Personal Transportation and the Environment

An Automotive View

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The U.S. automotive industry views the issue of transportation and the environment with concern and frustration. Most of the industrial decision makers in the United States today are just as concerned as everyone else about the future environment for their grandchildren, although their interpretation of that concern may differ from, for example, that of an environmentalist. Their frustration comes from the increasing difficulty in finding workable compromises between the public's environmental concerns and what is technically and economically feasible.

The U.S. automobile industry is currently faced with its two greatest challenges of all time: the prospects of increasingly severe energy and environmental regulations and, simultaneously, increasingly effective competition from

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foreign manufacturers. Even though the industry is making progress, success is not assured. The mistake of underestimating the severity of these challenges could be disastrous.

Representatives of the automobile industry believe that they have made major contributions to reducing air pollution. The questions of how much more can be accomplished and on what time scale are ones on which people reasonably differ. Perhaps a better understanding of the industry's problems can be gained by an examination of some of the options that have been considered.

Personal Transportation Community

The personal transportation community consists of elements of both the public and private sectors, including

- Vehicle manufacturers and their suppliers;
- Dealers and maintenance companies;
- Suppliers of energy, oil companies, and utilities;
- State and local governments (which provide theinfrastructure);
- The federal goverment (which provides the rules of the game);
- Transportation service operators, rental car companies, transit authorities, airlines, and so on; and
- Customers, vehicle purchasers, and drivers.

Although vehicle manufacturers (the primary focus here) are directly responsible for compliance with most of the transportation-related environmental regulations, other members of the transportation community also play roles in improving the environment.

Transportation manufacturers provide the equipment (cars, buses, trucks, railroads, and so on) required to satisfy the needs for movement of people and goods. If industry is to continue to provide these goods effectively, it must be sensitive both to the perceived desires of its customers and to the regulations that may be established in an effort to protect the common well-being. In the U.S. free market, cars are sold to willing buyers, and, therefore, the public perception that the industry can accomplish more to alleviate pollution or other problems must be taken seriously.

Day-to-Day Challenges

The regulations that the automobile industry must comply with cover safety and fuel economy standards, as well as reductions in pollutants, noise, and other environmental concerns. These requirements are often conflicting: for example, increasing engine efficiency to lower fuel consumption can in some instances increase emissions; and lowering weight and performance can compromise safety.

The weighted average air pollutants (hydrocarbons, nitrogen oxides, and carbon monoxide) produced by the automobile have been reduced by nearly 90 percent in the last two decades. This change has appeared to be deceptively easy. J. D. Power stated that the automotive industry's diversion of engineering and management resources to achieve government standards (in particular, those for energy) may have been responsible for some product designs that were not as attractive to the buyers as expected. The emphasis on regulations may even inadvertently have had some impact on quality. Power is president of J. D. Power and Associates, a marketing research and information firm.

The major development making it possible to achieve the existing requirements for efficiency and air quality (and meet the needs of the market) was the use of a technology not considered workable when the federal regulations were first enacted: the catalytic converter. The potential of this device, however, had not gone unrecognized. In the 1920s it was suggested that catalytic converters would be one way to reduce emissions. At that time, however, there were no feasible catalysts, and few people were interested in air pollution.

The gains that have been achieved are no longer considered adequate by many public decision makers. The industry can respond in two ways to improve the future environment: current technology can be improved, and new products and services to permit the use of automotive products in more environmentally acceptable ways can be produced or sponsored.

The Near Term: Costs and Compromises

Unquestionably, some improvements are still possible in the near term, but no know (but unrealized) technology appears capable of providing improvements of the same order as those offered by the catalytic converter. Gains will be made, but will be smaller and more difficult to achieve as the practical limits of the internal combustion engine are approached.

In the near term, reductions in fuel consumption (and emissions) per car may be the result of performance compromises and weight reductions rather than improvements in propulsion technology. Installing a smaller engine will reduce fuel consumption (and potentially, emissions) but compromise performance. For example, a family sedan with an engine that provides an acceleration time from 0 to 60 mph of 15 seconds should obtain 8 miles more per gallon than the same car with an engine capable of accelerating from 0 to 60 mph in 8 seconds. But this reduction in performance, in combination with further reductions in weight, would introduce both market and safety concerns.

