The Environmental Benefits of Moving Freight by Rail

ASSOCIATION OF AMERICAN RAILROADS MARCH 2017

Summary

Railroads are the most environmentally sound way to move freight over land. On average, **trains are four times more fuel efficient than trucks.** They also **reduce highway gridlock, lower greenhouse gas emissions, and reduce emissions of particulate matter and nitrogen oxides**. Through the use of greener technologies and more efficient operating practices, our nation's privately owned freight railroads are committed to even greater environmental excellence in the years ahead.

Freight Railroads and Fuel Efficiency Go Hand in Hand

Freight railroads are the environmentally friendly way to move freight:

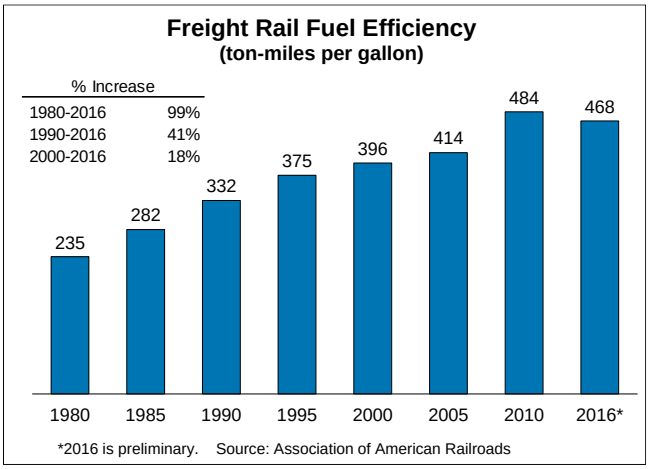

Figure 1

- ✓ In 2016, U.S. freight railroads moved a ton of freight an average of **468 miles per gallon of fuel** — up from 235 miles in 1980 (see Figure 1). **That's a 99 percent improvement**.
- ✓ On average, railroads are **four times more fuel efficient than trucks**, according to an independent study for the Federal Railroad Administration.
- ✓ Greenhouse gas emissions are directly related to fuel consumption. That means **moving freight by rail instead of truck lowers greenhouse gas emissions by 75 percent**.
- ✓ If just 10 percent of the freight that moves by Class 7 or Class 8 (the largest) trucks moved by rail instead, fuel savings would be around **1.5 billion gallons per year** and **annual greenhouse gas emissions would fall by approximately 17 million tons** — equivalent to removing around 3.2 million cars from the highways for a year or planting 400 million trees.

A Multi-Faceted Approach to Conserving Fuel

U.S. freight railroads' volume in 2016 was much higher than it was in 1980, but their fuel consumption was much lower. How did railroads do this? Through technological innovations, new investments, improved operating practices, and a lot of hard work. Among many other things, railroads have:

- ✓ Acquired thousands of **new, more efficient locomotives** and removed from service thousands of older, less fuel efficient locomotives.
- ✓ **Increased the amount of freight in rail cars and on trains.** Thanks to improved freight car design, the use of longer trains, and other factors, the amount of freight railroads carried in an average train in 2016 was 3,533 tons, up from 2,923 tons in 2000.
- ✓ Developed and implemented **highly advanced computer software systems** that, among other things, calculate the most fuel-efficient speed for a train over a given route; determine the most efficient spacing and timing of trains on a railroad's system; and monitor locomotive functions and performance to ensure peak efficiency.
- ✓ Installed idling-reduction technologies, such as **stop-start systems** that shut down a locomotive when it is not in use and restart it when it is needed, and expanded the use of **distributed power** (positioning locomotives in the middle of trains) to reduce the total horsepower required for train movements.
- ✓ Provided **employee training** to help locomotive engineers develop and implement best practices and improve awareness of fuel-efficient operations.

Freight Railroads Fight Highway Gridlock

Railroads help reduce the huge economic costs of highway congestion:

- ✓ According to the Texas Transportation Institute's 2015 Urban Mobility Scorecard, **highway congestion cost Americans $160 billion** in wasted time (6.9 billion hours) and wasted fuel (3.1 billion gallons) in 2014. Lost productivity, cargo delays, and other costs add tens of billions of dollars to this tab.
- ✓ **A single freight train, though, can replace several hundred trucks**, freeing up space on the highway for other motorists. Shifting freight from trucks to rail also **reduces highway wear and tear and the pressure to build costly new highways**.

