An Interpretive Summary of the 1997 Conference on

Policies for Fostering Sustainable Transportation Technologies

August 17-20, 1997

Asilomar Conference Center
Pacific Grove, California

by
Danilo J. Santini
Center for Transportation Research
Argonne National Laboratory

The submitted manuscript has been authored by a contractor of the U.S. Government under contract No. W-31-109-ENG-38. Accordingly, the U.S. Government retains a nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or allow others to do so, for U.S. Government purposes.

Conference Organized by:
Transportation Research Board
National Research Council
Committees on Transportation Energy, Alternative Transportation Fuels

Conference Sponsored by:
U.S. Department of Energy, Office of Transportation Technologies
U.S. Federal Highway Administration
Bureau of Transportation Statistics (U.S. Department of Transportation)
University of California Transportation Center
Toyota Motor Sales USA, Inc.

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED
DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
DISCLAIMER

Portions of this document may be illegible electronic image products. Images are produced from the best available original document.
The term "sustainability" was not redefined or even argued in this conference, but it was noted that the term means different things to different individuals and organizations. One group saw sustainability as the need to assure an adequate flow of funds and investment to maintain a specified level of service in transportation. Another group — the one predominating at this conference — tended to see the operative system design objective differently; this group was interested in including measures to reduce the aggregate undesirable side effects of an ever-enlarging transportation system, even if that enlarging system provides each new user as good a level of transportation service as that for existing users. In short, from the perspective of the majority at the conference, if the per-unit-of-service rates of emissions and oil use remain the same, expanding use of the service will also increase both oil use and emissions: an "unsustainable" situation if it continues indefinitely. A significant fraction of those attending the conference would probably consider a "cap" on emissions and oil use from transportation insufficient; instead, they would like to see significant reductions from present levels.

T.R. Lakshmanan, Director of the Bureau of Transportation Statistics, offered the following definition from the Bruntland Commission: “Sustainable development is development that meets the needs of the present generations without compromising the ability of future generations.”

The technologies and policies that received the most attention would provide per-unit-of-service reduction of three kinds of social costs (external costs, in economist’s terminology) with respect to light duty transportation. The main factors to be reduced were oil use, greenhouse gases, and air pollution. Undesirable side effects of continually expanding transportation activity, including congestion and habitat loss, were also discussed. The conference included debate about priorities among these five categories of social cost, about which organizations should take action to achieve the reductions needed in each, and about what specific actions these organizations should take.

SPEAKERS AND ORGANIZATIONS REPRESENTED

Organizationally, the conference included speakers from industry, the federal government, state government, academia, public interest groups, and a consulting firm. Industry representation was from three manufacturers of light duty vehicles (R. Purcell and C. Sloane of GM, J. Beseda of Toyota, and S. Wallman of Volvo), one firm that hopes to market an advanced technology to significantly improve the efficiency of vehicles and reduce their emissions (G. Ballard of Ballard), and one firm that provides fuel for present-day vehicles (T. Finizza of ARCO).

Federal government representatives came primarily from agencies and research institutions operating under the executive branch of U.S. government. The U.S. Department of Energy (DOE) provided, directly or indirectly (through national laboratories), David Greene and Paul Leiby of Oak Ridge National Laboratory, Larry Johnson of Argonne National Laboratory, Phil Patterson of the DOE Office of Transportation Technologies, and Barry McNutt of the DOE Office of Policy Planning and Analysis. Jonathan Rubin, coauthor with Paul Leiby and professor at the University of Tennessee, was also a representative of research done for DOE. The U.S. Department of Transportation was represented by T.R. Lakshmanan, Director of the Bureau of Transportation Statistics. Carl Nash, Adjunct Professor of Engineering at the George Washington University, and a retired executive from NHTSA, represented his own views. Howard Wesoky of the National Aeronautics and Space Administration (NASA) spoke on civil aeronautics R&D. Linda Lance of the White House Council on Environmental Quality
T. Cackette related how the regulatory process had significantly improved air quality in California. He indicated that the process had changed from a highly adversarial one initially to a much better organized, professional interaction between the regulators and the regulated. He also said that progress had been made in the nature of regulations and that, aside from the California "zero emissions vehicle" (ZEV) requirement, regulations had moved from requiring individual technologies on individual vehicles to requiring aggregate system performance; the latter approach allowed more flexibility for manufacturers to choose the technology mix to provide the required performance. While acknowledging a degree of trial and error in the process, Cackette observed that the history of regulation shows that industry (1) is capable of doing more than it contends is possible when regulations are first proposed and (2) does what it says it can do at less cost. (In his comments, L. Lave acknowledged that CARB had done a good job of cleaning up the air in Los Angeles.)

