CAFE Standards vs. a Carbon Tax:
A Comparative Analysis of Carbon Emission Reductions

Ike Brannon, Ph.D.
David Kemp
Capital Policy Analytics
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Executive Summary

Responding to the 1970s energy crisis, the federal government enacted Corporate Average Fuel Economy (CAFE) standards to reduce gasoline consumption. Forty years of evidence suggest that these standards have done relatively little to improve fuel efficiency or reduce emissions, while imposing high costs on consumers. We posit that CAFE standards should be replaced with a carbon tax to more efficiently reduce economy-wide carbon dioxide emissions and improve the environment.

The recent announcement by the Trump Administration of its intent to postpone the scheduled increase in the CAFE standards has galvanized the environmental community in opposition as they decry these actions as a threat to future progress in combating climate change.

The reality, however, is that CAFE standards have not been particularly effective at improving fuel efficiency—their ostensible purpose—and using the tool to reduce carbon emissions imposes high costs on U.S. drivers without achieving commensurate reductions in emissions. CAFE standards do not represent a costless technology-forcing policy, although they can be perceived as such.

We submit that a more effective (and less expensive) way to encourage automobile manufacturers to achieve greater fuel efficiency in their fleet would be to replace CAFE standards with an appropriately priced carbon tax.

Regulatory strategies may appear to some policymakers as a more politically appealing tool for the simple reason that voters may object to policies that explicitly lead to higher costs for driving. The reality, of course, is that drivers *do* pay a real price for regulation, and it is much higher than the cost of a tax set to achieve the same goal.

Introduction

One of the most significant environmental legacies of the Obama Administration was its increase in the CAFE standards. Standards set in 2011 by President Obama established that passenger cars and light trucks would be required to achieve an average fleet fuel economy of 54.5 miles per gallon by 2025. That is significantly above the 35 mpg standard set forth at the end of the Bush Administration for the 2020 model year.

Unlike the original implementation of CAFE standards in the 1970s, or the 2007 update passed by Congress and signed into law by President George W. Bush, the Obama Administration's intent in increasing standards was to not only reduce the consumption of gasoline but also reduce the emission of greenhouse gases.

At the time these new standards were adopted, they were considered highly ambitious, and it was unclear then (and now, for that matter) whether it is technically feasible for manufacturers to achieve these performance standards on this time frame. The 2016 Draft Technical Assessment Report produced by National Highway Traffic and Safety Administration (NHTSA), the Environmental Protection Agency (EPA), and the California Air Resource Board questioned the ability of automakers to meet the 54.5 mpg standard and suggested that it might be appropriate to reduce those standards.

The Trump Administration has done precisely that, recently moving to postpone the 2022-2025 increase in CAFE standards. If the administration's proposal is implemented the standards will be frozen at the 2021 level of 37 mpg with no current plans for future increases. The announcement has been met with protestations by many environmentalists. California Governor Jerry Brown stated that "Under [Trump's] reckless scheme, motorists will pay more at the pump, get worse gas mileage and breathe dirtier air. California will fight this stupidity in every conceivable way possible."[1] Various environmental groups have threatened to take legal

[1] Office of Edmund G. Brown Jr., "Governor Brown Issues Statement on Trump Administration's Proposal to Roll Back Clean Car Standard," August 2, 2018.

action to prevent any change in those standards, and California and 16 other states have already filed suit against the federal government.

However, a relaxation of scheduled increases of CAFE standards does not preclude meaningful reductions in greenhouse gas emissions from automobiles in the future. CAFE standards are a particularly inefficient way to reduce greenhouse gases—or to improve fuel efficiency, for that matter.

Mandating technological progress in one narrow sense—as CAFE standards dictate—inevitably results in a range of inadvertent consequences, and these have obviated many anticipated gains from the standards. For instance, the higher costs of producing cars that meet the stricter CAFE standards translates into higher retail prices for new automobiles. In response, drivers tend to hold onto their older, less-efficient cars longer, or purchase vehicles not completely covered by CAFE. For example, research suggests that the rise in popularity of pickup trucks in the last three decades appears to stem from cost increases that CAFE standards imposed on automobiles, and the looser standards that applied to a subset of trucks.

