CHAPTER 16
U.S. LAW AND POLICY: TRANSPORTATION

SYNOPSIS

I. INTRODUCTION

The U.S. transportation sector emits approximately one-third of the country's carbon dioxide emissions. "On-road" vehicles — passenger cars, sport utility vehicles, vans, motorcycles, trucks and buses — emit more than 80 percent of U.S. transportation emissions, and approximately 60 percent of these result from personal vehicle use. Transportation emissions have increased significantly since 1990. Indeed, according to the U.S. Energy Information Administration, the transportation sector accounted for 69 percent of the total increase in U.S. energy-related carbon dioxide emissions from 1990 through 2009. U.S. ENERGY INFO. ADMIN., EMISSIONS OF GREENHOUSE GASES IN THE UNITED STATES 2009 26 (2011).

In response, the United States has enacted and updated a number of policies to lower these emissions. Most of these policies aim to reduce greenhouse gas emissions from motor vehicles, the primary source of U.S. transportation emissions. These emissions are particularly high due to three factors: the number of vehicle miles traveled, the fuel efficiency of vehicles, and the type of fuel used. Climate change policy must therefore address all three factors to mitigate the transportation sector's contribution to climate change.

However, the U.S. legal system lacks a single, cohesive approach to regulating vehicle emissions. At least four federal agencies — the Department of Transportation, the Federal Highway Administration, the National Highway Transportation System Administration, and the Environmental Protection Agency — play significant roles in managing the on-road transportation sector. In addition, state and local governments have considerable influence over many transportation decisions. By and large, the laws governing highway construction, fuel efficiency, and fuel type operate in isolation from each other. Indeed, the different transportation-related laws have often operated at cross-purposes, by promoting fuel conservation through some programs and implicitly encouraging fuel use through others. Until recently, the agencies administering the laws rarely coordinated to harmonize the various goals of each law. As a result, the benefits gained through one federal program — such as the vehicle fuel economy requirements of the Energy Policy and Conservation Act — were often undermined through implementation of another program — such as highway construction funded through the Federal Highway Act. Not surprisingly, these inconsistencies have generated calls for a coordinated federal transportation program to reduce greenhouse gas emissions from the transportation sector. Although agencies have heeded these calls to some degree, comprehensive transportation planning remains a distant prospect. Nonetheless, federal agencies have taken a number of actions to reduce greenhouse gas emissions from vehicles and other road uses.

This chapter explores the effects U.S. transportation laws and policies have on the country's carbon footprint. Section II discusses the federal laws governing fuel economy standards. Section III then explores U.S. policies promoting alternative fuel and vehicle development. Finally, Section IV analyzes transportation system design and its impacts on vehicle miles traveled and greenhouse gas emissions.

II. AUTOMOBILE FUEL EFFICIENCY STANDARDS

In 1975, in response to the 1973 national oil crisis triggered by the Arab oil embargo, Congress passed the Energy Policy and Conservation Act (EPCA), 49 U.S.C. §§ 32901–32919, and established the Corporate Average Fuel Economy (CAFE) program. The CAFE program mandates average fuel efficiency requirements for passenger cars and other vehicles. Specifically, the EPCA requires the National Highway Traffic Safety Administration (NHTSA) to establish fuel economy standards, measured in miles per gallon, for fleets of vehicles. Under these fleet-wide standards, car manufacturers comply by demonstrating that their passenger fleets, on average, meet the CAFE standard. Thus, a manufacturer has discretion to produce some cars that exceed the standard so long as the company also produces enough fuel-efficient cars to bring the fleet's average fuel economy into compliance with the CAFE standard. For years, this program afforded manufacturers significant discretion while also steadily improving vehicle efficiency. By the early 1990s, however, the CAFE program began to backslide, and overall fuel economy declined. This decline continued until the late 2000s, when legislation, litigation, and regulatory action reversed the trend. More recently, fuel economy standards have increased significantly. This section reviews these developments.

A. The CAFE Program's Rise and Retreat

As already mentioned, the CAFE program establishes average fuel economy standards for fleets of vehicles. NHTSA establishes the standards at least 18 months before the beginning of the production year (the model year) to which the standard applies, which provides manufacturers time to design cars that can achieve the established standard. In its original form, the EPCA directed NHTSA to establish fuel economy standards for passenger automobiles, but it gave the agency discretion over non-passenger cars. The distinctions between passenger and non-passenger automobiles ultimately eroded the effectiveness of the EPCA after its first successful decade.

In the EPCA, Congress established presumptive statutory standards that required new passenger automobiles to meet an average fuel economy of 18 miles per gallon (mpg) for model year (MY) 1978 and 27.5 mpg for MY 1985. While Congress authorized NHTSA to modify the presumed statutory standards, NHTSA rarely exercised that authority in the first decade of the EPCA. The CAFE program thus initially yielded significant improvements in overall vehicle mileage. In 1974, before the CAFE program took effect, new cars achieved an average fuel economy of 12.9 mpg. By the late 1980s, average fuel economy for passenger cars exceeded 28 mpg. *See* BRENT D. YACOBBUCCI & ROBERT BAMBERGER, CONG. RESEARCH SERV., AUTOMOBILE AND LIGHT TRUCK FUEL ECONOMY: THE CAFE STANDARDS (Jan. 19, 2007). By that measure, the CAFE program appeared very successful.

However, beginning in the 1980s, car manufacturers and courts began to push back against NHTSA's efforts to increase fuel economy standards, and NHTSA itself retreated from its first decade of aggressive regulation. Most observers attribute these dynamics to three factors. First, the EPCA contained a so-called "SUV loophole" that allowed larger vehicles to benefit from much lower (if any) CAFE standards. Second, consumer choice and concerns about the safety of smaller cars resulted in courts invalidating standards that might have restricted the manufacture of less efficient vehicles. Finally, as disputes about the safety and efficacy of the CAFE standards intensified, Congress intervened with a moratorium prohibiting NHTSA from developing CAFE standards until the National Academy of Sciences could issue a report about the program's benefits and risks. Due to these developments, overall fuel economy actually declined after 1987, sinking to an average 23.1 mpg in 1999.

1. *The SUV Loophole*

The EPCA divides vehicles into three categories: passenger automobiles, non-passenger automobiles, and work trucks. The distinction between passenger and non-passenger automobiles became known as the SUV loophole. Under this loophole, many large cars, including minivans, sport-utility vehicles (SUVs), and pickups, avoided regulation and thereby benefitted from much weaker fuel economy mandates.

The EPCA defines a "passenger automobile" as

> An automobile that the Secretary decides by regulation is manufactured primarily for transporting not more than 10 individuals, but does not include an automobile capable of off-highway operation that the Secretary decides by regulation –
>
> (A) has a significant feature (except 4-wheel drive) designed for off-highway operation; and
> (B) is a 4-wheel drive automobile or is rated at more than 6,000 pounds gross vehicle weight.

49 U.S.C. § 32901(18). "Non-passenger automobiles," in turn, are simply any vehicles that qualify as neither passenger automobiles nor work trucks.[1] Under these definitions, cars without the capability to operate off-road would qualify as passenger automobiles. For other vehicles, however, NHTSA has discretion to determine that design features make vehicles "non-passenger automobiles." For example, a vehicle with high clearance and a 4-wheel drive could qualify as a non-passenger vehicle. Similarly, a vehicle with all-wheel drive that weighs more than 6,000 pounds would also qualify. Once NHTSA determined that vehicles with certain attributes qualified as "non-passenger automobiles," this exempted the vehicles from the presumptive statutory CAFE standards applicable to passenger automobiles. NHTSA then had discretion to establish CAFE standards for the non-passenger automobiles.

In developing or revising any CAFE standard, NHTSA must set the standard at "the maximum feasible average fuel economy level which such manufacturers are able to achieve in each model year." 49 U.S.C. § 32902(a). In deciding which standards represent the "maximum feasible" levels, NHTSA must consider technological feasibility, economic practicability, the effect of other Federal motor vehicle standards on fuel economy; and the need of the Nation to conserve energy. *Id.* at 32902(f). NHTSA's weighing of these factors frequently resulted in reduced fuel economy requirements for non-passenger automobiles.

Beginning in the 1980s, NHTSA enacted a number of regulations that allowed minivans, SUVs, and pickup trucks to avoid the more stringent fuel economy standards applicable to passenger automobiles. NHTSA decided to regulate certain types of "light trucks" weighing between 6,000 and 8,500 pounds, but it exempted vehicles heavier than 8,500 pounds from CAFE requirements entirely. For the "light truck" category, EPA set lower CAFE standards than it set for passenger automobiles. Although the agency was still obligated under the statutory mandate to set standards at "the maximum feasible average fuel economy level," the mitigating factors of technological feasibility and economic practicability typically allowed the light truck standards to remain weak. Moreover, by designating a separate light truck category, NHTSA created two separate vehicle fleets — passenger automobiles and non-passenger automobiles —

[1] Work trucks include non-passenger vehicles between 8,500 and 10,000 pounds. 49 U.S.C. § 32901(19).

subject to two separate standards. Over time, the CAFE standards increased for passenger automobiles, reaching 29.3 mpg by 2004. NHTSA had no obligation to meet an overall fuel economy requirement for passenger and non-passenger standards. As a result, the divergent CAFE standards under the SUV loophole resulted in the declines in overall U.S. fuel economy during the 1990s and early 2000s.

It is highly unlikely that, when Congress enacted the EPCA in 1975, it anticipated that large cars would come to dominate the U.S. car market. At that time, light trucks occupied a small fraction of the market, and most light truck owners used them for work purposes. Legislative history suggests Congress established the distinction between passenger and non-passenger automobiles to distinguish between passenger vehicles and vehicles used for agriculture and construction. H.R. Rep. No. 94-340, at 89–90 (1975) *reprinted in* 1975 U.S.C.C.A.N. 1762, 1851-52. Nonetheless, a number of developments in the 1980s led to their market dominance. Most notably, gasoline prices plummeted in the 1980s and created new markets for automobile manufacturers. At the time, foreign carmakers occupied the U.S. luxury and economy car markets, and U.S. automakers were struggling. Cheap gas allowed U.S. companies to carve out a new niche: sport-utility vehicles. As manufacturers increased their production of light trucks, particularly SUVs, consumers responded by purchasing unprecedented amounts of these larger vehicles. Over time, "light trucks" became more family-friendly (think minivans), luxurious (think the Cadillac Escalade), and sporty (think the Subaru Outback); few became more oriented toward work or construction. Americans responded to these design changes with enthusiasm. From 1980 to 1990, light trucks increased from 19.9 percent of the auto market to 47.5 percent. In numeric terms, the number of SUVs on the road increased from 200,000 in 1975 to more than 3 million in 1999.

As the numbers of these vehicles on the road increased, CAFE standards did not keep pace. Initially, technological limitations prevented automakers from establishing stringent CAFE standards for the light trucks category. The primary fuel efficiency "technology" involved reducing the size and weight of vehicles; however, various studies showed that larger, heavier vehicles provided passengers greater safety during collisions. Thus, automakers were able to paint fuel economy standards as presenting consumers with a choice of purchasing either safe vehicles or fuel-efficient vehicles, but not both. Once other fuel efficiency technologies — such as the hybrid engine — began to develop, NHTSA considered them cost-prohibitive for many consumers. Finally, consumers simply preferred trucks and SUVs to smaller vehicles. As a result, overall fuel economy (combining passenger automobiles and light trucks) in the United States declined from an all-time high of 26.2 in 1987 to a much lower level of 23.8 mpg in 1999.

Over time, public pressure to increase fuel economy requirements for light trucks began to build. Congress then intervened with a series of appropriations bills prohibiting NHTSA from revising CAFE standards. *See* Department of Transportation and Related Agencies Appropriations Act, Pub. L. 104-50, 109 Stat. 436, § 330 (Nov. 15, 1995). As a result, fuel economy standards for light trucks remained stagnant for several years. Overall fuel economy similarly remained suppressed.

2. *Early Case Law and Deference to NHTSA*

The courts, most notably the D.C. Circuit, played a key role in maintaining the SUV loophole and limiting the CAFE program. In a typical case, conservation organizations or consumer groups argued that the CAFE standards were too weak, while conservative think tanks argued that the CAFE standards were too stringent and threatened public safety. The following case provides an example of how the D.C. Circuit typically resolved challenges to CAFE standards set by the NHTSA.

CENTER FOR AUTO SAFETY v. NATIONAL HIGHWAY TRAFFIC SAFETY ADMIN.,

793 F.2d 1322 (D.C. Cir. 1986)

HARRY T. EDWARDS, Circuit Judge:

The National Highway Traffic Safety Administration ("NHTSA") is required to set mandatory fuel economy standards for passenger cars and light trucks pursuant to the Energy Policy and Conservation Act of 1975 ("EPCA"). In October 1984, NHTSA issued a final rule that amended its previously published fuel economy standards for light trucks for the 1985 model year and established light truck standards for the 1986 model year. The new 1985 standard required each manufacturer to achieve a fleetwide average fuel economy of 19.5 miles per gallon ("mpg") for its light trucks, a reduction of 1.5 mpg from the original 1985 standard of 21.0 mpg. The 1986 model year standard was set at 20.0 mpg, which also represented a retreat from the original 1985 requirement.

The petitioners, four non-profit consumer organizations that work to promote energy conservation, challenge this rule. They allege that NHTSA has violated EPCA's requirement that the agency designate standards at "the maximum feasible average fuel economy level." The gravamen of their complaint is that the 1985 and 1986 model year standards are too low because in determining those standards, NHTSA gave impermissible weight to shifts in consumer demand toward larger, less fuel-efficient trucks. * * *

I. BACKGROUND

A. *Statutory Framework*

The CAFE standards set a minimum performance requirement in terms of an average number of miles a vehicle travels per gallon of gasoline or diesel fuel. Individual vehicles and models are not required to meet the mileage standard; rather, each manufacturer must achieve *an average* level of fuel economy for all specified vehicles manufactured in a given model year.

Section 502(b) of the Act directs the Secretary of DOT ("secretary") to prescribe, by rule, standards for light trucks. The Secretary may set separate standards for different classes of light trucks, and they "shall be set at a level which the Secretary determines is the maximum feasible average fuel economy level which such manufacturers are able to achieve in each model year. . . .” Congress directed the Secretary to consider four factors in determining the “maximum feasible” fuel economy level:

(1) technological feasibility;

(2) economic practicability;

(3) the effect of other Federal motor vehicle standards on fuel economy; and

(4) the need of the Nation to conserve energy.

The Secretary may amend the standard, but amendments must also require the “maximum feasible average fuel economy level.” All standards are to be set at least 18 months prior to the beginning of the model year and any amendment that makes a CAFE standard more stringent must also be promulgated at least 18 months prior to the start of the model year.

At the end of each model year, the Environmental Protection Agency (“EPA”) calculates the fuel economy level each manufacturer has achieved based on the fuel economy of each model and the number of vehicles manufactured in each model line. If a manufacturer fails to meet a standard, the Secretary “shall assess” civil penalties.[17] The Secretary has limited authority to modify or cancel the penalty. * * *

B. *Rulemaking Proceedings*

For the model years at issue here, NHTSA issued separate standards for four-wheel drive and two-wheel drive light trucks. . . . In addition, NHTSA issued a “combined” standard. Manufacturers have two options: they may meet the combined standard for their entire light truck fleet or they may meet the separate standards for the two-wheel drive and four-wheel drive categories. The combined standard is set at a level intermediate to the two-wheel drive and four-wheel drive standards.

1. *The Standard for Model Year 1985*

In 1980, NHTSA set the light truck combined CAFE standards for 1984 and 1985 at 20.0 mpg and 21.0 mpg, respectively. These standards were based on projections of sales of various models calculated on the assumption that manufacturers would introduce new models of fuel-efficient light trucks and that consumer demand for these vehicles would be strong due to high prices and reduced supplies of gasoline. The standards for 1984 and 1985 were set at the fuel

[17] The penalties are calculated by multiplying $5 by the number of tenths of mpg by which the fleet average fails to attain the standard and by the number of vehicles subject to the standard in the fleet manufactured that year. A 1978 amendment allows the Secretary to base the calculation on $10 per tenth of a mpg if he finds such a step is necessary to improve conservation efforts and would not have ‘substantial deleterious impacts” on the economy.

economy levels attainable by the "least capable" manufacturer, Ford Motor Company ("Ford"). The agency acknowledged that higher standards could result in the introduction of new models or technologies by Ford, but also recognized the uncertainty of financing to undertake such ventures. It also cited the possibility that Ford might restrict the sale of its larger trucks or choose to pay penalties, thus further eroding its position in the marketplace.

In November 1983, Ford petitioned NHTSA to lower the light truck CAFE standards for model years 1984 and 1985. . . . Ford argued that a change in the standards was necessary due to changes in the "price of fuel, the attendant consumer reaction to falling fuel prices and stable fuel availability, and the increasing import penetration into the truck market." On January 30, 1984, Ford followed up its initial request with a petition for even greater reductions in standards for the 1985 model year . . .

In response to Ford's request, NHTSA published a Notice of Proposed Rulemaking on the 1984 and 1985 light truck standards in May 1984. The agency proposed to deny Ford's requested weakening of the 1984 standards because the model year was already underway. However, for the 1985 model year, NHTSA proposed to adopt Ford's requested level of 19.5 mpg, although it estimated that this amendment could eliminate gasoline savings of up to 1.1 billion gallons. In discussing the proposed modifications, the agency noted that consumer demand for small trucks was "significantly higher" than NHTSA had projected in 1980. However, although small truck sales by domestic companies accounted for a greater proportion of sales than had been anticipated, the bulk of the demand for small models was being satisfied by foreign imports. Significantly, domestic manufacturers were selling a higher proportion of trucks with larger displacement engines than the agency had projected in 1980, while experiencing lower sales of the smaller, more fuel-efficient engines and diesels.

In October 1984, NHTSA issued a final rule adopting Ford's proposed amendments for 1985. . . . Similar revised projections suggested that General Motors Corporation ("GM") and Chrysler would achieve fuel economy levels of 20.0 mpg and 20.3 mpg, respectively. * * *

2. *The Standards for Model Years 1986-1987*

In March 1984, NHTSA published a Notice of Proposed Rulemaking for light truck fuel economy standards for the 1986 and 1987 model years. Rather than proposing a specific standard, it suggested a range of 20.0 to 21.5 mpg for model year 1986 and 20.0 to 22.5 mpg for model year 1987.

After comment, NHTSA set the light truck combined standard for 1986 at 20.0 mpg and deferred issuance of the 1987 standards. The agency projected that Ford would be able to achieve an overall fuel economy level of 20.4 mpg in 1986, a gain of 0.9 mpg over the 1985 projection, due to technological improvements and growth in demand for small vans. It projected a composite average fuel economy of 20.6 mpg for GM and 21.5 mpg for Chrysler in 1986. NHTSA considered the possibility of requiring greater gains in fuel economy than it projected Ford would achieve, which would be possible if manufacturers restricted their production of larger trucks. However, based on Ford's predictions, the agency concluded that the effects of requiring a 1.5 mpg improvement would be "beyond the realm of "economic practicability" as contemplated in the Act."[38] * * *

Petitioners Center for Auto Safety and Environmental Policy Institute filed timely petitions for reconsideration with NHTSA. Both petitions challenged NHTSA's reliance on consumer demand as a major factor in setting CAFE standards, which they argue undercuts EPCA's goal of energy conservation. They further alleged that technology permitted greater fuel savings and that the statutorily required "maximum feasible" level of fuel economy is higher than the standard produced by accommodating Ford's capabilities, a practice they dubbed the "lowest common denominator" approach. They urged the agency to require marketing strategies to shift demand and advocated the imposition of penalties, rather than the lowering of standards, when manufacturers fail to comply with the standards. NHTSA denied the petitions for reconsideration and this appeal followed. * * *

III. MERITS

* * *

Congress delegated the determination of fuel economy standards to the Secretary, who in turn assigned this task to NHTSA. On its face, the statute gives the agency discretion to designate the classes of light trucks subject to standards. It then requires the standards to be set at the "maximum feasible" level and outlines four general categories of factors to be considered in making that determination. Consumer demand is not specifically designated as a factor, but neither is it excluded from consideration; the factors of "technological feasibility" and "economic practicability" are each broad enough to encompass the concept. Thus, the unadorned language of the statute does not indicate a congressional intent concerning the precise objections raised by the petitioners.

The legislative history of EPCA is similarly unilluminating. . . . The agency is directed to weigh the "difficulties of individual automobile manufacturers;" there is no reason to conclude that difficulties due to consumer demand for a certain mix of vehicles should be excluded. . . . [W]hile Congress rejected market forces as the *sole* means of improving energy conservation, that does not then mean that consumer demand is *irrelevant* to the determination of the mandatory standards. * * *

It is axiomatic that Congress intended energy conservation to be a long term effort that would continue through temporary improvements in energy availability. Thus, it would clearly be impermissible for NHTSA to rely on consumer demand to such an extent that it ignored the overarching goal of fuel conservation. At the other extreme, a standard with harsh economic consequences for the auto industry also would represent an unreasonable balancing of EPCA's policies.

[38] Ford predicted that in order to achieve a 1.5 mpg benefit in fuel economy, sales losses of 100,000 to 180,000 units with an accompanying loss of 12,000 to 23,000 jobs could occur. It also suggested that sales restrictions on its part would simply shift consumer demand for large trucks to other manufacturers, with no net gain in fuel economy.

The agency concluded that if manufacturers had to restrict the availability of larger trucks and engines in order to adhere to CAFE standards, the effects "would go beyond the realm of 'economic practicability' as contemplated in the Act." The original projections of technological feasibility for the 1985 model year standards were based on the assumption that gasoline prices would remain high and consumer demand for fuel-efficient vehicles would remain strong. No one disputes that actual circumstances have deviated from these assumptions. NHTSA acted within the reasonable range of interpretations of the statute in correcting the 1985 standards to account for these changed conditions. Consideration of product mix effects was also reasonable in setting the standards for 1986, as there is no evidence that the same trends in consumer demand will not continue. * * *

In short, while it may be disheartening to witness the erosion of fuel conservation measures in the face of changes in consumer priorities, this court is nonetheless compelled to uphold the agency's standards. They are the result of a balancing process specifically committed to the agency by Congress, and, in this case, the weight given to consumer demand was not outside the range permitted by EPCA.

QUESTIONS AND DISCUSSION

1. On what basis did the D.C. Circuit uphold the CAFE standards set by NHTSA? Do you believe the court decided the case correctly? Why or why not? If you represented the Center for Automotive Safety, what other arguments, if any, would you have made challenging the NHTSA standards? Does the ruling mean that the Agency is held hostage to consumer demands?

This approach to fuel economy standards had significant impacts on future vehicle designs. In the 1980s, many SUVs weighed closer to 6,000 pounds than 8,500. Decisions like the *Center for Auto Safety* allowed car companies to increase their production of larger SUVs, which Americans preferred, without offsetting the lost fuel savings by designing or marketing more efficient small SUVs.

