Toward Effective Transportation Policy

Daniel Sperling
Institute of Transportation Studies
University of California, Davis
dsperling@ucdavis.edu
(on leave 1999-2000 at OECD/ECMT in France)

Pew Center on Global Climate Change and Royal Institute of International Affairs

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For those concerned about energy use and greenhouse gases in the transport sector, virtually all trends are in the wrong direction -- in the US as well as in most other countries of the world:

- Transit market share continues to drop, now accounting for less than 2% of passenger travel in the US;
- vehicle use and ownership continues to set new records every year, with each licensed driver in the US now owning 1.1 vehicles and driving over 14,000 miles per year on average;
- vehicles are getting larger and heavier every year;
- fuel economy of new vehicles is worsening and is now at its lowest level in the US since the early 1980s;
- GHG emissions from transportation are increasing at 2% per year in the US and at similar or higher rates in virtually all countries with expanding economies;
- transportation accounts for an increasing share of increasing CO_2 emissions virtually everywhere (increasing from 16.9% of worldwide total in 1971 to over 20% today).

These trends are disturbing, but not unchangeable. Indeed, the potential for energy saving and greenhouse gas reduction in transportation is huge. The many strategies for doing so may be clustered into three groups:

- reduce vehicle travel;
- improve conventional vehicle technology; and
- introduce advanced technologies and low-carbon fuels.

All three are important. The first, reductions in vehicle travel, are desirable for a variety of reasons, and certainly merit strong support. But in terms of GHG reductions, technology-based strategies (the 2nd and 3rd strategies) are likely to be far more effective, especially in the US and probably in all OECD countries. Very large reductions are possible with improvements in conventional vehicle technology, and even greater reductions are possible with emerging electric-drive technologies and low-carbon fuels.

From a policy perspective, however, the principal challenge is *not* development of new and better technologies. Rapid technological advance will continue to occur with normal rates of industrial R&D investment. Rather, the chief challenge is moving technology from the "lab" (i.e. prototypes) to the marketplace. In the case of technologies with strong environmental benefits, this movement from lab to market requires -- by definition -- a strong government presence. For both incremental and leapfrog technologies, even modest political leadership would have a dramatic effect in reducing energy consumption and greenhouse gas emissions.

Consider fuel consumption. Contrary to conventional wisdom, vehicle fuel efficiency has improved rapidly over the past 15 years. You might ask how can that be, since data show that the fuel economy of new light duty vehicles has been slowly decreasing in the US for over 10 years (from 25.9 mpg in '87 to 23.8 in '99).

The explanation has to do with the distinction between fuel efficiency (defined as energy used to accomplish work, such as moving two tons one kilometer) and fuel economy (defined as miles per gallon). Tremendous improvements in efficiency have been made, but those efficiency improvements were *not* used to improve fuel economy (i.e., mpg); rather, efficiency improvements were diverted to increase the weight and power of new vehicles. During the past 13 years, light vehicles increased in weight and acceleration (0-60mph) by 20%, and horsepower by 58%. Indeed, if today's vehicles had the same weight and performance characteristics of 10 years ago, but incorporated all the technological and efficiency improvements that accrued over those years, then vehicles would be consuming at least 20% less fuel and producing that much less greenhouse gases.

Lessons Learned

The lessons learned from this recent fuel economy experience are:

1. energy efficiency innovation *has* continued in recent years;
2. vehicles will likely become still larger, more powerful, and more fuel consuming unless government intervenes; and
3. large fuel economy gains are possible, even with today's technology.
4. to *realize* fuel economy gains, whether with conventional or advanced technology, government policies must change, which in turn influence changes in consumer and industry behavior.

With advanced technologies, many already being commercialized, even greater reductions in fuel consumption and greenhouse gas emissions are possible.

The automotive industry is awash with new electronic, information and materials technologies, and is just beginning to appreciate the large potential benefits that result from development of advanced energy-storage and energy conversion technologies. Advances in fuel cells, ultracapacitors, power electronics, batteries, and even internal combustion engines, combined with advances in lightweight materials and energy-conserving features, have the potential to significantly improve fuel economy and

greenhouse gas emissions, as well as eliminate air pollutants -- without compromising performance and perhaps even without adding cost. Indeed, the next generation of electric-drive vehicles are likely to excel not only environmentally, but also in satisfying customers. Companies such as DaimlerChrysler, General Motors, Ford, and Toyota are each investing hundreds of millions of dollars in fuel cell technology because they think fuel cells are a superior technology -- not only more energy efficient and less polluting, but also because they have the potential to be more reliable, quieter, longer lasting, better suited to tomorrow's electronic-laden cars, and eventually perhaps even less expensive.