Forty years of evidence shows that CAFE standards have done relatively little to improve fuel efficiency standards or reduce emissions—as compared to higher gasoline prices or other regulatory actions—while imposing higher costs on consumers.[2]

There is a more efficient, less costly way to achieve a tangible reduction in emissions from motor vehicles—namely, a carbon tax. We suggest, in the soon-to-come battle over improved fuel efficiency standards, that both sides agree to replace CAFE standards with a carbon tax high enough to induce an equivalent reduction in automobile emissions.

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[2] See for example David R. Henderson, "The Economics of Fuel Economy Standards," *Regulation* 9, no. 1 (January/February 1985): 45-48; Andrew N. Kleit, "The Effect of Annual Changes in Automible Fuel Economy Standards," *Journal of Regulatory Economics* 2 (1990): 151-172; and Soren Anderson, Ian Parry, James M. Sallee, and Carolyn Fischer, "Automobile Fuel Economy Standards: Impacts, Efficiency, and Alternatives," Resources for the Future Discussion Paper no. 10-45, October 2010.

Putting a price on carbon emissions creates incentives for producers to reduce emissions and to do so in the least expensive way possible. A carbon tax—or any Pigouvian tax, for that matter—will not necessarily induce all producers to take steps to reduce emissions: producers that find it particularly costly to reduce emissions may find it more cost-effective to simply pay the tax, while others will decide to reduce emissions if doing so is less costly for them than paying the tax. The tax motivates the market to collectively make cost-effective decisions to achieve emissions reductions.

History of CAFE Standards

Congress first enacted CAFE standards via the Energy Policy and Conservation Act of 1975, which was a response to the 1973-74 oil embargo and an attempt to reduce America's dependence on foreign oil producers. The Act established the Strategic Petroleum Reserve, imposed a ban on the exportation of crude oil, and provided subsidies to domestic oil producers—all of which are in place in some form to this day.

The legislation also created energy conservation standards for myriad consumer products and fuel economy standards for passenger vehicles. The basis for government intervention in the market to create these standards was the notion that consumers undervalue energy efficiency and do not fully account for future fuel costs when purchasing a car.

The law assigned the task of administering CAFE standards to the NHTSA. Initially, the NHTSA only applied CAFE standards to passenger cars, and set the average fuel economy for each car manufacturers' fleet at 18 miles per gallon for model year 1978. It also required average fuel economy to reach 27.5 miles per gallon by 1985. NHTSA began to apply CAFE standards to light trucks—including minivans, SUVs, and pickup trucks—beginning with model year 1979, with a standard of 17.2 miles per gallon.[3]

In 2007, with oil prices approaching $150 a barrel, Congress again became preoccupied with improving energy efficiency. Congress passed the

[3] Thomas Klier and Joshua Linn, "Corporate Average Fuel Economy Standards and the Market for New Vehicles," Federal Reserve Bank of Chicago Working Paper no. 2011-01.

Energy Independence and Security Act of 2007, which, for the first time, raised CAFE standards. The act required car manufacturers to reach a fleetwide goal of 35 miles per gallon by 2020 for passenger cars and light trucks.

In 2009 the Obama Administration accelerated the compliance date for the average fuel economy of 35 mpg to the 2016 model year. Additionally, the Administration announced that, for the first time, CAFE standards would be used to regulate the greenhouse gas emissions of cars and trucks. To accomplish this, it provided joint authority for CAFE administration to both the NHTSA and the EPA.

Under this new authority, the EPA and NHTSA announced new, higher rules in 2010 that, like the old CAFE standards, determined each manufacturer's average fleet performance using a production-weighted average of vehicle performance targets. However, the new calculation also included a new component: vehicle footprint. Car manufacturers are now required to meet standards that are based on the size of vehicles, with smaller cars required to meet higher standards and larger cars adhering to less stringent standards. This means that the manufacturers are incentivized to reach higher fuel economy in a specific vehicle size class, but are also incentivized to build larger average vehicles and thus face lower standards overall.

These rules, which took effect in 2012, constituted a compromise between federal regulators, car manufacturers, and state regulators—primarily the California Air Resources Board.[4] Under the Clean Air Act, California has the unique ability to enact more stringent clean air standards than the federal government, provided they receive a waiver from the EPA. The result of the compromise was more stringent standards requiring a fleet average fuel economy of 54.5 mile per gallon by 2025.

