CHAPTER 15

Toward a Transportation Policy Agenda for Climate Change

David Burwell and Daniel Sperling

How might we move forward in reducing greenhouse gases? Participants at the tenth Biennial Asilomar Conference on Climate Change Policy did not come to many definitive conclusions. But they did agree that climate change is an issue of pressing public concern that calls for innovative solutions. The conference outlined many potential strategies to address this problem from a wide variety of perspectives, including regulatory and voluntary approaches; technology-based approaches for both vehicles and fuels; and market and policy approaches to increase energy supply and reduce consumption. As the public becomes better informed on both the potential impacts of climate change and the contributing role of transportation in generating greenhouse gas (GHG) emissions, many of these strategies, alone or in combination, will help define strategic remediation plans to protect the global climate.

Opportunities abound. Most transport-related GHG strategies are synergistic with existing policy initiatives; solutions to traffic congestion and air pollution, and measures to improve transportation efficiency are each generally consistent with the goal of reducing transportation GHG emissions. International and local initiatives are expanding and will eventually force a coherent national policy to emerge within the United States and other nations. The public is demanding corporate responsibility in this area, and both energy and transportation companies are responding with their own roadmaps and narratives.

This chapter is intended as a synthesis of the various conference presentations and of the issues raised during conference discussions. Data and other quantitative measures are drawn from previous chapters and from conference presentations listed at the end of this chapter. These presentations addressed a wide range of strategies for reducing transportation-related GHG emissions, some in combination with each other and some self-standing. A summary of these strategies includes the following:

- Improved fuel economy, accomplished through improved fuel systems and vehicle technologies (Sloane, 2005)
- Alternative fuel technologies including electric and plug-in hybrids, biofuels, biodiesel, and hydrogen (Jackson, 2005)
- Tailpipe emissions regulations coupled with consumer education campaigns and incentives to promote and reward more fuel-efficient purchasing and driving behavior (Dumas, 2005; Reilly-Roe, 2005)
- Regulatory programs including possible application of stationary "cap-and-trade" programs to mobile sources of GHG emissions (German, 2005)
- Marketing campaigns to associate fuel-efficient purchasing behavior with self-identity, values, and peer group association (Kurani, 2005)
- System integration and management including improved road connectivity, inter-modal connectivity, bicycle and pedestrian access, and a variety of transit, paratransit and bus investments (Toth, 2005)
- Transportation Demand Management (TDM) programs to improve transportation and land use planning at the project and regional level, access management, zoning, redevelopment planning, transit-oriented development, and regional growth management (Ewing, 2005; Garry, 2005)
- Integration of transportation and urban development planning, improved system and financial management, consolidation and coordination of competing private transit systems, and investment in a variety of transit improvements including express bus, bus rapid transit (BRT), nonmotorized transport (NMT), and TDM (Bleviss, 2005; Hook, 2005; Mehndiratta, 2005; Schipper, 2005)

Crisis and Opportunity: Numbers, Needs, and the Not Particularly Rational Transportation Consumer

Transportation-related energy use and resulting GHG emissions pose looming threats to economic growth, the global environment, public health, and overall quality of life. The consequences for national economies vary by region. Transportation energy use will increase most dramatically in the developing economies, especially in Asia and Latin America.

The Numbers: Growth in Demand

Vehicle usage around the world continues to increase—rapidly in some regions. Increased vehicle travel is swamping vehicle efficiency improvements, with the result that GHG emissions continue to increase. Unless low-carbon fuels begin to replace petroleum and substantial improvements are made in fuel efficiency, this trend will continue.

Total carbon emissions from passenger transportation would actually decline if, for instance, average fleet efficiency in North America improved from 20.5 miles per gallon (mpg) in 2003 to 29 mpg by 2030, new car efficiency improved from 21 mpg to 38 mpg, and advanced gasoline and diesel burning internal combustion engines (ICEs) grew from 1 to 42 percent of total sales (Johnston, 2005). These ambitious targets for the United States would bring the country to efficiency levels that already exist in Europe. In 2003 European passenger fleet efficiency was 31.5 mpg, new car efficiency was 35 mpg, and advanced gasoline and diesel ICE comprised 39 percent of the market.

