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# **Do the Benefits of Tightening CAFE Outweigh the Costs?**

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## **Executive Summary**

Proponents of tightening the Corporate Average Fuel Economy (CAFE) standards for passenger vehicles point to potential benefits in terms of reduced greenhouse gas emissions and oil dependency. However, a full assessment of the economic benefits and costs of tightening CAFE should take into account prior fuel taxes, its impact on a broad range of social costs arising from automobile use, and the value of fuel-saving benefits relative to added vehicle costs.

This paper reviews the evidence on each of these considerations. Some estimates of the costs of oil dependency and carbon emissions per gallon actually fall short of existing fuel taxes, suggesting that motorists are already charged for a substantial portion of these social costs, if not overcharged. And the costs of added congestion, traffic accidents, and local pollution as people drive their vehicles more in response to lower per mile fuel costs could also be sizeable relative to carbon and oil dependency benefits. However, a number of engineering studies suggest that many technologies for improving fuel economy could more than pay for themselves in terms of fuel savings over vehicle lifetimes, though there is much dispute about this among policy analysts. If net fuel savings are positive, tightening CAFE could still produce significant economic gains overall, despite prior fuel taxes and additional driving.

Even so, other policies, such as broad-based oil taxes, carbon taxes, and tradable carbon permits, are far superior instruments for reducing oil dependency and carbon emissions. This is because they exploit opportunities for emissions reductions and oil conservation throughout the economy; in contrast, CAFE places the entire burden on passenger vehicles, which account for only a fraction of economy-wide carbon emissions and oil consumption.

## 1. Introduction

Many environmentalists and their Congressional allies were dismayed by the Bush Administration's decision to withdraw from the Kyoto Protocol signed by President Clinton. They also tried unsuccessfully in Spring 2002 to mandate new Corporate Average Fuel Economy (CAFE) standards, which would have helped to reduce both greenhouse gases and oil dependency, instead settling for a mandate that the National Highway Traffic Safety Administration should review the current standards.<sup>1</sup> Regardless of the conclusion of that review, the question of whether to tighten CAFE standards will likely be raised again, as CAFE has considerable appeal among many political constituents.

Leaving aside the politics of CAFE, and also distributional effects, its economic merit depends on its expected costs and benefits, and these are worth assessing carefully. In making this assessment, it is important to consider a number of potentially important factors. First, tightening CAFE may have an impact on a broad range of social problems associated with motor vehicle driving. By lowering the (gasoline) costs of driving, improved fuel economy could have perverse effects on traffic congestion and the number of traffic accidents, as people drive their vehicles more. Second, at least to some extent, the social costs of greenhouse gas emissions and oil dependency are already captured in fuel prices through gasoline taxes. And third, the net benefit/cost of improved fuel economy will depend to a significant degree on the value of fuel saving benefits over vehicle lifetimes, relative to the added vehicle costs.

It is also important to consider alternatives to CAFE, such as broad-based carbon and oil taxes, that might achieve desired policy goals at lower cost to society. These other measures exploit all potential sources of emissions and oil reductions throughout the economy, rather than imposing the entire burden on passenger vehicles, which account for only a fraction of economy-wide greenhouse gases and oil consumption.

Nonetheless, the most cost-effective instruments may not be the most practical at the moment, because of political constraints.<sup>2</sup> It is also conceivable that tighter CAFE standards may become part of a package of measures that might include, for example, carbon controls in the

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<sup>1</sup> The CAFE program, which requires auto manufacturers to increase the average fuel economy of their vehicle sales, was initiated after the 1973 oil price shock. Currently, the CAFE standards are 27.5 MPG (miles per gallon) for cars and 20.7 MPG for light-duty trucks (SUVs, minivans and pickups). The Kerry-McCain bill, which was recently rejected by the Senate, would have boosted the CAFE standard to 36 MPG for all passenger vehicles by 2015.