Figure 1 Change in National Emissions for Criteria Pollutants, Reduction by 1996 Relative to the Prior Peak, and Projection from 1996 to 2010. (Source: EPA 1995)

Concern was expressed at the conference about the potential for conflict among the three goals of reducing oil use, greenhouse gas emissions, and air pollution. M. Delucchi (who has completed a 20-volume study on the social costs of the motor vehicle) and others voiced concern over contemporary interest in substitution of diesel for gasoline engines. This interest has involved both (1) the 3X fuel economy vehicle technology choice "neck down" of the vehicle design for the Partnership for a New Generation of Vehicles (PNGV) and (2) a shift in DOE research toward the development of advanced diesel engines for use in light duty motor vehicles. Those concerned expect that the net air pollution damages from increases of fine particulate matter from diesel engines will offset acknowledged benefits from reductions in oil use and greenhouse gas emissions.

The subject of trade-offs, and the need to deal with them, came up in the "open-mike" session. Delucchi coined the term "NPGV" (Negative Population Growth Vehicle) to express his concern over the diesel-for-gasoline engine trade-off. R. Kassel of the Natural Resources Defense Fund lamented that the lack of coordination in federal
fuel cell (FC) hybrid electric vehicle (HEV) (i.e., RFG-fueled FC/HEV); (2) methanol-fueled FC/HEV; (3) non-FC/HEV; (4) hydrogen (H2) FC/HEV; (5) RFG-fueled spark-ignition-engine (SIE) vehicle; and (6) lead-acid-battery electric vehicle (BEV). There was considerable overlap in the estimated ranges for 2, 3, and 4, and for 5 and 6. For 2010, the ranking was (1) petroleum FC/HEV, (2) petroleum ICE modern diesel (MD), (3) petroleum non-FC/HEV, (4) BEV, and (5) RFG/SIE. There was considerable overlap in the ranges estimated for 2 and 3. For 1995, the ARCO ranking was (1) diesel compression-ignition engine (CIE), (2) gasoline SIE, (3) RFG/SIE, (4) CNG SIE, (5) methanol SIE, and (6) ethanol SIE. There was also considerable overlap in the estimated ranges among 2, 3, and 4. By implication, given the fuels and technologies that were included and excluded in the graphs, petroleum would be the fuel of choice in 2010, but battery electric vehicles would still be in the market. The petroleum fuel cell hybrid vehicle was, in effect, predicted to be the winner of the competition among PNGV technologies to triple fuel economy. Finizza indicated that an oil glut was more likely than a shortage, and that diesel fuel could be produced from natural gas if there were a shortage. However, he did not present total energy efficiency for such a technology pathway. Ethanol was missing in 2010 in Finizza’s presentation, but it was a major part of the market in one of the scenarios analyzed by P. Leiby and J. Rubin (see below).

In the last Asilomar conference, ethanol from cellulosic biomass received considerable attention. Although total energy use for such a technology pathway may in fact be higher than for gasoline, the nature of the process, if configured properly, has been estimated to be capable of producing significant reductions in net greenhouse gas emissions. However, a vehicle that tripled fuel economy would also do so, and ARCO predicts that the vehicle of choice to triple fuel economy will be a fuel cell hybrid using a fuel refined from petroleum. That fuel will have to be a very low-sulfur fuel, a refining challenge. In any case, ARCO in effect predicts that fuel efficiency, not fuel switching, will be the path to a reduction in greenhouse gas emissions.