The Trump Administration recently announced their intention to freeze CAFE standards at 2021 levels, at a fleet average fuel economy of about 37

[4] Jody Freeman, "The Obama Administration's National Auto Policy: Lessons from the 'Car Deal,'" *Harvard Environmental Law Review* 35, no. 2 (July 2011): 343-374.

mpg.[5] The stated justification for the change focused on the technological difficulties in complying with the 2025 standards and the lower incremental returns from further increases in fuel economy.

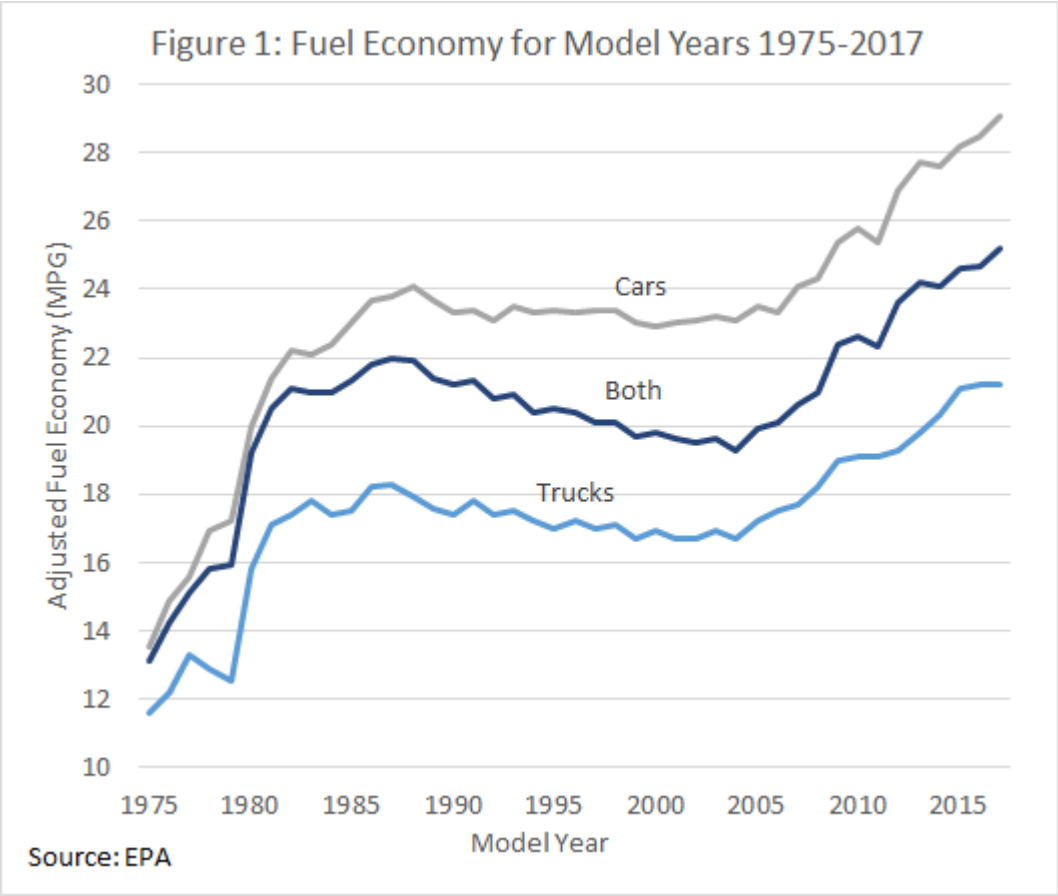
Presently, CAFE standards and CO_2 emissions standards remain the only tools with which the federal government regulates the greenhouse gas emissions of passenger cars and trucks. The EPA also regulates emissions from stationary sources via the regulatory power given to it by the Clean Air Act. Top-down regulations such as these are more costly and less effective compared to market-based mechanisms, particularly a carbon tax.

