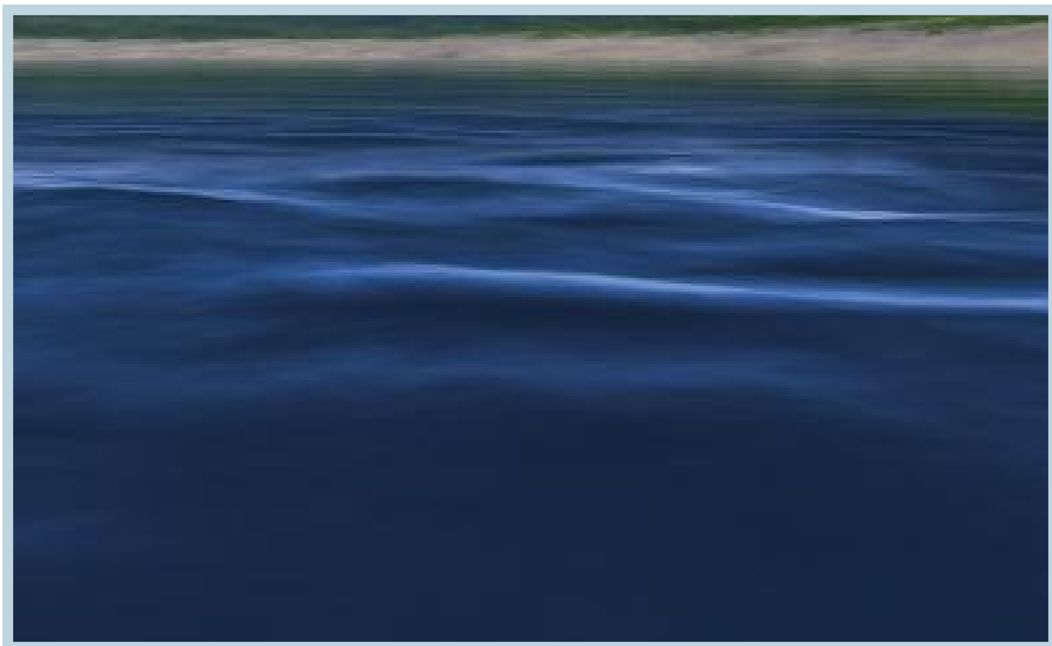


LOST – Energy Use in Our Transportation System

by John A. "Skip" Laitner

Growing the Economy Through Global Warming Solutions

Global warming is one of the most urgent problems of our time.

The good news is that many of the solutions to this extraordinary problem are within reach. Many of the solutions to global warming are not only feasible, they are economically and socially beneficial. While some claim that addressing global warming will have a negative impact on the economy, the most recent report by the Intergovernmental Panel on Climate Change ("IPCC") asserts that there is substantial economic potential for the mitigation of greenhouse gas emissions over the coming decade. In fact, there is a growing global market to address global warming, and the United States must act now or risk being left behind.

Growing the Economy through Global Warming Solutions sets forth the steps we can take to curtail global warming, the governance models needed to encourage such a transition, and the economic benefits of doing so. By taking these steps as soon as possible, we not only will minimize the grave risks of global warming, we will position the United States as the leader in the clean industries and technologies that are emerging as the key growth engine of the Twenty-First Century.

It is now a given that global warming is happening. It is caused by the emissions of greenhouse gases – primarily carbon dioxide released during the combustion of fossil fuels -- and already has begun to inflict harms on climate, ecology and people. The most recent IPCC report confirms that global warming is here and will accelerate in the future with serious harms and risks if greenhouse gas emissions are not promptly limited. Dr. James Hansen, of NASA's Goddard Institute for Space Studies, warns that a global average warming of 3.5 degrees Farhenheit will produce a "different planet" by taking us over dangerous climate thresholds that greatly magnify the risks of disintegrating the great ice sheets on Greenland and West Antarctica, an event that would cause massive and rapid sea level rise. Dr. Hansen emphasizes that we can keep the planet within the known boundary conditions by limiting the future global temperature increase to no more than 3.5 degrees Fahrenheit.

To do so, we must stop the business as usual approach in which carbon dioxide and other greenhouse gas emissions increase every year. One of the primary obstacles to moving from this business as usual approach to a problem solving approach is the argument that mandates to limit emissions will cripple the U.S. economy and that the market will produce all necessary solutions on its own. But this argument focuses too narrowly on the economic impact to "big energy", which for too long has dominated the political discussions in Washington. Growing the Economy through Global Warming Solutions asserts that we cannot afford to wait for voluntary market solutions. We must either invest now to implement solutions, or we will pay much more later as we have to adapt to the growing impacts of global warming. Many mitigation strategies, those that will help reduce emissions now, will not only be cheaper to implement, they will stimulate the economy.

Government has an essential role to play in developing a strong governance model – those procedures, rules and regulations that can work to bring greenhouse gas emissions under control. In fact, with the right set of government incentives to help focus their attention, the business community, which is already beginning to recognize challenges and opportunities - and looking to both adapt and innovate - will see even more possibilities for capitalizing on economic opportunities while achieving environmental gains. The good news is that, if we get started right away, we can rapidly move to this solutions-oriented approach in which emissions are limited and reduced in time to avert the worst risks of global warming.