William Clay Ford, Chairman of Ford Motor Company, expressed the new conventional wisdom of the automotive and energy industries in a recent, widely quoted speech (January 19, 2000):

> "I believe fuel cell vehicles will finally end the 100-year reign of the internal combustion engine as the dominant source of power for personal transportation. It's going to be a winning situation all the way around - consumers will get an efficient power source, communities will get zero emissions, and automakers will get another major business opportunity."

But without policy leadership, the transition to fuel cells and other low-GHG technologies will be greatly slowed. Companies, even GM with over $160 billion in annual revenue, is daunted by the huge risk and start-up costs of these new technologies. Indeed, one reason so many mergers are taking place in the automotive industry is that even mid-sized companies with annual revenues of up to $50 billion worry that they are not large enough to assume the risk and investment needed to stay near the leading edge.

Companies are willing to make R&D investments in leapfrog technologies, and are doing so. But without strong policy support -- not necessarily financial -- they cannot justify the much larger investments needed to commercialize those technologies on a large scale. The risk is too great. Only a year ago, at least four major automakers each said they would be producing 100,000 fuel cell vehicles per year by 2004. It now appears that those goals will not be realized -- not because of lagging technological progress -- but because of uncertainties about public support and fuel supplier commitment. Those uncertainties and risks could be greatly reduced with relatively modest initiatives by government regulators and policymakers -- thereby accelerating the commercialization of clean and efficient technologies.

To illustrate what is possible when government regulators and policymakers behave in a clear and deliberate fashion, consider the case of emission control technology for gasoline vehicles. Ten years ago, automakers estimated that the cost of reducing emissions to "ultra-low" (ULEV) levels would be over $2000 per vehicle, and that doing so probably was not practical with gasoline. There were very wrong. Regulators pushed ahead, especially in California, and companies are now certifying new gasoline vehicles as ULEVs, and within months the first vehicle will be certified as SULEV, a category so stringent -- another 50-80% lower -- that it hadn't even been conceived at that time. It is now estimated that the cost of attaining ULEV levels is less than $200 per vehicle, and

will soon drop to half that or less within a few years. Similarly dramatic improvements are possible with advanced electric-drive technologies.

Recommendations and Conclusions

We must take a hard look at our current transportation system: at how we pursue technological progress, rally around public goals, and bring to bear the powers of government. Given the crucial nature of these societal behaviors and the uncertainty of how they will be borne out, the future is largely unpredictable. It is for that reason that the linchpin of any policy strategy must be flexibility, experimentation, and harnessing of market forces. There are many ways of doing so. Below I provide a policy framework for accelerating the development and use of low-GHG transportation technologies.

1. Strengthen and Re-Structure National R&D for Advanced Vehicle Technology

Current public R&D efforts to accelerate the development of low-GHG vehicle technologies appear to be largely ineffective. Programs such as EUCAR in Europe and PNGV in the US do not appear to be having much influence or effect. The most aggressive efforts in the world to develop and commercialize advanced technologies -- gasoline hybrids by Toyota and Honda, fuel cells by Ballard and (Daimler Benz part of) DaimlerChrysler -- are not the result of PNGV, EUCAR, or related government R&D programs. Indeed, California's ZEV mandate, with all its shortcomings, has had a far more dramatic effect in accelerating advanced technology than any national R&D program. These public R&D efforts to often fail to recognize that companies don't want government meddling in proprietary and critical technologies; that much if not most of the initial innovation is within supplier and small companies and university and other independent research centers; and that governments can not hope to match the R&D resources of large automotive companies. A first recommendation, therefore, is to re-structure public R&D programs to focus on promising long term technologies, and to distance these programs from the large "original equipment manufacturers" (OEMs). But more effective public R&D programs, and even more and better technology, are not enough by themselves.

2. Encourage Diversity and Experimentation

Today's transportation monoculture — as defined by our limited types of vehicles, fuels, pricing, parking, and road infrastructure — stymies diversification and change. Much greater effort is needed to identify and nurture desirable technologies, institutions, and practices. Certainly our transportation system can be more economically efficient and socially responsive. We should design experiments with transportation and land use arrangements, infrastructures, and markets to determine what works in particular circumstances — that is, to explore new and better options. We need to determine how people will respond to new road and vehicle types, new methods of pricing, and new forms of transport (e.g., smart car sharing and smart paratransit coupled with greater access to travel and transit information). Consider, for instance, that Ford, Toyota, Nissan, Honda, and others have built very impressive small electric vehicle prototypes that would generate about 70% less greenhouse emissions in the US than a subcompact gasoline car and would meet the needs of most drivers in most situations. But those

companies are afraid the vehicles will flop in the marketplace and have therefore invested few resources in commercialization. Much more experimentation is needed, with communities, consumers, and companies, to determine what is attractive where. We need experiments in new funding processes, technologies, regulatory approaches, and policies.