2. Two years after issuing its decision in *Center for Auto Safety*, the D.C. Circuit again rejected a challenge to CAFE standards NHTSA had lowered on the basis of economic practicability. *Public Citizen v. Nat'l Highway Traffic Safety Admin.*, 848 F.2d 256 (D.C. Cir. 1988). The court found that the agency properly considered increased consumer demand for larger, but less fuel-efficient vehicles when it allowed average fuel economy standards to fall below the presumptive 27.5 mpg standard for passenger automobiles. *Id.* at 264–65. The court also rejected the argument that the agency violated its duty to consider the "need of the Nation to conserve energy," 15 U.S.C. § 2002(e)(4), noting that the standards adopted by NHTSA, while weaker than the presumed statutory standard, would result in only a 0.09 percent yearly increase in fuel consumption. *Id.* at 265.

3. *The CAFE Penalty.* The EPCA established a $5.00 penalty per vehicle for each 0.1 mpg by which a manufacturer's fleet falls below the applicable CAFE standards. For example, if the CAFE requirement for MY 2010 is 27.5 mpg, and if manufacturer produces a fleet of 3.5 million passenger automobiles with an average fleet fuel economy of 26.5 mpg, then the manufacturer will owe a penalty of $5.00 x 3.5 million x 10 = $175 million.

For years, some European luxury car manufacturers — such as Mercedes and BMW — frequently opted to pay the penalty rather than meet the standard. U.S. and Japanese car manufacturers, in contrast, always met the standards. PAUL R. PORTNEY ET AL., THE ECONOMICS OF FUEL ECONOMY STANDARDS, 1 (Resources for the Future, Nov. 2003). What does this dynamic suggest about the efficacy of the CAFE program and its penalty provision? Do you think automakers should be able to effectively opt out of CAFE by paying a per car penalty for failing to meet the standard? Does the penalty provision encourage NHTSA to set low standards to protect U.S. automakers?

4. ***The Gas Guzzler Tax.*** In an effort to prevent companies from building too many car models with low fuel economy, Congress also imposes a gas guzzler tax on inefficient vehicles. The Energy Tax Act of 1978, 26 U.S.C. §§ 4064 et seq., imposes a tax on the sale of each automobile that fails to meet specified fuel economy requirements. The legislation exempts "non-passenger" automobiles, such as light trucks, mini-vans, recreational vehicles, and emergency vehicles (as well as the subsequently-developed sport-utility vehicle). Each year, EPA publishes a list of car models subject to the tax. EPA also calculates each model's gas guzzler liability before vehicles enter into commerce, so that vehicle stickers can display the tax. In theory, consumers might opt to purchase other cars if they know the vehicle will cost more due to its gas-guzzling nature.

The gas guzzler tax does not apply to cars with an average fuel economy (based on both highway and city driving) of at least 22.5 mpg. For cars with fuel economies below 22.5 mpg, the tax per vehicle increases as fuel economy decreases, as the following chart shows.

GAS GUZZLER TAX	
Unadjusted MPG (combined)*	**Tax**
at least 22.5	No tax
at least 21.5, but less than 22.5	$1000
at least 20.5, but less than 21.5	$1300
at least 19.5, but less than 20.5	$1700
at least 18.5, but less than 19.5	$2100
at least 17.5, but less than 18.5	$2600
at least 16.5, but less than 17.5	$3000
at least 15.5, but less than 16.5	$3700
at least 14.5, but less than 15.5	$4500
at least 13.5, but less than 14.5	$5400
at least 12.5, but less than 13.5	$6400
less than 12.5	$7700

See Environmental Protection Agency, Gas Guzzler Tax, Program Overview, Tax Schedule, *available at* http://www.fueleconomy.gov/FEG/info.shtml.

As noted, EPA publishes an annual list of car models subject to the gas guzzler tax. Most of the cars on the list are foreign and domestic sports and luxury cars. For example, the 2009 list of gas guzzlers included cars manufactured by Aston Martin (the brand preferred by 007 James Bond), BMW, Audi, Ferrari, Mercedes Benz, and Rolls Royce, as well as the Ford Mustang, the Corvette, and the Viper. Environmental Protection Agency, Vehicles Subject to the Gas Guzzler Tax for Model Year 2009 (Oct. 2008). Thus, despite the penalties imposed by the CAFE program and the gas guzzler tax, luxury automakers continue to produce and sell inefficient cars. What policies would you propose that Congress adopt if you wanted to ensure that luxury vehicle manufacturers improve fuel economy?

5. ***CAFE Standards and Safety.*** In the 1990s, the safety of larger vehicles became a factor underlying NHTSA's establishment of CAFE standards. *See* Competitive Enterprise Institute v. Nat'l Highway Traffic Safety Admin., 956 F.2d 321 (D.C. Cir. 1992) ("*CEI I*"); Competitive Enterprise Institute v. Nat'l Highway Traffic Safety Admin., 45 F.3d 481 (D.C. Cir. 1995) ("*CEI II*"). In *CEI I*, the court remanded a 27.5 mpg CAFE standard for model years 1989 and 1990 for passenger automobiles on the basis that NHTSA did not respond to the "contention that the standard will force carmakers to produce smaller, less safe cars, thus making it more difficult and expensive for consumers to buy larger, safer cars." 956 F.2d at 323. The court accepted CEI's contention that "the 27.5 mpg standard will increase traffic fatalities if, as a general matter, small cars are less safe than big ones," *Id.* at 326 and went on to state:

> Nothing in the record or in NHTSA's analysis appears to undermine the inference that the 27.5 mpg standard kills people, although, as we observed before, we cannot rule out the possibility that NHTSA might support a contrary finding. Assuming it cannot, the number of people sacrificed is uncertain. . . . Yet the actual number is irrelevant for our purposes. Even if the 27.5 mpg standard for model year 1990 kills "only" several dozen people a year, NHTSA must exercise its discretion; that means conducting a serious analysis of the data and deciding whether the associated fuel savings are worth the lives lost.

Id. at 327. When, on remand, NHTSA again concluded that the 27.5 mpg standard would not price consumers out of larger, and presumably safer cars, the D.C. Circuit somewhat unexpectedly upheld NHTSA's conclusion. *CEI II*, 45 F.3d 481. Nonetheless, the court emphasized, and NHTSA appeared to concede, that large cars are safer than small cars. *Id.* at 485. This influenced CAFE standards for several years thereafter.

Several studies published in the late 1980s and early 1990s concluded that CAFE standards would result in increased traffic fatalities because they would encourage companies to produce lighter, smaller, and thus less safe, cars. Smaller cars typically had less "crash space," or room to absorb the impact of vehicle collisions. Lighter cars may also have had a lower capacity to withstand collisions. Thus, studies routinely concluded that, in collisions between vehicles and stationary objects, passengers in small, lightweight cars had a greater chance of dying than those in large, heavy cars. The studies also found that passengers in larger vehicles had a higher survival rate in collisions involving other cars or trucks. These studies played an important role in keeping CAFE standards low. As discussed below, more recent studies have challenged the older conclusions regarding the safety of larger vehicles and have influenced the development of more recent CAFE standards.

6. *The Moratorium on Revised CAFE Standards*. In the late 1980s and early 1990s, the CAFE program met spurred significant controversy. In addition to contending that fuel economy standards increased traffic fatalities, critics also argued that fuel economy standards undermined fuel efficiency because consumers that bought more fuel-efficient vehicles would simply drive more (the so-called "rebound effect"). In addition, because the CAFE program established more stringent requirements on passenger cars than light trucks and SUVs, some researchers claimed that the CAFE program would simply result in higher sales of light trucks and SUVs, which would likely cost less than cars subject to heavier regulation. *See, e.g.*, Paul E. Godek, *The Regulation of Fuel Economy and the Demand for "Light Trucks"*, 40 J. L. & ECON. 495 (1997). Nonetheless, conservationists stepped up their criticism of the "light truck loophole" (as the SUV loophole was sometimes called), especially as sales of minivans and SUVs grew by 42 percent between 1988 and 1994. In 1994, in apparent agreement with conservationists, NHTSA began rulemaking proceedings to address the SUV loophole. Congress then intervened to prohibit NHTSA from spending any money on CAFE standard revisions for light trucks.

Instead, Congress directed the Department of Transportation and the National Academy of Sciences (NAS) to study CAFE standards. The resulting NAS study concluded that it was technologically and economically feasible for combined average CAFE standards for passenger cars and light trucks to increase to 33 mpg by 2012 and to 37 mpg before 2017. *See* NATIONAL RESEARCH COUNCIL, EFFECTIVENESS AND IMPACT OF CORPORATE AVERAGE FUEL ECONOMY (CAFE) STANDARDS (2002) [hereinafter NAS report]. The NAS report also signaled a potential shift in how costs and benefits of fuel economy would be analyzed. The study analyzed the "cost efficiency" to consumers of fuel economy standards by comparing the added costs of purchasing cars with fuel efficiency technologies to the benefits from purchasing less gas. *Id.* at 64. At the time of the report's release, in 2002, gasoline prices were around $1.50 per gallon, and the NAS report concluded that consumers would save approximately $2,500 more than they would spend in buying a fuel-efficient car. Additionally, the report concluded that the CAFE program had improved overall fuel economy and that whatever "rebound effect" may exist, it would offset only about 10–20 percent of the efficiency achievements of the CAFE standards. *Id.* at 19. Finally, although the NAS report did not reach definitive conclusions regarding the safety of large cars, a dissenting opinion challenged the majority's conclusion that heavier vehicles are necessarily safer. *Id.* at 117. The NAS report thus paved the way for reinvigoration of the CAFE program.

Since the NAS released its 2002 report, several events have suggested the report may have been overly conservative regarding the technological and economic feasibility of increasing fuel efficiency. Technologies, particularly those involving hybrid and electric engines, have advanced much more quickly than the NAS committee members anticipated. Moreover, fuel prices increased far above the $1.50 figure used in the NAS report. Finally, several studies called into doubt the safety of larger vehicles, and in fact suggested that larger vehicles may present greater safety risks than smaller ones. These issues all came to a head once Congress lifted the moratorium against NHTSA revising the CAFE standards.

C. Recent Developments in the CAFE Program: A New Era?

After the publication of the draft NAS report in July 2001, Congress lifted the moratorium prohibiting NHTSA from spending budget allocations on revisions to the CAFE standards. Shortly thereafter, changes to the CAFE program began to develop. First, in 2005, NHTSA revised its approach to establishing CAFE standards and began using a methodology called "Reformed CAFE." Second, in 2007, Congress adopted the Energy Independence and Security Act, which establishes a minimum statutory CAFE standard of 35 mpg by MY 2020 for passenger and non-passenger automobiles combined. Finally, NHTSA and EPA promulgated joint regulations that combine CAFE standards with vehicle emissions standards under the Clean Air Act. These developments, and the litigation that has surrounded them, suggest the CAFE program has entered a new era.

1. *Reformed CAFE and Light Trucks*

Congress lifted the CAFE moratorium at a time of intense public debate and advocacy around climate change. Many conservation groups and states considered CAFE standards a critical component of climate mitigation. They also believed that the NAS report presented them with opportunities to reform NHTSA's approach to establishing CAFE standards. In particular, they sought to close the SUV loophole, constrain automakers' ability to design extremely inefficient vehicles, and require NHTSA to consider the costs of climate change in its assessment of whether CAFE standards were technologically and economically feasible.

For years, the CAFE program had faced criticism for its fleet-wide mandates. Once NHTSA set the CAFE standard for a given model year, vehicle manufacturers could achieve the standard by producing any mix of vehicles they wanted. A carmaker could produce a SUV that got only 8 mpg, so long as it also produced enough efficient light trucks to meet the fleet-wide standard. If manufacturers could demonstrate that consumers would not buy the more efficient vehicles, they could also advocate for lower standards. Nothing prevented carmakers from designing extremely inefficient cars, and the program may have unintentionally promoted that outcome.

The 2002 NAS report proposed alternative ways in which NHTSA could establish CAFE standards. One proposal suggested that NHTSA establish standards based on vehicle attributes:

> [T]argets could vary among passenger cars and among trucks, based on some attribute of these vehicles such as weight, size, or load-carrying capacity. In that case a particular manufacturer's average target for passenger cars or for trucks would depend upon the fractions of vehicles it sold with particular levels of these attributes. For example, if weight were the criterion, a manufacturer that sells

> mostly light vehicles would have to achieve higher average fuel economy than would a manufacturer that sells mostly heavy vehicles.

NAS Report, at 87. NHTSA decided to pursue the NAS's recommendation by adopting a Reformed CAFE program for light trucks.

Under the Reformed CAFE program, NHTSA initially established "footprint" categories of light trucks, based on the trucks' size (as measured by its wheelbase times its average track width). For each footprint category, NHTSA established a target fuel economy level. As a truck's footprint increases, the fuel economy standard would decline. However, NHTSA refused to establish a fleet-wide average fuel economy requirement for all trucks covered under Reformed CAFE. Instead, the manufacturers' fuel economy requirements would depend upon the manufacturers' vehicle production levels; if a manufacturer chose to produce several trucks with large footprints and only a handful of trucks with smaller footprints, its fuel economy requirements would be lower. In essence, then, the automaker would determine its own fleet-wide average fuel economy standard by determining its production levels of each truck model.

In the following case, several states and conservation groups challenged NHTSA's approach to Reformed CAFE. They also used the new CAFE standards as an opportunity to challenge the SUV loophole and NHTSA's refusal to consider the economic benefits of carbon dioxide reductions.

CENTER FOR BIOLOGICAL DIVERSITY v. NATIONAL HIGHWAY TRAFFIC SAFETY ADMIN.,

508 F.3d 508 (9th Cir. 2007)

BETTY B. FLETCHER, Circuit Judge:

Eleven states, the District of Columbia, the City of New York, and four public interest organizations petition for review of a rule issued by the National Highway Traffic Safety Administration (NHTSA) entitled "Average Fuel Economy Standards for Light Trucks, Model Years 2008-2011," 71 Fed.Reg. 17,566 (Apr. 6, 2006) ("Final Rule") (codified at 49 C.F.R. pt. 533). Pursuant to the Energy Policy and Conservation Act of 1975 (EPCA), 49 U.S.C. §§ 32901-32919 (2007), the Final Rule sets corporate average fuel economy (CAFE) standards for light trucks, defined by NHTSA to include many Sport Utility Vehicles (SUVs), minivans, and pickup trucks, for Model Years (MYs) 2008-2011. For MYs 2008-2010, the Final Rule sets new CAFE standards using its traditional method, fleet-wide average (Unreformed CAFE). For MY 2011 and beyond, the Final Rule creates a new CAFE structure that sets varying fuel economy targets depending on vehicle size and requires manufacturers to meet different fuel economy levels depending on their vehicle fleet mix (Reformed CAFE).

* * *

D. The Final Rule: CAFE Standards for Light Trucks MYs 2008-2011

. . . NHTSA set the CAFE standards for MY 2008-2010 (Unreformed CAFE) at the same levels as proposed in the [Notice of Proposed Rulemaking (NPRM)]. Unreformed CAFE sets a fleet-wide average fuel economy standard "with particular regard to the "least capable manufacturer with a significant share of the market." NHTSA has reformed the structure of the CAFE program for light trucks, effective MY 2011 (Reformed CAFE). Under Reformed CAFE, fuel economy standards are based on a truck's footprint, with larger footprint trucks subject to a lower standard and smaller footprint trucks subject to higher standards. . . . A manufacturer's CAFE compliance obligation will vary with its fleet mix. A manufacturer that produces more large footprint light trucks will have a lower required CAFE standard than one that produces more small footprint light trucks.

During MYs 2008-2010, manufacturers may choose to comply with Unreformed CAFE or Reformed CAFE.

NHTSA used the manufacturers' preexisting product plans as the baseline for its analyses of technical and economic feasibility under both Unreformed and Reformed CAFE. NHTSA made adjustments to the product plans by applying additional technologies in a "cost-minimizing fashion," and stopping at the point where marginal costs equaled marginal benefits. . . . However, NHTSA did not monetize the benefit of reducing carbon dioxide emissions…but concluded:

> [T]he value of reducing emissions of CO_2 and other greenhouse gases [is] too uncertain to support their explicit valuation and inclusion among the savings in environmental externalities from reducing gasoline production and use. There is extremely wide variation in published estimates of damage costs from greenhouse gas emissions, costs for controlling or avoiding their emissions, and costs of sequestering emissions that do occur, the three major sources for developing estimates of economic benefits from reducing emissions of greenhouse gases.

* * *

NHTSA rejected the idea of a "backstop" under Reformed CAFE. NHTSA stated that a backstop, or a required fuel economy level applicable to a manufacturer if its required level under Reformed CAFE fell below a certain minimum, "would essentially be the same as an Unreformed CAFE standard." NHTSA argued that "EPCA permits the agency to consider consumer demand and the resulting market shifts in setting fuel economy standards," and that a backstop "would essentially limit the ability of manufacturers to respond to market shifts arising from changes in consumer demand. If consumer demand shifted towards larger vehicles, a manufacturer potentially could be faced with a situation in which it must choose between limiting its production of the demanded vehicles, and failing to comply with the CAFE light truck standard."

Finally, NHTSA declined to change the regulatory definition of cars and light trucks to close the SUV loophole and refused to regulate vehicles between 8,500 and 10,000 lbs. GWVR, other than [medium-duty passenger vehicles (MDPVs)].

*** * ***

III. DISCUSSION

A. Energy Policy and Conservation Act Issues * * *

2. Failure to monetize benefits of greenhouse gas emissions reduction

Even if NHTSA may use a cost-benefit analysis to determine the "maximum feasible" fuel economy standard, it cannot put a thumb on the scale by undervaluing the benefits and overvaluing the costs of more stringent standards. . . .

To determine the "maximum feasible" CAFE standards, NHTSA began with the fuel economy baselines for each of the seven largest manufacturers — that is, "the fuel economy levels that manufacturers were planning to achieve in those years." NHTSA then "add[ed] fuel saving technologies to each manufacturer's fleet until the incremental cost of improving its fuel economy further just equal[ed] the incremental value of fuel savings and other benefits from doing so." The standard is further adjusted "until industry-wide net benefits are maximized. Maximization occurs when the incremental change in industry-wide compliance costs from adjusting it further would be exactly offset by the resulting incremental change in benefits." NHTSA claims that this "cost-benefit analysis carefully considers and weighs all of the benefits of improved fuel savings," and that "there is no compelling evidence that the unmonetized benefits would alter our assessment of the level of the standard for MY 2011."

Under this methodology, the values that NHTSA assigns to benefits are critical. Yet, NHTSA assigned no value to the most significant benefit of more stringent CAFE standards: reduction in carbon emissions. Petitioners strongly urged NHTSA to include this value in its analysis, and they cited peer-reviewed scientific literature in support. . . . The NAS committee, on which NHTSA relies for other aspects of its analysis, also valued the benefit of carbon emissions reduction at $50 per ton carbon.

NHTSA acknowledged that "[c]onserving energy, especially reducing the nation's dependence on petroleum, benefits the U.S. in several ways. [It] has benefits for economic growth and the environment, as well as other benefits, such as reducing pollution and improving security of energy supply." NHTSA also acknowledged the comments it received that recommended values for the benefit of carbon emissions reduction; however, the agency refused to place a value on this benefit. NHTSA stated:

> The agency continues to view the value of reducing emissions of CO_2 and other greenhouse gases as too uncertain to support their explicit valuation and inclusion among the savings in environmental externalities from reducing gasoline production and use. There is extremely wide variation in published estimates of damage costs from greenhouse gas emissions, costs for controlling or avoiding their emissions, and costs of sequestering emissions that do occur. . . .

> Moreover, . . . commenters did not reliably demonstrate that the unmonetized benefits, which include CO_2, and costs, taken together, would alter the agency's assessment of the level of the standard for MY 2011. Thus, the agency determined the stringency of that standard on the basis of monetized net benefits.

NHTSA's reasoning is arbitrary and capricious for several reasons. First, while the record shows that there is a range of values, the value of carbon emissions reduction is certainly not zero. NHTSA conceded as much during oral argument when, in response to questioning, counsel for NHTSA admitted that the range of values begins at $3 per ton carbon. NHTSA insisted at argument that it placed no value on carbon emissions reduction rather than zero value. We fail to see the difference. The value of carbon emissions reduction is nowhere accounted for in the agency's analysis, whether quantitatively or qualitatively. * * *

Second, NHTSA gave no reasons why it believed the range of values presented to it was "extremely wide"; in fact, several commenters and the NAS committee recommended the *same* value: $50 per ton carbon. . . . NHTSA argues that the problem was not simply "the ultimate value to be assigned, but the wide variation in published estimates of the three major underlying costs of carbon dioxide emissions-the cost of damages caused by such emissions, the costs of avoiding or controlling such emissions, and the costs of sequestering resulting emissions." But NHTSA fails to explain why those three "underlying costs" are relevant to the question of how carbon emissions should be valued. We are convinced by Petitioners' response:

> To monetize the benefits of reducing CO_2 emissions from automobiles, NHTSA did not need to calculate the "costs of sequestering emissions." Carbon capture and sequestration, though a feasible means of reducing emissions from large stationary sources such as coal-fired power plants, was not within the range of actions at issue in this automobile fuel economy rulemaking. Nor were "costs for controlling or avoiding [CO_2] emissions" a genuine methodological barrier here: NHTSA already performed an elaborate analysis of the costs of mandating increases in fuel economy. For purposes of this rule-making, that was the relevant category of control costs.

In sum, there is no evidence to support NHTSA's conclusion that the appropriate course was not to monetize or quantify the value of carbon emissions reduction at all. * * *

Third, NHTSA's reasoning is arbitrary and capricious because it has monetized other uncertain benefits, such as the reduction of criteria pollutants, crash, noise, and congestion costs, and "the value of increased energy security."

Fourth, NHTSA's conclusion that commenters did not "reliably demonstrate" that monetizing the value of carbon reduction would have affected the stringency of the CAFE standard "'runs counter to the evidence'" before it. The Union of Concerned Scientists concluded that "including [a $50/tC value] in the determination of cost-efficient fuel economy could increase the 2011 targets by an average of 0.4-1.1 mpg." Given that the CAFE standards set by NHTSA increase only 1.5 mpg from MY 2008 to 2011, an additional 0.4 to 1.1 mpg increase by

MY 2011 is significant. * * *

Finally, there is no merit to NHTSA's unfounded assertion that if it had accounted for the benefit of carbon emissions reduction, it would have had to account for the adverse safety effects of downweighting, and the two would have balanced out, resulting in no change to the final CAFE standards. No evidence supports this assertion. The assertion is also based on the controversial assumption that higher fuel economy standards for light trucks causes adverse safety effects from downweighting.

Thus, NHTSA's decision not to monetize the benefit of carbon emissions reduction was arbitrary and capricious, and we remand to NHTSA for it to include a monetized value for this benefit in its analysis of the proper CAFE standards. *** * * ***

4. Backstop for Reformed CAFE

Under Reformed CAFE, a manufacturer's required CAFE level would depend on its fleet mix. Reformed CAFE (setting individual fuel economy targets for vehicles of every footprint size) plus a backstop (overall fleet-wide average) would prevent manufacturers from upsizing their vehicles or producing too many large footprint vehicles, if the backstop were set high enough. Under Unreformed CAFE, manufacturers had to meet only a fleet-wide average, which means that they could increase the number of small vehicles (with higher fuel economy) they produced in order to balance out the larger vehicles (with lower fuel economy) and achieve the required CAFE standard. NHTSA argues that Reformed CAFE will alleviate the problem of downweighting because there will no longer be a large gap between the CAFE targets for passenger cars and light trucks. . . .

