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INTRODUCTION

Success of any efforts to reduce oil imports will depend on many complex, unpredictable factors, including world oil prices, the success of technological developments, consumer behavior, general economic conditions, and–significantly –Government policies and programs.

Government policy is vitally important, because energy inevitably affects, whether directly or indirectly, all production and consumption decisions in an industrial society. How quickly and to what level the Nation displaces oil imports have direct implications for who benefits from, and who pays the costs of, energy independence. Such distributional questions arise regardless of policy choices. Thus, the policy choices made by Congress transcend a simple choice between intervention and nonintervention.

This chapter describes the policy issues and options for increasing automobile fuel efficiency and accelerating synthetic fuels development. (For a detailed discussion of policy options related to fuel switching and conservation in stationary uses of petroleum, and to biomass, the reader is referred to other OTA publications.1) The chapter addresses the circumstances which might justify direct Government intervention to displace oil imports. The well-established auto industry and the newly developing synfuels industry are then described; and those economywide and sector-specific characteristics which shape, direct, and pace each industry's ability to displace oil imports are identified. A brief, recent history of Government policy towards each industry is also provided. Finally, the major policy options available to Congress are discussed and evaluated based on the characteristics of the industries.

'Energy From Biological Processes, OTA-E- 124, July 1980; Residential Energy Conservation, OTA-E-92, July 1979; ***Dispersed Electric Energy Generation Systems,*** OTA, forthcoming; ***Energy Efficiency of Buildings in Cities,*** OTA-E-168, March 1982.

THE NATION'S ABILITY TO DISPLACE OIL IMPORTS

The three principal means for displacing oil imports-increased automobile fuel efficiency, synfuels production, and fuel switching and conservation in stationary uses—can all make important contributions to the Nation's energy future. Legislation has recently been enacted in all three areas to reduce conventional oil use, including the Energy Policy and Conservation Act of 1975, the Energy Security Act of 1980, the Fuel Use Act, and various taxes and credits to encourage capital investment for energy conservation in industries and buildings. z Some progress in displacing imports can be expected as a result of these Government programs working in concert with market forces.

OTA'S technical analysis, presented in this report, concludes that if Congress wishes to eliminate net oil imports, significant accomplishment in all three areas may in fact be necessary to achieve this goal by 2000 if domestic production falls from 10 million to 7 million barrels per day (MMB/D) or less by 2000, as OTA expects.3 In general, if there are no additional policies and programs, if technology developments are only partially successful, and if strong market forces for import displacement do not materialize, the United States can expect to import 4 to 5 MMB/D or more by 2000 (see issue on "How Quickly Can Oil Imports Be Reduced?" in ch. 4).

In the near future, Congress will face a number of decisions about whether to increase efforts to displace oil imports, and if so, at what speed imports should be displaced, Major decisions will

2For details of recent legislation, see for example Congressional Quarterly, Inc., *Energy Policy,* 2d cd., March 1981.

3 ***World Petroleum Availability: 1980-2000—A Technical Memorandum, OTA-TM-E-5*** (Washington, D. C.: U.S. Congress, Office of Technology Assessment, October 1980).

concern the two major programs enacted by Congress: the setting of fuel efficiency (Corporate Average Fuel Economy (CAFE)) standards beyond the 1985 mandate for new cars sold in the United States, and the provision of large subsidies to promote rapid development of the synfuels industry. Such decisions will shape the future of both the auto and synfuels industries. Whether new policy initiatives are feasible, practical, and appropriate cannot be determined until Congress specifies the desired level and rate of import displacement. IS the goal to "eliminate" or to "reduce" imports?* IS this oil import displacement goal so vital to national interests that an emergency effort is required, regardless of any accompanying disruptions and dislocations?

Given the uncertainties, risks, and unpredictability associated with both the automobile fuel-efficiency and synfuels options, it is difficult to determine how far and in what direction present policies and market forces will take the Nation. OTA has not attempted to predict the detailed outcomes of alternative policy futures, but rather to demonstrate that the ability to displace oil depends on complex, interrelated factors, and to demonstrate that the Government's policy choices—whether to implement additional policies or to "do nothing"—will make a difference in the ability to achieve oil displacement goals. Policies are also identified that could be effective if future Government action is necessary.**

OTA'S low estimate is that the average fleet fuel efficiency for new cars could reach at least **40** to **so** miles per gallon (mpg) by the early to mid-1990's and 45 to 60 mpg by 2000,*** based on relatively pessimistic expectations about how quickly improved automotive technology is deployed and purchased. Fleet fuel consumption for passenger cars would be about 2.1 MMB/D in 2000, for a cumulative savings of over 1 billion barrels of oil between 1985 and 2000 (assuming that the same proportion of large, medium, and small cars are sold in 2000 as are expected to be sold in 1985). The "high estimate" assumes that technology development is both successful and rapidly introduced into volume production. Average mpg ratings would be **55** to 65 mpg by 1995 and 60 to 80 mpg by 2000; and fleet fuel consumption for passenger cars could be as little as 1.3 MMB/D in 2000 for a cumulative savings of over 4 billion barrels (relative to a 30-mpg fleet and assuming a rapid shift to small cars).

However, the actual level of fuel consumption will depend on market demand for fuel-efficient cars and/or additional Government policies designed to facilitate either the manufacture or purchase of these cars. Although the low estimates are believed to be achievable in the absence of additional Government policies, they would be contingent on consumer expectations that the real price of gasoline will continue to increase. The high estimates are unlikely to be achieved in the absence of supporting Government policies unless a strong and continuing consumer demand for fuel efficiency is coupled with favorable technological progress.

OTA'S estimates for a low- and a high-development scenario for synthetic fuels production depend principally on the price of conventional oil and the ease and rate with which synfuels processes are proven. A rapid buildup of the industry could begin as early as the late 1980's or as late as the mid-l990's, resulting in technically plausible production levels of fossil-synthetic transportation fuels of 0,3 to 0.7 MM B/D by 1990, 0.7 to 1.9 MMB/D by 1995, and 1 to 5 MMB/D by 2000. * In the absence of additional Government policies, the lower estimates are probably attainable but are contingent on a Government-supported commercialization program that reduces the high technical and associated financial risks to private investors of first generation plants.

Without a successful commercialization program, even the low estimates are probably unat-

***"Elimination of oil imports" herein is assumed to mean the reduction of net oil imports to a level of about O to 1 MMB/D by 2000. At this level, the "security premium" for oil—the difference between the market price and full economic cost to the Nation of oil imports-would approach zero. This level of supplies could be procured primarily from the United Kingdom, Canada, and Mexico; and foreign producers generally would be forced to compete for markets. Because of the "security premium, " policy decisions about the value of displacing imports should not be based solely on the international price of oil.**

****An examination of Government policy related to the use of petroleum in the stationary sector is beyond the scope of this report. A summary of the major policy options for the stationary sector, however, is found in app. 3A to this chapter.**

*****Earlier trends showing relatively strong demand for fuel economy have encouraged some domestic manufacturers to predict new-car fuel economy averages of over 30 mpg by 1985 (the 1985 CAFE standard requires a fleet average of 27,5 mpg), while individual vehicles already on the market exceed 45 mpg.**

***These estimates exclude contributions from biomass.**

tainable. If there is a commercialization program, synfuels production **theoretically** could reach the high estimates without additional Government programs if: 1) early commercial-scale demonstration units are built and work successfully, and 2) synfuels production becomes unambiguously profitable. The maximum displacement of oil imports, however, would occur only if synfuels production concentrates on transportation fuels. it is OTA'S judgment that, even with a commercialization program, the high estimates are likely to be delayed by as much as a decade unless policies tantamount to energy "war mobilization" are enacted.

