Testimony of Steven E. Plotkin, Center for Transportation Research, Argonne National Laboratory, to the Committee on Science and Technology, U.S. House of Representatives, May 16, 2007

Hearing on: ***The State of Climate Change Science 2007: The Findings of the Fourth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC): Mitigation of Climate Change***

FINDINGS OF THE TRANSPORTATION SECTOR ANALYSIS

Mr. Chairman and members of the Committee, thank you for this opportunity to discuss the findings of the Intergovernmental Panel on Climate Change (IPCC) on mitigating greenhouse gas (GHG) emissions from the transport sector. I draw extensively in this testimony from Chapter 5 of the full report, of which I was a co-author.

SUMMARY

The transport sector is an especially important focus of policy concern because it represents nearly a quarter of energy-related greenhouse gas (GHG) emissions and is growing rapidly, and because it is bound so tightly with oil – oil supplies 95% of its fuel, and transport represents half of world oil use (and about 2/3 of U.S. oil use).

Technologies are available today to sharply reduce the growth of oil use and GHG emissions from transport, but strong government actions will be needed for these technologies to reach their full potential. Useful policies include fuel economy standards, registration and annual fees on vehicles tied to efficiency, public support for transit and urban planning, and a host of others.

For the longer term, there are a number of technologies that could make a major difference in transport emissions, but all of these require significant advances that must be addressed by strong research and development programs. Some promising examples are radical improvements in conventional gasoline engines; lightweight materials for vehicle structures; advanced biofuels from cellulosic materials; hydrogen fuel cell vehicles; plug-in hybrids; blended-wing aircraft bodies and unducted turbofan engines; and advanced diesel engines for freight trucks.

A combination of careful urban planning and promotion of efficient public transport and walking and cycling can have a profound longer-term positive impact on GHG emissions from urban transport as well as on the livability of cities. Although the greatest impacts will be in the developing world whose cities and transport systems are undergoing rapid transformation, important positive impacts can occur in the industrialized nations as well.

DETAILED TESTIMONY

Transportation accounts for about 23% of the world's energy-related GHG emissions, and is the fastest growing end-use sector. Three quarters of its emissions come from road vehicles. If transport energy use and GHG emissions continue on their current path, world transport emissions will grow at about 2% per year; by 2030 they will have grown by 80%. Much of that growth will occur in the developing world – the nations outside of the OECD account for 36% of emissions today, but are expected to account for 46% by 2030, with nations like China leading the way with its astonishing 20%/year growth in private vehicle ownership. However, the United States is expected to have transport growth not much lower than the world average during this period.

Much of the growth of transport is driven by rapid increases in the ownership of personal vehicles – including two-wheeled scooters and motorcycles as well as passenger cars. As personal wealth has grown in developing nations, the motorized personal vehicle is being seen as a status symbol as well as a means to faster, more flexible and convenient, and more comfortable travel than public transport. In this part of the world, development of excellent public transport systems and intelligent shaping of urban growth will be crucial to future GHG emissions as well as to adequate access of urban populations to jobs, recreation, and other services.

Although most attention in transportation has been paid to personal travel, freight transport now accounts for over a third of transport energy use and GHG emissions, and is growing more rapidly than passenger transport. Freight operations are driven more strongly than personal travel by energy costs, but pressure to increase speed and reliability and provide smaller "just-in-time" shipments means that there has been an ongoing movement to faster and more energy-intensive modes.

Air travel, most of it for personal travel, is also a crucial sector – currently it accounts for about 12% of transport GHG emissions, it is growing the fastest of all modes (5%/year), and its effects on climate change are magnified by contrails and on cirrus cloud enhancement caused by the high altitude of aircraft emissions.

The importance of the transport sector's energy use and GHG emissions is magnified by the fact that transportation and oil are inextricably linked….worldwide, oil supplies about 95% of transport energy, and the ratio is similar in the United States – and transport accounts for about 50% of worldwide oil use, a share that will grow over time (for the U.S., transport's share is about two thirds). There is now a debate about the likelihood that conventional oil production may be nearing its peak, which could have drastic consequences for both energy security and GHG emissions. If conventional oil production cannot keep pace with transport demand growth, the most likely fuels to supplement oil-based fuels would be liquid fuels from unconventional fossil resources – tar sands, heavy oil, and coal – and liquids synthesized from natural gas. These supplements would tend to increase GHG emissions. In my personal view, it is quite likely that the transition to such fuels would not go smoothly, and supply disruptions and very high prices would be probable. Further, even if oil resource optimists prove to be correct, expanding production to match demand will require huge investments in oil-producing regions with troubled investment environments. If these investments are not forthcoming, future supply problems will be severe. These issues create a strong added incentive to focus on reducing the growth rate of demand for oil.

Efficiency Technology

Improvement in energy efficiency is a key method of reducing GHG emissions. Since the Third Assessment Report (TAR) in 2001, there have been significant advances in efficiency technology. For example:

- Turbocharged direct injection diesel engines, capable of improving fuel efficiency by 30% or more over similar gasoline engines, have attained a market share of over 50% of new car sales in Europe. These engines are much cleaner than the last generation of diesels, and their emissions performance continues to improve.
- Hybrid-electric vehicles had just been introduced at the TAR's publication; since the TAR, automakers have made great strides in improving their performance and reducing their costs, and their use has spread to bus fleets and recently to urban trucks. They clearly will play a larger role in the future, but the extent of their penetration into the road vehicle fleet depends strongly on further reducing their costs.
- There has been steady progress in hydrogen fuel cell development, especially in reducing the cost, size and weight of fuel cell systems; however, further progress in reducing costs and increasing onboard hydrogen storage capability is crucial to future commercialization – and hydrogen is likely to play a significant role only with strong government support.