Petitioners generally agree that Reformed CAFE, with its progressive fuel economy targets based on vehicle footprint, is an improvement over Unreformed CAFE. However, they argue that Reformed CAFE must include a "backstop" so that the "minimum level of average fuel economy applicable to a manufacturer in a model year" would not be determined solely by the manufacturer's fleet mix. *See* 49 U.S.C. § 32901(a)(6). They argue that the statutory language — "*maximum* feasible average fuel economy level," *id.* § 32902(a) (emphasis added), "*minimum* level of average fuel economy applicable to a manufacturer in a model year," *id.* § 32902(a)(6) (emphasis added) — and the statutory structure contemplate a fixed minimum CAFE standard for light trucks.

NHTSA argues that a backstop would unduly limit consumer choice and perpetuate the problems with Unreformed CAFE. It argues that the statutory requirement that there be a "minimum" level of average fuel economy applicable to a manufacturer does not necessarily mean a *fixed* minimum and is consistent with a minimum standard applicable to a manufacturer based on that manufacturer's fleet mix.

Neither the EPCA's language nor structure explicitly *requires* NHTSA to adopt a backstop. The issue is whether it was arbitrary or capricious in not adopting a backstop. Under Reformed CAFE, manufacturers would still be required to meet a minimum average fuel economy level-there would simply be no *corporate* minimum average fuel economy level. That is, each vehicle of a particular footprint would be required to meet a minimum average fuel economy level, but there would be no fleet-wide minimum. The corporate or fleet-wide minimum would depend entirely on the number of vehicles of each footprint that the manufacturer decided to produce.

Although Congress has not directly spoken on this issue, it has directed the agency to set the average fuel economy level for light trucks at the "maximum feasible" level, 49 U.S.C. § 32902(a), considering technological feasibility, economic practicability, the need of the nation to conserve energy, and the effect of other motor vehicle standards of the government, *id.* § 32902(f). NHTSA did not consider these factors in deciding whether to adopt a backstop. Instead, the agency explained:

> The intent of the CAFE program is not to preclude future mix shifts and design changes in response to consumer demand. A backstop would likely have this influence. . . . Such a system would be in opposition to congressional intent to establish a regulatory system that does not unduly limit consumer choice.

NHTSA may consider consumer demand, but "it would clearly be impermissible for NHTSA to rely on consumer demand to such an extent that it ignored the overarching goal of fuel conservation." We believe that NHTSA has committed this error here. Although EPCA is not intended to "unduly limit[ ] consumer choice," energy conservation is the fundamental purpose of the statute and an explicit statutory factor that NHTSA "shall" consider, … NHTSA did not adequately consider the "need of the nation to conserve energy," as it was required to do under 49 U.S.C. § 32902(f), and it has not argued that a backstop would be technologically infeasible or economically impracticable. * * *

6. Changing the definition of passenger and non-passenger automobiles in order to close the SUV loophole

Petitioners challenge NHTSA's decision not to reform the SUV loophole. They argue that this decision is arbitrary and capricious because it runs counter to the evidence showing that the majority of SUVs, minivans, and pickup trucks function solely or primarily as passenger vehicles, and because NHTSA has not provided a reasoned explanation for why the transition to Reformed CAFE could not be accomplished at the same time as a revision in the definitions.

The EPCA defines "passenger automobile" as "an automobile that the Secretary decides by regulation is manufactured primarily for transporting not more than 10 individuals," excluding "an automobile capable of off-highway operation that the Secretary decides . . . has a significant feature except 4-wheel drive designed for off-highway operation" and is 4-wheel drive or more than 6,000 lbs. GVWR. 49 U.S.C. § 32901(a)(16). "Non-passenger automobiles" are thus defined by exclusion. NHTSA defines an automobile other than a passenger automobile as a "light truck," a term not used in the statute. 49 C.F.R. § 523.5 (2007). Under 49 U.S.C. § 32901(a)(16), the Secretary has discretion to decide what constitutes a "passenger automobile" within the confines of the listed criteria.

NHTSA initially sought input on ways to revise the regulatory distinction because the passenger automobile/light truck distinction had become obsolete: "The application of the regulation to the current vehicle fleet (designed with the regulatory distinctions in mind) less clearly differentiates between passenger cars and light trucks than it did in the 1970s." However, in the NPRM, NHTSA decided not to:

> chang[e] those classification regulations at this time in part because [NHTSA] believe[s] an orderly transition to Reformed CAFE could not be accomplished if [NHTSA] simultaneously change[s] which vehicles are included in the light truck program and because, as applied in MY 2011, Reformed CAFE is likely to reduce the incentive to produce vehicles classified as light trucks instead of as passenger cars.

We conclude that NHTSA's decision not to otherwise revise the passenger automobile/light truck definitions is arbitrary and capricious. First, NHTSA has not provided a reasoned explanation of why an orderly transition to Reformed CAFE could not be accomplished at the same time that the passenger automobile/light truck definitions are revised.

Second, NHTSA asserts that it reasonably decided to look to the purpose for which a vehicle is manufactured instead of consumers' use of a vehicle because it is a more objective way of differentiating between passenger and non-passenger automobiles. But this overlooks the fact that many light trucks today *are* manufactured primarily for transporting passengers, as NHTSA itself has acknowledged: "Many vehicles produced today, while smaller than many other passenger cars, qualify as light trucks because they have been *designed* so that their seats can be easily removed and their cargo carrying capacity significantly enhanced." 68 Fed.Reg. at 74,927 (emphasis added); *see also* 71 Fed.Reg. at 17,621 n. 102 ("NAS Report . . . noted that [the passenger automobile/light truck fuel economy] gap created an incentive to design vehicles as light trucks instead of cars."). Today's design differences, which capitalize on the lower light truck CAFE standard, are the very reason that NHTSA sought input on ways to revise the regulatory distinction "in light of the current and emerging motor vehicle fleet."

In addition, NHTSA's new focus on the purpose for which automobiles are manufactured conflicts with its earlier assertion that "Congress intended that passenger automobiles be defined as those *used primarily* for the transport of individuals."

Third, NHTSA's decision runs counter to the evidence showing that SUVs, vans, and pickup trucks are manufactured primarily for the purpose of transporting passengers and are generally not used for off-highway operation. The NAS committee found that:

> The less stringent CAFE standards for trucks did provide incentives for manufacturers to invest in minivans and SUVs *and to promote them to consumers in place of large cars and station wagons.* . . . By shifting their product development and investment focus to trucks, they created more desirable trucks with more carlike features: quiet, luxurious interiors with leather upholstery, top-of-the-line audio systems, extra rows of seats, and extra doors.

Consumers use light trucks primarily for passenger-carrying purposes in large part because that is precisely the purpose for which manufacturers have manufactured and marketed them. A pickup truck usage study conducted by R.L. Polk & Co. showed that 73% of light pickup users use their trucks to carry passengers on a daily or weekly basis, 68% use them for personal trips on a daily or weekly basis, 58% use them for commuting on a daily or weekly basis, 59% *never* use them for towing, and 69% *never* use them for driving off-road. Seventy-three percent of medium pickup users use them for carrying passengers on a daily or weekly basis, 65% use them for commuting on a daily or weekly basis (61% daily), and 64% *never* use them for driving off-road. Even among heavy pickup users, 76% use them for carrying passengers on a daily or weekly basis, and 52% never use them for driving off-road. The NAS Committee further found:

> When CAFE regulations were originally formulated, different standards were set for passenger vehicles and for work/cargo vehicles. . . . because [work/cargo vehicles] needed extra power, different gearing, and less aerodynamic body configurations to carry out their utilitarian, load-carrying functions. . . . [But this] working definition distinction between a car for personal use and a truck for work use/cargo transport[ ] has broken down, initially with minivans, and more recently with sport utility vehicles and other "cross-over" vehicles that may be designed for peak use but which are actually used almost exclusively for personal transport. . . . The car/truck distinction has been stretched well beyond its original purpose.

One of the changes the NAS committee recommended to alleviate this problem was to "tighten" the definition of a light truck, a step the EPA has already taken for emissions standards purposes. We agree with Petitioners that NHTSA's decision not to do the same was arbitrary and capricious, especially in light of EPCA's overarching goal of energy conservation. Thus, we remand to NHTSA to revise its regulatory definitions of passenger automobile and light truck or provide a valid reason for not doing so. * * *

QUESTIONS AND DISCUSSION

1. *Carbon Dioxide and CAFE*. *Center for Biological Diversity* is the first decision to require NHTSA to consider carbon dioxide emissions in establishing CAFE standards. Do you agree with the Ninth Circuit's decision? Why or why not?

In an earlier decision issued by the D.C. Circuit, environmental organizations had challenged NHTSA's failure to consider the effects of a weakened CAFE standard on carbon dioxide emissions under the National Environmental Policy Act. *City of Los Angeles v. National Highway Traffic Safety Admin.*, 912 F.2d 478 (D.C. Cir. 1990). NHTSA had admitted that its weakened standard would result in 17.75 billion pounds of increased carbon dioxide emissions over the fleet's 20-year lifespan. *Id.* at 500. While Judge Wald found this increase significant enough to merit discussion in an Environmental Impact Statement (EIS), then-Judge Ruth Bader Ginsburg noted that this increase represented only one percent of carbon dioxide production over that time period, and found the increase legally insignificant. *Id.* at 501, 504. Judge Douglas H. Ginsburg concluded that the groups lacked standing to address this global problem. *Id.* at 483-84.

2. ***Reformed CAFE***. As the Ninth Circuit notes, the environmental organizations challenging the NHTSA's rule agreed that Reformed Cafe represented an improvement in how CAFE standards are set. Why would environmental organizations think this? Do you agree with their view?

2. *The Energy Independence and Security Act*

In December 2007, Congress passed the Energy Independence and Security Act (EISA), which requires NHTSA "to achieve a combined fuel economy average for MY 2020 of at least 35 miles per gallon for the total fleet of passenger and non-passenger automobiles manufactured for sale in the United States for that model year." Unlike the previous EPCA's presumed 27.5 mpg requirement, the 35-mpg standard is a minimum standard, and NHTSA may not establish CAFE requirements that fall short of the 35-mpg requirement. Moreover, all passenger automobiles must, at a minimum, achieve a 27.5 mpg average CAFE standard by 2011. For interim standards, as under EPCA, NHTSA must establish the CAFE standards at least 18 months before the MY to which the standards apply. It may establish standards for up to five years in a single rulemaking.

In enacting EISA, Congress attempted to address some of the problems under EPCA. Most notably, EISA specifically codifies Reformed CAFE, by requiring NHTSA to set standards based on vehicle attributes.

ENERGY INDEPENDENCE AND SECURITY ACT

Pub. L. No. 110-140, 121 Stat. 1492 (2007)
Codified at 49 U.S.C. § 32902(b)

(b) Standards for automobiles and certain other vehicles.—

(1) In general.--The Secretary of Transportation, after consultation with the Secretary of Energy and the Administrator of the Environmental Protection Agency, shall prescribe separate average fuel economy standards for--

(A) passenger automobiles manufactured by manufacturers in each model year beginning with model year 2011 in accordance with this subsection;

(B) non-passenger automobiles manufactured by manufacturers in each model year beginning with model year 2011 in accordance with this subsection; and

(C) work trucks and commercial medium-duty or heavy-duty on-highway vehicles in accordance with subsection (k).

(2) Fuel economy standards for automobiles.--

(A) Automobile fuel economy average for model years 2011 through 2020.--The Secretary shall prescribe a separate average fuel economy standard for passenger automobiles and a separate average fuel economy standard for non-passenger automobiles for each model year beginning with model year 2011 to achieve a combined fuel economy average for model year 2020 of at least 35 miles per gallon for the total fleet of passenger and non-passenger automobiles manufactured for sale in the United States for that model year.

(B) Automobile fuel economy average for model years 2021 through 2030.--For model years 2021 through 2030, the average fuel economy required to be attained by each fleet of passenger and non-passenger automobiles manufactured for sale in the United States shall be the maximum feasible average fuel economy standard for each fleet for that model year.

(C) Progress toward standard required.--In prescribing average fuel economy standards under subparagraph (A), the Secretary shall prescribe annual fuel economy standard increases that increase the applicable average fuel economy standard ratably beginning with model year 2011 and ending with model year 2020.

(3) Authority of the Secretary.--The Secretary shall--

(A) prescribe by regulation separate average fuel economy standards for passenger and non-passenger automobiles based on 1 or more vehicle attributes related to fuel economy and express each standard in the form of a mathematical function; and

(B) issue regulations under this title prescribing average fuel economy standards for at least 1, but not more than 5, model years.

(4) Minimum standard.--In addition to any standard prescribed pursuant to paragraph (3), each manufacturer shall also meet the minimum standard for domestically manufactured passenger automobiles, which shall be the greater of--

(A) 27.5 miles per gallon; or

(B) 92 percent of the average fuel economy projected by the Secretary for the combined domestic and non-domestic passenger automobile fleets manufactured for sale in the United States by all manufacturers in the model year, which projection shall be published in the Federal Register when the standard for that model year is promulgated in accordance with this section.

QUESTIONS AND DISCUSSION

1. ***Does EISA Close the "SUV loophole"?*** Section (b)(1) requires separate standards for non-passenger automobiles and medium- and heavy-duty on-highway vehicles. At a minimum, then, it should prevent NHTSA from exempting certain vehicles from CAFE standards entirely. In addition, Section (b)(2) requires NHTSA to establish combined CAFE standards for passenger and non-passenger automobiles, and Section (b)(3) requires the standards to be based on attributes. Are these mandates, in the aggregate, adequate to close the SUV loophole? What about the Ninth Circuit's holding? Should NHTSA have to regulate some light trucks as passenger automobiles moving forward? Consider these questions again after you read in the next section about the joint rules NHTSA and EPA promulgated.

2. Is the 35-mpg by 2020 standard adequate? On the one hand, the standard includes both passenger and non-passenger cars, so the standard may require significant improvement in fuel economy for passenger cars if automakers continue to produce a substantial number of large, non-passenger cars. On the other hand, if demand for light trucks were to decline, this could actually reduce manufacturers' incentives to improve fuel economy for passenger vehicles. Does the Reformed CAFE provision in Section (b)(3) ameliorate this concern? How should Congress have addressed the possibility that light truck sales could decline over time?

3. ***Credit Trading***. EISA created a credit trading system that would allow manufacturers to earn and trade credits by going beyond minimum efficiency requirements. First, each manufacturer may "trade" credits internally by applying credits earned from going beyond fuel economy standards for one class of vehicles to offset shortfalls in efficiency for another class of vehicles. Second, EISA allows credit trading between manufacturers. Is credit trading a useful component in the CAFE program?

4. ***CAFE Standards and Heavy-duty Trucks***. For years, medium and heavy-duty trucks weighing more than 10,000 pounds were not regulated under the CAFE program. Various studies, however, showed that regulation could yield significant reductions in fuel use. For example, a study commissioned by the National Center on Energy Policy concluded that, by 2015, tractor-trailers could improve their fuel economies by 58 percent using conventional technologies and by 71 percent using hybrid technologies. THERESE LANGER, AM. COUNCIL FOR AN ENERGY-EFFICIENT ECON., ENERGY SAVINGS THROUGH INCREASED FUEL ECONOMY FOR HEAVY-DUTY TRUCKS 16 tbl.6 (2004). Trucks weighing 10,000 to 19,500 pounds could see a 93 percent improvement in fuel economy using hybrid technology.

EISA adds new elements to the CAFE program addressing these vehicles. It directs NHTSA to establish fuel economy standards for commercial medium-duty and heavy-duty on-highway trucks weighing more than 10,000 pounds, as well as "work trucks" weighing between 8,500 and 10,000 pounds. NHTSA must establish these standards once NAS completes a study analyzing fuel economy requirements for these classes of trucks.

3. *Joint CAFE/Clean Air Act Standards*

In 2009, NHTSA and EPA issued joint regulations establishing combined CAFE standards and Clean Air Act emissions standards for greenhouse gas emissions from motor vehicles produced for MY 2012-2016. *See* Chapter 13 for a discussion of the Clean Air Act requirements.

In 2012, the agencies issued another set of joint regulations covering MY 2017-2025. The agencies anticipate the combined fuel economy for passenger and non-passenger automobiles could reach 54.5 miles per gallon by 2025. NHTSA, Fact Sheet, NHTSA and EPA Set Standards to Improve Fuel Economy and Reduce Greenhouse Gases for Passenger Cars and Light Trucks for Model Years 2017 and Beyond 1 n.3 (2012). However, actual fuel economy mandates will vary according to a vehicle's footprint. For example, the agencies expect that compact cars will have fuel economies of approximately 61.1 mpg, large cars will achieve 48.0 mpg, minivans will achieve 39.2 mpg, and midsize SUVs will achieve 43.4 mpg. *Id.* at 6–7 tbl. 3. Nonetheless, the agencies' regulations anticipate significant improvements in fuel economy through 2025.

The joint rules maintain the Reformed CAFE approach discussed in *Center for Biological Diversity* above. Thus, rather than setting fixed corporate average mandates that automakers must achieve, the joint rules establish footprint-based requirements, under which bigger cars will have lower standards. Moreover, like the rules at issue in *Center for Biological Diversity*, the rules do not include a "backstop." Instead, NHTSA explains, "because the standards are footprint-based and the fleet projections and distributions change slightly with each update of our projects, manufacturers' actual compliance obligations for any model year will not be known until the end of that model year based on actual vehicle sales." *Id.* at 4 n.9.

QUESTIONS AND DISCUSSION

1. *Reformed CAFE, Revisited.* Concerns about Reformed CAFE seemed to dissipate after the first set of joint rules the agencies issued in 2009. However, as the agencies set about to develop the 2017–2025 standards, concerns about Reformed CAFE again emerged. Most notably, a design scientist and mechanical engineer from the University of Michigan published an article exploring how car manufacturers might respond to the footprint-based requirements. Kate S. Whitefoot & Steven J. Skerlos, *Design Incentives to Increase Vehicle Size Created from the U.S. Footprint-based Fuel Economy Standards*, 41 ENERGY POL'Y 402 (2012). They concluded that the standards, which become less stringent as footprint sizes increase, would encourage manufacturing of larger vehicles, particularly in the light truck category. *Id*. at 410. Based on these dynamics, the authors predicted that footprint-based standards could actually increase carbon dioxide emissions. *Id.*

2. *The Real Standards*. Although the press statements and most media reports declared that the joint regulations would require vehicles to meet combined fuel economy levels of 54.5 mpg by 2025, they will likely not be quite that high. First, as explained above, the footprint-based standards tie the actual fuel economy mandates to production levels; if carmakers produce more large trucks, the actual standards will be lower than the agencies' projections. Second, the 54.5 mpg projection itself is based on the unlikely possibility that automakers will seek to reduce their vehicles' greenhouse gas emissions solely through improvements in fuel economy. However, they can more easily reduce emissions by installing air conditioning controls. If most automakers follow the latter action, NHTSA expects average fuel economy will be closer to 49.5 mpg.

3. *Automakers' Response to the Joint Regulations, Part One*. When NHTSA and EPA first issued their joint regulations, some people were surprised that U.S. automakers supported the regulations. However, their reactions are less surprising when one considers the political and economic dynamics at play.

In 2008, the U.S. auto industry was in free-fall due to the economic crisis and escalating fuel prices, which made large cars particularly undesirable. The Big Three Detroit automakers went to Congress seeking a multi-billion dollar bailout. During the bailout discussions, several environmental organizations asked Congress to attach environmental conditions to the bailout. For example, the Union of Concerned Scientists proposed that Congress require each company to improve its average fuel efficiency by four percent each year as a condition to receiving bailout funds. Press Release, Union of Concerned Scientists, Auto Bailout Should Link to Fuel Economy Boost (Nov. 18, 2008). Ultimately, Congress decided against linking bailout money to fuel economy or other environmental measures when it approved an initial bailout in December 2008. However, the stage was set for the Obama Administration to demand concessions from the automakers as EPA and NHTSA began developing their joint regulations.

At the time the agencies began developing joint regulations, several other legal actions were underway. California had sued automakers for contributing to a public nuisance by designing and marketing inefficient cars. While a district court had dismissed the case, California was poised to file an appeal. California had also developed its own vehicle emissions standards under the Clean Air Act (which many other states had adopted). While the Bush Administration had refused to allow the standards to take effect, the Obama Administration had agreed to reconsider that decision. The EPA was also in the process of developing federal emissions standards under the Clean Air Act, and NHTSA had just lost the *Center for Biological Diversity* case. In a worst-case scenario, automakers could have found themselves subject to new state and federal emissions standards, damages under a nuisance suit, and new fuel economy mandates developed in response to the *Center for Biological Diversity* decision. In addition, U.S. automakers had earned significant public scorn for demanding the bailout and, according to one article, using some of the bailout money in litigation challenging California's emissions standards. *See* Elizabeth Kolbert, *Will the Big Three Take Our Money and Sue?*, News Desk, THE NEW YORKER (Jan. 29, 2009). Auto companies were ready to make a deal. As a result, when the EPA and NHTSA announced their joint CAFE/Clean Air Act rules in 2009, they did so with the automakers' full support.

4. *Automakers' Response to the Joint Regulations, Part Two*. In 2011, as EPA and NHTSA worked on their revised joint rules covering MY 2017–2025, they again sought, and received, automakers' support. This time, however, Volkwagen refused to go along with the standards. In Volkswagen's view, the footprint-based standards unfairly favored manufacturers of large vehicles and penalized companies like Volkswagen, which produce many more small cars. Press Release, Statement by Tony Cervone, Executive Vice President, Communications, Volkswagen Group of America, Regarding Proposed Cafe Standards (July 29, 2012).

Id. Volkswagen also criticized the joint standards for failing to reward automakers that use "clean diesel" engines. While the rules allow natural gas and electric vehicles to count more heavily towards a company's compliance, diesels do not. What do you think of Volkswagen's concerns?

5. In April 2013, the University of Michigan's Transportation Research Institute reported that the average fuel economy of all new vehicles (including passenger and non-passenger automobiles) reached an all-time high of 24.6 mpg in March 2013. Eugene Mulero, *Fuel Economy of New Vehicles Hit[s] Record High*, E&E NEWS PM, Apr. 3, 2013. Researchers attributed the increases to improvements in hybrid, electric, and gasoline-powered technologies, as well as high gasoline prices. *Id.* What do these results suggest about the fuel economy standards and their critiques?