<sup>2</sup> There is very strong opposition to energy taxes. For example, despite a major effort, the Clinton Administration was only able to increase the federal gasoline tax by 4 cents/gal in 1993.

electricity sector.<sup>3</sup> Thus, while far from an ideal policy, higher fuel economy standards are still worth assessing on their own merit.

The purpose of this article is to provide a non-technical framework for thinking about the costs and benefits of higher fuel economy standards, and their cost-effectiveness in achieving policy objectives, compared with other instruments.<sup>4</sup> We begin by summarizing evidence on the social costs of oil dependency and carbon emissions; perhaps surprisingly, many estimates fall short of current fuel taxes, although estimates are subject to much dispute. We then discuss additional costs of CAFE resulting from the “rebound effect”; this refers to possible increased costs of congestion, accidents, and local air pollution as lower fuel costs induce people to use vehicles more intensively. Costs from the rebound effect could actually be as large as benefits from reduced oil dependency and carbon emissions. On the other hand, engineering studies often suggest that higher CAFE standards will induce manufacturers to incorporate vehicle technologies that more than pay for themselves in terms of fuel saving benefits. If so—and this is a contentious issue—tightening CAFE may be beneficial overall, despite fuel taxes and the rebound effect. The latter part of the paper discusses other policy alternatives that might reduce carbon emissions and oil dependency at lower social costs than those resulting from higher fuel economy standards.

## 2. Social Costs of Gasoline Consumption

Economists justify policy intervention to reduce the amount of gasoline consumption on externality grounds. An “externality” occurs when drivers impose costs on other people whom they do not take into account when deciding how much to drive, or what class of vehicle to use. An extensive literature attempts to measure the external costs associated with motor vehicle driving, although uncertainty and controversy often surround the estimates.

*Oil Dependency.* Analysts have called attention to the relation between oil price volatility and macroeconomic performance. This relation has weakened over time; the oil intensity of GDP has halved over the last 30 years. We might expect that the benefits of oil price reductions would offset the costs of price increases; however the empirical literature has identified an apparent asymmetry in these responses: rising oil prices seem to reduce economic growth more than falling prices increase

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<sup>3</sup> Two proposed bills to reduce utility emissions that have been reported by the Senate environment committee would impose caps on carbon emissions in addition to reducing conventional air pollutants, although the Bush Administration’s Clear Skies Initiative would not regulate carbon (see [www.rff.org/multipollutant](http://www.rff.org/multipollutant)).

<sup>4</sup> Policymakers might be concerned about other effects of CAFE, such as the implications for employment, and the competitiveness and profitability of the US auto industry. These issues are beyond the scope of our discussion.

it (see Hamilton, 1996). To the extent that this asymmetry is due to adjustment costs elsewhere in the economy (e.g., the costs of temporarily idled labor and capital as energy-intensive industries contract) that are not taken into account by energy consumers and producers, there can be an externality. Vulnerability to volatility of oil prices depends on total oil consumption relative to GDP and not simply on the level of imports—even if the United States produced all its own oil, it would still suffer from supply disruptions elsewhere in the world because the price of oil is determined in world markets. The only way to reduce vulnerability to oil price spikes is to further reduce the oil intensity of GDP.

Another issue has to do with market power. Production restraint by a few low-cost producers in the Middle East, notably Saudi Arabia, keeps the price of oil far above its per unit production cost in those countries. Individual oil importers in the United States have no ability to influence the world price; however, the United States as a whole can be said to have monopsony power in the world oil market. This means that policies designed to reduce US oil imports will lower the world price, thereby benefiting all US oil importers. Again, the magnitude of this “externality” is uncertain, as it depends on how OPEC suppliers, and other oil-importing countries, would respond to a change in price (e.g., Leiby et al. 1997).

Based on available evidence, a recent panel of experts (National Research Council 2002) put the combined macroeconomic and monopsony externalities at \$5 per barrel of oil, or 12 cents per gallon of gasoline, with a range of 2-24 cents. Seven recent studies summarized by the California Energy Commission (2003) put the cost at between 0 and 31 cents per gallon.

