Climate and Transportation Solutions:

Findings from the 2009 Asilomar Conference on Transportation and Energy Policy

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Chapter 6:

A Shared Goal: Addressing Climate Change and Energy Security

by Dave McCurdy and Kathryn Clay

Energy security and environmental protection have converged at the center of the national political agenda in the United States (U.S.). The colliding realities of continued dependence on imported oil, two costly wars in the Persian Gulf region, wildly fluctuating energy costs, and deep economic recession have focused public attention and calls for action. Combined with the emerging international consensus on the science and challenges of global warming, support for a new approach on energy and climate policy in the U.S. is needed. Recognizing that energy and global climate change solutions will not be achieved without strong leadership from the United States, President Barack Obama has made energy security and global climate change a signature issue for his administration.

Meanwhile, the auto industry is facing unprecedented economic challenges. The national economy has been in recession, and the auto industry was among the first to be hit by the downturn. The swiftness and the extent of the impact on the auto industry surprised even the most seasoned industry analysts. Annual sales in North America contracted from 16 million in 2007 to 13 million units in 2008. Sales figures for 2009 will continue this downward trend still further to less than 11 million units (Ward's Automotive Group 2007, 2008, 2009).

In the midst of this turbulence, auto industry chief executives joined the Obama administration to forge a single national standard for fuel economy and greenhouse gas (GHG) emissions. On May 19, 2009, President Obama announced the culmination of this effort in a Rose Garden ceremony. The centerpiece of this landmark agreement was a new fuel economy standard for the overall U.S. motor vehicle fleet of 35.5 miles per gallon (mpg) by 2016. Between 2012 and 2016, efforts to implement this standard will reduce U.S. oil consumption by 1.8 billion barrels over the 4-year period, and will lower national emissions of GHGs by over 950 million metric tons over the same period (White House Press Office 2009).

Prior to the 2009 presidential announcement, automakers supported provisions in the Energy Independence and Security Act (EISA) in 2007 to raise fuel economy standards to at least 35 mpg by 2020, an increase of 40 percent. Before EISA, the industry had resisted efforts to change automobile fuel efficiency standards, which were unchanged since 1990.

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Automakers support moving to a low-carbon future. Other stakeholders, including fuel providers and consumers, will also need to take on commitments and be accountable. Government can contribute most by creating the conditions that promote private sector investment and innovation, and that incentivize consumer adoption of advanced, low-carbon technologies.

Developing a Comprehensive Energy and Climate Strategy

Policies addressing the transportation sector are essential, but by themselves will not be sufficient to meet overall national goals. New federal legislation is needed to create a national, economy-wide program to replace the current patchwork of conflicting standards. Existing legislative authority is not adequate to accommodate the fundamentally different approach required for GHG emissions compared to other types of pollutants. The legislative framework of the federal Clean Air Act, developed in the 1960s and 1970s, did not envision GHG emissions and was not designed to address them. Even the emissions trading provisions for pollutants related to acid rain, included in the 1990 amendments, are inadequate as a model for a GHG abatement program. The acid rain program addresses pollutants for which local, rather than global, concentrations are the predominant concern. Moreover, the acid rain program addresses a comparatively small number of emissions sources within one sector of the economy, and so has limited utility to inform the design of an economy-wide GHG program regulating literally hundreds of millions of emission sources.

A number of key principles should be incorporated into a national program to reduce GHG emissions. Most importantly, the overall program should encompass the national economy as completely as possible, whether the approach is based on a cap-and-trade program or on other measures, such as a carbon tax. If cap-and-trade is the preferred framework, the program should be designed to achieve the greatest emissions reductions, while minimizing economic disruption. This will require taking equitable carbon reductions across all sectors of the economy. Policies directed at transportation sector emissions, such as the new national fuel economy program, are an important element. At the same time, sector-based approaches cannot substitute for a more economically efficient, economy-wide program.

Additionally, the national approach should include market measures to the greatest extent possible. Market measures will lend advantages to the most economically feasible actions. Using market mechanisms can provide the pull needed to incentivize the rapid deployment of advanced technologies. Such measures will work to maximum effect if policies are also adopted to increase public and private investment in the research and development (R&D) needed to produce new, clean energy technologies. Finally, a national climate change strategy should clearly delineate appropriate roles for federal, state, and local governments.

In the United States, energy security is closely tied to oil security. Any discussion of oil security necessarily centers on the transportation sector, because transportation accounts for 71 percent of U.S. petroleum consumption. Today's transportation sector relies on petroleum for 94 percent of its primary energy (Davis *et al.* 2009). At the same time, the transportation sector accounts for 30 percent of national GHG emissions. Automobiles and light duty trucks account for slightly less than two-thirds of this total, or 17 percent (EPA 2009).