Fuel switching and conservation of oil in stationary uses will also be extremely important for displacing oil imports and would complement both fuel-efficiency and synfuels efforts. Although much of the potential for displacement could probably be achieved by market forces by 2000 (under the high oil price scenario of the Energy Information Administration (EIA)),[4] additional policies to encourage fuel switching and conservation will likely be required to accelerate the changes or completely eliminate stationary fuel oil use. The level of displacement that can be obtained depends not only on future oil prices, but on financing, regulation, and technical factors. Efficiency increases in the various nonautomobile transportation uses could also be significant.

Displacing oil imports is a necessary but not a sufficient condition for achieving national energy security. Such security translates into an essential self-reliance, availability, affordability, and sustainability of energy resources. Alternative energy sources may present their own set of supply and/or distribution problems. Furthermore, the relationship between the level of imports and the level of insecurity is not proportional in an obvious way. Even if the Nation could eliminate all of its oil imports, U.S. energy security could still be seriously affected if interruptions in world oil supplies threatened international commitments with allies, imbalances in the world monetary system, and pressures on foreign exchange markets. Thus, efforts to displace the Nation's most insecure oil resources—its imports-should not divert attention away from ensuring the resilience of the alternatives chosen and thus the stability of both domestic and international energy systems.

[4]Department of Energy, Energy Information Adminstration, *Annual Report* to *Congress, vol. II 1,* May 1982.

RATIONALE FOR A DIRECT FEDERAL ROLE

The basic rationale for direct Federal involvement in a market economy is that—in limited but important areas— market prices and costs used to evaluate returns on private investments do not reflect the full value and cost of the investments to society as a whole. National security and environmental protection are classic examples of values and costs that are not reflected in profit and loss statements. Private calculation of profits also causes market mechanisms to be most responsive to short-term economic forces as opposed to long-term social and economic goals.

The three principal reasons for such market "failures" are that: 1) some of the social benefits are public and not private goods, 2) some of the costs are not paid by the private sector, and 3) costs and benefits are not fully known. All three situations arise in the context of displacing oil imports in general and of both increasing automobile fuel efficiency and producing synfuels in particular. The inability of the conventional marketplace to ensure the effective and rapid displacement of oil imports has major implications for the Federal role, depending on the goals chosen and the resources made available.

National security is a public good that has traditionally received Government support. National energy security, promoted by the displacement of oil imports, is an important component of overall security. Direct Government involvement would thus be justified if market forces alone were not believed capable of achieving the quantity and rate of oil displacement required by national security goals. The value to the Nation of

accelerating automobile fuel efficiency increases and synfuels production would be in addition to any private returns to investment.

Both increased automotive fuel efficiency and synfuels production give rise to side effects and tradeoffs; those who benefit from the investments are not necessarily the ones who bear the full costs. Side effects can fall on different sectors of the economy, regions, or consumer groups depending on the investments chosen. In the case of increased automobile fuel efficiency, the rationale for Government policy is that the activities stimulated by market forces alone do not provide, for example, adequate safety and employment safeguards. There are other possible tradeoffs, on the one hand, between improving the competitive position of the U.S. auto industry by encouraging investments in increased auto fuel efficiency, and, on the other hand, possible declines in auto-related employment levels (because of increased automation, contraction of the domestic industry), increased consumer costs, and decreased safety. With respect to synfuels, Government intervention could be similarly warranted if market decisions do not reflect environmental, health, safety, and other social concerns.

Both increased automobile fuel efficiency and synfuels production are characterized by financial risks and uncertainties. If market forces alone determine outputs, investments associated with these alternatives might be delayed or canceled. In such cases, the Government could choose either to assume some of the risk or to help reduce components of uncertainty. The auto industry's uncertainty focuses on unpredictable consumer demand for fuel-efficient cars, the long leadtimes for investments, and, to a lesser degree, on the rate of technological development. Synfuels production is subject to significant technological uncertainties and, in turn, financial risks. Both the auto and synfuels industries are also affected by uncertain and as yet undetermined future Government policies.

DISTINGUISHING FEATURES OF INCREASING AUTOMOBILE FUEL EFFICIENCY AND SYNTHETIC FUELS PRODUCTION

The major forces that will shape, direct, and pace increases in automobile fuel efficiency and synfuels production are summarized in table 7. Identifying these forces may indicate both the potential opportunities for and limitations of Government policies in achieving a desired level and rate of import displacement, and the appropriateness, practicality, and desirability of specific policies or combinations of policies.

Although increased automobile fuel efficiency and synfuels production share several attributes, essential differences between them suggest that there is no single role for Government policies and programs. These two options should be viewed as complementary measures for reducing oil imports. Each option has different implications for the rate of oil import displacement and will give rise to different types of economic and noneconomic impacts on the Nation. In addition, within the uncertainty about investment costs (per barrel per day oil equivalent (B/DOE) produced or saved), neither increased automobile fuel efficiency nor synfuels production appears to have an overall unambiguous enconomic advantage over the other. For this reason, the nonmonetary and often nonquantifiable differences between these options will be the principal means for distinguishing between them for policymaking purposes.

The factors that determine the rate of fuel switching and conservation in stationary applications will share some common elements with automobile fuel efficiency increases and synfuels production. The success of fuel switching will depend critically on the efficiency of stationary energy uses, the technologies for producing natural gas from unconventional sources, the supply and future price of conventional natural gas, and the ability of the utility industry to solve its current financial problems. in the absence of mandated conservation or performance standards, conservation measures will depend primar-

Table 7.—Distinguishing Features of Increasing Automobile Fuel Efficiency and Synfuels Production