An array of potential improvements to new light-duty passenger vehicles conceivably could double their fuel economy by 2030. Aside from hybrid drivetrains, there can be substantial improvements in both gasoline and diesel engine technology, weight reduction through lightweight materials and improved designs, better aerodynamics and tires, improved transmissions, and so forth. However, a key issue will be the extent to which these technologies are used for reducing fuel consumption or instead to obtain other things – larger vehicles; better acceleration performance; more amenities such as 4-wheel drive; and improved safety. The U.S. Environmental Protection Agency has estimated that the U.S. new car and light truck fleet's fuel economy in 2005 would have been 24% higher had the fleet remained at the weight and performance distribution it had in 1987. Instead, it became 27% heavier and 30% faster in 0-60 mph acceleration time – and fuel economy actually declined a bit. Although the U.S. may be an extreme case, this type of tradeoff of performance and size versus fuel economy is being made to some degree throughout the world.

A wide array of technologies exists to reduce GHG emissions in other transport areas. For example, an array of body shaping and other measures on intercity freight trucks can sharply reduce aerodynamic drag; coupled with significant improvements in diesel technology, fuel economy improvements as high as 50% may be possible for high speed operation. Similarly, substantial improvements in efficiency are possible for trains and airplanes.

Biofuels can play a substantial role in reducing GHG emissions from all transport modes. A recent International Energy Agency study estimated that biofuels could substitute for

4-7% of transport fuel in 2030 and 13-25% by 2050 at costs less than US$25/metric ton of CO_2. However, the higher values require substantial progress in developing the technology for using cellulosic materials (such as switchgrass and wood waste) as fuel feedstocks.

Policy

There is an array of potential policy tools that could help to reduce GHG emission growth throughout the transport sector. As noted above, in areas with rapid urbanization and transport systems in the early stage of development, good urban design, development of efficient public transport systems, and promotion of walking and biking can reduce the growth of personal vehicles while providing excellent mobility and access to services. These policies also have an important role to play in the United States and elsewhere in the industrialized world, although much of the die is cast in terms of dependence on personal vehicles and in the form of urban areas.

A key policy tool that is applicable worldwide is the fuel economy standard for personal vehicles. Such standards are now widely used, even in countries with much higher fuel prices and vehicle taxes than ours, and much better public transport systems. These have been effective in slowing the growth of oil use and GHG emissions, and they were effective in the United States – in consort with higher fuel prices – in raising new light-duty vehicle fuel economy from 13.1 mpg in 1975 to 22.1 mpg in 1987. Some form of fuel economy or CO_2 standard or agreement is now in place in Japan, the European Union, China, Australia, and elsewhere, and the State of California and a group of other States are attempting to establish their own CO_2 standards. In my personal view, the new attribute-based standard for light trucks recently established by the National Highway Traffic Safety Administration, based on a vehicle's "footprint" (wheelbase times track width) is worthy of close attention as a candidate for a standard for the combined fleet of cars and light trucks.

Taxation policies on fuel and vehicles can also play an important role. Many countries do heavily tax motor fuels and have lower rates of fuel consumption than countries with low taxes. However, vehicle travel demand, the demand for vehicles, and fuel use are not highly price elastic, so relatively high taxes are required to have major effects on fuel use and GHG emissions. A variety of transportation demand management (TDM) strategies can also reduce the use of personal vehicles and reduce GHG emissions.

Several of the "high potential" technologies that could allow sharp reductions in GHG emissions from transport will require substantial additional development, so government support of research and development activities aimed at these technologies is an important policy tool. Key technology areas include:

- Cellulosic biomass – production and sustainability
- Batteries for hybrids, plug-in hybrids and electric vehicles
- Aircraft engines and high efficiency aircraft structures (e.g., the blended wing concept)
- Hydrogen fuel cells
- Vehicle structural materials

- Advanced gasoline and diesel engines

Mitigation Potential

The IPCC estimates that the mitigation potential for the transport sector is about 1600-2550 million metric tons of CO_2 at carbon prices below $100/ton of CO_2. This estimate does not consider heavy-duty freight and transit vehicles, rail transport, shipping, and shifts from private vehicles to public transport and non-motorized travel. The estimate is highly uncertain, however, because of the limited number of studies of world transport mitigation potential and strong uncertainties about future oil prices and future progress in technology development. Key areas of uncertainty are biomass fuel production technology and biomass production sustainability in massive scale, and battery cost, lifetime, and energy storage capacity.

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Steve Plotkin is a staff scientist with Argonne National Laboratory's Center for Transportation Research, specializing in analysis of transportation energy efficiency. He has worked extensively on automobile fuel economy technology and policy as a consultant to the Department of Energy, and was a consultant to the National Research Council's study on the *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards*. He is a lead author on the Intergovernmental Panel on Climate Change (IPCC) 2007 Assessment Report on Mitigating Climate Change. He was for 17 years a Senior Analyst and Senior Associate with the Energy Program of the Congressional Office of Technology Assessment (OTA) and prior to that he was an environmental engineer with the U.S. Environmental Protection Agency.

Mr. Plotkin has a BS degree in Civil Engineering from Columbia University, and a Master of Engineering (Aerospace) degree from Cornell University. He is the 2005 recipient of the Society of Automotive Engineers' Barry D. McNutt Ward for Excellence in Automotive Policy Analysis.