P. Leiby and J. Rubin presented a discussion of the “Transition to Alternative Fuels” (TAFV) model. They indicated that it would be difficult to accomplish a significant switch away from oil. One of their key findings was that the “long-run penetrations for alternative vehicles and fuels anticipated in the earlier EPACT 502b study are not likely to be achieved absent significant policy intervention.” (Note: the “502b” study indicated that a 30% share of alternative fuels in 2010 would be possible, given long-run equilibrium and high-volume alternative fuel vehicle production). Another finding was that “it may be hard for the vehicle/fuel market to get started.”

At present, the TAFV model includes BEVs, as well as vehicles fueled by CNG, ethanol, methanol, and liquefied petroleum gas (LPG); however, it does not include HEVs. The cheapest vehicles to introduce were alcohol fuel vehicles (ethanol and methanol) and LPG vehicles; these vehicles generally captured market share in the illustrated scenarios, while the other vehicle types did not. According to the TAFV fuels characterizations, ethanol from cellulosic biomass, LPG, and CNG are “low greenhouse gas” fuels, with cellulosic biomass much lower in greenhouse gas emissions than CNG or LPG. (The characterization of biomass ethanol as a very low greenhouse gas fuel is in contrast to its low “total energy efficiency” as estimated by ARCO. Low total energy efficiency is not necessarily equivalent to high greenhouse gas emissions.) Under the assumption that the included fuels will be significantly subsidized (or taxed) according to their greenhouse gas benefits (or disbenefits), the TAFV model estimated that ethanol would capture over 20% of the fuel market in 2010, with a rapid start after 1999. The simulation implied that the ethanol supply would be limited; as the ethanol fuel market share tended to level off a bit after 2005, LPG would begin to capture an increasing share of the market. Leiby and Rubin pointed out that automakers are planning to introduce a number of flex-fuel trucks
1960s and early 1970s worked their way into the U.S. fleet. According to Schipper's estimates, the U.S. fleet realized a reduction of fuel consumption per kilometer of about 33% from 1973 to 1992, while European countries showed declines of less than 10%, and Japan showed an increase.

**Price (tax) vs. Regulation.** In past conferences, the subject of price vs. regulation often came up in discussions of CAFE. Many contended (and still do) that the new-car fuel economy increases from 1973 to 1983 were caused by fuel price increases and not by the CAFE regulation. However, proponents of this view have to explain why U.S. fuel economy remained high from 1982 to 1992, when real gasoline prices dropped by about the same amount. There is also the problem of why the EPA's estimates of fuel economy for the light duty vehicle fleet declined slightly from 1988 to 1990, whereas real gasoline prices rose by 16% over that time interval. In any case, at this conference there was little debate about the fact that CAFE has had an important effect on the average fuel economy of the U.S. light duty fleet.

D. Greene presented a partial summary of the paper that he submitted to the conference. He indicated that he had shown in his paper that the use of a fuel economy regulation can be economically efficient. He concluded that such a regulation would be more efficient when combined with an appropriate fuel tax, but that the U.S. economy could still be better off with a well-designed fuel economy regulation alone than without such a regulation. L. Lave commented that the issue was one of economic efficiency, not whether regulation or taxation should be the mechanism to accomplish the improvement. He offered criticisms of the CAFE regulation itself, but these seemed to be more to the effect that the regulation could have been better crafted than that it had been undesirable. He said that CAFE worked if one's goal was to increase fuel efficiency, but he noted that we cannot seem to agree on our goals. While claiming that gasoline prices alone have "no effect," L. Lave indicated that he would favor an increase in CAFE with a commensurate increase in fuel price, but that the price increases justifiable on the grounds of social costs of greenhouse gas emissions and oil supply security would be less than 40¢ per gallon in total. He implied that even tax levels in Europe were ineffective in increasing fuel economy.

