Global Energy and Climate Change:

The Transportation – Land Use – Environment Connection

UCLA Lake Arrowhead Conference Center
Lake Arrowhead, California
Sunday afternoon, October 22nd through
Tuesday morning, October 24th 2006

Foreword

This report is a summary of proceedings from a prominent policy and research symposium on **Global Energy and Climate Change**, held October 2006 at the UCLA Conference Center in Lake Arrowhead, California.

UCLA Extension Public Policy Program convened the symposium, which was the sixteenth in an annual series created to address the importance of ***The Transportation, Land Use, and Environment Connection***. Each year a specific focus is selected for detailed examination of the interrelationships among these three areas. The goal of this year's topic was to examine the use of energy resources in regards to transportation and land use, linking those uses to changes in our climate on a global scale.

The core of the program focused on the following topics:

- Energy and climate change implications for public policy
- Links of global climate change and land use/transportation
- How businesses view uncertain energy and climate futures
- Global energy reserves, usage, and prospects
- Near and long term possibilities of future fuels and vehicles
- Roles of alternative fuels and propulsion
- Transportation energy and greenhouse gas emission planning outside of the U.S.
- Reponses to global energy and climate issues in Sacramento and Washington
- Local to international efforts linking decision-making to global energy/climate issues
- Making wise policy under uncertain conditions

To ensure that the symposium identified with the needs of policymakers, practitioners, and researchers, the program was developed with the considerable help and underwriting from numerous sponsoring and cooperating agencies and organizations. These include governmental, business, environmental, and public interest groups (Appendix D). They deserve special recognition for their personal and organizational investments in the program, most as part of the Arrowhead Steering Committee.

I gratefully acknowledge the collaborative partnership that is fostered between UCLA Extension and the UCLA Institute of Transportation Studies in convening this annual symposium series. The diligent and thought provoking contributions of co-chair Brian Taylor, Associate Professor and Vice Chair, Urban Planning, UCLA School of Public Affairs, and Director, UCLA Institute of Transportation Studies are invaluable.

Thanks are also due to two individuals who prepared this comprehensive proceedings report: Adina Ringler and Michael Smart, both affiliated as graduate students with the UCLA Institute of Transportation Studies.

It is the hope of the symposium organizers that this forum will contribute to ongoing policy dialogue and lead to the introduction of solutions through research and practice.

Catherine Showalter
Director, UCLA Extension Public Policy Program

Introduction

Global Energy and Climate Change, the 2006 UCLA Lake Arrowhead Symposium on *The Transportation, Land Use, Environment Connection*, brought together scientists, researchers, practitioners, and policymakers to discuss the complex relationships between transportation and climate change. No topic is more current or more pressing to address than climate change, so it was appropriate that this year's symposium focused on the relationships between land use, transportation, and green house gas emissions. In the past year, world temperatures have reached record highs, oil prices climbed to new peaks, and the market for clean energy technologies grew dramatically. These trends illustrate both the imperative to move beyond outdated patterns of energy use and the enormous opportunities awaiting enlightened innovators with the courage to pursue new approaches. Visionary leaders are finding exciting new ways to confront these challenges. Many companies and communities are cutting costs with energy-efficiency programs. Municipal leaders are promoting better-designed cities. Investors and entrepreneurs are racing toward alternative fuels and plug-in hybrid engines.

This year, the **Global Energy and Climate Change** symposium discussed specific steps for cutting emissions of heat-trapping gases and shaping a clean energy future. In broad outline, the path is clear: we need to use less energy and find cleaner sources. We need to break down barriers – including lack of information – that slow the adoption of clean energy technologies. We need sufficient funding to bring down costs for clean technologies and polices that promote their adoption. This conference provided an opportunity for such dialogue. It brought together policy-makers and experts in governments, international organizations, industry, research institutes, and municipalities from many countries. Participants explored perspectives on environmentally sustainable transportation; attempted to reconcile goals for transportation, environment, technology, energy, and development; contributed to the development of principles that will guide nations in implementing environmentally responsible transportation programs; and identified policies and measures that should be adopted to achieve sustainable transportation.

The proceedings that follow summarize the discussions that took place during the **Global Energy and Climate Change** symposium. Panelists discussed the nature of the problem, possible solutions and concrete steps that can make a difference. Each of the nine sessions is presented under a separate heading, beginning with synopses of the panelists' presentations and concluding with an account of the discussion period that ended the

session. This report is intended to serve as a reference for those who organized and attended the symposium, but is also available as a resource for anyone interested in these issues.

Symposium Proceedings

Sunday, October 22, 2006

Session I

Energy and Climate Change: Implications For Public Policy

Catherine Showalter (Moderator), Director, UCLA Extension, Public Policy Program
David Menninger, Interim Dean, Continuing Education and UCLA Extension

The opening session laid the groundwork for the wide-ranging three-day symposium which discussed the links between local land use and transportation systems, and global weather systems and energy markets. **Catherine Showalter** and **David Menninger** welcomed the attendees to the 16th Annual Symposium, focusing on Global Energy and Climate Change—a current hot topic in research, policy, and the media. This year's topic brought in new individuals from outside California and from other countries, which contributed to lively discussions and an excellent learning opportunity. The following presentations set the stage for the rest of the symposium with an overview of current scientific evidence on climate change, the role of the transportation sector in energy consumption and atmospheric emissions, a framework for evaluating energy and climate change policies, and strategic political considerations in energy and environmental security.

Debates among scientists who study the effects of human activity on climates, and policymakers seeking both economic growth and environmental sustainability have intensified in recent months as fuel prices have climbed to unprecedented levels. How are fuel prices likely to fluctuate in the years to come? What effects will higher fuel prices have on travel and commerce? What effects do transportation systems have on global climate change? How might changes in climates affect both land development and transportation networks? What, if any, cleaner, cheaper fuels and propulsion technologies are on the horizon? And what are policymakers – local, state, national, and international – doing to cope with these issues in effective and affordable ways?

These and related questions will be answered by a wide variety of experts on these topics, expanding on what we know, what we need to learn, what others are doing, and what is not being done to address changes in global energy markets and climate patterns in the years to come.

Symposium Co-Organizers:
Catherine Showalter, UCLA Extension Public Policy Program

Symposium overview

Brian D. Taylor, Associate Professor and Vice Chair of Urban Planning, UCLA School of Public Affairs; Director, UCLA Institute of Transportation Studies

Taylor gave a thematic overview of the symposium and opened with the familiar saying of, "Think Globally, Act Locally." However Taylor took this saying one step further and challenged audience members to "think globally, act in a considered, consistent, and effective way locally." There are many challenges to this mindset because uncertain futures prompt many questions about current decision-making. And it is these challenges which prompted this symposium to bring together participants from disparate disciplines. Debates among scientists who study the effects of human activity on climates, and policymakers seeking both economic growth and environmental sustainability have intensified in recent months as fuel prices have climbed to unprecedented levels.

An uncertain future prompts many questions about current decision-making. What should transportation, land-use, and environmental analysts and policy-makers know about climate change? Some of the key questions motivating this symposium are:

1. What should transportation, land use, and environmental analysts and policy-makers know about research on global energy markets and climate change?
2. How are projected trends in energy prices and climate conditions likely to affect land use and transportation systems in the coming years?
3. How, in turn, are local, regional, and national transportation, land use, and environmental policies likely to affect (or not affect) global energy and climate changes in the years to come?
4. How are fuel prices likely to fluctuate in the years to come and what effects will higher fuel prices have on travel and commerce?
5. How might changes in climates affect both land development and transportation networks?
6. What, if any, cleaner, cooler, and cheaper fuels and propulsion technologies are on the horizon?
7. What are local, state, national, and international policy makers and analysts doing to cope with these issues in effective and affordable ways?

Our goal is to bring together a wide variety of experts on these topics to speak on and debate – from many perspectives – what we know, what we need to learn, what others are doing, and what is not being done to address changes in global energy markets and climate patterns in the years to come. It is difficult charting the best course into an uncertain future, but we all have a role in linking causes, effects, and public policy into making concrete changes.

This opening session laid the groundwork for the wide-ranging three day symposium. Four presentations will address current scientific evidence on climate change, the role of the transportation sector in energy consumption and atmospheric emissions, a framework

for evaluating energy and climate change policies, and strategic political considerations in energy and environmental security.

Climate change science: What we know and don't know

Thomas C. Peterson, Research Meteorologist, NOAA's National Climatic Data Center

The science behind climate change is rapidly being acknowledged as the most important environmental issue of our time. **Peterson** presented fresh, relevant scientific data and provided context and perspective. His presentation started with defining the climate change issue and set forth powerful evidence that this bout of climate change is not merely part of natural cycles. The majority of scientists now agree that the earth's climate is warming, as indicated by a rise in the average surface temperature of the earth. Warming is thought to be the result of human-generated emissions, principally of carbon dioxide (CO2). Carbon dioxide, like the greenhouse gases methane (CH4) and nitrous oxide (N2O), allows solar radiation to pass through the atmosphere, but prevents surface radiation from escaping to outer space—effectively "trapping" it. This process leads to an overall increase in surface temperature because sunlight warms the surface and gets reemitted as Infrared.

So what is the problem? This natural process has been around for millions of years and is responsible for the earth to be inhabitable. The problem is that these processes are increasing. Humans are responsible for the dramatic increase in CO2. The observational evidence for positive climate change is circumstantial but extensive; direct measurement has established that atmospheric carbon dioxide levels have increased since the industrial revolution and the related surge in fossil fuel consumption. Global temperatures are up 0.7 - 1.4 degrees F over the past 100 years. Glaciers are retreating world wide. Sea level has risen 4 - 8 inches due to thermal expansion.

Peterson pointed out many common misconceptions about climate change. He began with the common misconception that solar variations are responsible for global warming. Satellite measurements (late 1970s) show no appreciable changes in total solar output at time of rapid global temperature increases. However, consistent with the warming is evidence of:

- Glacial retreat
- 10-15% reduction in Arctic sea ice extent (1970s)
- Snow-cover decrease (10% since 1970s)
- Freeze-free periods lengthened (20th century)
- Sea-level increased 4-8 inches (since 19th century)
- Lake and river ice shortened season (~ 2 weeks, 19th to 20th century)

Global warming does not change the variability we have in climate, but on average it is getting warmer, as documented by satellite data. Observed changes and predictions in weather patterns include heavy precipitation, tropical storms, and drought. Transportation is particularly sensitive to changes in extremes. Some impacts will be negative, such as increased potential for rail track buckling, and some impacts will be positive, such as the likely opening of the Northwest Passage. In all cases, planning that considers climate change will be important.

Transportation, energy, and emissions: An overview

George Eads, Vice President, CRI International

Eads began his presentation with an overview of the amount of energy consumed by the transport sector. Each of the four sectors of the U.S. economy — industrial, commercial, residential, and transportation — is responsible for a significant share of national emissions. All of these sectors are heavily reliant on energy derived from fossil fuels, which emit CO2. The United States produces one-quarter of the world's global greenhouse gas (GHG) emissions. The transport sector is a very large user of energy and one of the largest emitters of CO2. In 2002, the transportation sector accounted for 26 percent of all energy consumed and was responsible for 21 percent of all CO2 emissions; this number is expected to rise to 29 percent for energy usage in 2030 and 23 percent for CO2 emissions. This makes American transportation a substantial factor in the global climate change equation and, as such, one of the primary targets of any comprehensive emissions reduction strategy.

Surface transportation includes cars, trucks, buses, trains, and ships, all of which rely predominately on fossil fuels. With growth in the economy overall, activity in the transportation sector has grown as well, resulting in a steady increase in the number of vehicle miles traveled in passenger and freight vehicles over the past two decades. Well over 90 percent of transport fuels are oil-based. Three transport modes account for about 80 percent of all transport energy use: air, freight trucks, and light duty vehicles (LDVs). The same three modes also account for about 80 percent of transport vehicle CO2 emissions. At present, the Organisation for Economic Co-operation and Development (OECD) countries are responsible for nearly 70 percent of transport energy use, but this will change as developing countries grow. The principal driver of transport energy and transport CO2 growth has been – and will continue to be - growth in the demand for personal and goods transport services. Personal transport demand is predicted to grow substantially in India, China and Latin America. The personal transport demand projections do not imply private motorized vehicle ownership rates typical of OECD countries; nor do they imply personal transport levels per capita that are equivalent to today's OECD country levels.

The projections of personal and freight transport activity for 2000-2050 show that personal and freight transport activity will both grow, with expansion being especially rapid in certain parts of the developing world. However, these projections also demonstrate that the growth will not be adequate to provide the average citizen of some of the poorest developing nations and regions with mobility opportunities that are in any sense comparable to those experienced today by the average citizen in the developed world. This disparity is referred to as the "mobility opportunity divide." **Eads** believes that this mobility opportunity divide must be narrowed. This statement does not imply that the average African should travel as many kilometers each year as the average American or European. The mobility opportunity divide will cease to exist when people everywhere have comparable opportunities to "move freely, gain access, communicate, trade, and establish relationships."

Eads provides a rough sense of the present magnitude of the mobility opportunity divide and how it may evolve if present trends continue. By 2050, Eastern Europe and the Former Soviet Union will have closed the gap with OECD Europe and OECD Asia in terms of personal mobility opportunities. Latin America will show a significant narrowing of its gap. But per capita travel by the average inhabitant of Other Asia, India and the Middle East will remain at about 20 percent of the OECD Europe/OECD Asia level. Annual travel by the average African in 2000 was only 13 percent of the annual travel of the average inhabitant of OECD Europe/OECD Asia, and this number is expected to decline by 2050 to 8 percent. In other words, for the average inhabitant of Africa and the Middle East, the mobility opportunity divide is projected to widen. These growth rates also imply growth for future income levels.

To obtain a sense of the potential impact of various technologies and fuels in reducing transport-related GHG emissions, **Eads** showed a number of simulations. He began by examining the impact of single technologies on worldwide road transport CO2 emissions. Such technologies included – dieselization, hybridization, fuel cells, "carbon neutral" hydrogen, and biofuels. This exercise was intended to help understand the impact on GHG emissions from road vehicles if such technologies were implemented.

From this single technology assessment it is evident that even if implemented worldwide, diesels and hybrid ICEs fueled with conventional gasoline and diesel fuel, or fuel cells fueled by with natural gas-derived hydrogen, can no more than slow the growth in road transport CO2 emissions during the period 2000-2050. Only the use of carbon-neutral hydrogen in fuel cells and advanced befouls in ICE-powered vehicles can largely or totally offset the growth in CO2 emissions produced by the growth in road travel during the period 2000-2050.

This does not mean that vehicle energy use characteristics are irrelevant. They may not have a major impact on the trajectory of road vehicle GHG emissions over the very long term, but they *will* have a major impact on the amount of low-carbon or carbon-neutral fuel that must be produced to power the world's road vehicle fleet. This means that they can have a very important impact on the *cost* of significantly reducing GHG emissions from road vehicles. Based upon these results, **Eads** concludes that it will only be through a combination of fuel and powertrain solutions that significant CO2 reduction will be attained. No single technology pathway stands out enough to compel its selection as the sole long-run solution.

Eads concludes with four observations:

1. Growth in demand for transport services (personal and freight) has been the primary driver of transport energy demand and transport-related GHG emissions. Demand for transport services will continue to grow as incomes grow. The rate of growth of demand for transport services is not immutable, but shouldn't underestimate difficulty of change.
2. Eventually, transport must be largely eliminated as a significant source of GHG emissions. To do this, transport GHG emissions must be decoupled from transport energy use; requires renewables and/or carbon sequestration of emissions from production of synthetic fuels.

3. Transport energy use is likely to grow more rapidly than demand for transport services due to the increased energy requirements of producing carbon-free transport fuels.
4. In the very long run, transport vehicle energy efficiency is likely to become virtually irrelevant to transport GHG emissions; it will only determine the amount of carbon-free transport fuel that must be produced.

Evaluating the costs and benefits of energy and climate change policies: An overview

Joe Aldy, Fellow, Resources for the Future

Environmental protection and economic progress are critical to California's thriving future. The purpose of this panel is to discuss how to create market-based solutions that are equitable and effective in reaching aggressive climate change emission targets. The relationship between economic development and energy consumption is important in the context of a number of pressing policy issues. The increasing demand for energy as economies develop can influence when the world's oil production may peak. Growing energy consumption also poses a variety of public health and environmental risks that can spur government and market actions to modify the fuel mix and adopt new emissions control technologies. As economic growth encourages greater fossil fuel combustion, the increase in carbon dioxide (CO_2) emissions can exacerbate the risks of global climate change.

Aldy discussed the costs and benefits of energy and climate change policies. A benefit-cost analysis provides a framework for evaluating policies to address climate change. In order to balance the benefits and costs of mitigating climate change risks, it is necessary to analyze the incremental benefit of mitigating the last ton of greenhouse gas (GHG) emissions. This effort should equal the incremental cost of that mitigation. It is important to recognize that some additional climate change will occur in the future. **Aldy** then introduced the concepts of a spatial scale and temporal scale. When looking at the problem spatially, a ton of GHG emitted in Boston has the same climatic impact as a ton of GHG emitted in Beijing. This is an example of a global public good—benefits of mitigating emissions are global but costs of mitigation are local. When looking at the problem temporally, GHG emissions today could remain in the atmosphere for hundreds to tens of thousands of years. Mitigating emissions today delivers benefits well into the future but imposes costs on the present. Most benefits of mitigating GHG emissions occur in the distant future. This makes policy changes especially difficult when forecasting for the next 100 years. Problems 100 years ago were very different from the problems we have today. Hence, there are many challenges in monetizing impacts identified by natural scientists and it is difficult to forecast out into the future.

The distribution of impacts will be felt mostly in the developing countries, with the biggest temperature and weather changes. Distributional impacts may present challenges in Africa, Latin America and small islands, which have the least capacity to adapt to climatic changes. The rapid rate of change in developing countries is occurring without enough time for adaptation, whereas more developed countries have a higher capacity to adapt to climate change. This uncertainty commands action now.

Aldy then discussed the determinants of costs and went over several different scenarios, including: business-as-usual emissions; substitution to carbon-lean fuels; improving the efficiency of energy consumption; technological change; and designing the optimal policy portfolio. With business as usual forecasts, carbon emissions continue increasing to 2030. **Aldy** then examined a substitution to carbon-lean fuels. The costs will be lower the easier it is to switch to low-carbon energy, such as changing electricity production from coal and gas to renewables and nuclear. For the transportation sector, there are few substitutes for petroleum. Improving the efficiency of energy consumption can be reflected in prices and information. Consumers care about more just energy expenditures associated with products they buy. Technological change also holds great potential for research and development (R&D) in the future. Promoting technological development can help to ensure that zero-carbon technologies are feasible and cost-competitive in future.

Aldy's conclusion called for the need for well-designed, cost-effective policies, which can send price signals that spur technology diffusion and development and lower emissions. It is important to understand the cost of mitigation to design the next track of policies.

Global Politics of Energy and Environmental Security: An Assessment

Jason Grumet, Executive Director, National Comission on Energy Policy

Each of the major fossil fuels - oil, natural gas, and coal - faces significant challenges and presents interesting opportunities. World energy markets experienced turmoil in the past year. With global demand growing sharply and fears of instability among key suppliers, oil prices soared. The deepest impact was felt in poor countries. Energy prices and the physical security of energy supplies were top priorities for political leaders in many countries.

The U.S. is the top world oil consumer and accounts for 25 percent of global consumption. Saudi Arabia and Russia are the top world oil producers. The U.S. is the third largest producer, but only has 3 percent of world's proved reserves. Ninety seven percent of U.S. transportation is petroleum dependent. From an economic standpoint, it has nothing to do with where the oil comes from, but it has to do with how much oil we use. In order to improve oil security, three steps are necessary: 1) improve the reliability and resiliency of the global oil supply chain; 2) dramatically improve transportation efficiency (fuel economy); and 3) diversify transportation fuels.

Grumet emphasized that it is important to look at the supply side quotient. He stated that a barrel of oil produced is not the same as a barrel of oil saved. A barrel saved is worth about four times as a barrel produced. We have to think in terms of the global market. It is necessary to hold oil consumption constant while our economy grows in order to make ourselves more resilient to oil price shocks. In order to achieve these successes, it is necessary to displace 8 thousand barrels per day (MBD) of oil by 2030. Improved efficiency by 2025 must be placed on heavy-duty trucks, passenger vehicles and delivery trucks. It is necessary for the fuel economy to improve by four percent a year.

Alternatives to conventional oil include hydrogen, unconventional oil, coal to liquids, traditional ethanol, and cellulosic beffouls. These alternative fuels are ways to substantially increase our fuel economy through the diversification of our fuel supply. In terms of Climate Change, **Grumet** believes technology is the answer. The question is who pays to accelerate technology development and deployment. It is necessary to combine a long-term market signal and technology incentives.

Discussion

Lee Schipper began the discussion with what he cautioned to be a sensitive and political question. He asked if there are any prominent scientists left who do not believe that the warming is anthropogenic? **Peterson** answered yes, there are a number of people who still disagree, but they're not working in this field. They've got a history like John Christie who was a missionary in Africa during the oil embargo. However, **Peterson** was not concerned with this small group of people. There are very few scientists who say it's not anthropomorphic and the people who do are a small minority and aren't working in this field.

Michal Moore noted that MCAR had a model which predicted the jet stream shifting off to the east as a result of global warming. His question was about the modeling used to make these long-term predictions. Were they similar to MCAR and did they look at long-term shifts where rainfall is being dumped? What about temperature regime changes? **Peterson** answered that changes in weather patterns will affect wave patterns – but since he is not a modeler, this is not his area of expertise and he is not familiar with that particular study. He noted there was increased precipitation seen in Alaska in most models, but other models showed great variation in all other areas of the USA.

The next question was regarding recent TV specials on this issue of global dimming. Global dimming is when the particulate matter in the air (from air pollution) actually reflects sunlight. It is hypothesized that global dimming could be viewed as a mitigating factor to global warming, and if particulate matter is reduced, it will accelerate global warming. **Peterson** addressed this question by stating that he is not an expert on global dimming. He is not sure what affect this will have on global warming predictions.

Axel Friedrich disagreed with some of the points in the second presentation. He stated that it was virtually impossible to have these technologies in 30 years. Therefore, efficiency is necessary, even if you get the carbon out of the fuel. Efficiency has to be the number one priority.

