Fuel efficiency standards’ roles in reducing greenhouse gas emissions and air pollutants

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Abstract

Fuel efficiency standards are often touted to help reduce greenhouse gases and air pollutants’ emissions, but where does the correlation ends, and does a limit exists on fuel efficiency? Specifically, is there a limit beyond which fuel efficiency of vehicles running on fossil fuels could not be improved further? And what is a better yardstick for environmental sustainability for electric and hybrid vehicles? Could energy efficiency calculated based on the efficiency in which energy is used in transporting a specific weight per kilometer be used in place of fuel efficiency? Searching for answers to the above questions, this analysis describes the conceptual underpinning of how improving fuel efficiency is related to the reduction of greenhouse gas emissions and common air pollutants (such as nitrous oxide, sulphur dioxide, carbon monoxide etc.), but expounds on whether a finite limit exists in fuel efficiency for gasoline powered vehicles, as well as whether energy efficiency would be a better environmental sustainability measure for vehicles moving forward, especially with the use of renewable energy for charging electric vehicles.

Keywords: fuel efficiency standards, hybrid cars, electric vehicles, greenhouse gas, carbon emissions, air pollution, environmental sustainability, energy efficiency, renewable energy, fossil fuels,

Subject areas: atmospheric chemistry, coupled natural and human systems, ecosystem science, environmental impacts,

Fuel efficiency first come to the fore of car buyers’ minds when Japanese carmakers successfully produced highly fuel efficient compact cars that gained significant market share in developed economies such as the U.S. and Europe. This phenomenon of fuel efficient vehicles, where Japanese models use significantly less fuel per kilometer compared to their oil guzzling American counterparts, come about through a combination of innovations in engine technology, rise of new materials that reduced the weight of cars, as well as better technologies in reducing cars’ aerodynamic drag.

But, what is the role of fuel efficient vehicles in combating climate change? And what does increasingly stringent fuel efficiency standards do to reduction of air pollutants, especially in cities?
Conceptually, a fuel efficient vehicle uses less fuel for every kilometer travelled; thus, less carbon dioxide is emitted for the same distance travelled compared to a less fuel efficient car. But, does fuel efficiency equates better environmental sustainability of the vehicle?

The answer is the correlation between high fuel efficiency and lower levels of air pollutant emissions such as nitrous oxides, sulphur dioxide and carbon particulates is generally correct, given the need for significant innovations in engine technology as well as control algorithms for fine tuning the combustion environment where oxygen in air mediates the conversion of carbon in gasoline into carbon dioxide and other gases, which releases energy for powering the drivetrain of the car.

Hence, given that improving fuel efficiency of cars through promulgation of better fuel efficiency standards would bring about add-on benefits such as reduction in carbon dioxide and air pollutants’ emissions, could we reach a bottleneck where technology limits the amount of gains possible in achieving higher fuel efficiency and, by extension, environmental protection? If yes, how far are we from that limitation? Or, from another perspective, how far can we push fuel efficiency standards to achieve greater reduction in greenhouse gases and air pollutants?

Advent of electric cars, plug-in hybrids, gasoline-electric hybrids and their supporting recharging and fuel infrastructure could change the scales on which we measure the environmental sustainability of vehicles. Specifically, fuel efficiency standards do not apply to electric vehicles and they are typically much better for gasoline-electric hybrids relative to conventional gasoline powered cars. Additionally, the energy source for charging electric cars also contribute substantially to the calculation of energy efficiency of cars, where those from wind or solar energy are more favorable, from an environmental standpoint, compared to fossil fuel.

Hence, fuel efficiency does contribute to the development and design of cars which have a lower carbon dioxide and air pollutants’ emissions profile, but a limit may exist on how far policy makers are able to drive fuel efficiency standards for achieving stated goals in reducing greenhouse gas emissions from transportation. Additionally, moves away from fossil fuel powered vehicular technology towards electric ones or hybrid power changes the metric by which carbon emissions from cars are measured to the ultimate energy source that powers personal transportation, be it wind, solar, or oil and gas.

Thus, casting a glance towards the future, fuel efficiency for transportation may also be defined at the energy source level, and energy efficiency of individual vehicles may be a more appropriate yardstick for measuring the environmental sustainability of cars. Specifically, inefficiencies in fossil fuel fired power plants or wind farms incur a certain amount of carbon
emissions, and full electric vehicles need to compete based on their efficiency in using stored battery charge in powering the car forward for a specific passenger load.

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