

Carbon Emissions Reduction via Increased Fuel Economy

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Introduction

Global Climate Change (GCC) is the most pressing problem the world faces today, due to the potentially catastrophic and far-reaching nature of its effects. If the world's governments do not successfully cut their projected carbon dioxide (CO₂) emissions in half by 2056, extremely damaging and irreversible effects will likely result [1, 2]. There are myriad ways to reduce these emissions, and many of them must be undertaken to accomplish the necessary reductions. One of the most readily achievable methods is to increase the average fuel economy of the global automobile fleet from the current 30 miles per gallon (mpg) to 60 mpg by 2056. With U.S. leadership, the gradual increase in global efficiency standards is not only feasible, but will provide ancillary benefits to the U.S. and other nations. In fact, it would address many of the most important national priorities, including job creation, protecting national security, and promoting a cleaner environment.

Background

Global Climate Change is the first issue that is of a bona fide global nature – it is the only problem facing the world today that is so diffuse as to affect the entire world and all its beings; no living creature can evade its effects. Few scientists disagree that the primary cause is the emission of so-called “greenhouse gases” (GHGs), which act to trap solar radiation inside the earth's atmosphere, resulting in an overall warming of the planet. If not mitigated, the effects of GCC would be catastrophic, including increased incidence of and deaths caused by extreme weather events, massive species extinctions, increased food deprivation, and other far-reaching problems. The emission of GHGs has steadily increased since pre-Industrial times and has increased 70% between 1970 and 2004 (figure 1) [2]. Many naturally-occurring and artificial gases act as GHGs, but the most important of these is CO₂ because it is emitted on a much larger scale (approximately 7 billion tons per year) than other GHGs [1]. To prevent the worst and most irreversible effects of climate change from occurring, scientists believe that the global concentration of CO₂ should reach no higher than 560ppm. According to Socolow and Pacala, CO₂ emissions must stabilize at 7 billion tons per year by 2056 to achieve this concentration, down from the projected 14 billion tons. They visualize each billion tons of CO₂ reduction as a “wedge,” and note that seven such wedges must be created to prevent the worst effects of GCC from occurring.

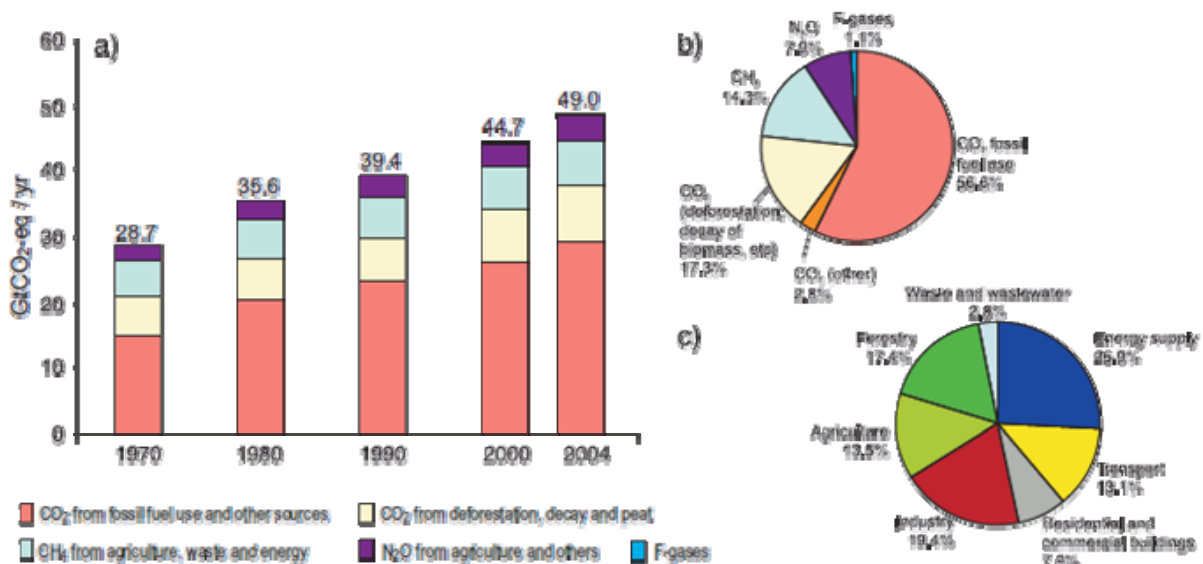


Figure 1. Global anthropogenic GHG emissions since 1970 [2]

Anthropogenic CO₂ emissions result primarily (56.6%) from the burning of fossil fuels (figure 1), much of which is due to the transportation sector [2]. Transportation experts predict that there will be 2 billion cars on the road globally by 2056. By steadily increasing the average fuel economy of the global fleet from 30 miles per gallon (mpg) in 2006 to 60 mpg in 2056, 25 billion tons less of CO₂ per will be emitted in those fifty years. The following will demonstrate that with leadership from the United States this goal is achievable and will significantly contribute to mitigating the worst effects of GCC.