Freight Railroads Mean Fewer Harmful Emissions

The Environmental Protection Agency (EPA) regulates emissions of particulate matter (PM) and nitrogen oxides (NOx) from locomotives and trucks.[1] For locomotives, EPA regulations are based on progressively more stringent "tiers." The most recent locomotive standards are "Tier 4" standards and apply to all locomotives built or remanufactured since 2015. EPA standards for locomotives and trucks are phased in over time. This means that that the percentage of the overall locomotive and truck fleets that meet the newest, most stringent standards is constantly

[1] Particulate matter consists of airborne microscopic solid particles and liquid droplets. Nitrogen oxides are highly reactive acids that, among other things, interact with water, oxygen, and other chemicals to form acid rain and haze.

rising as older locomotives and trucks that don't meet the standards go out of service and are replaced by newer units that do.[2]

A March 2015 study[3] by an economist at the Congressional Budget Office (CBO) compiled data from a variety of sources to estimate the unpriced external costs — that is, costs to society not covered by taxes — associated with freight transport by rail and truck. The study estimated that **the external costs associated with emissions of particulate matter, nitrogen oxides, and carbon dioxide are three to five times higher for trucks than for railroads.**[4] **In other words, moving freight by rail rather than by highway significantly reduces the harmful emissions that the EPA regulates**.

Figures 2 through 4 below, which cover emissions of particulate matter, nitrogen oxides, and carbon dioxide from locomotives and trucks, are based on EPA and industry data and are broadly consistent with the CBO study's findings. The charts contain information on emissions for both rail and highway movements based on the existing locomotive and truck mix, and also show what hypothetical emissions would be if all locomotives and trucks met the most stringent existing EPA standards.

Figure 2 covers emissions of particulate matter (PM). The bars on the left refer to rail movements; the bars on the right refer to highway movements. For both rail and highway, heavier movements (e.g., coal or other bulk products) yield fewer emissions per ton-mile than lighter movements (e.g., intermodal containers). The height of the bars in Figure 2 reflect the range of PM emissions based on the commodities being hauled. Put another way, the top of the bars approximate emissions per ton-mile for, say, light intermodal containers, while the bottom of each bar approximates emissions for, say, heavy coal shipments. The average for all movements is near the middle of each bar.

In Figure 2, the top bar on the rail side shows the approximate range of rail PM emissions given the existing locomotive fleet. The bottom bar on the rail side shows what PM emissions would be if all existing locomotives met Tier 4 standards. Eventually, as locomotives that do not meet Tier 4 standards are phased out and replaced by locomotives that do, the lower bar will become increasingly representative of actual rail PM emissions.

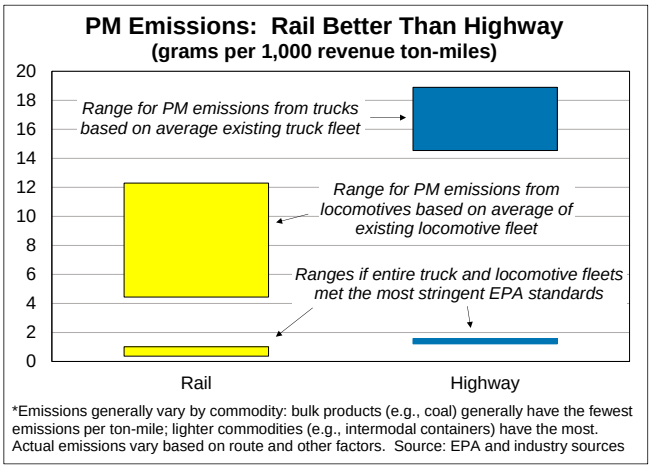

Figure 2

[2] A phase-in is the only feasible way to incorporate new standards without bringing freight movements, and therefore the economy, to a halt.

[3] David Austin, Pricing Freight Transport to Account for External Costs, Congressional Budget Office Working Paper 2015-03, March 2015. Available at https://www.cbo.gov/publication/50049.