Efficacy of CAFE Standards

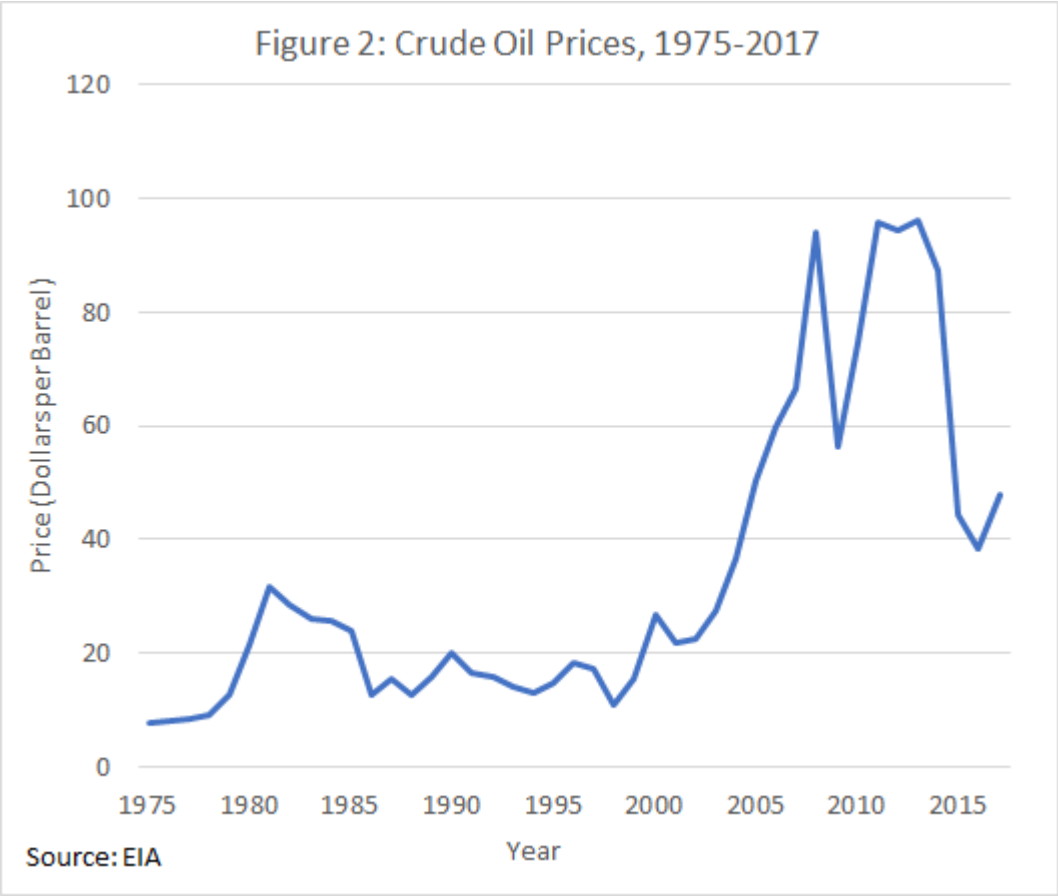
The average fuel efficiency for cars driven in the U.S. has increased substantially in the four decades following the advent of CAFE standards. However, these standards have not been the sole reason for that occurrence. It is all but impossible to disentangle the impact of CAFE standards, higher fuel prices, and myriad other factors on fuel economy increases.

Figure 1 shows that fuel economy in cars and light trucks increased rapidly between 1975 and 1985 and again after the mid-2000s. The first increase occurred concurrently with the initial implementation of the standards between 1978 and 1985. The second increase coincides with the 2007 Energy Independence Act's imposition of higher standards and the progressively more stringent standards since then.

[5] NHTSA and EPA Notice of Proposed Rulemaking, "The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks," August 2, 2018.



However, at the same time that the United States began to impose fuel economy standards, gasoline prices increased as well. Figure 2 shows that for both periods during which average fuel economy increased, oil prices were also increasing, which increased demand for fuel-efficient autos.