Growing the Economy through Global Warming Solutions is a series of papers written by experts in the fields of economics, public policy, energy policy, architecture, insurance, investment, transportation, and agriculture. It details the solutions that can be taken off the shelf today. While there is no single silver bullet for addressing global warming, there are a wide variety of solutions that, taken together, will lead to a reduction of carbon dioxide emissions, the key to stopping global warming. These promising solutions must be phased in as we phase out our outmoded reliance on foreign oil and coal. Along with its companion reports, *LOST – Energy Use in Our Transportation System, by John A. "Skip" Laitner*, sets out important next steps that can and should be taken in the near and medium term to ensure that we do everything possible to address the challenges of global warming.

We have the know-how and it is the American Way to innovate and problem solve. We have time.

We have to get started now.

> **"We have at most ten years—not ten years to decide upon action, but ten years to alter fundamentally the trajectory of global greenhouse emissions."** *– Jim Hansen, Director of the NASA Goddard Institute for Space Studies, and Adjunct Professor of Earth and Environmental Sciences, Columbia University's Earth Institute.*

Executive Summary

The transportation system in the United States is vast, accounting for almost 30 percent of total energy use, and about 70 percent of petroleum consumption. While there have been some improvements in vehicle efficiency in the last three decades, they have been overshadowed by the significant increase in number of cars, types of cars/trucks, and number of miles traveled. As a result, substantial opportunities for increasing efficiency remain, and will be a necessary element of any strategy to address the challenges of global warming. In order to achieve the potential efficiency gains, we will need public policies that require increased vehicle efficiency as well as improvements in a whole range of system efficiency improvements.

The transportation system includes the obvious—cars, trucks, buses, trains, planes and ships—as well as the somewhat less obvious—roads, traffic management, shipping patterns, and work patterns. Automobiles currently account for about two thirds of fuel use in the U.S. To do its part, Congress recently increased fuel economy requirements, but greater efficiencies are both necessary and possible. An important next step in improving vehicle efficiency is to extend new efficiency technologies into more of the vehicle fleet will yield substantial benefits. And while it is true that such technologies increase production—and thus sales—costs, because they use less fuel, such increases can be offset in a few short years by decreased operation costs.

Another large, and largely untapped, area of potential efficiency improvements is to reduce travel requirements for the movement of both goods and people. These efficiencies may be accomplished in a number of ways includes through the use of smart technologies that reduce driving distance and time in traffic as well as utilizing high-tech supply chain logistics and warehousing technologies. In addition, increasing the use of video conferencing and telecommuting reduced the transportation requirements for workers.

In order to achieve an optimal configuration of transportation technology systems, we will need smartly-crafted policy solutions to overcome existing social, economic and structural barriers. Such policies should focus simultaneously on improving fuel economy requirements and reducing overall travel demands through a combination of funding for alternative transportation as well as changes in land use and economic development policies. With these policies, we could yield a 60 percent improvement in fuel efficiency as well as a 20 percent reduction in travel by 2030, which would make a substantial contribution to addressing the challenges of global warming.

In 1970, taking the family car to do some shopping at the local grocery and other nearby stores—a total roundtrip of perhaps 12 to 14 miles—might have required a full gallon of gasoline. The total transportation fuel consumption for the United States in that year was the equivalent of about 119 billion gallons of petroleum. That meant in 1970 we had to burn about 3,782 gallons of fuel each second to power all of the cars, trucks, planes, trains as well as all the other forms of travel within the U.S. Today that same trip in a reasonably fuel efficient new car might require less than half a gallon of gasoline; but we also use more total energy now than we ever have before – burning fuel at a rate of 6,791 gallons per second, or using about 214 billion gallons of fuel per year. While we generally have more fuel-efficient vehicles—whether cars, trucks, or planes—we are a richer nation and have many more people who also travel a good deal more than in 1970. The bottom line is that despite significant fuel productivity gains in our transportation technologies over the past several decades, our demands for travel have increased at a substantially higher rate.

> Given its huge impact on both the economy and the environment, it's surprising how inefficient our transportation system turns out to be. But the good news is that ... we can reduce our dependence on petroleum fuels in ways that save money, reduce greenhouse gas emissions, and improve our overall national security.

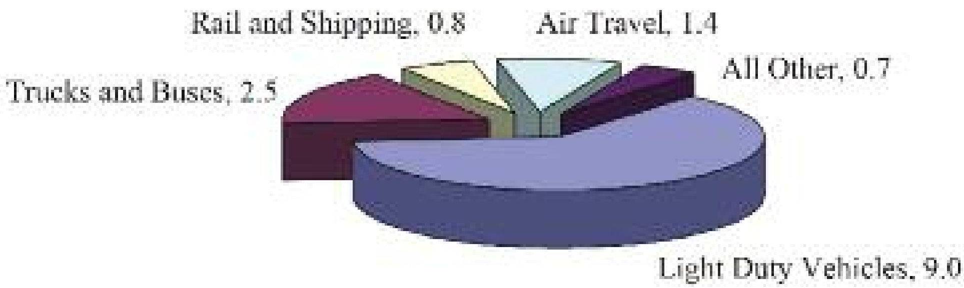
The transportation and delivery of people, goods, and services now account for almost 30 percent of total energy use in the United States. At the same time, transportation is responsible for about 70 percent of our total petroleum consumed. The costs are huge, in terms of overall expenditures, imported oil, and environmental impacts—most certainly including global warming. Given its huge impact on both the economy and the environment, it's surprising how inefficient our transportation system turns out to be. But the good news is that with the appropriate mix of price and policy signals, and a serious national commitment to increased transportation "system efficiencies," we can reduce our dependence on petroleum fuels in ways that save money, reduce greenhouse gas emissions, and improve our overall national security.

