Comparing Emissions Benefits from Regulating Heavy Vehicle Idling

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Background

Current idling regulations are inconsistent from state to state; some proposed regulations could further increase these disparities and impede implementation of IR technology.

This study compares the potential air quality benefits from such regulations as a function of regulatory limits and exemptions.

Abstract

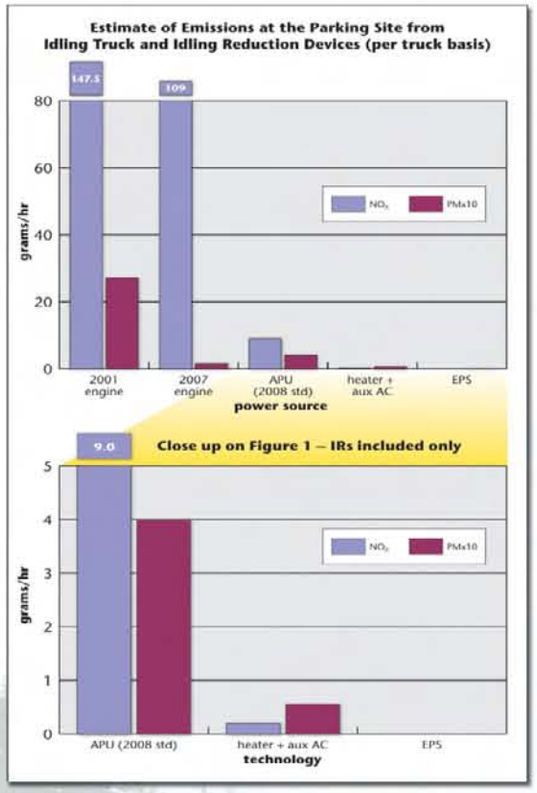
Numerous states regulate long-duration diesel engine idling as a way to reduce emissions and improve air quality. However, the regulations are inconsistent, and proposed regulations in California could further increase the disparity and impede implementation of idling reduction (IR) technology. This poster compares the potential air quality benefits from such regulations on long-haul trucks as a function of regulatory limits and exemptions. Benefits are estimated in terms of reduced emissions of particulates, and NO_x, as well as reduced diesel fuel use. These benefits are compared for different IR methods, such as heaters, auxiliary power units (with and without particulate filters), and wayside systems, under various scenarios, in order to identify the key parameters.

Sources of data include previous work by the U.S. Environmental Protection Agency (EPA), preliminary results of demonstration programs sponsored by the U.S. Department of Energy's Advanced Vehicle Testing Activity, and manufacturer data. However, there are no data on 2007-compliant diesel engines. Although emissions over the heavy-duty engine test cycle must comply with the regulations, long-duration idling is not included in the cycle and no emissions data are available. Furthermore, there are no data published on emissions from large or small engines running on the ultra-low-sulfur diesel fuel that will be mandated for use at the time the proposed regulations come into effect, nor are there data on emissions from IR technologies with emission controls, such as California is proposing. We therefore estimate these emissions.

Previous analyses of emissions and energy use from idling trucks and from idling-reduction devices have examined only the direct impacts at the site of combustion (at the truck or the electric power plant). We find that adding the impacts from producing the fuels, especially particulate matter (PM), significantly alters the relative merits of the different alternatives.

Idling Regulations Today

Comparison of Emissions from Idle Reduction Equipment



Assumptions

The current analysis assumes the following:

- Cab comfort devices were assumed to operate 7 hours/day, 303 days/year, except for the heater and air conditioner, each of which runs 150 days/year.
- Heater and current truck idling emissions and fuel consumption were derived from EPA (Lim, 2002) measurements, assuming 50% air conditioning and 50% heat.
- The air conditioner was assumed to run off batteries, charged during the truck's driving cycle.
- Emissions from 2007 engines were based on California Air Resources Board's estimates (CARB ISOR, 2003), as no measurements are available. Fuel consumption was assumed to be 5% greater than current trucks' due to emissions control equipment.
- Auxiliary power units (APUs) are expected to surpass 2008 standards when 2007 trucks are introduced; PM emissions were assumed to be 50% of the standard, in keeping with current surpassing of standards. NO_x emissions were assumed to be 60% of the combined NO_x + hydrocarbon (HC) small-engine standard. Fuel consumption was derived from measurements of a Caterpillar APU. Addition of a diesel particulate filter (DPF) was anticipated to reduce particulate matter (PM) emissions by 90%.
- Total energy cycle impacts were generated by adding the direct emissions and energy consumption to the impacts from producing the diesel fuel burned, as calculated from the Argonne GREET (Greenhouse gases, Regulated Emissions, and Energy use in Transportation) model. Similarly, impacts from fuel production and electricity generation were estimated from GREET, for both U.S. average and California generation mixes.