For over thirty years, energy policy has been dominated by the Corporate Average Fuel Economy (CAFE) standards. The Energy Policy Conservation Act, enacted into law by Congress in 1975, established CAFE standards for passenger cars and light trucks in response to the Arab oil embargo of 1973 and 1974. Historically, CAFE has made an important contribution to lessening our dependence on foreign oil. The National Academy of Science concluded in 2002 that, in the absence of CAFE, motor vehicle fuel consumption would have been approximately 14 percent higher than it actually was at that time (NRC 2002).

The national experience with CAFE standards illustrates the importance of developing a more comprehensive, integrated approach to energy security and climate change policy going forward. Past vehicle efficiency

gains under CAFE have been offset by increases in total vehicle miles traveled (VMT) in the U.S. Between 1980 and 2007, VMT nationally nearly doubled, a growth rate three times faster than the growth in population (BTS 2009). CAFE, while it drives progress on vehicle technologies, is insufficient on its own to guarantee reductions in GHG emissions or oil consumption. Addressing one dimension of the transportation sector, while neglecting other aspects, profoundly limits what is ultimately achievable.

Another limit on the absolute utility of CAFE is that it affects only a subset of a single sector of the U.S. economy. A better approach would integrate transportation energy policy with the rest of the economy by attaching a price on carbon, and perhaps imposing an energy security surcharge on imported fuel. While the Obama national program creates a process for coordinating fuel economy and GHG tailpipe emissions standards, a need for an additional level of harmonization still remains if transportation emissions are included under an economy-wide energy and climate program.

Achieving sustainable mobility will require an integrated approach that considers the four main dimensions of transportation energy use and GHG emissions: vehicle technologies, transportation fuels and alternative fuels infrastructure, conventional transportation infrastructure investments, and consumer behavior.

Advancing Vehicle Technologies

The automobile industry is a leading sector in R&D, investing in a diverse array of vehicle technologies. Major automobile manufacturers typically invest four to five percent of their gross revenue in R&D each year. Total global R&D investment by automakers in 2008 was over $86 billion.

Many new advanced technology vehicles under development today are likely to fail in the marketplace. The market responds to many variables, such as cost, quality, reliability, and risk, and should be allowed to operate freely in the pursuit of sustainable mobility. Market competition between the technology options that emerge is also needed. The best policies are based on performance metrics rather than technology mandates, allowing markets to find optimal, least-cost solutions, while maximizing public goods.

Delivering any new vehicle technology to the market requires years of product planning. Policies that provide automakers with regulatory certainty and adequate lead time are essential. The development of a new drivetrain typically requires five to seven years and an investment on the order of $1 billion. Even after a new technology is introduced, it can take years before it achieves a significant market penetration. One of the first and the most successful hybrid electric vehicle models to date took eleven years from its first commercial introduction to selling its one-millionth unit worldwide.

Because technology development is inherently unpredictable, technology neutrality in policies should be maintained to the greatest extent possible. A broad-based approach that promotes a wide range of vehicle technologies has the best overall chance of producing market success. This principle of technology neutrality should guide government vehicle technology programs that span the range from basic and applied research to manufacturing R&D, and through deployment and commercialization activities.

Tax policy is a powerful tool to encourage the deployment of advanced technology vehicles, and should also be technology neutral overall. Many new technologies have upfront cost premiums that deter consumers, despite the expectation of lower fuel costs over the lifetime of the vehicle. Consumer tax incentives can compensate early adopters for these cost premiums, accelerating the acceptance of new technologies by the market. These incentives can help promote early market penetration, achieving greater scales of manufacturing more quickly and hence driving down cost curves more rapidly. This, in turn, supports the more rapid development and deployment of second generation technologies.

While it is impossible to predict with certainty what the automobiles of the future will look like, in the coming decades the vehicle fleet will likely become much more diverse technologically, with growing proportions of vehicles powered by biofuels, clean diesel, hydrogen, fuel cells, and battery-electric drivetrains. Continued

advancements to gasoline powered internal combustion engines will also play a role in increasing the overall fuel economy of the vehicle fleet for decades to come.

Providing Cleaner Fuels

Vehicles and fuels form a system. A full discussion of fuel quality should address both the need for new low-carbon alternatives and the need for stricter standards for the quality of gasoline and diesel fuel. Stricter quality standards would enable further improvements in gasoline and diesel engines, yielding fuel economy and environmental gains. The auto industry's best efforts to develop and deploy new, alternative fuel vehicles will succeed only if consumers have access to the fuels to support these vehicles. Policies to promote the production and distribution of these new fuels will be critical to their success in the market.