To reduce GHG emissions from the entire transport sector, though, broader changes are needed. Light-duty passenger vehicles consume only about half the energy used for transportation. GHG emissions from freight trucks, bus and rail, off-road vehicles, aviation, and marine transportation would remain as additional challenges.

Another factor to consider is upstream emissions. So far, only GHG emissions from combustion of fuel in the vehicle—the "pump-to-wheel" portion of the fuel cycle—have been considered. A considerable quantity of GHG emissions are also generated upstream in the transportation fuel supply chain, during the extraction, refining, and transporting of fuel to the pump, known as the "well-to-wheel" fuel cycle. And still more GHG emissions result from fossil fuels consumed in the materials and construction of vehicles and infrastructure for roads, rail, aviation, and marine transport. While these tend to be secondary sources, they need to be considered in crafting effective action plans.

Many at Asilomar argued that more emphasis needs to be given to vehicle usage. Reid Ewing, relying on U.S. Energy Information Administration data (AEO, 2004), argued that increased travel will swamp expected technology improvements (Ewing, 2005). Indeed, that will be the case if technology and fuel improvements do not accelerate.

The most rapid increases in transportation-related CO_2 emissions are in the densely populated Asia Pacific region, which includes India, China, and Japan. The world population is forecasted to grow from 6.3 billion people in 2003 to 8.0 billion in 2030, with the Asia Pacific region increasing from 3.5 billion people to 4.4 billion. Asia will likely account for well over 50 percent of total world population in 2030. Car ownership in the region is expected to soar from 15 per thousand population to 100 per thousand. The result would be 420 million vehicles by 2030. Optimistically assuming significant fuel efficiency improvements and increased use of diesel engines in the Asia Pacific region, emissions will still increase roughly fourfold.

Even with this increasing rate of car ownership in the Asia Pacific region, vehicle ownership and emissions per capita would fall far short of those in the United States and Europe. Johnston estimated that vehicle ownership would be less than 12 percent of the North American per capita car ownership and less than 22 percent of European car ownership (Johnston, 2005).

Transportation growth is not limited to the Asia Pacific region. It is a significant component of growth in energy demand in virtually all rapidly developing economies. Meeting the expected growth in travel—and, therefore, energy—requires accelerated gains in vehicle efficiency, provision of timely and adequate alternative transportation services, increasing the diversity of the transportation energy mix, and integrating transport services to meet mobility and access needs through a seamless and efficient intermodal transportation network.

If supply or demand challenges are not met, economic growth is compromised. The transportation sector must accept its proportionate responsibility in addressing this threat by pursuing at least the following strategies (Johnston, 2005):

- Developing and adopting a portfolio of transportation management and innovation approaches that have proven effective in reducing transportation GHG
- Promoting research and development and improvements in governance that encourage deployment of successful innovations
- Acknowledging and addressing the critical role of consumer choice, at the individual and collective level, in defining successful policy approaches

Needs: Policy, Connectivity, Technologies, Fuels

To pursue those strategies, a broader and deeper portfolio of scientific and engineering initiatives is needed to inform the climate change debate. Clearly, the more we know about climate change science, the better. Initiatives in this area by the Bush administration are welcome (Mahoney, 2005). However, such inquiries must be accompanied by policy action.

An effective national research and policy agenda will need to reflect the accelerating global connectivity of Science, Technology, and Engineering (ST&E) resources and capabilities. Significant and essential intellectual capacity exists in all regions of the world. Increased connectivity creates synergies between technical communities in academia, industry, and government. Policymakers can help leverage this capacity by working to remove legal and trade barriers to joint development projects and by supporting long-term protection of intellectual property. Government funding of research related to energy and climate change needs to encourage international collaboration. The issue is *global* climate change, and programs to address it need global resources. This approach acknowledges the existence of an international marketplace for ideas as well as for technologies. In a global economy, capital will follow intellectual property and market opportunity, and capital is essential to sustained innovation.