There are generally two categories of actions we can take to achieve these gains. The first is to further improve the fuel economy of our nation's cars, trucks, trains, planes, and other vehicles. The second is to reduce travel requirements by making it easier to produce goods and services closer to where we live, work, and play. Reducing the need for travel has much the same impact as increasing overall fuel economy. This paper examines the current pattern of energy use and then outlines opportunities to reduce that demand in ways that saves money for consumers and businesses.

Understanding the Transportation System

When we climb into our cars or other vehicles to get where we want to go, we're really climbing aboard an incredibly extensive and highly diverse transportation system. It involves the obvious things like roads, bridges, tractor trailers and shipping containers, but it also includes a much larger array of elements—each with inefficiencies that if corrected, or even changed in reasonably minor ways, can help reduce the need for gasoline and other petroleum products. Among the less obvious aspects of the transportation system are traffic signals and controls, information and enforcement activities, and the scheduling, coordination, and management of facilities, goods, and services. Perhaps even less obvious in some ways is all the freight that must be hauled—to get the food from the farm to the processing plant and then to the grocery store; to get the lumber from the forests to the mills, from the mills to the lumber yards, and finally to our homes and offices; or to get the clothing, medicines, books, and consumer electronics to the stores for purchase by consumers and businesses.

Figure 1. Transportation Energy Use by Mode
(million barrels per day oil equivalent)



Source: U.S. Department of Energy, Annual Energy Outlook 2007

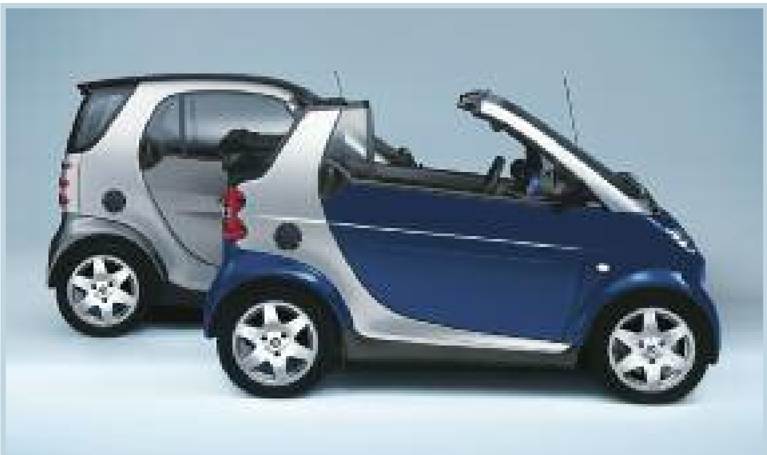
Adding up all the energy required by these various transportation needs, Figure 1 suggests that for the year 2007 it appears we need 14.4 million barrels of oil each day to maintain current levels of use (and inefficiencies). Cars and other light duty vehicles demand 9 million barrels per day, or about 63 percent of the total. While automobile fuel economy has grown from 13 miles per gallon in 1973 compared to an average of about 23 miles per gallon today—a respectable 70 percent over that period—there are more and more cars driving more and more miles so that we are using more and more gasoline and other petroleum fuels. And the kinds of cars we are driving have also changed. In the mid-1970s only one out of five new cars sold was a pickup or other light truck. Today trucks, sport utility vehicles and minivans are more like half of the total sales for new light duty vehicles (Davis and Diegel 2007). Their overall fuel economy is substantially less at 16 miles per gallon. As a result, all the gains in fuel economy for new cars have been eaten away by the growing sales of less-efficient trucks, minivans, and SUVs.

There is some good news in this. Whether we are talking about passenger cars, railroad trains, trucks, aircraft or ships, over the next twenty years the potential for technology improvements that increase the fuel efficiency of individual vehicles is significantly greater than is generally imagined or appreciated. But an even larger "system gain" in energy efficiency is possible if we make wholly achievable cost-effective improvements in system operations, in infrastructure and in land use patterns—in addition to those vehicle efficiency improvements.

Whether we are talking about passenger cars, railroad trains, trucks, aircraft or ships, over the next twenty years the potential for technology improvements that increase the fuel efficiency of individual vehicles is significantly greater than is generally imagined or appreciated.

The Many Efficiency Opportunities

To gain some insight into the full opportunity for system efficiency improvements, let's start with the more familiar area of vehicle efficiency improvements. Even a cursory look at the "Best of 2008" cars makes it clear that gains in energy efficiency come from a wide range of technologies. Hybrid vehicles such as the Toyota Prius or the Honda Insight have been claiming the limelight when it comes to high miles-per-gallon vehicles, but fuel-efficient technologies are also being installed in more conventional cars as well. Intelligent engines with features such as cylinder deactivation and variable valve control; advanced transmissions, including 6–7 speed automatics or continuously variable transmissions (CVTs); and lightweight materials, engine-off-at-idle, friction reduction, and improved aerodynamic designs all do their part to help make these cars more energy-efficient. By extending these and other technologies to include more of the new car and new truck fleet (in effect, so that the best becomes the typical), there is a huge potential to improve the energy efficiency of conventional vehicle technology (IEA, 2005).