Low Carbon Fuels

Automakers support efforts to reduce the carbon content of fuels. Well-designed low carbon fuel standards (LCFSs) can help achieve that goal. Efforts to develop low carbon fuel standards are underway at the state and regional level, and federal legislation has proposed a national LCFS. Standards currently under discussion would include fuels derived from biomass, as well as electricity generated using renewable sources, such as solar, wind, or biomass.

Multiple LCFS systems may emerge, requiring careful coordination between state, regional, and national programs. On the biofuel side, calculating the carbon content for purposes of these standards will likely include indirect effects, such as the consequences of bringing additional land into agricultural production. Since fuels produced in one state or region may be transported great distances before reaching their final point of use, adopting common methodologies to calculate life cycle carbon content will facilitate smoother implementation of these programs.

Developing standards that use carbon content as a single, common denominator for comparisons between fuels will lead to the greatest transparency and efficacy in achieving transportation carbon reductions. In practice, adhering to this principle will require considerable political will. Potentially, these standards could be used to advance other environmental and local economic goals unrelated to carbon abatement. For example, regions experiencing pressure on local water supplies could choose to weight their standard to encourage biofuel production that is less water intensive, even beyond accounting for carbon associated with energy use due to irrigation or water consumption at the biorefinery.

Producers of local agricultural crops might similarly press for favorable weighting within the standard to recognize their contributions to regional rural development. While such objectives are laudable, using an LCFS as a vehicle for their advancement would dilute the standard's effectiveness as a carbon reduction strategy and should be resisted.

Automakers support the inclusion of electricity generated by renewable sources in low carbon fuel standards. Again, coordination between state, regional, and national standards that may emerge will maximize effectiveness and facilitate program implementation. Including electricity produced from renewable sources in a state-administered LCFS will require policy makers to decide whether to look at the electrical generating mix within their borders or to look more broadly at the generation mix in their regional power pool. If the latter course is taken, questions of double counting of renewable electricity credits may emerge if neighboring states adopt similar but independent standards. The question is further complicated by the fact that the definition of sources that qualify as renewable electricity generation varies between states.

For states that also have adopted renewable electricity standards, policy makers must also decide whether credits for renewably generated electricity should be included in an LCFS calculation. Allowing credits for renewable electricity generation under both programs could be viewed as mutually reinforcing, or as duplicative. Similar questions will need to be addressed if the federal government enacts a national renewable electricity standard.

Fuel Quality

Gasoline. The vehicle technologies automakers can offer in a given market may be limited by the characteristics of the transportation fuel they burn. In some developing countries, the presence of lead in gasoline is still a limiting factor to the introduction of catalytic converters that could yield huge benefits to local health. In the United States, the introduction of ultra-low sulfur diesel allowed the successful introduction of technologically advanced emissions control equipment that enabled light duty diesel vehicles to meet stringent emission standards.

Adopting stricter standards for the sulfur content of gasoline would open the U.S. market to gasoline lean burn engines capable of providing 10 to 20 percent improvements in fuel economy. Other markets have adopted lower gasoline sulfur standards, including the European Union and Japan (AIR 2009). A national clean gasoline standard with lower gasoline sulfur and other quality improvements could achieve significant benefits.

Biofuels. As the nation strives to replace more petroleum-based fuels with biofuel components to reduce GHG emissions and improve energy security, policies directed at ensuring the quality of these new fuels are needed. The Renewable Fuel Standard established under the Energy Independence and Security Act of 2007 encouraged the rapid expansion of a national biofuels industry and created legal requirements to absorb greater quantities of bio-based fuels into the national transportation fuel mix. The United States needs to act to ensure that standards keep pace with the new types of fuels that will increasingly reach consumers.

Mid-level Ethanol Blends. Today's fleet of gasoline-powered vehicles can safely accommodate blends of up to ten percent ethanol. Higher blends of ethanol can damage polymer-based materials that are used in fuel lines, seals, and other vehicle components. Flexible fuel vehicles, which are designed to run on blends of up to 85 percent ethanol, use materials chosen to withstand the effects of exposure to higher ethanol blends. Fueling a conventional, non-flexible fuel vehicle with ethanol blends exceeding ten percent can void the vehicle's warranty.

A joint research effort, conducted by the U.S. Department of Energy (DOE) and Environmental Protection Agency (EPA), is considering the effects of higher-level blends of ethanol on the existing light duty vehicle fleet. One challenging aspect to this research is that it must assess the long-term durability of vehicles under higher ethanol exposure. The EPA is considering whether to approve blends of ethanol of up to fifteen percent with gasoline. The automobile industry supports efforts by the EPA and DOE to ensure that the eventual regulatory decision is based on sound and thorough research on vehicle and fuel compatibility.

