **Diesel vehicles emit up to 4x higher NOx:** 2010 diesel engines with SCR emitted up to 4 times higher NOx emissions than its EPA certification standard. Emissions increased as the duty cycles decreased.

While port applications are illustrated in the figure above, UCR CE-CERT also tested refuse and transit applications and found that they provided similar comparative results. These duty cycles represent a significant majority of heavy-duty vehicle trips in the South Coast Air Basin and in other urbanized areas.

¹g/bhp-hr is an abbreviation for grams per brake horsepower-hour, which is a standard measurement used by the EPA to measure a gram of emissions per unit of work (one horsepower in one hour).

About the Report:

- » Authored by Dr. Kent Johnson (PI), College of Engineering-Center for Environmental Research and Technology (CE-CERT), University of California Riverside.
- » The goal of the report is to evaluate the ISL G near-zero natural gas vehicle emissions during in-use conditions.
- » The testing was done on duty cycles that represent operations in the South Coast Air Basin. These cycles included the urban dynamometer driving schedule (i.e., city driving conditions), port cycles (including near dock, local and regional), refuse cycles, and central business district cycles. Refuse and central business district duty cycles show similar in-use emissions performance to the local and near-dock port cycles, while urban dynamometer driving schedule (UDDS) represents the standard cycle the EPA uses for vehicle and fuel emissions testing.
- » The report concludes that ISL G near-zero natural gas engines perform with NO_x emissions below the optional 0.02 g/bhp-hr emission target and averaged between 0.014 and 0.002 g/bhp-hr. With these near-zero emission factors demonstrated, it is expected that natural gas vehicles with the ISL G near-zero engine could play an important role in the reduction of the NO_x inventory in the South Coast Air Basin.
- » The report also found that methane emissions were notably lower than previous versions of the same engine, likely due to the closed crankcase ventilation system.
- » Funding for the emissions testing work was provided by the California Energy Commission, the South Coast Air Quality Management District, and the Southern California Gas Company.

Background Information:

- » Diesel-fueled medium- and heavy-duty vehicles are the number one source of smog-forming emissions of nitrogen oxides (NO_x) in almost every single metropolitan region in the U.S.
- » In areas with the most severe air quality problems – such as southern and central California – achieving healthy air quality will require a transition of heavy-duty vehicles to ones that emit zero or near-zero emissions.
- » Since 1994, the EPA has systematically reduced the allowable emissions of NO_x from new heavy-duty engines, through application of progressively lower federal standards.
- » With the 2010 NO_x certification limit of 0.2 g/bhp-hr, NO_x emissions dropped over 90% compared to 2006 and older heavy-duty vehicles. Additional NO_x reductions of another 90% are desired for the South Coast Air Basin to meet its 2023 NO_x inventory requirements.
- » NO_x emissions lead to the formation of ozone and small particulate matter (PM_{2.5}), each of which contributes to significant health impacts, including asthma and heart disease.

Contacts

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The full report of the Ultra-Low NO_x Natural Gas Vehicle Evaluation can be found on the UCR CE-CERT website or by clicking [here](#).

The previously released CE-CERT report on heavy-duty diesel trucks referenced in the figure can also be found on the UCR CE-CERT website or by clicking [here](#).