Norm King asked a clarification question to **Eads**. He didn't understand what was meant by it taking about ½ gallon of oil to produce corn, which uses a lot of fertilizers and pesticides. Have you taken into account these additives and their environmental effects? **Eads** responded that there is a lot of argument over the oil displacement effect of biofuels. All of these synthetic fuels take energy to make. However, it is energy of a different sort. They use more energy, but essentially you're still displacing oil.

Steve Brye asked about a simulation that showed the effects of changing different types of fuels. His question was what if people drove less? Wouldn't that be another option and how come it is not presented in the slide? **Eads** answered yes, it would change things. However, the simulation was just meant to show what would happen if we changed the propulsion. It is also important to work on the demand for transport side. The answer lies in a combination of technologies, fuels and demand management.

Dave Souten brought up a question regarding energy efficiency over the past 20 years. He noted that it has been getting better and then flattening out – what are the causes? **Eads** responded that there are two primary causes: increased fuel economy and pushing oil out of power generation. He says that is it necessary that we focus on transportation and fuel economy. We would have to roughly double our fuel economy to have the same effect that we had 20 years ago.

Roland Hwang asked a question about energy security in the next two years in Congress. He stated that there have been a lot of predictions and climate will be a real driver for the energy debates in 2008, especially since oil prices have gone down. **Hwang** asked **Eads** what he sees as the interplay with energy policy and climate change. **Eads** responded that this was a very insightful question. Oil is dominated by national security concerns. Substantively, we need to keep energy policy and climate change totally together. However, politically, we keep them totally apart. The political issue is more potent than the climate change approach. Environmental concerns are important, but security is huge. So we might build a coalition on oil separately than on climate change. Because of this separation, different people line up for both of those causes. Oil intensive industries and the military care a lot about oil security but so does Dominoes Pizza for delivery; they want increased efficiency as well. This brings more people into the debate so they might be one coalition.

The Honorable Christopher Cabaldon raised a question about the relationship between the well to wheel and the power of fuel economy versus land use and transportation strategies that reduce the travel demand. The Clean Air Act brought about changes in land use through smart growth which lowered travel demand. This demonstrates the relative power of fuel economy and land use decisions. But if efficiency is better, then these relationships are undermined. Travel demand and land use might be more powerful tools than just focusing on fuel economy. Cabaldon asked, what is the likely power of the efficiency standards versus land use and transportation strategies? **Eads** answered this question by thinking about the actual impact. Land use does matter, but it is a slower driver to fuel economy. Land use changes take between 50-70 years. Fuel economy is faster. However, it is not either or, both have to come into play. Long-term and short-term strategies are both necessary and you can't rely on either entirely.

Tom Kelly asked a question regarding the benefits from climate change. He argued that climate change is not going to be a good thing for anyone. **Aldy** addressed these concerns by stating that low levels of climate change will provide economic benefit to colder regions.

Axel Friedrich stated that oftentimes there is an overestimation of the mitigation costs and an underestimation of the benefits. He brings up the example of Bangladesh. A lot of people live at sea level in this country, so migration will be a huge issue with sea level

rise. This will be a huge cost, but it is underestimated. Why? **Aldy** responds that there are many reasons. First, economists don't underestimate or overestimate. Economists don't always know how to monetize things. We throw out things we can't monetize. CBA has started to pay attention to non-monetized costs and benefits. Traditional command and control is a wash – some are more expensive than originally thought and some are less expensive than originally thought. Market-based programs are more flexible. Allowing for more flexibility through the market makes it more efficient. It is more universal to look at market-based approaches these days.

Session II:

Links Between Global Climate Change and Land Use / Transportation

Brian D. Taylor (Moderator), Associate Professor and Vice Chair of Urban Planning, UCLA School of Public Affairs; Director, UCLA Institute of Transportation Studies

This second session explored the transportation – land use connection to global climate change. The first presentation examined how possible changes to weather patterns and sea levels may affect cities and the transportation networks that link them in the coming years. The second talk addressed whether and how land use and transportation policies may help to mitigate rates of climate change in the years and decades ahead.

Projected effects of global climate change on land development and transportation infrastructure

Joanne Potter, Senior Associate, Cambridge Systematics

This presentation examined the effects of long-term climate change on development patterns and infrastructure investment. **Potter** pointed out that transportation infrastructure has a long lifespan, and that the development and use of this infrastructure may need to be modified in order to cope with climate change issues. In order to do this, climate change will need to be added explicitly to the decision-making process. However, **Potter** pointed out, there is not enough research available at present to guide the inclusion of climate change in the decision-making process. Decision-makers may therefore draw upon experience with other extreme situations, such as cold-weather research. Most of the literature has traditionally focused on the impacts of transportation on global climate change, not the other way around.

Potter noted that the Transportation Research Board (TRB) and DELS have begun a look at new transportation design standards for an uncertain climate future. In addition to design standards, the project is developing operational strategies for uncertain climate conditions. The research draws on lessons from other major areas of uncertainty, such as earthquake planning.

The United States Department of Transportation (US DOT) and the United States Geological Survey (USGS) cooperated on a study of the impacts of global climate change on the Gulf Coast. The study was conducted prior to the 2005 Gulf Coast disaster of Hurricanes Katrina and Rita. The Gulf Coast was selected because it is nationally significant, with its ports accounting for 60% of national energy imports. Furthermore, the region is home to an extensive intermodal network, with highways and railroads connecting significant port facilities, airports, and major population centers.

The Gulf Coast study assessed the vulnerability of this intermodal network to disruption caused by global warming. In particular, the study examined the effects of sea level rise and increasingly frequent extreme weather situations. Its goals were to identify significant risks, develop a risk assessment methodology, and identify strategies for adapting infrastructure to an uncertain climate future.

Potter pointed out that increased storm surge necessitates heartier design standards and increased maintenance of facilities. Furthermore, changes in precipitation patterns could affect drainage and storm water retention, requiring further engineering solutions to maintain the usefulness of transportation facilities during storms. Sea level rise poses another major threat; a rise of four feet would submerge many of the regions' major population centers.

Strategies that the US DOT / USGS study suggests include: increased maintenance of facilities and improved response time in emergency maintenance; structural reinforcement of existing facilities; increased system redundancy to provide transportation alternatives in the event of an emergency; and the relocation of facilities that appear to face ongoing high levels of risk. In sum, the planning, maintenance, and use of transportation systems will have to "embrace uncertainty", acknowledging the possibility of climate change impacts and preparing for a multitude of possible future scenarios.

Climate Change and Transportation and Land Use Planning

John Poorman, Director, Capital District Transportation Committee

Poorman began by pointing out that his perspective on global climate change is likely quite different from that of most audience members. As the director of a Metropolitan Planning Organization (MPO) in the Albany, New York region, **Poorman**'s expertise lies in the area of transportation and land use planning, while he pointed out that his knowledge of the science of climate change is somewhat limited. Thus, his presentation focused on the question, "can transportation and land use planning mitigate the rate of global climate change?"

Poorman focused on those changes that can be made at the regional (or MPO) level to "make a dent" in the rate of global climate change. For transportation and land use planners to approach this topic effectively, they must be both holistic (willing to consider all options) and honest (willing to discuss frankly what, for example, transit can and cannot do). Honesty involves respecting the laws of physics, economics, politics, and household behavior; the future will not be radically different in these regards, and planners should not assume otherwise. However, while these laws and behaviors will not change, the availability and cost of choices that are common today will become scarcer and more expensive in the future.

Poorman pointed out that radical changes in Americans' lives are not viable options, as the *possible* isn't always *probable.* For example, while road pricing has been possible, and even advocated by transportation planners for decades, it remains politically improbable in the United States. **Poorman**, paraphrasing Alan Altschuler, reminded the audience that public policy exists to accomplish a finite goal while disrupting as little as possible; radical impacts on citizens' lives are not tolerated in the absence of an obvious and grave crisis. Furthermore, Americans prefer to look to technology as a solution to crises.

However, **Poorman** pointed out that technological change almost always comes unexpectedly and has unintended consequences. For example, it would be unwise to assume that a technological improvement that reduced gasoline consumption by 50% would actually lead to a net halving of gasoline consumption. One may assume that, ceteris paribus, drivers would respond to the lower cost of fueling a vehicle by driving more.

Poorman pointed out that household travel behavior is remarkably consistent though the public policy choices that serve as inputs to travel behavior choices can vary greatly. One example of this is the difference in travel behavior between Rotterdam and Amsterdam, two cities in the Netherlands. Both cities are very similar in tax policy, transit provision, and other conditions, but differ in other significant ways, such as urban form. As a result, travel patterns are quite different in both cities. Citizens of Rotterdam do not respond differently to stimuli than do citizens of Amsterdam; the offered stimuli are simply different.

Poorman then presented his perspective ways to mitigate global climate change. He stressed that market forces can not reduce the rate of global climate change. Macro-level policy decisions and local planning choices *can* help reduce the rate of climate change, though they may not necessarily do so. Macro-level policy decisions have the greatest power to reduce climate change, while local planning decisions (such as pedestrian-oriented land use patterns) will likely have minimal impacts on climate change. While these changes will likely only have small impacts on greenhouse gas emissions, this does not mean that making these local changes is not worthwhile.

Discussion

Lee Schipper stated that, if Los Angeles were denser, its residents would travel less. He asked the panel and audience for estimates of the impacts of density and transit-oriented development (TOD) on travel behavior and housing costs. **Schipper** stated he was aware of Todd Littman's estimates, but would like to hear others.

Poorman responded that there are many such studies, and that they indicate that land use planning and growth regulations could have a sizeable impact on travel demand. However, he questioned the political will to impose such changes. It seems that there is little consensus on the purpose of increasing density. In some communities, such as Albany, density and TOD is seen as a quality of life issue, while in others it is primarily an environmental concern. Finally, even if travel behavior were to change, its impacts on climate change would likely be small; one should keep this in mind and not "promise too much."

Roland Hwang asked **Poorman** what he meant by "macro-level" policies having the most potential to reduce climate change. What, for example, would be feasible in the coming five years?

Poorman pointed out that a great deal of sprawl is caused by uneven property tax levels in a metropolitan area. If regions were to "level the playing field" by removing inherent tax disincentives in the central city, suburbanization would likely decrease. He

commented that the regulatory environment has greater impacts on climate change than do either land use or transportation planning.

Michal Moore believed there to be a discontinuity in **Potter's** remarks. He pointed out that local governments are driven by self-propagation and tax-revenues, while the scientific community is driven by stochastic models of likely outcomes. Local governments are making the decisions, and therefore will likely ignore much of what is known about global climate change.

Potter responded that local governments are largely reactive, and are driven by the market. If consumers are more aware of what's at risk and what can be done about climate change, local governments will react in a rational manner. However, the public opinion must be guided by honesty; for example, rail advocates should not claim that light rail will reduce congestion when there is no evidence this will happen.

Donald Shoup commented that **Poorman's** framing of the climate change issue was very appropriate. The question should indeed be how to *mitigate* climate change. From a policy analysis perspective, this can be reframed as "does the policy accelerate climate change?" **Shoup** believes that minimum parking requirements and low-density zoning do indeed accelerate climate change.

Steve Brye commented that TOD does not have to be a long-term strategy. Retrofitting of existing neighborhoods could lead to more sustainable travel patterns.

Poorman replied that the retrofitting of neighborhoods is a priority in the Albany region. Initially, commuter rail was seen as the number one priority in Albany for more sustainable travel patterns, but today the focus is more on increasing the density of close-in, already transit-supportive neighborhoods. The region is not "chasing development" in the suburbs; instead, it is focusing its attention on existing, transit-supportive areas.

Nathan Landau commented that blaming sprawl for today's climate change is problematic. Decentralization was a response to real needs for better housing, and is a product of both market forces and policy choices.

Session III:

The Business of Uncertain Energy and Climate Futures: A Roundtable Discussion

Norm King (Moderator), Director, Leonard University Transportation Center, CSUSB

To com plement the focus on science, data , and public policy evaluation in the two opening sessions, this evening panel explores private-sector perspectives. How will future changes in energy prices, clim atic patterns, and policies that aim to address energy and climate changes, affect busines s? The discu ssion focuses on m easures that particularly relate to la nd develop ment, shipping and tra vel. Som e of the m ajor question s this discussion will a ttempt to answer are: Can we sim ultaneously inc rease global sec urity and reduce global warming? How do we value ecosystems? Can a ton of carbon be given value? Is it important to determine what is necessary for the US to take a leadership role? Finally, at what point is the investment greater than reducing the risks?

Petroleum Interests

Randy Armstrong, Manager Compliance Assurance, Shell Oil

Armstrong shared his experiences and thought s on Shell Oil Com pany and clim ate change. He began his presentati on by stating that there has b een a 50 p ercent increase in energy dem and in th e world. Thus it is nec essary that supply m ust increas e to m eet the demand. The population is expected to rise to 9 billion by 2050, m ainly in poorest and developing countries. Shifting the developm ent profile to a "low poverty" world means energy needs double by 2050. Shifting the developm ent profile further to a "developed" world m eans energy needs triple by 2050. Th e a mount of energy available far exceeds any imaginable demand. Some of the proposed solutions are to increase the real costs of energy. Solutions to the "Energy Challenge" must be acceptable to society. Shell is reinvesting in new energy through explora tion, liquefied natural gas (LNG), heavy hydrocarbon production, efficiency improvem ents, gas to liquids, wi nd, solar, hydrogen, clean coal, and sequestration. People often as k about nuclear power, but there is a big problem over what to do with the waste. When dealing with transportation, it is important to m ake m ore ef ficient vehicles, lo w or zero em itting f uels, and develop an arra y of personal choices for consum ers. Such c hoices, which Shell is supporting, include: gasoline, diesel, natural gas, liquefied petroleum gas (L PG), ethanol (corn/sugar, cellulose), biodiesel, and hydrogen. Policies whic h best support the ac tivities required to meet the "Energy Challenge" include: R&D support, voluntar y reduction efforts, tax policy, education, and adaptation support.

Development Interests

Dan Cashdan, Senior Managing Director, HFF Securities

Cashdan presents the real estate's industry's view regarding clim ate change. He begins by presenting three sets of players: develope r owners, investors (who are m otivated to make profit s), and ten ants of space users. T here is con cern about clim ate change

developing in all three of these sectors. The largest real estate developers have all assigned staff to study energy issues. The biggest tenant, the government, is paying more attention to energy use and efficiency. Investors are the farthest behind in the curve. **Cashdan** asks the audience to think about if this is a relevant topic for the real estate industry? He thinks it is. The U.S. Green Building Council (USGBC) is one example of the real estate market rising to address issues of climate change. Green building can help address pressing environmental problems in the urban environment. A green home uses less energy, water and virgin materials, while construction waste and the presence of toxic products are minimized or eliminated. The components of green building include site development, materials, water conservation, energy efficiency and health. Sustainable development has had a large impact on the building design and construction field in the last decade. The Urban Land Institute (ULI) also developed a sustainability council, offering city planners the opportunity to interface with developers on issues of sustainability and green building.

The environmental and health benefits sited by the U.S. Green Building Council in the development of the Leadership in Energy & Environmental Design (LEED) sustainable building rating system include tangible improvements to the status quo of building. Such improvements enhance and protect ecosystems and biodiversity, improve air and water quality, reduce solid waste, and conserve natural resources. LEED is a national standard for what constitutes a "green" building. Within this broad spectrum, green building design strives to balance environmental responsibility, resource efficiency, occupant comfort and well-being, and community sensitivity. Wal-Mart has made enormous strides on this topic by the greening of Wal-Mart Stores. They are making great strides to reduce energy consumption. Wal-Mart expects to be a major player in the carbon credit business. These examples illustrate the important role real estate plays in addressing issues of climate change.

General Business Interests

Gerald Secundy, Vice Chair, State Water Resources Control Board

Secundy spoke of his role with the water board and specifically brought up questions of who owns what water and what can they do with it. He asked the audience to think about what water has to do with energy and climate change. Secundy stated that the second largest consumption of energy is water. It uses somewhere between 15-20 percent of all electric energy in the U.S. Forty percent of the water in Los Angeles comes from ground water and 40 percent comes from up north and has to be pumped over the mountains. This is related to climate change because when the sea level will rise, more saline water will enter the delta. We have two choices to address this problem: 1) either put in barriers or 2) treat the saline water. Sea water intrusion comes in along the coast and is a consequence of global climate change. Other predicted changes will affect the snow pack. We will loose our natural storage of water in the form of snow, and more water will fall as rain. Snow pack is basically a natural reservoir. If we don't have this natural reservoir, we will have to build one to store more water. We are going to be growing as a state and as a country, with 80 percent of the growth in California from people already here.

We need to accommodate this growth, but we cannot continue to pave over paradise. Permeable surfaces are one way that we can naturally recharge our water basins. Low-

Impact Development (LID) is a new way of thinking about storm water management and is an effective strategy for controlling contaminated urban runoff. LID uses techniques that reduce the impact of development through the use of systems that retain, detain, filter, treat, use, and reduce storm water runoff. The primary goals of LID design are to reduce runoff volume through infiltration, retention, and evaporation, and to find beneficial uses for water rather than exporting it as a waste product down storm sewers. LID practices can be applied to all elements of the urban environment, turning parking lot islands, street medians, planter boxes, and landscaped areas near buildings into specialized storm water treatment systems. Retention basins, used to collect runoff from areas of redevelopment or new construction sites, are already required in many cities. Innovative designs for urban areas may include roof gardens, methods for capturing and using rainwater, and use of permeable pavement in low-traffic areas, parking areas, and walking paths. It is necessary to change our culture in the way we construct and build things. Not everything has to be concrete. We have a love affair for rolling green lawns, but maybe Southern California is not the best place for this. We need to start building sustainable communities in order to assure our future water supply.

Goods Movement

T.L. Garrett, Vice President, Pacific Merchant Shipping Association

Garrett spoke of ways to reduce the amount of energy used in "goods movement" — the ship, rail and truck traffic associated with transporting goods to the port and throughout the state. The ports of Los Angeles and Long Beach aim to reduce air pollution by upgrading the vehicles that use the nation's busiest harbor complex by land and sea. The ports are responsible for 40 percent of the cargo that comes into the US. Hence, goods movement is an integral part of our everyday life. The industry continues to get more efficient and more effective. When taking economies of scale into consideration, ships are extremely energy efficient and produce low amounts of GHG emissions. However, this industry can still be improved. One way to improve the industry is to require the owners and operators of cargo-handling equipment such as cranes and forklifts to use only the cleanest-burning equipment on the market. **Garrett** expects that rule to achieve a significant reduction in smog-forming nitrogen and airborne particulates will drop by 75 percent simply by policing incoming ships. According to the South Coast Air Quality Management District, air pollution related to goods movement causes 750 premature deaths in California every year, with diesel particulate as the prime culprit. Another strategy is the vessel speed reduction program. It takes a lot of energy to push a ship through the ocean, so by slowing down the speed, operators will be able to save energy and a lot of money. As ships have gotten bigger, they have traded those efficiencies for speed. **Garrett** concluded that they would prefer international standards and regulations as a way to reduce energy and emissions. He called such incentives a proven, effective way of encouraging corporations to become early adopters of improved anti-pollution technology without suffering a competitive disadvantage. "Market-based incentives are very viable," **Garrett** said. "They are an elegant and brilliant approach to making positive changes."

Goods Movement

Eugene Pentimonti, Senior Vice President, Government Relations, Maersk Line Limited

Efficient goods movement is more important than ever to America's economic prosperity. The statistics back it up: the U.S. transportation infrastructure makes it possible to move $6 trillion worth of freight each year. Goods movement accounts for an increasingly larger slice of the economic pie. Transportation services are now responsible for roughly 11 percent of the gross domestic product, with Wal-Mart being one of their biggest customers. There are currently over 13 million people who work directly or indirectly in the field. Crowded interstates, highways and ports that are stretched to the limit have become commonplace and threaten to curtail the efficiency that consumers and businesses have come to rely upon. And rising fuel prices have made energy costs the fastest growing component of the industry and have heightened awareness of the need to conserve energy. Congestion and capacity problems are producing negative environmental consequences, with air and noise pollution and other quality-of-life impacts affecting people that live near ports, rail yards, and along high-traffic corridors. As the system's infrastructure and environmental problems mount, so too do the costs – in dollars and public health impacts. It is necessary to reduce the amount of fuel it takes to operate a container from one point to the next. Some strategies are to operate with ultra low sulfur diesel, but it would take millions of dollars to modify the vessels. Performance indicators are another strategy to reduce emissions and the amount of fuel needed to move a container across the ocean.

International Business Interests

Nancy Kete, Director, EMBARQ World Resources Institute

Kete began her talk with a focus on cities and a slideshow presentation of the Sustainable Transportation work done by EMBARQ. Cities are the focal point and drivers of societal development in all countries. They are also the largest consumers of natural resources and by far are the biggest sources of pollution and greenhouse gases on the planet. **Kete** believes that cities will define the 21st century because more people live in cities than in the countryside. Today it is a challenge to name half of the 300 cities in the world with populations over 1 million. Nearly 3 billion people – or every other person on earth – live in a city. By 2015, there will be 3.9 billion people living in cities.

Kete then addressed issues of urban mobility. She stated that it is much easier to be energy efficient if you can concentrate people in a dense setting. The quality of life is better in cities than in the romanticized version of the countryside. However, issues of transportation get worse with increasing wealth. As a city or country gets richer, there is no reason to believe that problems will fix themselves. She used China as an example to illustrate the complexities between urban transportation and increasing wealth. While clean fuels and clean engines will help, what about congestion, long commutes and the dangerous mix of trucks, buses, cars, bicycles and pedestrians that share city roads in China? How does a business model built on selling ever more cars contribute to sustainable cities? Can car companies go a step further and really think about the best way to meet shareholder expectations of profits while serving the mobility needs of the people of China and helping her cities achieve a sustainable future? Transportation decisions are inherently political and controversial.

EMBARQ's most recent success was the launch of a new Metrobus system in Mexico City this summer. The new mass transit system consists of 80 low-pollution buses carrying 250,000 passengers per day. These now replace 350 high-polluting and dangerous buses previously run by 262 chaotic, unregulated operators. The new bus system is designed to improve the quality of life of the city's citizens by reducing pollution, congestion and commute time. A similar partnership between *EMBARQ* and the city of Porto Alegre, Brazil, was signed earlier this year and is now being recognized by the Clinton Global Initiative for its commitment to address climate change and urban poverty.

Kete concluded that fixing transport systems requires new models. Through the formation of public-private partnerships, EMBARQ has turned the attention of the private sector towards the needs of cities, their citizens, and their environment. EMBARQ has also proven that the design and implementation of sustainable urban transport models in the developing world can translate into economic opportunities for the forward-thinking business.