Other actions are needed to understand and influence the factors that affect the rate of market penetration of new transportation technologies, the growth in transportation demand, and how transportation choices are made. We need to understand purchasing behavior, mode choice, driving behavior, and choice of fuel technologies. An informed analysis of the political and economic risks of various courses of action is needed, with the results being transparent and widely distributed to interested audiences, including policymakers and the general public.

The global reliance on oil as the almost exclusive transportation fuel must be addressed in any program to limit global climate change. In the United States, for example, oil accounts for 97 percent of all transportation fuel. Success in reducing vehicle-related emissions will require a larger diversity in the transportation energy mix. Even if, optimistically, 50 percent of vehicles in 2025 had 50 percent better fuel economy than in 2002, the United States would still experience a 35 percent increase in total transportation fuel use, given projected growth in vehicles (Sloane, 2005).

Transportation is the fastest growing source of GHG emissions in the world. It already accounts for more than 20 percent of global GHG emissions and more than 30 percent of U.S. GHG emissions.

To stabilize carbon dioxide concentrations in the atmosphere at even twice pre-industrial levels would require a sharp reduction in emissions across all economic sectors, on the order of 50 percent by 2050. Incremental improvement in conventional vehicle technology is not enough. New fuel and vehicle technologies will be required, along with other strategies, if the transportation sector is to contribute its proportionate share to this reduction. Based on the present level of vehicle manufacturer investment in hydrogen fuels, market introduction of hydrogen-based fuels should begin between 2010 and 2015. In the meantime, a focus on other fuel technologies such as biofuels can help lower the rate of growth of transportation-related GHG emissions (Sloane, 2005).

The Human Factor

While good data and science, and deployment of innovative technologies can go far in improving the energy efficiency of transportation and in assessing the risk of climate change from the transportation sector, consumer behavior also plays a central role. Unfortunately, consumer response to new technologies and shifting public priorities is not well understood. As Kurani argued in his presentation, and earlier in this book, vehicles have symbolic meaning to consumers beyond their utility in providing access to goods and services. Convincing consumers to be more energy sensitive in their vehicle purchases and use is difficult when energy is just one of many factors they consider.

More generally, economic self-interest is not always the dominant factor in consumer behavior. Symbolic meanings—transportation as a statement of self-identity, values, and peer-group association—are also important. In addition, the cost savings gained from purchasing fuel-efficient vehicles is less of a factor in consumer behavior than feelings about being a "smart consumer," or "buying a piece of the future" for your children. Stories or narratives that appeal to consumer self-identity or interest in creating a better world may achieve better results in improving the efficiency of consumer transportation behavior than appeals that focus on self-interested arguments such as improved fuel efficiency. These stories and narratives may also work at the community level and affect the collective behavior of communities, governments, and corporations. Research, including modeling, can help these entities articulate their preferred future narratives or community "scenarios," and even lead to changes in behavior (Johnston, 2005; Kurani, 2005).

The Regulatory Landscape for Transportation, Energy, and Climate Change

Policy places an important role in shaping the behavior of individuals and companies. DeCicco highlighted the scale of the energy and GHG challenge by noting that oil consumption from motor vehicles increased 25 percent between 1990 and 2003 to 8.6 million barrels per day (bpd). This total oil consumption figure is approximately equal to the average annual oil production of Saudi Arabia over the last 15 years. An increasing share is consumed by light-duty trucks, which due to their lower fuel economy emit, on average, 39 percent more CO_2 per mile than passenger cars. Light trucks now represent 59 percent of total vehicle fleet CO_2 emissions. DeCicco argued that these numbers support action to reduce emissions from transportation vehicles (DeCicco, 2005).

There is increasing support nationally for a regulatory approach to transportation-related CO_2, according to Grundler (2005). Leadership is emerging within Congress and the Bush administration for action. However, any regulatory scheme must be based on a solid understanding of externalities, and the costs and savings must be transparent to the consumer.