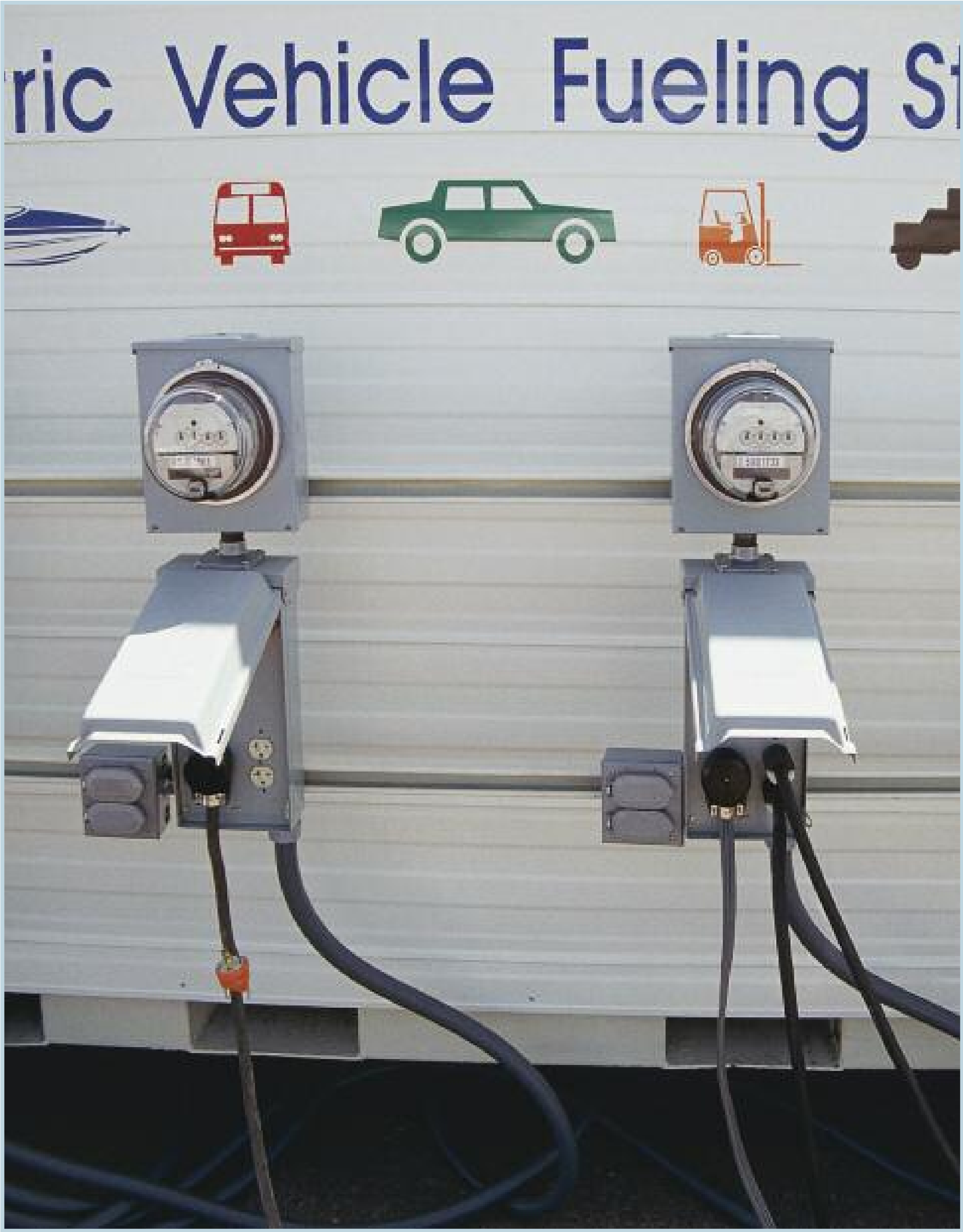


Engine efficiency improvements that would result in up to a 20 percent reduction in fuel consumption should be achievable over the next decade or so by taking advantage such design changes (see, for example, the extended discussion in the International Panel on Climate Change's (IPCC) Fourth Assessment Working Group 3 on Mitigation, Kahn et al. 2007; and also see the report issues by the National Research Council 2002). Near-term improvements to transmissions have the potential to improve fuel economy by another 10 percent. The International Energy Agency (2006) estimates that the fuel economy of standard vehicles could be improved 40 percent by the year 2050. But others think this target may be too modest. A recent report of technology experts funded by the United Nations Foundation called for a 35 percent increase in fuel economy by 2020 and a 60 percent increase by 2030 for new light-duty vehicles (Expert Group on Energy Efficiency 2007).

These advanced technologies admittedly increase the manufacturing costs of vehicles but at the same time they also reduce the energy costs of operating them. DeCicco et al. (2001), for example, suggested that fuel economy standards could increase from 37 to 70 percent over a 15 year period with no more than a 4.5 to 6.6 percent increase in costs. In other words, a car that might cost an additional $1200 might also save 150 gallons of gasoline annually. With current gasoline prices in the range of $3 per gallon, this might imply a typical payback of less than three years. Similarly, a car that might cost an extra $3000 might save 190 gallons of gasoline which means that at $3 per gallon, the extra investment would pay for itself in just over five years. Although a shorter payback period would be better, either of the technology upgrades would generate a positive return for a vehicle with an expected life of 17 years or more. (For other comparative estimates of costs and savings associated with vehicle efficiencies, see IEA 2006, tables 5.2 and 5.6; and Vattenfall 2007.)