III. ALTERNATIVE FUELS

The type of fuel used in automobiles and other forms of transportation heavily affects the United States carbon footprint. Oil and gasoline account for more than 95 percent of all fuels used in transportation sources. While alternative fuels have begun to play an increasingly important role in transportation, they account for less than 1 percent of all vehicle fuels. However, this percentage is expected to increase as Congress dedicates more subsidies to alternative fuel production. In fact, federal subsidies and mandates have generated an explosion in domestic production and use of alternative fuels, and particularly of biofuels. Corn-based ethanol production rose from 1.6 billion gallons in 2000 to 5 billion gallons in 2006 to more than 13 billion gallons in 2012. Whether or not these production rates can or should continue to rise is debatable; but there is little doubt that alternative fuel policy will play a key role in U.S. transportation policy development in the future.

All alternative fuels, however, are not created equal. Within the transportation sector, the most common alternatives fuels are: natural gas; ethanol derived from corn; biofuels derived from soybeans, switchgrass, and other crops; second-generation biomass-to-liquid (BTL) biofuels; and hydrogen. Most of these fuel sources do not actually have lower end-of-pipe emissions than gasoline and diesel. However, depending upon how alternative fuels are produced, their lifecycle greenhouse gas emissions may be significantly lower than petroleum-based fuels. Determining which alternative fuels have the greatest impact in terms of climate change mitigation involves a number of considerations and calculations. For example, corn-based ethanol typically requires significant inputs of petroleum-based pesticides and herbicides, as well as energy-intensive processing, before it can be used as an automotive fuel. Natural gas and other alternative fuels may be imported from other countries, and the energy expended in their production and transportation may offset end-of-pipe emission reductions. As scientists develop more sophisticated models to calculate overall greenhouse gas emissions from alternative fuels, it appears that first-generation biofuels may not provide the benefits policymakers initially anticipated.

The use of alternative fuels may also have unintended consequences. Recent reports suggest that crop production for biofuels has displaced food production in many parts of the world, contributing to a global food shortage and increased food prices. Policies promoting biofuels may also spur landowners and governments to convert forest land into agricultural land. The resulting greenhouse gas emissions from land conversion may eclipse any greenhouse gas reductions gained from biofuel use.

On the other hand, biofuels and alternative fuel sources present many opportunities. Technologically, alternative fuels can already substitute for gasoline and diesel in many types of engines. It is also relatively easy and inexpensive to convert other engines for alternative fuel use. If policymakers develop innovative alternative fuel policies that can assimilate new information and promote low carbon fuels, alternative fuels may have great promise for reducing greenhouse gas emissions from transportation sources.

This section begins with a summary of the types of alternative fuels that are currently available or in development. It then discusses some of the unintended consequences of biofuel production, with a particular focus on the impacts on food production and climate change mitigation. Finally, it examines the laws that currently regulate and promote alternative fuels, and asks whether the legal system is adequately addressing the many issues involved in alternative fuel production and use.

A. An Overview of Alternative Fuel Production and Use

Alternative sources of transportation fuel are not a new concept. The first diesel engine was likely powered by peanut oil in 1900. In 1925, Henry Ford predicted that the fuel of the future would come from vegetation. Several studies in the 1930s and 1940s explored using a range of biofuel sources, including peanut oil, fish oil, animal oil, and castor oil, to power automotive engines. *See* Gerhard Knothe, *Historical Perspective on Vegetable Oil-Based Diesel Fuels*, 12 INFORM 1103 (2001). Yet, despite early interest in alternative fuels, climate change and escalating oil prices have only recently spurred investment in alternative fuels as viable energy sources. This investment has quickly resulted in soaring demand for certain alternative fuels.

This section briefly describes the common types of alternative fuels, their production methods, and current uses. As you read these descriptions, consider the following questions:

1. Which fuels, if any, have the best chance of reducing greenhouse gas emissions in the short term? Which would reduce long-term greenhouse gas emissions?

2. How should the U.S. promote development of alternative fuels for vehicles? From the excerpts below, do you think the U.S. approach is successful? Why or why not?

3. Is alternative fuel development policy consistent with U.S. efforts to increase vehicle fuel efficiency and recommended reforms to the transportation infrastructure? What other types of policies could the U.S. employ to reduce overall greenhouse gas emissions from motor vehicles?

1. *Biofuels*

The most common types of agricultural sources of fuels are often divided into two categories: ethanol and biodiesel. Ethanol is an alcohol processed from starchy vegetation. Biodiesel is any oil made from renewable sources such as plant oils or animal fats. These two types of agricultural fuels dominate the alternative fuels market in the United States.

a. *Ethanol*

Ethanol is a "clear, colorless liquid" that can be "produced from any biological feedstocks that contain appreciable amounts of sugar." L. Leon Geyer, Phillip Chong & Bill Hxue, *Ethanol, Biomass, Biofuels and Energy: A Profile and Overview*, 12 DRAKE J. AGRIC. L. 61, 69 (2007). In the United States, corn serves as the primary feedstock for ethanol production. Corn ethanol production is energy intensive, due to the significant inputs used to grow corn and the amount of energy required to convert corn starches into liquid fuel.

> While corn is currently the primary source of ethanol, it is possible that more efficient sources of energy may be developed. For example, switchgrass, also called tall panic grass, is a warm-season plant that is thought by many experts as the ideal alternative to corn for cellulosic ethanol production. . . . Preliminary research by USDA scientists has found that switchgrass has an energy output/input ratio more than 3.5 times greater than corn ethanol. Similarly, sugar feedstock such as sugar cane and sugar beets offer "more efficient" alternatives to corn based ethanol. According to scientific data reported by Larry Rohter, Brazil's sugar cane ethanol yields nearly eight times as much energy as corn-based options.
>
> Aside from corn, sugar, and switchgrass based ethanol, cellulosic ethanol is another type of ethanol derived from biomass which "refers to a wide variety of plentiful materials obtained from plants — including certain forest-related resources . . . , many types of solid wood waste materials, and certain agricultural wastes (including corn stover) — as well as plants that are specifically grown as fuel for generating electricity." Cellulosic ethanol may be seven to eight times more efficient in respect to corn-based ethanol's net energy balance ratio. Y.H. Percival Zhang of Virginia Tech stated that "[i]f we want to produce 30 to 60 billion gallons of ethanol, which is what is needed to meet the President's goal, we have to use the entire plant, or the stover (leaves, stalks, and cobs)." The technology necessary to utilize the entire plant lies in cellulosic ethanol and requires the "technologies that can break the cellulose into the sugars that are distilled to produce ethanol."

Id. at 69–70.

b. *Biodiesel*

Biodiesel is derived from vegetable oil or animal fats that can be converted into fuel. Although some engines can run directly on vegetable oil, most engines require oils to be processed through a relatively simple chemical reaction before the oils can be used as fuel. The processing uses alcohol to remove glycerin and make the oil less dense. The processing is considered relatively efficient, and each gallon of oil will yield almost one gallon of usable biodiesel.

UNION OF CONCERNED SCIENTISTS, ALTERNATIVE FUELS: BIODIESEL BASICS

http://www.ucsusa.org/clean_vehicles/big_rig_cleanup/biodiesel.html

Global Warming Impacts and Benefits

According to a model developed by the Argonne National Laboratory (ANL), neat (100%) biodiesel from soybeans can cut global warming pollution by more than half relative to conventional petroleum based diesel. The emissions benefits are higher for canola oil. In the future, non-conventional sources like algae may have the potential to provide dramatic (90%) reductions in global warming pollution. * * *

<u>Land Use, Biofuels, and Global Warming</u>

It is important to note that the ANL model of global warming impacts does not take into account changes in land use. When soybeans are used for fuel, they are taken out of the market for food. This increases prices and stimulates demand that farmers around the world respond to by bringing more land into cultivation. With soybean production increasing in the Amazon, it is possible that the lifecycle global warming pollution of soybean biodiesel is even higher than petroleum diesel, once indirect land use changes are considered (see our fact sheet on land use changes for more details).

When biodiesel is made from recycled food oil or other waste products these land use considerations do not apply. Also advanced technologies including biomass gasification may allow the use of other waste streams to be converted to synthetic diesel fuels, expanding the pool of potentially low carbon diesel.

In addition to land use, there is also some controversy over the emissions impact of fertilizer use and other land use practices (such as tillage practices). As a result, the estimated emissions from biodiesel can be expected to change as our understanding of the lifecycle improves.

Large scale production of biodiesel would require more virgin plant oils or other waste stream sources to meet larger demands. However, such large-volume biodiesel use could raise concerns about genetically modified crops, pesticide use, and land-use impacts common to ethanol and all other plant-based fuels. Crops for biodiesel must be grown in a manner that supports wildlife habitat, minimizes soil erosion, avoids competition for food crops, and does not rely on the use of harsh chemicals and fertilizers.

QUESTIONS AND DISCUSSION

1. *Emissions from Corn-based Ethanol.* Are greenhouse gas emissions from corn-based ethanol lower than emissions from petroleum-based fuels? Scientists have reached different conclusions regarding this question, and the debate appears to be far from settled. Most scientists had assumed that corn-based ethanol production would result in a 10 to 20 percent reduction in overall greenhouse gas emissions, based on the assumption that the plants would remove more carbon than the resulting fuels would release. For example, scientists at Iowa State University concluded that, when considering emissions from the refinery phase, emissions and removals from the agricultural phase, and direct land use changes associated with increased corn production, corn ethanol would still reduce greenhouse gas emissions by at least 11 percent and up to 39 percent. Bruce A. Babcock *et al.*, *Is Corn Ethanol a Low-Carbon Fuel?*, 13 IOWA AG. REV. No. 4 at 1–3, 10 (Fall 2007). However, in August 2007, another group of scientists concluded that emissions of nitrous oxide that occur when biomass is converted into biofuels would offset any benefits of carbon dioxide removals associated with plant growth. P.J. Crutzen *et al.*, *N_2O Release from Agro-Biofuel Production Negates Global Warming Reduction by Replacing Fossil Fuels*, 7 ATMOS. CHEM. PHYS. DISCUSS. 11,191 (2007). For corn-based ethanol, the study found that global warming effects from nitrous oxide would be 0.9 to 1.5 times higher than any cooling effects from reduced carbon dioxide emissions. *Id.* at 11,197. How should policymakers handle these scientific disputes?

2. *Biofuels, Agricultural Practices, and Greenhouse Gases.* The indirect effects of biofuels production may actually contribute to significant global increases in greenhouse gas emissions. These impacts are particularly profound when biofuels are produced from virgin sources.

In February 2008, a controversy erupted when *Science* published two separate studies claiming that biofuel production would significantly *increase* greenhouse gas emissions due to land use changes. One study concluded that corn-based ethanol production would almost "double greenhouse gas emissions over 30 years and increase[] greenhouse gasses for 167 years." Timothy Searchinger *et al.*, *Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change*, SCIENCEXPRESS (Feb. 7, 2008), available at www.sciencexpress.org. To reach these conclusions, the study authors assumed that increased demand for ethanol would spur United States farmers to quit growing soybeans and wheat in favor of growing more lucrative corn. *Id.* at 2. The authors also assumed that feed prices for livestock would increase. *Id.* Over time, the United States' agricultural exports of these crops and animals would decline, leading to increased food production and land conversion as other countries attempt to replace U.S. exports with locally grown food. *Id.* Since much of the existing land would otherwise provide carbon benefits in the form of carbon storage and sequestration, and since land conversion would for some time remove these carbon benefits, the study authors concluded that biofuel production will lead to increased greenhouse gas emissions. *Id.* A separate study found that land conversion due to biofuels production would initially release 17 to 420 times the amount of greenhouse gas emissions that biofuels will save on an annual basis. Joseph Fargione *et al.*, *Land Clearing and the Biofuel Carbon Debt*, SCIENCEXPRESS (Feb. 7, 2008).

These studies received considerable attention and criticism after their release. For example, the U.S. Department of Energy (DOE) claimed that many of the assumptions in the studies were either incorrect or unrealistic. DOE, *DOE Actively Engaged in Investigating the Role of Biofuels in Greenhouse Gas Emissions from Indirect Land Use Change*, 1–2 (2008). The controversy spilled into the California Air Resources Board (CARB)'s development of the state's low carbon fuel standard. Some DOE scientists urged CARB to disregard the indirect emissions, arguing the science remained inconclusive. Letter from Blake A. Simmons, *et al.*, to Mary D. Nichols, Chairman, CARB (June 24, 2008). In response, Timothy Searchinger, lead author of one of the controversial ethanol studies, criticized the DOE researchers for urging CARB to ignore a key consideration in any complete analysis of the greenhouse gas impacts of alternative fuels. Letter from Timothy D. Searchinger to Blake A. Simmons, *Re: Letter to California Air Resources Board* (July 2, 2008). Ultimately, another set of researchers who officially advised CARB regarding the low carbon fuel standard agreed that CARB should not ignore indirect land use change. Their letter ominously stated that their own analyses, while not complete, had similarly "found very similar GHG emission results to Searchinger's for ethanol from corn." Letter from Mark A. Delucchi *et al.*, to Mary D. Nichols, Chairman, CARB (July 3, 2008).

What do these exchanges suggest about the overall potential for biofuels to mitigate climate change and the development of an effective climate change strategy? Are you surprised that scientists would try to affect policymaking as they did with CARB? How should regulatory agencies treat evolving and controversial studies?

How should the law address these indirect or induced emissions? Studies concluding that biofuels will lead to increased greenhouse gas emissions largely reach this conclusion based on market models showing that reduced agricultural imports from the U.S. will spur increased crop production in other countries. They also suggest that renewable fuel standards that allow importation of biofuels could spur other countries to increase biofuel production on unsuitable lands and thereby emit even more greenhouse gases than gasoline. Can domestic laws address these concerns? Should international law provide a solution?

3. ***Cellulosic Ethanol and Second-generation Biofuels.*** Many ethanol advocates believe that cellulosic ethanol would achieve greater greenhouse gas reductions than corn or switchgrass ethanol. If produced using wood waste and agricultural residue, cellulosic ethanol would presumably not displace food crops and thus presents a lesser risk of causing indirect land use changes described below. *See* note 3. The U.S. Department of Energy (DOE) estimates that cellulosic ethanol would reduce greenhouse gas emissions by 85 percent compared to refined petroleum. However, as with corn, disputes regarding the overall benefits of cellulosic biofuels abound. One study concluded that cellulosic ethanol production requires 170 percent more energy than corn ethanol because cellulosic ethanol starches are difficult to extract. *See* David Pimentel & Marcia Pimentel, *Corn and Cellulosic Ethanol Cause Major Problems*, 8 ENERGIES 35, 36 (2008). Others have disputed the study's findings. In the meantime, the DOE has dedicated $385 million for six new cellulosic ethanol refineries. Press Release, DOE Selects Six Cellulosic Ethanol Plants for Up to $385 Million in Federal Funding (Feb. 28, 2007).

4. ***Biofuels and Soaring Food Prices***. One of the major concerns surrounding biofuels is that farmers will shift crops away from food production and toward fuel production and thus trigger a world fuel crisis. At least some organizations, including the United Nations Food and

Agricultural Organization (FAO), believe that biofuels have already contributed to this effect. For example, in 2006, 2007, and 2008, world food prices soared to unprecedented levels, increasing annually by 8 percent, 24 percent and 53 percent, respectively. By April 2008, the price of grains had climbed by 87 percent compared to 2006 levels. FAO, HIGH-LEVEL CONFERENCE ON WORLD FOOD SECURITY: THE CHALLENGES OF CLIMATE CHANGE & BIOENERGY, SOARING FOOD PRICES: FACTS, PERSPECTIVES, IMPACTS AND ACTIONS REQUIRED 3 (2008). While no one contends that biofuels are the sole cause of rising food prices, many experts believe that the biofuels market, which is tapping important agricultural commodities such as sugar, maize, cassava, oilseeds and palm oil for biofuels production, is playing an important role. *Id.* at 7. In December 2012, the FAO again reported that biofuels have contributed to volatile food prices and food shortages in several countries. FAO, THE STATE OF FOOD AND AGRICULTURE (2012).

In response to these concerns, the FAO asked the United States and Europe to suspend their biofuels mandates in 2012, after droughts ravaged U.S. corn and other food crops. *FAO Report Links High Food Prices to Biofuel Demand*, EurActiv.com, Dec. 14, 2012. In response, the European Commission began considering significant reductions to its biofuels mandate. *Id.* The United States, in contrast, refused to alter its own mandates after concluding they would not significantly change global food prices. *Id.* How do you think countries should balance the fuel versus food debate?

5. *Waste Vegetable Oil*. Some companies and local governments have attempted to avoid the indirect negative consequences of using virgin feedstock by using waste vegetable oil (WVO) as a source of biodiesel. Using waste oil reduces pressure on agricultural lands that virgin oil production causes and also reduces impacts on landfills and sewer systems caused by waste oil disposal. The city of Jacksonville, Florida, has created its own biodiesel distillation facility, where it converts waste oil from local restaurants into 100 percent biodiesel (B100). *See* Karen Gardner, *City Makes Biodiesel from Used Cooking Oil*, JACKSONVILLE BUS. J., Jun. 27, 2008, at 3. The city provides the restaurants stainless steel tanks in which they can dump their waste oil and then collects the oil on a regular basis. *Id.* Jacksonville anticipates that its recycling enterprise will save the city a great deal of money and ultimately generate a profit, since it is able to process the waste oil for approximately $1.50 per gallon and biodiesel currently sells in Jacksonville for more than $4.00 per gallon. SeQuential BioFuels, a commercial biodiesel production facility in Oregon, primarily processes biodiesel from waste oil collected from Kettle Foods (a potato chip company) and Burgerville (a fast food restaurant). *See* SeQuential Pacific Biodiesel, The Fuel, http://salembiodiesel.com/Fuel.htm. Despite these initatives, waste oil contributes a tiny fraction overall of biofuel production. Why do you think that is?

6. *Algae-based Biofuels.* Algae-based biofuels have the greatest potential for the air industry; most biofuels congeal at low temperatures, but some algae-based fuels can withstand the freezing temperatures of high-altitude air travel. Many scientists also believe that algae could serve as a more sustainable source of biofuels, due to algae's quick growth rate and because it would not displace existing food crops. Consider the following:

> Among the most photosynthetically efficient plants are various types of algaes. . . . Some species of algae are ideally suited to biodiesel production due to their high oil content (some well over 50% oil), and extremely fast growth rates. * * *
>
> NREL's research showed that one quad (7.5 billion gallons) of biodiesel could be produced from 200,000 hectares of desert land (200,000 hectares is equivalent to 780 square miles, roughly 500,000 acres). . . . [T]o replace all transportation fuels in the US, we would need 140.8 billion gallons of biodiesel, or roughly 19 quads (one quad is roughly 7.5 billion gallons of biodiesel). To produce that amount would require a land mass of almost 15,000 square miles. To put that in perspective, consider that the Sonora desert in the southwestern US comprises 120,000 square miles. Enough biodiesel to replace all petroleum transportation fuels could be grown in 15,000 square miles, or roughly 12.5 percent of the area of the Sonora desert (note for clarification — I am not advocating putting 15,000 square miles of algae ponds in the Sonora desert. This hypothetical example is used strictly for the purpose of showing the scale of land required). That 15,000 square miles works out to roughly 9.5 million acres — far less than the 450 million acres currently used for crop farming in the US, and the over 500 million acres used as grazing land for farm animals.
>
> The algae farms would not all need to be built in the same location, of course (and should not for a variety of reasons). . . . It would be preferable to spread the algae production around the country, to lessen the cost and energy used in transporting the feedstocks. Algae farms could also be constructed to use waste streams (either human waste or animal waste from animal farms) as a food source, which would provide a beautiful way of spreading algae production around the country. Nutrients can also be extracted from the algae for the production of a fertilizer high in nitrogen and phosphorous. By using waste streams (agricultural, farm animal waste, and human sewage) as the nutrient source, these farms essentially also provide a means of recycling nutrients from fertilizer to food to waste and back to fertilizer. Extracting the nutrients from algae provides a far safer and cleaner method of doing this than spreading manure or wastewater treatment plant "bio-solids" on farmland.
>
> These projected yields of course depend on a variety of factors, sunlight levels in particular. The yield in North Dakota, for example, wouldn't be as good as the yield in California. Spreading the algae production around the country would result in more land being required than the projected 9.5 million acres, but the benefits from distributed production would outweigh the larger land requirement.

Michael Briggs, Widescale Biodiesel Production from Algae (revised Aug. 2004), *available at* http://www.americanenergyindependence.com/algaefarms.aspx.

7. ***Caffeinating Your Car*****.** Researchers have recently found a new source for biodiesel that should put some pep in your car — used coffee grounds. It turns out that coffee grounds yield 10 to 15 percent biodiesel by weight. Over 7 million tons of coffee are consumed every year, which could produce an estimated 340 million gallons of biodiesel. At the end of the process, the coffee grounds can still be composted and, best of all, unlike cars that run on french fry grease that smell like a fast food restaurant, caffeinated cars smell a little like a morning latte from your favorite coffee house. *See Fuelled by Coffee,* THE ECONOMIST'S TECH QUARTERLY, Mar. 7, 2009, at 6.

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2. *Natural Gas and Hydrogen*

Other than biofuels, natural gas and hydrogen have the greatest potential to serve as alternative fuels for vehicles. Natural gas vehicles have expanded in some markets — although they remain a miniscule portion of the vehicle fleet — and hydrogen technology and deployment have advanced as well. However, because these alternative fuels occupy such a small part of the market, this section will provide only a brief overview of each.

a. *Natural Gas*

Compressed natural gas (CNG) provides fuel for a number of public transportation systems in the United States. CNG burns much cleaner than other petroleum-based fuels. For example, CNG vehicles emit approximately 80% fewer ozone-forming emissions than gasoline and diesel engines. Thus, the abatement of localized air pollution provided the initial impetus for CNG vehicles. In terms of climate change, CNG may reduce a vehicle's greenhouse gas emissions by up to 25 percent. However, these benefits may diminish if emissions from natural gas production and transportation are included in CNG's total emissions.

CNG has both practical and environmental limitations as an alternative fuel. CNG can function as a fuel only in specifically designed vehicles. In addition, fuel stations require CNG-specific facilities. These practical constraints have generally limited the use of CNG to public buses (which fuel up at specified transportation facilities) and other vehicles owned by municipalities. Although some states, like California, have expanded their CNG infrastructure, the number of CNG fueling stations is still relatively small. Only 534 public CNG stations exist in the United States, compared to more than 120,000 gasoline stations in the country. Outside of California, which has more than 140 stations throughout the state, the CNG station infrastructure cannot support long-distance travel. Thus, for most vehicle owners, CNG does not currently offer a realistic alternative to gasoline.

The long-term benefits of increasing CNG vehicle use and infrastructure development remain unclear. While CNG produces lower tailpipe emissions of greenhouse gases, the lifecycle emissions of natural gas may be quite high. Moreover, expansion of the CNG infrastructure could help lock in reliance on fossil fuels. For these reasons, CNG may not serve as an ideal replacement for oil.

b. *Hydrogen*

Hydrogen has long fascinated scientists as a potential clean energy source. When separated from other compounds, hydrogen (H_2) has the potential to store massive amounts of emissions-free energy. However, the process of separating hydrogen from other elements involves significant amounts of energy. Moreover, hydrogen must be stored in fuel cells or some other storage device, and technologies to make storage abundant and affordable have yet to emerge.