Increasing automobile fuel efficiency	Synfuels production
1. Both near- and long-term restructuring of an existing industry	1. Growth and promotion of a new industry
2. Dominated by a few large, mature companies	2. Likely to be dominated by a few large, mature companies
3. Automobiles as consumer durables; differentiable; deferrable	3. Synfuels as uniform, consumable commodities
4. New technology involved, but can proceed incrementally; associated risks are an ongoing feature of industry	4. Large technical risks; possibilities for "white elephants, " major risk occurs with first commercial-scale demonstration plants
5. Industry must produce competitive products each year, including fuel-efficient cars	5. Sponsoring industry is involved in a breadth of activities that provides alternative investment and business opportunities, of which synfuels is one
6. Precariousness of industry's current financial position; need to ease readjustment of an industry in distress	6. Soundness of sponsoring industry's current financial position; need to facilitate growth
7. Large demand uncertainty	7. No unusual demand risk except insofar as synfuels differ from conventional fuels
8. Dispersion of industrial activities, domestically and, increasingly, internationally; some concentration of activities in the North-Central region of the United States	8. Dispersion of activities among coal regions; current oil shale activity concentrated in a small area of the West
9. Capital intensity and associated risks	9. Capital intensity and associated risks
10. Declining profit margins in domestic industry	10. Potential for profit still highly uncertain
11. Significance of international competition (i.e., auto imports); importance of domestic market to financial viability	11. Long-term export potential; importance of international competition (i.e., oil imports) in terms of establishing the marginal price
12. Large amounts of capital continually required for redesign, retooling, etc.; final costs for improved fuel efficiency uncertain; calculation of capital costs for fuel economy dependent on methods for cost allocation	12. Large amounts of capital required primarily in the initial construction phase; final costs for synfuels production uncertain
13. Can make significant contributions to reducing U.S. oil imports; contributions have a long leadtime but can have significance incrementally	13. Can make significant contributions to reducing U.S. oil imports; contributions have a long leadtime and will not be significant until commercialization
14. Caters to a saturated market; focus on product replacement rather than growth markets	14. Caters to a slowly growing or possibly declining market
15. Consumer costs are investment to reduce future fuel purchases	15. No investment needed by consumer; consumer pays incrementally for each increment of consumption
16. Reduces consumption of fuel	16. Substitutes one fuel for another
17. Fuel savings in automobiles limited to about 3.5 MMB/D with about 1.5 MMB/D savings coming from achieving a 30-mpg fleet	17. Fuel-replacement potential ultimately limited by demand for synfuels, environmental impacts of synfuels plants, and coal and oil shale reserves
18. Principal health impact may be increased auto deaths due to smaller cars	18. Environmental and health impacts from: large-scale mining of coal and oil shale; possible escape of toxic substances from synfuels reactors (major risks are direct worker exposures, contamination of ground water); visibility degradation; development pressures on fragile, arid ecosystems

SOURCE: Office of Technology Assessment.

ily on investor behavior. Although there are few technical constraints, there are technical uncertainties about the conservation potential of buildings and the success of particular conservation investments. Both fuel switching and conservation are difficult to put into practice because the measures are varied, site-specific, and in some cases costly.

Factors Affecting the Rate of Automobile Fuel= Efficiency Increases

In order to be internationally competitive, the domestic automobile industry is currently undergoing major structural adjustments. 5 This readjustment is the consequence of two interrelated forces. First, the domestic industry is undergoing a long-term restructuring that is being experienced by auto manufacturers worldwide. Resource pressures and a trend towards small, fuel-efficient, and standardized "world cars" have resulted in a period of corporate consolidation, with firms being more closely tied by joint design and/or production ventures, and a geographic dispersion of product assembly. Secondly, U.S. auto manufacturers are uniquely faced with a series of short-term problems that arise because they have historically served a market that demanded large, relatively fuel-inefficient cars. U.S. manufacturers have been the principal producers (and promoters) of large cars and have historically earned their greatest profit margins on these cars.

The strains placed on the domestic industry, as it redesigns its products and retools its facilities for fuel efficiency in the near and midterm,6 are the forces that could most appropriately be targeted and eased by Government policies. In addition, because of the size and dispersion of the U.S. auto industry throughout the national economy, maintaining the health of the industry and minimizing the side effects on both upstream activities (e.g., dealers, suppliers), and downstream activities (e.g., consumers) are of potentially great Government concern.

Some aspects of the domestic industry's short-term readjustment problems are caused by economywide factors such as rising energy prices, tight credit, and high interest rates. These factors have affected both manufacturers—by making capital scarce and expensive—and consumers, who (with approximately two-thirds of all purchases historically being on credit) are deferring purchases.

The market changes associated with high gasoline prices and the threat of gasoline shortages experienced in the 1970's have shown that consumer demand is the most powerful influence on the rate and manner of fuel-efficiency increases. However, the prices consumers will pay, and the tradeoffs consumers will accept in vehicle attributes—of which fuel efficiency is only one—are highly uncertain and ambiguous. For example, in the mid-1 **970's,** and again in 1980-81, the proportion of relatively small cars purchased to large cars purchased decreased. * Furthermore, consumers did not consistently buy the most fuel-efficient car in a given size class. The ability of the industry to sell cars is made additionally difficult because there has been a steady slowing in the total demand for automobiles due to stagnant per capita disposable income and a general aging of the population, implying that the industry is mainly serving a domestic replacement rather than growth market. And at the same time, imports have captured an increasing share of the domestic market.

The need to make large investments under conditions of uncertain demand for fuel efficiency and slowing overall demand for automobiles, aggravated by economywide stresses, is the most significant contributor to the financially precarious position now facing the domestic auto industry. Losses to U.S. auto manufacturers exceeded $4 billion in 1980. As sales have decreased, profits have declined, and the industry's longstanding ability to reinvest with internally generated funds has decreased. Because the industry is capital-intensive, any underutilization of capacity also implies large costs. Large amounts of outside capital will be required to retool for increasing fuel economy. If companies are forced to cut back on their capital investment programs in the near term (as some are doing), they will not only forestall fuel-efficiency improvements but may also become increasingly vulnerable to foreign competition.[7]

In adjusting to this, U.S. manufacturers face a series of complex decisions. Domestic manufac-

[5] See also *U.S. Industrial Competitiveness-A Comparison of Steel, Electronics, and Automobiles,* **OTA-ISC-135 (Washington, D. C.: U.S. Congress, Office of Technology Assessment, July 1981).**

[6] See **General Accounting Office, "Producing More Fuel-Efficient Automobiles: A Costly Proposition," CED-82-14, Jan. 19, 1982.**

***These data include both domestically produced and imported cars.**

7U. S. *Industrial Competitiveness,* **op. cit.**

turers' weak competitive position is primarily due to high production costs relative to foreign producers and consumers' perceptions of value in domestic v. imported cars, that are difficult to quantify. If a strong demand for fuel efficiency develops, rapidly increasing the fuel efficiency of domestic automobiles could help to sell them. Demand for fuel efficiency, however, is usually accompanied by a shift in demand to smaller cars, the market area where U.S. manufacturers have been least competitive with imports. This shift would therefore also require that domestic manufacturers devote some of their investments to changes unrelated or only partially related to fuel efficiency. Corporate strategy, the way complex investment decisions are handled, overall demand for new cars, and the demand for fuel efficiency vis-a-vis other attributes of automobiles will all interact in a complex way to affect the actual rate at which fuel efficiency increases.

Technological uncertainties will also figure in determining fuel efficiencies actually achieved. These uncertainties relate to the behavior of various elements of the vehicle system, the way in which these elements are integrated and possible performance tradeoffs among elements, and the cost of specific manufacturing techniques. The rate of product and process development, and particularly the success of the development efforts (by no means assured) will influence the extent of fuel-efficiency increases. Basic research could lead to additional fuel economy gains by providing a better understanding of some of the complex processes related to fuel consumption (e.g., nonsteady-state combustion).