At the same time, the actual fuel economy that is achieved in driving motor vehicles can be greatly affected by how they are operated and how they are maintained. Whether in the form of speeding and aggressive driving, excessive engine idling, improper tire pressure, and even poor choice of motor oil, the behavior and maintenance decisions of drivers can also affect the on-road fuel economy. One recent study concluded that programs which promote improvements in driving style through training and technology aids could generate a 10 percent reduction in typical fuel consumption and therefore in greenhouse gas emissions (ECMT/IEA 2004).

Although automobiles now use about two-thirds of the transportation fuel consumed in the United States, large savings are also possible in the movement of freight as well as the movement of passengers in business, air, and train travel. One professor of transportation logistics has suggested that heavy trucks might save 32 percent of energy use through a combination of improved fuel efficiencies, and better coordination to reduce empty backhauls and unnecessary travel (McKinnon 2007). Although rail transport is one of the more energy-efficient transportation modes, the IPCC suggests that substantial opportunities for further efficiency improvements remain. These include reduced aerodynamic drag, lower train weight, regenerative breaking and higher efficiency propulsion systems, all of which can make significant reductions in rail energy use. While passenger jet aircraft produced today are 70 percent more fuel efficient than equivalent aircraft produced


ric Vehicle Fueling St

40 years ago, the IPCC notes that a 20 percent improvement over 1997 aircraft efficiency is likely by 2015 and "possibly 40 to 50% improvement is anticipated by 2050. Still greater efficiency gains will depend on the potential of novel designs such as the blended wing body, or propulsion systems such as the unducted turbofan" (Kahn et al. 2007).

Emergence of Information Technologies

One especially interesting opportunity that is emerging is the use of information and communication technologies to increase transportation efficiencies by decreasing travel demands and increasing transportation system efficiencies (Laitner and Ehrhardt-Martinez 2007).

Maximum energy-efficiency gains can be provided through a combination of intelligent transportation systems (ITS) and smart vehicle systems that rely on a variety of sophisticated electronic technologies including GPS, sensors, processors and on-board communications equipment.

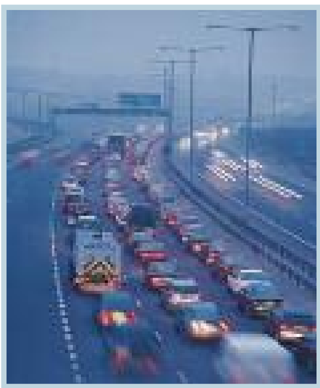
Smart vehicle technologies, for example, provide a range of innovative means for reducing transportation-related energy consumption while maintaining the services on which we depend. Vehicles are increasingly integrating sophisticated communications and information technologies that collect and communicate information regarding vehicle performance, routes and maps, road and traffic conditions, energy consumption, and environmental variables. As more and more vehicle manufacturers integrate on-board wireless technology, smart cars will increasingly be able to communicate with regional data centers as well as other vehicles on the road to share road data, travel information, traffic conditions, and other information. Moreover, on-board display devices will make this information readily accessible to drivers through the use of networks of sensors and communications devices. Maximum energy-efficiency gains can be provided through a combination of intelligent transportation systems (ITS) and smart vehicle systems that rely on a variety of sophisticated electronic technologies including GPS, sensors, processors and on-board communications equipment. In the future, these technologies will enable automated management of traffic flows, allow drivers to avoid congested roads, and locate and map the shortest routes to specified destinations—resulting in shortened drive times, reduced energy consumption, and lower greenhouse gas emissions.

Governments and businesses are also looking to integrate high-tech supply chain logistics and warehousing technologies. Advanced logistics technologies can help companies reduce fuel use, costs, and carbon emissions through:

- Intermodal shipping strategies that utilize a variety of shipping modes including rail resulting in reduced traffic congestion and idling time and increased shipping mode flexibility allowing shippers to choose the most fuel-efficient, cost-effective, reliable and timely mode of transportation.
- Improved truck tracking and logistics management to improve scheduling the pickup and delivery of goods so as to reduce wait times, maximize the size of truck loads, and reduce the number of wasted "backhaul" of empty trailers.
- Improved routing of traffic by providing real-time information about the quickest routes to reduce travel time and idling.
- Improved tracking and management of store and warehouse inventories to improve the management and flow of goods and increase the viability of intermodal shipping opportunities.

These strategies can minimize inefficient freight operations, saving fuel, increasing revenue for trucking companies, and reducing carbon dioxide emissions. For example, according to the US Environmental Protection Agency, the use of intermodal shipping for long distance shipments (over 1000 miles) cuts fuel use and greenhouse gas emissions by 65 percent, relative to truck transport alone (EPA 2004).

Still another transportation option is the use of telecommuting and videoconferencing. The emergence of information and communication technologies enables high quality work to be completed from a home office location in a way that saves gasoline – even after other energy uses are considered. For example, while a telecommuter may save gasoline as a result of a net reduction in commuter travel, there is some increased energy use associated with working in the home office. But even with a full accounting of those increased uses, a new estimate by the Consumer Electronics Association indicates that the regular telecommuting of some 4 million workers is now saving an estimated 840 million gallons of gasoline equivalent. More critically, the report suggests that the potential could grow 25 to 50 million workers which would significant increase current levels of energy savings (TIAX LLC 2007). By the time we include other ICT-enabled services ranging from expanded videoconferencing to increased electronic banking and other retail and entertainment services, the suggestion is that "normal" transportation efficiency gains could be greatly complemented by new patterns of working and living enabled by information and communication technologies.