For advocates of hydrogen, its potential as an abundant and clean energy source makes investment in research and development for hydrogen worthwhile. To some people, however, investments in hydrogen technologies divert resources that could go to help develop other more viable carbon-free fuel options. *See* Joseph Romm, *California's Hydrogen Highway Reconsidered*, 36 GOLDEN GATE U. L. REV. 393, 401-05 (2006).

B. The Legal Framework Regulating Alternative Fuels

The United States and many state governments have enacted laws promoting research and development of alternative fuels. These laws generally take two forms: 1) financial incentives in the form of subsidies, grants, and tax credits, which promote production and use of alternative fuels; and 2) renewable fuel standards (RFS) specifying a minimum percentage of vehicle fuel which must come from renewable sources.

1. *Tax Incentives and Subsidies*

The primary way that the United States has promoted alternative fuel development is through tax incentives and subsidies. The vast majority of these subsidies are aimed at corn production and corn-based ethanol. While the United States has also subsidized other forms of alternative energy research and development, corn ethanol has benefitted the most from the government's largess. This section provides a snapshot of the many laws that incentivize corn ethanol.

MELISSA POWERS, KING CORN: WILL THE RENEWABLE FUEL STANDARD EVENTUALLY END CORN ETHANOL'S REIGN?

11 VT. J. ENVTL. L. 667, 678–81 (2010)

A. Early Efforts to Promote Ethanol

Early corn ethanol production resulted from a change in farm policy that began in the 1970s. During the Great Depression, President Franklin D. Roosevelt initiated the country's first comprehensive farm policy aimed at addressing the boom-and-bust cycle that had dominated the agricultural industry for decades. President Roosevelt created a new loan program to even out food production and increase security in the U.S. food supply. The program provided farmers with guaranteed loans to purchase agricultural supplies and allowed farmers to defer payment on the loans until their crops produced. When crop prices were low, farmers could store their crops and defer payment on loans. Whenever the crop prices rose, farmers could then sell their surplus at the higher rates and then repay the government. Farmers also had the option of making payments in the form of grains, thereby increasing the government's direct access to crops. This system evened out the boom-and-bust cycle by providing farmers with guaranteed access to loans and allowing farmers to store crops when market prices were low. . . .

In the early 1970s, however, a series of events unrelated to the loan program led to the first decline in food production since the 1930s. In response, President Nixon's Secretary of Agriculture substantially revised the farm payment system so that farmers received a guaranteed payment for every bushel of grain they produced. Production-based subsidies created the sought-after increase in food production. However, because the system included no cap [o]n the amount of subsidies available, over-production and plunging market prices for the subsidized grains soon followed. * * *

Ethanol became the other major corn product developed to take advantage of the surplus crops. Initially, corn ethanol entered the scene as a novelty; the Arab oil embargo of the early 1970s, however, followed by the energy crisis that lasted for several more years, created an opening for corn ethanol to fill. * * *

B. Ongoing Subsidies and Tax Credits

Once the corn-growers' industry convinced Congress that corn ethanol could lead the United States toward energy independence, Congress passed several laws to promote corn ethanol. Concerns about clean air further enabled the growth of the ethanol industry, as gasoline that contained ethanol released fewer pollutants into the air and thus enabled various cities to meet their air quality requirements. * * *

Congress initially began promoting corn ethanol as a means to achieve energy independence in the 1970s when it passed the Energy Tax Act of 1978, which gave a $0.40 per gallon subsidy for ethanol use in gasoline. Congress followed this initial step by passing several other laws, including the Energy Security Act of 1980, the Surface Transportation Assistance Act of 1982, and the Tax Reform Act of 1984, all of which increased the tax incentives and subsidies for ethanol, resulting in a subsidy of $0.60 per gallon by 1984. Even this substantial subsidy, however, could not make ethanol competitive with gasoline when oil prices plummeted to $10 per barrel in 1985. Several ethanol producers went under as a result, and the industry appeared doomed.

However, concerns about air quality revived the ethanol industry beginning in the late 1980s, when states and then Congress mandated the use of oxygenated fuels. Oxygenated fuels, including fuels mixed with additives like ethanol and methyl tertiary butyl ether (MTBE), allowed gasoline to burn more completely and thus release fewer pollutants. However, MTBE turned out to be a toxic, carcinogenic chemical that readily leached into and contaminated groundwater supplies, which enabled ethanol to dominate the oxygenated fuel market. The ethanol industry thus regained its footing as a result of the oxygenated fuels requirement.

Congress, meanwhile, continued to award ethanol more subsidies and to pass additional laws requiring its use. In 2005, Congress restructured these tax incentives to create the alcohols fuels credit, which amounted to a $0.51 per gallon credit in 2008, and a separate excise tax credit, which allowed ethanol users to take a $0.51 per gallon credit. Congress also imposed a $0.54 per gallon tariff on imported ethanol. Although the interactions between the tax credits and subsidies are quite complicated, the combined amount of subsidies for corn and subsidies for corn ethanol runs into the billions of dollars per year. Total U.S. corn subsidies from 1995 to 2005 exceeded $56 billion, and ethanol subsidies cost $5.1 to $7 billion in 2006. On a per gallon basis, subsidies amounted to $1.05 to $1.38 per gallon. When combined with the import tariff, corn ethanol costs $120 more than every barrel of oil saved. * * *

QUESTIONS AND DISCUSSION

1. *Subsidy Expiration.* In 2011, Congress allowed two of the major ethanol subsidies — the tax credit awarded to ethanol users and the tariff on imported ethanol — to expire. Many commentators from both conservative and liberal quarters had opposed subsidies for corn-based ethanol for years. The Cato Institute, a libertarian think tank that promotes free markets, and the Environmental Working Group (EWG), a liberal environmental advocacy organization, had shown that most farm-based subsidies (including those that fund ethanol) go to large agribusiness enterprises, such as Archer Daniels Midland. These organizations also believed that subsidies distorted the marketplace and prevented other more effective alternative fuel technologies from taking hold. These arguments, however, never resulted in subsidy reform. In 2011, however, concerns about the U.S. deficit and repeated disputes regarding the federal budget led to a broader public outcry against subsidies and, ultimately, their expiration. Is this a positive result? Should subsidies for other biofuels also expire? You might want to return to these questions after you read the next section.

2. *Renewable Fuel Standards*

In addition to establishing subsidies, Congress has taken a more directive approach to biofuels promotion by establishing a renewable fuel standard (RFS). An RFS defines the fuels that qualify as renewable and requires fuel refiners, blenders, and importers to blend a certain quantity of renewable fuels into their gasoline production. These mandates have spurred substantial development of biofuels, particularly corn ethanol.

Congress first established a national RFS (“RFS1”) when it adopted the Energy Policy Act of 2005 (2005 EPAct). It revised the RFS (“RFS2”) in 2007 with its passage of the Energy Information and Security Act (EISA), which increased the mandates and aimed to promote development of more advanced biofuels. RFS1 established many of the structural elements that continue to influence biofuel investment and development even after the adoption of RFS2.

a. *RFS1*

The 2005 EPAct amended the Clean Air Act to establish a nationwide RFS directing the EPA to develop regulations requiring gasoline sold in the United States to contain a minimum percentage of renewable fuel. 42 U.S.C. § 7545. Pursuant to RFS1, the mandate increased from at least 4.0 billion gallons of renewable fuel in 2006 to 7.5 billion gallons in 2012.

Table 15-1: Applicable Volumes of Renewable Fuel Under the RFS Program

Calendar Year	Billion gallons
2006	4.0
2007	4.7
2008	5.4
2009	6.1
2010	6.8
2011	7.4
2012	7.5

Source: Environmental Protection Agency, Regulation of Fuels and Fuel Additives: Renewable Fuel Standard Program, 72 Fed. Reg. 23,900, 23,903 tbl.1.B-1 (May 1, 2007).

RFS1 established the structure for implementing the renewable fuel mandates, as the next excerpts explain. Note that the structure the EPA developed to implement RFS1 also applies to RFS2.

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A. 2005 EPAct and Equivalence Values

Congress passed the first national renewable fuel standard in 2005 as part of its expansive energy bill. The heart of RFS1 consisted of mandatory volume requirements, establishing the amount of renewable fuels that importers, refiners, and blenders (collectively, "obligated parties") must add to motor vehicle fuels between 2006 and 2012. Beginning in 2006, obligated parties collectively were required to add four billion gallons of renewable fuels, and by 2012, that amount increased to 7.5 billion gallons. . . . To figure out each party's annual obligations under RFS1, EPA employed a formula reflecting anticipated fuel production, each party's share of production, and the proportion of renewable fuel each party would need to use to meet the national goal.

Congress directed EPA to establish a credit trading system to provide flexibility for obligated parties to meet the volume mandates established under the law. To implement this trading scheme, EPA assigned each gallon of produced or imported renewable fuel a Renewable Identification Number (RIN). Whenever a party produced or imported renewable fuel, it received a unique RIN assigned to the batch of fuel produced. An ethanol producer, for example, would receive a RIN for each batch of ethanol produced, and whenever the producer sold the ethanol to an obligated party, it would also sell or transfer the RIN. At the end of each year, obligated parties needed to demonstrate that they had obtained enough credits, as reflected by the number of RINs they had obtained, to meet their volume requirements. If an obligated party had purchased and used more renewable fuel than necessary, it could sell its excess RINs to another obligated party. If another obligated party had not purchased enough fuel, it could nonetheless meet its obligations by purchasing enough RINs to meet its obligations; even though a different party actually used the renewable fuel, each party's ultimate compliance was measured according to the number of RINs it collected, and not according to the actual amount of fuel used.

RINs, however, did not carry equal value under RFS1. In an attempt to incentivize development of cellulosic and waste-derived biofuels, Congress assigned these fuels equivalence values 2.5 times the value of corn ethanol. Under this system, each gallon of ethanol would receive a RIN worth one, but each gallon of waste-derived biofuel would have a RIN worth 2.5. Presumably, Congress expected these differential values to create adequate incentives for obligated parties to purchase more cellulosic and waste-derived biofuels. EPA, in turn, followed Congress's lead by assigning other biofuels different equivalence values, all of which were higher than the baseline value assigned to corn ethanol. In theory, these higher equivalence values should have increased investment in and production of biofuels other than corn ethanol. In reality, the equivalence values had no effect on corn ethanol production. Indeed, corn ethanol accounted for approximately 95% of all biofuel production in the United States in 2007. Thus, the equivalence values seem to have had no effect on reversing corn ethanol's dominance in the biofuels industry. * * *

The equivalence values established in RFS1 have not, and likely cannot, offset the substantial subsidies and tax credits that corn ethanol producers and corn growers already receive. As a result, equivalence values seem unlikely to spur a transition away from corn ethanol and toward other, less damaging biofuels. When one considers the existing technology to produce corn ethanol compared to other biofuels, existing facility capacity and infrastructure, and other factors, the equivalence values seem especially weak.

As noted above, corn growers themselves benefit enormously from subsidies: corn receives more subsidies than any other commercial crop. Many biofuels crops, such as switchgrass and algae, have historically received almost no subsidies at all. But even when compared to soy, which is the other major domestic crop currently used to produce first-generation biofuels and which benefits greatly from subsidies and tax credits, corn still receives far more in subsidies annually. EPA assigned soy-based biodiesel an equivalence value of 1.5, meaning that each gallon of biodiesel could earn 1.5 credits towards compliance with the mandate. Simply comparing the growers' subsidies to the equivalence value suggests that the equivalence value would not offset corn's dominance. Of course, this simple comparison ignores other factors, such as the demand for the commodity and the capacity to convert the crop into a biofuel, which could make other biofuels more competitive with corn than direct growers' subsidies might suggest. However, when these additional factors come into play, the equivalence values seem even weaker.

Corn ethanol has benefitted from having a significant head start over other biofuels due to clean air requirements that mandate blending ethanol into gasoline. These mandates spurred the initial construction of corn ethanol production capacity, such that EPA estimates that facilities in existence as of December 2007 could produce more than fifteen billion gallons of corn ethanol per year. First-generation biodiesel production capacity, in comparison, comes in at less than a billion gallons per year. From there, production capacity for other biofuels drops precipitously. For example, only one plant in the United States currently operates to produce cellulosic biofuels, and algae biofuel production is in its infancy. Clearly, absent the capacity to produce the fuels, the equivalence values themselves will not promote development of advanced biofuels.

It may be, however, that the new mandates under EISA will spur greater investment in advanced biofuels production and make the equivalence values more relevant in the future. But for this to happen, the trading program itself would require much more activity than it has experienced to date. In 2008, EPA reported that RINs under RFS1 traded at less than 5 cents per gallon on average and never exceeded 6.5 cents per gallon, an almost negligible value. Even using the highest multipliers in the equivalence values — 2.5 — would result in credits worth only 12.5 cents to 16.25 cents per gallon of fuel, which is well below the 51 cent excise credit ethanol receives under existing subsidies. For the equivalence values to work to make cellulosic fuels competitive with corn ethanol, RINs for corn ethanol would need to cost more than corn ethanol receives in subsidies.

QUESTIONS AND DISCUSSION

1. *RINs as Tracking and Trading Tools*. Renewable Identification Numbers (RINs) serve two purposes under the RFS. First, they provide renewable fuel purchasers and users a device for verifying compliance with the RFS by assigning a specific identification number to each batch of renewable fuel. Second, they allow parties to profit from trading RINs in a secondary market: the initial purchaser of renewable fuel can potentially profit by accumulating an over-supply of RINs when market prices are low and reselling RINs at a higher price when market prices are high. Do you understand how these work? Should EPA promote trading within the RFS? Why do you think EPA added a trading component?

2. RIN prices stayed low throughout 2012, usually averaging 2 to 3 cents per gallon. In the beginning of 2013, however, RIN prices spiked dramatically, sometimes exceeding $1.00. A number of factors may have contributed to the spikes, including increased mandates, fraud in the RIN market (see the next note), and reduced gasoline consumption. As of early April 2013, regulators had yet to pinpoint the causes of RIN price spikes, but some members of Congress had begun investigating the causes and using the escalating prices as a reason to call for suspension of the RFS.

3. *Fraud in the RIN market*. RIN purchasers have filed a number of cases alleging that renewable producers have transferred fraudulent RINs and thus breached RFS sale contracts. *See, e.g.*, Cargill, Inc. v. Int'l Exch. Serv., LLC, No. 12-CV-7042(HB) (S.D.N.Y. 2012), GP&W, Inc. v. Int'l Exch. Serv., LLC, No. 4:12CV00404 ERW (E.D. Mo. 2012), Lansing Trade Grp., LLC v. OceanConnect, LLC, No. 12-2090-JTM (D. Kan. 2012). RIN fraud has also spurred criminal actions. Indeed, federal officials raided the offices and arrested the CEO of one biofuel company for allegedly selling RINs associated with biodiesel that failed to meet federal standards. *See* Ron Kotrba, *Green Diesel Offices Raided, Absolute Fuels CEO Remains in Custody*, BIODIESEL MAGAZINE BLOG, July 25, 2012. In response to the allegations of fraud, EPA developed a proposed quality assurance plan that would help reduce future fraudulent actions. *See EPA RFS Credit Fraud Plan Draws Praise Despite Data, Timing Concerns*, INSIDEEPA DAILY NEWS, Feb. 20, 2013. What, if anything, do these fraudulent transfers say about the integrity of the biofuel market, the use of RINs, or RFS mandates overall?

b. *RFS2*

In December 2007, Congress increased the RFS requirements under EISA. In the near-term, overall levels of renewable fuels must increase. By 2016, however, increased renewable fuels must come from "advanced biofuels," as the Congressional Research Service explains:

> This subtitle extends and increases the renewable fuel standard (RFS) set by P.L. 109-58 (§1501). The RFS requires minimum annual levels of renewable fuel in U.S. transportation fuel. The previous standard was 5.4 billion gallons for 2008, rising to 7.5 billion by 2012. The new standard starts at 9.0 billion gallons in 2008 and rises to 36 billion gallons in 2022. Starting in 2016, all of the increase in the RFS target must be met with advanced biofuels, defined as cellulosic ethanol and other biofuels derived from feedstock other than corn starch — with explicit carve-outs for cellulosic biofuels and biomass-based diesel. The EPA Administrator is given authority to temporarily waive part of the biofuels mandate, if it were determined that a significant renewable feedstock disruption or other market circumstance might occur. Renewable fuels produced from new biorefineries will be required to reduce by at least 20% the life cycle greenhouse gas (GHG) emissions relative to life cycle emissions from gasoline and diesel. Fuels produced from biorefineries that displace more than 80% of the fossil-derived processing fuels used to operate a biofuel production facility will qualify for cash awards.

FRED SISSINE, CONG. RESEARCH SERV., ENERGY INDEPENDENCE AND SECURITY ACT OF 2007: A SUMMARY OF MAJOR PROVISIONS 5 (2007). Although RFS2 had some requirements designed to improve the environmental performance of renewable fuels, it is not clear if it will achieve that result.

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11 VT. J. ENVTL. L. at 697–702

By the end of 2008, it had become clear to most scientists and policymakers that first-generation biofuels, and corn ethanol in particular, had several negative impacts that required regulatory attention. At the same time, outside of a few state efforts to address these negative effects, EPA appeared unwilling to take meaningful steps to limit production of these first-generation biofuels. However, the passage of EISA in December 2007 created several new mandates for advanced biofuels production and specifically required new corn ethanol production to achieve a 20% reduction in greenhouse gas emissions as compared to emissions from fossil fuels. Most significantly, EISA directed EPA to conduct life-cycle analyses of greenhouse gas emissions from various biofuels. EPA interpreted this requirement to allow it to consider both direct and indirect emissions resulting from domestic and international land use changes. If nothing else, EISA appeared likely to radically alter biofuels production and corn ethanol's dominance. * * *

A. Life-cycle Analyses and Advanced Biofuels

One of the most promising aspects of EISA, in addition to its direct mandates for advanced biofuels, is Congress's recognition that biofuels may cause an overall increase in emissions of greenhouse gases when direct and indirect emissions are considered. EISA, therefore, includes [] important changes from RFS1 that have the potential to revolutionize the renewable fuels industry and ensure that biofuels are climate friendly.

First, EISA establishes new and aggressive production mandates for various advanced biofuels. EISA phases the requirements in slowly by requiring, for example, that 0.6 billion gallons of biofuels come from advanced fuels in 2009. By 2016, advanced biofuels must supply 7.25 billion gallons of the mandate, and cellulosic biofuels must account for at least 4.25 billion. By 2022, advanced biofuels must supply 21.0 billion gallons of all renewable fuels and will account for almost 60% of all renewable fuels required under the RFS. When compared to RFS1 under the 2005 EPAct, the mandates under EISA represent a significant improvement in biofuels policy. While RFS1 had nominal production requirements for cellulosic and advanced biofuels, RFS2 signals a new, and generally positive, direction for U.S. biofuels policy towards advanced and likely more sustainable renewable fuels.

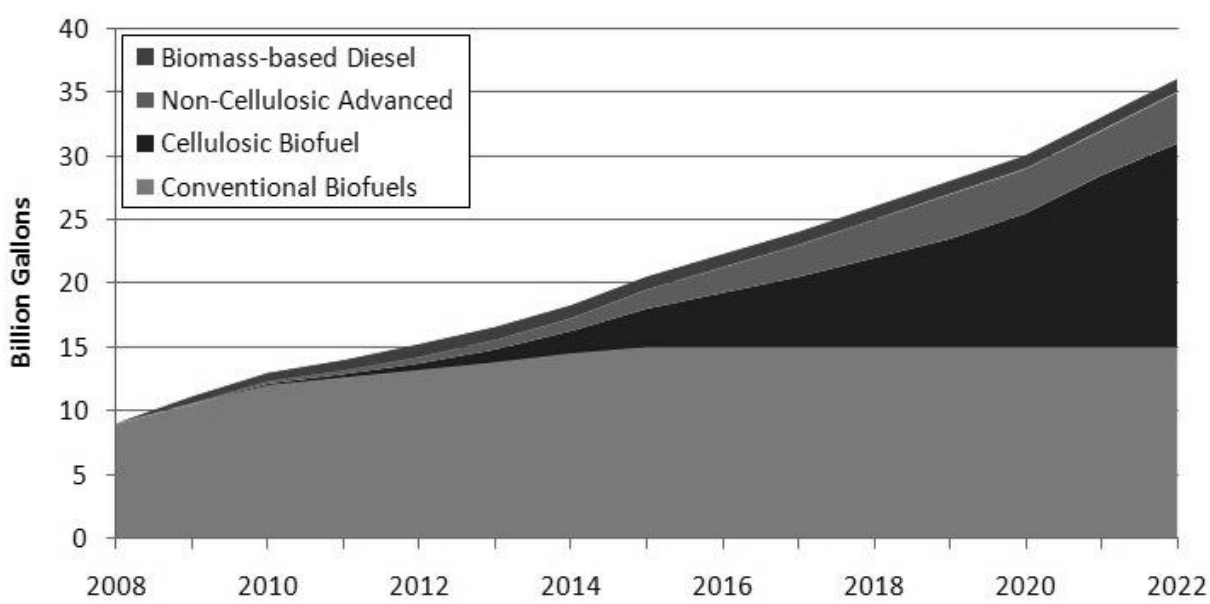
Second, and perhaps more importantly, EISA defines various biofuels according to their life-cycle greenhouse gas emissions and only allows those biofuels that achieve net reductions in these emissions to qualify for the RFS mandates. With an important exception for existing corn ethanol production, renewable fuels must reduce life-cycle greenhouse gas emissions by 20% compared to the baseline emissions of the fossil fuels they replace. EISA creates three new categories of renewable fuels-advanced biofuels, cellulosic biofuels, and biomass-based diesel-all of which must achieve even greater life-cycle greenhouse gas reductions compared to baseline emissions from fossil fuels. "Advanced biofuels" are any renewable fuels other than corn ethanol that achieve a life-cycle greenhouse gas emission displacement of 50% compared to the fossil fuel it displaces. Cellulosic biofuels are any renewable fuels derived from any cellulose, hemicelluloses, or lignin, and achieve a 60% reduction in life-cycle greenhouse gas emissions compared to fossil fuels. Finally, biomass-based diesel must achieve at least a 50% reduction in greenhouse gas emissions. In sum, EISA requires a minimum reduction of 20% and up to a 60% reduction in greenhouse gas emissions compared to fossil fuels. This change undoubtedly represents a significant step forward for U.S. biofuels policy. * * *

B. New Versus Old Corn Ethanol Production

Although EISA defines renewable fuels to mean fuels that achieve a 20% reduction in life-cycle greenhouse gas emissions compared to fossil fuels, this definition applies only to fuel produced from new facilities that commenced construction after December 19, 2007. Fuel produced from facilities that commenced construction before then is exempt from the 20% reduction requirement. In addition, EISA declares that facilities that commenced construction after the December 2007 cutoff date but that used natural gas or biomass to power the facility in 2008 or 2009 are "deemed compliant" with the 20% reduction requirement. These two exceptions, and particularly the grandfathering provision for "old" ethanol facilities, have the potential to allow continued production of significant quantities of corn ethanol-perhaps up to fifteen billion gallons per year-despite EPA's conclusions that existing corn ethanol production emits more greenhouse gases than it prevents. The "old" versus "new" distinction therefore represents a significant flaw in RFS2 that could undermine the otherwise laudable goals of EISA.
* * *

QUESTIONS AND DISCUSSION

1. ***Advanced Biofuel Mandates.*** Congress anticipated that advanced biofuel production would increase to keep pace with the mandates in RFS2. Indeed, as the following chart shows, Congress expected advanced biofuel production to expand steadily and significantly through 2022:



Source: C2ES, Center for Climate and Energy Solutions, Renewable Fuel Standard Figure 1, http://www.c2es.org/federal/executive/renewable-fuel-standard (last visited Apr. 7, 2013).