Technology policy can play a particularly significant role in developing innovative GHG-reduction strategies (Rubin, 2005). It can help smooth out the innovation process through such interventions as research and development support to promote invention, patent protection to foster innovation, tax credits or procurement support to favor adoption, and education to encourage diffusion. Historically, public policy has contributed to technology innovation. For example, patent filings for clean air technologies increased from less than 10 to more than 100 annually in the ten years after enactment of the Clean Air Act. Both regulatory and nonregulatory policies will be needed to stabilize transportation-related GHG emissions. However, little is known about the relative efficacy of such policies, their most effective sequencing, or the potential benefits and risks of various combinations of them. Ongoing research is needed but does not eliminate the need for action (Rubin, 2005).

Vehicle regulation is the most prominent and widely used tool to improve vehicle fuel consumption and reduce carbon emissions. Regulations have been adopted in nine countries and regions, as presented by An (2005). Efficiency goals vary widely by region and implementation is nonuniform, however. Efficiency is regulated by a variety of standards including average fleet efficiency, vehicle category, total weight, and engine weight. The European Union (EU) and Japan have the most stringent vehicle standards, calling for between 16 and 19 percent reduction over 2002 vehicle fleet efficiency, respectively, by 2008 and 2010, respectively. The 16 percent target would reduce vehicle CO_2 emissions to 140 grams per kilometer of driving. Japan is on track to meet the standards, but the EU might fall somewhat short.

According to An (2005), the EU, China, Canada, and California would improve fuel efficiency by at least 20 percent by 2016 if all presently enacted standards for future years were met. He reported that the United States is projected to have both the lowest fuel economy rating and the lowest gains, just a 3 percent gain in fuel efficiency (An, 2005).

Energy companies also have a key role to play in both balancing transportation energy supply and demand and in addressing energy security issues. With respect to transportation energy, a short-term priority is to develop clean fuel technologies with lower carbon emissions. In the longer term, energy companies can assist in the gradual transition in engine technology from the conventional ICE drivetrain to hybrid electric drives, and ultimately to fuel cell systems. Whether this transition will be driven by the regulatory environment or by voluntary industry innovation is as yet uncertain (Eggar, 2005).

Other regulatory options, such as carbon trading and so-called "feebate" programs, may also play a role in reducing GHG emissions. Both options offer creative approaches, but also come with implementation and political uncertainties (Dumas, 2005).

Integration of transportation into a national carbon trading program, including a cap-and-trade program, is possible but problematic (German, 2005). According to German, downstream systems that focus on consumer purchasing and driving behavior face large political and administrative barriers. Upstream trading systems focusing on fuel suppliers are possible but work only by limiting fuel availability. Sector strategies that focus on vehicle manufacturers have a variety of barriers—including double counting, allocating responsibility between manufacturers and oil producers, and uncertainty about future emissions based on user behavior—that make this strategy very difficult. A system where manufacturers buy or sell credits to the government based on relative fuel intensity may be the most promising strategy.

Feebate programs, where fees are imposed on purchasers of vehicles that fail to meet a set fuel economy or emissions standard and cash rewards or rebates are granted for the purchase of vehicles that exceed the standard, are under active consideration in Canada but are not presently imposed anywhere in the world (Dumas, 2005). Factors influencing the design of a feebate program include price elasticities, the cost of technologies, feebate structure, selection of the standard, and the quality and availability of fuel economy data. Feebates can result in significant reductions in fuel consumption but only with a large transfer of payments between consumers or between customers and governments. There are many variations to such a program, including imposing the charges only on the purchase of vehicles with very high or low fuel efficiency. The efficacy and acceptability of such a program varies depending on whether it is specific to a state or province or encompasses an entire country or group of countries.

Despite the plethora of potential policy approaches, such as those highlighted here, policy makers in the United States have, to date, largely ignored the transportation sector in developing a national climate change strategy. National policy on transportation CO_2 is characterized by resistance to increases on fuel economy standards, gas taxes, energy taxes, and carbon-reduction requirements. The only progress nationally in the United States at this time is a minor increase in fuel economy standards for light-duty trucks. Miller argued that policy in this area is highly influenced by party politics, leading to a probable stalemate in the near future (Miller, 2005). While the U.S. Congressional Budget Office prefers gasoline taxes over corporate average fuel economy (CAFE) standards, neither is receiving much political support.

