ENERGY

- **Is there a need to achieve greater conservation of petroleum in automobile use?**
- **Is there a need to accelerate the development of alternative energy sources for the automobile?**

Total U.S. petroleum demand has reached over 18 million barrels per day (MMBD), of which the automobile system, exclusive of trucks and buses, now uses over 5.2 MMBD or about 30 percent.

What of the future? Despite current conservation measures, the U.S. demand for petroleum will grow and could reach as high as 22.4 MMBD by 2000. The difference between need and domestic supply, about 15.4 MMBD, would have to be made up by imports and/or alternative energy sources— if available.

Will There Be a Petroleum Shortage?

The likelihood of a petroleum shortage over the next two to three decades depends on a number of factors or events:

- growth in total world demand for oil,
- conservation policies of major oil-consuming nations,
- drilling and finding rates for new oil,
- growth in oil refinery production capacity,
- production and price decisions, and associated political considerations, by oil-producing nations,
- U.S. Government regulatory and pricing policies,
- the time when the world production of oil peaks,
- rates of development and commercialization of alternative fuels,
- ability of some users to convert to other energy sources,
- environmental constraints on the production and use of alternative fuels, and
- the amount of conservation practiced in all sectors that consume liquid fuels.

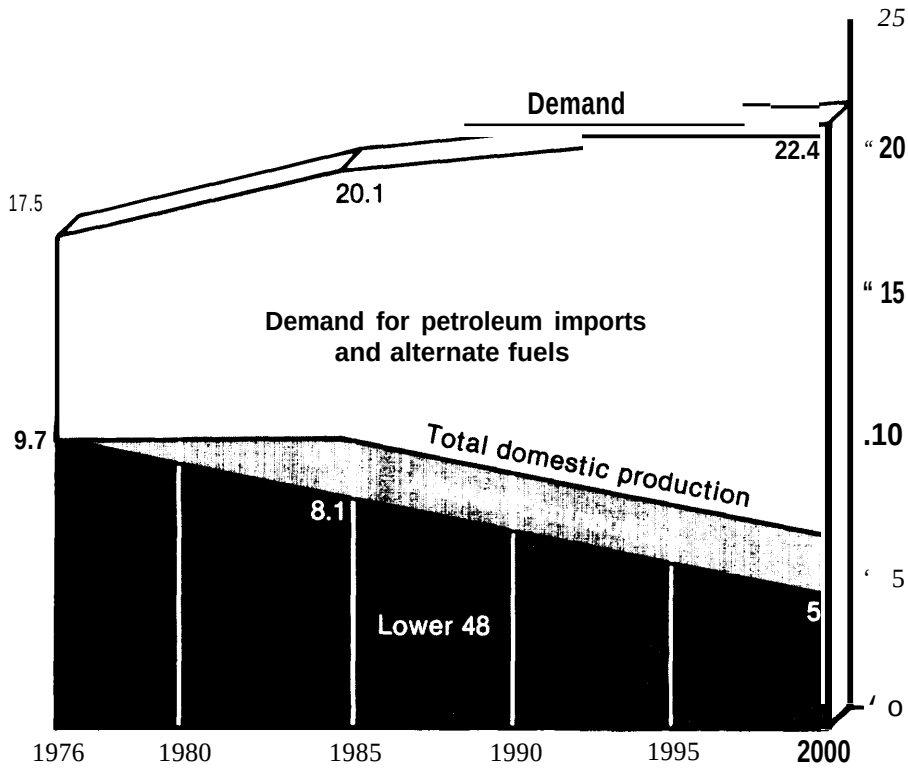
It is beyond the scope of the present study to investigate in detail 'all the factors affecting petroleum supply and demand. Several recent studies, of which the Workshop on Alternative Energy Strategies (WAES)[3] is probably the most exhaustive, point to the possibility that world demand for oil will outstrip the growth of oil-producing capacity by the middle or late 1980's. These studies show a high degree of uncertainty about the long-term forecasts for oil supply. For example, if the Soviet Union decides to, or finds it necessary to, import oil from the Middle East, the strain on the free world oil supply would increase significantly. If, on the other hand, the People's Republic of China finds quantities of oil and decides to become an oil-exporting nation, or if major new discoveries in Mexico and other parts of the world are brought to the market, the strain on oil supply would be lessened.