S. Wallman (Volvo) provided information that, to a degree, calls L. Lave's conclusion about fuel prices into question. Wallman estimated that the average European car sold today, tested on the U.S. cycle, gets about 40.4 mpg. The EPA estimated that U.S. cars obtained an average of 28.5 mpg in 1996 (Heavenrich and Hellman 1996). European taxes are on the order of $3/gallon, so a 40¢ tax would induce a change in fuel economy of perhaps one to one and a half miles per gallon. Wallman's estimate amounts to about 40% better fuel economy in Europe than in the United States. This is consistent with the ratio of estimates of on-road fuel consumption in Europe and the U.S., as of 1995, presented by L. Schipper in his Fig. 14. Note that the real U.S. gasoline price increase from 1973 to 1981 was on the order of 80¢, and that increase was not sustained. European gasoline prices have been far higher than U.S. prices for years. Accordingly, the portion of the fuel economy increase from 13 to about 27 mpg could only have been accounted for in small part (a few mpg) by the real gasoline price increase.

The preceding conference's featured economist, J. Sweeney, told the registrants that only taxes are an appropriate means toward achieving economic efficiency, in

---

1 L. Lave's role was that of a discussant. Owing to the nature of his comments, it would be very difficult to isolate his personal opinions from his professional judgments concerning the best way to accomplish a given social (or corporate) goal that might be inconsistent with his own views. Of course, the same may be said of others, especially those responsible for presenting corporate positions.
the National Research Council's 1992 study, “Automotive Fuel Economy.” This logic implied to Lave that a fuel economy standard of 32-34 mpg would be appropriate for cars, but it would only work if combined with an increased requirement for trucks. Schipper showed that the fuel efficiency of automotive technology actually has been improving when one controls (in the statistical sense) for acceleration capability. However, he showed that for several countries, over the last few years, consumers and automobile manufacturers have chosen to use increases in thermodynamic efficiency of vehicles to obtain more rapid acceleration capability. In other words, if consumers and automobile manufacturers had chosen a constant acceleration capability, they would have obtained an increase in fuel economy during this period.

**Acting Alone vs. Acting Together.** Greene noted that there are some contradictions in human behavior that are readily understood. These involve a willingness to take collective action if there are rules that everyone must do so, but an unwillingness to take the same action on a voluntary basis. In a presentation by Toyota's Beseda that included an edited video of a focus group discussion concerning young consumer behavior, she emphasized that young consumers indicated a reluctance to sacrifice for the sake of the environment. Greene, however, noted that the young consumers in the video said that they would do so if they were required to, and that they relied on the government and industry to tell them when it was necessary. Greene also quantified the risk for an individual car manufacturer to introduce more costly, but more fuel-efficient, technology than its competitors. The price elasticity for one manufacturer increasing vehicle cost was indicated to be -5, but if all manufacturers introduced the same level of technology with the same price increase, the loss in sales for an individual manufacturer would involve a price elasticity of -1. Beseda expressed this same point in qualitative terms, stating that no company can unilaterally commit to emission reductions or fuel economy increases that would put them at a cost disadvantage. Greene's point was that a collective agreement, such as CAFE, can eliminate the risk of acting alone.