Discussion

Dean Taylor began the discussion with what he thinks to be a serious problem in this industry—there is not a common metrics to analyze these problems. **Kete** responded by stating that setting a common index will complicate some of the solutions. It is important to analyze the various benefits separately – to put all of this into a single index would really obscure the various successes. Setting a common index would complicate the various solutions that may exist.

Lee Schipper had a question regarding the real estate interests. He asked if there was a greater movement towards infill development. Over the years we've had a decentralization of goods and services, such as bigger car washes, bigger markets, bigger stores in the suburbs. Do you think that these big scale services will change and move back to smaller walkable shopping centers? Such strategies will reduce travel kilometers. What we thought was cheaper was further away, but now we are discovering the true costs associated with travel. Does the real estate industry see that? **Cashdan** answered that the real estate industry spends a lot of time thinking about these issues. But there is no real answer about how it will play out. The industry is seeing a return to the urban core. Four hundred million new people are expected in the next 20 years, so there will be development everywhere. The real estate industry has been talking for the past 20-25 years about a return to the urban core. It has taken a long time to get going, but all major cities and secondary cities are returning to the urban core. The population growth means we'll continue to see development at the fringe, but at higher densities.

Axel Friedrich asked several questions regarding demand and responding to demand. He stated that about 20-30% of NOx comes from ships, which has a high impact on climate. Do we need to keep shipping goods or can we think about changing behavior and not shipping goods? **Garrett** responded that the NOx emissions from ships are actually about only 4%, not 20-30%. The fundamental question is what are you willing to give up? What are you going to sacrifice in your lifestyle? There's no cleaner way to move goods than ships. The consumer decides the volume of goods they want to consume. Market

forces are at work.

Huasha Liu asked if there were any cleaner ways to move goods by ship. **Garrett** responded that the industry is looking for cleaner ways and it is a constant evolving process. There's no cleaner way for the current price charged.

Margaret Bruce had a comment regarding energy efficiency. One way is to individually meter occupancy tenant spaces. If you measure something you are more likely to manage it. She stated that small organizations need to be more involved in energy efficiency. **Cashdan** responded to her comment and said it is true that individual tenants don't have a reward for doing better and this is a big problem. Interaction between tenants and utilities is very difficult. Utilities resist anything that reduces consumption. And they don't want to have to change the metering. However, rewarding better behavior is the goal to strive towards.

Roland Hwang asked a question regarding climate stabilization. He stated that Armstrong's presentation gave us a clear impression of where the oil industry is going. There is a lot of pressure on Shell to look at unconventional sources like shale. But for climate stabilization, we need to make 60-80% reductions by 2050. Hwang's concern is that the direction the oil industry is looking is more carbon intensive. Shell is eager to do the oil shale. These are huge generational investments and huge sunk costs. **Armstrong** responded to these comments. He stated that the observation that conventional fuels are running out is correct. Shell will be looking at heavier hydrocarbon fuels and carbon sequestration to deal with this. Shell is working on a process that would recover oil from oilshale in place. This takes the development of technology that we don't use at this present time.

Tom Peterson commented that ships are very efficient, but what are the numbers? He asked **Armstrong** to give the audience something that we can understand. How much energy does it really take to move something across the ocean? **Armstrong** responded that it takes about 2/10 a gallon per mile per ton. This is 500 times more efficient than an airplane. Trains are about 4 times better than a truck, and a ship is about 60 times better than that.

Steve Brye commented that it's common for seminars like this to report back to the national academies. His question was regarding the shipping industry. Other than making better engines, is there anything you can do with wind in order to lessen the impact of the goods movement? **Pentimonti** answered that certainly there are more efficient ways of moving things across the ocean. However, the answer lies in finding more efficient ways of getting power to ships, such as nuclear power. Huge sails would probably make the ships less efficient, but it would be an interesting study.

Mike Savonis asked a question about business interests and their concerns with climate change. He says that we can't trust voluntary intervention, so how should government intervention be structured? **Pentimonti** answered that the industry needs to stand up and volunteer, but the government has to set the parameters. It is important to allow for flexibility to find cost effective methods. Let the industry decide how best to reach their targets. However, there has to be rewards along the way, not just an incentive for zero emissions. **Cashdan** added that this was a great question. It's important to think about the

function of the governm ent. In the next 2 ye ars how should we use tax dollars in this country? We can m ake the choice to get off coal in a decade if we decide to really go after that. We can make the choice and the investment. It's a purchase decision.

Norm King closed the session by saying that while he does not disagree that taxpayer money is important, he believes it's a fee issu e of what the consum er should pay. One of the facts in society is th at we're in creasing the num ber of externalities that we are not accountable for in our cost st ructure. W e have to gradually begin to fold those externalities back into the price. It's accepting personal responsibility for the cost you are imposing on others. Business doesn't reject that, they just want clarity and goals.

Session IV

Global Energy: Reserves, Usage, and Prospects

Donald Shoup (Moderator), Professor, Urban Planning, UCLA School of Public Affairs

Rising energy prices, particularly for transportation, have garnered a lot of attention in recent years. Are these changes part of normal cycles and fluctuations, or do they portend an era of rising energy prices? If the latter, how are energy markets expected to change in the coming years? This session examined these questions by first reviewing projections on reserves and prices of conventional energy sources, the market potential for future energy sources in the coming years, and the implications of rising and/or volatile energy prices on the economy and travel in the future.

Donald Shoup opened this session, commenting that volunteerism will not be the solution to global warming. Planning and policy choices will have created much of the problem, and these will have to be a large part of the solution.

Understanding energy markets I: Future reserves, production, and prices for conventional energy sources

John Kilduff, Senior Vice President , Energy Risk Management Group, Fimat USA, Inc.

Kilduff presented on the economics of the energy market. Specifically, he examined short-, medium-, and long-term projections for energy prices. Since 2000, crude oil prices have experienced a sustained rally. India and China have driven up demand for crude, but even more important has been an ongoing political destabilization in oil-producing regions. Uncertainty about the continuity of oil supply has been responsible for all price increases above roughly $40 per barrel. For example, Hezbollah's attacks on Israel in 2006 had the effect of driving oil prices to $80 per barrel, even though Israel has no oil supplies. Should there be a successful attack on Saudi Arabia, oil prices would likely jump to greater than $100 per barrel. Iran has the ability to shut down the Straits of Hormuz, through which much of the world's oil supply passes. This would lead to massive increases in oil prices. **Kilduff** further pointed out that oil is traditionally a major flight-commodity, to which capital is attracted in periods of uncertainty.

The United States is still the world's largest consumer of oil. China is the second largest consumer, and its rate of consumption is increasing rapidly, with a 15% increase in 2004, virtually no increase in 2005, and a 12% increase in 2006. India is actually importing fewer refined products today than in the past. Both countries' economies have been hurt by higher energy prices.

Kilduff pointed out that the supply (amount) of oil is not the controlling factor today, but rather uncertainty about the continuity of supply. Investors have flocked to energy as a hedge against inflation and terrorism, and crude oil is a very good hedge against terrorist attacks; if terrorists succeed, oil prices increase drastically.

Kilduff finds that there are three schools of thought on oil reserves:

1. Peak Oil Theorists: Oil supply will dwindle in the coming years.
2. Creation Theorists: We will continue to find oil reserves.
3. Data Theorists: There are billions of barrels of oil left.

Finally, **Kilduff** pointed out that technology solutions follow from crises; passenger vehicle fuel efficiency increases came after the oil crises in the 1970s. Since then, there has been little substantive change.

Understanding energy markets II: Future reserves, production, and prices for alternative energy sources

Heather MacLean, Associate Professor, Civil Engineering, University of Toronto

MacLean began by stating that low-carbon fuels will need to be part of a solution that includes land use changes and other measures. Low-carbon energy sources can help to reduce greenhouse gas emissions; currently, the production of electricity accounts for 40% of all anthropogenic greenhouse gas (GHG) emissions, while transportation accounts for roughly 33% of anthropogenic GHG emissions.

The Department of Energy projects that, by 2030, the use of alternative energy sources will change very little, while the use of coal for electricity production will increase considerably. Motivating any moves toward renewable resource use are concerns about the externalities of conventional energy sources, tax incentives, and technology development.

MacLean pointed out that "well-to-wheels" (lifecycle) studies show that the environmental benefits (or detriments) of befouls vary greatly by crop, production method, and other factors. Some befouls have net benefits, while others have net detriments.

Currently, about one fourth of U.S. electricity is produced from low-carbon fuels. The majority of this is currently nuclear power generation, though renewable sources such as wind power are growing rapidly. However, the major centers of wind power production would be in the upper Midwest; this is not where much of the energy would be consumed. Thus, transmission of power becomes a major problem. Hydro power

production also has significant costs associated with it, such as displacement and environmental damage. Biomass as a fuel source has potential, but land use constraints, logistics, and availability of sufficient biomass are all limiting factors. Carbon-capture and sequestration technologies may be a significant part of future low-carbon electricity production, though these technologies are still new and relatively untested.

The transportation sector is currently 97% dependent on crude oil. Here, biofuels have some potential. However, land use constraints are also a major issue for biofuels. Fossil fuels may also continue to be used for transportation purposes with carbon capture and sequestration technologies attempting to mitigate climate change externalities. Again, these technologies are relatively untested, and their role remains uncertain.

Estimates for the cost-effectiveness, production capacity, and net carbon effects of biofuels vary greatly. Ethanol can likely supply 20% of today's light-duty vehicle needs, though the efficiency of doing so varies greatly by crop. **MacLean** pointed out that CO2 emissions cannot be the only factor considered. In sum, the future of alternative energy sources remains uncertain, though it is increasingly clear that there are greater and more immediate options for low-carbon electricity than there are for motor fuels.

The Effect of Fuel Prices and the Fuel Cost of Driving on the Demand for Driving and for Fuel

Kurt van Dender, Assistant Professor, Economics, UC Irvine

Van Dender began by examining changes in drivers' behavior in response to fuel price increases. In general, research has found that the elasticity of demand for driving has decreased from the 1960s to today. Whereas a study covering the past four decades found that a 10% increase in fuel prices led to a 2% decrease in driving, a study covering just 1997-2001 found that a 10% increase in fuel prices led to a 1% decrease in driving. The elasticity of demand has clearly declined over time, and consumers are less responsive to changes in fuel prices. Income growth explains a fair amount of this, as wealthier consumers spend a smaller percent of their income on fuel than do lower-income drivers. However, a larger increase in fuel prices would lead to a higher elasticity of demand.

This low elasticity of demand has policy implications. **Van Dender** pointed out that fuel taxes would have to be increased drastically to achieve a desired level of fuel consumption. As drastically increased fuel taxes are likely politically infeasible, Corporate Average Fuel Economy (CAFÉ)-style regulation of mandated fuel efficiencies is likely a more attractive option. However, as more fuel-efficient vehicles make driving less costly, there will be a small "rebound effect", whereby consumers take advantage of lower costs by driving more.

Studies have shown that the marginal external costs of driving on energy security and climate change are covered by the motor fuel tax, but the costs of congestion, infrastructure and noise are not. Thus, a small increase in the amount of driving comes with a high cost. In sum, while greater fuel efficiency may have positive impacts on climate change, increased driving will result in many other negative externalities.

Discussion

Andrew McAllister asked what the price of gasoline would have to be to achieve a significant change in travel behavior. Furthermore, he asked for a more detailed analysis of the change in demand elasticities over the past several decades.

Van Dender answered that the elasticity of demand would likely return to -0.2 at about $3.50 or $4.00 per gallon, assuming no growth in personal income. Elasticities of demand have declined steadily over the decades, though our certainty about the elasticities declines as we examine fewer years.

An audience member commented that the reduction in elasticities has been quite dramatic, and that the downward trend appears to be continuing. He asked **Kilduff** what the price of oil would likely be if uncertainty in oil-producing regions were eliminated.

Kilduff replied that the long-term stable price had been about $20 per barrel. With the increased investment in the sector, we may see a decline of the price to about $25 to $35 per barrel. Currently, the cost of oil based on supply and demand alone, as stated above, would likely be about $40 per barrel.

Woody Clark stated that he disagreed with all three analyses. Thinking globally, he stated, the United States could draw a lot from countries such as Germany and Denmark, increasing mass transit usage.

Kilduff replied that fossil fuels are still incredibly cheap, and that hydrogen will forever remain the fuel of the future. Other alternatives, such as light rail transit (LRT), are expensive, and cannot compete effectively with the automobile under today's conditions. Biodiesel is one of the options that appears to have the most promise in today's market.

MacLean replied that the analyses presented today examine policy options in the United States given a realistic starting point, and that European conditions are very different.

Van Dender pointed out that in the United States, transit's share of commute trips is only 6%. Origins and destinations are widely dispersed in the United States; therefore, if any investment in transit should be made at all, it should be in bus transit, not in rail. However, **van Dender** remains skeptical about transit in general.

Axel Friedrich pointed out that Germany's policy of high motor fuel taxes makes elasticities of demand much higher in that country.

Van Dender replied that access to alternative forms of transportation in Germany also increases the elasticity of demand for driving.

Friedrich added that biofuels have net detriments on CO2 emissions when one takes into account the entire lifecycle of the fuel. Thus, the German government has decided to invest very heavily in solar and wind power. Currently, these sources are subsidized, but the government expects these to become competitive by 2011.

Steve Kimsey commented that, while the presentations indicated an ability to raise the costs of energy to the consumer, there exists a lack of political will to do so.

Kilduff replied that the fuel tax is regressive, as the poor have fuel-inefficient cars and often no mass transit alternatives.

Michael Moore asked **MacLean** to elaborate on the greenhouse gas implications of biomass.

MacLean replied that it really depends upon the source of the biomass. From municipal solid waste, for example, there are large net benefits. Agricultural residues are similarly beneficial. When new crops are grown for biomass, however, the benefits are much less obvious, as there are typically many fossil fuel inputs to the process of growing these crops.

An audience member from SANBAG contested the notion that petroleum will remain readily available in the long term. The USGS estimates that there are approximately 2.1 trillion recoverable barrels of oil left; to date, we have extracted roughly 1 trillion barrels. However, the ease of extracting oil will continue to decline, as all the readily-available sources are depleted. The extraction of this oil alone will be much more energy-intensive than has been the case so far.

Kilduff replied that there are, as mentioned above, three schools of thought on the remaining oil resources, and that peak oil theorists comprise one such group. It is true that the remaining resources are more difficult to extract, but new extraction technology is making this easier and less costly. Furthermore, there will likely be tremendous oil discoveries in the coming years, for example in the Gulf of Guinea, which may hold more oil than the entire North Sea.

Session V

New Vehicles, New Fuels: Near Term Possibilities

Michael Shelby (Moderator), Chief Economist, Transportation and Climate Division in the Office of Transportation and Air Quality, U.S. EPA

The commercial success of hybrid-electric vehicles has raised awareness among public officials and the public about the possibilities for substantially cleaner and more efficient vehicles in the coming years. The presentations will examine: How and when do new fuels and/or engines become cost-competitive? What are the near-term possibilities for cleaner movement of goods? What are likely to be the relative roles of new engines, new fuels, and behavioral changes on future rates of fuel consumption and emissions?

Air quality concerns have increased the importance of alternative fuels and advanced transportation technologies like electric vehicles. By increasing alternative fuel use, consumers have fuel choices that compete with gasoline and diesel and reduce environmental impacts associated with driving. **Shelby** stated that it is a fact that CO2 emissions are going to rise in the next century. The magnitude of this problem is truly global. Every emitter is going to have to take significant steps, with transportation playing a significant role. Some of the solutions, which will be discussed in this panel, include alternative fuel vehicles and changing vehicle behavior. Clean vehicle technology, efficient travel demand management, and green fuels all hold promise to reduce greenhouse gas emissions emitted by vehicles. Petroleum saving and GHG reductions are two benefits of new fuel technology. It is important to keep emissions at today's levels with all expected future growth. One major problem is to understand how to commercialize new technologies with up front costs. Although we have enough conventional oil to last a long time, we still need fuel conventional changes. **Shelby** believes that biomass will play a bigger role in the future.

Future Fuels and Vehicles: What are the Near and long Term Possibilities

Daniel Sperling, Director, Institute of Transportation Studies, and Professor, Civil & Environmental Engineering, UC Davis

The history of alternative transportation fuels is largely a history of failures. Methanol never progressed beyond its use in test fleets, despite support from President George H. W. Bush. Compressed natural gas remains a niche fuel. And nearly every major automotive company in the world has abandoned battery-electric vehicles. Only ethanol made from corn is gaining market share in the United States, largely because of federal and state subsidies and a federal mandate. Some alternatives have succeeded elsewhere for limited times, but always because of substantial subsidies and/or government protection.

Improved efficiency and fuel economy should be the number one energy and GHG priority, but these efforts are not enough to meet California, U.S., and global GHG goals. It is important to keep in mind that there is no silver bullet when it comes to alternative fuel vehicles, but many "shards." The most promising non-petroleum, low-carbon

alternatives are: biofuels, electricity (PHEVs and BEVs), and hydrogen. These energy strategies would all be competitive at ~$55/bbl and all provide potentially large benefits. But they all face huge challenges and all will take time to implement. It is unlikely that one fuel will fully dominate the market. It is more likely to be regional differences, and likely to be a mix of options in the future.

Currently, gasoline is being "re-carbonized" due to increasing use of tar sands and heavy oil. Tar sands produces ~50% more GHGs/gallon than conventional gasoline. Vehicle travel continues to increase (~2%/yr), while transit only accounts for two percent of passenger travel (flat for many years). Increases in vehicle performance, size, and weight are offsetting vehicle efficiency improvements of 1-2%/yr. The net effect is that GHG emissions from transportation continue to increase in California, U.S., and the world. New cars are getting bigger, heavier and more powerful. A lot of people like to think that hybrids are the solution. It is a success in some ways. Although incremental enhancements are far from exhausted, there is almost no hope that oil or carbon dioxide (CO_2) reduction improvements in vehicles could even offset increases in vehicle usage, never mind achieve the radical de-carbonization and petroleum reductions likely needed later this century.

The principal long term energy options for vehicles include: Hydrogen (used in fuel cells), Electricity (used in battery electric vehicles and plug-in hybrids), and biofuels (used now in combustion engines with little energy/environmental benefit). Biofuels can be made from lignin cellulose (residues, grasses, trees), as well as starch and sugar (corn, sugar cane, etc). Corn ethanol supplies 3 percent of U.S. gasoline using 18 percent of U.S. corn production, with ~$3 billion in subsidies/yr.

The case for hydrogen is threefold. First, hydrogen fuel cell vehicles appear to be a superior consumer product desired by the automotive industry. Fuel cells fit into the automotive business model. Second, as indicated by the National Academies' study, the potential exists for dramatic reductions in the cost of hydrogen production, distribution, and use. And third, hydrogen provides the potential for zero tailpipe pollution, near-zero well-to-wheels emissions of greenhouse gases, and the elimination of oil imports, simultaneously addressing the most vexing challenges facing the fuels sector, well beyond what could be achieved with hybrid vehicles and energy efficiency.

Current policy initiatives include:

- CAFE and California 1493 vehicle standards (30% reduction by 2016)
- Subsidies for ethanol (and oil and other fuels)
- Zero Emission Vehicle (ZEV) mandate (2500 fuel cell vehicles in 2009-11)
- California Hydrogen Highway
- Tax credits and High Occupancy Vehicle (HOV) lane access for some hybrids
- California Global Warming Act (AB 32)

Currently Ethanol and Plug-in Hybrids are gaining momentum, but there has been a backlash against hydrogen. The transition to a hydrogen economy will be neither easy nor straightforward. Like all previous alternatives, it faces daunting challenges. But hydrogen is different. It accesses a broad array of energy resources, potentially provides broader and deeper societal benefits than any other option, potentially provides large private

benefits, has no natural political or economic enemies, and has a strong industrial proponent in the automotive industry.

Commentary

Margaret Bruce, Director of Environmental Programs, Silicon Valley Leadership Group

Bruce joined the Silicon Valley Leadership Group (formerly the Silicon Valley Manufacturing Group) as Director of Environmental Programs in March of 2001. In her role with the SVLG, Ms. **Bruce** works with local industry, environmental, and regulatory agency leaders in developing innovative and effective legislative, regulatory and voluntary action solutions to the environmental issues facing Silicon Valley and California. She has been especially involved in water, climate, hazardous materials and electronic waste issues.

Bruce discussed how every year the organization asks the Chief Executive Officers (CEOs) what they care about. Their responses include: affordable housing to employers, schools, environmental quality of life that is desirable, etc. She believes that taxes on gasoline are opaque to us as consumers. Our current transportation system imperils our water systems and takes up valuable land. But we as consumers are not aware of this. Fear, greed, and vanity—how do we motivate by fear? National security risks are here. **Bruce** believes that investment in new technology could make a difference in the world. She stated that one way to make an impact is to engage employees to drive less by enabling companies to telecommute. Another strategy is to engage in policy matters to lead us to the next generation. Why wait, we have to do something now.

Commentary

Roland Hwang, Senior Policy Analyst, Natural Resources Defense Council

Hwang began with a commentary on Moving America beyond Oil. The NRDC believes that we must get serious now about reducing GHGs. "A slow start means a crash finish." In order to reduce GHG emissions, we must avoid investments in unconventional oil production to avert dangerous global warming. Unconventional oil production includes: tar sands, oil shale and coal to liquids, which are all more carbon intensive than current oil production. Transportation solutions are known, but the challenge is political will. We need a package of solutions that includes efficiency, low carbon fuels, and demand reduction.

While **Hwang** does not agree with the statement that the reason Dan **Cashdan** is optimistic about the fuel cell is because car companies like it, he thinks that we have to be careful about this rationale. The NRDC is interested in issues of economics and the environmental benefits. In order to reduce U.S. emissions, we need to cut down on our energy usage. If we reduce electricity demand by 25% through better motors and controls, better lighting, better refrigeration, etc. we can reduce emissions by 325 million tons (1.3 wedges). If we reduce direct fuel use in buildings and industry by 40% through better building design, advanced industrial processes, and combined heat and power we can cut emissions by 275 million tons (1.1 wedges). If we increase vehicle efficiency to 54 miles per gallon through improvements to conventional vehicles, widespread

deployment of hybrids, and possibly the introduction of fuel cells we can reduce emissions by 250 million tons (1 wedge). If we increase the efficiency of heavy trucks and aircraft, and build smart communities that provide viable alternatives to driving we can reduce emissions by 225 million tons (0.9 wedges). If we use renewable energy sources, such as wind power, to provide 30% of our electricity needs by 2050 and produce 40 billion gallons of biofuels we can reduce emissions by 325 million tons (1.3 wedges). If we equip 180 large coal fired power plants (180 GW) with carbon capture and storage and increase the efficiency of our energy supply system we can reduce emissions by 325 million tons (1.3 wedges). The AB32 Global Warming Solutions Act requires return to 1990 levels by 2020 likely through a combination of regulatory standards and market based measures (cap and trade). Transportation is the largest single source of GHG emissions and will need to contribute a substantial portion of the total reductions necessary. It is necessary to identify policies needed to create a market for low carbon fuels.