The argument for implementing CAFE standards in lieu of taxes largely rests on the assumption that consumers are too myopic or otherwise constrained to make a cost-optimal choice. However, the economic literature has found mixed evidence in this regard. While a recent EPA review suggested that consumers significantly undervalue fuel economy, other studies suggest that consumers correctly perceive or even overestimate the potential savings of greater fuel efficiency.[6]

Economists Antonio Bento, Shanjun Li, and Kevin Roth argue that many of the studies devoted to this question ignore consumer heterogeneity.[7] They contend that when different consumer preferences are not accounted for, the estimates of consumers' willingness to pay for increased fuel economy is biased and the undervaluation of fuel economy is exaggerated.

[6] See David L. Greene, "How Consumers Value Fuel Economy: A Literature Review," Environmental Protection Agency, March 2010.
[7] Antonio M. Bento, Shanjun Li, and Kevin Roth, "Is there an energy paradox in fuel economy? A note on the role of consumer heterogeneity and sorting bias," *Economics Letters* 115 (2012): 44-48.

More recent papers have found either modest undervaluation or no undervaluation. For instance, Hunt Allcott and Nathan Wozny estimate that consumers are willing to pay only 79 cents for one dollar in discounted fuel cost savings.[8] Meghan Busse, Christopher Knittel, and Florian Zettelmeyer found that an increase in fuel prices of $1 per gallon is associated with a large change in the relative prices of used and new cars (a reduced quantity demanded for pricier new cars and higher demand for used cars), as well as significantly increased market share for new car models with the highest fuel economy.[9] Further, Laura Girgolon, Mathias Reynaert, and Frank Verboven found that while consumers in Europe modestly undervalue fuel economy, a fuel tax would more effectively reduce total fuel usage, especially when considering consumer heterogeneity.[10]

Even if consumers correctly value or modestly undervalue fuel economy, they may not have the necessary information to properly account for it. For instance, Ian Perry, Carolyn Fischer, and Winston Harrington suggest that consumers find it difficult to discern short-term versus long-term price fluctuations in gasoline prices, and therefore cannot properly decide on the optimal car to purchase.[11]

For people predisposed toward driving pickup trucks, such a calculus may be irrelevant. Economist Benjamin Leard suggests that the owners of light-duty trucks may not pay attention to fuel costs in their vehicle purchase decision at all; he notes that in parts of the West it is not uncommon for people to use F-350s as commuting vehicles despite the fact that this makes little economic sense, as the vehicle is optimized for off-road activity. Leard suggests the vehicle's function may be more of an expression of personal identity or status than actual use of its technical design capabilities, a

[8] Hunt Allcott and Nathan Wozny, "Gasoline Prices, Fuel Economy, and the Energy Paradox," NBER Working Paper no. 18583, November 2012.
[9] Meghan R. Busse, Christopher R. Knittel, and Florian Zettelmayer, "Are Consumers Myopic? Evidence from New and Used Car Purchases," *American Economic Review* 103, no. 1, 220-256.
[10] Laura Girgolon, Mathias Reynaert, and Frank Verboven, "Consumer valuation of fuel costs and tax policy: Evidence from the European car market," Toulouse School of Economics Working Paper no. 17-836, August 2017.
[11] Discussion paper 04-53, Resources For the Future, Washington, DC.

reality that makes understanding consumer sentiment difficult and one that is not unique to this cohort.[12]

But positing a world where car buyers have myriad variables in their preference function does not discount the idea that prices can induce them to buy more fuel-efficient cars—it merely suggests that it may take a higher fuel price to convince them to obtain a more fuel-efficient vehicle.

Unlike a tax, fuel economy standards create significant inefficiencies. Among these is a "rebound effect." As CAFE standards reduce the cost of driving, people begin to drive more. The rebound effect of U.S. fuel economy policies is conservatively estimated to be between 5 and 30 percent.[13]

CAFE standards also incentivize consumers to use older vehicles that emit more pollutants, which further weakens the impact of the standards. As increased fuel economy standards raise the prices of new vehicles, demand for used vehicles also increases. This, in turn, leads to consumers buying and holding onto cars, particularly large and inefficient vehicles, for much longer than they otherwise would have. Mark Jacobsen and Arthur van Bentham examined vehicle scrappage rates and found that the increased use of previously owned, fuel-inefficient vehicles offsets the impact of CAFE by about 15 percent.[14]