The implication of a price elasticity of -1 is that revenue to the automobile industry would remain constant, because the per vehicle price increase revenues would be exactly offset by the effect of the decline in vehicle sales. Assuming that profits are earned on a per-dollar-of-sales basis, profits would be constant. However, this does not take into account the positive effect arising from reduced fuel cost, which would increase sales, offsetting the price effect and increasing auto industry revenue. Duleep estimated a vehicle price elasticity of -0.72. According to that estimate, automakers would increase revenue under a tightened CAFE standard that forced them to raise their costs simultaneously in order to provide higher fuel economy. Furthermore, given Duleep's estimate that the elasticity of vehicle sales vs. fuel price is -0.34, and assuming that this has essentially the same meaning as if fuel cost ($/mile) had been used instead of fuel price, then industry revenues would increase nicely under a reasonable CAFE standard. Fuel cost per mile would drop due to (a) increased vehicle efficiency and (b) a decrease in fuel price via reduced demand. It is important to keep in mind that the elasticity estimates apply in the data region for which the estimates were constructed; the estimates should not be construed to imply that these elasticity values would hold regardless of the stringency of the CAFE standard being considered.

L. Schipper also suggested that collective agreements are desirable for improving fuel efficiency and reducing CO₂, but he argued in favor of the voluntary agreements being adopted by manufacturers in some European countries.

---

2 In this paragraph, an extension of the material presented at the conference is developed.
-0.34), compounded by the loss of share of high-profit-margin large cars (consistent with a graph presented by Greene, showing a strong positive association of gasoline price and small car market share).

Sloane emphasized that the concept of cooperation fostered in the Partnership for a New Generation of Vehicles is a difficult one to implement. U.S. automakers (not to mention foreign manufacturers), being in competition, do not wish each other well. Collaboration requires a lot of discipline. Objectives are to achieve technical goals, credibility in social concerns, and national competitiveness. Government's role, in part is to translate regulations and infrastructure issues. Taxes were not mentioned.

THE FUTURE

Sloane restated the goal of producing a proof-of-concept vehicle in 2000 and a prototype in 2004. Many new technologies are being evaluated. In light of the scenario to which Toyota ascribes — oil demand exceeding supply in the 2007 to 2014 time frame — would that be soon enough, absent any other fuel efficiency or fuel switching shift until then? C. Nash expressed the opinion that R&D alone would not be enough to cause introduction of a high-fuel-efficiency vehicle developed by PNGV. Nash quoted Jefferson, saying “a little revolution now and then is a good thing, and as necessary in the political world as storms in the physical... it is medicine for the sound health of government.” According to Nash, the American auto market got a valuable boost from the stimulation provided by the oil shortages of 20 years ago and the challenge of Japanese competition. What we need today, Nash suggested, is a similar “cleansing storm,” perhaps coming from an economic or environmental crisis, an energy shortage, or a maverick company outside the current club of auto companies. Nash believes that major technical changes are almost always driven by such forces. In order to promote — without waiting for these forces — what he considers needed technical change he recommended a gasoline tax of $3/gallon, with the proceeds being used to replace Social Security and Medicare taxes or income taxes for incomes under about $100,000. However, several conference participants lamented that price policy seemed to be “off the table” in the United States.

L. Lance, in response to a query by Nash, indicated that the White House wanted to act before a crisis hits. She was primarily concerned about greenhouse gases, rather than oil supply or air quality. Toyota and GM appeared more concerned that fuel efficiency (or oil use) might once more become a very important priority for the consumer, but both implied that the problem was not today’s concern.

What are the odds of the “cleansing storm” that Nash said might come from any of four forces? Participants did not discuss the potential for an economic crisis or its effects. Nor did participants seem to expect either an air quality crisis or weather-related behavior that could be easily blamed on global warming. However, Toyota did subscribe to a prediction concerning the timing of an oil supply crisis, which was expected to be a decade away. Concerns over the worst “El Nino” of the century might be a trigger for action far sooner. Nash suggested that Bill Gates of Microsoft might provide the competition needed. Toyota also might provide some of this “maverick” behavior, perhaps as indicated by its newfound interest in participation in conferences of the type held at Asilomar. Another possible “maverick” firm, Ballard, was also represented.