The single most important factor limiting the development of electric vehicles (EVS) is battery technology. Even if EVS were to become practical, however, they would not have the potential to displace significant amounts of imported oil, primarily because they would be substitutes for the most fuel-efficient gasoline or diesel-powered cars. The Government could justify accelerating the development and introduction of EVS if the goal is to reduce automobile pollution in the inner cities or to promote a transportation mode that does not use petroleum. EVS are petroleum independent except insofar as electricity is generated from oil.

Automobile Fuel Efficiency—Policy Background

The industry has been regulated by Government policies and programs primarily since the 1960's. Worker and public health and safety aspects are regulated by the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration; product safety and emissions by the National Highway Traffic Safety Administration (N HTSA) and EPA. Auto sales are affected by all policies that influence consumer demand. In the aftermath of the 1973-74 oil embargo, the Government became actively interested in promoting automobile fuel efficiency, and legislation was subsequently enacted to reduce U.S. dependence on oil imports.

Policy for increasing automobile fuel efficiency is embodied principally in two programs. * The principal policy instrument for increasing fuel efficiency was established by the 1975 Energy Policy and Conservation Act (EPCA) and specifies CAFE (i.e., fleet) standards for new cars and light trucks between the model years 1978 and 1985. Provisions of the CAFE program have generally tried to recognize the financial difficulties of the auto industry. CAFE standards mandate that new-car fuel efficiency will double, incrementally, between the early 1970's and the mid-1980's. (American-made cars had averaged about 14 mpg over the period 1965-75; the 1985 CAFE standards require fleet averages of 27.5 mpg and are to remain in force after 1985.**) Subsequent provisions in the Fuel Efficiency Act of 1980 eased the compliance requirements of the CAFE program, but the basic efficiency standards remain in force. Possible alteration of the standards set by the program for post-1 985 could be a major policy issue coming before Congress.

a The sources and magnitude of these cost advantages are not well understood. Understanding the nature of any cost advantages enjoyed by competitors will be critical for determining how, when, and if U.S. manufacturers can get their cost structure into line, See *U.S. Industrial Competitiveness,* op. cit., pp. 96-99.

***A third program was enactment of the 55-mph speed limit.**

****The Energy Policy and Conservation Act provided guidelines for the Department of Transportation to set standards for the early 1980's; Congress set standards for 1978 and 1985.**

The second major program, part of the 1978 National Energy Act, establishes excise taxes for purchases of automobiles with low fuel-economy ratings beginning in the model year 1980. Current "gas-guzzler" taxes range from $200 for cars rated at 14 to 15 mpg in model year 1980 up to $3,850 for specialty cars rated under 12.5 mpg beginning in model year 1986. Such taxes raised only $1.7 million in fiscal 1980.9

OTA'S analysis indicates large uncertainties in both economic and noneconomic costs of fuel-economy increases. OTA has also identified uncertainties in demand for fuel-efficient cars as critical to increasing fuel efficiency. These uncertainties, together with the desire of domestic manufacturers to serve a wide variety of consumer tastes with a limited level of capital investment, are mainly responsible for the industry's reluctance to accelerate the development and introduction of fuel-efficiency increases. Until fuel efficiency is a–or perhaps the–major selling point for new car buyers, this reluctance, understandably, is likely to continue.

Factors Affecting the Rate of Synthetic Fuels Production

Unlike increasing automobile fuel efficiency, which may entail restructuring a major existing U.S. industry, production of synthetic fuels involves the emergence of a major new industry. * The costs and therefore the profitability of producing synfuels are influenced by major uncertainties that both characterize the economy as a whole and are specific to the synfuels industry. At the economywide level, factors such as the price of oil, the cost of capital, inflation in general and hyperinflation in the construction industries, and the availability of appropriate labor and materials will determine the financial risks that must be assumed by investors. Like the auto industry, the synfuels industry is capital-intensive. A moderately sized (50,000 B/DOE) fossil synfuels plant could require an investment of $2 billion to $5 billion; the industry's growth and ability to attract capital will thus be highly sensitive to the investment climate.

The major constraint on the development of a synfuels industry is the technical uncertainty associated with synfuels processes. There is essentially no domestic commercial experience with synfuels processes, and processes and design concepts have not yet been adequately demonstrated at a commercial scale. It is thus conceivable that design errors and unexpected operational problems could delay construction or cause a completed facility to be inefficient, even a "white elephant" operating at only a fraction of its capacity or at greatly higher cost than anticipated. As with any capital-intensive industry, there are high costs associated with the underutilization of capacity.

Synfuels production will bean attractive investment if investors view the technical risks as being low (i.e., commercial-scale demonstration units are successful) and they expect oil prices to rise sharply in the future, or if they want to secure an early market share in case synfuels do become competitive with the oil market. Unless oil prices rise more rapidly than synfuel construction costs, however, synfuels plants may not be economically attractive even after the processes are proven and the technical risk is small.

Synthetic Fuels Production—Policy Background

Congress created the National Synfuels Production Program (NSPP) under the Energy Security Act of 1980 (ESA) to promote the rapid development of a major synfuels production capability. Specific goals are set for 500,000 B/DOE by 1987 and 2 MMB/DOE by 1992.[10]

'Congress rejected 60 proposals to tax purchases of inefficient new cars and 19 proposals to raise gasoline taxes between 1973 and 1977. In 1977, President Carter proposed a stringent "gas guzzler" tax keyed to CAFE standards which included a rebate program for purchases of especially efficient cars (which Congress decided would violate the General Agreement on Tariffs and Trade—or GAIT). When the current excise taxes were enacted, critics argued that they would save only 10,000 bbl/d of imported oil, while the Carter proposal, with higher taxes applied to more vehicles, was estimated to be able to save 170,000 bbl/d (New York *Times,* Dec. 10, 1978).

***The liquid and gaseous fuel industry may also undergo a restructuring, however. Synfuels development will tie up capital in considerably larger blocks and for longer periods than historically experienced by the industry. A concentration of ownership is also likely.**

0IOs„th,ti, substitutes for petroleum and natural gas are the focus of the NSPP; other programs support development of synthetic fuels from biomass. Biomass subsidy options have been reviewed in detail in the Office of Technology Assessment's *Energy From Biological Processes.* For the NSPP definition of synfuels see Public Law 96-294, sec. 112 (17) (A).