Discussion

Nancy Kete began the discussion by asking why LNG was not represented in the talk of alternative fuels. **Sperling** responded by saying that most people think it's just as limited as petroleum, except in places where there's a lot of local national gas. There is not a lot of interest from consumer perspectives.

The Honorable Tom Cosgrove commented that it is good to point out that we have per capita reductions in energy consumption, but also that we have a growing population. Technology seems to be one of the greatest benefits for reducing or avoiding pollutants and improving air quality. How can electric vehicles play a part in reducing the sort of trips we make, relative to the other opportunities we've outlined here? **Sperling** responded that cheap green electricity with good batteries is essential. This will be an attractive option for plug-in hybrids. Plug-in hybrids will play a major role if we clean up the grid and start producing cleaner energy. It is also important to get away from the transportation monoculture, and start moving toward carsharing and smaller vehicles.

Jose Luis Moscovich asked a question about state targets. What kind of uncertainty do we have on each of the different methods for reducing GHGs? **Daniel Sperling** said that in the real world, per capita VMT is going up. The only way it will be reduced is if something dramatic happens. **Hwang** added that it is important to think about smart growth and other demand reduction strategies. However, we need to show how these strategies will actually reduce demand and identify the metrics to show the reduction.

George Eads made an observation that it is important to keep in mind all modes of transport, including light duty vehicles. Road freight is a very large part of the transportation system, as well as air transport. So when we are talking about these problems, be sure to keep the whole range of the transportation sector in mind. Even if all cars were zero emissions by 2050, we'd still have transportation GHG emission increase. **Bruce** addressed this comment by stating that avoiding inherent costs of purchasing from far away is one solution Silicon Valley is taking. For example, Kaiser Permanente started buying local food for the cafeteria. Efforts such as these will reduce VMT.

John Kilduff commented on telecommuting panacea. While you are getting the car off the road, the energy savings could be offset by the amount of energy you use in your home. More people will be sitting at home by themselves in their own air conditioned world in a McMansion. This might defeat the purpose of telecommuting. **Bruce** comments that this is a great point. It is necessary to retrofit our homes with energy efficient appliances to operate in an energy conscious way. We need real-time measuring of carbon content like we have nutrition information. That would help make working from home more efficient.

Session VI

New Vehicles, New Fuels: Longer Term Possibilities

Daniel Sperling (Moderator), Director, Institute of Transportation Studies, and Professor, Civil & Environmental Engineering, UC Davis

This second session explored longer-term changes to fuels and vehicles: what are the possibilities and how do they compare? This question was examined in a plenary talk, followed by a moderated panel discussion.

After Diesel: Technologies for Cleaner Cars, Trucks, and Trains

Magdi Khair, Emission Research Engineer, Southwest Research Institute

Khair discussed the role of the diesel engine in today's transportation system, finding that it has been the "power plant of choice" for commercial applications worldwide. The diesel engine is notable for its low fuel consumption and its durability. As the developing world has achieved higher levels of automobility, there has been a dramatic increase in the use of the diesel engine.

However, the diesel engine has serious detrimental impacts on the environment. Responding to increased regulatory demands, engineers have made the diesel engine more fuel efficient and cleaner over the years. From higher compression rations, to turbo charging, to intercooling, efficiency has been improved and technology solutions have made a better diesel engine. **Khair** expects the emissions of the diesel engine to reach internal-combustion engine levels by 2014. However, these improvements have come with high costs.

Khair introduced the HEDGE concept: the High Efficiency Dilute Gasoline Engine, an engine that inherits some of gasoline's low emissions attributes with some of diesel's high efficiency attributes. This engine has performed well in tests, proving that in the short- and mid-term, incremental technological changes to existing engine technology may prove to be an effective way to reduce the environmental harm of travel by automobile. In the long term, **Khair** believes that other technologies, such as fuel cells, may prove effective.

Moderator **Dan Sperling** pointed out that there are two lessons to take away from **Khair's** presentation: 1) there may be different societal goals at work in many instances, e.g. reducing emissions while improving energy efficiency; and 2) technological innovation can make a significant impact in achieving these goals.

Electric Transportation and Goods Movement Technology

Bill West, Southern California Edison, *presenting for*
David L. Modisette, California Electric Transportation Coalition

Daniel Sperling announced that **David Modisette** was unable to attend the symposium, and that **Bill West** would present in his place.

West began by stating that electric technologies, including but not limited to electric vehicles and plug-in hybrid vehicles, are a viable component of a portfolio of strategies to reduce emissions and petroleum consumption. Air pollution and global warming are major drivers of the push for more electric vehicles, though reducing America's dependency on foreign oil is of growing importance.

Another reason for the push, particularly in California, for the electrification of personal vehicles, is the unique nature of electricity: it is not storable. Currently, the typical load profile of a power plant shows significant peaking at mid-day. The widespread introduction of plug-in hybrid electric vehicles (PHEVs) would add load to the grid during off-peak hours, increasing the efficiency of power plants from 70% to 80%, **West** estimates.

There are other, shorter-term, electrification strategies. These include truck stop electrification and port electrification. **West** estimates that there are over 75,000 long-haul trucks with sleeper cabs in California. Currently, these cabs idle overnight at truck stops; plugging these cabs in at truck stops would greatly reduce pollution and fuel consumption and would save truckers money. **West** estimates that truck stop electrification by 2020 could result in the emissions reduction equivalent of removing 360,000 cars from the road.

Port electrification is a particularly hot topic in Southern California, and it could lead to a significant reduction in pollution. An average ship produces four tons of pollutants while docked in a harbor. Plugging in (cold-ironing) 100 ships would have the emissions reduction effect of removing 535,000 cars from the road. Furthermore, cranes and container cooling units could be electrified in the short term, leading to significant reductions in emissions.

Finally, **West** discussed the prospects of plug-in electric vehicles (PHEVs), which are similar to hybrid electric vehicles, but have larger battery packs, and can be recharged from a standard wall outlet. **West** estimates that PHEVs can reduce emissions by over 60% from that of conventional automobiles, and that PHEVs can achieve nearly 100 miles per gallon fuel efficiency. A current PHEV example is DaimlerChrysler's new Sprinter van, which has a 20-mile electric range and consumes 40% less fuel than a conventional Sprinter van.

An Overview of Biofuels

Steve Shaffer, Office of Environmental Stewardship, California Department of Food and Agriculture

Shaffer began by stating that there exists the potential for biofuels to replace 35 to 70 billion gallons of gasoline yearly. Combined with increases in energy efficiency, the introduction of biofuels could mean a total replacement of oil as a fuel source. However, there remain many unanswered questions about the viability and sustainability of biofuels. There are currently many conversion processes for biofuels, each competing for market penetration, subsidy, and widespread acceptance. Some of these conversion processes are cleaner than are others. There also remain questions about the sustainability of producing fuel crops, with the inherent increase in water and land consumption that this would entail. However, **Shaffer** warns against framing the issue as a question of food vs. fuel; instead, he urges researchers and policymakers to view the increase in biofuels production as an opportunity for collaboration with the agricultural sector.

Shaffer pointed out that there are many different feedstock sources for biofuels, including conventional crops such as corn, sorghum, and sugarcane, as well as agricultural, urban, and forestry residues and wastes. Additionally, new, dedicated crops are being developed for use in creating biofuels. These crops include switchgrass and aquatic systems such as algae. **Shaffer** stressed the need for biodiversity; governments should move away from wholesale subsidies for certain crops, such as switchgrass. Rather, performance measures should be used to reward environmental benefits independent of crop and processing methods.

Shaffer then turned to corn ethanol, about which he believes there to be considerable confusion. There is a great deal of corn being shipped from the Midwest to the dairy industry in California. The starch from this corn could be processed into ethanol, and the remainder of the corn could be used as cattle feed. The cow manure produced in this process could also be used as biomass in power generation on-site. Shaffer believes there to be numerous such opportunities for agriculture and the energy sector to collaborate in coming years.

In sum, abundant biologically-derived renewable materials have the capacity to produce heat, electric power, transportation fuels and other useful products. Bio-energy helps contribute to the state's energy supply and is vital to waste and resource management efforts. Biofuels can be a significant part of our energy mix and will play an important role in meeting the Governor's targets for reductions in greenhouse gas emissions.

Natural Gas Engines for Heavy Duty Truck and Bus

Mostafa Kamel, Director, Alternative Fuels Product Development, Cummins Westport

Kamel presented on the opportunity for natural gas engines in heavy-duty trucks and buses. Natural gas is favored in these applications for its advantage over conventional fuels in CO2 emissions. Because natural gas resources are geographically constrained, there exist certain natural markets for the introduction of these vehicles. These markets include parts of the United States, Canada, France, Austria, China, the Philippines, Egypt, and others. Natural gas engines may be used in buses, refuse trucks, delivery trucks, street sweepers, and other heavy duty applications. Current natural gas engines produce a fraction of the greenhouse gases produced by conventional diesel engines, and new developments in engine technology will reduce emissions dramatically again by 2010.

However, natural gas buses are more expensive than are conventional diesel buses, and this has hampered their widespread introduction, excluding certain markets, such as Southern California. Both the natural gas vehicles and the natural gas filling stations are more expensive than are their diesel counterparts, though this gap is likely to shrink in coming years. Furthermore, as diesel prices have risen, the cost of natural gas has remained relatively stable, making it relatively more attractive. Coupled with growing concerns over energy independence, this has made natural gas a prudent option in many applications, and we are likely to see increased adoption of this natural gas engine technology.

Currently, only 14% of U.S. buses run on compressed natural gas (CNG), though this number is increasing; roughly 20% of all new bus orders are CNG vehicles. Fuel cost savings from CNG fleets can be significant, especially in high fuel use applications like transit bus and refuse collection operations. While transit bus operations are rapidly introducing CNG vehicles, refuse collection operations have been slow to adopt the technology, with only 1% of refuse collection vehicles using natural gas technology.

In sum, natural gas engines will be part of a broader energy strategy for the United States in the coming years. Natural gas resources are local, with large deposits remaining within the United States. The life cycle cost of natural gas engines is decreasing rapidly while conventional engine life cycle costs continue to climb. And finally, the emissions advantages of natural gas technology will play an increasingly important role as the nation looks for ways to reduce greenhouse gas emissions.

Prospects for Hydrogen in Automobiles and as a Long-Term Carrier in Future U.S. Energy Systems

Gene Berry, Engineer, Energy Storage and Conversion Group, Energy and Environment Directorate, Lawrence Livermore National Laboratory

Berry outlined the fundamental considerations of hydrogen as an energy carrier, describing ongoing work at the Lawrence Livermore National Laboratory on hydrogen storage and its use in a hydrogen hybrid Toyota Prius. **Berry** began by stressing that hydrogen is not an energy source in these applications, it is simply an energy storage medium. The energy stored by hydrogen can be created by thermal, chemical, or electrical processes, and the process of storing energy has inherent inefficiencies; the energy used to produce the hydrogen is greater than the energy won back by combusting it. However, if carbonless energy sources are used to create the hydrogen, these vehicles can decrease energy dependence and reduce greenhouse gas emissions dramatically.

Hydrogen vehicles have been researched for decades; indeed, BMW developed a hybrid liquefied hydrogen-gasoline vehicle 30 years ago. Honda has developed a hydrogen fuel cell vehicle that achieves a 90 miles per gallon fuel efficiency equivalent. However, all tests of hydrogen vehicles have had great difficulty with the storage of hydrogen fuel. There are four methods of storing hydrogen: as a liquid, a gas, chemically, or absorbed. Liquid hydrogen has been a favorite for long, but even a small leak in a liquid hydrogen tank can empty a tank in a matter of days. Compressed gas storage has similar problems, and the increased pressure leads to very high temperatures. Chemically bonding hydrogen to metals is certainly the safest process, but it is a slow and costly procedure. The

reliability of storage procedures is increasing, though more work must be done in this area to ensure safe and effective hydrogen storage before this technology will be widely accepted.

Clean electrical generation is necessary for hydrogen fuel to have a climate change impact. If hydrogen fuels can be produced using electricity generated from wind, solar, and other carbonless sources, hydrogen can become a clean, effective fuel.

Discussion

Phil Misemer asked **Khair** whether the HEDGE concept was applicable to light duty vehicles, heavy duty vehicles, or both.

Khair responded that it is applicable to light and medium duty vehicles.

Sperling commented that Honda has produced a diesel engine that is very elegant and simple, and that this development has been driven largely by regulation.

A question was raised as to the ability to retrofit existing diesel engines. **Khair** replied that the technologies outlined in his talk were not retrofit technologies; retrofitting is possible, though it has a different set of technologies not covered here. A Department of Energy project recently retrofitted a diesel engine with various technologies, such as a particulate filter, and this retrofit met 2010 diesel requirements.

A member of the audience asked **Khair** to comment on the competition between diesel and natural gas solutions.

Khair replied that engines can run on liquefied natural gas, but that this technology requires a great deal more infrastructure investment in, for example, filling stations, than does diesel.

Lee Schipper commented that many people, including the participants in the symposium, may not take the externalities of greenhouse gas emissions seriously enough.

Steve Brye added that hydrogen is used as rocket fuel; if policymakers took climate change as seriously as they do rockets, there would be infrastructure in place to fuel automobiles with hydrogen. **Brye** asked for comments on why there has been so little investment in hydrogen technology.

Axel Friedrich commented that the German government has been looking at a hydrogen-based energy market, and has found that it is not economically viable, with the possible exception of stationary electrical generation.

Berry replied that hydrogen should, in fact, only be used for transportation purposes.

Sperling commented that hydrogen is only used for energy storage; thus, it is useful in transportation applications. However, the real challenge, he posited, was to change behavioral paradigms to combat global warming.

Brye asked **West** whether Southern California could require cold-ironing for locomotives, as New York City does.

West replied that there are various reasons why cold-ironing for locomotives is not embraced, though diesel locomotive manufacturers are looking at retrofit technologies for just such an eventuality. He commented that electrification of railways is a good idea.

An audience member asked what the technical hurdles are to introducing plug-in electric hybrids.

West replied that the primary hurdle is the battery of the vehicle, though this is improving rapidly. The lithium-ion battery in particular shows a great deal of promise for making PHEVs economically feasible.

Tom Cosgrove commented that the city of Lincoln is the first city in California with a neighborhood electric vehicle (NEV) transportation plan. As part of this plan, lamp posts are fitted with electrical sockets. The city's strategy is to invest in infrastructure in advance of the widespread adoption of the technology. **Cosgrove** then asked about efficiency gains in the transmission of electricity.

West replied that there has been a lot of research in transmission and new composite materials, and that efficiency gains were likely in the future.

Carrie Downey mentioned to Shaffer that, though generation resources using biomass are located in certain areas, consumption takes place in other areas, and that an efficient transmission system is required between the two points.

Shaffer concurred.

An audience member asked **Shaffer** about invasive species being used for biomass. He asked if *arundo donax* could be used in the place of sugarcane.

Shaffer replied that researchers are looking at a number of biomass options. For example, studies have been conducted in Arizona and New Mexico using tumbleweed as a fuel crop. Gourds and melons have been used in experiments, also. Finally, crop rotation will be necessary in any instance to help stabilize the soil.

Session VII

What in the World? Transportation Energy and Greenhouse Gas Emission Planning Outside of the U.S.

Dave Calkins (Moderator), Partner, Sierra Nevada Air Quality Group

Global energy and climate change issues are just that: global. This second evening session will explore policy and planning efforts to increase energy efficiency and reduce greenhouse gas emissions in some developing and other developed countries.

Calkins opened this discussion by stating the importance of learning from foreign countries. In the next presentations, we will learn about foreign government policies and other voluntary and mandatory programs. We will see if other countries have the used command and control or incentives. Are there increasing efforts at the local level in your country? At the municipal level? And how do you make it happen?

Europe

Axel Friedrich, Head of Environment and Transport Division, Umweltbundesant, Germany

Friedrich began his presentation by stating if you take 50 actions at the same time, we can get rid of GHG in transport. In the European Environment Agency (EEA), there has been a big increase in GHG in transit. In Germany and UK, people believe that climate change is the biggest threat in the world. Integration of environmental concerns into sector policies has long been recognized as an important strategic approach to environmental policy-making in the European Union (EU). Improvements in fuel efficiency and pollution control over the last two decades, while not inconsiderable, have been more than offset by increases in the ownership, use, and power of motor vehicles of various kinds. The number of vehicles is growing almost everywhere at higher rates than both population and gross national product (GDP). Overall road traffic grows even more quickly. The largest increases over the next several decades are likely to occur in non-OECD countries, particularly in the Asia-Pacific region. Air transport is growing even more rapidly than road traffic, while use of public transport, which is generally more environmentally benign, is declining in many countries.

There has been a rise in energy consumption in road transport in 15 EU Member States between 1995 and 2003. The environmental and health impacts of transport, present and potential, are increasingly well understood. Governments have in recent years become increasingly concerned with setting long-term transportation goals that are consistent with sustainable development objectives. More than ever, because transport presents such special challenges, dialogue among disciplines, among levels of government, and among economic sectors is required to move forward.

Friedrich spoke of the voluntary agreement with the European Automobile Manufacturers Association (ACEA), Japan Automobile Manufacturers Association (JAMA) and Korea Automobile Manufacturers Association (KAMA). It is a voluntary agreement of the EU- commission and the EU council with ACEA to reach 140 gt/km in

2008 as a sales average of all sold vehicles in the EU. For JAMA and KAMA the goal is 140 g/ km in 2009. In 2012 the goal is 120/km if technically feasible. The Commission, being determined to address energy efficiency and CO2 emissions from cars, will if necessary propose in 2007 legislation to ensure that the 120 g CO2/km target is achieved by 2012 through a comprehensive and consistent approach, in accordance with the agreed EU objective. In parallel it will propose to strengthen EU requirements for labeling of cars. **Friedrich** also spoke of the correlation between fuel prices and transport fuel intensity. Taxes and consumption are highly correlated. The more you consume, the more you have to pay in taxes. He proposed to develop modeling tools to monitor and to project environmental conditions. This would assist countries in making action plans with clear goals for sustainable transport. **Friedrich** finally spoke of the implementation of the EU Biofuels Directive. In accordance with the biofuels directive, the Commission will bring forward a report in 2006 on the directive's implementation, with a view to a possible revision. It will address the issues of: national targets for the market share of biofuels; using biofuels obligations; requiring that, through a system of certificates, only biofuels whose cultivation complies with minimum sustainability standards will count towards the targets. Efficiency of given modes makes a difference in Germany, but mode split change has a bigger impact.

China and Mexico

Lee Schipper, Director of Research, EMBARQ The World Resources Institute (WRI) Center for Sustainable Transport

Schipper began his presentation by stating that he is not going to talk about national plans because he doesn't believe in them. **Schipper** works for EMBARQ, whose strategy is to foster viable government-business-civil society partnerships whose members are committed to finding solutions to the transportation-related problems facing the cities in which they operate. Established in May 2002, with the support of the Shell Foundation, EMBARQ - The World Resources Institute Center for Sustainable Transport - acts as a catalyst for socially, financially, and environmentally sound solutions to the problems of urban mobility. Working with politically and financially empowered authorities at local and global levels, EMBARQ can dramatically reduce the costs, risk, time, and complexity required to diagnose key transport problems, and design and implement sustainable, "best practice" solutions.

EMBARQ is making big change in Mexico City. In May, 2002, EMBARQ, signed a Memorandum of Understanding with the city government to create the Center for Sustainable Transport (CTS in Spanish), a clean urban mobility organization equipped to tackle local congestion, traffic accidents, and pollution problems through the implementation of sustainable transport solutions. This formal agreement with Mexico City outlined a strategy to allow EMBARQ and the CTS to serve as consultants to the city, promoting and advising projects to drastically reduce congestion, increase access to public transport, and make transit cleaner and safer in Mexico City. The four primary projects are: 1) Bus Rapid Transit: Design and assist with the development of a BRT system on city's primary avenues; 2) Diesel Retrofit: Retrofit the city's heavy-diesel bus fleet with catalytic converters and ultra low sulfur diesel after proving significant emissions reductions; 3) Test Clean Fuels and Buses: Test of best engine/fuel combinations for new high-capacity, low emission transit buses for future city purchases;

4) Non-Motorized Transport: Promote walking and cycling as sustainable transportation alternatives. These strategies have made great impacts for CO2 reductions in Mexico City, as well as air quality improvements.

Schipper then spoke of social sustainability, which contributes to building community. Governance is what makes the rules work. Working towards the goal of sustainable transportation systems is key. If you solve the tail pipe problem and fuel efficiency, you will still be plagued by a bad transport system.

However, China's growth and industrialization is a major factor for global GHG emissions. China's significant economic development over the past two decades has led to its rapid growth in industrialization, urbanization and subsequently, motorization. Its economic improvements have led to an increase in disposable personal income, while the increase in population has also resulted in additional consumer demand. Finally, the opening of the automobile market to foreign investors since the 1980s has created one of the largest automobile markets in the world. It is thus not surprising that the demand for private motorization has increased substantially over the past two decades, contributing to about 20 percent of the total increase in motor vehicles, where the total number of registered vehicles is now 27 million.

The externalities of motorization could be costly and include undesirable environmental and social consequences that could be reduced by various technology and policy measures if decisions are made promptly. Air and noise pollution due to transportation are now common in many urban cities, where air qualities are beyond national standards. Congestion and traffic safety have also become serious problems. Greenhouse gases (GHG) emissions, though not significantly emitted by the relatively small transport sector, have the potential to increase as motorization continues to grow. With the expanding burdens of energy security and environmental pollution, China is increasingly concerned with its growth in the transport sector and the need for fuel consumption diversity. Current policies are drafted to encourage energy efficiency, together with stringent fuel economy and quality standards imposed by the Government of China.