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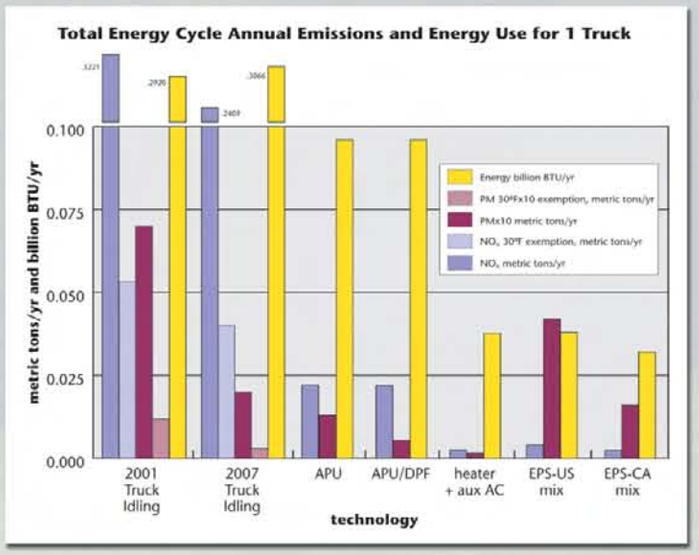
Results

Idling reduction (IR) devices: All of the idling-reduction options enable significant reductions in energy use and all emissions compared to idling of current trucks, and also compared to 2007 trucks. There are pros and cons for each type of device considered here. APUs supply all necessary services and can be used anywhere, any time the driver needs them. Electrified parking spaces (EPS) have zero impacts at the parking location, and most of their life cycle impacts (except PM from coal processing) are below those of the APUs because electricity generation at a large power plant is almost twice as efficient as it is in the APU (17 vs 31%). In addition, almost no power plant energy is in the form of oil. But parking must be restricted to equipped spaces, and there are economic problems getting that infrastructure (and any needed on-board equipment) in place. The first market for EPS use is likely to be for fleets with fixed routes.

Regulatory impacts: A sleeper exemption, would, of course, result in no reduction in the significant impacts from overnight idling. A temperature cutoff, below which trucks would be permitted to idle, would reduce sleeper impacts, but would compromise driver comfort when the temperature is just above the cutoff. We show the impact of a cutoff that would allow idling about 50 days per year (assumed to be 30°F for a moderate climate zone). If a locality instituted a short-time (e.g., 30-minute) exemption, sleeper impacts could be reduced more, but with potentially severe driver comfort issues. A timed exemption would enable significant idling during the course of the work day. On the whole, it appears that use of IR devices offers greater potential for reduction of long-duration idling than do regulatory approaches. Therefore, incentives to encourage installation of IR equipment should be seriously considered.



Particulate matter (PM)

There is special concern because PM from diesel exhaust has been declared to be an air toxic. PM emissions for all of the IR devices are much lower than those from idling current engines. However, direct PM emissions from APUs may be somewhat higher than from idling 2007 engines. Although no data are available yet on 2007 engine idling emissions (or on any engines running on ultra-low sulfur diesel), the Air Resources Board in California has proposed a regulation that would require particulate filters or other control measures on the small engines used in APUs for use on post-2007 trucks. Such a measure can be seen to produce minimal benefits when upstream emissions are included, and could inhibit APU installation in cross-country trucks, resulting in higher impacts nationally. Furthermore, cost and regeneration issues for the APU DPF need to be addressed. Note that significant quantities of PM are produced in upstream fuel processing. For processing of diesel fuel, some of these emissions occur in California. For coal processing, they occur elsewhere.

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