In the first of three phases, the Department of Energy (DOE) was authorized to offer financial incentives for the production of alternative or synthetic fuels. The original authorizing legislation (Public Law 96-1 26) made about $2.2 billion available, mainly for purchase commitments or price guarantees pursuant to the provisions of the Federal Nonnuclear Research and Development Act of 1974; total funds were subsequently increased to approximately $5.5 billion. ' 11

ESA created the Synthetic Fuels Corp. (SFC) in the second phase as a quasi-investment bank, to provide incentives to promote private ownership and operation of synfuels projects. SFC is backed by funds deposited in a special Energy Security Reserve in the U.S. Treasury and to be used for financial assistance in the form of: 1) price guarantees, purchase agreements, and loan guarantees; 2) direct loans; and 3) support to joint ventures. " The governing board of SFC can decide which DOE projects it will take over once the board becomes fully operational. Total funds authorized for SFC are approximately $17 billion through June 30, 1984.12

The third phase of the NSPP is to begin in mid-1984, at which time Congress may appropriate an additional $68 billion on the basis of a comprehensive synfuels development strategy to be submitted by the SFC board. SFC is scheduled to lose the authority to make awards in 1992 and to be terminated in 1997. Some revision of NSPP dates, goals, and/or financing may have to be made if the production of synfuels falls short of the original NSPP goals—as is expected. In OTA'S judgment, Congress is unlikely to have sufficient information by 1984 about the technical aspects of synfuels processes to be able to make long-term synfuels decisions.

SFC has received continued political support, and the administration is committed to ensuring the development of a commercial synfuels industry, as announced in its *A Plan for Economic Recovery* (February 1981). In addition DOE has committed about 50 percent of its approximately $5.5 billion, and provisional commitments have been made to two projects. *

Reflecting a recent major policy change however, Government support is now to emphasize long-range, high-risk research and development (R&D) activities that are unlikely to receive private sponsorship. This shift is likely to have different effects on the two main types of synfuels projects: 1) projects designed to test and demonstrate akernative design concepts, learn more about the details of the processes involved, and gain operating experience (demonstration plants); and 2) projects designed to demonstrate commercial-scale process units (CSPUs).

Demonstration plants are generally smaller than commercial-scale plants and are not intended to earn a profit. Under the new policies, DOE programs to support demonstration plants

[11]This figure does not include **an additional $1.27 billion that has been made available for biomass energy, including alcohol fuels and energy from municipal waste. For further details on this legislation, see Public Law 96-294, Public Law 96-304, and the CRS issue brief (No. MB70245) "Synthetic Fuels Corporation, Policy and Technology," by Paul Rothberg.**

During the interim program, DOE awarded, in a first "round," $200 million of these funds, half each for feasibility studies and for cooperative agreements. Of the first $200 million, approximately two-fifths, or $80 million were for biomass projects, while the remainder went to synfuels activities. DOE has in past years also provided support for a variety of research and demonstration activities to support synfuels development.

DOE originally planned a second "round" of awards for feasibility studies and cooperative agreements, but at the request of the Reagan administration the $300 million authorized for these awards was rescinded as an economy measure.

***In its guidelines to investors, SFC indicates that it strongly favors price guarantees, purchase agreements, and loan guarantees, which emphasize "contingent liabilities. " The cost to the Government of such aid varies with the success of the assisted projects; it is minimized when projects produce synfuels that can be priced competitively with other fuels. To prevent overconcentrating funds, SFC can give no project or person more than 15 percent of its authorized funds, which is about $3 billion during its early years (1981-84). In the case of loan guarantees, SFC cannot assume a financial liability for more than 75 percent of the initial estimated cost of the project, requiring the assisted company or companies to risk a sizable amount of their own funds. Although there are broad guidelines, the terms of each award will be negotiated separately with project sponsors.**

None of the contingent liability incentives available to SFC can exceed the amounts held for SFC in the U.S. Treasury; that is, SFC cannot "leverage" *its* funds by guaranteeing loans in excess of its actual reserves. In the period since the passage of the synfuels legislation, estimates of the cost of commercial-scale synfuels plants have continued to increase; therefore, unless investors are willing to negotiate guarantees for smaller percentages of project costs than allowed by legislation, the amount of synfuels produced by the subsidy program may be much smaller than originally anticipated.

[12]Synthetic Fuels Corp., **"Assisting the Development of Synthetic Fuels," p. 1. The $17-billion figure is an approximation. SFC is authorized to spend up to $2o billion, but the money obligated in the interim program is to be subtracted from the larger figure.**

***These are a loan guarantee of up to $1.5 billion to the Great Plains Coal Gasification plant in North Dakota and an as yet unnegotiated assistance agreement with the Union Oil Co, oil shale project (product purchase guarantee).**

are being terminated, but these projects presumably can apply to SFC for support.

If CSPUs can be made to operate properly, several such units might be built and operated in parallel in a commercial synfuels plant. Because the process unit is intended to be part of a commercial synfuels plant, support for CSPU demonstrations continues to be available through SFC, under the new administration policies.

Termination of DOE support may lead to cancellation of several demonstration plants, since they must now compete against more developed technologies for SFC support. * This would result in a poorer understanding of various synfuels processes and a narrower range of technology options available to potential investors. It could also reduce the prospects for commercializing plants capable of producing fuels from a variety of coals found in different regions of the country.13 Finally, processes with the greatest immediate (i.e., not necessarily long-term) commercial promise are likely to be favored by SFC in order to meet production targets. *

Although every commercial-scale process will have gone through a demonstration plant stage, the design of the CSPU will also be based on numerous other sources of relevant information. Terminating demonstration plant projects will reduce this pool of information, thereby increasing the risks that CSPUS will not function properly and reducing the design options for correcting malfunctions. Development of promising longer term synfuels processes may also be delayed or overlooked entirely. For these reasons, it is OTA'S judgment that DOE's termination of support for demonstration plants is likely to reduce the rate at which a synfuels industry is built.

***Apparently as a result of reduced Government interest in directly promoting synfuels, three projects previously supported by DOE have been canceled (SRC 11 and two high-Btu gasification projects, the Illinois Coal Gasification Project and the CONOCO Project in Noble County, Ohio). Four additional demonstration projects are continuing with reduced levels of DOE support and their futures are in doubt: H-Coal, EDS, Memphis Medium-Btu, and SRC 1. At least one upcoming project, not yet at the demonstration stage, has also been canceled in light of recent developments (a low-Btu Combustion Engineering project).**

13See Paul Roth berg, "Coal Gasification and Liquefaction, " CRS issue brief No. IB77105, Aug. 12, 1981.

***Legislation calls for SFC to consider a wide range of alternative synfuels technologies in order to broaden industry's experience with the technical and economic characteristics of many processes. This requirement may conflict with the mandate to meet production targets—targets that already appear unrealistic.**

POLICY OPTIONS

This section evaluates the major policy options available for displacing oil imports generally and specifically for stimulating auto fuel-efficiency increases and synthetic fuels production. The evaluation is based on the industry characteristics so far discussed and on the technical analysis which appears later in this report. In particular, the impacts of several policy options that have recently received congressional attention are estimated. Note, however, that policies are not discussed in the context of emergency oil shortfalls.

The policy choices available to Congress differ along several key dimensions: 1) the rate and degree of oil import displacement; 2) the degree and specificity of Government intervention and budgetary effects; 3) the types, magnitude, and distribution of benefits and costs; 4) implications for the long-term, sustainable, and competitive health of the affected industries; 5) the relationship of the choices to other Government programs; and 6) the feasibility of future actions. The selection of policy instruments and resulting

tradeoffs will reflect the priority ascribed to each dimension. Policies can generally be designed either as incentives or penalties, incentives more closely approximating the conventional marketplace. Policies can be directed at either economywide or sector-specific measures.