When comparing and contrasting Mexico and China, **Schipper** points out that cities in Mexico are built around the car and are more sprawling, whereas Chinese cities are built around the pedestrian and tend to be denser. In Mexico, there is high car ownership (>100/thousand), poor fuel economy, and a low share of urban trips are by non-automotive modes. In China, there is low car ownership (<12/thousand), higher fuel economy standards, but low prices. In terms of transportation, Mexico is more influenced by the U.S., whereas China is developing its own path.

Schipper concludes with asking the question: Are Mexico and China de-carbonizing? In Mexico the Metrobus is a huge step for reform, but the next step is to implement stricter fuel economy standards and put restraints on car use (possibly through congestion pricing). In China, fuel economy standards are a valuable first step, but it is important to establish real urban transport – not just token bus rapid transit (BRT). The next steps are car restraints and protection for NMT. Overall, fuel economy is necessary but not sufficient; good urban transport is necessary but not sufficient; more demos of success are needed in both countries. Good urban transport is necessary and it is important to make it convincing.

Argentina

Lucila Serra, Coordinator, Center for Global Change Studies, Torcuato Di Tella Fundacion, Buenos Aires

Currently fossil fuels dominate Argentina's energy consumption. In 2000 Argentina was South America's third largest energy consumer and emitter of carbon, resulting from the consumption of fossil fuels (with Mexico first and Brazil second). During the 1990s Argentina's energy demand grew annually at an average rate of 6%. Energy consumption in Argentina has been dominated by the industrial and transport sectors, and until the country's financial collapse in 2001, were expected to continue growing rapidly. Argentina's total energy consumption in 2000 was 2.7 quadrillion Btu, or 0.7% of the worlds total energy consumption.

For green house gas emissions, the Transport Sector represents 14% of the total emissions; enteric fermentation represents 20% of the total emissions; and the production of cement and metals represents 80% of the industrial processes emissions. The impacts caused by fossil fuels include: 1) Human health impacts, such as respiratory problems, heat-related deaths and illness, spread of disease (insect-borne diseases), drought (devastating effect on food resources, drinking water supplies); 2) Economic Impacts, such as national security, the end of cheap oil and gas, property loss & skyrocketing insurance claims; and 3) Environmental impacts, such as air pollution, water pollution, loss of biodiversity, desertification, and droughts. **Serra** states that while all countries will experience impacts, the developing world is most vulnerable to climate change. For Argentina, it is vital to address climate change because it is a new and additional barrier to sustainable development and it's adverse effects divert resources essential to social policies (such as housing, health, education and environment). Thus, it is of the country's interest to contribute to the international climate policy regime after 2012. In the last three decades Argentina has been working towards actions to mitigate climate change. Such actions include: Hydroelectric power (50% of electricity generation); substitution of fuel oil for natural gas in combined cycles; subsidies to wind energy; National Biofuels Act (5%); National Hydrogen Act, and the largest automotive fleet run with natural gas (1,100,000 vehicles). **Serra** concludes that climate change is a top policy priority in Argentina. Securing energy supply for its economic growth and curbing environmental pollution are top policy priorities. Argentina embraces technology cooperation with different parties in the field of climate change and clean energy. Argentina is now recovering from an economic and social crisis, and these systems are gradually getting reactivated, generating new investment and possibilities of development.

Canada

Michal C. Moore, Senior Fellow, Institute for Sustainable Energy, Environment, and Economy, University of Calgary

Canada is a country that is energy and resource rich, rather than technologically rich. Major Canadian industries include: Thermal energy generation, oil and gas extraction and processing, pulp and paper generation, cement and lime production, chemical production, mining, smelting and refining, iron and steel production. Many of these industries serve

the U.S. The Canadian population is concentrated near the borders. Hydrocarbon resources (e.g. oil sands) are concentrated in non-shield areas. Oil sands and unconventional oil production have begun to rapidly increase. However, it is an energy intensive process to get the oil out of the oil sands. **Moore** states that the development and growth in the oil sands, which is a tremendous problem, is one of the best things to happen to Canada. Initial export focused on US, but it is now increasing to China and in the future to India. With the expansion of oil sands activity, GHG emissions have increased and exceeded Kyoto targets. Overall energy demand in Canada has increased, even with improved energy efficiency. Challenges that will influence oil sands operations and consequent GHG emissions include competitive markets, long term cost of fuel, transport challenges, future cost of carbon reduction credits, difference in domestic versus international markets, and policy uncertainty.

Moore believes that climate change can open up passage ways, which will open up geopolitical struggles. Climate change has also led to changes in permafrost levels, which makes it difficult to access the oil sands. **Moore** concludes with advice given and beginning to be taken: "There are a number of compelling legal and economic reasons that corporations would be well advised to give careful consideration to the issue of climate change and even develop their own climate change action plan in advance of any regulatory requirement. . . . [T]here is reason for genuine concern that liabilities may be lurking for those who neglect the issue now, to the later detriment of the corporation and its shareholders."

Discussion

Larry Allen began the discussion by asking, what kind of opposition did Germany face from the vehicle fleet owners with regards to taxes? How did you overcome these problems? **Friedrich** stated that taxes are always a problem. In the UK, there is a tax on pollution levels, which is sort of regressive. The poor have older cars, so they get taxed more heavily. We say that taxes not only reduce pollution but also create safe jobs. Climate change costs over 50 billion per year, so the government has a great interest in stopping it. Education is also an important component to gain public approval.

Timothy Papandreou commented on **Schipper's** presentation in that he has been waiting two days to hear a talk like this from someone who is looking at a sustainable future, not just technological solutions. What can we import back to the United States within the existing transportation governance? How can we make the US more sustainable? How can we get people out of their cars and envision a car free future? **Schipper** responded that the US is a very greedy country. We can afford to pay $3.00 a gallon, but we don't want to and we see that we can force the price back down with public opinion. We've gotten so hung up on things being cheap and technical fixes – we can't accept the major change – until things get so bad. On Washington's agenda is cheaper fuel. As we have seen in this symposium, there is disagreement over what works and what doesn't. It's important not to give up hope, but the task is so huge. There are as many people in Atlanta as there are in Barcelona, but how do we get Atlanta to look like Barcelona? We have to start being able to say yes and stop being NIMBYs (Not in My Back Yard). We have to allow our corridors to be the ones we densify through infill development.

A question was asked about the general perception of climate change in Argentina and the sense of urgency. **Serra** responded that people are more concerned with poverty, security issues, and the energy crisis, but the government decided to make climate change a major priority. The government has been working towards public awareness and public policies. Argentina is just coming out of a real economic crisis and we are still trying to get on our feet again. To make climate change a priority and fundable will require help from outside. **Serra** also commented that transportation is more of a local issue in Argentina. And in this sector we're looking for small molecular solutions, not looking for a silver bullet.

Steve Brye commented about carbon sequestration. He stated that it's wonderful if it works, but disastrous if it doesn't. He relates it to when we thought nuclear was totally safe and saying it wasn't was blasphemous. **Brye** then asked about the risks of a leak. Are there other approaches that might work better? **Moore** agreed that the risks are high. When there's a major leak, it's likely to be catastrophic somewhere sometime. If a leak occurs, nothing locally will happen – but it will be catastrophic in the long term. How do you make someone pay when you can't match a leak to a scale of disaster? We just have to be really safe about figuring out how to sequester for a long time. This is not a riskless society. **Brye** then asks a follow up question about death of animals and people with releases of sequestration? What are the risks of asphyxiation? **Moore** responds by saying that he doesn't mean to sound callous, but the population density in the places of sequestration in the first round will be so low that while the biosphere will be a problem, humans won't be directly affected.

Roland Hwang asked a question about Canada adopting CA vehicle standards? **Moore** responded that all 12 Canadian cars have CA vehicle standards. Taking CA standards is a deflection of a macro-regional issue. Transportation emissions are not a major concern in Canada. Providing offsets for the dirtiest plants is more important. If oil sands are developed, the act of providing a sequestration process will be a top priority. Building a cable to transmit that energy will allow hydro plants to develop in the far north.

Session VIII

Responses to Global Energy and Climate Issues in Sacramento and Washington

Elizabeth Deakin (Moderator), Director, UC Transportation Center, Professor of Civil and Environmental Engineering, UC Berkeley

This penultimate session examined policy efforts to address energy and climate change by the U.S. federal government as well as in California and other states – particularly as they relate to transportation.

Elizabeth Deakin opened the session by commenting that very little discussion on land use had occurred at the symposium thus far. As an aside, she presented a slide show from **Donald Shoup** that showed a typical suburban shopping mall. She commented that the amount of land set aside for parking, especially considering the small percentage of that parking space that was used, was of serious environmental consequence. Large parking lots such as the one shown, she stated, damage the ecosystem by covering the earth with impermeable surface and creating heat islands. Furthermore, she commented, such parking lots are extremely hostile to pedestrians and cyclists. She urged participants to consider land use when thinking about climate change; too often the focus is only on vehicles and technology. She added that, as mentioned earlier, buses can be either inefficient or very efficient, depending on how full the vehicles are; coordinated transportation and land use planning can ensure that buses are full.

Federal Efforts to Reduce Oil Imports and Greenhouse Gas Emissions from Transportation

Greg Dotson, Minority Counsel, U.S. House of Representatives, Office of Representative Henry Waxman

Dotson began by stating that there has been a recent surge in federal interest in reducing oil imports and curbing greenhouse gas emissions. While there has been a great deal of interest on the federal level, he commented, there has been little action. Indeed, he commented, there has been a refusal to take meaningful and substantive action. The majority of action has occurred within the nonprofit sector.

The current administration, **Dotson** added, has set a nonbinding goal to allow U.S. greenhouse gas emissions to increase by 14% by 2012. Furthermore, the Bush administration has declared CO2 not a pollutant, rejected the Kyoto protocol, rejected any regulation of CO2, and opposed increasing Corporate Average Fuel Economy (CAFÉ) standards. While the administration has supported tax credits for hybrid vehicles, these incentives have been far outweighed by early incentives for sport utility vehicles (SUVs) weighing more than 6,000 pounds.

The Cantwell Amendment, recently defeated in the Senate, would have set the aggressive target of reducing oil imports by 40% by 2025. The administration, Dotson commented, was strongly opposed to this proposed amendment and similar legislation, and Republicans overwhelmingly voted against the amendment.

The administration's Environmental Policy Act (EPACT 05) requires the production of 4 billion gallons of renew able fuels per ye ar in 2006 and 7.5 bil lion gallons in 2012. However, industry experts a nd the Environm ental P rotection Agency report that the demand for such fuels already outstrips these requirem ents. **Dotson** added that the majority of ethanol plants are coal-fired, which negates greenhouse gas benefits that might be won by the use of renewable fuels.

Dotson estimated that the cost of oil imports had risen from $250 million daily in 2001 to $650 m illion daily today. In W ashington, support is growing to reduce this figure for multiple r easons: ener gy independence, national secur ity, and the environm ent. He commented that legislation to reduce oil dependence is gaini ng support, and that increased media attention will likely drive this interest higher.

Assessing the Impact of the Federal Energy Bill's renewable fuels standard (and other alternative fuels) on GHG emissions

Larisa Dobriansky, Deputy Assistant Secretary, U.S. Depa rtment of Energy, National Energy Policy

Dobriansky opened by stating that the United Stat es needs to increase investm ent in biomass research and d evelopment, and that re cent inc reases in crude oil price s will likely drive this funding. She countered **Dotson's** presentation by stating that his analysis of the current adm inistration's actions l ooked only at mandates, while leaving out incentives and voluntary program s that are, she feels, making a great deal of progress on energy security and climate change issues. She cited the Energy Star program as one such example. Mandates, in conjunction with incentives and voluntary programs, comprise the whole array of government actions on clim ate change, and these various approaches are, she commented, indeed spurring technological innovation.

Nevertheless, **Dobriansky** believes there is still much to be done on the federal level. The President's current focus on ener gy issues com es from his desi re to reduce the country's dependence on foreign oil, and this f ocus may work well in conjunc tion with ef forts to curb global war ming. Biom ass energy produc tion is a m ajor focus of the cur rent administration's energy policy; incentives for bio-energy programs have already been put in place, and these appear to be working.

Dobriansky em phasized the n eed to m ove ne w technologies quickly from the demonstration phase into the m arket. The Depa rtment of Energy, in pu rsuit of this goal, is focusing on deployment strategies, believing that the Department should see more from the b illions it inve sts in r esearch and development. The Departm ent of Energy is exploring strategic public-private partnerships , tax incentives, and other strategies to speed the deployment of new technologies.

Dobriansky further countered Dotson's arguments that EPACT 05's requirements for 7.5 billion gallons of alternativ e fuels by 2012 are too low by st ating that, though it appears the market will produ ce nearly 10 b illion ga llons by 2012, the requ irement sets a us eful minimum in the case that conditions change significantly in the coming years.

Dobriansky further stated that community-scale development and sustainable land use planning will need to be a significant portion of a set of integrated strategies to combat global warming. She cited a pilot project underway in Chula Vista, California, to develop model energy communities in which energy-efficient processes are integrated into the design of the community energy system. This project hopes to optimize energy use and productivity, yielding increased grid reliability, minimizing peak demand, and substantially reducing pollution and greenhouse gas emissions.

Assessing efforts to regulate greenhouse gas emissions in California

Ann Carlson, Associate Dean, UCLA School of Law

Carlson opened by stating that California is leading the way to reducing greenhouse gas emissions, and that the rest of the country can learn from the development of programs in California. While in some ways, the federal Environmental Protection Agency (EPA) has helped California's efforts, in other ways, the federal government has hindered the state's efforts.

The California legislature has passed several important pieces of legislation in recent years. AB1493 requires the state air quality board to reduce emissions from automobiles, while AB32 requires an overall reduction in greenhouse gas (GHG) emissions, regardless of the source. This bill requires the state to return to 1990 GHG levels by 2020, and institutes a system of mandatory reporting for major sources. SB1368, a little-noticed bill, requires utilities entering in to long-term contracts to purchase from energy providers that are as clean as current natural gas power plants.

Carlson pointed out that the Clean Air Act categorically preempts all states except California from regulating motor vehicle emissions. California can be granted an exception on the condition that state standards are at least as stringent as federal standards, and only under the condition of "compelling and extraordinary circumstances." California's request for a waiver is currently under review by the EPA.

Currently, the State of Massachusetts and others are suing the U.S. EPA. In Massachusetts et al v. EPA, the state is arguing that the agency has ignored its statutory duty by failing to promulgate regulations controlling greenhouse gases. The EPA has claimed that CO2 is not a pollutant, while the plaintiffs contend that it is. The fate of AB1493, which treats CO2 as a pollutant, depends upon the decision made in this case.

However, **Carlson** pointed out, there are additional legal hurdles for AB1493. As mentioned above, the EPA may grant waivers to the state of California only in "compelling and extraordinary circumstances." It is difficult to argue that greenhouse gas emissions, a global problem, constitute an "extraordinary" circumstance in California as opposed to, for example, Nevada or Texas.

Discussion

Michael Moore asked **Dotson** if he knew of the market penetration of the F150 truck with dual fuel capacity.

Dotson replied that E85 (ethanol fuel) market penetration has been limited by the retail outlets for the product. Some consumers who have purchased a dual-fuel vehicle are unable to take advantage of this feature because there are no E85 outlets near them.

Moore asked if there appeared to be a "tipping point" at which Congress will likely take more aggressive action.

Dotson replied that it is possible that President Bush will announce a climate initiative in the next State of the Union in an attempt to take leadership on that issue from the Democratic Party.

Steve Shaffer commented that an organization known as "25x'25" advocates for rural land-based activities providing 25% of the nation's energy supply by 2025, through the deployment of technologies such as hydroelectric dams, photovoltaic cells, and biofuels.

Dotson agreed that new engagement from the agricultural sector in energy issues could have enormous impacts on national and state policy.

Bob Larson commented that E85 has substantial benefits, and that greater efforts to link E85 stations with flex fuel vehicles are needed.

Dotson commented that there are roughly 60 U.S. Senators who would likely vote for most pro-ethanol legislation.

Lindell Marsh asked **Dobriansky** where the demonstration project she mentioned will be located.

Dobriansky replied that it will be in Chula Vista, south of San Diego, and that the project is moving to deployment soon. She added that this project demonstrates the need to not only meet demand in cleaner, less carbon-intensive ways, but also to lower our energy consumption baseline as much as possible. In effect, it should be a major goal to manage energy demand.

Huasha Liu commented that, though it is vitally important to discuss such programs, it is equally important to take action to implement ideas to lower greenhouse gas emissions, and to implement these strategies soon.

Dobriansky replied that it is important to use the "whole arsenal" available at all levels of government, and that a great deal of citizen participation and local action are also required.

Diane Forte asked **Carlson** how AB32 might be linked to enforcement opportunities and concrete action.

Carlson replied that this remains unclear, as the bill is fairly vague.

Forte asked if it is possible to link CO2 to ozone in order to classify it as a pollutant.

Carlson replied that the classification of CO2 is entirely a matter of statutory interpretation, and that the term "pollutant" is very well defined.

An audience member added that there are risks associated with simply focusing on higher fuel efficiency, and that much more attention should be paid to smart growth and land use planning. He commented that the second biggest contributor to lower emissions that California expects is sustainable land use planning.

Bruce Riordan asked what role laypersons can play in urging public agencies to include explicitly climate change in their long-range planning.

Carlson replied that laypersons can write amicus briefs, though these rarely have much impact on the court. She added that public opinion does not and should not be the place to look for answers in court cases; Congress, she stated, should have spoken clearly on this issue, and Congress looks to public opinion.

Timothy Burroughs mentioned that, especially in California, planners are looking at the land use – transportation connection to the environment. The state, he stated, must look for greater local government participation in order to meet targets.

Steve Brye commented that the U.S. EPA has approved hundreds of Environmental Impact Statements (EIS) over the years that classify CO2 as a pollutant.

Carlson replied that the EPA has done many such things in the past that conflict with its current stance on CO2.

Robert Wyman added that EIS documents do not currently evaluate climate impacts of projects.

Carlson replied that it is likely that environmental plaintiffs will soon begin to make climate change claims.

Session IX

Linking Decision-making to Global Energy and Climate Issues – Opportunities and Uncertainties

Brian D. Taylor (Moderator), Associate Professor and Vice Chair of Urban Planning, UCLA School of Public Affairs; Director, UCLA Institute of Transportation Studies

This closing session directed its attention both globally and locally by examining local and regional efforts to address both energy and climate change issues here in the U.S. and abroad – again with a focus on transportation and land development policies. What are some local actors doing to address these issues, and can acting locally make a difference? The session concludes by examining the question of what policymakers ought to do about these complex, global issues and when they should do it? How can we make wise decisions in times of uncertainty? When is it best to act, and when is it best to wait?

Efforts by local and regional governments in the U.S. to link transportation and land use planning to global energy and climate change issues

Debbie Cook, Council Member, Huntington Beach City Council

Cook began her presentation with an energy mandate: we cannot solve the climate change challenge without addressing **land use** and **transportation**. Forty two percent of Americans say that the number one national security issue is energy independence. To meet the unprecedented challenge these dramatic changes present, it is imperative that policymakers at every level of state and local government join with environmental, business, labor, public health, education, and social equity leaders to devise and implement solutions that will ensure long-lasting environmental protections for our local communities, our natural places, and the resources that sustain our health, economy, and quality of life. We know that climate change is a serious threat to our future and that the countless environmental challenges we now face will either contribute to or will be exacerbated by global warming. Now is the time to address these challenges. Now is the time to change the climate in our statewide, regional, and local policymaking. We have reached the tipping point for this issue. Conventional oil and gas production has peaked and we are beginning to turn to more carbon intensive sources. The question now is who will provide the leadership needed for change? If no one thinks there is a problem, nothing will change. However, we are receiving conflicting information from the media. When people are confused, they don't act. People believe that the government isn't doing anything.

Cook believes we need a combination of conservation, efficiency, electrified transport, CAFE standards, transit oriented development (TOD), green building standards, localized services and agriculture, planting of trees, and assumption of high energy costs. Renewables make up such a small portion of our energy usage. A gallon of gasoline is very intensive and energy quality is an important part. One of the environmental challenges **Cook** brought up is the tar sands discussion. North America has peaked in

natural gas production and the way we are extracting oil around the world is unsustainable. In China 5,000 men die every year in coal mining disasters. She asks the audience: What are *you* (as elected, staff, or citizen) willing to do to bring about a different outcome? **Cook** believes that California is doing an incredible amount of things. How do we communicate different levels? CDs are a good way to distribute information. However, there are real challenges ahead. It is important to get people motivated and excited about this project. She concludes by stating that "We as individual citizens must embrace the culture of conservation so that we change the balance... I am suggesting a national effort in the way we behave and use energy, including autos, homes, work..." We all have to dance on the edge of the scope of your authority. We need to be more urgent in everything we do.

Local efforts outside the U.S. to increase energy access and reduce greenhouse gas emissions

Timothy Burroughs, Program Officer, International Council for Local Environmental Initiatives (ICLEI)– Local Governments for Sustainability

Burroughs began by stating that local governments can make an enormous contribution in the greenhouse gas (GHG) solution. ICLEI is a membership organization committed to reducing GHG emissions through local government action. The organization provides technical assistance to communities wishing to become more sustainable. ICLEI believes that the physical design of an urban settlement has inertia that helps determine energy demand for 50 to 100 years. Local governments also own vehicles and buildings and produce GHG emissions, too – usually between 2% and 10% of a city's total GHG emissions.

Local governments can implement many sustainable energy policies. Chief among them are land use and transportation policies, though municipal solid waste facilities also produce significant GHG emissions. Local governments are best equipped to tackle these problems because they are closest to their constituents and are more responsive than is the federal or state government.

Burroughs pointed out that there are also co-benefits to measures to increase sustainability: primarily, these are budget-friendly measures. Coordinated land use and transportation planning can also protect public health and reduce congestion, ICLEI believes. By taking charge on the issue of global warming, local officials can also increase their image as leaders.

ICLEI approaches its technical assistance outreach by estimating a municipality's current emissions, setting a target, developing a reduction plan, and assisting in the implementation of this action plan. Burroughs stated that it is important to be able to quantify the GHG baseline of a community and to measure progress accurately from that baseline. Monitoring and evaluating progress along the way, ICLEI then assists local governments in setting new goals. Another key activity for the organization is technology transfer and cataloguing best practices found throughout the world.