Arguably, there are other costs of oil dependency, such as the power that oil gives to undemocratic governments in the Middle East, although these costs are difficult to quantify.<sup>5</sup>

*Climate Change.* A number of studies attempt to measure the damages from carbon emissions by assessing the economic impacts of future climate change on agriculture, the costs of protecting valuable coastal regions from sea level rise, and so on.<sup>6</sup> These estimates are highly speculative and

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<sup>5</sup> It is often argued that we need to maintain a larger military in order to ensure uninterrupted oil supplies from the Middle East, and that the military expenditures constitute another source of externality. However the amount of extra military expenditure is tricky to assess; for example, some Middle East military spending is to protect the security of Israel. Moreover some research (e.g., Bohi and Toman 1996) suggests that we may not need to spend more to ensure a continued supply of imports because it would be hard for Middle East countries to prevent other countries they supply from redirecting oil to the US. Even if they were successful in stopping such shipments to the US, the sharp increase in world oil prices would provide strong incentives for other OPEC members to defect and sell to the US, or for non-OPEC suppliers such as Canada, Russia, and Mexico, to increase production.

<sup>6</sup> See for example Nordhaus (1994), Fankhauser (1994), and Tol et al. (2000).

controversial. For example, it is difficult to assign a value to the ecological impacts of climate change (such as species extinction); there is much controversy over the appropriate discount rate to use for converting future damages into current dollars; and it is also difficult to allow for the small likelihood of catastrophic climate change from possible instabilities within the climate system. Furthermore, poor countries tend to be the most vulnerable to climate change, as agriculture is a larger share of their GDP; aggregate damage estimates can obscure potentially adverse effects on the distribution of world income.

Most of the damage estimates in the literature are below \$50/ton of carbon, if not below \$25/ton (Tol et al. 2000); however a few studies obtain much higher estimates (e.g., Azar and Sterner 1996).<sup>7</sup> One reason for the fairly moderate “mainstream” damage estimates is that the huge bulk of world GDP—manufacturing and services—is not very sensitive to the changes in climate predicted over the next century. Another is that the effects of current emissions may not be felt for several generations, because oceans slow the adjustment to higher temperatures, and even a small amount of discounting reduces economic costs dramatically in present value terms. The National Research Council (2002) put the external costs of carbon emissions at \$50 per ton, which translates into about 12 cents per gallon of gasoline, or roughly 8% of the retail price of gasoline.<sup>8</sup>

*Summary and Comparison with Gasoline Taxes.* In principle, an economically efficient tax to address fuel-related externalities would equal the external costs per gallon; that way, people would take into account the full social costs of fuel consumption when deciding how much to drive, and whether to drive a vehicle that is relatively fuel efficient versus one that is relatively inefficient.<sup>9</sup> If this tax were imposed, it effectively removes the economic distortion in the gasoline market created

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<sup>7</sup> For comparison, if the US were to meet its initial pledge under the Kyoto Protocol—which would have required emissions reductions of about a third below projected US emissions in 2010—the required carbon tax (or permit price under a system of tradable carbon allowances) would have been around \$50 to \$150/ton of carbon (e.g., CEA 1998). In other words, this abatement would probably have been excessive on pure externality grounds, according to most estimates.

<sup>8</sup> On the other hand, a \$50/ton carbon tax would more than double the price of coal. This underscores the point emphasized later that a cost-effective strategy to reduce carbon emissions would include reducing coal consumption, in addition to gasoline.

<sup>9</sup> There are other externality justifications for fuel taxes, particularly their impacts on reducing mileage-related externalities such as congestion. In fact Parry and Small (2003) computed the optimal fuel tax at around \$1 per gallon. However, this does not affect the point that the net efficiency benefit/cost per gallon of reduced fuel demand equals the external cost per gallon minus the fuel tax.