The Midterm: Improving Technology and Regulations

In the midterm, the industry will seek opportunities for incremental improvements in technology, as well as in regulatory approaches and transportation concepts. Achieving significant environmental improvements with the internal combustion engine will require extensive

investments in research and development. The research results must be discounted to allow for manufacturing tolerances and performance life before setting standards. The implementation of a new standard should allow sufficient time for the testing necessary to provide assurance that the improvement will meet performance, safety, and other requirements before it is placed on the market. The time required to develop and place a new automotive technology in production is seldom less than five years.

Technology: Promises, Challenges

The General Motors passenger car diesel program, which had quality problems (and a poor reputation, even after the problems were resolved), is an example of why the accelerated implementation of technology can be counterproductive. Although the GM commercial diesels had a reputation for reliability, and the automotive diesels were developed by people who had previously developed good engines and who thought they understood the problems of diesels, apparently not enough testing was conducted before the product was released.

Alternative fuels such as methanol and compressed natural gas are expected to help reduce pollution. Whereas the automobile industry recognizes the potential environmental benefits from the use of alternative fuels, industry leaders assume the major benefits to be economic. Methanol can provide the fuel needed for future transportation systems at retail prices about 50 percent higher than gasoline in the United States today, assuming no changes in tax philosophy. Compressed natural gas is less expensive, but has high initial costs, and its use would limit the range of cars to about 100 miles per refueling. The industry's interest in alternative fuels stems largely from the likelihood that their use will place a cap on imported oil prices in the long run.

The environmental benefits of alternative fules (or of any new strategy) should be approached with care. If overly optimistic promises are made and the public does not receive the benefits that it expects, there could be a backlash with less progress toward the use of methanol (or other technologies) than otherwise might have been achieved. Industrial researchers should provide benefits to the public that will be perceived as at least equivalent to the costs—whether monetary, societal, or in mobility—that the public will have to pay.

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U.S. Secretary of Transportation Samuel K. Skinner receives updating on "smart car" technology by GM President and Chairman elect Robert C. Stempel at TransExpo held in conjunction with TRB Annual Meeting in January.

Regulatory Strategies: Available Answers

The benefits of alternative regulatory strategies should also be considered. Could new incentives make it possible to improve the regional environment with essentially the same technology? The environment could be improved if people would make informed choices in the ways in which they travel and the vehicles that they select.

Today, U.S. mobile source air quality regulations apply almost exclusively to vehicles and are the same for all automobiles, large and small. Some manufacturers suggest that decision makers consider other options, such as the creation of incentives for the operator-owner in purchasing and using the most energy efficient, environmentally benign vehicles available. If drivers selected the smallest cars available to them, instead of luxury sedans, for one- or two-person trips, the improvement in air quality might, for all practical purposes, approach that achieved by improved propulsion technology.

Although transit does not provide an effective answer to all of the urban traveler's needs, it can alleviate pressure on other modes. The automobile manufacturers have made serious attempts to participate in the transit and high-speed ground system businesses. General Motors, for instance, supplied the majority of U.S. buses until the late 1960s, when its transit developments ceased as a result of an antitrust consent decree. The Ford automobile company built automated people movers in the 1960s and early 1970s but found the market to be limited—or perhaps Ford's interest may have been premature.

Existing U.S. rail transit system configurations are based on technology developed in the late 1800s. It is likely that the costs of rail transit, particularly that of subways, could be reduced significantly by the implementation of innovative concepts. Unfortunately, U.S. manufacturers see little incentive to research innovations and develop products to improve public transit services. The market is undeveloped, the customers (that is, the cities) are looking for proven technologies, and the time required to plan, fund, and construct a system creates an essentially insurmountable barrier for innovative suppliers. As a result, no U.S. manufacturer currently produces transit equipment, except for buses. European and Japanese manufacturers fare much better in this arena because they have developed home markets and government support.