The Promise of Integrated Transportation Solutions

A recurring theme of the Asilomar Conference was the need for more and stronger collaborations and partnerships—between vehicle and fuel suppliers, emerging and economically advanced nations, and the many public and private entities investing in and managing transport services.

Vehicle and System Efficiency: A New Partnership

The most promising strategies to reduce transportation-related GHG emissions in the highly motorized societies of North America and Europe are those based on technology improvement and new fuels. This is true not just for passenger vehicles but also for large trucks. These advances increasingly require partnerships between fuel and vehicle suppliers, with investments in new and improved engines linked to new and improved fuels. Examples include diesel engines with low-sulfur diesel fuel, biofuels with flexible fuel engines, natural gas vehicles with natural gas stations, electric vehicles with recharging locations, and fuel cell vehicles with hydrogen supply.

Other strategies targeted at vehicle use are also promising. They may or may not be as effective at reducing GHG emissions, but they undoubtedly could make a substantial contribution. These other strategies include managing vehicle use while enhancing access. Importantly, these other demand-based strategies can contribute to other important metropolitan goals. Key players in the United States are state departments of transportation (DOTs), which are rapidly switching from a focus on system expansion to system management (Toth, 2005). The impetus for this transition comes from several sources, including completion of the interstate highway system; rising land costs in metropolitan areas that often render road expansion prohibitively expensive; and an emerging realization that beyond a certain level of development system expansion is no longer a cost-effective means of reducing congestion and improving access.

Improved system management as a focus of state DOT efforts to address congestion is also advanced by the recent realization that system expansion has done little to reduce congestion. According to the Texas Transportation Institute (TTI), the total delay experienced by a peak hour urban traveler rose from 16 hours in 1982 to 62 hours in 2000. In addition, the period of delay during rush hours expanded from 4.5 hours to 7.0 hours and the extent of the system experiencing congestion increased from 34 to 58 percent over the same time period (Lomax and Schrank, 2005). These results have encouraged state DOTs to give increased attention to strategies that manage overall travel demand, rather than increase total system capacity. This new approach has collateral energy conservation and climate benefits.

Toth described New Jersey DOT's policy of integrating transportation and land use planning. Their goal is to encourage the use of alternative modes, especially walking and bicycling; improve road connectivity to diffuse trips across the network; and coordinate transportation and land use planning and invest in low-cost incremental improvements that support efficient land uses (Toth, 2005). The New Jersey DOT is promoting this new policy through the New Jersey Future in Transportation (NJFIT) campaign, which is designed to solicit local planning partners to help the agency advance these objectives. It has also initiated a cooperative training program in support of this effort.

Better data and modeling at the regional level can support both technological innovation and state DOT "smart transportation" investment initiatives. Regional planning agencies are now using integrated transportation and land use planning models to conduct "scenario planning" of alternative regional growth plans. These models provide projections of increases in VMT and GHG emissions resulting from alternative land use and transportation investment scenarios with sound planning principles. These exercises suggest the potential for reduced land consumption, VMT growth, and GHG emissions (Garry, 2005).

In the Sacramento, California, region, for example, a two-year "regional blueprint" scenario planning exercise combined widespread public participation with three different types of models that evaluated alternative spatial distribution of economic activity, trips, and land use parcels, based on density, design, diversity of uses, and destinations—the four Ds. Results indicate that the consumer-preferred growth scenario reduced the share of trips by personal vehicles from 93.7 percent in 2050, under base case conditions, to 83.9 percent in the preferred scenario. VMT dropped by 25 percent and GHG emissions fell by 15 percent. These reductions assumed no efficiencies resulting from CO_2 tailpipe emission reductions, improvements in fuel economy, or change in regional growth rate or economic structure (Garry, 2005).