Economywide Level.–''Economywide" policy choices are concerned with overall economic and business conditions—as measured by such indicators as inflation, unemployment, and interest rates—that determine the financial health, investment climate, and productive capabilities of U.S. industries. Fiscal and monetary policies are the primary instruments in this category; other measures could promote innovation, regulatory reform, technology development, and human resources development. Such Government policies generally seek either to remove or to reduce impediments to a strong and stable economy, as well as to raise business and consumer confidence in the face of changing economic conditions. The advantage of such policies is that they can be directed at many industries, although they will have different impacts on the various affected industries. They are most commonly preferred as a complement to market forces, because their scope enables them to enlist the broadest base of support, and they are best equipped for integrating a wide range of economic and social objectives. General economic policy, however, has only limited ability to promote the displacement of oil imports and to stimulate specific actions, and may indirectly distort capital flows among oil displacement alternatives.

Automobile fuel efficiency and synfuels production (as well as fuel switching and conservation in stationary applications) are influenced by such economywide factors as high interest rates, tight credit, increasing resource costs, and changes in real disposable income. As for the auto industry, general economic conditions influence the ability of consumers to buy cars and the ability of manufacturers and suppliers to invest in needed changes. General economic policy could help to stimulate demand for automobiles by lowering the costs of consumer credit and by making credit available. Strong demand for new cars, together with stimuli that reduce the effective costs of capital and retooling can, in turn, stimulate the supply of fuel-efficient automobiles.

Economywide measures, however, would not induce consumers to buy domestically manufactured vehicles rather than imports; and they could have a mixed effect on local automobile production and employment. Economywide measures may facilitate investments by foreign firms in U.S. facilities, but they also assist investments by local producers in labor-saving equipment and investments by domestic manufacturers in low-cost production facilities abroad. These investments may ensure the financial health of individual, American-owned firms, but attendant reductions in domestic employment may aggravate regional economic problems.

Deployment of synfuels production capacity will also be sensitive to general economic conditions: interest rates not only influence the availability of capital for building plants; the capital costs also help determine whether products can be priced competitively. Once established, however, the synfuels industry is expected to be relatively insensitive to general economic conditions to the extent that synfuels are indistinguishable from conventional fuels and are competitively priced, and the plants do not require frequent retooling. Based on the analysis provided in this report, it is OTA'S judgment that favorable economywide conditions, by themselves, are still unlikely to provide sufficient incentive for private firms and investors to accelerate the commercialization of a synfuels industry because of the large technical risks associated with as yet commercially unproven synfuels processes.

Sector-Specific Level .–Policies can be aimed at specific industries to stimulate industrial competitiveness, ease the adjustment of firms to new economic conditions (rapid growth, short-term distress, or long-term decline), or to promote the achievement of national or regional objectives (e.g., national security, regional development). To formulate policies at this level, analyses of individual sectors and linkages among sectors are essential. The major disadvantages of such policies are that they do not always address the underlying causes of market distortions and they discriminate against other industries which are

not similarly assisted. in terms of the auto industry, sector-specific policies would be most effective if they addressed the market risk, which is a major factor determining the rate of fuel-economy improvements. The major constraint on rapid deployment of a synthetic fuels industry is technical uncertainty with respect to unproven processes and, currently, the cost of conventional oil products.

Economywide Taxation—Oil and Transportation Fuels

General taxation measures are one vehicle for stimulating capital investment across the economy. Economywide taxation measures that specifically relate to displacing oil imports are taxes on oil imports, on oil in general, and on transportation fuels (e.g., gasoline and diesel fuel) in particular. To the extent that the Nation's energy "problem" is defined as dependence on insecure foreign sources, an oil or transportation fuel tax would promote security by reducing oil demand. However, an oil or gasoline tax could be counterproductive to the degree that the energy "problem" is defined as a lack of relatively low-cost, high-quality fuels. Consumers may oppose an oil import tax, even though its impact would be minor compared with that of large OPEC price increases, as was the case when an oil import tax of $0.33/bbl was in effect briefly during the Ford adminstration. Its impact, if any, was minor in comparison with that of OPEC's hikes.

Oil taxes can be imposed either on oil generally or on oil imports in particular. The advantages of an oil tax arise because of three features. First, the tax would make all uses of oil more expensive without prejudging which kinds of adjustments would be most desirable. A general tax on oil would thus reduce consumption and, in turn, imports. Second, the tax could be designed to isolate consumer oil prices from reductions in international oil prices. For example, if OPEC prices remain steady through 1984 and if inflation continues at current rates, the real price of oil could decline by as much as 20 to 30 percent during this period. While perhaps beneficial to consumers in the short term, declining real prices for petroleum products would probably lead to increased petroleum demand. Consistent price signals would also provide assurance both to the auto industry that demand for fuel-efficient cars would be at least sustained if not increased, and to synfuels developers that they would receive at least a constant real price for their products. Finally, tax revenues could be used, for example, to support import displacement investments, or to offset some of the potential adverse effects of the tax (e. g., to fund income support programs).

Taxing only crude oil, however, and not its products could reduce the international competitiveness of industries heavily dependent on oil—such as refineries and petrochemical companies. * Furthermore, because oil taxes do not differentiate among industries that use oil, they are not effective means of altering the competitive position of either automobile fuel economy or synfuels production relative to any other method for displacing imports (if such alteration is desired). Such taxes could also contribute to inflation generally and would be paid for disproportionately by consumers with low incomes. Compensatory programs and payments could deal with such side effects, but at additional implementation and administrative expense.

Taxes targeted at only oil imports could discriminate against companies, and regions of the country, that are heavily dependent on imported oil. It is more likely, however, that import taxes would cause the general price of oil to increase to a level close to the price of taxed imports. Any general price increase, in turn, would create additional revenues for domestic petroleum produc-

***It is possible that refining activities would relocate overseas unless additional import restrictions were also imposed. With respect to synfuels production, refiners might be able to cut profit margins and continue to process and sell oil at prices below synfuels prices in order to maintain refining volumes (which are already rather low). Because many old refineries do not have capital charges, refining costs would be dominated by the variable costs of about 15 to 20¢/GALproduct plus the oil acquisition costs. Consequently, taxes may have to raise the cost of imported oil to within about $6/bbl of synfuel product (150gal of gasoline equivalent) to ensure that the refiners cannot economically use oil imports as copetitors for synfuels. This would directly harm some companies ened in oil refining, but this may be a necessary tradeoff to ensure that synfuels actually displace imported oil, rather than act to reduce domestic petroleum product prices and thereby discourage a reduction in domestic oil consumption.**

ers. The total revenues generated by an import tax would thus be only partially received by the Government. Compared with a general oil tax, an import tax is thus likely to result in a smaller fraction of revenues being available to the Government for additional import displacement measures or to offset any adverse impacts of higher oil prices. The windfall profits tax captures some additional revenue, but is more complex to administer than a general tax on all oil.