G. Ballard, founder of Ballard Power Systems, discussed the fuel cell. He was forthright about the marketing strategy that had originally been formulated, and the one that had since evolved. He presented information on a rapidly improving technology, the proton-exchange-membrane (PEM) fuel cell, noting improvements in packaging efficiency,
Finizza indicated that transportation would be the chief cause of increased demand for oil. He projected an increase in the demand for oil, an additional 27 million barrels per day from 1997 to 2010; two thirds of the increase (i.e., about 18 million barrels per day) is expected to arise from increased transportation demand. The vast majority of that increase is projected to occur outside the industrialized Organization for Economic Cooperation and Development (OECD) members. To put this in perspective, U.S. gasoline demand in 1996 was about 8 million barrels per day. The U.S. consumed about 18 million barrels of oil per day in 1996, so Finizza’s projected rise in worldwide transportation oil demand by 2010 is equivalent to adding another United States to the world oil market. Note that in 1973, the nation consumed 17 million barrels per day (DOE 1997b). Schipper’s Fig. 5 shows that, although the United States reduced its passenger-movement-related CO₂ emissions per capita from transportation from 1973 to 1992, the U.S. remained a larger generator of CO₂ than the eight major European nations examined by Schipper, plus Japan, combined. So, if the industrialized nations decide that the world should reduce CO₂ emissions and have transportation do its fair share, then Finizza’s vision of the future will have to be changed by dramatic action. If the OECD’s industrialized nations wish to ask less-industrialized and industrializing nations to reduce CO₂ emissions and restrain transportation emissions, those nations will have to ask the United States to provide its share of reductions, to show that industrialized nations really believe global warming is a problem.

On the other hand, if no agreements can be reached, and only research on new technologies is conducted until about 2005, most of the growth projected by Finizza will be well under way. One wonders whether demand for oil one-and-one-half times the present U.S. level of demand can really be added to world demand and still have a glut at the end of that period. In any case, such a future is not the goal of a large fraction of those attending the conference. Many are interested in a broad definition of sustainability and primarily in seeing that the United States can accomplish that goal. Also, where global warming is concerned, many conference participants would likely want the nation to do its share in preventing the increase in world oil demand predicted by Finizza.

**RECENT COUNTERPRODUCTIVE TRENDS**

The short-term trends in light duty transportation in the United States, the actual focus of this conference, are counterproductive. Since about 1987-88, new light duty vehicle fuel economy has been slowly declining, largely due to expanding truck sales (Heavenrich and Hellman 1996, p. 5). Earlier, it was pointed out that the fleet fuel economy, which lags new-vehicle fuel economy, peaked in about 1992. Those who have chosen cars since 1987 have actually continued to choose an average fuel economy of a little more than 28 mpg, while those choosing trucks have chosen slightly less fuel-efficient vehicles (dropping about 1 mpg from a 1987-88 average of 21.4 mpg). Fatality rates have stopped declining over the last four years. Nash indicated that when heavier, stiffer, higher light trucks collide with passenger cars they are likely to inflict far greater harm to passenger car occupants than do similar crashes between cars. Greene cited an NHTSA study that examined the effect of reducing weight and size of trucks more than for cars, such that the weight and size of the two classes of vehicles converged. Under some circumstances, a net reduction in overall fatalities was obtained. Passenger car occupants and pedestrians and bicyclists (individuals making choices that would reduce fuel consumption, CO₂ emissions, and criteria pollutant emissions) would benefit from this truck mass and size reduction, while the truck owners would have an increase in fatalities. Clearly, there would be a collective benefit in terms of the goals of sustainability. Consumer surveys and projections, however, suggest that the trend toward increasing truck shares will continue.
accompany a proposal to increase taxes. Perhaps another lesson is that projects sometimes require a very great need before they will be undertaken.