National surveys of regional and local planning initiatives show even more significant VMT and GHG emissions reductions from specific development projects. In these surveys comparisons were made between total VMT generated by projects under an unconstrained land use regulatory system, where development occurred primarily at the urban fringe on undeveloped land, called greenfield development, versus similar project location in an urban, transit-oriented location on a redeveloped site, called brownfield development. These comparisons showed VMT and GHG emissions reductions of about 50 percent for the brownfield developments when compared to greenfield development (Ewing, 2005). In the case of a specific mixed use redevelopment of a brownfield site in downtown Atlanta, a 33 percent reduction in VMT was projected due to improved regional accessibility of the site, and another 5 percent reduction was projected from the adoption of favorable density, design, and diversity of use criteria. While such results are site dependent, the travel demand management and GHG emissions reduction potential of redevelopment planning appears significant (Ewing, 2005).

Careful studies are needed that integrate analyses of transportation energy and GHG reduction benefits resulting from both technology and fuel improvements and from land use and growth management initiatives. The two strategies have some countervailing tendencies, since improved road system efficiency tends to increase total travel demand and encourage dispersed settlement patterns. Also, since vehicle manufacturers, energy companies, state DOTs, and regional land use planners operate within entirely separate regulatory structures, come from different professional disciplines, and manage for almost separate outcomes, coordination between these groups is extremely difficult.

Lessons from Abroad: Thinking Like a System

While more advanced economies can significantly reduce GHG emissions from mobile sources through technological innovation, the situation is different in developing regions. Emerging economies where motorization is just getting underway have limited ability to reduce GHG emissions from fuel- and vehicle-based strategies alone. In these societies the most promising strategy for improving transportation efficiency appears to be in system development and management, also known as sustainable transportation systems or simply sustainable transport.

Except for a few island nations, climate protection is not a policy priority in the developing world. Development of reliable transportation systems is the overriding priority. Yet, sustainable transport is the "horse" that can pull the climate "cart" (Schipper, 2005). The three pillars of sustainable transport are environmental protection, with a focus on safety, public health, and air pollution; social equity, to ensure reliable access for the poor, nondrivers, and all races and genders; and economic sustainability, creating a level playing field for all modes and producing financially sustainable public and private operators.

Many of the strategies to reduce GHG emissions are the same as those that lead to economically, socially, and environmentally sustainable transport services. The challenge is to identify these strategies and to create the effective governance structure with clear laws to implement and enforce them.

Establishing sustainable transportation systems is not easy. Developing economies, by their very nature, have relatively undeveloped and uncoordinated transportation infrastructure. Management of the infrastructure that does exist is often chaotic. In these countries, avoiding the GHG emissions that have not yet occurred is the best GHG reduction strategy (Mehndiratta, 2005; Schipper, 2005). This can be advanced through improved system planning, design, development, finance, and management (Bleviss, 2005). The key is to blend climate protection into locally relevant issues such as public transport, congestion, local air quality, and urban livability.

The demographic shifts of developing economies support transportation policies that have climate benefits. As these economies grow people migrate to urban areas, causing stress on underdeveloped public infrastructure. In Asia alone, at least seven cities—Jakarta, Shanghai, Hyderabad, Bejing, Tokyo, Seoul, and Bangkok—will have populations exceeding 10 million by 2015 (Mehndiratta, 2005). The population densities in these cities are so high that meeting transportation needs through automobiles is not feasible. Sustainable transportation systems are needed to improve air quality and reduce traffic congestion and fuel costs. Air pollution from dirty, two-stroke motorbikes and old vehicles is an acute problem. Congestion cripples economic development and fuel costs are a burden on fragile economies. The public benefits associated with sustainable transportation systems are therefore more tangible in developing as compared to developed economies. Climate change prevention is simply a beneficiary of these efforts.

Examination of the Latin American and Caribbean region offers an opportunity to study a system development and management approach for transportation and climate planning. According to Bleviss (2005), to be successful, such an approach must include decentralization of transportation system management from the federal to the regional and local levels; regional transportation planning capacity; land use and urban development planning that is effective at, for instance, eliminating the barriers to mixed use developments at transit nodes; mixed transportation structures that include bus rapid transit, nonmotorized transport, and consolidation of redundant private taxi and minibus fleets into efficient publicly regulated and scheduled routes; and transportation demand management measures at the project level.

