Technology Testing and Analysis

- *Technology Verification Program*
  - *EPA tested benefits of Single-wide tires and trailer aerodynamics, publishing the findings*
- *Grants*
  - *EPA also distributes grant money for fleets to conduct real-world tests of the fuel saving technologies*

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Effect of Single Wide Tires and Trailer Aerodynamics on Fuel Economy and NOx Emissions of Class 8 Line-Haul Tractor-Trailers

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ABSTRACT

We hypothesize that components designed to improve fuel economy by reducing power requirements should also result in a decrease in emissions of oxides of nitrogen (NOx). Fuel economy and NOx emissions of a pair of class 8 tractor-trailers were measured on a test track to evaluate the effects of single wide tires and trailer aerodynamic devices. Fuel economy was measured using a modified version of SAE test procedure J1321. NOx emissions were measured using a portable emissions monitoring system (PEMS). Fuel consumption was estimated by a carbon balance on PEMS output and correlated to fuel meter measurements. Tests were conducted using drive cycles simulating highway operations at 55 mph and 65 mph and suburban stop-and-go traffic. The tests showed a negative correlation (significant at $p < 0.05$) between fuel economy and NOx emissions. Single wide tires and trailer aerodynamic devices resulted in increased fuel economy and decreased NOx emissions relative to the baseline tests. Decreases in NOx emissions were disproportionately larger than increases in fuel economy; however, this effect may be an artifact of the particular engine being tested. These results demonstrate that emissions reductions can be achieved using strategies that decrease fuel use and save truck operators money.

INTRODUCTION

BACKGROUND

Fuel consumption of heavy-duty vehicles can be reduced by the installation of components that reduce the vehicle's power requirements. A simple load relation equation presented by Clark [1] shows that two important sources of energy loss in vehicles are tire rolling resistance and aerodynamic drag:

$$P = 1/2\rho_a C_d A V^3 + \mu M g V + M g V \sin\theta \qquad (1)$$

Where P is the power needed to maintain a steady speed, ρ_a is the density of air, C_d is the Aerodynamic drag coefficient of the vehicle, A is the frontal area of the vehicle, V is the vehicle speed, μ is the tire rolling resistance coefficient, M is the mass of the vehicle, g is gravitational acceleration, and θ is the angle of inclination of the road grade. At a steady speed of 65 miles per hour on a flat road, aerodynamic drag and rolling resistance account for 21 percent and 13 percent, respectively, of the total energy used by a class 8 heavy-duty tractor trailer [2]. At lower speeds, rolling resistance assumes a greater fraction of the vehicle's power requirements.

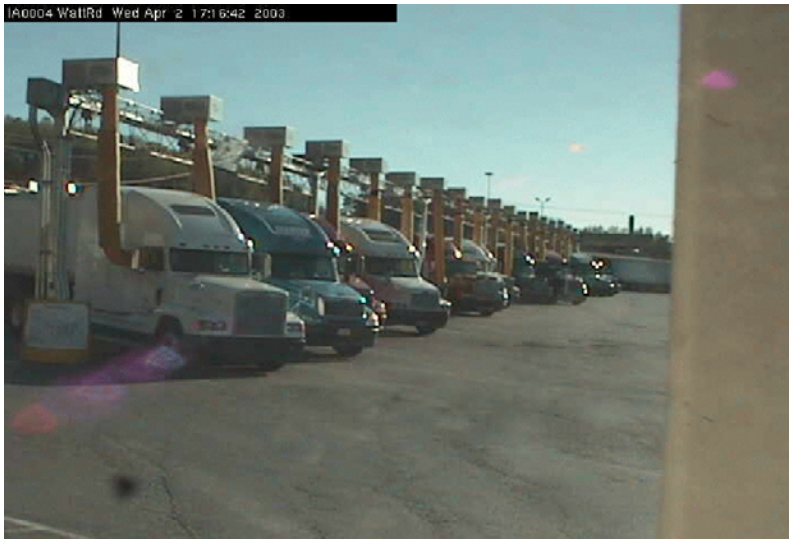
Further, because total vehicle emissions are a function of the power output of the engine, [2] reductions in power requirements should be expected to also result in a corresponding reduction in vehicle emissions. This is more likely the case for emissions of oxides of nitrogen (NOx), as opposed to emissions of particulate matter (PM). NOx is primarily a function of power output, whereas PM is controlled by a more complex set of factors in addition to power output, including fuel composition, and transient engine properties, such as air/fuel ratio, oil leakage through piston rings, and exhaust gas temperature.

Measurements of whole-vehicle emissions from class 8 tractor-trailers are not readily available because historically such measurements involve dynamometer testing in the laboratory, and dynamometers suitable for class 8 tractor trailers are rare. Also, because each model of heavy-duty diesel engine is used on a large number of vehicle types, it is the engine, not the whole vehicle, that is certified by regulatory agencies. In recent years, however, advances in the technology of **O**n-**R**oad **E**missions **M**easurement (OREM; also called "PEMS," **P**ortable **E**missions **M**easurement **S**ystem) allow for the possibility of emissions measurements being conducted in conjunction with on-road fuel-economy measurements, thus permitting the examination of the relation between fuel economy and emissions under "real world" driving conditions.

Idle Reduction Technology Testing

Grants

- *Awarded several grants to states, nonprofit groups, and universities to evaluate:*
  - *Truck Stop Electrification*
  - *Auxiliary Power Units*
- *Goal: build "idle-free" transportation corridors along major interstate highway roads so a truck driver always has a place to rest and not idle their engines.*



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Expansion: SmartWay Truck

- Truck Stops
  - Goal: recruit truck stops to create "idle-free" zones whereby trucks are not allowed to idle.
- Truck Dealerships
  - Goal: recruit truck dealerships to sell the SmartWay Upgrade Kits so truck owners only need to go to one location to have all four items installed.
- SmartWay Truck
  - Designation identifying specific trucks as clean and efficient.
  - Labeling provides publicity for carriers, and encourages them to buy SmartWay Trucks

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Expansion: SmartWay Truck

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