Another issue has to do with the earmarking of gasoline taxes for highway spending. It follows that, if reduced gasoline demand erodes the amount of fuel tax revenue and therefore highway spending, then the net economic benefit per gallon of reduced gasoline consumption is equal to the external cost per gallon minus the product of the gasoline tax rate and the social value per dollar of extra highway spending. Therefore, if highway spending has a high social value (in excess of a dollar per dollar of spending) this makes it more likely that the net economic benefit from reducing gasoline consumption is negative.

by externalities. If the gasoline tax is less than external costs per gallon, people are not charged for full social costs; consequently they consume too much fuel from society's perspective and a policy, such as tightening CAFE, that reduced fuel demand would enhance economic efficiency. Conversely, if the fuel tax exceeds external costs, people are already overcharged for fuel, and reducing demand further reduces economic efficiency.

The current fuel tax in the US averages about 40 cents per gallon.<sup>10</sup> If we follow the National Research Council (2002) and assume external costs of 12 cents per gallon for both oil dependency and carbon emissions, this yields a total of 24 cents per gallon, which is well short of the current fuel tax. Of course, if we assume higher estimates the combined costs can easily exceed the fuel tax; for example if oil dependency costs are \$15 per barrel and carbon damages are \$100 per ton, external costs are 54 cents per gallon. Nonetheless, based on the available evidence it is (perhaps surprisingly) unclear that the reduction in gasoline demand itself actually improves economic efficiency.

### **3. Costs of the Rebound Effect**

An improvement in fuel economy is thought to induce a “rebound effect” on the level of driving: as the fuel costs of driving a mile decline, most likely people will drive their vehicles a bit more. There is disagreement over how large the rebound effect is, but based on the existing evidence the increase in demand for gasoline as people drive more appears to offset around 10%-20% of the initial fuel reduction from tighter standards (e.g., Greene et al., 1999). This effect sounds relatively modest, but the economic efficiency costs of the rebound effect can still be significant, because the costs of mileage-related externalities—congestion, accidents, and local pollution—are fairly substantial. We consider each of these in turn.

*Congestion.* To estimate the societal costs of traffic congestion, studies have assessed how much time is lost because people are driving at slower speeds than they would be if roads were free-flowing, and then multiplied this amount by a value for people's time (measured at roughly one-half the market wage rate). Obviously congestion costs can be quite high in urban areas at peak periods, and low or zero at off-peak periods or in rural areas. A “best estimate” for the economy-wide marginal congestion cost, one that reflects the shares of driving in both rural and urban areas and at peak- and off-peak periods, as well as the reduced driver responsiveness to fuel taxes at peak

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<sup>10</sup> This consists of 18 cents at the federal level and, on average, about 22 cents at the state level. For comparison, the UK gasoline tax, the highest among industrial countries, is equivalent to about \$2.80/gal.

periods, is 3.5 cents per mile (Parry and Small 2003). This translates into about \$1 per gallon of gasoline, assuming average fuel economy is 20 miles per gallon.<sup>11</sup>

*Traffic Accidents.* The societal cost of traffic accidents largely depends on human fatalities and injuries—in the US around 40,000 people are killed on the roads each year. Other costs include traffic hold-ups and property damage. It is tricky judging what portion of accident risks individuals might take into account in their driving decisions, and what portion they do not consider. It seems plausible that people will take into account the injury risks to themselves (and other vehicle occupants), and some of the property damage if they anticipate higher insurance premiums following a claim. Most likely, they will not take into account the costs of traffic delays or the injury risk to pedestrians. Whether extra driving by one person increases the accident risk to other drivers is not clear: the frequency of collisions rises with more traffic on the roads but, if people drive more slowly or more carefully in heavier traffic, a given accident will be less deadly. Based on available evidence, Parry and Small (2003) put the average accident externality at around 3 cents per mile (60 cents per gallon) for the US.<sup>12</sup>