Municipalities can implement various policies and programs to reduce GHG emissions. Some are "low-hanging fruit", easily accomplished, while others are long-term goals. Burroughs highlighted some of these measures implemented worldwide:

Surabaya, Indonesia
- 5% surcharge of gas
- Taxing old and polluting vehicles
- Odd-even car days on demonstration bus way
- Environmental trust fund established

- Baguio, Philippines
- Number-Coding Scheme for Motor Vehicles, with one rest day for each vehicle (no driving allowed)

Sao Paulo, Brazil
- Methane to Energy
- Guntur, India
- Streetlight Management: Install energy savers and meters at 352 junction boxes

Bhopal, India
- Streetlight retrofit for greater efficiency

Querétaro, Mexico
- Retrofit 10,000 street lights
- Increase efficiency of public buildings
- Modernize water pumping equipment
- Convert vehicles to LPG
- Separate solid waste at source
- Separate solid waste collection & composting

Keene, New Hampshire
- Conversion of municipal fleet to biodiesel

Finally, **Burroughs** introduced a software tool, the Harmonized Emissions Analysis Tool (HEAT), which helps local governments measure their current emissions and identify potential ways to reduce GHG emissions.

Making wise policy under uncertain conditions: Energy futures, climate change, and transportation

Robert J. Lempert, Senior Scientist, RAND

Lempert began by introducing the RAND Corporation. RAND is a nonprofit institution dedicated to conducting objective, nonpartisan research. Currently, RAND has a major climate change research endeavor underway. **Lempert** believes that, regardless of emerging solutions to the greenhouse gas problem, the Earth will experience significant climate change already set in motion. The exact effects of this climate change, however, are difficult to predict. For example, precipitation could either increase or decrease; it is extremely difficult to plan for this kind of uncertainty, but it is necessary. **Lempert**

believes that our visions of the future are inherently anchored in the reality of today, and that we must be aware of this tendency in order to be able to plan for a radically different tomorrow.

Though there will remain deep uncertainty about the future of the Earth, the research community must construct models to make predictions, and policymakers must respond to this research with action. However, it has proven tremendously difficult to construct valid models of the effects of climate change, as it remains unclear which systems are in play and in which ways they will interact with one another. Thus, researchers must remain mindful of the vast uncertainty of their predictions, and policymakers must plan for various scenarios, choosing policies and actions that help prepare for as many future outcomes as possible.

Lempert introduced the concept of "incremental steps to radical change." This concept includes a variety of strategies to ameliorate the effects of global climate change already set in motion while reducing greenhouse gas emissions and further climate change. Through technology research, the development of a market for new technologies, and changing attitudes toward climate change, emissions can be reduced. The introduction of a carbon-trading market and performance incentives can furthermore create a climate in which the transition to low-carbon technologies occurs with few problems. **Lempert** believes, for example, that while the creation of a carbon market may prove difficult, sustaining the market will require little effort at all, as industry adapts and the market becomes accepted.

Discussion

Tom Kelly began the final discussion by stating that he wished this panel had spoken at the beginning of the symposium. **Kelly** clarified that the Kyoto Protocol does not end in 2012, as was stated in the earlier presentation. The next phase of Kyoto began after the last Montreal conference.

Nancy Kete commented on programs which limit driving on certain days, such as the program implemented in Mexico City. She stated that this was not an effective program because instead of driving own cars, people took taxis, which were highly polluting. She was alarmed to hear that people are following this model in other countries. Is this program a good idea? **Burroughs** responded that these types of programs have worked in some places, but not in others. It is equally important to study what works *and* what doesn't work. In Indonesia, they are achieving quantifiable results by enacting programs such as these. We need to learn why Mexico didn't work. It is important to try different creative policies to see what is possible. **Lempert** agreed that learning from our mistakes is valuable information. We have to try many different solutions. Given the magnitude of the climate program, we have to experiment with radical changes. **Cook** echoed these points and stated that local governments could serve as role models by enacting creative policies and allowing workers to telecommute one day a week.

Richard Napier commented that small changes today could make a big effect in 30 years. Napier wanted to clarify the take-home message from this final presentation. The three important points that he noted were: 1) education, which will have an immediate

impact; 2) fuel efficiency of transportation; 3) work on new initiatives, incentives, regulations and mandates. **Lempert** commented that this is a good list, but he would like to add one more: think locally and place specific. A small change in design could make a big savings down the line. **Burroughs** added that we shouldn't underestimate the policies of smart growth and land use. There are a lot of great changes happening now and we don't start from zero. We should look at what's already working and build on that.

Timothy Papandreou commented that the most important thing he learned at this symposium is the importance of working for the environment. We must all lead by example. **Papandreou** said that he is not afraid of getting fired, so that allows him freedom in his work. He also shared that he doesn't own a car, so it is possible to get around Los Angeles without a car. It is a personal choice he made. The future is about choices; if we can't conceive of a future where it is possible to be carless, then we are not thinking outside the box. We need to retrofit our cities instead of just talking about fuels. Cars should be for special trips only. **Papandreou** posed a question to **Lempert** about immigration flows from the losers in climate change refugees. What strategies have you considered? **Lempert** answered that we haven't looked at any strategies yet, but it's very important to do so.

A comment was made about the importance of urban structure. Instead of patting ourselves on the back for small local solutions, we need to start acting with a greater sense of urgency in the U.S. We need to focus on that as a very concrete form of local action that will have huge impacts, without worrying about the rest of the world. **Cook** responded that we really have our heads in the sand here. It is important to look at world news and see what other countries are doing, but also focus on local changes. The EU is poised to pass really stringent energy efficiency standards. This means we can't sell there if we don't meet those standards as well. This will impact our economy if we don't think in those terms.

Nathan Landau offered ruminations on land use issues. When we think of the time scale of the built environment, such as castles built in the 1300s, we are now constructing a disposable landscape. A big box store has a life span of 9 years. At what time frame could we really start to retrofit our cities? How long would it take before we notice? What's the time frame on this? **Lempert** agreed with **Landau's** comment. He stated that it is important to think about the decisions we're making now and what their impacts will be in the future. The time frame depends on what the strategy is and when we'll see the effects. Land use strategies are longer-term.

Steve Brye asked a clarification question about zero net emissions. What does this term mean and what are the implications of failure? **Lempert** answered that in order to stabilize GHG emissions, we need zero net human contributions. This is an incredible goal, but is an example of the radical change we need to get back to pre-industrial climate. There is no such thing as a stable climate. **Taylor** added that we are looking at changes in the slope of the growth rate.

Tom Cosgrove noted that land use planning is in the title of this conference, so how can we use planning to accomplish local change? We are dealing at the local level with communities that are widely varied. How can we address all these communities while still looking at the big picture? **Cook** believes that a regional approach might be the best

way to address these issues. SCAG could act as a repository for information. We can also put pressure on League of California Cities to think about energy and global warming.

Bob Larson addressed the issue of a vehicle tax which Axel brought up in his talk about Germany (the Oekotax). **Larson** asked, how did these taxes get passed? Was there a big educational campaign on why this tax was good for Germany? This is an example of a top down approach. How important is it that there is bottom-up support? **Lempert** believes that working with local officials is very important because they have good contacts with Washington. All three levels of government have to work together, but unfortunately there is not a lot of coordination. Thus, there must be a combination of top-down and bottom-up approaches. The power of community members and local officials is very important.

Steve Shaffer emphasized the importance of land use planning and preserving California's agricultural land. However, there is a lack of funding for updating general plans. This must be changed. **Burroughs** agreed that this is a very important point because many plans are 10-20 years old. It is necessary to encourage cities to integrate land use planning into the general plan. Plans must also be updated to include a climate plan into the comprehensive general plan. Marin County is a leader in this.

The Honorable Steve Kinsey commented that Marin is trying to go fossil free by 2033. Some of the strategies include a carbon credit card for municipalities. Carbon credits have the potential to generate funding for municipalities. We also have to start putting smart growth in areas where we want it, not in the Central Valley for example. His final comment was that we waste a lot of time fighting each other instead of working together. **Burroughs** agreed that coordination among local government is necessary for a climate task force to work.

The last few comments involved using the 1970s Clean Air Act as a model to reduce GHG emissions. It is important to look at short term actions as well as long term solutions. **Judy Corbett** suggested that people who are interested in issues of land use should attend the National Smart Growth conference which will take place in Los Angeles in 2007. See: http://www.newpartners.org.

Brian Taylor closed the symposium and concluded by echoing the final panelists. He stated that if we agree about the urgency of problems right now, the actions we take can have effects in decades ahead. The question still remains, specifically how do we bring that urgency forward together and merge today's issues (affordable housing, etc.) with GHG reduction goals? These questions warrant more reflection.

Conclusion

The 16th annual ***Transportation, Land Use and Environment Connection*** symposium addressed a timely topic with its focus on **Global Energy and Climate Change** in 2006. It succeeded in underscoring the complexity of the issues related to our use of energy resources and changes to our climate on a global scale.

The discourse of the speakers and participants included the sharing of diverse perspectives of academicians, business and government professionals, environmentalists, economists, scientists, industry experts, and elected officials. The discussion was reflective, passionate, confusing and yet forward thinking. The variety of views underscored the immensity of the issues which cannot be understated and are not well understood as a whole.

In the search for solutions, strategies were offered and discussed which varied widely and ranged from immediate, simple and easily-implemented to long-term, far more challenging efforts. Vehicle and fuel technologies will certainly play a significant role in reducing greenhouse gas (GHG) emissions. Automobiles, trucks, and other vehicles can and will be made cleaner, more efficient, and less carbon-intensive. The pros and cons of different fuels were discussed, and although improving personal and commercial vehicle fuel efficiency is one tactic in any GHG reduction strategy, another equally important tactic involves the reduction of vehicle miles traveled (VMT). One such means is expanding the overall share of transit in U.S. transportation. In addition, land use patterns and regulations, including parking regulations, all have the ability to influence travel behavior, and should be part of a larger mix of emission reduction techniques offered in our communities.

One of the paramount notions put forward by the symposium was that the exact ramifications of energy choices and climate change are not yet clear or well understood, yet most researchers agree that steps must be taken now to help ameliorate the effects, whatever they might be. Strategies were offered as useful tools and it is apparent that they will have to account for this continued uncertainty and attempt to compensate for a variety of potential future scenarios. Public policy decision making in this climate of uncertainty is plagued with difficulties.

In summary, the issues are global and complex. The call to action is urgent, yet undefined. One notable achievement of the symposium was conveying this sense of immediacy in recognizing the plethora of issues surrounding **Global Energy and Climate Change**. In choosing appropriate actions, it is imperative that public policy decision makers take into account that knowledge of the effects of our actions in addressing these issues is limited and unfolding. The link with research has never been more critical.

Program

APPENDIX A:

SYMPOSIUM PROGRAM

October 22-24, 2006
UCLA Conference Center at Lake Arrowhead
850 Willow Creek Road
Lake Arrowhead, California

OVERVIEW

The links between local land use and transportation systems, and global weather systems and energy markets were cast in the sharpest possible relief when Hurricane Katrina slammed into New Orleans late last summer. Debates among scientists who study the effects of human activity on climates, and policymakers seeking both economic growth and environmental sustainability have intensified in recent months as fuel prices have climbed to unprecedented levels. How are fuel prices likely to fluctuate in the years to come? What effects will higher fuel prices have on travel and commerce? What effects do transportation systems have on global climate change? How might changes in climates affect both land development and transportation networks? What, if any, cleaner, cheaper fuels and propulsion technologies are on the horizon? And what are policymakers—local, state, national, and international—doing to cope with these issues in effective and affordable ways?

These and related questions motivate the
16th annual UCLA Lake Arrowhead Symposium on the Transportation-Land Use-Environment Connection.
Our goal is to bring together a wide variety of experts on these topics to speak on and debate, from many perspectives, what we know, what we need to learn, what others are doing, and what is not being done to address changes in global energy markets and climate patterns in the years to come.

Symposium Co-Organizers:

Catherine Showalter, Director, UCLA Extension Public Policy Program

Brian D. Taylor, Associate Professor and Vice Chair of Urban Planning, UCLA School of Public Affairs, and Director, UCLA Institute of Transportation Studies

Sunday Afternoon, October 22

1:00 pm — Symposium Overview

Brian D. Taylor, UCLA

1:30 pm — **ENERGY AND CLIMATE CHANGE: IMPLICATIONS FOR PUBLIC POLICY**

This opening session lays the groundwork for this wide-ranging three-day symposium. Four foundation talks will address current scientific evidence on climate change, the role of the transportation sector in energy consumption and atmospheric emissions, a framework for evaluating energy and climate change policies, and strategic political considerations in energy and environmental security.

Climate Change Science: What We Know and Don't Know

Stephen H. Schneider, Professor, Department of Biological Sciences, and Senior Fellow, Center for Environmental Science and Policy, Institute of International Studies, Stanford University

Transportation, Energy, and Emissions: An Overview

George Eads, Economist, Charles River Associates

- **Evaluating the Costs and Benefits of Energy and Climate Change Policies: An Overview**

Joe Aldy, Fellow, Resources for the Future

- **Global Politics of Energy and Environmental Security: An Assessment**

Jason Grumet, Executive Director, National Commission on Energy Policy

3:15 pm — BREAK

3:30 pm — **LINKS BETWEEN GLOBAL CLIMATE CHANGE AND LAND USE/TRANSPORTATION**

This second session will explore the transportation-land use connection to global climate change. The first presentation will examine how possible changes to weather patterns and sea levels may affect cities and the transportation networks that link them in the coming years. The second talk addresses whether and how land use and transportation policies may help to mitigate rates of climate change in the years and decades ahead.

- **Projected Effects of Global Climate Change on Land Development and Transportation Infrastructure**

Joanne R. Potter, Senior Associate, Cambridge Systematics

- **What Contributions Can Land Use and Transportation Planning Make to Mitigating Climate Change?**

John Poorman, Staff Director, Albany Metropolitan Planning, New York

5:00 pm — CHECK-IN AND RECEPTION

6:30 pm — DINNER

Sunday Evening, October 22

8:00 pm **THE BUSINESS OF UNCERTAIN ENERGY AND CLIMATE FUTURES: A ROUNDTABLE DISCUSSION**

To complement the focus on science, data, and public policy evaluation in the two opening sessions, this evening panel will explore future changes in energy prices, climatic patterns, and policies that aim to address them from a private sector perspective—particularly as they relate to land development, shipping, and travel.

Moderated Discussion

■ Auto/Truck/Engine Manufacturers

■ Development Interests

Dan Cashdan, Co-Head of Investment Banking, HFF Securities

■ General Business Interests

Gerald Secundy, Boardmember, State Water Resources Control Board

■ Petroleum Interests

James Randolf (Randy) Armstrong Jr., Manager Compliance Assurance, Shell Oil

■ Goods Movement

Gordon Dorsey, Senior Director of Corporate Communications, Maersk Shipping (invited)

■ Insurance

TBA

■ International Business Interests

TBA

9:30 pm INFORMAL RECEPTION AND DISCUSSION

Monday Morning, October 23

7:30 am BREAKFAST

8:30 am **GLOBAL ENERGY: RESERVES, USAGE, AND PROSPECTS**

Rising energy prices, particularly for transportation, have garnered a lot of attention in recent years. Are these changes part of normal cycles and fluctuations, or do they portend an era of rising energy prices? If the latter, how are energy markets expected to change in the coming years? This session examines these questions by first reviewing projections on reserves and prices of conventional energy sources, the market potential for future energy sources in the coming years, and the implications of rising and/or volatile energy prices on the economy and travel in the future.

■ **Understanding Energy Markets I: Future Reserves, Production, and Prices for Conventional Energy Sources**

John Kilduff, Senior Vice President, Energy Management Group, Fimat USA, Inc. (invited)

■ **Understanding Energy Markets II: Future Reserves, Production, and Prices for Alternative Energy Sources**

Heather MacLean, Associate Professor, Department of Civil Engineering, University of Toronto

■ **How Have and How Will Changes in Transportation Energy Prices Affect the Economy and Travel Behaviour?**

Kurt Van Dender, name and title to come

10:15 am BREAK

10:30 am **NEW VEHICLES, NEW FUELS I: THE LONG VIEW**

How and when do new fuels and/or engines become cost-competitive? By what standards should we make such judgements? How much transition should be handled by private markets, and what roles should public policy play? What are likely to be the relative roles of new engines, new fuels, and behavioural changes in regards to future rates of fuel consumption and emissions? These questions and more will be addressed in a plenary presentation, commentaries, and ensuing discussion.

■ **Future Fuels and Vehicles: What Are the Near and Long Term Possibilities?**

Daniel Sperling, Director, Institute of Transportation Studies, and Professor, Civil & Environmental Engineering, UC Davis

■ **Commentary**

Roland Hwang, Senior Policy Analyst, Natural Resources Defense Council

Margaret Bruce, Director of Environmental Programs, Silicon Valley Leadership Group

12:00 pm LUNCH

Monday Afternoon, October 23

1:30 pm **NEW VEHICLES, NEW FUELS II: EXPLORING THE ALTERNATIVES**

The commercial success of hybrid-electric vehicles has raised awareness among public officials and the public about the possibilities for introducing substantially cleaner and more efficient vehicles in the coming years. Accordingly, this session will examine many of the most important alternatives to conventional fuels and propulsion. What are the pros and cons of each, and what is the prognosis for wide-spread implementation in the coming years?

■ **After Diesel: Options for Cleaner Trucks, Trains, and Ships**

TBA

■ **Electricity**

David Modisette, Executive Director, California Electric Transportation Coalition

■ **Bio-Fuels**

Steve Shaffer, Director, Office of Agriculture and Environmental Stewardship, California Department of Food and Agriculture

■ **Hydrogen**

Scott Samuelson, Professor and Director, Advanced Power and Energy Program, UC Irvine (invited)

■ **Other Sources for Transportation**

TBA

3:15 pm FREE TIME

5:15 pm RECEPTION

6:00 pm DINNER

Monday Evening, October 23

7:30 pm **WHAT IN THE WORLD? TRANSPORTATION ENERGY AND GREENHOUSE GAS EMISSION PLANNING OUTSIDE OF THE U.S.**

Global energy and climate changes issues are just that: global. This second evening session will explore policy and planning efforts to increase energy efficiency and reduce greenhouse gas emissions in some developing and other developed countries.

Moderated Panel

■ **Europe**

TBA

■ **China**

TBA

■ **Mexico**

TBA

■ **Canada**

TBA

9:00 pm INFORMAL RECEPTION/DISCUSSION

Tuesday Morning, October 24

7:30 am BREAKFAST

8:30 am **RESPONSES TO GLOBAL ENERGY AND CLIMATE ISSUES IN SACRAMENTO AND WASHINGTON**

This penultimate session examines policy efforts to address energy and climate change by the federal government here in the U.S. as well in California and other states—particularly as they relate to transportation.

- **Federal Efforts to Reduce Oil Imports and Greenhouse Gas Emissions from Transportation**

Greg Dotson, Minority Counsel, U.S. House of Representatives

- **Assessing the Impact of the Federal Energy Bill's Renewable Fuels Standard (and Other Alternative Fuels) on CHG Emissions**

Larisa Dobriansky, Deputy Assistant Secretary for National Energy Policy, U.S. Department of Energy

- **Assessing Efforts to Regulate Greenhouse Gas Emissions in California**

Ann Carlson, Associate Dean and Professor, UCLA School of Law, and Co-Director, Frank G. Wells Environmental Law Clinic

- **California's Climate Action Plan**

Linda Adams, Secretary for Environmental Protection, California EPA

10:15 am BREAK

10:30 am **LINKING DECISION-MAKING TO GLOBAL ENERGY AND CLIMATE ISSUES—OPPORTUNITIES AND UNCERTAINTIES**

This closing session goes both global and local by examining local and regional efforts to address energy and climate change issues here in the U.S. and abroad—again with a focus on transportation and land development policies. What are some local actors doing to address these issues, and can acting locally make a difference? The session concludes by examining the question of what policymakers ought to do about these complex global issues, and when they should do it? How can we make wise decisions in times of uncertainty? When is it best to act, and when is it best to wait?

- **Efforts by Local and Regional Governments in the U.S. to Link Transportation and Land Use Planning to Global Energy and Climate Change Issues**

Debbie Cook, Council Member, Huntington Beach City Council

- **Local Efforts Outside the U.S. to Increase Energy Access and Reduce Greenhouse Gas Emissions**

Abby Young, Director of Strategic Planning, ICLEI, Local Governments for Sustainability (invited)

- **Making Wise Policy Under Uncertain Conditions: Energy Futures, Climate Change, and Transportation**

Robert J. Lempert, Senior Scientist, RAND

12:15 pm LUNCH AND ADJOURNMENT

APPENDIX B:

SPEAKER BIOGRAPHIES

MARLON G. BOARNET is Professor of Planning, Policy, and Design and Economics and Department Chair at the University of California, Irvine. Boarnet is guest editor of the forthcoming (Winter, 2006) *Journal of the American Planning Association* special issue on the topic of planning and health. Boarnet is co-author, with Randall Crane, of *Travel by Design* (Oxford University Press, 2001). That work provided methodological grounding and empirical evidence on the question of how the built environment influences travel behavior. Boarnet has since extended that work to examine the link between the built environment, walking travel, and physical activity. Boarnet's research on planning and non-motorized travel has been funded by the California Department of Transportation, the Robert Wood Johnson Foundation, and the University of California Transportation Center. In 2003, Boarnet was invited to write the background paper on data sources and empirical methods for a panel on transportation, physical activity, and health convened by the National Research Council's Transportation Research Board and the Institute of Medicine. Since that time, Boarnet's research on planning and health has resulted in publications in the *Journal of the American Planning Association*, the *American Journal of Preventive Medicine*, and the *Handbook of Urban Health*. In 2005, Boarnet spoke on the topic of planning and health at the annual conference of the Robert Wood Johnson Foundation's Active Living Research Program and in meetings or seminars at Caltech, the Southern California Planning Congress, and the California Planning Roundtable. Boarnet is co-editor of the *Journal of Regional Science*, is an associate editor of the *Journal of the American Planning Association*, and is on the editorial boards of *Papers in Regional Science* and the *Journal of Planning Literature*

DAVID CALKINS has nearly 40 years experience in government and the private sector. Since leaving his position as Air Programs Branch Chief for U.S. EPA (Region 9) in 1995, he has worked as an independent consultant. His government career included time with the Bay Area Air Quality Management District, the World Health Organization, United Nations Development Programme, the U.S. Agency for International Development, various environmental organizations, and the National Commission on Air Quality (a congressional commission). In addition, Mr. Calkins was personally involved in the last three Clean Air Acts (1970, 1977, and 1990), both in providing direct assistance in writing and reviewing mobile source and land use measures for congressional staffs. As a consultant, Mr. Calkins has worked in the U.S. and abroad. He has special expertise in evaluating the relationship between transportation system changes and their effects on air quality. His current projects include revising the CO SIP for Las Vegas, developing control measure strategies for the Dallas-Fort Worth 8-hour ozone SIP, evaluating air quality impacts of a new mixed-use development in Oregon, providing on-going air quality and transportation policy assistance to the San Joaquin Valley COGs, and participating in the development of an EIR for a major new

international airport near Las Vegas. He was involved for EPA in planning the initial Arrowhead Symposium in 1991 and has participated in nearly all of the symposia since that time.