The WAES projections of petroleum supply and demand to the year 2000 found that, while potential (maximum) production of petroleum appears sufficient up to 1985, supply would drop rapidly thereafter. By the year 2000, large deficits of oil supply were projected for all WAES scenarios, such that one-quarter to one-third of previous demand would be unsatisfied. This projection was made even under assumptions of rising energy prices, WAES concluded

Supporting detail for this section of the Summary and Findings is contained in chapter 5 of the Technical Report.

'MIT Workshop on Alternative Energy Strategies (WAES), *Energy: Global Prospects* 1985-2000 (New York: McGraw-Hill, 1977).

U.S. Petroleum Supply and Demand (MMBD)



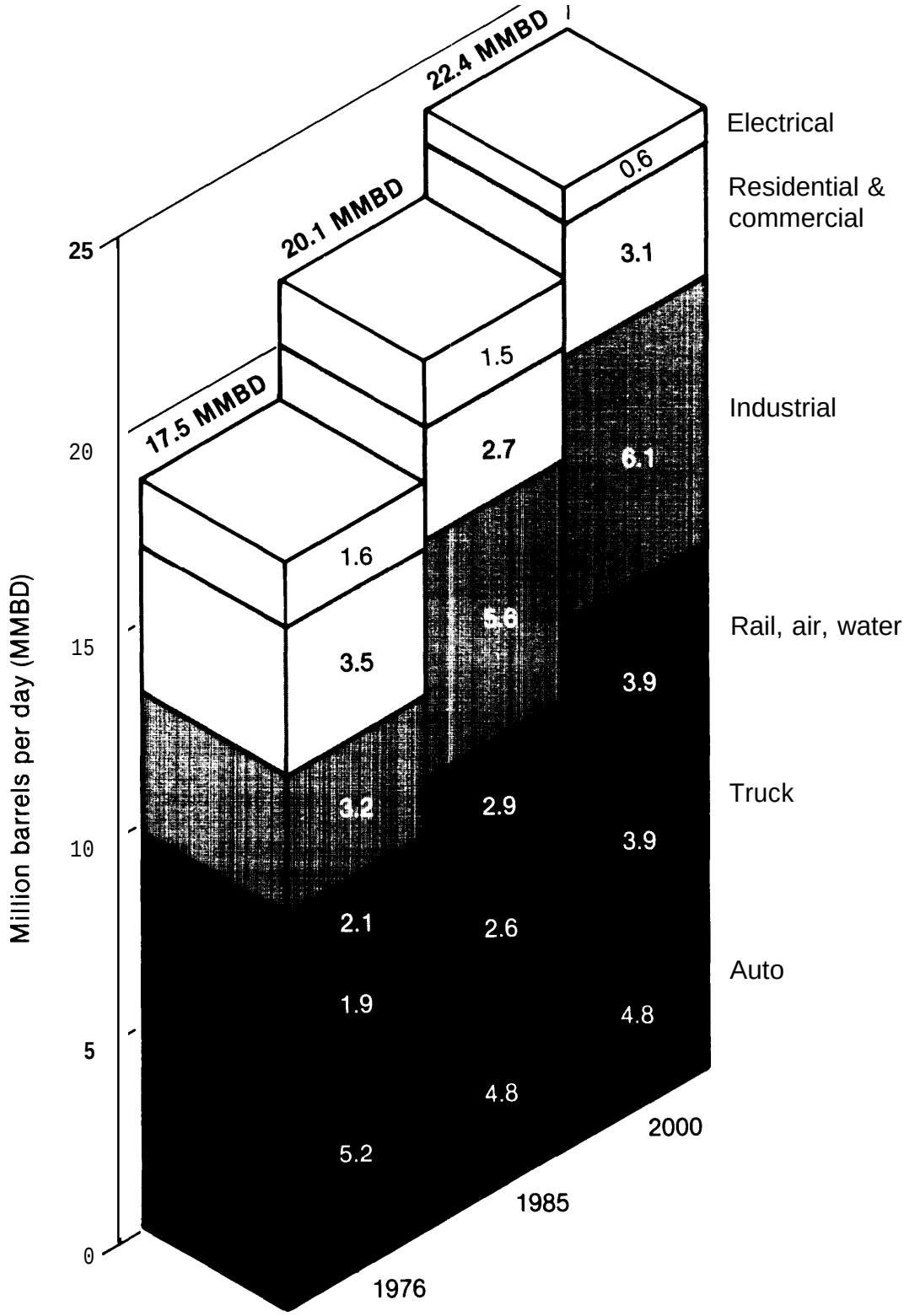
SOURCE Adapted from SydecEEA p III 2

that balancing energy supply and demand by the year 2000, while maintaining economic growth, would require a massive shift to nuclear energy and coal, with petroleum reserved almost exclusively for transport and petrochemical feedstocks. Domestic and industrial users of petroleum would need to shift to other energy sources. WAES also concluded that, while there is a range of opportunities for maintaining an adequate energy supply, all require enormous efforts in planning, intensive engineering efforts, and major capital investments, with lead-times usually of 10 or more years. To achieve this result, most of these efforts would have to be well under way by 1980-85.