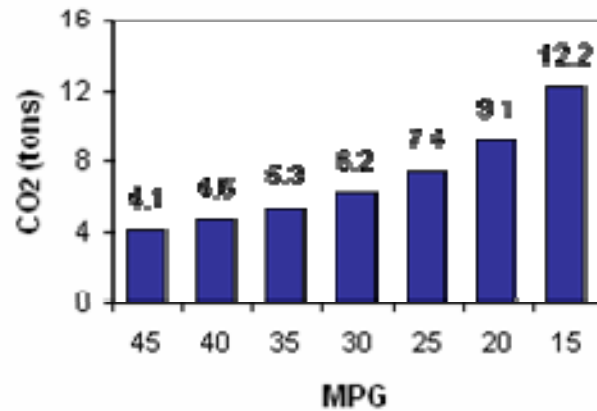


Figure 2. Relation of mpg to tons of CO₂ emitted per vehicle annually [3]

Solution

A solution for increasing fuel economy in order to significantly reduce the release of CO₂ is multifaceted and needs to be scientifically, economically, and politically feasible. It also needs to be intelligently implemented so that all of these factors can combine to produce desired results.

Scientific Feasibility

Much of the technology required to reach the desired efficiency already exists and the required new technology should not take long to develop if funding is appropriately applied. Existing hybrid cars are already achieving efficiencies of nearly 50 mpg, and this number can be radically increased by researching improved battery technology. Research into battery technology also benefits into other areas of renewable energies (e.g. wind and solar energy production) that are often restricted by limited storage capabilities. Thus, scientific breakthroughs here translate to other “wedges” in the carbon emission reduction plan. In internal combustion engine vehicles the engine size can be gradually reduced to improve efficiency. Currently there are automakers (Volkswagen for example) that use turbochargers in engines to improve the size-to-output ratio [4]. This allows for smaller, more efficient engines while still providing consumers with desirable power outputs.

Improvements can also be made outside of the engine to reduce energy losses that decrease fuel efficiency. Reducing vehicle weight reduces the amount of gas required to power a vehicle. Composite materials for both the engine and body can offer lighter weight cars without compromising safety. Investigations into better bearings, tires, and other wheel components that reduce rolling friction may reduce energy losses. Vehicle electrical systems efficiency improvements should also be implemented. A 200W load on the alternator reduces fuel efficiency by 1.7mpg [5]. Aerodynamic improvements to reduce drag losses result in improved fuel economy. A 2% reduction in aerodynamic drag translates to a 1% improvement in fuel efficiency [6].

Economic Feasibility

Without economic feasibility however, such technological improvements are impractical. As with most industries, economies of scale will reduce the cost of new technologies when they become more widespread. As the U.S. is one of the largest markets for automobiles, requiring imported cars to

meet efficiency standards would lead to the supply side being dominated by more fuel efficient vehicles. Global gas prices drive the market for vehicles with better mpg. In 2008 when gas prices were at an all time high demand for fuel efficient vehicles skyrocketed. Waiting lists for the Toyota Prius were weeks to months [7]. In the current economy the consumer's desire to save money by using less gas complements the need to reduce carbon emissions by doing the same thing. Providing American consumers with the vehicles they desire will help boost the faltering US auto industry as well. Finally, stimulating the production of a new fleet of fuel-efficient cars will provide jobs to the domestic automobile industry.

Political Feasibility

This is primarily a political initiative. The EPA must set regulations and standards for fuel efficiency as they have in the past with CAFE standards. It is possible to justify this not only on economic grounds, but security grounds, for oil use reductions will decrease our dependence on foreign oil and will reduce funding to petrodictators, thereby strengthening national and global security [8]. The first hundred days of the Obama administration is an ideal time to announce these initiatives, as not only does the American public expect a change in energy policy, but the Democratic majority in Congress makes enacting the CAFE standards much more feasible.

Implementation

As a basic framework 45 mpg will be required by 2031 and finally reach 60 mpg by 2056. With US leading initial improvements ahead of this projected pace the rest of the world will be encouraged to follow suit. Standards can also be tied to the government funding of the auto industry by reducing funding or imposing penalties for those companies that fail to comply and rewards to those that improve efficiencies beyond the minimum requirements. Trade agreements with foreign companies should be reworked to complement the goals set for domestic production. Taxes proportional to the efficiency of new vehicles purchased would encourage consumers to purchase the more efficient models.

As discussed in the scientific feasibility section, there are several technologies currently available that would enable significant initial mpg reductions. Once these methods are employed the improvement rate slows down and is more limited and controlled by technological breakthroughs. Revenue accrued during the time of the initial improvements should then be applied toward researching these technologies for further development.

Conclusion

With the U.S. leading the way, global CO₂ emissions can thus be reduced by 25 billion tons by 2056 by systematically increasing CAFE standards. It should be noted that beyond improved gas mileage of vehicles other measures can be taken to reduce carbon emissions in cars. For example, the electricity grid is currently fueled primarily by coal and thus produces a tremendous amount of CO₂. If the grid were replaced with or considerably supplemented by non-carbon renewable sources, plug in hybrids or electric vehicles would be an attractive carbon-reducing transportation option. Also, market signals can be used to reduce gasoline use. According to the Nobel Laureate economist Paul Krugman, a 10 percent increase in gas prices results in a 7 percent decrease in gasoline demand [9]. Assuming 142 billion gallons of gas is consumed annually in the US a 20 cent tax on gas would raise the prices enough to eliminate 10 billion gallons of gas from being used, resulting in 100 million tons of CO₂ reductions as well as a government profit of \$2 billion [10, 11]. In short, there is no limit to ways by which to reduce global carbon dioxide emissions, and the fuel efficiency increase standards outlined in this paper should be seen as a starting point. However, it is imperative that initiatives be taken *now* to address global climate change, for though there are many solutions, none of them will come easily, and global climate change is too important a problem to risk anything but a positive outcome.

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