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Democracy Dies in Darkness

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Let's make an effort to move more freight by rail and less by road. Trains are more efficient.

New technology minimizes the energy that is lost when a train comes around a curve. (Bigstock)

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Last month, President Obama announced an initiative to improve the fuel efficiency of trucks. That's a lofty goal, but here's an even better idea: Let's make an effort to move more freight by rail and less by road. Trains are far more energy-efficient than trucks — and they always will be.

Trains have a significant friction advantage over trucks. The degree of "stickiness" between two surfaces is expressed mathematically as the coefficient of friction. For a steel wheel rolling over a steel rail, its value is approximately 0.001. For a rubber tire rolling over pavement, the coefficient is between 0.006 and 0.010, or roughly an order of magnitude greater. Some friction is good — it stops the vehicle when a person runs out in front of it. But too much friction means less energy driving the vehicle forward.

The strength of steel gives trains another efficiency advantage. Rubber tires sag under 80,000 pounds of freight, the amount carried by many trailers. The weight of the truck deforms the pavement, and the road cradles the flattened wheel. This increased surface-area contact means yet more friction. Train wheels and railroad rails deform, too, but the stiffness of steel limits the damage.

As for aerodynamics, trains also trump trucks. Every vehicle has to "punch a hole in the atmosphere," explains Christopher Barkan, executive director of the rail transportation and engineering center at the University of Illinois at Urbana-Champaign. Once a tractor-trailer has punched its way through, that hole closes. The next truck must punch a new hole. Trains can carry more than 100 trailer-size containers. When the locomotive punches its hole in the atmosphere, each car that follows can sneak into that same hole, saving a tremendous amount of energy. The faster a vehicle travels, the more significant these aerodynamic effects become.

The train engine itself is a more efficient device than the engine of a truck. "A highway semi-tractor has a roughly 500-horsepower diesel engine, while a freight locomotive has a 4,400-horsepower diesel prime mover," notes Tyler Dick, a research engineer at Urbana-Champaign. Nine truck engines have nine sets of parts rubbing against each other whenever they each attempt to combust a drop of diesel fuel. A single train engine can produce the same output with less rubbing.

Obama pushes for tighter fuel efficiency

President Obama announced that the government will tighten its fuel efficiency standards for medium and heavy duty trucks.

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Industry consolidation also speeds implementation of new technologies. There are dozens of large trucking companies in the United States, in addition to thousands of independent truckers, which makes it difficult to broadly implement good ideas quickly. (That's one reason President Obama is getting involved.) By contrast, a small number of companies dominate American rail freight, giving them the power and motivation to improve efficiency.

In all of the areas mentioned above — friction, aerodynamics and engine efficiency — railways have made improvements over the past two decades.

For example, to minimize the energy that is lost when a train comes around a curve— the squealing of the wheels is "the sound of energy being wasted," says Dick — modern freight trains release a small amount of lubricant as they round a curve. It's enough to cut down on the friction, but not so much that it inhibits braking.

Changes in how trains are loaded can improve aerodynamics. You may have seen a freight train pass by with empty beds, or spaces between the freight cars. That's bad. Open slots create turbulence, forcing the next car in the train to fight air currents and waste energy. Railroads in recent years have worked to eliminate open slots, either through improving management of the freight they have or by placing empty trailers on beds if they're out of loaded cars.

The efficiency improvements in trains is notable over the past few decades. "Between 1980 and 2013, the number of ton-miles moved by railroads has doubled," Dick says, referring to the unit that train operators use to measure the weight of their freight and how far it has moved. "But the amount of fuel they are using has remained relatively constant."

You may have heard railroad commercials bragging that trains can move a ton of freight more than 450 miles on a gallon of fuel. What they don't tell you is that, in 1980, that distance was only 235 miles. While freight trains have doubled fuel efficiency over the past few decades, tractor-trailers remain nearly as inefficient as they were in the 1970s. The average semi got 5.6 miles per gallon in 1973, and today that has improved to just 6.5 miles. (The American Trucking Association did not respond to a request for comment.)

Columnist George Will once called the preoccupation with trains a "disorder" that "illuminates the progressive mind." He's wrong. Recognizing a 30-year trend, accepting simple physics and caring for the environment isn't a sickness — it's a cure.