G. Giuliano of the University of Southern California gave a presentation indicating that land use policy cannot be relied on to help achieve environmental or sustainability goals. Giuliano presented examples worldwide that indicated that increased use of the car and decentralization of urban areas will continue. In short, Giuliano said to rely on technology, not land use policies. R. Johnston gave a presentation on land use models. He indicated that it was indeed very hard to get community leaders excited about land use policy when 20-year projections are used. He had come to the conclusion that 50-year scenarios had to be used. When these longer-term scenarios are used, he said that the implications can be alarming. He said that the individuals and organizations interested in the results of his land use modeling are concerned about habitat loss, quality of service, and equity. The individuals that he interacts with are not concerned about those issues emphasized at the conference. Schipper mentioned habitat loss as one of the seven deadly sins of transport, and he included congestion/access.

EDUCATION

In the questionnaire administered at the conference, the areas that obtained the highest percentage of high importance ratings were (1) industry research, (2) federal regulation, and (3) education. No speaker specifically addressed the last issue, but several comments indicated that education about sustainability goals and the means to achieve them is important. In the introductory session, Delucchi expressed an opinion that the highest value of the social cost framework might be as a source of inspiration for a long-term vision of the transportation system. He suggested that social cost analysis could be used as a means for changing our world view, and perhaps as a tool for changing perceptions. He acknowledged that the form of delivery of the message can be as important as the message itself, citing Rachel Carson's Silent Spring as an example of effective delivery of an environmental message.

RECOMMENDATIONS

In his closing remarks, economist C. Lave commented that "technology is still the answer."

It is important to note that the conference participants reached no consensus in the closing session. It is an open question whether the participants would consider the recommendations offered below to represent a consensus view on appropriate recommendations. Instead, these recommendations emerged from a more leisurely examination of the conference material, with only moderate extensions of that material.

The issue of whether a CAFE-type regulation or a voluntary agreement among automakers is more or less effective than the use of a fuel tax can be readily addressed, using some of the numbers cited at the conference. Suppose it is desired to have a "holding action" on U.S. light duty transportation greenhouse gas emissions and fuel use until the PNGV results are in. Assume a 20% improvement in vehicle efficiency is needed. The figures provided by Greene from a 1992 NRC automotive fuel economy study suggest that the net cost to the consumer of achieving such a goal would either be positive (i.e., a benefit, not a cost) or perhaps amount to as much as $500 per vehicle. If the 20% increase provides a benefit, then L. Lave's recommendation for a CAFE increase seems obvious. Suppose the real cost is $500. With 15 million light duty vehicles sold each year, this
imposed fuel price increase of the magnitude recommended by L. Lave (he did not recommend that it be used alone) would thereby lead to an initial loss of vehicle sales and profits. After automakers developed new models efficient enough to offset the fuel price increase, sales would rise; however, they would not return to original levels, because vehicle costs and prices would be higher (total auto industry revenues might, however, recover to original levels). A several-year increase in taxes to the level recommended by L. Lave would probably still not lead to increases in fuel economy as rapidly as would a CAFE regulation. There would be a “you first” mentality among automakers, in view of the potential sales losses associated with being the first to proceed alone with a costly technology and commensurate price increase (in which case, they face an elasticity of demand of -5). Using only a fuel economy regulation would lead to quicker introduction of new vehicles and a greater increase in fuel economy, at a lesser cost. Except for money spent to determine the best form of regulation and governmental administration and policing, all the money would stay in the private sector, and the allocation mechanisms for spending the required dollars would stay in the “economically efficient” private sector rather than be allocated by the government.

Note that a group of automakers faced with increasing fuel taxes but not with fuel economy regulations could achieve the same ends as a fuel economy regulation by adopting a “voluntary agreement.” All would be better off if they were to reach such an agreement. Faced with the most rapidly rising gasoline taxes on the European continent from 1990 to 1996 (67%), German automakers have adopted such an agreement (IEA 1997).