Another disadvantage of an import tax, frequently discussed, is the possibility that oil exporting nations might see the acceptance of added cost by U.S. users as an indication that their crude prices could be further increased without reprisal or economic hardship. This objection probably is not valid, however, during times of crude oil surplus in the producing nations.

With respect to transportation fuel consumption, a tax either on oil or on transportation fuels reduces demand for all uses of transportation fuel, including automobile travel, as well as increasing the relative demand for fuel efficiency. It could reduce new-car sales, however, and could also reduce the profitability of truck transports, agriculture, airlines, tourism, and other fuel-dependent industries. Taxes on only gasoline would avoid some of these problems, but they could encourage the purchase of diesel-fueled automobiles.

Gasoline taxes in this country have increased only slightly during the past two decades.l A The Federal tax has been $0.04/gal since 1960, while the average State tax has increased from $0.065 to $0.08/gal. A gasoline tax that increased the price of gasoline by, say $0.05/gal (i.e., a 3-percent increase over a $1.50 price) would raise about $5 billion per year at current consumption rates, as would a $1 .00/bbl crude oil tax. l n order to offset inflation since 1960, the current gasoline tax would have to increase by about $0,1 5/gal. Taxes on gasoline are significantly lower in the United States than abroad. *

The ultimate effect an oil, gasoline, or diesel fuel tax would have in displacing oil imports depends on at least three factors. First, the effectiveness of the tax in the long run depends on the actual purchase and use of fuel-efficient vehicles. Estimates of the responsiveness of demand (its "elasticity") to changes in gasoline, auto, and other prices vary widely from study to study, but they suggest that a tax on crude oil or transportation fuels would have to be relatively large to motivate consumers to trade in their relatively inefficient cars for more efficient ones. ' [5]Note, however, that tax provisions per se would not differentiate between domestic and foreign manufacturers except insofar as one produces more fuel-efficient vehicles.

Secondly, tax impacts will depend on final oil or fuel prices. The entire tax amount need not be passed onto consumers if producers are able to maximize profits by lowering the price of gasoline, absorbing part of the tax, and increasing sales. As long as demand for oil is slack relative to supply, at least part of the tax will be absorbed by producers.

Finally, the effect of taxes will depend on the degree to which driving is reduced. While OTA'S analysis of oil savings attributable to fuel economy improvement assumes a steady increase in vehicle miles traveled (VMT) (but a drop in VMT per capita), lower total VMT induced by high gasoline prices would increase actual oil savings. * However, this could also reduce car sales.

While gasoline stations and refineries would be affected by reduced demand, industry analysts already expect that the number of service stations and refineries will decline in the 1980's. Remain-

~4S$_{ee}$ Hans H. Landsberg, Energy Po/;cy Tasks for the 1980s, RFF reprint 174 (Washington, D. C.: Resources for the Future, 1980).

***Taxes on gasoline (per gallon) in 1979 were, as examples, $1.59 in France, $0.88 in the United Kingdom, $1.14 in West Germany, and $1.58 in Italy.**

IsDemand response is difficult to quantify because there is only limited past experience with periods of gasoline price increases ("preenergy crisis" conditions appear to be of limited value for predicting "postcrisis" consumer behavior); crude oil and transportation fuel prices affect consumers in dynamic, multiple ways to alter real income and demands; and it is difficult to understand demand response when vehicles have many different attributes, of which fuel efficiency is only one. (See *Motor Vehic/e Demand Mode/s: Assessment of the State of the Art and Directions for Future Research,* prepared by Charles River Associates, Inc., for the U.S. Department of Transportation, April 1980.)

***For example, OTA estimates that about half of the 0.5 MMB/D reduction in gasoline consumed by autos in 1978-80 was due to reduced driving, while about half was due to increased efficiency of vehicles in use.**

ing stations and refineries should be financially stronger and better able to adapt to gasoline price increases. Any reduction in highway trust fund revenues could presumably be balanced by proceeds from the gasoline tax or other taxes.

Economywide Taxation—Special Provisions

Special taxation provisions are often applied at the economywide level to promote investment (e.g., by encouraging capital formation and restructuring cashflow positions). Examples of such provisions are investment tax credits, depreciation allowances, R&D tax credits, and capital gains. As with other taxes, special taxation provisions could have differential impacts on industries and distort private returns to capital. Both the auto and synfuels industries (as well as the electric utility industry), being capital-intensive, could benefit from special taxing provisions. The scope for additional special taxing provisions, however, is believed to be limited because of the many existing provisions,

Although a firm would generally have to be profitable to take advantage of special taxation provisions, tax credit sales rules have been expanded and liberalized to give unprofitable firms the chance to sell their investment tax credits and depreciation rights. The auto industry has already taken advantage of liberalized rules for selling tax credits.lb This type of sale can help to strengthen the financial position of the auto industry, although it does not directly encourage increased fuel economy.

It is speculative to analyze how special taxing provisions would stimulate investment in synfuels. Special taxing provisions have historically been applied at the sector-specific level for domestic oil producers in the form of special depreciation allowances, and currently for expensing drilling costs and for foreign tax credits.

[16]For example, Ford Motor Co., with losses in excess of $700 million in 1981, sold its tax credits on 1981 equipment purchases for somewhere between $100 million and $200 million to IBM (*Washington Post,* Nov. 11, 1981).

Research and Development

Government policies and programs could stimulate technical R&D at either the economywide or sector-specific levels to help displace oil imports. The primary rationale for Government support of R&D is that there are social benefits from R&D which surpass private gains, in large part because of high front-end learning costs. in addition, the Government tends to support research that is too risky for private funding, and which does not, for a variety of reasons, attract private investment in the short term. A major advantage of Government support for R&D is that programs can assist the economy, and specific industries, without direct intervention. However, the types of basic research that Government has traditionally supported often have benefits only in the long term, so a nearer term oil import savings implies Government involvement in shorter term R&D areas. Applied R&D also offers the opportunity for the Government to acquire equity in projects or royalties from the results of the R&D.

EconomyWide R&D support could be designed to stimulate opportunities for displacing oil imports generally and for both increasing automobile fuel efficiency and accelerating synfuels production. Such measures could, as examples, sponsor basic research, promote the climate for technical innovation (e.g., increasing the rewards to innovators through patent laws and/or special tax incentives), or establish mechanisms for assembling and disseminating technical information. Such nonspecific support, however, is unlikely to have much impact on resolving the specific technological uncertainties that impede both auto fuel-efficiency increases and synfuels development.

Although the Government has supported sector-specific R&D in the past, policies have seldom supported product development with direct commercial application except in agriculture and nuclear power. Research to increase automobile fuel economy and to develop synfuels, as well as other technologies for displacing oil imports, would have direct commercial application.