New Options in Vehicles

A novel personal vehicle, less than half the width of the typical family sedan, is being considered by the California Department of Transportation. These "cars" can operate on narrow, low-cost lanes, or two can run side-by-side on a conventional street. The vehicles are more maneuverable than conventional cars and can be equipped with all typical automobile amenities. They have the potential of significantly reducing congestion, energy consumption, and air pollution.

General Motors demonstrated the technical feasibility of "half-width cars" (called the Lean Machines), which can carry a single passenger, or two passengers if used in tandem. These vehicles have been displayed at EPCOT Center in Florida and at many public meetings. Their light weight and exceptionally low drag enable them to achieve more than 150 miles per gallon of fuel at freeway speeds (less if air conditioning is in use) while maintaining the acceleration capabilities required to operate in a mix with standard cars. These half-width cars should be able to meet motor vehicle safety regulations.

The Long Term: Old Limits, New Answers

Engines Old and New

In the long term, the development of alternatives to the gasoline piston engine is inevitable. Gasoline engines have been under development for 100 years and are approaching maturity. Long-term environmental goals cannot be met given the inherent performance limits of the internal combustion engine. Even the most efficient fossil-fueled stationary power plants, in which weight and transients are not concerns, seldom exceed 50 percent efficiency. It is true that innovations in transmissions, tires, and aerodynamics will provide some improvements, but most of the benefits have already been achieved.

Gas turbines have been proposed for future propulsion systems because of their apparent simplicity. They may create less air pollution but, at the present time, are also less efficient than piston engines. Although the efficiency of ceramic turbines and other high temperature components will improve to the point that energy consumption could be reduced, it is unlikely they will be cost-competitive with piston engines.

Hydrogen: What a Gas!

Hydrogen has been proposed as an environmentally benign fuel to replace gasoline. The primary exhaust product would be steam, and although there would be no carbon dioxide or unburned hydrocarbons, there would still be some nitrogen oxides.

Some European automobile manufacturers are experimenting with hydrogen-fueled vehicles. The use of hydrogen, however, will require more attention to safety than the use of gasoline or other liquid alternatives. Contact with the cryogenic liquid hydrogen or poorly insulated parts of the fuel system can cause severe injuries. Liquid hydrogen is difficult to contain and tends to make metals brittle. Various methods for storing hydrogen in the vehicle are being considered, but all will require more capacity than a gasoline or methanol tank.

Batteries and Cells

Battery electric cars are frequently proposed as the solution, but their current limited range (less than 100 miles in freeway traffic) has made them unacceptable for most personal travel. Market researchers such as independent transportation consultant Bill Hamilton (May 1988) have found that the sales of battery electric cars would be negligible unless this range can be increased. Industry experience indicates that customers will not accept cars that cannot travel more than 300 miles between refueling. Replacing only 1 percent of the California fleet with these vehicles, for example, would represent a market for approximately 140,000 vehicles. Regulatory initiatives, particularly in the Los Angeles air basin, may soon create this market. But there appears to be little basis for optimism over the development of a super battery that would be competitive with the piston engine in the absence of regulatory incentives.

There is a family of electric propulsion systems that has the potential to improve efficiency and the environment: the fuel cells. These energy sources avoid the well-known limits of the piston engine and can theoretically achieve efficiencies of 90 percent or better. Single-cell efficiencies of more than 60 percent have been demonstrated. The most attractive cells, those made of solid polymer, will use hydrogen as a fuel. One possible approach, which avoids the problems associated with liquid hydrogen, would be to use methanol as the hydrogen storage medium and disassociate it ahead of the fuel cell. Fuel cells should not generate nitrogen oxides, carbon monoxide, or other health-threatening pollutants.

The use of fuel cells for vehicle propulsion has not yet been demonstrated. The military has just started to use alkaline cells for submarine propulsion. Some cells have short lives, and all are much too expensive to be considered for use in family cars. It is important, however, that work on these problems by industry and government begins soon. Eventually, solutions to the cost problems will be found, but may easily take 20 to 30 years.

