CHAPTER 1

Introduction and Overview

Dan Sperling, Institute of Transportation Studies, University of California, Davis, and James S. Cannon, Energy Futures, Inc.

Climate policy was center stage as government officials from more than 150 countries converged on Montreal in December 2005 for the eleventh meeting of the United Nations Framework Convention on Climate Change (UNFCCC). It was the largest intergovernmental climate conference to date, with over 10,000 participants in attendance. More than 40 actions strengthening global efforts to fight climate change were endorsed at the conference (UNFCCC, 2005).

Although a significant event, the Montreal meeting was neither the first nor the most important international meeting on climate change, and it certainly won't be the last. As far back as 1992, voluntary reductions in emissions of heat-trapping greenhouse gases (GHG) were endorsed by delegates from 189 countries at an international conference held in Rio de Janeiro, Brazil. Then in 1997, as part of the Kyoto Protocol, these voluntary reductions were replaced by a set of mandatory emission reduction targets for developed nations.

The Kyoto Protocol formally went into effect in February 2005 after countries contributing 55 percent of all GHG emissions had finally approved the Protocol (with Russia's approval pushing it over the threshold). Every rich country in the world adopted the Protocol except the United States and Australia. While opposition by the United States, the world's largest GHG emitter, was hugely unpopular in Europe, it was indicative of withering enthusiasm for the Protocol itself.

The program of international diplomacy and mandatory GHG reductions created by the Kyoto Protocol is the most comprehensive response to date, but not the only one. Overall, the global political commitment to GHG reduction is clearly growing. Within the United States, growing

numbers of cities, states, and corporations are embracing strategies to reduce GHGs. Nearly every developed nation is now making an effort to address GHG emissions.

Emissions continue to grow, however, not only from the United States and developing countries but also Kyoto signatories. Indeed, the Kyoto Protocol imposes no penalties for noncompliance and provides many opportunities to buy compliance without making any effort to actually reduce emissions. Russia, for instance, with the collapse of its economy since 1990 and corresponding drop in energy use, is allowed to sell these unearned credits to others. And giant developing countries such as China and India have no responsibilities under the Protocol.

As the political wheels spin, scientific evidence continues to mount, suggesting that impacts on Earth's climate from GHG emissions, mainly from the burning of fossil fuels, is likely causing significant shifts in climate. As the Montreal meeting was winding down in December 2005, new independent scientific assessments by the U.S. National Oceanic and Atmospheric Administration and the United Kingdom Meteorological Office concurred that the eight hottest years in more than a century of record keeping have occurred in the last decade. Analyses at the Center for Atmospheric Research in Colorado concluded that 75 percent of the 4 million square miles of permafrost in Arctic regions could melt in the next century, and a multinational assessment predicted an almost complete melting of the Arctic ice cap each summer in this century.

The Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2001), representing the consensus opinion of 1,500 scientists, in its most recent report concludes that Earth's climate system has demonstrably changed on both global and regional scales since the preindustrial era, and that there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities. Scenarios based on a range of climate models point to an increase in globally averaged surface temperatures of 1.4° to 5.8°C over the period 1990 to 2100.

Despite the mounting scientific evidence of warming and melting ice, the exact scientific connections between increased GHG emissions and climate change remain uncertain. It is not clear how much, how fast, and where the climate will change, but it is becoming increasingly certain that there is a connection—and that transportation is a major source of those GHG emissions.

Transportation is the largest source of GHG emissions in the United States and is the sector where GHG emissions are growing the fastest. Nearly all transportation emissions stem from the burning of petroleum-derived gasoline and diesel fuel.

Against this backdrop, 200 climate change leaders assembled at the Tenth Biennial Conference on Transportation Energy and Environmental Policy at the Asilomar Conference Center in August 2005 to address what

could or should be done to reduce emissions from the transport sector. This book, which emerged from that conference, addresses strategies and policies to reduce GHG emissions from transportation.

Almost all programs currently under way to reduce GHG emissions from transportation are incremental. They are mostly aimed at reducing fuel consumption by vehicles. Their modest goal is to stem the tide of growing GHG emissions. They are not aimed at transforming our transport and energy systems or altering travel behavior and land use development. But if climate models are right and carbon dioxide concentrations must be stabilized, even at twice preindustrial levels, then emissions will need to be reduced by one third from projected growth by 2050, and by 90 percent by the end of this century.

The long-term solution to climate change will most likely involve a complete transformation of the energy sources used to propel human society. This will include elimination of most carbon-containing fossil fuels, capturing and sequestering carbon from the remaining fossil fuels, and a more efficient use of energy. A global shift to hydrogen is one possible long-term solution to climate change. It was the subject of the previous book in this series, *The Hydrogen Energy Transition* (Sperling and Cannon, 2004).