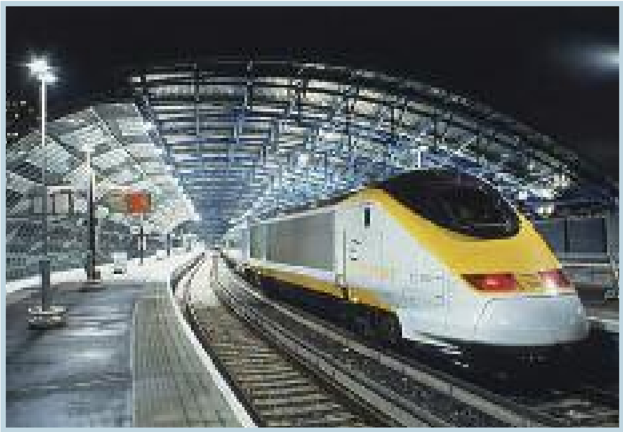
The Need for a New Policy Framework

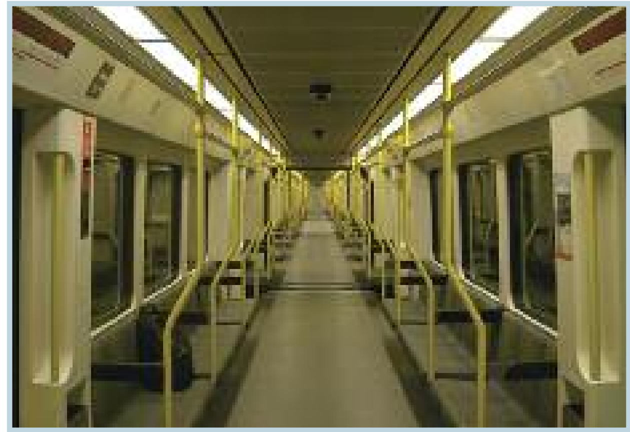
Even with all this good news about the potential for greater system efficiencies, however, transportation energy use is likely to increase by another 37 percent between now and 2030—in the absence of policy intervention that might otherwise guide an optimal mix of technology improvements and new services demands. This result is driven, in large part, by an increase in vehicle and air miles traveled that will roughly double the growth in our population in that same period of time (EIA 2007). One significant downside of the expected increased demand for petroleum resources is that this will likely push even harder on the rising energy prices faced by businesses and consumers. That same growth in energy use will also increase the burden associated with continued emissions of greenhouse gases.

A more successful outcome, one that achieves an optimal configuration of transportation technology systems, will require smartly crafted policy solutions to overcome important social, economic and structural barriers. Yet, at a recent transportation policy forum sponsored by the U.S. General Accounting Office (described as the audit, evaluation, and investigative arm of the United States Congress), participants said that "the nation's transportation policy has lost focus and that the nation's overall transportation goals need to be better defined." They further noted that "the federal share of total transportation spending continues to decline" (U.S. Controller General 2007). The evidence certainly seems to point in that direction.

> Initial thinking suggests that, with supportive policies, a 20 percent (or greater) reduction in total vehicle travel might be possible by the year 2030.

Although it has been highly cost-effective to substantially raise fuel economy standards for both cars and heavy trucks at least since the early 1980s, we have not done so until very late this year. As of the writing of this report, Congress enacted and President Bush signed into law a new energy bill that, among other things, will increase the average fuel economy of new cars from 27.5 to 35 miles per gallon by 2020. This is a positive step that will increase the average fuel economy of our national fleet of cars and light trucks over time. With the typical life of a vehicle on the order of 17 years or more, however, it will take at least that long for the full stock of vehicles to reach an average fuel economy of 35 MPG. So including the stock of existing but less-efficient vehicles that will need to be replaced over time, the new standards might actually increase average from about 20 MPG today only to perhaps just under 30 MPG by 2030 (author calculations drawn from EIA 2007). Unfortunately, this modest gain in average fuel economy is unlikely to offset the growth in overall travel within the United States. A more realistic focus on both climate change and world energy policies will require a more aggressive improvement in our system-wide energy and transportation efficiencies.