*Local Air Pollution.* Gasoline combustion causes local air pollution, notably carbon monoxide, and hydrocarbons that react with sunlight to form smog. Recent studies suggest that the combined environmental costs from these pollutants amount to, very roughly, 2 cents per mile (40 cents per gallon).<sup>13</sup> These damage assessments mainly reflect harmful effects on human health from dirty air, especially mortality effects on seniors, though visibility and other environmental costs are also included. In assessing these damages, studies use epidemiological evidence on the link between air quality and human health, and they measure people's willingness to pay for reducing mortality risk at the equivalent of several million dollars per death avoided.<sup>14</sup> Damage estimates have dropped

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<sup>11</sup> Averaging over the current standards for cars and light trucks, and scaling back 15% because on-road fuel economy is lower than EPA-required dynamometer testing, gives the above figure.

<sup>12</sup> The effect of tighter CAFE standards on safety through changes in vehicle technology (as opposed to changes in miles driven) is especially difficult to assess. Manufacturers have a variety of design options for improving fuel efficiency, some of which involve reducing vehicle size and weight; both downsizing and downweighting tend to put vehicle occupants at higher risk in the event of a collision, even if people drive more carefully.

However the issue is complicated. People may crash less often if they drive more carefully in smaller vehicles. Furthermore, the risks to a driver depend on the composition of the vehicle fleet—if most of the weight reduction occurs in light trucks rather than cars, there could be an overall improvement in road safety. Moreover, from a pure economic efficiency perspective, it is the change in the external component of accident costs that matters: even if more fuel efficient vehicles are less safe for their drivers these risks may be taken into account when people choose vehicles and how much to drive them.

<sup>13</sup> See for example, Small and Kazimi (1995), McCubbin and Delucchi (1999), Krupnick et al. (1997) and US FHWA (2000).

<sup>14</sup> This is based on, for example, evidence about how much people are willing to accept in lower wages to take jobs with lower risks of occupational fatalities.

significantly over the last two decades as new cars have become cleaner, and they should continue to fall as emissions-per-mile standards on new vehicles are tightened under EPA's Tier II rules. Roughly speaking, local pollution emissions are proportional to miles driven rather than gasoline consumed. This is because emissions standards on new vehicles are defined on a grams-per-mile basis, and there is much less deterioration of state-of-the-art abatement technologies over vehicle lifetimes.<sup>15</sup>

Summing up, according to estimates of the rebound effect, each gallon reduction in fuel use from improved fuel economy will be offset by about a 0.15 gallon increase as people drive their vehicles more. If 20 miles are driven on each gallon of gasoline, then the rebound effect will increase driving by 3 miles per initial gallon of fuel reduction. Using the above estimates, this leads to a cost of  $3 \times (3.5 + 3 + 2) = 25.5$  cents. This loss is actually slightly greater than the per-gallon benefits from reduced oil dependency and carbon emissions assumed by the National Research Council (2002)!

#### **4. Vehicle Costs and Benefits of Improving Fuel Economy**

A particularly controversial issue is whether, leaving aside externalities, the market would provide the economically efficient level of fuel economy. A number of engineering studies suggest that there is a wide range of technological possibilities for improving new vehicle fuel economy, for which the discounted fuel saving benefits over the vehicle lifetime would exceed added vehicle production costs. For example, an extensive analysis by the National Research Council (2002) found that the marginal value of fuel saving benefits might exceed the marginal vehicle cost for improvements in fuel economy from zero to as much as 50% above current standards, across a wide range of different vehicles. This suggests that more stringent CAFE standards might produce a source of net economic benefits.

There are a number of possible explanations as to why manufacturers may not adopt so-called "no-regrets" technologies that would seem to pay for themselves in terms of fuel saving benefits. For example, consumers may undervalue future fuel saving costs because they lack information, have short horizons, or are uncertain about future fuel prices. In addition, the automobile industry might be viewed as an oligopoly rather than a competitive industry; if so,

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<sup>15</sup> Pollution emissions are also released upstream from leakages during fuel refining and distribution. However, these releases are tightly regulated—National Research Council (2002) put the damages at only 2 cents per gallon.

economic theory suggests it might be privately optimal for manufacturers to undersupply vehicle attributes, even when consumers would be willing to pay for them.