In this book, and at the conference, we take a first step toward developing a strategy for the transport sector. What is the role of technology versus behavioral changes? Are entirely new technologies needed? What type of research is needed, and by whom? What is the role of transportation vis-à-vis other sectors? Which policy instruments might be most effective, and which might be most acceptable? Definitive answers are not possible at this time. They may never be—but we make a strong beginning.

The authors in this book identify and discuss promising programs and policies. They address the many opportunities to reduce emissions. They address new and improved vehicle technologies and low-carbon fuels; international programs that refocus mobility on efficient mass transit and walking and bicycling; innovative urban planning that leads to less fuel consumptive lifestyles; and the role of public involvement.

GHG Emissions Headed in Wrong Direction

Despite a variety of political commitments around the world to reduce CO_2 emissions, including the Kyoto Protocol, emissions continue to increase. The majority of GHG emissions occur in the form of carbon dioxide (CO_2), and most CO_2 emissions are the result of the combustion of fossil fuels. According to official U.S. government sources, global CO_2 emissions grew from 21.4 billion metric tons in 1990 to roughly 26 billion tons in 2004, and they are expected to increase another 50 percent by 2025, an annual increase of 2 percent per year (EIA, 2005). Table 1-1 charts this real and projected global growth in CO_2 emissions, including those of the world's five leading emitters.

TABLE 1-1. World Carbon Dioxide Emissions: 1990–2025 (Billion Metric Tons Per Year)

	1990	*2002*	*2010*	*2015*	*2020*	*2025*	*Annual % Change 2002–2025*
Total World	21.4	24.4	30.0	33.0	35.6	38.4	2.0
United States	5.0	5.7	6.4	6.7	7.1	7.6	1.2
China	2.3	3.3	5.5	6.5	7.4	8.1	4.0
Former Soviet Union	3.8	2.4	2.8	3.0	3.2	3.4	1.5
India	0.6	1.0	1.4	1.6	1.8	2.0	2.9
Japan	1.0	1.2	1.2	1.2	1.2	1.2	0.2

Source: EIA, 2005.

TABLE 1-2. U.S. Carbon Dioxide Emissions by Energy Sector: 1990–2004 (Million Metric Tons Per Year)

	1990	*1998*	*2002*	*2004*
Total U.S.	5,002	5,598	5,809	5,973
Transportation	1,570	1,758	1,865	1,934
Industrial	1,692	1,791	1,671	1,730
Residential	954	1,089	1,190	1,212
Commercial	781	934	1,020	1,024

Source: EIA, 2005.

Table 1-1 shows that the United States is by far the world's leading CO_2 emitter, accounting for about 27 percent of the total. It also shows great projected emission growth among the developing nations in the next two decades, with China projected to eclipse the United States before 2020. The United States, however, will remain far ahead of all others in emissions per capita into the foreseeable future.

Transportation is the largest and fastest-growing source of CO_2 in the United States among all energy sectors. No approach to climate change prevention can be comprehensive without a major focus on transportation. In the United States, transportation accounts for about one third of all emissions (see Table 1-2). Since 1990, transportation emissions have grown at an annual average rate of 1.5 percent, and that rate is not diminishing.

Most of the emissions come from cars and trucks burning petroleum fuels. Sixty percent of transportation CO_2 emissions results from gasoline combustion in cars, and 22 percent from diesel fuel combustion in trucks and buses.

The Asilomar Declaration

In summary, GHG emissions are growing, the scientific evidence linking GHG emissions to troubling climate changes is gathering momentum, and the global political response, though strengthening, remains largely ineffective. Transportation is a particularly difficult challenge. Against this backdrop, roughly 200 climate change leaders and experts were invited to focus on the transportation GHG challenge at the tenth Biennial Conference on Transportation Energy and Environmental Policy convened at the Asilomar Conference Center in Pacific Grove, California, August 23–26, 2005.

The three-day meeting featured more than 25 presentations by international leaders and experts from industry, government, academia, and nongovernmental organizations. From the presentations and discussions, 14 chapters were prepared for this book, 12 by presenters and 2 by other participants. Specific session topics at Asilomar included climate change trends and research, CO_2 reduction through new technologies and alternative fuels, options to restrain vehicle travel growth, responses in developing nations, GHG policy instruments, and U.S. GHG reduction initiatives.

The lively discussions highlighted the lack of a clear consensus, even among experts, about what steps should be taken and when to prevent global climate change. Nonetheless, several threads of agreement surfaced among the experts. These were put into writing and endorsed by participants near the end of the conference. Called the Asilomar Declaration, the agreement states the following three commonly held beliefs.