The focus of multilateral aid, according to Bleviss (2005), should be on medium-sized cities that reflect these transportation characteristics and have the financial ability to build and manage their transportation systems. Cities in Latin America that have achieved success with this model include Bogota, Colombia; Curitiba, Brazil; and Cuenca, Ecuador.

Mediating organizations exist to facilitate collaboration between developed and emerging economies in reducing transportation energy use and GHG emissions. The Global Environmental Facility (GEF) provides public funding for environmentally sustainable transportation projects funded by the World Bank, regional development banks, the UN Development Program, and the UN Environmental Program. However, an early GEF focus on hydrogen-fueled buses has failed to yield any net GHG emissions reductions (Hook, 2005). Bleviss suggests that similar one-shot funding of NMT and BRT projects have yielded few positive GHG emissions results, and in some cases the results have been negative.

Successful projects require integrated, coordinated action. In Bogota, Colombia, a coordinated program to integrate NMT and BRT projects, coupled with a campaign to dampen growth in motor vehicle use, has proven effective.

The clean development mechanism (CDM) provides a method for governments that are signatories to the Kyoto Protocol and private CO_2 emitters to secure credits toward their GHG reduction targets. This is done by funding clean transportation projects in the developing world. However, the effectiveness of the CDM to reduce transportation-related GHG emissions is hampered by difficulties in establishing a baseline from which additional, or surplus, GHG emissions are calculated for credit. Determining the price of carbon credits is another challenge. No transportation project has yet qualified for CDM credits, and only three transportation projects are in the CDM pipeline, including the Bogota TransMilenio project (Winkelman, 2005).

The project-level focus of the CDM cripples its utility as a transportation-related GHG reduction strategy. Winkelman (2005) argues the CDM mechanism would be much more effective in reducing transportation emissions in developing countries and regions if CDM credits could be given for sectorwide transportation policies such as travel demand reduction, smart growth, renewable fuel standards, and fuel economy regulations. He suggests that this change be made if and when the Kyoto Treaty is renegotiated.

Overall, the key lesson learned from presentations on developing economies is that these areas face unique development challenges that require unique transportation solutions. While rapid mobilization will occur, population densities are already so high that a systems approach is the only feasible strategy for meeting transportation needs. This provides significant opportunities to control GHG emissions through a focus on preventing the emissions that don't yet exist. While climate change is of marginal concern in most developing economies, other considerations such as air quality, congestion, fuel costs, and social equity can drive transportation investments that support energy efficient and climate friendly outcomes.

The final session of the conference revisited barriers to, and opportunities for, implementing transportation energy and climate strategies in combination. Such combined strategies are beginning to appear in Europe under the label of integrated transportation strategies and are primarily promoted as a scheme for addressing congestion where road expansion is not feasible. The most visible example of integrated transportation strategies in operation is the London congestion-pricing scheme where cordon fees, parking restrictions, and increased transit service levels are applied in combination to achieve the desired reduction in congestion. This scheme has reduced car trips by 20 percent with resulting energy and climate benefits. While not expressly labeled as such, the Bogota, Colombia, TransMilenio project that includes bus rapid transit and nonmotorized transport improvements to provide better access to transit, and demand management in the form of auto-free zones, parking reforms prohibiting parking cars on sidewalks, and car-free days is another example of a combined strategy that has reduced congestion and increased access for the transit-dependent, while also yielding transportation energy and climate benefits (Hook, 2005).