Human and Other Solutions

To reduce regional pollution, automobile manufacturers could also become involved in providing or sponsoring equipment that would improve the ways in which vehicles are used. The technology might include vehicle locating and routing systems to enable drivers to make informed choices of routes, thus reducing time and mileage wasted while stopped in traffic or hunting for a destination. Other possibilities include automatic highways and driver augmentation controls. Another project to be considered is effective coordination of traffic control signal lights. In combination, these approaches are expected to reduce travel time by 5 to 20 percent, with equivalent savings in fuel and reduction of pollutants.

Changes in the ways in which people in the United States work, shop, and travel could also result in improvements in the environment. Personal transportation can be divided into four categories:

- Access to work or other work-related travel;
- Access to stores for food, clothing, and other necessities;
- Access to amenities, including recreation and friends; and
- Intercity transportation.

Access to work (commuting) creates most of the congestion and vehicle pollution. It is frequently observed that if only more commuters could be persuaded to share rides, much of the congestion, air quality, and energy concerns would be resolved. In the United States, however, people willingly (almost eagerly) pay a very high price for the independence and time savings provided by the single-occupant automobile. Automobile ownership is the first or second most important expenditure in most families.

New technologies, based on the use of computers and improved communications, can alter how Americans work and live in ways that are currently unpredictable. Changes in technology have reduced much of the need for large industrial plants, as well as the need for most face-to-face contact in business. Factories can be smaller and more widely distributed. Economic and environmental concerns are making it attractive to locate plants in smaller cities, or even in places that are not yet towns but have access to good personal and freight transportation.

It is worth noting that the location of employment and the efficient delivery of goods depend on access to an effective freight system. Each mode, including marine shipping, railroads, trucks, and air, has a specific niche. Prospects for improvements in the air quality of freight transportation systems may be equivalent to those from automobile technology.

Already, the computer revolution is making it possible to locate the routine functions of financial companies miles away from their headquarters, even in other nations. Telecommuting, which usually means working some or all of the time at home (or at least away from the central office), will increase. Electronic merchandising may reduce the need to travel to stores for food, clothing, and other necessities. In the United States of the future, the staples of life may be ordered at home by phone or computer (probably entailing more delivery trucks) or purchased in neighborhood electronic catalog stores. Access to amenities, including recreation, will become more important with increases in income and as reductions in time required for work or for shopping increase "free" time.

Personal Transportation and Future Needs

The personal transportation industry recognizes the need to respond to the health risks and other problems created by air pollution. At the same time, this industry must anticipate how transportation needs may change and must be prepared to respond to the market. Change will be driven by the market and the public's perception of its quality of life, as well as by advanced technology and regulatory pressures.

Industrial Concerns

Despite some success in its efforts to find improvements, the automotive industry looks on recent initiatives to increase environmental and energy standards with serious concern. Automobile manufacturers face some particularly troublesome technical and marketing problems. Whereas they would prefer to contribute to the improvements in the environment, the standards established must be technically and economically achievable if the industry is to comply and remain viable.

Needed: Communication and Cooperation

The automotive industry's record in indicating those improvements believed feasible has been poor. Environmental advocates frequently take the position that the industry is bargaining and can really do better. Better communication between public and private sector decision makers and those who will benefit from or be affected by environmental initiatives must be developed.

Manufacturers will continue to invest heavily in an effort to improve the environment. However, advances in technology do not come easily; they require research, product development, and adequate time for testing. Manufacturers find it difficult to decide on the appropriate strategies because these choices require predictions of future societal priorities and how political decision makers will interpret the public interest.

Industry cannot resolve these concerns by itself. Fortunately, there appears to be an increasing willingness by both the public and private sectors to attempt to find ways to achieve an improved environment that are compatible with the market economy. If this challenge is to be successfully met, all members of the transportation community, both public and private, must gain an understanding of the sometimes conflicting objectives of improved environmental conditions and market economics.

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