[4] In addition to harmful effects from exhaust emissions, these costs to society include, among other things, wear and tear on roads and bridges; delays caused by traffic congestion; and injuries, fatalities, and property damage from accidents. The CBO study finds that, in total, "The unpriced external costs of transporting freight by truck (per ton-mile) are around eight times higher than by rail."

The bars on the right side of Figure 2 cover PM emissions for highway movements. The range of emissions for the current truck fleet (represented by the upper right bar in Figure 2) is higher than the range of PM emissions for the current locomotive fleet (the upper left bar in Figure 2). Likewise, the range of PM emissions if all trucks on the road today met the most stringent EPA standards (the lower right bar in Figure 2) is higher than the range of PM movements if all locomotives met the most stringent EPA (the lower left bar in Figure 2).

Put another way, under current EPA emissions standards, moving freight by rail results in fewer emissions of particulate matter than moving freight by highway. That holds today and will hold in the future as newer trucks and locomotives enter their respective fleets.

The story is the same for emissions of nitrogen oxides (NOx), shown in Figure 3. **NOx emissions when moving freight by rail are significantly lower than emissions for moving freight by highway**, both for the existing locomotive and truck fleets and for the hypothetical case in which all locomotives and trucks meet the most stringent EPA NOx standards. This is demonstrated in Figure 3 by the fact that the respective rail bars are lower than the corresponding highway bars.

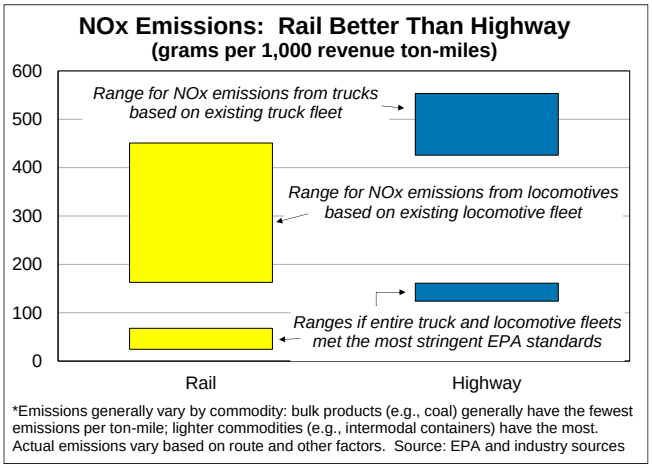

Figure 3

Finally, Figure 4 refers to rail and highway emissions of carbon dioxide, one of the primary greenhouse gases. The EPA's Tier 4 locomotive regulations do not target rail emissions of carbon dioxide directly, so the range of CO_2 emissions for rail is the same for the existing locomotive fleet (in which some locomotives meet Tier 4 standards and some do not) as it is for a fleet where all units met Tier 4 standards. For trucks, the range of CO_2 emissions would be slightly lower than it currently is if all trucks met the most stringent EPA standards, but they still far exceed rail emission rates. Rail CO_2 emissions per ton-mile are approximately one-fourth of truck emissions per ton-mile. **This means that, for carbon dioxide, as for particulate matter and nitrogen oxides, emissions associated with rail movements are significantly lower than emissions associated with highway movements.**

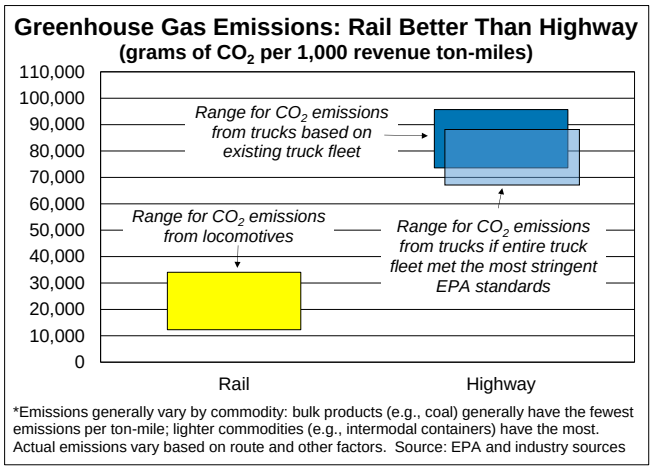

Figure 4

Railroads recognize the importance of environmental excellence and will continue to work to ensure that they remain the environmentally friendly way to move freight.