

Why Strengthening Trailer Fuel Efficiency Standards is Critical for Reducing Emissions



Heavy-duty vehicles, despite being just 5% of the on-road fleet, are responsible for 31% of on-road greenhouse gas (GHG) emissions, a full quarter of the transportation sector's GHG emissions¹ and more than 6% of total U.S. GHG emissions, making any improvement highly significant². Tractor-trailers account for nearly 2/3rds of all heavy-duty vehicle fuel consumption and emissions³. For these vehicles, better trailer design is vital to reducing fuel use and GHG emissions.

The "Phase 2" fuel efficiency and GHG standards for heavy-duty vehicles, which were adopted in 2016 but have yet to be fully implemented, would save 800,000 barrels of oil per day by 2040⁴. They will also improve air quality and public health, as more than 230 million Americans — 2/3rds of the U.S. population — live in areas impacted by unhealthy heavy-duty vehicle emissions⁵.

Because trailer design is such an important determinant of tractor-trailer fuel consumption, the Phase 2 standards included requirements for trailers, which were slated to take effect starting with Model Year (MY) 2018⁶. ACEEE projected that the trailer regulations alone would save almost 100,000 barrels of oil per day by 2040, more than the total highway fuel consumption of 17 states⁷. Additionally, the EPA and NHTSA ("the agencies") estimate that the current trailer standards will deliver about 1/3rd of the total achievable reductions in tractor-trailer vehicle fuel consumption and GHG emissions⁸.

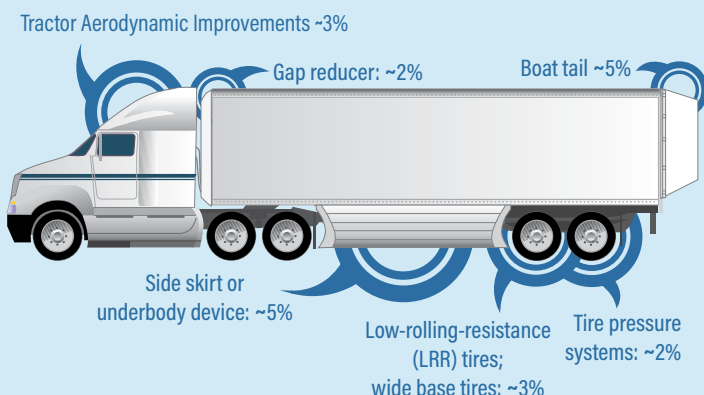
Prior to regulation, over 20% of tractor-trailer energy loss came from air drag⁹. An additional 13% of energy

- ▶ Current trailer regulations account for 1/3rd of the total achievable reductions in heavy-duty vehicle fuel consumption and GHG emissions, according to EPA and NHTSA estimates.
- ▶ By 2040, trailer regulations could save almost 100,000 barrels of oil per day. This is more than the total daily highway fuel consumption of 17 states.
- ▶ Adopting current cost-effective trailer aerodynamics and tire technology can improve trailer fuel efficiency by more than 10%. Tomorrow's standards should push technological development further, rather than lagging behind.

loss came from rolling resistance¹⁰, 40% of which is attributable specifically to the trailer's tires¹¹. Improved aerodynamics and fuel-saving technologies can dramatically reduce these losses.

The more efficient a trailer is, the less force required for the tractor to pull it. This allows for smaller, less fuel-guzzling tractor engines and smaller fuel tanks. Overall, the Phase 2 trailer standards are expected to lead to fuel economy increases of 9% for trucks hauling long box trailers and 5-6% for short box trailers by 2027¹². The agencies demonstrated in the rule how these fuel efficiency improvements could be achieved cost-effectively using air-drag reduction and tire technologies. These technologies are shown in Figure 1, and their fuel savings and payback periods are summarized in Table 1.

Figure 1: Fuel Efficiency Gains from current Aerodynamic and Tire Improvements ¹³



Air Drag Reduction Devices prevent air from getting trapped in dead spots around the truck (reduce turbulent flow by redirecting air around the truck).