Are the WAES projections too pessimistic? Although there is no question that there is only a finite amount of oil and that there are limits to the rate at which it can be recovered, differences of opinion do exist regarding estimates of the world's ultimately recoverable reserves. One basis for more optimistic forecasts is the expectation that new discoveries may be larger than assumed by WAES, particularly in countries such as Mexico that have not yet been fully explored. Another basis for a more optimistic projection is the expectation that major technological breakthroughs will make it possible to recover substantially more oil from known sources than was assumed by WAES. Neither of these possibilities can be ruled out. The effect of more optimistic estimates would be to postpone the projected date for an oil shortage beyond the year 2000.

Actually, the complete exhaustion of oil resources is not likely. As production by conventional methods declines and oil becomes more scarce, the price will rise and more expensive recovery methods and novel technologies will be used to produce additional oil. If major improvements in oil recovery techniques were to be made, they would probably not raise the

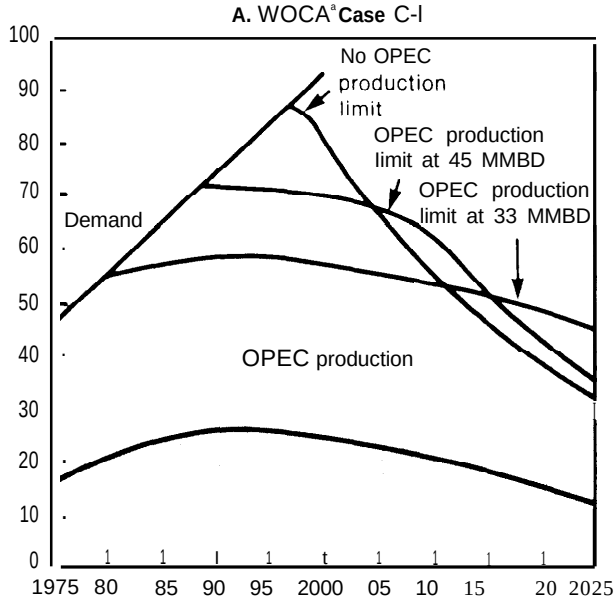
U.S. Petroleum Demand



NOTE: Assumes continuation of 27.5 mpg for new cars beyond 1985
SOURCE: Sydec/EEA and OTA estimates

Estimates of World Oil Production

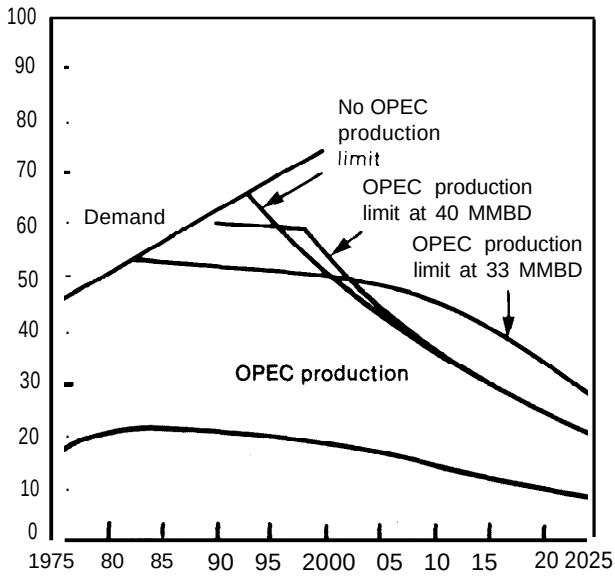
A. WOCA[a] Case C-I



C-1 Assumptions—high economic growth rate, rising energy price, vigorous government response, coal as the principal replacement fuel, and gross additions to oil reserves 20 billion barrels per year