TODD CAMPBELL, Burbank Vice Mayor, serves as member of the MSRC representing the Los Angeles County Metropolitan Transit Agency. Todd has served as a member of numerous organizations and committees, many with an emphasis on environmental issues, including the California Natural Gas Vehicle Partnership, the California Fuel Cell Partnership, the Burbank Environmental Oversight Committee, the Arroyo Verdugo Subcommittee, the Southern California Association of Governments' Goods Movement Task Force, and the Center Trust/Downtown Revitalization Task Force. In addition to his public service, Todd also serves as Policy and Science Director for the Coalition for Clean Air. As Policy Director, Todd heads the policy and research arm of the organization and directly manages both the Transportation and Public Health and Air Toxics programs. Todd has an extensive background in public health, industrial hygiene, mobile source pollution, clean alternative fuel transportation technologies, and air toxicology. Prior to taking a position with the Coalition for Clean Air, Todd was a policy analyst with the Natural Resources Defense Council working on public health issues.

DON CHEN is the founder and Executive Director of Smart Growth America (SGA) and leads its coalition building, policy development, communications and research efforts. SGA is a national advocacy coalition promoting a better way to grow: one that preserves open space and farmland, reinvests in existing communities, keeps housing affordable and offers more transportation choices. Throughout his career, Don has published numerous writings on land use, transportation, social equity and environmental policy, including "The Science of Smart Growth," which appeared in the December 2000 issue of Scientific American, and co-authoring *Once There Were Greenfields*, an authoritative review of the economic, environmental and social costs of sprawl. He has lectured widely in North America, Europe, Australia and Asia, has testified before the United States Congress on smart growth issues, and is frequently interviewed by the media, including recent appearances on CNN, National Public Radio, The New York Times and many other programs and publications. Don serves on the Boards of Directors for West Harlem Environmental Action, the Institute for Location Efficiency, Grist Magazine and the Growth Management Leadership Alliance. He was a founding Co-Chair of the Environmental Leadership Program and now serves on its Advisory Board. Prior to SGA, he was a researcher for the Surface Transportation Policy Project, World Resources Institute, and the Rocky Mountain Institute.

RANDALL CRANE (MODERATOR) studies travel behavior, the causes and impacts of sprawl, housing markets, the public finances of developing countries, and environmental governance initiatives such as smart growth. His most recent book is, "Travel by Design: The Influence of Urban Form on Travel," Oxford, coauthored with Marlon Boarnet. He recently served on a National Academy of Sciences panel of experts looking at how the built environment influences travel and public health. At UCLA, Crane is Professor of Urban Planning, Associate Director of the Institute of Transportation Studies, and Director of Undergraduate Programs in the School of Public Affairs. He teaches courses

on environmental policy, transportation policy, sprawl, and cities in developing countries. Abroad, he has consulted for the World Bank, USAID, and the governments of Guyana, Indonesia, Kenya, Mexico, Thailand, and Yemen.

ELIZABETH DEAKIN (MODERATOR) is Director of the University of California Transportation Research Center and Associate Professor of City and Regional Planning at UC Berkeley, where she also is an affiliated faculty member of the Energy and Resources Group and the Master of Urban Design group. Deakin's research focuses on transportation and land use policy and the environmental impacts of transportation. She has published over 100 articles, book chapters, and reports over the past fifteen years, on topics ranging from environmental justice to transportation pricing to development exactions and impact fees. She currently is developing benchmarks for transit investment policy for Bay Area transit operators and is leading a project developing a system plan for express bus services for the San Francisco Bay Area. She recently served as chair of the National Academy of Sciences' Advisory Board on Surface Transportation-Environmental Research, mandated by Congress. She has worked with Dan Solomon and Peter Calthorpe on new urbanist designs for infill development, transit station areas, and new towns, and has been a member of the Duany-Plater design charrette team for projects in California and Florida. She was on the selection committee for the Isla Vista (Santa Barbara Co.) design competition and has served on several UC Berkeley development plan review committees. She was a member of the team that developed the UC Santa Cruz campus plan update in the 1990s.

JOAN E. DENTON has been the Director of the Office of Environmental Health Hazard Assessment for the State of California (OEHHA) since November 1997. She is responsible for the performance of the scientific risk assessments for the regulation of chemicals in the environment, providing information about the health and environmental risks of chemicals to government agencies and the public, providing overall scientific guidance and consultation to the Secretary of the Environmental Protection Agency and oversight of activities by regulatory agencies within OEHHA. Dr. Denton also oversees the implementation of the Safe Drinking Water and Toxic Enforcement Act of 1986. Before her appointment, Dr. Denton was a Senior Air Pollution Specialist for the California Air Resources Board and was a Research Specialist for the Air Resources Board Executive Office, Stationary Source Division and the Research Division.

JONATHAN E. FIELDING is Director of Public Health and Health Officer for Los Angeles County responsible for all public health functions including surveillance and control of both communicable and non-communicable diseases, and of health protection (including against bioterrorism) for the County's 10 million residents. He directs a staff of 3,600 with an annual budget exceeding $650 million within the Department of Health Services. Dr. Fielding is also a Commissioner of the First 5 L.A. Commission, which distributes over $100 million per year to improve health and development of children, ages 0-5. He chairs the US Community Preventive Services Task Force. He was also a founding member of the US Clinical Preventive Services Task Force. Dr. Fielding is also a Professor in the Schools of Medicine and Public Health at UCLA and has authored over 160 peer-reviewed articles, chapters and editorials on a wide range of public health and preventive medicine issues. He teaches the course "Determinants of Health" in the School of Public Health. He is Editor of Annual Review of Public Health, Chairman of the National Partnership for Prevention and an elected member of the National Academy of Sciences Institute of Medicine. Formerly Dr. Fielding was Massachusetts Commissioner of Public Health and was a Vice President of Johnson & Johnson.

GENEVIEVE GIULIANO is Professor in the School of Policy, Planning, and Development, University of Southern California and Director of the METRANS joint USC and California State University Long Beach Transportation Center. She also holds courtesy appointments in Civil Engineering and Geography. She conducted research at the UC Irvine Institute of Transportation Studies before joining USC in 1988. Professor Giuliano's research interests are interdisciplinary and wide-ranging. Her background is in geography, economics and political science, and her application field is transportation. Her research focus areas include relationships between land use and transportation, transportation policy evaluation, and information technology applications in transportation. Recent projects include mobility patterns of the elderly, international comparisons of metropolitan growth and travel patterns, and new technology applications in public transit. Current projects include intra-metropolitan freight modeling and analysis, evolution of employment centers in the Los Angeles region, and sensor networks applied to urban traffic monitoring. She has published over 120 papers, and has presented her research at numerous conferences both within the US and abroad. Professor Giuliano is a former faculty fellow of the Lincoln Institute of Land Policy and former member of the Executive Committee of the Association of Collegiate Schools of Planning. She serves on the Editorial Boards of *Urban Studies*, *Journal of Transportation and Statistics*, *Journal of Transport Policy,* as well as on Advisory Boards for transportation institutes at UC Davis and University of Minnesota. She is a member and past Chair of the Executive Committee of the Transportation Research Board, and has been named a National Associate of the National Academy of Sciences. She has participated in several National Research Council policy studies; currently she is a member of the Committee on Climate Change and Transportation.

ELOISA GONZALEZ is a resident of Los Angeles, where for the past five years she has been the Program Director for the Physical Activity Program at the Los Angeles County Department of Health Services. In this capacity, Dr. Gonzalez creates, implements, and evaluates programs to promote physical activity among youth and adults in Los Angeles County. Some of her focus areas include increasing the quantity and quality of physical education in schools, and advocating for walkable/bikeable communities in order to increase the opportunities for LA County residents to engage in physical activity

everyday. Dr. Gonzalez is an active member of the California State Senate's Task Force on Youth and Workplace Wellness, a Board Member of the Los Angeles Chapter of the American Heart Association, and is the spokesperson for the California Latino 5 A Day Campaign.

LEROY GRAYMER (MODERATOR) is Founding Director Emeritus of the Public Policy Program at UCLA Extension, which he established in 1979. The program addresses public policy issues of state, national and international importance through numerous conferences, seminars, workshops, and facilitation activities. Graymer was formerly Associate Dean of the Graduate School of Public Policy at the University of California, Berkeley, and Vice President and Professor of Political Science at California State University, Dominguez Hills. Recent work includes a special research project for the Hewlett Foundation on California governance reform options and the State Transportation Plan for the California Department of Transportation.

ELLEN GREENBERG is Principal at Freedman Tung & Bottomley Urban Design. She is a city planner focused on resolving problems at the complex intersection of land use, transportation, and urban design. Her ability to solve questions that cross the usual boundaries between both professional disciplines and governmental agencies have made her a highly-regarded leader of comprehensive and strategic plans, policy studies and research. Ms. Greenberg is an authority on new techniques in emerging practice areas including zoning reform, street and circulation network design, and transit oriented development. From 2000-2004, Ms. Greenberg was on the staff of the Congress for the New Urbanism, serving as Director of Research and Interim Executive Director. She is a contributing author to "The New Transit Town," "Codifying New Urbanism," and "Civilizing Downtown Highways."

SUSAN HANDY is an Associate Professor in the Department of Environmental Science and Policy and the Institute of Transportation Studies at the University of California at Davis. Her research interests focus on the relationships between transportation and land use. She is well known for her work on the link between the built environment and travel behavior, and her studies of the influence of neighborhood design on walking have been widely cited in the physical activity literature in recent years. She is currently working on projects funded by the California Department of Transportation and the Robert Wood Johnson Foundation on this topic. She recently served on the Institute of Medicine Committee on the Prevention of Obesity in Children and Youth and completed a report for the Transportation Research Board and Institute of Medicine Committee on Physical Activity, Health, Transportation, and Land Use.

STEVE HEMINGER is Executive Director of the Metropolitan Transportation Commission (MTC). MTC is the regional transportation planning and finance agency for the nine-county San Francisco Bay Area. It allocates more than $1 billion per year in funding for the operation, maintenance and expansion of the Bay Area's surface transportation network. Since 1998, MTC has served as the Bay Area Toll Authority (BATA) responsible for administering all toll revenue from the seven state-owned bridges. BATA has a "AA" credit rating and plans to issue over $6 billion in toll revenue bonds to finance bridge, highway, and transit construction projects over the next several years. MTC also functions as the region's Service Authority for Freeways and Expressways (SAFE) and operates a fleet of 70 tow trucks and 2,000 roadside call boxes to assist

motorists in trouble. In addition, MTC manages the TransLink® universal fare card program for public transit and the popular 511 traveler information telephone number and web site. Mr. Heminger serves as Vice Chair of the Policy Committee of the Association of Metropolitan Planning Organizations. He is also a member of the Board of Trustees for the Mineta Transportation Institute, the Board of Advisors for the ENO Transportation Foundation, and the Research and Technology Coordinating Committee for the Federal Highway Administration. Prior to joining MTC in 1993, Mr. Heminger was Vice President of Transportation for the Bay Area Council, a business-sponsored public policy group. He also has served as a staff assistant in the California State Legislature and the U.S. Congress.

SUSAN B. HERBEL is a Senior Associate with Cambridge Systematics. She has nearly 25 years of experience in the fields of highway safety, transportation safety planning, federal programs, highway safety research and evaluation, public policy analysis, and program development, implementation and evaluation. Dr. Herbel has been instrumental in developing and implementing strategies associated with the TEA-21 requirement for integrating safety as a priority planning factor in the transportation planning process. She also works with a number of state and regional jurisdictions on the development of comprehensive state or regionwide transportation safety plans.

ANGELA JOHNSON MESZAROS is the Director of Policy and General Counsel for the California Environmental Rights Alliance (CERA). She has more than a decade of experience working with communities and organizations on environmental justice issues in the Los Angeles region. During this time, Angela has used a range of tools to enhance the health, safety, and quality of life of impacted communities including: litigation in federal court, filing regulatory challenges, lobbying state legislators, providing community legal education, testifying before relevant boards and commissions, serving on agency policy work groups, engaging in media advocacy, and negotiating with wide ranging stakeholders. Angela's efforts have been focused on policy development, implementation, and enforcement in a variety of environmental issues including: childhood lead poisoning, freeway siting, siting of sources of air pollution, land use policies and their impact on community health, health impacts of air toxics from mobile and stationary sources, and air permit development and compliance. Prior to joining CERA, Angela was a Research Associate at the University of Southern California's Sustainable Cities Program where she explored the intersections between environmental sustainability and social justice, the role of networks in environmental justice work in the Los Angeles region, and the need for more parks in the urban core of cities. Previously, Angela was the Executive Director of the California League of Conservation Voters Education Fund where she worked to understand, encourage, and engage voters of color on environmental issues. Angela also has served as a staff attorney with Environmental Defense and she was an echoing green fellow for three years where she provided legal, community organizing, and policy development support to several Los Angeles area communities and organizations.

RAUL LEJANO's primary research interest revolves around developing new models for policy analysis. The research incorporates differing ethical theories into models for environmental governance. For example, in the area of environmental risk, he and colleagues have developed new descriptives for understanding cumulative risk and vulnerability --these problems, in turn, lead to new approaches for regulation and

advocacy. Dr. Lejano is an assistant professor in the Department of Planning, Policy, and Design at UC Irvine. He has also previously been on the faculty of the Environmental Policy Group at MIT and a lecturer at UCLA.

MIRIAM LEV-ON is Executive Director of The LEVON Group, LLC. Dr. Lev-On has over 25 years of professional experience in environmental and sustainability issues. She provides worldwide consulting and facilitation services in the areas of greenhouse gas inventories, clean fuels and energy technologies and their linkage to urban air quality. During her 15 years tenure at ARCO and BP, Dr. Lev-On conducted studies on vehicles and facilities emission characterizations and their impact on urban air quality and global atmospheric processes. She was the founding chair of the API Greenhouse Gas Emissions Working Group and led the development of the API Compendium of Greenhouse Gas Emissions Methodologies. She worked with the International Petroleum Industry Environmental Conservation Association (IPIECA), the United Nations Environmental Program (UNEP), the US EPA, and other partners to launch the Partnership for Clean Fuels and Vehicles (PCFV), where she is currently a member of the Sulfur Working Group.

ANASTASIA LOUKAITOU-SIDERIS is professor and chair of the Department of Urban Planning at UCLA. Her work focuses on issues of transportation, land use, and urban design. She has published extensively on issues of transit safety and security, transit-oriented development, downtown development, inner city revitalization, cultural determinants of design, and parks and open spaces. Current or recent projects include a study that examines pedestrian-automobile collisions in Los Angeles, research on domestic and international responses to transit terrorism, and studies on the relationship between walking and physical activity and safety and security considerations. Her projects have been funded or commissioned by the California Department of Transportation, the Transportation Research Board, the Mineta Transportation Institute, the University of California Transportation Center, the California Policy Research Center, the National Endowment for the Arts, the Poverty and Race Research Action Council, the John Randolph and Dora Haynes Foundation, and the UCLA International Institute. She has served as a consultant to the Transportation Research Board, Federal Highway Administration, Southern California Association of Governments, South Bay Cities Council of Government, Los Angeles Neighborhood Initiative, Los Angeles Department of Transportation, Roger Wood Johnson Foundation, the Greek government, and many municipal governments on issues of urban design, land use and transportation. She is the co-author of the book *Urban Design Downtown: Poetics and Politics of Form*, published by the University of California Press in 1998, and the co-recipient of the 2003 Rapkin Award for her work on transit crime.

NOREEN MCDONALD is an Assistant Professor in the Department of Urban and Environmental Planning at the University of Virginia. Her primary teaching and research interests are in transportation planning, with an emphasis on children's travel behavior and the relationship between transportation and land use. Her previous research focused on mode choice for the school trip and the decline in walking to school over the past thirty years in the United States. Noreen's current research looks at how neighborhood social factors, such as trust, influence where children are allowed to walk within their communities.

PATRICIA MOKHTARIAN is a Professor of Civil and Environmental Engineering, Associate Director for Education of the Institute of Transportation Studies, and Chair of the interdisciplinary graduate program in Transportation Technology and Policy at the University of California, Davis. She joined UC Davis in 1990, after nine years in regional planning and consulting in Southern California. Dr. Mokhtarian has specialized in the study of travel behavior for more than 20 years. A key research interest has been the impact of telecommunications technology on travel behavior, with additional interests in congestion-response behavior, attitudes toward mobility, adoption of new transportation technologies, land use and transportation interactions and the transportation/air quality impacts of transportation demand management measures. She has directed or participated in more than a dozen projects related to these and other areas, involving extramural funding totaling about $7 million. She has authored or co-authored more than 100 refereed journal articles, technical reports, and other publications. She currently serves on the editorial boards of the Transportation Research Part A and Transportation journals.

MARY NICHOLS (MODERATOR) currently serves as Director of the UCLA Institute of the Environment (IoE). In addition to leading the Institute, she also has a joint appointment at the UCLA School of Law where she will teach a seminar on State Environmental Law and policy in spring 2005. Nichols brings a breadth of environmental experience within the government sector to her teaching at UCLA. She began practicing law at the Center for Law in the Public Interest in Los Angeles where she brought the first litigation under the then recently passed Clean Air Act. She was employed by the state of California as the Secretary of Environmental Affairs and the Chair of the Air Resources Board and briefly served as Los Angeles Chief Assistant City Attorney in charge of the civil branch. After a brief stint in private practice she helped found the Los Angeles office for Natural Resources Defense Council as senior attorney. In 1993, Nichols was appointed s Assistant Administrator of Air and Radiation for the U.S. Environmental Protection Agency where she was responsible for tightening the nation's air quality standards. She then headed the Environment Now Foundation as Executive Director. Prior to joining UCLA, she served as the California Secretary for Resources, overseeing natural resources, including parks, wildlife, forestry, coastal protection, and energy and water.

KATHERINE AGUILAR PEREZ is the Executive Director of the Transportation & Land Use Collaborative of Southern California (TLUC), a non-profit dedicated to educating the region's diverse communities about issues of planning that affect their lives. She was recently recognized as an "Outstanding Leader" in Business Life Magazine based in the San Gabriel Valley. Before coming to TLUC, Katherine served as the Deputy to Pasadena Mayor William Bogaard, Pasadena's first city-wide elected Mayor. She was able to work with community on many developments such as the Gold Line Light Rail Extension, a 13 mile project from Los Angeles to Pasadena. Katherine is a frequent speaker at national, state and local conferences, and has been featured on FOX11 News, KNX News radio and KPCC FM, the *Los Angeles Times*, *California Real Estate Journal*, *Architecture Magazine*, the *Oregonian* and *USA Today*. She was commentator for "Surviving Sprawl" a three part series on KCET's *Life & Times*.

STEVEN M. PICKRELL is a Senior Vice President of Cambridge Systematics and national manager of the firm's transportation planning practice. He is actively involved in performance measurement for transportation, and has worked with a variety of

transportation agencies to apply system condition and perfor mance data in planning, investment and m anagement decisions. Mr. Pickrell was principal author of National Cooperative Highway Research P rogram (NCHRP) Re port 446, A Guidebook for Performance-Based Transportation Planning. His recent work for public agency clients has focused on integrating performance measures into the long-range multimodal system planning process, as w ell as developing perf ormance-based management approaches to the broad spectrum of agency internal and external operations. Mr. Pickrell will speak at the sym posium on incorporating environm ental and health benefits and costs into measures of transportation system performance.

WILLIAM SATARIANO is Professor of Epide miology and Community Health in the School of Public Health at the University of California at Berkeley. Prior to his appointment at UC Berkeley, he served as Deputy Director of the Division of Epidemiology and the Metropolitan Detroit Can cer Surveillance System at the Michigan Cancer Foundation from 1980-89. His research interests include the epidem iology of aging and disability, functional assessm ent, cancer rehabilitation and survival, physical activity and health in older populations, and the effects of social factors and the built environment on health and functioning.

ERIC SCHREFFLER is an independent transportation consultant located in San Diego with over 20 years of experien ce in planning and evalua ting transportation dem and management (TDM) program s. He specializes in quantifying the travel and em ission impacts of various measures aimed at reducing vehicle miles of travel. Mr. Schreffler has advised various governm ental clients, incl uding m etropolitan planning organizations, state agencies, the US EPA and US DOT, the European Comm ission, and the Organization for Econom ic Cooperation and Development. He was form erly the Planning Manager at Commute r Transportation Services and m anaged the southern California office of COMSIS Corporation. He currently chairs the Transportation Research Board's Committee on TDM and serves on several advisory boards, including the National Center for Transit Research, th e Transportation Planni ng Council of the Institute for Transportation Engineers, and the TDM Institute of the Association for Commuter Transportation.

CATHERINE SHOWALTER (SYMPOSIUM CO-CHAIR) has recently joined UCLA Extension as Director of the Public Policy Progr am. She is known throughout California and the nation for her leadership role in areas that have long connected to the w ork of the public policy program , specifically, transporta tion dem and m anagement, environm ental resources protection, and re gional econom ic developm ent. She has had executive responsibilities within the public, private, and not-for-profit sectors, and has earned praise and trust from all the constituencies with which she has worked. Catherine is skilled and experienced in dissem inating technical information in a straightforward m anner for ease in understanding by diverse audiences, nationa lly and internationa lly. Catherine led a non-profit organization, RIDES for Bay Ar ea Commuters, Inc. She has had executive positions within gov ernment agencies, notab ly first a s m anager and th en Dire ctor of Transportation Programs f or the South Coas t Air Quality Managem ent Distr ict. And before turning to public service, sh e was th e v ice president of a specialized consu lting firm, Transportation Management Services.