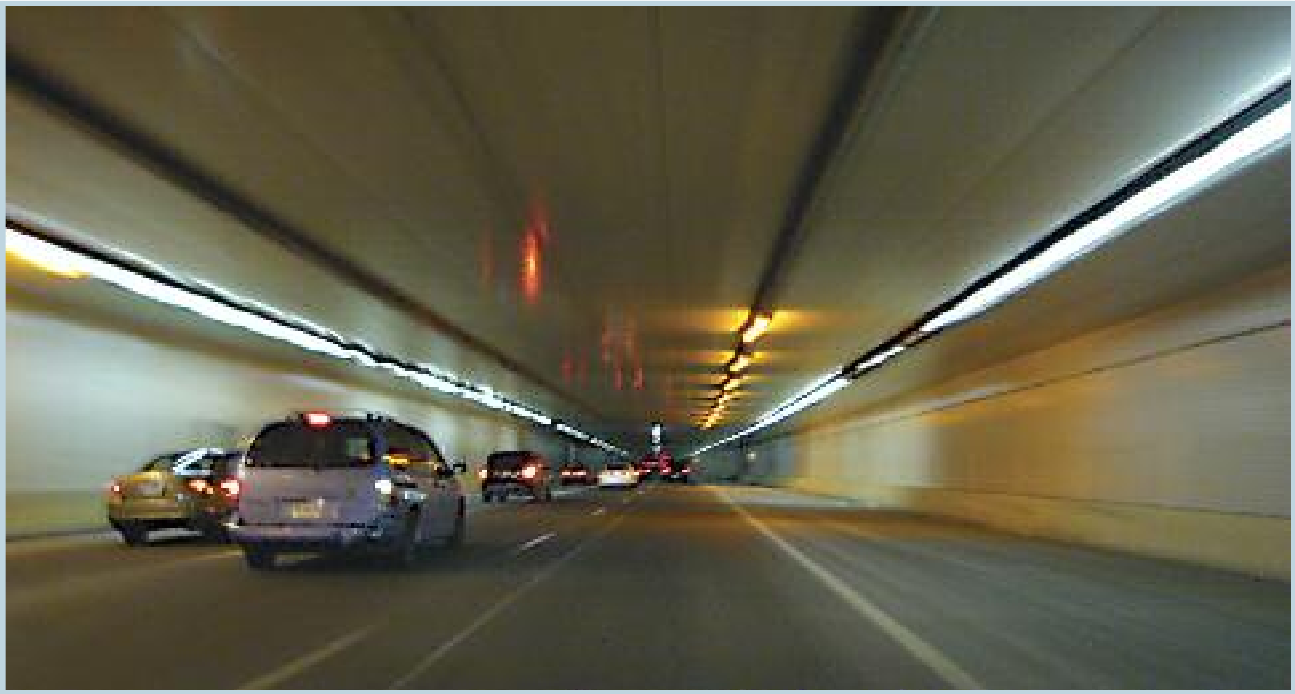


Hence, a meaningful set of long-term policies should address an even greater level of fuel economy improvements, as well as significantly reducing overall travel demands, while maintaining a higher quality of life.

Following the recommendations of the United Nations Foundation panel of experts, for instance, a longer-term focus would increase fuel economy standards for light cars, trucks and heavy duty freight vehicles by at least 60 percent by the year 2030. There is an emerging consensus that—with the right set of policies, and with further investment in research and development activities directed toward transportation systems—a 60 percent improvement is still an economically achievable target (Expert Group on Energy Efficiency 2007; and Langer 2007). At the same time there should also be an emphasis on reducing the demand for travel through a combination of funding for alternative transportation systems as well as changes in land use and economic development policies.

Initial thinking suggests that, with supportive policies, a 20 percent (or greater) reduction in total vehicle travel might be possible by the year 2030 (Ewing et al. 2007 and Langer 2007). Alternative transportation technologies would include rail and mass transit systems as well as a greater emphasis on improving the logistics of freight shipments. Both approaches would either reduce travel or encourage the use of more fuel efficient modes of transport (e.g., piggybacking truck shipments with rail transport). A smarter transportation policy would also embrace greater reliance on telecommuting and videoconferencing in ways that reduce both automobile and air travel. Economic development and land use policies might encourage production technologies that can be located closer to where new goods and services are actually needed. In this way travel demands can be reduced even further (Laitner and Ehrhardt-Martinez 2007).

Policy solutions will play a pivotal role in strengthening the continued development, dissemination, and widespread adoption of energy-efficient transportation technologies and systems. Without a sensible framework of policy objectives and targets, the unfolding of these many technologies and their efficiency gains might follow any number of less productive paths.



REFERENCES

Controller General of the United States. 2007. Highlights of a Forum: Transforming Transportation Policy for the 21st Century. GAO-07-1210SP. Washington, DC: U.S. General Accounting Office.

Davis, Stacy C. and Susan W. Diegel. 2007. *Transportation Energy Data Book 26.* Oak Ridge, TN: Oak Ridge National Laboratory.

DeCicco, John, Feng An, and Marc Ross. 2001. Technical Options for Improving the Fuel Economy of U.S. Cars and Light Trucks by 2010-2015. ACEEE Report T012. Washington, DC: American Council for an Energy-Efficient Economy.

Energy Information Administration (EIA). 2007. *Annual Energy Outlook 2007 with Projections Out to 2030.* DOE/EIA-0383(2007). Washington, DC: U.S. Department of Energy.

Ewing, Reid, Keith Bartholomew, Steve Winkleman, Jerry Walters, Don Chen, Barbara McCann, and David Goldberg. 2007 *Growing Cooler: The Evidence on Urban Development and Climate Change.* Washington, DC: Urban Land Institute.

Expert Group on Energy Efficiency. 2007. *Realizing the Potential of Energy Efficiency Targets, Policies, and Measures for G8 Countries.* Washington, DC: United Nations Foundation

Edwards, R., Larivé, J-F, Mahieu, V., Rouveirolles, P. 2006. Well-To-Wheels Analysis of Future Automotive Fuels and Powertrains in the European Context." EUR 22342 EN. Brussels, Belgium: European Commission, Joint Research Centre, Institute for Environment and Sustainability. http://ies.jrc.cec.eu.int/WTW.