Biodiesel. Biodiesel can be compatible with diesel engines when blended in low proportions with conventional diesel fuel. However, biodiesel has different properties from conventional diesel, and further variations occur depending on the fuel stock used to produce the biodiesel. These variations include viscosity changes at different ambient temperatures and susceptibility to microbial contamination. Coordinated efforts between fuel providers, standard-setting bodies, and government agencies responsible for enforcement are needed to ensure that biodiesel entering the fuel mix is safe and reliable for diesel engines.

Emerging Biofuels. Research efforts are underway for new classes of second, third, and even fourth generation biofuels. Some of the biofuels under discussion are chemically distinct from conventional gasoline and diesel. Further research will be critical to ensure that these emerging fuels can meet appropriate standards for safe and reliable use.

Alternative Fuels Infrastructure. Government has traditionally played a role in financing infrastructure projects. Alternative fuel and electric vehicle charging infrastructures will require a significant new public investment. It is not yet clear which alternative fuels will make the most headway in the market, so acting too quickly on new fueling infrastructures risks locking in on technology choices too soon. Moreover, regional solutions may emerge. Establishing a biofuels infrastructure may be less costly in rural areas that

are closer to biofuels feedstock production and biorefineries. Urban areas, where many residents drive relatively fewer miles per day, may be better suited to grid-charged vehicles, at least until battery technology matures further.

President Obama's commitment to plug-in hybrid electric vehicles must be accompanied by greater efforts to understand consumer preferences for recharging, and initiatives to accelerate investments in a recharging infrastructure. Other alternative fuel vehicle technologies have not presented the same scope of challenges that face the electric recharging paradigm. Natural gas, methanol, diesel, ethanol, and hydrogen could adopt a fueling infrastructure model that closely parallels that of gasoline because each of these alternative fuels allows vehicles comparable in size and performance to conventional gasoline vehicles to achieve ranges consistent with consumer expectations for all-purpose driving.

Current battery technologies provide only limited ranges for battery, plug-in hybrid, or extended range electric vehicles. Some automakers have announced plans to introduce grid-charged electric vehicles capable of 40 miles of electrically powered driving between charges of the battery pack. This range would be sufficient for nearly 80 percent of trips taken by Americans (FHWA 2002). Still, it is not clear whether consumers will come to view electric drive vehicles as commuter cars suitable for most daily driving or whether they will demand an electric refueling infrastructure that enables them to use these vehicles for less frequent, but significantly longer, trips. If consumer acceptance relies on a ubiquitous charging infrastructure, a strong government role will be needed to support its establishment.

Estimates of the costs of building an adequate charging infrastructure for electric drive vehicles vary depending on the assumed vehicle ranges provided by the onboard battery pack and on the vehicle use and charging patterns assumed for consumers. These factors will also determine whether utilities will need to provide additional electrical generating capacity. The Pacific Northwest National Laboratory estimates that, if vehicle charging is conducted during off-peak periods, existing electrical generation capacity could support the energy requirements of 73 percent of the U.S. light duty vehicle fleet (Kinter-Meyer *et al.* 2007). Off-peak charging fits well with utilities' business models because it allows for load leveling, or greater use of currently underutilized generating capacity during nighttime hours.

Consumers will likely demand some level of daytime charging; this could mean significant costs for both the additional generating capacity and for a network of non-residential charging stations on a national scale. This type of charging pattern is not necessarily in alignment with electric utility business interests. Policies to encourage the inclusion of recharging infrastructure investments into utility rate bases will be essential to enlisting the participation of utilities at significant scale. The federal government could also show leadership by developing model building codes for residential and commercial retrofits to accommodate vehicle recharging stations, helping localities overcome regulatory barriers. Standardization of vehicle-charger interfaces will be an important part of this effort.

In summary, encouraging the adoption of plug-in hybrid vehicles can best be achieved through a better understanding of consumer expectations for vehicle recharging, government policies to facilitate the establishment of a recharging infrastructure in synch with consumer expectations, and increased investment in research and development of next generation battery technologies.

Investing in Transportation Infrastructure

The safe and efficient movement of people and goods is intrinsic to commerce and a cornerstone of a strong economy. Yet the nation's transportation infrastructure is aging and in urgent need of revitalization. Failing to invest sufficiently in transportation infrastructure will exacerbate traffic congestion that afflicts urban areas across the nation and create a system that is less efficient, consumes more fuel, produces more pollution, and detracts from quality of life. Achieving sustainable mobility will also require the establishment of infrastructures to support the next generation of alternative fueled vehicles, including electric drive vehicles.