Conclusion: Toward a Policy Agenda for Climate Change

Participants at the Asilomar Conference sought to explore the outlines of a policy agenda that would allow the transportation sector to reduce transportation-related GHG emissions. With climate science models suggesting that carbon dioxide and other greenhouse gas emissions must be reduced 50 percent or more from baseline projections by 2050 to stabilize atmospheric carbon dioxide levels at twice preindustrial levels, what is the role and responsibility of the transport sector? Can this 50 percent goal be achieved? The unique characteristic of this book and the Asilomar Conference was the careful examination of a wide variety of possible strategies by a wide range of experts and leaders. Many examples were discussed, including efforts by individual companies such as FedEx and Kinkos to reduce GHG emissions from their transportation activities, the novel memorandum of understanding between the government of Canada and the auto manufacturers to voluntarily reduce GHG emissions from their vehicle product lines, and introduction of low-carbon fuels by energy companies. Likewise, the commitment of infrastructure suppliers such as the New Jersey DOT to build and manage more energy-efficient transportation systems, and a renewed commitment by regional agencies to growth management, provide another set of initiatives.

At the intersection of these three public and private groups—transportation and energy providers, infrastructure builders and managers, and land use planners and decision makers—lies the real responsible party, the consumer of transportation services. Ultimately it is personal behavior—the way we access transportation services and the way we settle upon the land—that dictates the actions of energy and transportation providers. Since virtually every citizen is a transportation planner and decision maker in meeting his or her transportation needs, the challenge of climate change can only be addressed by broad public participation in changing energy use and travel behavior.

Acknowledgments

The author wishes to thank John E. Johnston, Planning Executive, ExxonMobil Research and Engineering Company and Jamie Knapp, Principal, J Knapp Communications, for their help in the development of this chapter. Any error in representing the views of the various presenters is the author's sole responsibility.

References

All presentations that were made at the 10th Biennial Asilomar Conference, 2005, can be accessed at http://www.its.ucdavis.edu/events/outreachevents/asilomar2005/.
An, F. Presentation at tenth Biennial Asilomar Conference, 2005.
Bleviss, D. Presentation at tenth Biennial Asilomar Conference, 2005.
DeCicco, J. Presentation at tenth Biennial Asilomar Conference, 2005.
Dumas, A. Presentation at tenth Biennial Asilomar Conference, 2005.
Eggar, D. Presentation at tenth Biennial Asilomar Conference, 2005.
Ewing, R. Presentation at tenth Biennial Asilomar Conference, 2005.
Garry, G. Presentation at tenth Biennial Asilomar Conference, 2005.
German, J. Presentation at tenth Biennial Asilomar Conference, 2005.
Grundler, C. Presentation at tenth Biennial Asilomar Conference, 2005.
Hirsch, R. Presentation at tenth Biennial Asilomar Conference, 2005.
Hook, W. Presentation at tenth Biennial Asilomar Conference, 2005.
Jackson, M. Presentation at tenth Biennial Asilomar Conference, 2005.
Johnston, J. Presentation at tenth Biennial Asilomar Conference, 2005.
Kesghi, H. Presentation at tenth Biennial Asilomar Conference, 2005.
Kurani, K. Presentation at tenth Biennial Asilomar Conference, 2005.
Lomax, T. J., and D. Schrank. "The 2005 Urban Mobility Report." Texas Transportation Institute, May 2005.
Mahoney, J. Presentation at tenth Biennial Asilomar Conference, 2005.

Mehndiratta, S. Presentation at tenth Biennial Asilomar Conference, 2005.
Miller, C. Presentation at tenth Biennial Asilomar Conference, 2005.
Reilly-Roe, P. Presentation at tenth Biennial Asilomar Conference, 2005.
Rubin, E. Presentation at tenth Biennial Asilomar Conference, 2005.
Schipper, L. Presentation at tenth Biennial Asilomar Conference, 2005.
Sloane, C. Presentation at tenth Biennial Asilomar Conference, 2005.
Toth, G. Presentation at tenth Biennial Asilomar Conference, 2005.
U.S. Energy Information Administration (EIA). *Annual Energy Outlook: 2004.* Washington, D.C.: EIA, 2005.
Winkelman, S. Presentation at tenth Biennial Asilomar Conference, 2005.
World Resources Institute. Climate Analysis Indicators Tool (CAIT), version 3.0. Washington, D.C.: World Resources Institute, 2006. Available at www.cait.wri.org.