[a]WOCA—World Outside Communist Area

B. WOCA Case D-8



D-8 Assumptions— low economic growth rate, constant energy price, restrained government response, nuclear as the principal replacement fuel, and gross additions to oil reserves 10 billion barrels per year

SOURCE Workshop on Alternative, Energy Strategies (WAESI Energy Global *Prospec!s 19852000 p 20*

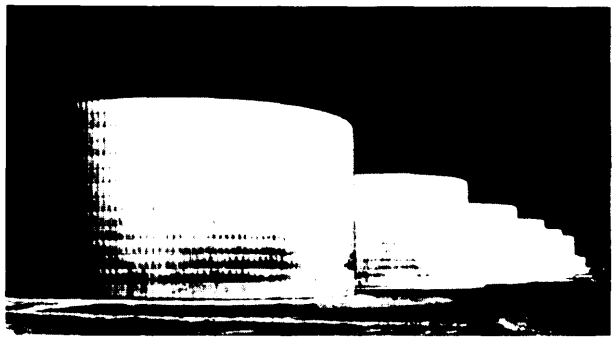


Photo Credit: U.S. Department of Energy

. . . a decreasing supply of a nonrenewable resource . . .

peak production level. They would be more likely to create a plateau in the production curve or to make the decline from the peak less abrupt.

In the classic economic sense, demand and supply are the two sides of an equation, with price being the variable. To put it another way, demand cannot exceed supply if free-market forces are allowed to determine price. On the other hand, in the case of a decreasing supply of a nonrenewable resource such as oil, the price necessary to equate supply and demand would become so high as to price millions of former users out of the market. As the price of oil rises, there would be strong economic incentives to develop alternative fuels. The development process would take many years, however, and the decision to provide an alternate fuel supply would have to be made many years before the price rise signaled the need.

This study does not attempt a comprehensive analysis of energy supply and demand, and it is not our role to judge the validity of the opposing views. It is our responsibility, however, to consider the consequences for the U.S. automobile system of a possible petroleum shortage in the future.

Implications for the Automobile System

It is outside the purview of this study to consider policies to allocate petroleum between transportation and other sectors of the economy (industrial, residential, and power generation), or to promote conservation in other sectors. It is

evident, however, that if the WAES projections are correct, all sectors of the economy will have to take further steps to limit petroleum usage in the future. Here we have focused on two kinds of policies affecting petroleum usage in the automobile sector:

. Conservation, and

. Transition to Alternate Energy Sources.

Conservation

The Technical Report considers a number of automobile fuel conservation policies, among which:

- more stringent auto fuel-economy standards,
- higher gasoline taxes,
- deregulation of oil and gasoline prices,
- gasoline rationing, and
- measures to encourage alternatives to auto use.

More Stringent Auto Fuel-Economy Standards

A progressive tightening of the new car fuel-economy standards to 35 mpg by the year 2000 would result in savings of about 0.6 MMBD compared to the Base Case. Increased fuel economy can be achieved by a continuation of current efforts to reduce automobile weight (substitution of materials and reduction of size) and to improve engines, transmissions, and other components. However, these measures to increase fuel economy might necessitate compromises in safety, utility, and performance.

A further improvement in fuel economy (beyond the 35-mpg new car average) by the year 2000 would be difficult to achieve and might produce greatly diminishing returns compared to raising fuel economy from 27.5 to 35 mpg. A fleet average fuel economy greater than 35 mpg would require fewer large cars in the fleet and much more efficient propulsion systems—either greatly improved spark-ignition and diesel engines or advanced Stirling or gas turbine engines. The availability of these advanced engines before 1995-2000 and their competitiveness with spark-ignition and diesel engines in terms of cost, performance, reliability, and maintainability are doubtful at the present time.

Higher Gasoline Taxes

Small, gradual increments in the price of gasoline would not make significant reductions in the use of fuel. Analysis of historical data shows that a 15-percent increase in the real price of gasoline would reduce VMT by only about 3 percent.

To achieve major VMT reductions (on the order of 25 percent) would require that the real price of gasoline be 4 times higher than that projected for the Base Case in the year 2000.[4] Such large increases would place a heavy burden on low- and moderate-income families, particularly in rural and low-density suburban areas where alternate modes of travel cannot easily be provided. A tax rebate or gasoline stamp plan for such families would alleviate some of the hardship.