On the basis of this “back of the envelope” examination of the implications of the numbers presented by the participants at Asilomar, if one were asked whether to recommend only a transportation fuel tax or only a fuel economy regulation, it is clear that a regulation would be recommended. The remaining question is whether or not a tax would also be recommended. If so, what level of tax would be recommended, and how would the tax revenues be used? With respect to air quality regulation, conference participants have suggested (or conceded) that the regulatory process has worked. According to presentations made at the conference, the issue is not one of whether or not regulation should be used (instead of a tax), but rather how the regulation can be made to be efficient. Cackette emphasized that his experience as a regulator was that, over time, industry demonstrated that it could do more than had been anticipated before it was forced to work on the problem. By this logic, technological discoveries and breakthroughs are to be expected, if only industry is directed to address the proper problem. The conference participants’ retrospective on CAFE indicated that it worked.

The PNGV program may lead to many technologies that can in the future push the cost for fuel efficiency down below its present levels, though there is no tax or regulatory mechanism in the United States to ensure that those technologies are “spun off” into the U.S. market. Nevertheless, each of the three companies involved is a world producer of automobiles, and tax-related pressures do exist in Europe to cause introduction of more efficient vehicles. A part of the process that Cackette described was that technologies were forced into the market by regulation, though it was conceded that government should set flexible regulations and allow industry to use a menu of technologies. Industry requested even more flexibility in regulations, and many non-industry participants suggested that regulations needed to be written both in a coordinated fashion and in a fashion that allows trade-offs to be made. In pointing out that industry occasionally came to CARB with information on a new technology that would allow a tightening of the regulation (to their advantage), Cackette implicitly acknowledged that there was an attempt by CARB to be
but certainly more equitable, transfer effects. Despite the concerns expressed here over choice of a high tax to cause improvements in vehicle fuel economy, a small symbolic increase in taxes on fuel (Howell’s $1/gallon) to cause some sharing of the costs across nearly all segments of the population would be entirely reasonable; the revenue could be used to foster experimentation with locally appropriate technologies and with transportation system modifications that could achieve significant sustainability benefits per dollar of investment. A 40$/gallon ultimate tax increase might be more readily acceptable if it were scheduled to be imposed over a period of years and only initiated after some of the regulation-promoted fuel economy gains had reduced the cost of driving.

That, in C. Lave’s words, “technology is still the answer” is implicitly accepted by the government-industry Partnership for a New Generation of Vehicles. Also, the Energy Policy Act of 1992, written after what Nash would call a “cleansing storm” (Desert Storm, in this case), is only the latest example showing that action will be taken to get technology into the market. In advanced industrialized nations, it is not a matter of whether, only a matter of when. The process of getting technologies into the market as well as keeping them out when they do not belong is promoted by research and development, demonstration, and evaluation. When implementation of available technology seems desirable, education becomes necessary. If education is not sufficient, then events will run their course — a “cleansing storm” will occur — and regulation or taxation (or both) to promote the technology and/or control its negative side effects will follow. In some respects, this exercise will be a failure. If taxes are used to promote the technologies of interest, subsidies are highly likely, because those promoting change through taxation realize that the use of the tax revenue has to be acceptable to those taxed. Experimentation and subsidization of technologies left waiting at the door is a very likely outcome of this sequence of events. Those technologies will then be researched, developed, demonstrated, and evaluated. The worthy ones will remain “on the shelf” until the need to educate the population about their value (or lack thereof) emerges again.

ACKNOWLEDGMENTS

The material presented here represents the author’s attempt to reflect, but also to extend and interpret, a “sense of the conference” summary of participants’ research or views. The material also develops several implications of numbers presented by participants but not discussed at the conference. The views and interpretations are not necessarily those of the sponsors of this review, nor of any conference participant. This work was supported by the U.S. Department of Energy, Office of Transportation Technologies (DOE-OTT), under contract W-31-109-Eng-38. The support of Dr. Phil Patterson (DOE-OTT) is gratefully acknowledged. Comments by Phil Patterson, Barry McNutt (DOE-PE), Douglas Eisinger (Sonoma Technologies), Dan Sperling (U. of Calif. at Davis), and Carl Nash (George Washington U.) are appreciated. The author, however, is solely responsible for the contents.

REFERENCES