3. Flexible Regulatory Approaches

Today's regulatory system for motor vehicles does not allow tradeoffs amongst different energy and environmental goals, nor even between different pollutants -- not anywhere in the world (with minor exceptions). There is also no method for accounting for upstream emissions (which can be greater than the emissions from the vehicle with many new fuels and technologies), and little incentive to commercialize innovations, beyond meeting the prescribed rules. This command-and-control system worked well in the past when gasoline-powered internal combustion engines dominated, but is becoming anachronistic. It is incapable of handling the new fuel and technology options now becoming available, will keep some attractive options out of the marketplace, and is becoming increasingly inefficient. Some potentially attractive innovations for increasing flexibility and economic efficiency include "fee-bates" (charging fees to buyers of dirtier and less efficient vehicles and providing rebates to buyers of more efficient and cleaner cars), marketable credits, inclusion of full fuel cycle emissions, and inclusion of greenhouse gases (perhaps in lieu of fuel economy).

4. Fuel Economy Reform

The stalemate in the US over fuel economy standards cannot be allowed to continue. A simple first step would be to fix anachronistic rules that set different standards for light trucks and cars, and for imported and domestic cars. Mechanisms are also needed to handle new electric-drive vehicles that may use non-petroleum fuels, multiple fuels, and have large upstream emissions. A more important procedural step might be to allow trading of fuel-economy credits; the result would be to create incentives for more efficient vehicles, and could be a first step in creating a greenhouse gas emissions trading system for vehicles. More controversial would be a tightening of standards. A modest tightening of standards would arguably benefit almost everyone, even automakers. Although companies may struggle to reconcile consumer desire for size and power within mandated fuel-economy standards, that difficulty would affect the entire industry rather than hurting only certain companies. To be most effective, tighter standards would be accompanied with at least modest fuel-price increases. Meanwhile, the international community should carefully monitor lessons learned from Japan's newly imposed stringent class-based fuel economy standards, and from the voluntary agreement by European automakers to reduce fuel economy by 25% by 2008.

5. Bully Pulpit

Government initiative and leadership is key to resolving transportation, environmental and energy challenges. That is because much of the transportation sector is in the public sector, and environmental problems are mostly outside the marketplace. Leadership becomes especially pivotal and valued in the case of products with environmental attributes. An automaker or oil company trying to sell a more environmental car or fuel faces a credibility problem. Government leadership is needed to

create a framework that rewards those products and companies and that aggressively endorses them. Government has far more credibility than business in promoting environmental attributes. For new transportation options to become familiar and acceptable to the public, government must take a stand. Government must take leadership in endorsing those products that are truly superior.

6. Technology Transfer to Developing Countries

The preponderance of greenhouse-gas emissions will eventually come mostly from China, India, and other large emerging nations. Given their less advanced state of technology and less entrenched energy and guideway infrastructures, it tends to be less expensive and often easier to reduce emission rates in those countries by improving their energy efficiency and deploying leapfrog technology. The cost of eliminating one ton of emissions in China (below baseline projections) would be far less than the cost of eliminating one ton in the US. Therefore it is wise to assist rapidly industrializing countries in slowing their production of greenhouse gases through mechanisms ranging from fellowships, cooperative-education programs, and technical assistance, to major investments in leapfrog technologies such as fuel cell buses and cars. These programs can be conducted by governments, universities, and businesses. Given the disproportionately high emissions and high international profile of the US, it is important that efforts to apply new and improved technology in other countries be seen as complementing, not substituting for, domestic US efforts.

In conclusion, I am not arguing for, nor promoting any particular strategy or technology. To the contrary, I am arguing that many changes in behaviors and technologies are possible that can greatly reduce fuel consumption and greenhouse gas emissions. It is not obvious exactly which technologies and which changes will prove to be most attractive. It is obvious, though, that we need to create the incentives and policy frameworks that encourage industry and the market to pursue a number of different paths. For progress to occur in a timely fashion, government leaders must lead.