Reality, however, has not kept pace with expectations. Under RFS2, EPA must provide a "projected volume of cellulosic biofuel production" for each calendar year. 42 U.S.C. § 7545(*o*)(7)(D)(i). If this projection falls below the RFS2 mandates for cellulosic biofuels, EPA must lower the mandates to reflect its projection. *Id.* at §§ 7545(*o*)(3)(B), 7545(*o*)(7)(D)(i). In 2013, the D.C. Circuit invalidated as too aggressive EPA's method for projecting future production of cellulosic biofuel. Am. Petroleum Inst. v. EPA, 706 F.3d 474 (D.C. Cir. 2013). The D.C. Circuit determined that EPA's projection relied too heavily on the RFS's objective of promoting growth in the advanced biofuel industry and thus set the projection too high. *Id* at 479-80. As a result, EPA seemed poised to lower its cellulosic biofuel mandates. *After Court Losses, EPA Expected to Revise 2011 Cellulosic RFS Mandate*, INSIDEEPA DAILY NEWS, Mar. 8, 2013. What does this suggest about the future production of advanced biofuels? Do you think it reveals a flaw in the RFS structure, or does it simply suggest that Congress over-estimated how quickly advanced renewable fuels would develop?

2. ***The Ethanol "Blend Wall."*** Gasoline producers and blenders have also argued the RFS imposes impossible burdens on them due to the lack of vehicles capable of using fuels with a high percentage of ethanol blended in. Under federal law, gasoline retailers could sell fuels with up to 10 percent ethanol (E10) for use in all vehicles, although E85 vehicles could purchase fuels with 70 to 85 percent ethanol content. The "blend wall" refers to the dynamic under which biofuel mandates could require gasoline producers and blenders to produce fuels with an ethanol content that exceeds 10 percent without having the ability to sell the gasoline into the market under existing law. While producers could theoretically blend the required increases of ethanol into fuels used for E85 vehicles, that market is too small to absorb much of the increased blending mandate. Thus, absent a revision to federal law, gasoline producers and blenders would have the obligation to produce ethanol blends they could not legally sell.

In response to this dynamic, EPA took the obvious step of allowing sales of fuel blends containing up to 15 percent ethanol (E15). This, however, may not resolve the "blend wall" problem, because many consumers and gasoline retailers do not believe regular engines can use E15 without risk. *See* Robert Rapier, *Refiners Hit "Blend Wall" with Ethanol. Now What?*, CS MONITOR, ENERGY VOICES, Mar. 22, 2013. Thus, fixing the legal hurdles to the blend wall problem may not increase the market and design problems inherent in the RFS mandate.

What does the blend wall problem say about the RFS approach generally? Does it make sense for regulators to establish production or sales mandates to promote alternative fuels? Should regulators instead mandate the production of specific types of vehicles, rather than fuel types? Is there a better approach to promoting alternative fuels?

3. ***Low Carbon Fuel Standards***. Some states, led by California, have developed state-specific low carbon fuel standards (LCFSs), rather than a general RFS. For example, on January 18, 2007, Governor Arnold Schwarzenegger signed an Executive Order directing the California Air Resources Board (CARB) to adopt a low carbon fuel standard for the state. Exec. Order No. S-01-07 (Cal. 2007), *available at* http://gov.ca.gov/index.php?/executive-order/5172/. The order established a statewide goal of reducing the carbon intensity of California's transportation fuels by at least 10 percent by 2020. *Id.*, para. 1. It applied to "all refiners, blenders, producers or importers" of transportation fuels, and requires that the carbon emissions be measured "on a full fuels cycle basis." *Id.*, para. 4. Other states, including Massachusetts and Oregon, have also begun efforts to develop LCFS.

While many policy advisors believe that an LCFS represents a significant improvement over a typical RFS, the development of an LCFS is extraordinarily complicated. The California process, for example, took several years and required the creation of numerous policy documents, public comments, and scientific reports to justify the state's determination of which fuels qualified as "low carbon" under the standard. Once California established the standard, it then faced even more significant legal hurdles in challenges to the LCFS filed by both petroleum producers and ethanol manufacturers. A district court ruled that the Clean Air Act may preempt California from adopting an LCFS. Rocky Mountain Farmers Union v. Goldstene, 719 F. Supp.2d (E.D. Cal. 2010) (while the Clean Air Act does not expressly preempt the LCFS, the plaintiffs stated a claim for conflict preemption). It also ruled the LCFS, which incorporated lifecycle emissions into its carbon intensity calculations, violated the dormant Commerce Clause by discriminating against out-of-state ethanol producers and regulating extraterritorially. Rocky Mountain Farmers Union v. Goldstene, 843 F. Supp.2d 1071 (E.D. Cal. 2011). As of April 7, 2013, the appeal of the district court's decisions remained pending. *See* Chapter 18 for more discussion of the LCFS under the dormant Commerce Clause.

4. ***The RFS Waiver Provision and Unintended Consequences of Biofuel Mandates***. As noted above, various reports have linked biofuel production to increased greenhouse gas emissions and food insecurity. However, EPA may waive in whole or in part the RPS if a state petitions for a waiver and can demonstrate that meeting the RPS will "severely harm the economy or environment of a State, a region, or the United States." 42 U.S.C. § 7545(o)(7)(A)(i). Do you think this waiver could mitigate the unintended consequences of biofuels mandates? Consider the following.

> B. The Waiver Policy
>
> Congress included another mitigating measure in its first RFS by giving EPA the authority to waive the national renewable fuel requirements if "implementation of the requirement would severely harm the economy or environment of a State, region, or the United States." For the first three years of the RFS, the waiver went essentially unnoticed. However, in April 2008, when soaring gas, ethanol, and food prices sent commodity values sky-high, Texas's governor petitioned EPA to waive the RFS requirements for the 2008-2009 corn marketing year. Texas sought the waiver to protect its cattle industry, which had become heavily dependent on corn feed, and which faced escalating prices due, in part, to the corn ethanol boom. Texas argued that the sheer size of its cattle industry, which was the largest in the United States and amounted to about one-quarter of the entire U.S. herd, justified the waiver request. Despite EPA's calculations that waiving the RFS mandates could potentially decrease feed costs in Texas by anywhere from $53 million to $207 million — and even perhaps as much as $919 million — EPA denied Texas's request for a waiver. . . .

As noted, the statute gives EPA discretion to waive a RFS mandate if the Administrator determines that implementation of the requirement would severely harm the economy or environment of a state, region, or the United States. EPA determined that this statutory authorization requires the agency to make two findings before it exercises its discretion to grant or deny the waiver. First, because the statute requires a finding that implementation of the RFS "would" harm the economy or environment, EPA stated that evidence must demonstrate, to a high degree of confidence, that the RFS is itself the cause of the harm. Second, EPA concluded that evidence must also show, to a high degree of confidence, that the resulting harm would be severe. This latter condition also requires petitioners to show that granting the waiver would provide effective relief from that harm. Once EPA established the framework by which it would analyze Texas's waiver request, it became nearly a foregone conclusion that EPA would deny it.

First, EPA concluded that Texas could not demonstrate that the RFS itself had caused Texas's economic woes. The agency rejected Texas's argument that Congress intended the waiver to apply whenever the RFS contributed significantly to severe economic or environmental harm; instead, it concluded that the RFS alone must act as the cause of the asserted harm. Texas argued that the EPA's interpretation would render the waiver provision a nullity, since the RFS will never be the sole and direct cause of injury. Although EPA appeared to agree that the RFS will always work in conjunction with other factors, such as gasoline and food prices, to affect the economy and environment, EPA nonetheless held that the waiver requires a demonstration that the RFS, acting alone, is the cause of the alleged harm. . . . While implicitly acknowledging Texas's point that EPA's interpretation could render the waiver option a nullity, EPA concluded that its interpretation more fully adhered to Congress's intent to promote the use of renewable fuels.

Second, EPA determined that whatever economic impacts Texas could show did not amount to the "severe" impacts required for a waiver. EPA concluded that the threshold level of harm required for a waiver fell somewhat below "extreme" harm, but required Texas to demonstrate more than a "significant adverse impact[]" on its economy. Moreover, Texas needed to show that the RFS would severely harm the entire economy of a state, region, or the United States, not only one sector. Based on the high threshold of harm EPA required, it is not surprising that EPA denied Texas's waiver request. Ultimately, EPA concluded that waiving the RFS for the 2008-2009 marketing period (the year for which Texas sought the waiver) would likely alter cattle feed prices by between 1.2% and 4.7%, or, at the very most, 20%. While this would decrease annual feed costs by $53 million, $207 million, or even $919 million, depending upon the factors considered, EPA found these economic effects small compared to Texas's $1 trillion economy.

Melissa Powers, *King Corn*, at 690–93. Is the EPA's interpretation of the RFS mandate reasonable? Do you think any state will be able to demonstrate that the RFS caused the harm and that the harm was severe?

C. Are Hybrids and Electric Vehicles the Solution?

Some advocates believe that hybrid vehicles, plug-in hybrid electric vehicles (PHEVs), and pure electric vehicles (EVs) could provide the best solution for reducing greenhouse gas emissions from automobiles. A hybrid vehicle contains both an internal combustion engine and an electric motor. The electric motor assists the engine with acceleration, passing, and hill climbing, and thus enables the use of smaller, more efficient engines. Braking and coasting generate power for storage in batteries and later use by the electric motor. The assistance electric motors offer can make gasoline-fueled vehicles much more efficient. With PHEVs, the battery gets recharged either during use or from stationary electricity sources. Finally, EVs use only electric motors and get their power from the electricity grid.

Hybrid, PHEV, and EV technologies have improved remarkably in a short time. In 2009, batteries could typically store enough energy for a vehicle to travel approximately 35 miles before the battery required recharging. In early 2013, electric vehicles could typically travel 100-200 miles before recharging. Moreover, the electric vehicle market has expanded significantly, with several well-known models on the market (e.g., the Ford Focus, Nissan Leaf, Honda Fit, and Tesla Roadster and S Model). While it may take decades before electric vehicles become the norm, they have the potential to completely reform the transportation — and electricity — sectors.

1. *An Overview of EV Technology*

PHEV and EVs have captured the interests of transportation and electricity experts alike. While the following article focuses on PHEVs, it applies with equal force to EVs.

DAVID SANDALOW, ENDING OIL DEPENDENCE: PROTECTING NATIONAL SECURITY, THE ENVIRONMENT AND THE ECONOMY

in Opportunity 08: Independent Ideas for America's Next President 8-9 (Michael O. Hanlon, ed., 2008)

Plug-In Hybrid Electric Vehicles (PHEVs)

To end oil dependence, nothing would do more good more quickly than making cars that could connect to the electric grid. The United States has a vast infrastructure for generating electric power. However that infrastructure is essentially useless in reducing oil dependence because cars can't connect to it. If we built cars that ran on electricity, the potential for displacing oil would be enormous. Fortunately, we can. Several small companies are already doing this. General Motors recently announced plans to produce light duty plug-ins.

Historically, electric cars have been limited by several factors, including short range (think golf carts), battery weight, and cost. The range problem is solved by hybrid engines that automatically switch over to a standard gas tank when the battery is drained. The weight problem is being addressed with new kinds of batteries made with nickel or lithium. Upfront costs are still high — roughly $5,000 to $6,000 more than a car with an internal combustion engine — but well within range of commercial acceptability. Purchase costs will drop once plug-in hybrids are in mass production.

The potential benefits are enormous. Electric utilities typically have substantial unused capacity each night, when electricity demand is low. Further, utilities maintain reserve generating capacity — known as “peaking power” — for days of unusually high demand. This unused and excess capacity could provide an important cushion for vehicles in case of a sudden disruption in oil supplies or steep rise in oil prices. Furthermore, driving on electricity is cheap. Even a first-generation plug-in hybrid car would travel about 3-4 miles per KwH — equivalent to about 75 cents per gallon, based on the national average for electricity prices.

Plug-in hybrids would dramatically cut local air pollutants and would be better from a global warming standpoint than cars with standard internal combustion engines. True, the energy to recharge a plug-ins vehicle needs to come from somewhere, and in much of the United States that somewhere would be a coal-fired power plant. However, the thermal efficiency of even an old-fashioned pulverized coal plant is roughly 33 to 34 percent, while that of an internal combustion engine is roughly 20 percent. In terms of heat-trapping gases emitted, plugging a car with an electric motor directly into a coal plant is better than running it on oil with an internal combustion engine.

How much oil could plug-in hybrids displace how quickly? A lot, although the data available on U.S. driving habits allow only a rough estimate. According to the Department of Transportation, 40 percent of Americans travel 20 miles or less per day and 60 percent travel 30 miles or less. One possible scenario, in which plug-ins hybrids replace one-third of the oil in U.S. light duty vehicles by 2025 is illustrated in Table 15–2. It assumes strong policies supporting early deployment of plug-ins and steady penetration in the vehicle fleet thereafter.

Table 15–2. Potential Fleetwide Oil Savings from Plug-in Hybrids (PHEVs)—An Illustrative Scenario

Year	PHEVs as a % of new car sales	% of PHEV’s in U.S. auto fleet	Fleetwide Oil Savings
2008	0	0	0
2010	5%	0.3%	0.2%
2015	35%	7.2%	4.8%
2020	75%	27.6%	18.4%

2025	75%	52.0%	34.7%

Notes: New car sales are roughly 6.5 percent of the total U.S. fleet each year. Calculations assume that each PHEV uses 2/3 the gasoline of a conventional vehicle.

Finally, tens of millions of PHEVs could be added to the fleet without the need for new electric generating capacity. Even with PHEVs making up half the US fleet, electricity demand would increase by only 4-7%. PHEVs could be recharged at night, when electricity demand is low. In fact, PHEVs could even sell electricity back to the grid to ease peak loads.

QUESTIONS AND DISCUSSION

1. ***Plug-in Vehicles and the Smart Grid.*** For years, electricity experts have promoted the idea of a "Smart Grid" to improve energy efficiency and promote development of renewable energy sources. The term "Smart Grid" typically refers to an electricity system integrated with intelligent technologies that allow for more efficient operations and responses to power demand. *See* Joel B. Eisen, *Distributed Energy Resources, "Virtual Power Plants," and the Smart Grid*, 7 ENVTL. & ENERGY L. & POL'Y J. 191, 194 (2012). A Smart Grid could also integrate power production from multiple sources and ensure better reliability on the power grid.

Electric vehicles could function in a Smart Grid as a portable electric storage device. This could enhance the development and economic value of renewable energy sources. It might also reduce demand for peak power produced from fossil fuels. For example, with a Smart Grid, vehicle owners could program their vehicles to charge at specific times, such as when wind power production is high and peak demand is low. This would ensure the wind power gets used and allow the vehicle owner to avoid using electricity during peak times. Similarly, vehicle owners could potentially sell electricity back to the grid during peak demand, having charged their batteries from wind power generated the night before. The integration of electric vehicle batteries onto the grid has significant potential to reform operation of the electricity sector. If you owned an electric vehicle, would you want it to become a part of the Smart Grid? What risks do you think this would pose to car owners?

2. ***PHEVs and Greenhouse Gas Emissions from Electricity Sources*****.** Some people have raised concerns that PHEVs could simply shift the source of greenhouse gas emissions from vehicles to stationary sources, without actually resulting in a net reduction. However, a study published by the Electric Power Research Institute (EPRI) and Natural Resources Defense Council (NRDC) concluded that overall greenhouse gas emissions would decline as a result of PHEV use, even if inefficient coal-fired power plants continue to provide the bulk of electricity. EPRI & NRDC, EXECUTIVE SUMMARY, ENVIRONMENTAL ASSESSMENT OF PLUG-IN HYBRID ELECTRIC VEHICLES, VOLUME I: NATIONWIDE GREENHOUSE GAS EMISSIONS (2007). According to the study, if greenhouse gas intensity from the power sector remains high, PHEV use would still result in overall emissions reductions. Depending upon the PHEV market and the emissions reductions from the power sector, annual reductions would range from 163 to 612 million metric tons, and cumulative reductions would total between 3.4 to 10.3 billion metric tons by 2050. *Id* at 2.

2. *Policies Affecting PHEV and EV Use*

The CAFE standards discussed in Section II above have likely had the most impact in promoting development of PHEV and EV technologies. In addition, advocates of PHEVs and EVs have identified several policy and legal tools that would promote and increase their use. These include federal and state purchasing programs, subsidies for automakers to promote production of PHEVs, and tax credits for purchasers of PHEVs. *See* Sandalow, *Ending Oil Dependence*, at 11–12, 15. Each of these policies has been employed in other contexts. As you read the following, consider which would most successfully promote PHEV and EV use.

a. *Federal and State Purchasing Programs*

Purchasing programs are a common tool used by governments to reduce their own vehicle emissions and to create a market for newer low-emission vehicles. For example, the Energy Policy Act of 1992 (1992 EPAct) requires federal agencies to ensure that alternative fuel vehicles account for at least 75 percent of all annual light-duty vehicle acquisitions for metropolitan areas. State governments with more than 50 vehicles in their fleets (20 of which must be used in metropolitan areas) must also ensure that 75 percent of newly acquired vehicles in metropolitan areas qualify as alternative fuel vehicles. Qualifying vehicles include vehicles powered by electricity, ethanol, and 100 percent biodiesel.

While the 1992 EPAct provides a model for how a purchasing program could be structured, it does not currently define commercial gasoline/electric hybrid vehicles as qualifying alternative fuel vehicles (AFVs). Thus, state governments that wish to increase their purchases of gasoline/electric hybrids or PHEVs must still ensure that 75 percent of their vehicles are qualifying AFVs. They could do this either by purchasing hybrids that use a qualifying alternative fuel (such as 100 percent biodiesel) instead of gasoline, by purchasing hybrids that run primarily on the electric motor (commercially available vehicles, such as the Prius, do not meet this requirement), or by seeking a waiver from the 75 percent AFV requirement. If a state seeks a waiver, it must establish an alternative compliance plan for reducing its petroleum use.

As a result of the 1992 EPAct, more than 70,000 federal vehicles, and tens of thousands of state-owned vehicles, used alternative fuels by 2010. The vast majority of vehicles — 94 percent of the nearly 13,000 state vehicles bought in 2006 — use E85, an ethanol/gasoline blend containing 85 percent ethanol. The 1992 EPAct appears to have effectively achieved Congress's goal of spurring production of alternative fuels. The next challenge for EPAct will likely be spurring a transition to other sources of vehicle energy.

QUESTIONS AND DISCUSSION

Purchasing Requirements and the Clean Air Act. Many states and municipalities have enacted their own purchasing laws requiring governments to purchase low-emission or zero-emission vehicles (LEVs and ZEVs, respectively). Automakers, in turn, have challenged the authority of state and local governments to establish these laws. Specifically, the automakers have alleged that the Clean Air Act preempts all non-federal purchasing requirements aimed at reducing vehicle emissions. Under the Clean Air Act, states are preempted from adopting their own vehicle emissions standards. 42 U.S.C. § 7543(a). However, Section 209(b) of the CAA allows California to adopt separate state emissions standards if EPA grants California a waiver from the preemption provision. If California receives a waiver, other states may adopt the California standards. *See* Chapter 13 for a more detailed overview of this provision.

In *Engine Mfrs. Ass'n v. South Coast Air Quality Mgmt. Dist.*, the Supreme Court concluded that California's laws establishing purchasing requirements qualified as "standards" subject to the Clean Air Act's preemption provision. 541 U.S. 246 (2004). The South Coast Air Quality Management District had enacted Fleet Rules requiring public and private operators of six types of vehicle fleets — street sweepers; government-owned passenger cars, light-duty trucks, and medium-duty vehicles; public transit vehicles and urban buses; solid waste collection vehicles; airport passenger transportation vehicles, including shuttles and taxicabs picking up airline passengers; and government-owned heavy-duty on-road vehicles — to purchase LEVs, ZEVs, or alternative fuel vehicles whenever they add or replace vehicles in their fleets. *Id.* at 249–51. The Supreme Court rejected California's argument that its purchasing requirements were not 'standards" under the CAA, because they did not establish emissions limitations. *Id.* at 254–55. However, the Court did not decide whether all the standards were in fact preempted, and it specifically declined to resolve the question of whether the CAA preempts internal state purchase decisions. *Id.* at 258–59.

On remand, the Ninth Circuit concluded that California's Fleet Rules established for state and local government entities were not preempted under the CAA. Engine Mfrs. Ass'n v. South Coast Air Quality Mgmt. Dist., 498 F.3d 1031 (9th Cir. 2007). The court based its holding on the "market participant doctrine" — which states that actions taken by a state (or its subdivisions) as a market participant, as opposed to actions a state takes as a regulator, are generally protected from federal preemption. *Id.* at 1041–49. Specifically, the court found that the state's "proprietary action" in establishing rules governing the purchase and procurement of government vehicles did not amount to regulatory action preempted by the CAA. *Id.* at 1045–46. The Ninth Circuit remanded to the district court the question of whether the rules setting purchasing requirements for private entities were preempted. *Id.* at 1049–50.

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b. *Tax Credits for Purchasers of PHEVs*

A common way of promoting energy-efficient technology is through the establishment of tax credits for specific purchases. Tax credits are meant to offset the increased purchase price or minimize the risk involved in buying advanced technology vehicles. For example, Congress developed a tax credit to promote early adoption of hybrid vehicles as they entered the market. The available credit that a consumer could take depended upon the type of vehicle purchased, the year in which the vehicle was purchased, and the total number of vehicles that consumers had purchased. Consider the following.

IRS, HYBRID CARS AND ALTERNATIVE FUEL VEHICLES

(Dec. 11, 2007)

The Energy Policy Act of 2005 replaced the clean-fuel burning deduction with a tax credit. A tax credit is subtracted directly from the total amount of federal tax owed, thus reducing or even eliminating the taxpayer's tax obligation. The tax credit for hybrid vehicles applies to vehicles purchased or placed in service on or after January 1, 2006.

The credit is only available to the original purchaser of a new, qualifying vehicle. If a qualifying vehicle is leased to a consumer, the leasing company may claim the credit. * * *

Quarterly Sales

Consumers seeking the credit may want to buy early since the full credit is only available for a limited time. Taxpayers may claim the full amount of the allowable credit up to the end of the first calendar quarter after the quarter in which the manufacturer records its sale of the 60,000th hybrid or advance lean burn technology. For the second and third calendar quarters after the quarter in which the 60,000th vehicle is sold, taxpayers may claim 50 percent of the credit. For the fourth and fifth calendar quarters, taxpayers may claim 25 percent of the credit. No credit is allowed after the fifth quarter.