Some economists, however, regard the new vehicle market as efficient, aside from externalities (e.g., Kleit 1990). According to this view, manufacturers should have incentives to incorporate fuel saving technologies that consumers are willing to pay for, and consumers are well informed about fuel economy, in part from stickers that displayed on all new vehicles. Moreover, engineering studies might provide an unreliable guide to the actual costs of mandated increases in fuel economy. They may not capture some costs involved in implementing new technologies, such as marketing, maintenance, consumer unfamiliarity, and retraining of mechanics. And technologies that could be used to improve fuel economy may instead be used to enhance other vehicle attributes such as increased acceleration. In this case, the cost of devoting technology to improving fuel economy is the foregone vehicle attributes that might otherwise have resulted. Furthermore, there is no guarantee that manufacturers would respond to tighter CAFE standards by adopting new, fuel-saving technologies. Instead, they may lower the relative price of fuel-efficient vehicles to increase their sales share, or reduce the weight and size of new vehicles.<sup>16</sup>

In short, whether tightening CAFE standards would lead to fuel saving benefits in excess of added vehicle costs remains an unresolved issue among policy analysts. If there were net fuel saving benefits, tightening CAFE could produce net economic benefits overall, despite fuel taxes and the rebound effect, at least over some range of fuel economy improvement. However, until more consensus emerges as to the likelihood of net fuel saving benefits, it remains difficult to judge whether the overall benefits of tightening CAFE might exceed the costs.

#### **4. CAFE vs. other Policy Alternatives**

Even if we were confident that the economic benefits of higher CAFE standards were substantially larger than the costs, tightening the standards may still be an undesirable policy option, if other measures can achieve objectives at much lower economic cost. We now discuss why other measures—such as carbon taxes and broad-based oil taxes—appear to be superior instruments on cost-effectiveness grounds for addressing concerns about climate change and oil dependency.

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<sup>16</sup> Another potentially significant market failure arises from possibly inadequate incentives for R&D into vehicle fuel economy. R&D will be too low from society's perspective if manufacturers cannot capture all the spillover benefits to other firms from their own innovation. Indeed a number of empirical studies suggest that the social return to R&D may greatly exceed the private return. Therefore, to the extent that tighter CAFE standards encourage more innovation, this could lead to an additional source of net economic gain. However the quantitative significance of this issue has not been explored in the literature.

*Cost-Effective Policies to Reduce Carbon Emissions.* Figure 1 illustrates the cost of reducing carbon emissions from the US economy under different policies.<sup>17</sup> The horizontal axis shows emissions reductions in tons, and the vertical axis indicates the marginal cost of reducing emissions; that is, the cost of reducing emissions by one additional ton. Economy-wide US carbon emissions were about 1500 million tons in 2001; a 10% reduction would be 150 million tons.

The bottom curve,  $MC_{CTAX}$ , indicates marginal costs under a tax imposed on the carbon content of fossil fuels. This is a relatively low-cost policy option because, by driving up fossil fuel prices throughout the economy, it takes advantage of all potential opportunities for emissions reductions. For example, it raises the price of coal (which has a high carbon content) relative to natural gas, thereby encouraging electricity generators to rely more on gas-fired plants; by raising the price of oil, it encourages oil conservation in transportation and other sectors of the economy.<sup>18</sup> According to energy models, the carbon tax required to achieve a 10% emissions reduction is estimated at between roughly \$20 and \$50 per ton of carbon.<sup>19</sup> For example, if it is \$30 per ton, then the total annual economic cost—triangle A under  $MC_{CTAX}$  between 0 and 150 million—would be \$2,250 million.