Transportation challenges, and in particular traffic congestion, are among the top issues that city officials believe most urgently require federal action. In a national survey of municipal and city leaders, transportation issues ranked second only to healthcare, and ahead of education as their most important concern (McFarland 2008). In 2007, congestion caused urban Americans to spend an additional 4.2 billion hours traveling and to purchase 2.8 billion gallons of fuel. This amounts to an effective "congestion tax" imposed on the economy of $87 billion, an increase of more than 50 percent than the previous decade (Schrank and Lomax 2008). Slower speeds and unproductive idling time in heavy traffic have also meant increased emissions of GHGs and smog-related pollutants. High gasoline prices and the recession have recently combined to slow the trend toward greater traffic congestion, but as the economy recovers, previous growth rates in VMT and traffic congestion are likely to resume.

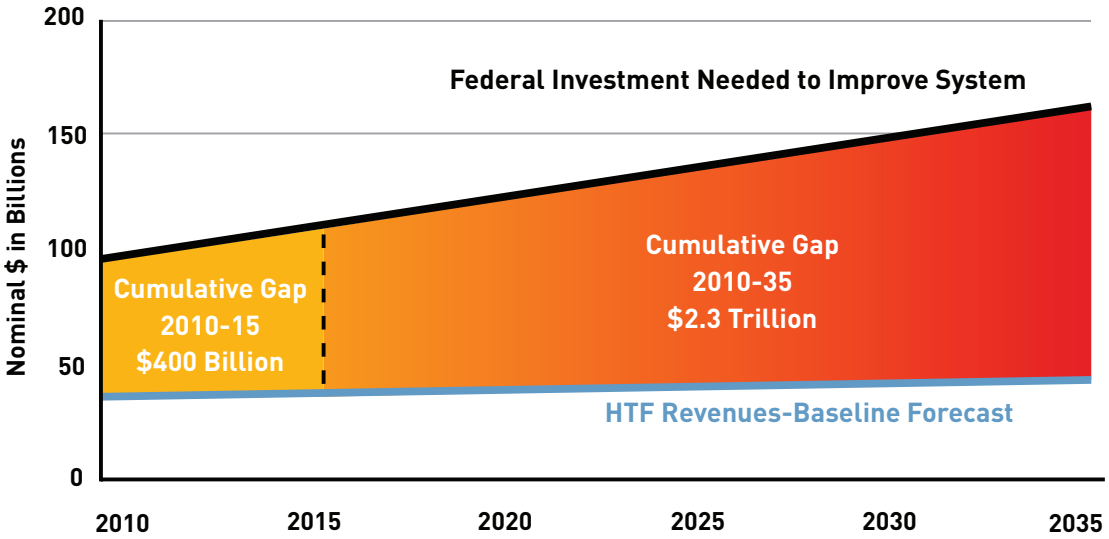
Alleviating congestion requires a balanced approach of policies, including adding roadway capacity and public transit in the most affected areas. Other important strategies include promoting ridesharing and flexible work schedules to reduce rush hour demand. A longer term solution involves diversified land development patterns that are more conducive to walking, biking, and mass transit.

Ensuring adequate roads and highways is a necessary element of the infrastructure component of sustainable mobility. The existing transportation infrastructure needs to be augmented to support the alternative fuel vehicles that will increasingly populate the roadways. Market deployment of alternative fuel vehicles is impeded by fueling anxiety among consumers. Consumers will not adopt alternative fuel vehicles unless they have confidence that an adequate refueling infrastructure is in place or will be established within an acceptable timeframe. At the same time, investors may be unwilling to commit sufficiently to an alternative fuel infrastructure until a significant number of compatible vehicles have entered the fleet. Successful policies to promote alternative fuel use need to address both sides of this issue.

Addressing Financing Challenges

The surface transportation infrastructure in the United States will require substantially more funding over the next few decades to deal with physical deterioration, congestion, and future demand for both passenger and freight travel. Over 13,000 Americans die each year on the nation's roadways due to inadequate highway maintenance (CSIS 2006). The Department of Transportation (DOT) estimates that the nation will

Figure 6-1: A large and widening gap between federal revenues and investment needs in nominal dollars



Source: NSTIFC 2009

need to increase highway capital spending by 12 percent and transit capital spending by 25 percent from 2005 through 2024 to maintain the current condition and performance of the system (FWHA 2007).

Recommended improvements would require even greater investments. Under current policies, revenues raised by all levels of government will total only one-third of the approximately $200 billion needed annually to provide needed improvements in the nation's highway and transit systems. The cumulative investment gap at the federal level alone is projected by the National Surface Transportation Infrastructure Financing Commission to be $400 billion between 2010 and 2015. As shown in Figure 6-1, the gap is projected to rise to $2.3 trillion when summed over the next 25 years (NSTIFC 2009).