For example, F Company is a manufacturer of hybrid motor vehicles, but not advanced lean burn technology motor vehicles. F Company sells its 60,000th hybrid car on March 31, 2006.

- Ms. Smith buys an F Company hybrid car on June 30, 2006, and claims the full credit.
- Ms. Maple buys an F Company hybrid car on Dec. 31, 2006, and claims 50 percent of the credit.
- Mr. Grey buys an F Company hybrid car on June 30, 2007, and claims 25 percent of the credit.
- Mr. Green buys an F Company hybrid car on July 1, 2007, and is unable to claim the credit, because the credit has phased out for F Company vehicles.

QUESTIONS AND DISCUSSION

1. How effective were tax credits in promoting hybrids? It depended, in large part, on the perceived quality of the hybrids at issue. For example, the tax credit spurred a buying frenzy for the Toyota Prius, the most popular of all the hybrid cars available in the United States. Toyota sold its 60,000th vehicle by the summer of 2006, and the tax credit phased out in September 2007. Even after the phase-out for Toyota, overall sales of the Prius continued to increase. Sales of other hybrid vehicles sold at varying rates. Sales of other hybrids produced by Toyota, Lexus, and Honda all reached the 60,000 mark and the credit phased out relatively quickly. In contrast, by March 2008, none of the U.S. automakers had sold 60,000 vehicles and the full tax credit remained available for cars purchased from these companies. *See* Peter Valdes-Dapena, *Hybrid Tax Credit Shock*, CNNMONEY.COM, Mar. 7, 2008. Ford eventually sold enough vehicles for the credit to phase out, but General Motors never did. Does this suggest that tax credits merely provide refunds to people who would have bought a Prius anyway? If so, do they serve any purpose? How else could Congress structure tax credits to incentivize purchases of new technologies?

2. In the 2005 EPAct, the value of the tax credit depended in part upon the fuel efficiency and reduced emissions from each vehicle. However, the most efficient vehicle, the Honda Insight (60 mpg) qualified for only a $1,450 credit, compared $3,150 for the Prius (46 mpg) and $2,600 for the Toyota Highlander (29 mpg). Does this make sense? Perhaps. Since the Insight could seat only two passengers whereas the other cars all seat four, it may be that the Insight would not yield the same overall pollution reductions.

3. How would you design a tax policy to promote PHEV use? Would you offer tax credits to a limited number of purchasers? If so, what would the value of the credits be? Who would be eligible for the credits? Would the credits phase out?

4. Tax credits for new vehicles tend to provide subsidies for wealthier car drivers. Most drivers who can afford to purchase hybrid cars are already driving relatively fuel-efficient vehicles. Yet studies show that replacing very inefficient cars for even moderately efficient cars would actually result in much greater fuel savings. *See* Duke University, *Gallons Per Mile Would Help Car Shoppers Make Better Decisions*, SCIENCEDAILY, June 20, 2008. For example, replacing a car with a fuel efficiency of 34 mpg for a car that gets 40 mpg would, over 10,000 miles, save 98 gallons of gas, whereas replacing an 18-mpg car for a 28-mpg car would save 198 gallons of gas. *Id.* How would you design a tax policy to promote greater efficiency?

5. In 2009, as part of the stimulus bill, Congress enacted President Obama's proposed Consumer Assistance to Recycle and Save (CARS), aka "Cash for Clunkers," program. The program offered financial incentives (on average, $4200) to consumers who agreed to turn in older, less-efficient vehicles with newer, more efficient ones. According to the American Council for an Energy-Efficient Economy (ACEEE), the program successfully spurred improvements in fuel economy; however, the actual efficiency gains were much lower than they could have been. BEN FOSTER & THERESE LANGER, ACEEE, CASH FOR CLUNKERS: A MISSED OPPORTUNITY FOR FUEL ECONOMY GAINS (2011). On average, participants bought vehicles with fuel economies only about 2.9 mpg better than they would have bought without the program. Does this suggest policy makers should stay away from incentive programs, or does it instead indicate that policy makers should aim higher than they did with Cash for Clunkers?

6. Is it possible that doing nothing is the best way to promote hybrids and other fuel efficiency technology in an age of higher gas prices? From February 2008 to June 2008, gasoline prices rose approximately $1.12 per gallon nationwide. In May 2008, gas prices were up nearly 40 percent from the prior year, and the Energy Information Administration expected gas prices to continue to climb. In response, driving and car ownership patterns changed. For example, in the first quarter of 2008, sales of SUVs and pickups fell by 28 percent and 14 percent, respectively. Moreover, overall driving in the United States fell by approximately 7.5 percent. *See* Christopher Palmeri, *Gas May Finally Cost Too Much*, BUSINESSWEEK, Apr. 23, 2008. Use of mass transit also increased by 10 to 15 percent in cities throughout the southern and western U.S. *See* Clifford Kraus, *Gas Prices Send Surge of Riders to Mass Transit*, NY TIMES, May 10, 2008, at A1. On the other hand, gas prices fell by the end of that year, and consumers began buying trucks again. Peter Valdes-Dapena, *With Gas Falling, Trucks Come Back*, CNNMONEY.COM, Dec. 29, 2008). Do these changes suggest that the best policy is maintaining high gas prices while letting consumers make their own decisions in response? What other policy choices would you promote?

IV. REFORMING THE TRANSPORTATION INFRASTRUCTURE

Many critics of the CAFE program believe that increased fuel efficiency will only result in greater vehicle miles traveled (VMT), as fuel economy standards make driving more affordable. Although several studies indicate this "rebound effect" has only a minimal impact, most transportation experts nonetheless recognize that the U.S. transportation system requires reform. Indeed, the U.S. infrastructure usually encourages inefficiency and often requires many Americans to drive long distances to accomplish daily tasks.

Land use policies promoting residential development in suburban and exurban areas have increased the overall VMT of the average American. Distances between the home and workplace have expanded significantly in the 1990s and 2000s, while alternatives to driving contracted. As a result, highways have become more crowded, congestion has increased, and overall greenhouse gas emissions from the transportation sector have climbed.

Historically, and to a large degree today, the federal response to congestion has been to increase the highway system. Federal transportation policy has long prioritized highway construction over other types of transportation infrastructure. As the federal highway system has expanded, so has suburban development. As a result, most new highways promote more driving, which leads to greater congestion, which leads to more highway construction, and so forth.

Moreover, federal policy does not provide the same support for public transportation as it does for highways. Indeed, most federal funding must, by law, support highway construction rather than public transportation. The lack of available funding for public transportation has prevented local governments from expanding bus, train, light rail, and subways systems. While some large metropolitan areas have robust public transportation systems, most cities of all sizes lack adequate public transportation. This spurs the majority of Americans to use their own cars as their primary means of commuting.

Reducing greenhouse gas emissions from the transportation sector will require several changes to the transportation infrastructure aimed at: reducing congestion; limiting single-passenger driving patterns and promoting high-occupancy vehicle use; expanding public transportation systems, bike lanes, sidewalks, and other low- or zero-carbon transportation options; and revising land use policies that reduce suburban and exurban sprawl. Many of these actions will require state and local governments to take the lead. However, the federal government will also play a key role, through funding transportation infrastructure, supporting state policies, and possibly developing tax policies that discourage personal vehicle use.

A. A Survey of Policies to Reduce Vehicle Miles Traveled (VMT)

The following excerpt summarizes several commonly proposed strategies that transportation agencies could employ to reduce overall VMT in the United States. Which of these are most likely to result in the greatest changes in driving patterns? Which have the greatest chance of receiving political support?

MICHAEL GRANT ET AL., U.S. DEPT. OF TRANSPORTATION, TRANSPORTATION AND GLOBAL CLIMATE CHANGE: A REVIEW AND ANALYSIS OF THE LITERATURE

31–63 (1998)

5.2 VEHICLE TRAVEL REDUCTION STRATEGIES

Vehicle travel reduction strategies attempt to reduce greenhouse gas emissions by reducing miles traveled in personal motor vehicles. Reductions in fuel consumption occur with the elimination of trips, reduction in trip lengths, or the replacement of vehicle trips with trips on alternative modes that consume less energy. * * *

Vehicle travel reduction strategies may be divided into the following categories:

- Travel pricing mechanisms;
- Provision of alternative modes;
- Parking management; [and]
- Land use planning measures . . .

5.2.1 TRAVEL PRICING MECHANISMS * * *

ROAD PRICING * * *

Roadway pricing involves the use of fees to increase the price of driving in specific facilities or on roadways, or within specific regions. Drivers who have more flexibility in their trip choices (therefore placing a lower value on a specific route or time) will switch to less expensive options, which can include other non-priced roads or alternate modes (such as transit, high-occupancy vehicles, bicycling, or walking). Congestion pricing is a specific type of road pricing where the per trip charge varies by the time of day, based on changes in the demand for travel and resulting congestion. Congestion pricing may encourage drivers to switch their time of travel to less congested times, resulting in a more even distribution of traffic throughout the day.

Road pricing is usually assessed at one or more points along a road. Currently, twenty states have toll roads, bridges, or tunnels with costs averaging between $0.02 and $0.10 per mile. . . . Cordon pricing is a related measure, which may be applied to a larger region where congestion is a severe problem. Cordon pricing establishes a series of pricing points in a ring around the congested area, whether it be a central business district or a greater metropolitan area. Motorists are charged as they enter the cordoned area. * * *

Low public acceptance can be a crucial roadblock to implementation of roadway pricing measures. Road pricing may be politically unpopular for a number of reasons. First, charging a fee on facilities that have traditionally been free often generates public dissatisfaction. Perhaps the leading objection to road pricing is that this measure is regressive and would disproportionately affect lower-income drivers. In the case of congestion pricing, drivers who could not alter their time of their trips due to inflexible work schedules would have no option but to pay the fees. A cordon zone pricing system around a central business district or downtown could conflict with land use strategies that seek to encourage employment in developed areas, though the land use impacts of cordon pricing are still being debated. * * *

VMT FEES * * *

A VMT fee refers to a charge that is levied on an annual or semi-annual assessment based on the number of vehicle miles traveled per year. This system could work in tandem with existing vehicle registration fees and inspection and maintenance programs. . . .

VMT fees target reductions in vehicle miles of travel. Unlike road pricing measures where costs can be reduced by switching travel times, use of routes, or type of vehicle used, the only way for an individual to reduce costs under this measure is to drive less, thus reducing traffic and emissions. * * *

Some economists believe that even though these fees are charged per mile of travel, drivers may not respond as strongly to VMT fees as to other travel pricing measures since the fees would only be charged on an annual basis or semi-annual basis. A 1994 study conducted for the Puget Sound Regional Council analyzed the potential impacts of VMT fees in the Puget Sound area as well as in the San Francisco Bay area. The fees ranged from $0.01 to $0.05 per mile and yielded 9.3 to 11 percent decreases in VMT and 8 to 20 percent decreases in carbon dioxide. * * *

Like other market-based measures, VMT fees raise concern regarding political feasibility and issues of equity. Taxpayers may suffer “sticker-shock” when they receive their VMT fee assessments. A fee of $0.05 per mile results in an annual VMT tax assessment of over $566 for the average vehicle (which traveled 11,329 miles in 1995). A household with two vehicles could easily receive a tax bill of over $1,000 annually in association with this VMT fee. * * *

FUEL PRICING * * *

Fuel taxes have long been used in this country to recover road construction and maintenance costs. However, in recent years, raising federal and/or state fuel taxes has increasingly been viewed as a potential tool to reduce VMT and improve fuel efficiency. Currently fuel taxes comprise 30 to 40 percent of fuel prices, but a very small percentage of total car ownership costs. Fuel tax advocates point out that American gasoline prices are a mere fraction of those in other industrialized nations, where the price of a gallon of gasoline can cost $2 to $3 more than in the US. * * *

Changes in fuel tax prices have two long-term effects:

- Increasing fuel prices raises the price of travel per mile, which encourages consumers to reduce vehicle miles of travel . . .
- Since the amount paid for fuel is directly proportional to the amount of fuel consumed, fuel pricing provides incentives for the purchase of more efficient vehicles . . .

The effectiveness of fuel pricing depends on consumers' responses to increases in the price of fuel. Advocates of higher fuel taxes point to their ability to levy the costs at the source of the activity, thus making the cost more visibly related to the act of driving. * * *

Although the federal government and all states levy gas taxes, the idea of increasing gas taxes may draw considerable political opposition. The contentious political debate surrounding the increase in the federal gas tax of $0.04 per gallon in 1996 suggests that large gas tax increases necessary to significantly reduce greenhouse gas emissions may be difficult. Some analysts have suggested that prices would have to be raised by more than $1.00 per gallon to have a large effect on national emissions. * * *

5.2.2 PROVISION FOR ALTERNATIVE MODES* * *

TRANSIT INVESTMENT * * *

Since transit is a motorized form of transportation, the effectiveness of transit investment at reducing greenhouse gases depends on the following factors:

- The level of improvement in transit frequency, coverage, or amenities;
- The extent to which increased transit investment reduces motor vehicle fuel consumption (which depends on the extent to which transit causes shifts in mode of travel, improvements in traffic flow, and any offsetting increases in travel due to improved traffic flow); and
- The extent to which any increases in transit fuel consumption offset these reductions.

There is some debate about the extent to which transit investment can reduce personal vehicle travel. When developing a new transit system, planners generally assume that ten trips on the new system will eliminate fewer than ten auto trips since some of the transit trips are new trips induced by building the new system and others have been captured from other transit systems or routes. Some warn that mass transit will have little effect at encouraging drivers to change their mode of travel since it is not compatible with most US automobile users' travel needs for flexibility and convenience, nor is it compatible with existing low-density land use patterns. On the other hand, others claim that transit has a "magnifying effect" in reducing auto travel since transit affects land use in ways that reduces the need to travel. An analysis conducted by the Natural Resources Defense Council (NRDC) and the Sierra Club suggests that each new transit mile traveled replaces four to eight miles of auto travel due to changes in land use that might result from transit development. Assumptions about the degree to which transit eliminates vehicle trips affect estimated emissions benefits. * * *

The effectiveness of transit is closely related to land use patterns. High-capacity transit is often not cost-effective for suburb-to-suburb trip patterns, which are prevalent in urban travel. The increasing importance of non-work trips also implies that an increasing portion of travel is not part of the traditional transit commuter markets. Improvements in transit routing, publicity, and service to underserved areas may attract ridership without requiring the operation of additional vehicles.

The effectiveness of transit to reduce greenhouse gas emissions may be small at the national level. Transit comprises a small portion of national travel — only 0.9 percent of total passenger miles in the US in 1994. An analysis by Apogee Research, Inc. suggested that transit improvements can reduce VMT by up to 2.6 percent in metropolitan areas, and most likely by only 1.0 percent. Despite these small effects, a significant portion of the literature suggests that transit is an important supporting measure for a variety of transportation control measures (TCMs), including road and fuel pricing. At the national level, emissions effects will depend upon the extent of increases in transit service feasible in urbanized areas. Vanpools, paratransit, and demand-responsive transit may be more appropriate for less urbanized areas. * * *

BICYCLE SUPPORT FACILITIES * * *

Strategies that enhance the environment for bicycles and bicycling as an alternative to single occupancy vehicles (SOVs) include:

- Development of bicycle routes, lanes, or paths;
- Provision of lockers, racks, other storage facilities, and ancillary facilities (such as showers, and clothing lockers);
- Integration with transit, either at stations or on vehicles;
- Educational, media, and promotional campaigns, including provision of bicycle maps; and
- Hiring of a local government or employer-site bicycle coordinator. * * *

Most estimates of VMT reduction from bicycle and pedestrian strategies are relatively low. Bicycle trips are generally limited to short trips. In addition, the potential number of trips that individuals may shift to bicycle is constrained by weather conditions, topography, and individual health and fitness. * * *

Estimates of VMT reductions from bicycle projects suggest that for a metropolitan area, bicycle projects may reduce regional VMT from under 0.01 percent to over 3 percent, with the latter figure assuming capital construction of facilities and an already existing favorable land-use configuration. * * *

HIGH OCCUPANCY VEHICLE (HOV) LANES * * *

High occupancy vehicle (HOV) lanes are specific lanes designated for use only by vehicles carrying two or more individuals (HOV-2) or three or more individuals (HOV-3). HOV lanes encourage carpooling and vanpooling by reducing travel time and reversing the time penalty generally incurred in picking up passengers. HOV lanes also reduce travel time for transit buses. They may be developed on freeway or arterial facilities. Lane restrictions are often limited to peak-hour driving periods. * * *

A number of analyses suggest that the net benefits of HOVs are positive. A study of HOV lanes on Interstate 5 in Seattle determined that adjusting for the growth in households and income, the increase in vehicles from 1978 to 1989 was less than had been projected originally without the HOV lanes for each year after the HOV lanes became available. It projected that the benefits increased over time, with a 6 percent reduction of VMT in 1984 to a 35 percent reduction in 1989.

HOV lanes are mainly effective at reducing peak-period travel on highly congested freeways and arterials. The regional effect of HOV lanes is generally smaller than the reduction in any one corridor. Apogee Research, Inc. estimated that HOV lanes could reduce regional VMT by up to 1.4 percent in major metropolitan areas. National effects would likely be somewhat smaller since HOV lanes would not be implemented in small towns and rural areas. * * *

5.2.3 PARKING MANAGEMENT * * *

PARKING PRICING * * *

Case studies of employer-based programs that involved raising employee parking fees to market rates have shown significant decreases in vehicle use, in the range of a 26 to 81 percent decrease in solo driving. Case studies of differential parking rates for SOVs and HOVs also show significant reductions in vehicle travel. A 1996 study examined eight employer programs in California, where parking measures have received considerable attention. The study found that, on average, the employers reduced VMT by 12 percent per employee per year as a result of the program.

Some economists have found that parking charges may have a greater effect on travel behavior than other costs since parking charges are often incurred on a trip-by-trip basis (a separate money transaction must be undertaken with each trip), unlike fuel purchases and other operating costs which are made periodically. * * *

MANDATORY PARKING CASH-OUT * * *

About 95 percent of those who commute to work by automobile in the US use free parking provided by their employers, and nearly all vehicle trips for non-commute purposes also include free parking. Part of the reason for this high rate is that the US tax code has subsidized employer-provided parking by exempting employer parking costs from federal and most state income and payroll taxes as a fringe benefit, provided the employer does not offer cash salary in lieu of the parking space. The Tax Relief Act of 1997 removed the restriction against offering taxable cash in lieu of tax-exempt parking benefits. A "mandatory parking cash-out" policy would make mandatory what the new tax law made possible. It would require employers who provide subsidized parking to also offer their employees the option of receiving taxable income instead of parking. Since employees would be given the choice between a parking space and taxable income, they would perceive the opportunity cost of driving to work in terms of the income forgone. . . . [T]he Climate Change Action Plan estimated that reforming the federal tax subsidy would reduce light-duty VMT by approximately 25 billion miles, or 1.1 percent, in the year 2000. * * *

PARKING SUPPLY LIMITS * * *

A number of policy instruments are available for government to attempt to limit the supply of parking for SOVs, including:

- Maximum parking-supply ratios in zoning;
- Reduced or eliminated minimum-parking ratios in zoning;
- Area-wide parking caps; and
- Restriction of access to parking at certain times of the day, for certain durations, or to certain classes of users (i.e., preferential parking for HOVs). * * *

Experience with a number of parking supply management techniques shows mixed effectiveness. . . . Clearly, the relationship of parking supply to demand and the extent and level of parking supply restrictions will affect a policy's success. Area-wide parking caps that are set above levels of parking demand will have little effect on reducing travel. In addition, parking supply ratios in zoning are limited because they only affect new development. If maximum parking supply ratios are too restrictive, they may encourage development to shift to areas that are not within the bounds of the restriction. * * *

5.2.4 LAND-USE PLANNING

The goal of land use planning as a greenhouse gas reduction strategy is to shape development patterns to encourage less vehicle travel and fuel consumption. Land use measures may be examined at both the neighborhood (micro) level and the regional (macro) level.

. . . Micro-level measures that might reduce fuel consumption from transportation include:

- Increasing density and mix of uses to provide opportunities for pedestrian trips, trip-chaining, and transit access;

- Orienting higher-density development around commercial centers, transit lines, and community facilities to encourage non-motorized trips; and
- Supporting pedestrian and bicycling activity through facilities for non-motorized modes such as sidewalks and bike lanes, urban design improvements, and traffic calming.

. . . Macro-level measures that might reduce fuel consumption include:

- Increasing the compactness of metropolitan areas;
- Focusing regional development around transit networks; and
- Providing a sub-regional balance of jobs and housing, so that individuals do not need to commute long distances.

Specific tools outlined in the literature include the following:

- Site-based tools—developer incentives, zoning requirements, development standards (density standards, requirements for mixed uses, grid street requirements; area or sector plans); and
- Regional planning tools—urban growth boundaries, concurrency requirements, and location efficient mortgages (LEMs).

Quantitative relationships among land use, travel, and fuel consumption have been examined by various researchers. Although land use patterns may account for 40 to 50 percent of urban-travel variations across cities, there are many challenges to altering land use patterns, and some researchers suggest that even significant changes in urban spatial structure may bring about travel reductions of no more than 12 percent. At least one simulation of comprehensive land use measures and travel pricing in Portland, Oregon, has suggested greenhouse gas reductions of nearly 8 percent relative to what they would have been without these measures. Although these estimated reductions are significant and exceed many estimates of the potential of conventional transportation demand management (TDM) measures, various conclusions have been drawn about the effectiveness of strategies that attempt to alter land use patterns. It is difficult to isolate the effect of individual land use strategies since they often occur in combination, and they may have synergistic effects. * * *

STRATEGIES TO INCREASE DENSE, MIXED USE, TRANSIT-ORIENTED DEVELOPMENT * * *

Increasing land use mixing involves locating land uses with complementary functions close enough to one another such that travel distances are minimized. Focusing dense development on transit stations and corridors provides the density necessary for efficient mass transit service and encourages transit use. In combination, these land use patterns may reduce vehicle travel by allowing individuals to walk or take transit among housing, shopping, and employment; to reduce vehicle trip lengths; and to combine trips rather than taking separate vehicle trips. A regional land use strategy might target new development to specific transit corridors or encourage infill development in existing communities and raise transit ridership sufficiently to realize a net reduction in greenhouse gases.