$MC_{GTAX}$  is the marginal cost of reducing carbon emissions under a gasoline tax. This policy is more costly than a carbon tax because all the emissions reductions must come from reducing the driving of, and increasing the fuel efficiency of, passenger vehicles. It does not exploit any of the options for emissions reductions in electricity generation, or from reducing non-gasoline oil combustion: indeed carbon emissions from gasoline consumption only account for 20% of total US emissions. The policy is probably at least several times as costly as a carbon tax in reducing economy-wide carbon emissions by a given amount.<sup>20</sup> In our example, the extra cost is shown by area B in Figure 1. This discussion of gasoline tax costs is somewhat misleading, however, as it ignores the beneficial effect of gasoline taxes on (non-carbon) driving externalities, and the possibility of net fuel saving benefits.

The top curve in Figure 2,  $MC_{CAFE}$ , is the marginal cost of reducing carbon emissions under fuel economy standards. Leaving aside the possibility of net fuel saving benefits, this policy is less

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<sup>17</sup> To simplify the discussion below, we ignore the effects of pre-existing fuel taxes and fuel economy standards.

<sup>18</sup>  $MC_{CTAX}$  is upward sloping, reflecting the increasing difficulty of achieving additional emissions reductions once the lowest-cost options have been exploited. It has a zero intercept as the price paid for carbon emissions in the absence of emissions control policies is zero.

<sup>19</sup> Cost estimates differ due to different assumptions about the ability of firms to substitute among different fuels, and the extent to which domestic firms can purchase reduction credits from other countries (e.g., CEA 1998).

efficient (i.e. more costly) than a gasoline tax at reducing motor vehicle emissions for several reasons. Unlike a gasoline tax, it does not penalize driving; it encourages people to drive their vehicles more, not less. Gasoline taxes encourage people to buy cars rather than light trucks, and to buy new (fuel efficient) vehicles more often; fuel economy standards do not provide these incentives. And CAFE imposes the same fuel economy standards across all manufacturers, regardless of how costly it is for them to comply with the standard. Under a gasoline tax, manufacturers with relatively low costs of increasing their fleet's average fuel economy will respond more to the increase in consumer demand for improved fuel efficiency than will manufacturers with relatively high costs.

The additional costs of reducing economy-wide carbon emissions by 10% under a fuel economy standard compared with a gasoline tax are shown by area C in Figure 2. The extra costs compared with a carbon tax are B+C; these extra costs might easily exceed \$10 billion per year.

*Cost-Effective Policies to Reduce Oil Dependency.* By similar reasoning, if the policy objective is to reduce the oil intensity of the US economy, a broad-based oil tax appears to be far better on economic grounds than tougher fuel economy standards. In addition to reducing gasoline consumption, an oil tax would encourage measures to conserve on diesel fuel for trucks and buses, aircraft fuel, and home heating oil. And even for merely reducing the gasoline component of oil products, a gasoline tax would be much more efficient than tightening CAFE, for the reasons just described.

## 5. Conclusion

Oil dependency, and particularly climate change, are legitimate causes of concern, and warrant some policy response. However, the ideal economic measures would involve (appropriately scaled) carbon taxes (or tradable carbon permits) and broad-based oil taxes, rather than more stringent fuel economy standards.<sup>21</sup> Indeed it is unclear whether the benefits of higher fuel economy standards outweigh their costs, at least when account is taken of gasoline taxes, and the rebound effect that exacerbates traffic congestion and other social costs of driving.

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<sup>20</sup> The required increase in the gasoline tax might be in the order of around 30 cents/gal, or more than 150% of the current federal gasoline tax.

<sup>21</sup> Taxes have advantages over other "market-based" approaches, such as systems of grandfathered tradable emissions permits. Taxes raise revenues for the government that can be used to improve economic efficiency by cutting other taxes in the economy, and to counteract the undesirable effects of environmental policies on the distribution of income (e.g., Parry 2002).

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Figure 1. Marginal Costs of Reducing Carbon Emissions under Alternative Policies