Additionally, by creating separate standards for passenger vehicles and light trucks, CAFE may have helped incentivize a counter-productive increase in the number of new trucks and SUVs bought in the U.S. Because light trucks have lower standards, car manufacturers have been incentivized to build car-like vehicles that qualify as trucks. Between 1978 and 2003, light-truck sales increased from 3 percent of total vehicle sales to

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[12] Leard, Benjamin, "Consumer Inattention and the Demand for Fuel Cost Savings,Resources for the Future Report, May 2018.
[13] Kenneth Gillingham, Matthew J. Kotchen, David S. Raspon, and Gernot Wagner, "The rebound effect is overplayed," *Nature* 493 (January 2013): 475-476. See also Gernot Wagner, "Nature: The Rebound Effect is Overplayed," Huffington Post, March 26, 2013.
[14] Mark R. Jacobsen and Arthur A. van Benthem, "Vehicle Scrappage and Gasoline Policy," *American Economic Review* 105, no. 3 (March 2015): 1312-38.

50 percent.[15] While other factors played a role in this increase—such as a shift away from station wagons to minivans and increased use of SUVs as family cars—it is reasonable to conclude that the incentives created by CAFE standards contributed to the increase.

The inefficiencies of CAFE make it a costly tool to reduce gasoline consumption and, incidentally, greenhouse gas emissions as well. By mandating expensive reductions in passenger-vehicle fuel consumption, CAFE standards, even in conjunction with market-based policies, supplant other, potentially more effective, tools to reduce fuel consumption.[16]

Economist Randy Lutter suggested that a modest increase in the gas tax--five to ten cents a gallon--could generate the same fuel efficiency increases that the pre-2007 CAFE standards engendered.[17] It is worth noting that a tax itself is not a cost; rather, it transfers the cost of emissions to drivers. If the tax were to precisely equal the external cost of carbon emissions there would be no deadweight loss.

A carbon tax that appropriately prices the externality can achieve the same emissions reduction goals of CAFE at a much lower cost. Specifically, economists have estimated that CAFE standards cost 3–6 times as much as a carbon tax for an equivalent reduction in fuel consumption.[18] However, because of largely political reasons, CAFE remains the primary tool used to regulate vehicle greenhouse gas emissions.

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[15] Soren T. Anderson, Carolyn Fischer, Ian Parry, and James M. Sallee, "Automobile Fuel Economy Standards: Impacts, Efficiency, and Alternatives," NBER Working Paper no. 16370, September 2010.
[16] Valerie J. Karplus, Sergey Paltsev, Mustafa Bibiker, and John M. Reilly, "Should a vehicle fuel economy standard b combined with an economy-wide greenhouse gas emissions constraint? Implications for energy and climate policy in the United States," *Energy Economics* 36 (March 2013): 322-333.
[17] For a discussion see Lutter, Randall "CAFE: The Numbers Behind the Story", AEI-Brookings Joint Center for Regulatory Studies, Policy Matters 02-1, 2002.

[18] See David Austin and Terry Dinan, "Clearing the air: The costs and consequences of higher CAFE standards and increased gasoline taxes," *Journal of Environmental Economics and Management* 50, no. 3 (November, 2005): 562-582; and Mark R. Jacoben, "Evaluating U.S. Fuel Economy Standards In a Model with Producer and Household Heterogeneity," *American Economic Journal: Economic Policy* 5, no.2: 148–87.

Regulatory vs. Market-Based Approaches to Reducing Carbon Emissions

Attempts to reduce carbon emissions through a top-down approach results in a complex system of regulations that collectively fail to effectively address the multitude of decisions that individuals and firms make that lead to carbon emissions.[19] Market-based solutions to reduce carbon emissions incentivize low-cost emissions abatement and are invariably more efficient than inflexible and often-complex regulations. Thomas Tietenberg suggests that market-based instruments can achieve emission reductions that are 40 to 95 percent greater than command-and-control regulations.[20]

The heterogeneity of emissions generators makes regulations costly. Similar standards applied to all firms create unequal costs and force some firms to use inordinately expensive methods to control their emissions. Strict performance standards such as maximum emissions rates and energy-efficiency standards also unevenly burden firms as different fuel sources require more expensive measures to reduce emissions to meet the standards.[21]

Additionally, the amount of information needed to identify the most cost-effective ways to reduce emissions make top-down regulations inefficient.[22] Market-based instruments incentivize those with the most information—firms and plant managers—to make the necessary decisions that reduce carbon emissions.