Side Skirts and Underbody Devices reduce drag below the main body of the trailer.

Boat Tails smooth air flow as it exits the back of the trailer.

Gap Reducers reduce the empty space between the trailer and tractor, where air can get trapped and push against the direction of movement.

Tire Pressure Systems let the driver know when tires are underinflated. Automatic Tire Inflation (ATI) technology will automatically re-inflate tires to optimal pressure, which is important to fuel economy.

LRR Tires reduce the resistance losses from the tires to the road.

Table 1: Current Technology Fuel Consumption Effects and Current Market Conditions for Box Trailers¹³

Technology		Fuel Savings	Payback Period
Air Drag Reduction Technologies	Side Skirts	3-7%	< 1-year
	Boat Tails	3-5%	1-3 years
	Gap Reducers	1-2%	2-5 years
	Underbody Devices	2-5%	2-5 years
Tire Technologies	Automatic tire inflation (ATI) and monitoring	0.5-2%	1 year
	Low Rolling Resistance (LRR) Tires	1-3%	High variability, 2 years or less is possible

Trailer Regulations are a Necessary and Logical Way to Improve Trailer Efficiency

Market forces cannot improve trailer efficiency on their own. Why not? One reason is the split-incentive problem: trailers are often shared among multiple freight companies and are not always owned or chosen by the fleets that use them¹⁴. In other words, those who buy the trailers often are not the ones that reap the fuel savings benefits of better trailer efficiency and hence may be unwilling to pay for it up front¹⁵. This problem affects up to 23% of all trailers, which collectively account for 5% of all heavy-duty vehicle fuel use¹⁶.

Despite the need for regulation, the Truck Trailer Manufacturers Association (TTMA) challenged the trailer standards in court on the basis that trailers “emit no pollutants and consume no fuel”¹⁷, and hence should not be regulated for emissions and fuel efficiency. The agencies defended their authority, noting that they can regulate the manufacturers of major vehicle components and that trailers are an integral component of a tractor-trailer¹⁸. It therefore follows that they can regulate trailers and trailer manufacturers¹⁹.

While the agencies continue to defend their authority in litigation to this day, they have also initiated a process to consider weakening the trailer standards²⁰. However, less-stringent trailer standards cannot be justified when the current rules offer demonstrated cost-effective improvements and when additional fuel efficiency potential remains to be realized. The adoption of current cost-effective trailer aerodynamics and tire technology can improve trailer fuel efficiency by more than 10%, greater than the reductions required for model year

2027²¹. Furthermore, beyond the currently available and cost-effective technologies listed above, manufacturers continue to develop and demonstrate new aerodynamic improvements that alone could exceed the current standards for all existing technologies combined²². This shows the importance of trailer standards in driving technological improvement. Without standards, and given the split-incentive problem, there is no reason to believe these technologies will be widely adopted.

Trailer Evolution is Vital to the Tractor-Trailers of the Future

Maintaining strong trailer standards is not only critical to reducing emissions, GHGs, and fuel consumption today, it will also be vital to enabling an electric truck future. Electrification of heavy-duty vehicles has advanced significantly since the Phase 2 rules were adopted in 2016²³. Lowering the power needed to move a loaded trailer, as the Phase 2 trailer standards do, would extend the range of electric trucks and reduce their battery costs, accelerating market adoption.

Logistical improvements, including internet-connected and GPS-tracked trailers, may enable further gains in efficiency by facilitating the intentional pairing of tractors and trailers, leading to better integration of the two halves of the vehicle.

Trailers must continue to evolve if we are going to achieve maximum energy reduction potential from heavy-duty vehicles. EPA and NHTSA should be looking for opportunities to strengthen — not weaken — trailer standards.

For more information on ACEEE’s work on heavy duty vehicles, freight, and autonomous and connected vehicles, contact Dr. Avi Mersky at amersky@aceee.org.

To learn more about ACEEE’s transportation initiatives, please visit our [transportation program page](#)

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