The issue has taken on new urgency recently due to funding challenges at the federal and state levels. The main revenue mechanism for the federal Highway Trust Fund, the transportation fuels tax, is faltering. Real highway spending per mile traveled has fallen by nearly 50 percent since the Federal Highway Trust Fund was established in 1956. Total combined highway and transit spending as a share of GDP has fallen about 25 percent in the same period, to 1.5 percent today (NSTIFC 2009). The trust fund provides almost all federal highway funds and approximately 80 percent of federal transit funds.

Funding shortfalls in the Highway Trust Fund are related to a few key underlying factors, particularly the erosion of the real per gallon value of the fuels tax. Because it is not adjusted for inflation, the federal gas tax has dropped in terms of purchasing power by 33 percent since 1993, the last time it was increased (NSTIFC 2009). Adjusting further for increases in the price of highway construction materials, the federal gasoline tax had only 49 percent of the purchasing power in 2006 that it did on 1993 (Slone 2008). Meanwhile, construction inflation rose by a cumulative 40 percent in just three years from 2005 to 2008 (Florian 2008).

The problem has become even more acute because the recent economic downturn has significantly depressed gasoline and diesel consumption, thereby decreasing federal fuel tax revenues. Providing the funding to improve and expand the transportation system is also a significant challenge for state governments. Lower rates of gasoline consumption have meant diminishing funds for beleaguered state governments that also depend on fuel taxes for revenue.

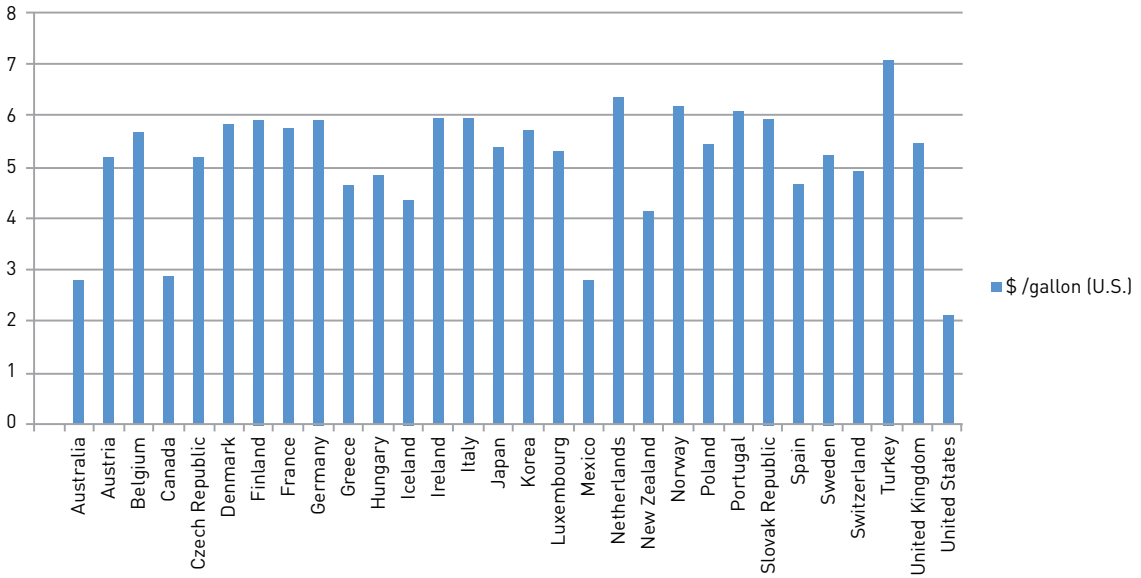
The precarious situation of transportation infrastructure finance has significant implications for emission mitigation in the transportation sector. First, transportation funding is needed for traffic congestion mitigation projects. Urban congestion means slower traffic speeds and increased vehicle idling, and both of these factors contribute to higher vehicle emissions per mile. Second, greater investment for public transit is essential. Greater access to public transit means more options for consumers, and well planned public transit can achieve fewer GHG emissions per passenger-mile, for its ridership, while simultaneously alleviating pressure on congested urban roadways.

There are increasing calls for a dedicated fuel tax to address the staggering costs that state and federal governments face in rebuilding the decaying transportation infrastructure. Increased fuel prices could also be structured to attach a price on carbon in transportation fuels. As shown in Figure 6-2, current national transportation policies in the United States support gasoline prices that are significantly lower than those seen in the rest of the developed world. A national debate is needed to assess whether this is the best way to price transportation fuels in the future.