European Council of Ministers of Transport/International Energy Agency (ECMT/IEA). 2005. *Making Cars More Fuel Efficient: Technology for Real Improvements on the Road,* OECD, Paris.

Hammett, Patrick, Michael Flynn, Maitreya Kathleen Sims, and Daniel Luria. 2004. *Fuel-Saving Technologies and Facility Conversion: Costs, Benefits, and Incentives.* Ann Arbor, MI: Office for the Study of Automotive Transportation (OSAT) and University of Michigan Transportation Research Institute (UMTRI), and Plymouth, MI: Michigan Manufacturing Technology Center.

International Energy Agency (IEA). 2006b. *Energy Technology Perspectives 2006: Strategies and Scenarios to 2050,* OECD/IEA, Paris.

Kahn Ribeiro, S., S. Kobayashi, M. Beuthe, J. Gasca, D. Greene, D. S. Lee, Y. Muromachi, P. J. Newton, S. Plotkin, D. Sperling, R. Wit, P. J. Zhou, 2007: Transport and its infrastructure. In *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Laitner, John A. "Skip" and Karen Ehrhardt-Martinez. Advanced Electronics and Information Technologies: The Innovation-Led Climate Change Solution, Brussels, Belgium: AeA Europe, 2007.

Langer, Therese. 2007. Personal communication with Therese Langer, Director of the ACEEE Transporation Program. December 18, 2007.

McKinnon, Alan. 2005. Oil Saving Opportunities in Freight Transport. Paris, France: International Energy Agency/European Conference of Ministers of Transport Workshop: Managing Oil Demand In Transport.

McManus, Walter. 2006. Can Proactive Fuel Economy Strategies Help Automakers Mitigate Fuel-Price Risks? Ann Arbor, MI: Automotive Analysis Division, University of Michigan Transportation Research Institute.

National Research Council (NRC). 2002. *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards.* National Academies Press, Washington, D.C.

National Petroleum Council (NPC). 2007. *Facing the Hard Truths About Energy: A Comprehensive View to 2030 of Global Oil and Natural Gas.* A report to the Secretary of Energy. Washington, DC: U.S. Department of Energy.

Office of Transportation and Air Quality. 2004. A Glance at Clean Freight Strategies: Intermodal Shipping. SmartWay Transport Partnership Program. Washington, DC: U.S. Environmental Protection Agency.

TIAX LLC. 2007. The Energy and Greenhouse Gas Emissions Impact of Telecommuting and e-Commerce. Washington, DC: Consumers Electronics Association.

Vattenfall AB. 2007. Global Mapping of Greenhouse Gas Abatement Opportunities up to 2030: Transport sector deep dive. (Unpublished report, January, 2007).

World Business Council for Sustainable Development (WBCSD). 2004. Mobility 2030: Meeting the challenges to sustainability. Hertfordshire, England, UK, WBCSD. Also available at: http://www.wbcsd.org/web/mobilitypubs.htm

Author Biography

John A. "Skip" Laitner is the Senior Economist for Technology Policy for the American Council for an Energy-Efficient Economy (ACEEE). He previously served almost 10 years in a similar capacity for the US Environmental Protection Agency (EPA), but chose to leave the federal service in June 2006 to focus his research on developing a more robust analytical characterization of energy efficiency resources within energy and climate policy analyses and within economic policy models.

In 1998 Skip was awarded EPA's Gold Medal for his work with a team of other EPA economists to evaluate the impact of different strategies that might assist in the implementation of greenhouse gas emissions reduction policies. In 2003 the US Combined Heat and Power Association gave him an award to acknowledge his contributions to the policy development of that industry. In 2004 his paper, “How Far Energy Efficiency?” catalyzed new research into the proper characterization of efficiency as a long-term resource.

Author of more than 150 reports, journal articles and book chapters, Skip has more than 35 years of involvement in the environmental and energy policy arenas. He’s been invited to provide technical seminars in such diverse places as Australia, Canada, China, France, Germany, Korea, South Africa and Spain. He recently served as an adjunct faculty member at the Virginia Polytechnic Institute and State University, teaching a graduate course on the Economics of Technology in the Science and Technology Studies program. He has a master’s degree in Resource Economics from Antioch University in Yellow Springs, OH.

Growing the Economy Through Global Warming Solutions
is presented by

Civil Society Institute
1 Bridge Street • Newton, MA 02458
(617) 243-3509
www.CivilSocietyInstitute.org

The nonprofit and nonpartisan Civil Society Institute is a think tank that serves as a catalyst for change by creating problem-solving interactions among people, and between communities, government and business that can help to improve society.

Insight into programs that have and have not worked in recent years has led Civil Society Institute to a unique model for addressing society's most pressing problems. Simply stated, our approach lies in the way we serve as catalysts for change, especially in key areas of critical need: global warming and global security and economic change, and science policy and regenerative medicine.

In each of these areas, we seek out examples of creative thinking and activities already underway, including those of individuals, community groups, businesses and the nonprofit and public sectors. We create interactions between people, communities, government and business in order to link successful programs to groups who can use them, to eliminate obstacles to success and to encourage informed debate of the issues. We also support these efforts with strategic planning and, on occasion, funding.

We're committed to improving society with breakthrough thinking and creative action.

Series Editor:
Lloyd J. Dumas
Professor of Economics and Public Policy,
University of Texas at Dallas

printed on recycled content paper