Regulations may also disincentivize innovation. The imposition of uniform emissions standards deters firms that find it inexpensive to reduce emissions below the maximum allowed level. For instance, Robert Stavins argues that "a business that adopts a new technology may be 'rewarded'

[19] N. Gregory Mankiw, "A Carbon Tax That America Could Live With," *New York Times*, August 31, 2013.
[20] T.H. Tietenberg, *Emissions Trading: Principles and Practices* (Washington, DC: Resources for the Future, 2006), 58-59.
[21] Alan Krupnick and Ian Parry, "What is the Best Policy Instrument for Reducing CO_2 Emissions?" in *Fiscal Policy to Mitigate Climate Change: A Guide for Policymakers*, eds. Ruud A. de Mooij, Michael Keen, and Ian W.H. Parry (International Monetary Fund, 2012), 10.
[22] See T.H. Tietenberg, *Emissions Trading: Principles and Practices* (Washington, DC: Resources for the Future, 2006), 26.

by being held to a higher standard of performance and not given the opportunity to benefit financially from its investment, except to the extent that its competitors have even more difficulty reaching the new standard."[23]

The Case for a Carbon Tax

Unlike CAFE standards, a carbon tax would incentivize reduced fuel consumption while allowing the market to determine the most effective methods for reducing emissions.

Market-based policies transparently apply the social cost of carbon emissions--that is, the estimate of the economic damages of a small increase in the amount of CO2--without burdening firms and individuals with excessive costs.

Carbon taxes are also more efficient than cap-and-trade systems. Whereas carbon taxes impose a preordained price on carbon emissions, cap-and-trade systems set a maximum cap for aggregate carbon emissions and allot permits to firms allowing them a certain amount of emissions.

Determining the optimal emissions level and the initial distribution of permits make cap-and-trade more complex than a carbon tax. A tax can easily be applied to all carbon emissions, but a cap-and-trade system would require the creation of a new market and a new bureaucracy to administer this market.[24]

Decisions on how to initially allocate permits across various industries can become exceedingly complex and lead to rent-seeking. The high value of permits creates significant incentives for firms to lobby to receive them.[25] Moreover, allocating permits *ex-ante* means that a cap-and-trade scheme would generate less government revenue.[26]

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[23] Stavins, 2.
[24] Gilbert E. Metcalf, "A Proposal for a U.S. Carbon Tax Swap: An Equitable Tax Reform to Address Global Climate Change," The Brookings Institution Discussion Paper 2007-12, October 2007, 24.
[25] Metcalf, 23.
[26] Mankiw, 2009, 18.

Carbon taxes also have much less cost uncertainty. A tax provides a known future cost of emissions, at least in the short run, which allows firms to effectively adapt to generation cost changes.

Conclusion

A tendency that bedevils many of those who devote their careers or their money to fighting environmental crusades is the desire to force some specific technological change or innovation upon the economy.

However, a particular "chosen" innovation may not, in fact, be the optimal, most cost effective strategy to reduce carbon emissions. The efficient path toward a targeted level of emissions will depend on myriad technological and policy changes in the coming years, and to some degree *those* changes will depend on the incentives we create to achieve such an outcome.

Reducing emissions by mandating precise technological outcomes—such as higher fuel-efficiency from passenger vehicles—may get us to the optimal outcome, but the odds are against it. If such changes prove to be difficult for automakers to achieve, then we end up forcing U.S. consumers to pay more than necessary to reduce emissions. What is more, fuel-efficiency mandates have already been shown to be somewhat counterproductive, as drivers evade the higher costs imposed by CAFE standards by driving further and driving older, less fuel-efficient cars. A more cost-effective way to achieve emission reductions would be to impose a carbon tax in place of a fuel-efficiency standard.

Regulatory strategies may appear to some policymakers as a more politically appealing tool for the simple reason that voters may object to policies that explicitly lead to higher costs for driving. The reality, of course, is that drivers *do* pay a real price for regulations, and it is much higher than the cost of a tax set to achieve the same goal.