Engaging Consumers

Success in implementing sustainable mobility hinges on consumers and their purchasing decisions. The current national energy policy as it pertains to vehicle fuel economy sends consumers conflicting signals. Automakers are mandated to manufacture more fuel efficient vehicles. At the same time, the government promotes policies supporting inexpensive gasoline, and in doing so undermines demand for more efficient vehicles. This contradiction should be corrected by new public policies that send consumers consistent market signals promoting fuel efficiency and GHG reductions.

Figure 6-2: Retail gasoline prices among developed nations (U.S.$)



Source: German Technical Cooperation 2009

Consumer choice involves several elements that relate to sustainable mobility, including VMT, vehicle fleet composition, the rate of adoption of new vehicle technologies, and consumer behaviors affecting real-world fuel economy, such as driving styles and commitments to proper vehicle maintenance. Too often, they are approached as distinct challenges requiring separate, and often complicated, policy solutions when the simple fact is that appropriate fuel price signals would address all of these elements of consumer behavior.

Policies to reduce VMT can lessen dependence on foreign oil and also reduce GHG emissions. Historically, growth rates for VMT and gross domestic product (GDP) have been strongly correlated (OHPI 2000). Policies to decouple VMT and GDP growth are possible, but efforts to reduce VMT demand careful analysis and planning to anticipate and avoid inadvertent impacts on the economy. In the future, as the vehicle fleet becomes more diverse and depends more on electricity and alternative fuels, VMT will not be the direct proxy for oil consumption it largely is today.

Eco-driving is another example of a powerful effect that consumer choices can have on real world fuel economy. The term refers to driving practices that maximize the fuel economy consumers obtain in real world driving. These practices include avoiding rapid stops and starts, maintaining a steady rate of speed while anticipating traffic flow, and consistently using the highest gear possible.

Experience in Europe demonstrates that eco-driving education campaigns can achieve results. The Netherlands and Sweden each launched eco-driving training programs in the late 1990s. The Dutch Ministry of Transport, Public Works and Water Management estimates that their eco-driving program resulted in a 600,000 ton reduction in carbon dioxide emissions in 2006 at an overall cost of only seven euros per ton of carbon dioxide emission avoidance. The Swedish eco-driving effort began with courses for drivers of passenger cars in 1999. Sweden has educated 27,000 drivers of light duty vehicles since the program's inception and projects an annual reduction in fuel consumption of 10 million gallons. This equates to a reduction of carbon dioxide emissions of 95,000 tons per year and an annual cost savings of 38.7 million euros (Cambridge Systematic 2009).

Consumer education on eco-driving has the potential to deliver significant improvements in fuel efficiency. In one U.S. study, 48 volunteers trained in eco-driving techniques showed an average 24 percent improvement in fuel economy as a result of the training. The results ranged from a six percent fuel economy improvement

to more than 50 percent, depending on driving style and the ability to master eco-driving behaviors (Ford 2008). Automakers support public-private efforts to educate drivers on eco-driving techniques. In 2008, Alliance members launched an online initiative to promote eco-driving awareness. To date, governors of 18 U.S. states and more than 20 organizations have announced their endorsement of the Alliance EcoDriving Initiative. To further these efforts, automakers support incorporating eco-driving techniques in student driver education programs administered by states, and the inclusion of eco-driving content in state and privately administered driving examinations.

The CAFE program requires automakers to produce vehicles that meet fleet-wide average fuel economy standards, with these standards becoming more stringent over time. Simply manufacturing these vehicles is not sufficient for automakers to fulfill their obligation under this form of regulation. More to the point, the public policy objectives of sustainable mobility are not met by simply producing these vehicles. The success of a CAFE approach ultimately depends upon deployment of these vehicles into the national fleet, and this rests in turn on purchasing decisions made by consumers.

Events during the summer of 2008 show how gasoline price signals can affect vehicle purchasing decisions. When gasoline prices surged to levels near $4.00 per gallon in May 2008, there was a dramatic shift in consumer preference towards cars over less fuel efficient trucks and sport utility vehicles, although this consumer preference lasted only as long as the high fuel prices persisted. By February 2009, with the national average price of gasoline once again below $2.00 per gallon, the U.S. market returned to favoring light trucks and sport utility vehicles over cars.

Feebate programs are designed to incentivize the purchase of more fuel efficient vehicles by issuing a rebate for vehicles exceeding a set fuel economy standard and imposing a fee on the sale of vehicles that fall below that standard. A feebate program is typically intended to be revenue neutral, with the rebate and fee portions offsetting one another. Predicting changes to consumer buying behavior under a feebate structure is difficult, and as a result it is hard to anticipate the revenue that will be generated by the fees and the amount required to fund the rebates. Experiences with the French and Canadian feebate programs, which have involved large government subsidies of their programs, illustrate the challenge of achieving revenue neutrality in practice.