SARAH J. SIWEK & Associates specializes in advising public and private sector organizations on transportation and air quality issues. Ms. Siwek has over 25 years experience including work with transportation and air quality agencies in New York, New Jersey, Illinois, Mississippi, Missouri, and California. Ms. Siwek has extensive experience in the development, integration, financing, and implementation of transportation and air quality programs as required under the Clean Air Act Amendments of 1990 (CAA), the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1990 and the Transportation Equity Act for the 21st Century (TEA-21). Her work has included county, regional, and state agencies, and the U.S. DOT's Federal Highway Administration and Federal Transit Administration. Over the past 12 years, Ms. Siwek has provided a range of consulting services to the U.S. Department of Transportation and other clients. Projects have included: initiation and management of the Gateway Cities Clean Air Program, writing publications including the Basic Guide to Transportation Conformity for Local Officials, the Transportation Conformity Reference Guide, Guides to Metropolitan and Statewide planning requirements, integration of Intelligent Transportation Systems into the planning process, and others. Current work includes for the National Transit Institute, courses for the Institute of Transportation Studies at the University of California, and conducting a research study of the integration of transportation and air quality planning through the SIP and conformity processes in six areas throughout the country.

BARBARA SMISKO has twenty years of experience in environmental, health and safety and is the Director of National Environmental, Health and Safety (EH&S) at Kaiser Permanente. Her areas of expertise include environmental management, injury and illness prevention and management, industrial hygiene management, EH&S training and recruiting. In her role as Director, Western Environmental Health & Safety Hub, Barbara was responsible for Kaiser Permanente's EH&S program in California including transportation systems management. Prior to Kaiser Permanente, Barbara was hired as part of the first Corporate Environmental Safety department at United Airlines, where she was a Senior Staff Representative - Environmental Compliance. Prior to United Airlines, Barbara worked in consulting for six years, first with IT Corporation, coordinating their regional EH&S Training programs, and then with ENSR Consulting and Engineering as a project manager. Barbara is a Certified Safety Professional (CSP), Certified Professional in Disability Management (CPDM), Certified Professional in Healthcare Quality (CPHQ), Certified Professional In Healthcare Risk Management (CPHRM) and a Certified Healthcare Environmental Manager (HEM).

DANIEL SPERLING is Professor of Civil Engineering and Environmental Science and Policy, and founding Director of the Institute of Transportation Studies (ITS-Davis) at the University of California, Davis. He is also co-director of UC Davis's Hydrogen Pathways Program and New Mobility Center. ITS-Davis is staffed by over 100 faculty, staff, and student researchers. Dr. Sperling is recognized as a leading international expert on transportation technology assessment, energy and environmental aspects of transportation, and transportation policy. In the past 20 years, he has authored or co-authored over 200 technical papers and reports and eight books. Daniel Sperling is Associate Editor of Transportation Research D (Environment) and a current or recent editorial board member of four other scholarly journals. He is a member of U.S. National Academies committees on Highway Gas Taxes, Hydrogen, Personal Transport in China, Surface Transportation Environmental Cooperative Research Program Advisory Board,

Biomass Fuels R&D, Enabling Transportation Technology R&D, Transportation and a Sustainable Environment, Transportation Options for Megacities, and Liquid Fuel Options. He was selected as a lifetime National Associate of The National Academies in 2004, is founding chair and emeritus member of the Alternative Transportation Fuels Committee of the U.S. Transportation Research Board, and serves on many advisory committees and Boards of Directors. He consults for international automotive and energy companies, major environmental groups, and several national governments. Professor Sperling worked two years as an environmental planner for the US Environmental Protection Agency and two years as an urban planner in the Peace Corps in Honduras. During 1999-2000, he was on leave as a visiting scholar at OECD (European Conference of Ministers of Transport).

BRIAN D. TAYLOR (SYMPOSIUM CO-CHAIR) is an Associate Professor of Urban Planning and Director of the Institute of Transportation Studies at UCLA. He is currently a Visiting Scholar in the Department of Civil and Environmental Engineering at the University of Hawaii at Manoa. His research centers on both transportation finance and travel demographics. He has examined the politics of transportation finance, including the influence of finance on the development of metropolitan freeway systems and the effect of public transit subsidy programs on both system performance and social equity. His research on the demographics of travel behavior has emphasized access-deprived populations, including women, racial-ethnic minorities, the disabled, and the poor. His work in this area has also explored the relationships between transportation and urban form, with a focus on commuting and employment access for low-wage workers. His current research examines both security and ridership on public transit systems, and on the causes and consequences of traffic congestion. Professor Taylor teaches courses in transportation policy and planning and research design. Prior to coming to UCLA in 1994, he was an Assistant Professor in the Department of City and Regional Planning at the University of North Carolina at Chapel Hill, and before that a Transportation Analyst with the Metropolitan Transportation Commission.

KRISTINE THALMAN joined the Orange County Chapter of the Building Industry Association (BIA/OC) as the organization's new chief executive officer. Kristine is charged with managing the operations of the largest chapter of the BIA of Southern California. Kristine oversees all aspects of a very active educational organization that organizes more than 30 programs and functions annually for over 900 member companies, representing over 112,000 employees in the homebuilding industry in Orange County. Kristine also serves as the chief spokesperson for the homebuilding industry in Orange County before administrative and legislative bodies and the media on California land use planning and environmental laws. Prior to joining the BIA/OC, Kristine served as Director of Local Government Affairs with KB HOME, where she created the company's government affairs program in the Greater Los Angeles and Orange County Divisions four years ago. Coupled with her prior experience as government relations manager for the City of Anaheim, Kristine has proven experience in public policy development and superior skills in local, state and federal legislative advocacy on issues related to the industry. Kristine has a unique understanding of the complex issues the residential construction industry is addressing today. Kristine also has experience in transportation systems management, and public affairs and community outreach in the

homebuilding industry. She is currently serving on the Orange County Council of Governments Board of Directors as the Private Sector representative.

MARTIN WACHS (MODERATOR) is Professor of Civil and Environmental Engineering and Professor of City and Regional Planning at UC Berkeley. He earlier spent 25 years at UCLA, where he served three terms as Chairman of the Department of Urban Planning and was Director of the Institute of Transportation Studies. Professor Wachs is the author of 160 articles and four books on subjects related to relationships between transportation, land use, and air quality, transportation needs of the elderly, techniques for the evaluation of transportation systems, and the use of performance measurement in transportation planning. His research also addresses issues of equity in transportation policy, problems of crime in public transit systems, and the response of transportation systems to natural disasters including earthquakes. His most recent work focuses on transportation finance in relation to planning and policy. Professor Wachs has served on the Executive Committee of the Transportation Research Board and was the TRB Chairman during the year 2000. He is currently a member of the Advisory Committee on Research and Development for the California Department of Transportation, and recently completed his term as the first Chair of the Advisory Panel for the Travel Model Improvement Program of the U.S. Department of Transportation.

MICHAEL WALSH is a mechanical engineer who has spent his entire career working on motor vehicle pollution control issues at the local, national, and international level. For the first half of his career to date, he was in government service, initially with the City of New York and subsequently with the U.S. Environmental Protection Agency. With each, he served as Director of their motor vehicle pollution control efforts. Since leaving government, he has been an independent consultant advising governments and industries around the world. For several years he served as the Chairman of the World Bank Advisory Panel to the Mexico City Transport/Air Quality Management Program. He then served in a similar capacity with the Chinese National Environmental Protection Agency. During the 1980's he was an advisor to the U.S. Senate Environment and Public Works Committee during development of the 1990 Clean Air Act Amendments. In addition he currently co-chairs the U.S. EPA's Mobile Source Advisory Subcommittee and is actively involved in projects in several countries. He has extensive and unique international experience with unleaded gasoline, alternative fuels, inspection and maintenance, vehicle pollution control technology, vehicle emissions standards and regulations and other motor vehicle pollution control strategies. He recently served as Chairman of the transportation subgroup of the IPCC Good Practices in Emissions Inventory Workgroup and is a contributing member of the IPCC Technology Transfer Workgroup. More recently, he was the principal author of the transportation chapter in a major study of common strategies for reducing both conventional pollutants and greenhouse gases sponsored by the Association of State and Territorial Air Pollution Control Administrators and the Association of Local Air Pollution Control Officials. The United Nations Environment Program has recently published two of his reports to assist developing countries in addressing motor vehicle pollution problems.

ACQUANETTA WARREN is a Deputy Public Works Director in the City of Upland. She joined the City of Upland as a consultant in Housing Programs and later became a City

employee in Fire, Building, Police, Code Enforcement and Integrated Waste Management Departments. Acquanetta is a member of the California Recreation Parks Society, Municipal Assistants of Southern California and League of California Cities Community Service Policy Committee. Previously she worked in banking as Vice President/Group Product Manager for Cash Management Services. Acquanetta was appointed to the Fontana City Council in December 2002. Prior to her appointment, Acquanetta served as Co-Chairperson of the General Plan Advisory Committee and Chairperson of the Village of Heritage Landscape Committee. She also participated with the City of Fontana Public Works Department on the development of the landscape specifications and new program standards to lower costs and increase quality. She is the first African American on the City of Fontana City Council. Governor Arnold Schwarzenegger recently appointed Acquanetta to the State Park Commission. Acquanetta is the Chairperson of the Fontana Housing Authority. She represents Fontana on the San Bernardino County Flood Control and the San Bernardino County Solid Waste Task Force and recently became a Board Member for The Oldtimers Foundation. Healthy Fontana is the brainchild of Fontana Councilwoman Acquanetta Warren. Alarmed with the growing rates of diabetes obesity and heart disease in her community of Fontana, Acquanetta decided to create a program that would inform, educate and change the way people eat, exercise and live.

ASHA WEINSTEIN (MODERATOR) is an Assistant Professor in the Department of Urban and Regional Planning at San José State University. Her research and teaching interests include transportation planning and policy issues related to pedestrian travel and designing livable streets, and transportation finance. She also works in the field of transportation and planning history. She recently published the article "Curing Congestion: Competing Plans for a 'Loop Highway' and Parking Regulations in Boston in the 1920s" in the *Journal of Planning History*. Other projects she has finished recently include "Addressing the Equity Implications of HOT Lanes," "How Much Do Americans Walk? An Analysis of the 2001 NHTS," "Can Consumer Information Tighten the Transportation/Land-Use Link? A Simulation Experiment," and "The Congestion Evil - Public Perceptions of Traffic Congestion in Boston in the 1890s and 1920s."

ARTHUR WINER is Professor of Environmental Health Sciences in the UCLA School of Public Health and a core faculty member in the UCLA Environmental Science and Engineering Program. Over the past 30 years, he has published more than 190 peer-reviewed journal articles and book chapters on a wide range of air pollution topics. His current research is focused primarily on air pollutant exposure measurements, with an emphasis on children's exposure in diesel school buses, portable classrooms, homes and other relevant microenvironments. In addition to his research contributions, Dr. Winer has worked extensively at the local, state, and national levels to promote legislation and public policies designed to address a broad range of air pollution and public health concerns.

APPENDIX C:

PARTICIPANT ROSTER

Gregg Albright
District Director
California Department of Transportation
San Luis Obispo, CA

Deborah Barmack
Director of Management Services
SANBAG
San Bernadino, CA

Dan Beal
Managing Director, Pubic Policy and Programs
Automobile Club of Southern California (AAA)
Costa Mesa, CA

Jane Berner
Graduate Student, Department of Urban Planning
UCLA School of Public Affairs
Los Angeles, CA

Susan Boyer
Program Manager
Southern California Edison
Rosemead, CA

Christopher Cabaldon
Sacramento Area Council of Governments
Sacramento, CA

David Calkins
Principal
Sierra Nevada Air Quality Group
Orinda, CA

Ping Chang
Lead Programmer Analyst Data and Monitoring
SCAG
Los Angeles, CA

Walter Arenstein
President
Writrac Consulting
San Jose, CA

Judith Battey
President/CEO
Inland Action, Inc.
San Bernandino, CA

Ruthane Taylor Berger
Deputy Executive Director
Western Riverside Council of Governments
Riverside, CA

Marlon G. Boarnet
Professor & Chairman
Department of Planning, Policy and Design,
UC Irvine
Irvine, CA

Mark Brucker
Transportation Planning Coordinator
Mark Brucker Consulting
Berkeley, CA

Ricardo Calderon
Area Health Officer, LA County SPA'3 and 4
LA County Dept. of Health Services, Public Health
Los Angeles, CA

Honorable Todd Campbell
Policy Director, Coalition for Clean Air
Councilmember and Vice-Mayor, City of Burbank
Los Angeles, CA

Deborah Chankin
Director of Program Development
Gateway Cities Council of Government
Paramount, CA

Kelly J. Chastain
Mayor Pro Tem
City of Colton
Colton, CA

Tom Christofk
Air Pollution Control Officer
Placer County AQMD
Auburn, CA

Michael Claggett
Air Quality Modeling Specialist
Federal Highway Administration/ FHWA Resource Ctr
Lakewood, CO

Maribel de la Torre
Director of Policy, Planning and Development
Transportation and Land Use Collaborative
Azusa, CA

Joan Denton
Director
Office of Health Hazard Assesment, State of CA
Sacramento, CA

Matthew Dresden
Graduate Student, UCLA School of Public Affairs
Student, UCLA School of Law
Los Angeles, CA

Suzanne Ekerling
Director of Communityt Development
Gilmore Associates
Los Angeles, CA

Scott Fruin
Air Pollution Engineer
California Air Resources Board
Sacramento, CA

Carol Gomez
Planning and Rules Manager
South Coast Air Quality Management District
Diamond Bar, CA

Don Chen
Executive Director
Smart Growth America
Washington, DC

Moises Cisneros
International Trade Manager
Los Angeles Chanber of Commerce
Los Angeles, CA

Randall Crane
Professor of Urban Planning
UCLA School of Public Affairs
Los Angeles, CA

Elizabeth Deakin
Director, UC Transportation Center
Professor of Civil and Environmental Engineering, UC Berkeley
Berkeley, CA

Honorable Richard Dixon
Councilmember
City of Lake Forrest
Lake Forrest, CA

Ted Droettboom
Regional Planning Program Director
ABAG/BAAQMD/MTC
Oakland, CA

Jonathan Fielding
Prof., UCLA School of Public Health, Dir. of Pub. Health Ofcr., LA County Dept. of Health Services
Los Angeles, CA

Genevieve Giuliano
Director, METRANS Transportation Center
Professor, USC School of Policy, Planing & Develpmt.
Los Angeles, CA

Eloisa Gonzalez
Director, Physical Activity Program
LA County Dept. of Health Services, Public Health
Los Angeles, CA

Rachel Gossen
Associate Transportation Planner
Metropolitan Transportation Commision
Oakland, CA

Ellen Greenberg
Principal
Freedman Tung and Bottomley
San Francisco, CA

Susan L. Handy
Associate Professor, Dept. of Env. Science & Policy & Inst. of Trans. Studies UC Davis
Davis, CA

Karen Heit
Transportation Deputy
Gateway Cities Council of Government
Paramount, CA

Susan Herbel
Senior Associate
Cambridge Systematics, Inc.
Heathrow, FL

Henry Hilken
Director of Planning and Research
Bay Area Air Quality Management Distric
San Francisco, CA

Angela Johnson Meszaros
Director of Policy and General Counsel
California Environmental Rights Alliance
El Segundo, CA

Sheila King
Continuing Education Specialist, Dept. of Humanities, Sci. & Soc. Sci, UCLA Extension
Los Angeles, CA

Julie Kirschbaum
Senior Transportation Planner
San Francisco County Transportation Authority
San Francisco, CA

LeRoy Gramer
Founding Director Emeritus
UCLA Extension Public Policy Program
Los Angeles, CA

Jennifer Gress
Consultant
Senate Transportation and Housing Committee
Sacramento, CA

Tim Havel
California Regional Director of Environmental, Health & Safety, Kaiser Permanente
Pasadena, CA

Steve Heminger
Executive Director
Metropolitan Transportation Commission
Oakland, CA

Gill V. Hicks
President
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Pacific Palisades, CA

Hasan Ikhrata
Director, Planning and Policy
SCAG
Los Angeles, CA

Alex Kelter
Chief, Epidemiology and Prevention for Injury Cont California Dept. of Health Services
Sacramento, CA

Keith Killough
Director, Department of Information Services
SCAG
Los Angeles, CA

Valerie Knepper
Associate Planner
Metropolitan Transportation Commission
Berkely, CA

Douglas Kolozsvari
Environmental Planner
BAAQMD
San Francisco, CA

Bob Leiter
Director of Land Use and Planning
SANDAG
San Diego, CA

Lewison Lem
Transportation Policy Manager
AAA of Northern California, Nevada, and Utah
San Francisco, CA

Holly Lenz
Senior Research Associate
AAA
Costa Mesa, CA

Yumi Hori
Program Representative II
UCLA Extension Public Policy Program
Los Angeles, CA

Miriam Lev-On
Executive Director
The LEVON Group, LLC
Thousand Oaks, CA

The Honorable Ron Loveridge
Governing Board Member/Mayor
South Coast AQMD/ City of Riverside
Diamond Bar, CA

Hollie Lund
Assistant Professor of Urban &Regional Planning
Cal Poly Pomona
Pomona, CA

Lindell Marsh
Attorney
Newport Beach, CA

Alan Kurz
Doctor
LA County Dept of Health Services, Pub Health
San Francisco, CA

Raul Lejano
Assisstant Professor, Department of Planning, Policy, & Design, UC Irvine
Irvine, CA

Sue Lempert
Commissioner
Metropolitan Transportation Commission
San Mateo, CA

Gary Hoggatt
Program Representative I
UCLA Extension Public Policy Program
Los Angeles, CA

Kelli James
Administrative Analyst
UCLA Extension Public Policy Program
Los Angeles, CA

Anastasia Loukaitou-Sideris
Professor & Chair, Department of Urban Planning
UCLA School of Public Affairs
Los Angeles, CA

The Honorable Bonnie Lowenthal
Council Member/MTA Director
City of Long Beach
Los Angeles, CA

Richard Marcus
Section Manager
Orange County Transportation Authority
Orange, CA

Noreen McDonald
Assistant Professor of PLanning
Universiy of Virginia
Charlottesville, VA

Kate McGregor
Air Pollution Specialist
California Air resources Board
Sacramento, CA

Patricia Mokhtarian
Professor of Civil and Enviromental Engineering
Associate Director, ITS-UC Davis
Davis, CA

Richard Napier
Executive Director
City/County Association of Governments
Redwood City, CA

Tom Neumann
Chief Supervisor of Office of Community Planning
California Department of Transportation
Sacramento, CA

Honorable Pam O'Connor
Mayor
City of Santa Monica
Los Angeles, CA

Jean Ospital
Health Effects Officeral Director
SCAQMD
Diamond Bar, CA

Katherine Perez
Executive Director
Southern California Transportation and Land Use
Azusa, CA

Steven Pickrell
Senior Vice President
Cambridge Systematics
Oakland, CO

Micahel Radetsky
Senior Health Educator
San Francisco Department of Public Health
San Francisco, CA

Gale McIntyre
Deputy District Director Planning
California Department of Transportation
Irvine, CA

Claudette Moody
Transportation Deputy
L.A. Metropolitan Transportation Authority
Los Angeles, CA

Nancy Neudorff
Executive Assistant
City of Irvine
Irvine, CA

Mary Nichols
Director of UCLA Institute of the Enviroment
Professor, UCLA School of Law
Los Angeles, CA

Robert O'Loughlin
Air Quality Team Leader
Federal Highway Administration
San Francisco, CA

Jeff Peltola
Senior Engineer
Minnesota Pullution Control Board
St. Paul, MN

Kathryn Phillips
Manager, California Clean Air for Life Campaign
Environmental Defense
Sacramento, CA

Tom Plenys
Research Manager
Coalition for Clean Air
Los Angeles, CA

Robert Reider
Planning Manager
San Diego County APCD
San Diego, CA

Bill Satariano
Professor of Epidemiology and Community Health
UC Berkeley
Berkeley, CA

Eric Shreffler
Principal
Eric Schreffler Transportation Consultants
San Diego, CA

Donald Shoup
Professor
University of California, Los Angeles
Seattle, WA

Sarah Siwek
President
Sarah J. Siwek & Associates
Culver City, CA

Ryan Snyder
President
Ryan Snyder and Associates
Los Angeles, CA

David Souten
Manging Principal
ENVIRON International Corporation
Novato, CA

Daniel Sperling
Director, ITS-UC Davis
Professor of Civil Eng. and Env. Science & Policy
Davis, CA

Brian Taylor
Visiting Scholar
Department of Civil and Environmental
Engineering, University of Hawaii at Manoa
Honolulu, Hawaii

Kristine Thalman
Chief Executive Officer
Building Industry Assoc. of Southern California
Irvine, CA

Mike Savonis
Air Quality Team Leader
Federal Highway Administration
San Francisco, CA

William Schuiling
Director of Planning/Programming
SANBAG
San Bernandino, CA

Catherine Showalter
Director
UCLA Extension
Los Angeles, CA

Barbara Smisko
Director of National Environemntal, Health and Safety
Kaiser Permanente
Oakland, CA

Joan Sollenberger
Division Chief, Transportation Planning
California Department of Transportation
Sacramento, CA

Peter Spaulding
Executive Director
CAL ACT
Sacramento, CA

Muggs Stoll
Division Chief
California Department of Transportations
San Diego, CA

Dean Taylor
Technical Specialist/Scientist
Southern California Edison
Rosemead, CA

Toby Tiktinsky
Air Planner
EPA Region 9 Air DIvision
San Francisco, CA

Martina Travis
Acting Area Health Office, LA County SPA's 5
LA County Dept of Health Services, Public Health
Los Angeles, CA

Michael Walsh
International Consultant
Walsh Carlines
Arlington, VA

Honorable Acquetta Warren
Councilmember
City of Fontana
Fontana, CA

Asha Weinstein
Assistatn Professor, Urban Planning Department
San Jose State University
San Jose, CA

Arthur Winer
Professor of Environmental Health Sciences
UCLA
Los Angeles, CA

Norman Wong
Administrative Specialist
UCLA School of Public Affairs
Los Angeles, CA

Honorable Toni Young
Councilmember
City of Port Hueneme
Port Hueneme, CA

Martin Wachs
Director & Professror of City & Regional Planning
University of California, Berkeley
Berkeley, CA

Beverly Ward
Director, Ethnography & Transportation Systems
University of South Florida
Tampa, FL

Honorable Dennis Washburn
Mayor
City of Calabasas
Calabasas, CA

Jeff Weir
Air Pollution Specialist
California Air Resources Board
Sacramento, CA

Deborah Wong
Transportation Policy Specialist
AAA of Northern California, Nevada, and Utah
San Francisco, CA

Michelle Wyman
Executive Director
International Council of Local Env. Initiative
Berkeley, CA

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