> ***Declaration 1:*** *It is the consensus of the Tenth Biennial Conference on Transportation Energy and Environmental Policy that climate change is real. Transportation-related GHG emissions are a major part of this global problem, and they must be reduced.*

This initial assertion indicated agreement among the various representatives of the national and international transportation community—practitioners, suppliers, consumers, researchers, policymakers, and advocates—that the time has come for the transportation sector to squarely confront the challenges for reducing GHG emissions.

> ***Declaration 2:*** *U.S. national policy has so far failed to adequately address the role of transportation in climate change. This must be remedied.*

Transportation is a principal contributor to climate change, and transportation infrastructure is threatened by changes in climate. More and better planning is needed to anticipate and respond to changes in climate. That is a challenge for the traditional transportation infrastructure community. But of greater concern is how to reduce GHG emissions—and, for additional reasons, oil use. Sometime in the near future, most likely

between 2010 and 2020, world conventional oil production in non-OPEC countries will peak, even as demand for oil, especially for transportation, continues to climb. New transportation fuels and new fuel technologies are needed to deal with the resulting shortfall. These new technologies require long lead times, often in excess of 20 years. While there was not detailed agreement about how and when to proceed, there was agreement that actions to reduce GHG emissions and oil use need to accelerate.

> ***Declaration 3:*** *By judiciously crafting a portfolio of solutions, it is possible to reduce transportation-related GHG emissions, while creating an efficient and effective transportation system for current and future generations.*

Opportunities abound to reduce transportation-related GHG emissions. Reductions can be realized even while increasing people's (and firms') access to goods and services. Opportunities include improved fuel efficiency, improved fuel and vehicle technologies, a more robust mix of transportation fuels, and demand-side strategies that improve the efficiency of the transportation system. These latter strategies include improved land-use planning, tolls and other pricing schemes, greater public investment in alternative modes of travel, consumer incentives, improved system integration, and mobility management. These many strategies for improving the transportation and energy systems are pursued in isolation from each other and are relatively ineffective, especially in the United States. There is an increasing urgency to pursue those that are most effective and beneficial.

The underlying issues and insights that led to the Asilomar Declaration are addressed within this book. The book is organized into five groups of chapters:

- Global oil and climate change
- Policies to reduce transportation GHG emissions
- International GHG reduction programs
- Public opinion and climate change issues
- Conclusions

The first two chapters that follow this introduction address the global trends in oil and climate change. World oil demand is expected to grow more than 40 percent by 2025. It is highly questionable today whether global production can expand even to meet this relatively short-term increase in demand before it reaches its peak output.

There exists no silver bullet for reducing petroleum fuel use in transportation, or for the resulting GHG emissions. There are, however, policy measures available to encourage the production, purchase, and use of more fuel efficient vehicles, as well as reduce driving. Speakers at Asilomar presented an encouraging array of fiscal and regulatory strategies that could be applied in the United States and elsewhere to displace petroleum

consumption in transportation and flatten the current GHG emissions trajectory. Three chapters discuss policies to reduce transportation GHG emissions.

While oil use in industrialized countries is growing by only 1 percent per year, it is growing by 6 percent annually in Africa, Asia, and Latin America. Climate change is not a binding concern in those regions, but all face escalating oil imports, air pollution, road construction costs, and traffic congestion. Efforts to address these other challenges also address climate change. Three chapters in this section of the book examine the cobenefits for climate change of creating better transportation systems.

The next section of the book includes three chapters discussing public opinion and climate change issues. Consumer behavior and public attitudes can inhibit or accelerate the use of energy and emissions of GHGs. But the public remains startlingly uninformed about climate change policy choices, and researchers and policymakers have only a weak understanding of consumer behavior. It is becoming increasingly clear that transportation has symbolic meaning to consumers beyond its utility in providing access to goods and services. How might behaviors and attitudes shift in ways that influence climate change, and what is the role of policy?

Finally, the book concludes with a summary chapter. It builds on the Asilomar Declaration in which the participants agreed that global climate change is real and that it is possible to reduce transportation-related GHG emissions while creating an efficient and effective transportation system. It notes that most transportation innovations have come about in response to policy objectives unrelated to climate change. That is not surprising. Large uncertainties continue to surround climate change, and politicians are accountable to local and national constituencies. But circumstances are changing. The science of climate change is improving. Climate change is becoming a public issue. And politicians and the general public are beginning to appreciate the links between oil imports, global tensions, and climate change. This book provides insights into the messy process of reducing GHG emissions from transportation without sacrificing quality of life.

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