Feebate programs present challenges to automakers by introducing uncertainty into their product planning. To keep the program revenue neutral, government must continually rebalance the rebate and fee halves, changing vehicle eligibility requirements each time. This is fundamentally at odds with the timescales for product planning needed by automakers. A feebate approach also suffers from the limitations inherent in the CAFE program. Both are narrow approaches that cannot address VMT growth or the carbon content of fuels. Like CAFE programs, feebates may succeed in increasing the fuel economy of the vehicle fleet while failing to deliver decreases in emissions from the fleet overall. Alternatively, appropriate fuel price signals can influence consumer choices along all of the relevant dimensions, including vehicle purchase decisions, VMT, and fuel economy enhancement behaviors, including eco-driving and proper vehicle maintenance.

A gasoline price floor is one policy option that would send a steady price signal to consumers, encouraging the sale of more fuel efficient automobiles. Under this approach, the government would impose a variable gasoline surcharge that would move inversely with the price of oil to maintain the retail price of gasoline at or above a selected level. Proponents have used a number of different terms to describe such a pricing mechanism, including a variable oil security charge, a fuel price stabilization program, or a gasoline price floor (Bordoff and Metcalf 2009; Lee 2009).

In setting the level of the floor, policy makers would first determine the amount of desired reductions in gasoline consumption and tailpipe emissions, and then select a price level that would deliver those reductions. If the price floor were set at $4.00 per gallon of gasoline and the market price would otherwise have been $3.00 per gallon, the government would assess a surcharge of $1.00 per gallon sold to bring the price seen by consumers to the $4.00 mark. If the price of oil increased, the surcharge would automatically

decline so that gas prices would stay about constant. If the market price for gasoline met or exceeded $4.00 per gallon, the surcharge would disappear.

The U.S. government has historically been much more resistant to imposing fuel taxes than is the case in most other countries. Fuel tax policies have empirically proved to be a powerful means to achieving national goals in other countries. European tax policies, for example, have encouraged diesel fuel over gasoline since the 1940s. Diesel vehicles are 20 to 40 percent more efficient than conventional gasoline vehicles. In the United States, diesel is taxed at a slightly higher rate than gasoline, discouraging its use. In Europe, diesel is taxed 12 percent less than gasoline (*Diesel Fuel News* 2003). In the United States, federal taxes for diesel are 25 percent more than those for gasoline (API 2009). In the European Union, clean diesel accounted for over 50 percent of new vehicle sales in 2008, while in the United States the figure is only three percent (U.S. DOE 2009; Ward's 2009). Thus, the United States is in the curious position of imposing higher taxes on a fuel that supports a more fuel efficient vehicle technology.

2012-2016 and Beyond

The auto industry is committed to achieving the goals of the new paradigm outlined in President Obama's May 2009 program. Policies for 2012 and beyond will need to build on the success achieved early in the implementation of the new CAFE standards. While CAFE has made significant contributions to driving more fuel efficient vehicle technologies to date, its potential is limited. A more comprehensive set of policies is needed that also addresses transportation fuels and the ways consumers buy and drive vehicles. A new transportation strategy also needs to be anchored to a comprehensive, economy-wide effort to address energy and climate challenges.

State governments should be actively engaged in the development of a new transportation strategy, although, ultimately, federal leadership is required. Inconsistent or contradictory state policies can cause regulatory burdens and can stifle innovation. Pursuing national, economy-wide programs will maximize the chances of success.

A portfolio approach is needed to achieve sustainable mobility. Progress must occur in all four pathways—improved vehicle technology, cleaner conventional and alternative fuels, improved transportation infrastructure, and greater consumer engagement. Contributions by many stakeholders, including automakers, will be essential.

As part of a technology neutral approach, policies that promote long-term vehicle technologies must be combined with those that can achieve near-term, incremental progress. Emission-free miles are part of a powerful long-term vision. Work towards the development of vehicles that can deliver that vision, including both hydrogen and battery powered vehicles, should continue. At the same time, other technologies, including continued improvements to internal combustion engines, will play a significant role in greater vehicle efficiency for many years to come.

Consumers in particular will play a key role in the years ahead. Past efforts have failed to engage consumers adequately, in large measure because of the absence of adequate price signals. Policies should be created that will motivate all Americans to make choices that will limit GHG emissions and petroleum consumption. While some of these measures may be politically challenging, they deserve due consideration in a serious, honest discussion about how best to achieve sustainable mobility.

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