. . . A number of regional analyses of alternative development patterns and transportation investments have suggested that more compact, transit-focused development patterns result in less vehicle travel than dispersed development patterns. * * *

In addition to simulation studies, empirical comparisons of various neighborhoods have been used to suggest that higher density, mixed use, and transit-oriented communities are associated with increased shares of transit and pedestrian travel and reduced VMT. For example, a 1994 study of the San Francisco Bay Area households found that households in newer suburban communities had substantially higher vehicle trip generation rates, a higher proportion of drive alone trips, and a lower percentage of public transportation trips than households in traditional communities. Similarly, a 1996 study that examined travel diaries of residents in three Seattle mixed-use neighborhoods concluded that the pedestrian share of work trips was 11.3 percent in mixed-use communities, as opposed to 3.6 percent in King County as a whole. An analysis of odometer readings from 27 California communities suggested that residential density and access to public transportation were the two urban form factors that most reliably predicted household auto travel behavior, and that doubling residential density reduced annual auto mileage per capita by 20 percent. Similarly, an analysis of trips reported in the 1990 National Personal Transportation Survey (NPTS) found that each doubling in density reduced VMT per capita by 28 percent over the entire urban range of densities.

Despite significant consensus that traditional and transit-oriented communities are associated with less vehicle travel than planned unit (suburban) development, there is disagreement on the total energy use implications of increasing density since denser areas are also often associated with reduced average travel speeds. In addition, nearly all of the empirical studies on land use and travel are cross-sectional. These studies show how variations in land use are associated with variations in VMT but do not prove a causal relationship or show how changes in one variable would result in changes in another. Resident self-selection may explain much of the observed correlation, since people who do not like to drive or cannot drive might tend to seek out high density neighborhoods with good transit access. Thus, some researchers assert that some studies do not support conclusions about how changes in structure will affect travel patterns.

Finally, there is some uncertainty about the effectiveness of planning strategies to alter land use. The amount of development that can be shaped by land use strategies depends on growth in population and employment and on preferences for various types of development styles. * * *

Modeling done in Portland, Oregon suggested that the pedestrian environment may be a significant factor in determining automobile ownership. In addition, it may also influence daily auto VMT and vehicle trips per person. In the LUTRAQ study, a pedestrian environment factor (PEF) was developed that measures ease of street crossing, sidewalk continuity, street connectivity, and topography, with a qualitative assessment on a scale of four to twelve. Each unit increase in PEF resulted in a reduction in 0.7 vehicle miles traveled daily per household. Similarly, the Maryland National Capital Parks and Planning Commission (MNCPPC) has shown that pedestrian and bicycle friendliness is a significant factor in determining work trip mode choice.

Empirical analyses have come to similar conclusions. For example, a comparison of employment sites in Southern California found that areas perceived as safe and aesthetically pleasing had lower levels of drive-alone commute trips and higher proportions of transit, bicycle, and walk trips than sites perceived as less pedestrian-friendly. A recent study compared two Puget Sound area neighborhoods that were similar in terms of gross residential density and intensity of commercial development. It found that the neighborhood with a high level of pedestrian network connectivity had almost three times as much pedestrian activity as the one with a low level of pedestrian connectivity. * * *

5.2.5 OTHER VEHICLE TRAVEL REDUCTION MEASURES * * *

TELECOMMUTING * * *

. . . Although telecommuting can reduce vehicle travel for those that participate, its effect is limited for a number of reasons. In particular, telecommuting only targets commute travel, which is only about one quarter of total vehicle miles traveled. Telecommuting is feasible for only a portion of all workers — primarily information workers — and those that participate will often only eliminate one to three days of commute per week. In addition, some of those that participate may have taken transit or carpools in the past. Trips previously chained with the work trip will still need to be made. * * *

COMPRESSED WORK HOURS * * *

Compressed work hours is a program that allows individuals to work more hours per day and fewer days per week. A typical program involves working 10 hours, 4 days a week, rather than 8 hours, 5 days a week. For each employee working under this schedule, this strategy eliminates one round-trip to work each week. In addition, the change in daily work hours can often reduce peak-period travel. * * *

Compressed work hours programs have many of the same limitations of telecommuting programs — commute travel is only a small portion of total transportation emissions, it only reduces travel one day per week or every two weeks, not all employees will be able to participate, and there may be some offsetting increases in travel. It also is not clear to what extent government efforts will induce adoption by private employers.

According to EPA’s Transportation Control Measures Information Documents, there is only one example in the literature where the transportation impacts of a coordinated compressed work-hours program have been systematically documented. Denver participated in a federal employee compressed work-week experiment from 1978-1981. Findings were favorable. Among employees participating, there was a 15 percent reduction in commute VMT, and a shifting of peak arrival and departure times. There was little change in modal share. Overall, participants reduced household VMT by almost 16 percent. Although there was some increase in non-work trips during the employees” day off, this was offset by a drop in weekend VMT. * * *

5.3 FUEL-ECONOMY-FOCUSED STRATEGIES * * *

5.3.1 IMPROVING TRAFFIC OPERATIONS

For a given vehicle, on-road fuel economy is a function of average speed and acceleration. At low speeds, a greater proportion of energy to the engine goes to internal engine friction and to operating accessories such as power steering and transmission, oil and water pumps, and air conditioners. Braking directly translates the vehicle's momentum into heat energy. Since characteristics of highway congestion — low travel speeds, increased braking and accelerations, idling — are associated with increased fuel use, strategies to reduce congestion and improve traffic flow can reduce greenhouse gas emissions. * * *

TRAFFIC FLOW IMPROVEMENTS * * *

Traffic flow improvements encompass a wide range of programs to smooth traffic flow, reduce idling, and eliminate bottlenecks:

- *Signalization improvements* can reduce intersection delay on arterials and other routes in urbanized areas.
- *Incident management* and advanced traffic sensing technologies allow faster response time to remove breakdowns and accidents from the road.
- *Intelligent Transportation Systems (ITS)* encompass a range of technologies that develop more intelligent vehicles and transportation infrastructure, including use of real-time information on traffic conditions, directions to unfamiliar places, and identification of alternate routes. * * *

LIMIT FREEWAY SPEEDS TO 55 MPH * * *

Beyond 55 miles per hour, fuel economy is generally a decreasing function of speed for both cars and trucks. The national 55 mph speed limit, repealed in 1995, was originally passed by Congress in 1974 as an energy conservation measure. A greenhouse gas reduction strategy would be to re-apply the national 55 mph speed limit or encourage states to voluntarily limit speeds on interstates and freeways to 55 mph. * * *

EPA estimates that traveling at 65 mph as compared to 55 mph lowers fuel economy over 15 percent. Preliminary testing of vehicles at Oak Ridge National Laboratory for US DOT suggest that an increase in speed from 55 to 65 mph may reduce fuel economy by over 11 percent and that increasing from 55 to 70 mph may reduce fuel economy by over 23 percent. * * *

Various estimates of energy savings from the national 55 mph limit indicate that despite imperfect compliance, it may reduce national fuel consumption on highways by about 1 to 3 percent. A 1984 study by the National Research Council (NRC) concluded that in 1983, the national speed limit reduced highway fuel consumption by about 2.2 percent.

QUESTIONS AND DISCUSSION

1. *Linking Urban and Suburban Areas.* One of the main challenges that planners face is connecting urban areas with suburban ones, and suburban areas with each other. The Metropolitan Policy Program at the Brookings Institution explains how the suburb has become a key feature of the American economy, but transportation planning has not kept pace.

> Suburbs are no longer just bedroom communities for workers commuting to traditional downtowns. Rather, they are now strong employment centers serving a variety of functions in the regional economies. An investigation into the location of jobs in the nation's largest metropolitan areas finds that over one half are located more than 10 miles outside of downtowns. Only about one in six metropolitan jobs is located near the metropolitan core, within 3 miles of downtown. * * *
>
> Although nearly half of work commutes still originate from, or terminate in, center cities, 40.8 percent of work trips are entirely suburban. Many older rail transit systems — which still move millions of daily commuters — capture very little of this market because they were laid out when the dominant travel pattern was still radial and before business and commercial development began to follow the edgeless pattern. . . . Plus, because commute trips make up only 15 percent of all trips, many other routes and options are being ill-served by these outmoded patterns.

METROPOLITAN POLICY PROGRAM, THE BROOKINGS INSTITUTION, A BRIDGE TO SOMEWHERE: RETHINKING AMERICAN TRANSPORTATION FOR THE 21ST CENTURY 15, 18–19 (2008). How should governments address transportation needs for suburban communities? Do any of the policies identified by the Department of Transportation do this?

2. *Cordon Pricing.* Some cities have begun using cordon pricing mechanisms, which charge drivers a fee to enter into a central business district. Most notably, London, England, enacted a cordon pricing mechanism in the "congestion charge zone" covering about 8 miles in the heart of London. Each car entering the city between 7:30 a.m. and 6:00 p.m. must pay £10.00 (approximately $15.00 as of April 2013). The number of cars entering the zone dropped by about 30 percent as a result of the charge.

3. *Congestion and Greenhouse Gas Emissions*. Many transportation experts have promoted traffic congestion reduction as a key strategy in limiting domestic greenhouse gas emissions. The average commuter in the United States spends approximately 38 hours per year in delayed traffic during rush hour traffic. In large metropolitan areas, this figure increases to 54 hours per year. These congestion-caused delays waste nearly 2.9 billion gallons of fuel each year, and result in 27.2 million metric tons of carbon dioxide emissions annually. Beyond this, economists estimate that traffic delays exact an enormous financial price, and account for approximately $78.2 billion in costs each year. *See* DAVID SCHRANK & TIM LOMAX, TEXAS TRANSPORTATION INSTITUTE, THE 2007 URBAN MOBILITY REPORT (2007).

The most common response to congestion problems has been development of new roads or new lanes on existing roads. Since congestion results from too many cars on the road at once, making new roads available should, in theory, increase space on the roads and thus reduce congestion-related delays. Studies, however, suggest that increased road-building may offer only temporary relief from congestion:

> One of the reasons that road-building shows disappointing results in easing congestion is that adding capacity to highways doesn't just meet the current travel demand: it actually spurs additional driving. When a road is widened, more people will also choose to drive on it — either switching from another route, time of day, or mode, or taking additional trips. Transportation engineers and planners call this "induced travel." While there is debate about how much capacity is lost to induced travel, some studies of induced travel estimate that, in the short-term, up to half of the new roadway capacity on a given road is consumed by induced travel. Over time, as land uses around the new roadway change, the road becomes even more clogged. New and wider roads encourage new development, often on the fringe of urban areas. These new developments generate new traffic. Several recent studies document the effect of induced traffic.

SURFACE TRANSPORTATION POLICY PROJECT, EASING THE BURDEN: A COMPANION ANALYSIS OF THE TEXAS TRANSPORTATION INSTITUTE'S CONGESTION STUDY 4 (May 2001). What other strategies can transportation planners use to reduce congestion?

4. ***Roundabouts*****.** Intersections with roundabouts (traffic circles) have the potential to dramatically reduce greenhouse gas emissions from vehicles. Studies at various intersections in different countries uniformly have found reductions in emissions of CO_2 and hydrocarbons. One study of three intersections in Kansas concluded that a roundabout reduced CO_2 emissions by 55 to 61 percent and emissions of hydrocarbons by 62 to 68 percent, depending on the time of day (i.e., the number of cars passing through the intersection). Because roundabouts reduce delay at intersections, they also reduce fuel consumption. SRINIVAS MANDAVILLI ET AL., ENVIRONMENTAL IMPACT OF KANSAS ROUNDABOUTS 16 (2003). *See also* TONY REDINGTON, MODERN ROUNDABOUTS, GLOBAL WARMING, AND EMISSIONS REDUCTIONS: STATUS OF RESEARCH, AND OPPORTUNITIES FOR NORTH AMERICA (2001).

5. Some companies recognize that efficient travel plans can reduce gasoline consumption and costs. For example, UPS trucks reportedly plot their travel routes to take only right turns. Efficient route planning and the "right turn only" approach saves the company an estimated three million gallons of fuel a year, which translates directly into reduced greenhouse gas emissions. Brian Rooney, *UPS Figures Out "Right Way" to Save Money, Time, and Gas*, ABC NEWS ONLINE, Apr. 4, 2007.

6. ***The Home Mortgage Interest Deduction and Climate Change.*** Tax analysts believe that restructuring the home mortgage interest deduction could play a role in climate change policy. Consider the following proposal.

Americans prefer large, single family homes. This low density housing pattern, often referred to as "urban sprawl" or "sprawl development", virtually requires the use of the private automobile. The federal government helps Americans buy their large homes through the home mortgage interest deduction. The home mortgage interest deduction is facially neutral in that a home buyer can use the deduction whether buying a condominium above a transit hub or a six bedroom home fifty miles away from a major urban center with no accessible public transportation. Deciding whether the home mortgage interest deduction encouraged sprawl and therefore road construction or whether subsidized road construction facilitated sprawl, which was then enabled by the home mortgage interest deduction, presents the classic, and unanswerable, chicken and egg problem. However, economists generally agree that the home mortgage interest deduction has created a false market signal for home buyers, encouraging them to over-invest in housing, and artificially inflating the price of homes.

Accordingly, I recommend that the home mortgage interest deduction be changed to correct this market failure. . . . Changing the home mortgage interest deduction can have a significant impact on the choices of home buyers if the tax benefit is tied to the location of the home. First, the home mortgage interest deduction should be changed to a federal income tax credit, so that its benefits will be distributionally equitable. The new "shelter credit" would have two components: a base amount and a location efficiency premium (LEP). The base amount of the credit would be determined by multiplying the median national home price by the annualized long-term tax exempt interest rate, and then multiplying that product by the lowest marginal tax rate. For example, if the median national home price was $100,000, and the long-term tax exempt rate was 5%, the base credit would be $500. The base amount of the credit serves as a proxy for the average mortgage interest deduction. The amount of the credit would be capped at the actual housing cost paid by the taxpayer and would be phased out at higher income levels in a manner similar to the phase out of itemized deductions.

The LEP would be based on calculations similar to those done by urban planner John Holtzclaw in his analyses of location efficiency. Location efficient mortgages (LEMs) were developed using data created by Holtzclaw, who determined average transportation savings in four urban areas in California by examining four factors: residential density, transit accessibility, availability of neighborhood shopping, and pedestrian accessibility. Lenders use the transportation savings factor to calculate the borrower's eligibility for the loan, thus making the borrower eligible for a larger loan. LEMs facilitate purchase of higher cost transit accessible property by low to moderate income buyers. Because the LEP is based on the additional value represented by the accessibility of the home to public transportation, it would create an incentive for home buyers to purchase transit accessible homes, which generally are located close to the

> urban core. In addition, the LEP might encourage extension of public transportation into previously unserved areas, thereby increasing transportation choices.

Roberta F. Mann, *On the Road Again: How Tax Policy Drives Transportation Choice*, 24 VA. TAX REV. 587, 647–50 (2005). What do you think of Professor Mann's proposal? Would it necessarily promote a move into urban centers? Would it promote development of increased transportation?

7. *Urban Growth Planning and Leaked Transportation Emissions.* Land use planning is not a perfect tool for reducing greenhouse gas emissions, because planning presents the risk of leakage. The case of Portland, Oregon, provides an example of this. Since the 1970s, the Portland metropolitan area has used an urban growth boundary (UGB) to limit suburban sprawl and promote relatively dense housing within the UGB. These strategies (combined with others) have yielded significant reductions in the city's overall greenhouse gas emissions. At the same time, however, property values and property taxes within the UGB climbed. To escape escalating property expenses, many people moved outside of the UGB to Vancouver, Washington, which is about 10 miles north of downtown Portland. In March 2007, an estimated 273,000 people commuted in cars to Portland from Vancouver each workday, offsetting many of the emissions reductions that Portland achieved through its land use planning policies. *See* Courtney Sherwood, *More Cross-River Commuters Leave Cars Home*, THE COLUMBIAN, May 7, 2008, at A1. Without regional land use planning, leakage is difficult to avoid. How should planners address this?

8. *Economic Equity and Transportation Planning.* Transportation planning strategies designed to reduce greenhouse gas emissions by raising transportation costs could place significant burdens on lower-income households. In 2003, the working poor spent approximately 6.1 percent of their income on commuting, and those who drove their own vehicles spent 8.4 percent. In comparison, the average worker spent 3.8 percent of their income on commuting. ELIZABETH ROBERTO, METROPOLITAN POLICY PROGRAM, THE BROOKINGS INSTITUTION, COMMUTING TO OPPORTUNITY: THE WORKING POOR AND COMMUTING IN THE UNITED STATES 7, 9 (2008). When all transportation expenses are factored in, the average American household spends approximately one-fifth of household income on transportation. BARBARA J. LIPMAN, CENTER FOR HOUSING POLICY, A HEAVY LOAD: THE COMBINED HOUSING AND TRANSPORTATION BURDENS OF WORKING FAMILIES 1 (2006). This percentage is higher for the working poor, who in 2003 spent more than 40 percent of their income on transportation. SURFACE TRANSPORTATION POLICY PROJECT, TRANSPORTATION COSTS AND THE AMERICAN DREAM: WHY A LACK OF TRANSPORTATION CHOICES STRAINS THE FAMILY BUDGET AND HINDERS HOME OWNERSHIP 3 (2003).

Several factors make transportation particularly expensive for lower-income households. Since the 1980s, many companies have relocated their businesses out of city centers and into the suburbs. Poverty has also moved into the suburbs. "In 2005, for the first time in American history, more of America's poor live in large metropolitan suburbs than live in big cities." METROPOLITAN POLICY CENTER, A BRIDGE TO SOMEWHERE, at 15. Lower-income workers frequently must travel either from a less affluent suburb or from an urban center, to reach their places of employment. In many cases, public transportation systems do not reach the suburban areas. Even when public transportation is available, commuting can take a prohibitively long amount of time. Thus, lower-income employees do not have any option other than driving. These workers often drive older, less efficient vehicles, and thus spend more money per mile to commute. Moving into the same suburb in which their workplace is located is also often not an option, due to high moving and housing expenses. How should transportation planners seeking to mitigate climate change address these issues? Do any of the above proposals present viable options for lower-income households?

B. The Role of the Federal Government in Transportation Policies

In contrast to the dominant role the federal government plays in administering most of the laws discussed throughout this book, the United States provides little national leadership or direction regarding the transportation infrastructure. This is true even though federal funding accounts for the majority of funds committed to highway projects. Indeed, the federal highway agencies play such a limited role in transportation planning that the U.S. Government Accountability Office (GAO) has described the federal transportation program as a "cash transfer, general purpose grant program." U.S. GAO, FEDERAL-AID HIGHWAYS: TRENDS, EFFECT ON STATE SPENDING, AND OPTIONS FOR FUTURE PROGRAM DESIGN 5 (2004).

The limited role of the federal government dates back to the early and mid-20th Century, when expansion of the federal highway system was a national goal. In 1916, Congress passed the Federal-Aid Road Act of 1916, 39 Stat. 355, which established "first authorized federal financial participation in the construction of the nation's roads." Stephen McDonald, Note, *Why VEETC is Not Enough: Protecting the National Highway Transportation Infrastructure*, 30 WM. & MARY ENVTL. L. & POL'Y REV. 731, 736 (2006) (quoting Craig J. Albert, *Your Add Goes Here: How the Highway Beautification Act Thwarts Highway Beautification*, 48 U. KAN. L. REV. 463, 469 (2000)). The Federal-Aid Road Act created a cooperative dynamic between the federal government and state governments, pursuant to which the federal government would fund, and state governments would build, highway construction projects. Since that time, the federal government's role has involved promoting and enabling highway construction and expansion. States, meanwhile, have had primary decision-making authority in transportation planning.

Congress reinforced these respective roles with its passage of the Federal Highway Act of 1956, which launched the construction of the interstate highway system, and the Highway Revenue Act of 1956, which established the Highway Trust Fund as the method for funding highway building and maintenance. As under the earlier law, the Federal Highway Act placed the decisionmaking power in the states and the funding responsibility largely in the federal government. The Highway Revenue Act established a tax system under which gasoline taxes get deposited into the Highway Trust Fund and distributed to the states pay for construction of the interstate highway system. *See* McDonald, at 735–41.

The use of gasoline taxes to pay for highway funding, and the requirement that gasoline taxes would fund highway construction, significantly affected the transportation system in the United

States. Following the federal government's lead, many state governments passed their own laws establishing state gasoline taxes and dedicating the revenues to highway and road construction. As a result, under both the federal and state programs, highway building received ample funding, while mass transit and alternative forms of transportation often received very little financial support. Not surprisingly, the highway system expanded while mass transit systems atrophied in many places or were simply never developed in others.

In 1991, Congress briefly adopted a new vision for federal transportation with its passage of the Intermodal Surface Transportation Efficiency Act (ISTEA). That law declared, "[i]t is the policy of the United States to develop a National Intermodal Transportation System that is economically efficient and environmentally sound, provides the foundation for the Nation to compete in the global economy, and will move people and goods in an energy efficient manner." Pub. L. No. 102-240, §2, 105 Stat. 1914, 1915 (December 18, 1991). It also expanded the list of projects eligible for federal funding to include transit capital projects, transit improvements, and transportation planning. In addition, ISTEA dedicated funding to high-speed transportation development. ISTEA also focused greater attention on long-range planning by directing state governments and separate metropolitan planning organizations to develop long-range transportation plans that considered land use, intermodal connectivity, and improved transit service. Finally, through the Congestion Mitigation and Air Quality (CMAQ) program, ISTEA authorized additional funding for congestion relief measures, including public transit improvements, development of bicycle and pedestrian facilities, and programs promoting carpools and high-occupancy vehicle use.

While ISTEA signaled a shift away from the federal government's almost exclusive focus on road building to a more expansive role in transportation planning, the actual priorities of the federal government remain focused on highway construction. In part, this is due to the funding allocations under ISTEA and two other statutes, the 1998 Transportation Equity Act for the 21st Century (TEA-21) and the 2005 Safe, Accountable, Flexible, Efficient Transportation Act: A Legacy for Users (SAFETEA-LU). These laws allocate federal transportation funds to states primarily based on the amount of roads, miles driven, and fuel consumed in each state. They thereby disincentivize reduced consumption, since lower consumption will lead to less funding. In addition, the laws require federal approval before new transit projects are developed and funded, whereas highway projects may proceed without prior federal approval. Finally, even though ISTEA authorized federal funding to go to transit projects, later laws have capped the amount. Whereas federal funds may contribute as much as 90 percent for highway improvements and maintenance, new transit projects may receive only a 60 percent federal share. In practice, the federal government contributes closer to 40 percent of transit costs. As a result, state and local governments bear a greater burden in funding metropolitan transportation programs aimed at reducing VMT and greenhouse gas emissions.

QUESTIONS AND DISCUSSION

1. ***The Role of the Federal Government.*** What role do you think the federal government should play in transportation planning? Although some policy analysts have called for the federal government to create a federal transportation program, others believe the federal government would be overstepping its role if it were to dictate how local governments should design their own transportation policies. Is transportation planning an inherently local process? Should it be?

2. ***Gasoline Taxes and Highway Funding.*** Since 1916, gasoline taxes assessed at both the federal and state level have provided the primary revenue for highway construction and repair. As gas prices have climbed and gas purchases have declined, revenues from gas taxes have accordingly fallen. If gas prices remain high — as many experts predict they will — states will continue to lose money for transportation infrastructure. This funding dynamic creates a somewhat perverse incentive for governments to favor increased driving to generate higher gas tax revenue. What other funding mechanisms governments should use to pay for transportation systems?