Oil Price Deregulation

Deregulation of petroleum prices would allow free-market forces to allocate the limited supply of petroleum and would serve to curtail demand. However, price deregulation could result in a major transfer of money from consumers of petroleum products to producers (oil companies, distributors, and leaseholders) with large windfall profits for some, unless excess profit taxes were imposed or unless provisions were made to ensure the use of these profits to explore for new sources or to develop alternate fuels. The increased costs of gasoline and other petroleum products could result in a substantial decrease in economic growth. There could be a reduction in employment in the petroleum supply and distribution industries, perhaps partially offset by an increase in the number of jobs in the alternate fuels production. It would also place a heavy burden on low- and moderate-income auto-dependent people.

Gasoline Rationing

Restricting fuel availability by rationing is an effective way of distributing the burden of conserving petroleum. Despite formidable administrative problems, rationing with marketable

[4]Based on current data on the price elasticity of gasoline.

coupons is a reasonably equitable short-term policy for achieving substantial and predictable petroleum conservation. Rationing would have limited value as a long-term policy because of its restrictive effect on economic growth and personal mobility.

Encouraging Alternatives to Auto Use

Several measures to constrain the use of the automobile were evaluated:

- expansion and encouragement of public transportation,
- ridesharing systems, and
- transportation system management programs emphasizing priority for high-occupancy vehicles.

Results of the analysis indicate that the potential of public transportation, ridesharing, and transportation system management to reduce auto travel is small—in most cases resulting in less than a 5-percent reduction in VMT nationally. However, the value of these measures in improving mobility may be considerable, as discussed later in the section on mobility.

Transition to Alternate Energy Sources

Petroleum reserves are finite, and as the supply is depleted, the price will rise. Sooner or later a shift will occur from petroleum to alternate energy sources for the automobile. Conservation policies can provide extra time and help smooth the transition, but they cannot forestall the need to develop alternate energy sources.

Roughly, these alternate energy sources fall into four categories:

- substitute liquid fuels derived from coal, tar sands, or oil shale;
- alcohol fuels or a combination of alcohol and gasoline (gasohol);
- electricity; and
- longer term alternatives such as hydrogen and fuel cells.

At this time there is no clear choice as to the most economical and practical alternate energy source for the period *1985* to *2000.* Most likely, a combination of alternative sources will be used.

Compared to petroleum, all of the alternative fuels:

- are more costly, and will remain so until the rising cost of petroleum meets the cost of alternatives;
- require more total energy (including recovery and distribution) per vehicle mile; and
- will not be available in quantity before the year 2000 unless an active development and investment program is undertaken soon.

An expeditious transition will require the joint efforts of private industry and Government and a stable long-term Government policy with respect to development of alternate energy sources. The risks are so great, the capital costs so high, and the rate of return so uncertain that private industry is unlikely to undertake development and large-scale investment at the presen t time without Federal Government action to moderate these factors.

The Federal Government has a number of policy options to promote development of alternate energy sources:

- expanded research, development, and demonstration (RD&D) programs with joint funding and attractive license and patent policies;
- tax incentives to foster research, development, and use of alternate energy sources;
- financial assistance (loans and grants) for investment in extraction and production fa - cilities;
- elimination of subsidies for production of oil and gas;
- import restrictions or taxes on petroleum;
- price guarantees for synthetic fuel products; and
- deregulation of petroleum price.

Even with these policies, the transition to alternate energy sources will be slow in coming. Under current Government policies, synthetic fuel production in the year *2000* will probably not exceed 3 MMBD. Higher production is dependent upon much stronger Government support and much greater private investment.

FINDINGS

- The current program to improve fuel economy will keep total auto fuel consumption at or below present levels to the year 2000.
- A petroleum scarcity and sharply rising prices severely affecting U.S. automobile usage are a real possibility in the late 1980's or 1990's with the severity depending primarily on OPEC production and pricing actions and U.S. Government policy.
- Deregulation of petroleum price would allow market forces to balance supply and demand but would have inflationary effects on the national economy, impose a disproportionate burden on low-income persons, and generally restrict the use of the automobile.
- If the Nation were to face a serious or prolonged scarcity of petroleum, only rationing or very large fuel price increases through taxation or deregulation would reduce petroleum consumption in the automobile sector by a significant amount.
- Sooner or later a shift will have to be made from petroleum to alternate energy sources for the automobile, and a strong Government program of support and incentives may be necessary to accomplish this in a timely manner.