There has not yet been any substantial Government support for R&D to assist the automobile industry. Several R&D and technology demonstration programs have been Government-sponsored, and a joint industry-Government-university R&D program (the Cooperative Automotive Research Program) was attempted unsuccessfully in 1979-80.17 Some of the basic research areas that could result in substantial long-term fuel-economy payoffs include:

1. the engine (e.g., advanced alcohol-fueled engines, nonsteady-state combustion, microprocessor controlled fuel injection, high-temperature materials);
2. vehicle structure (e.g., crashworthiness);
3. aerodynamics;
4. friction, lubrication, and wear;
5. innovative production technologies for lightweight materials; and
6. exhaust emissions.

The Government might also continue to provide some support for the advanced development of electric and/or hybrid vehicles, alternative engines, and alternative automobile fuels.

The technical uncertainties associated with synfuels development are substantial. It is OTA's judgment that, even in the presence of favorable economywide conditions, investors would not have sufficient incentive to accelerate synfuels development because of the magnitude of the technical risks associated with process technologies. For example, one of the major components of technical uncertainty is concerned with the flow and abrasive properties of solid/liquid process streams. Gaining a basic understanding of the properties of these streams so that equipment will function properly is both a theoretical and an empirical engineering challenge. At present, engineers must proceed to full-scale commercial plants without adequate analytical descriptions of how well designs will work. OTA believes there may be considerable benefit in continuing the original concept of a demonstration program to provide technical information. The results of both basic and applied research could lead to important near- and long-term advances in synfuels technology, as well as in other technologies concerned with solids handling.[18]

Trade Protection

Trade protection–tariffs and duties, quotas, local content requirements—has economywide implications but has traditionally been used to temporarily insulate specific industries and products from foreign competition. The case for import protection for the domestic auto industry is based on the claim that the industry requires only temporary protection in order to increase sales and thus to improve its revenue position, to generate capital for reinvestment, and to position itself for manufacturing fuel-efficient cars. On the other hand, it is argued that temporary trade protection would neither ameliorate the shot-t-term competitive problems of the industry nor promote long-term restructuring for fuel economy. It is seen as inefficient and indirect adjustment assistance that can lead to higher consumer prices due to reduced competition, to higher production costs for those industries that must compete, unsubsidized, against autos for resources, and to less innovation in general. Trade protection could also lead to retaliation on the part of trading partners, and some measures are restricted by the General Agreement on Tariffs and Trade (GAIT).[19]

Import quotas are generally considered less efficient than tariffs in reducing imports and stimulating domestic industries. This inefficiency arises because quotas directly distort both production and consumption (whereas tariffs change relative prices), and quotas can be bypassed with product differentiation. Duties have not generally figured in the policy debate, * but U.S. auto manufacturers have been granted temporary trade protection in the form of a 3-year Japanese automobile quota agreement. The ultimate effects of

[17] The Justice Department also recently agreed to ease restrictions which had barred the four major manufacturers from working together on development, as well as sale and installation, of pollution control devices. See *The Washington Post, Nov.* 10, 1981.

[18] See also "Report to the American Physical Society by the Study Group on Research Planning for Coal Utilization and Synthetic Fuel Production," Rev. *Mod. Phys. 53, 4* (pt. *2),* October 1981.

[19] "General Agreement on Tariffs and Trade, " 55 U. N.T.S. 194, T.I.A.S. No. 1700 (1947).

*Duties on car imports into the United States are 6 percent; this compares with 14 percent into Canada, and 11 percent into France, Italy, Germany, and the United Kingdom.

these **quotas on the domestic industry** are unknown, but thus far the impacts of import restraints appear to be small due to low new-car sales. However, if new-car sales recover, the prices of all small cars could increase to the extent that shortages are artificially induced by the trade restrictions.

Local content provisions are another form of trade protection that has been discussed in the context of the domestic automobile industry (H.R. 51 33). These measures would not displace oil imports directly but could help to protect domestic automobile manufacturing jobs. Such provisions are generally viewed as being economically inefficient, although they could serve other social/equity objectives.

Trade protection is not likely to address any of the major issues on which the future of the synfuels industry depends. Trade concerns may eventually arise if large quantities of materials and equipment are imported to construct synfuels plants or if the United States is in a position to export synfuels products or production experience.

Trade protection could be used to limit oil imports directly. Such a quota, however, could lead to domestic shortages and price increases in the absence of replacements. The Carter administration placed a quota on oil imports (and explored alternatives for allocations within the United States should demand exceed the quota), but it was set at a level which did not influence imports. import quotas were also in effect from 1959 to 1971.20

Sector-Specific Demand Stimuli—Purchase Pricing Mechanisms

Demand for increased automobile fuel economy is an extremely important factor influencing the rate of increases in new-car fuel efficiency. Autos are large, long-term, and deferrable investments for consumers. Furthermore, the decision to buy a particular car depends on many attributes, of which fuel economy is only one. Imported oil will not be displaced by the manufacture of more fuel-efficient cars unless these cars are actually bought. Demand uncertainty can be reduced, and the demand for fuel-efficient cars can be stimulated, by raising the costs to consumers of buying and operating inefficient cars and/or by lowering the costs of owning relatively efficient ones. The risks to manufacturers of producing fuel-efficient cars could thus be reduced. Car ownership costs can be altered by taxing gasoline, as discussed, or by taxing/subsidizing automobiles directly.

Synfuels per se should not be directly influenced by consumer behavior except insofar as weak demand for liquid fuels limits the profitability of synfuels production. Some synfuels, however, may not fully conform to end-use fuel specifications without more extensive processing or end-use equipment modifications. The extent of this potential demand problem cannot be determined in the absence of end-use testing, but is likely to be minor except for alternative fuels such as methanol.

Purchase Taxes and Subsidies

Automobile purchase taxes or price subsidies can directly change the costs of owning cars of differing fuel efficiencies. Purchase pricing mechanisms can be linked either implicitly or explicitly to fuel-efficiency performance criteria. Current taxes are now only loosely related to CAFE standards. The extent to which additional measures would discourage the purchase of inefficient cars, or encourage the purchase of efficient cars, depends on many factors, including the level of the effective tax (or subsidy), the range of vehicles affected, the extent that auto manufacturers' pricing policies counteract the effect of the taxes (or subsidies), and the responsiveness of consumer behavior to changes in car prices. * There is also

'"'Energy Policy," 2d cd., Congressional Quarterly, Inc., Washington, D. C., March 1981, p. 30.

***The difficulty in quantifying elasticities (i.e., the percentage change in demand for a l-percent change in price) is discussed in "Economywide Taxation—Oil Imports and Gasoline. " The international Trade Commission analysis of the Carter gas-guzzler tax proposal implied an elasticity of demand for subcompacts of –0.79 (i.e., sales of subcompacts increase less than proportionately with decreases in their prices) and an elasticity of demand for full-size cars of – 1.12 (i.e., sales of full-size cars decrease more than proportionately with increases in their prices). Assuming that these figures are accurate, to reduce full-size car sales by 50 percent, for example, their prices should be raised by about 45 percent, or at least $3,500.**

some risk that price subsidies targeting only domestic vehicles could violate the GATT provisions which prohibit most-favored-nation trading partners from taking actions that discriminate against imports from one another.

Low-interest loans for consumers could stimulate the purchase of all new cars, which are generally more efficient than the average car on the road. By tying the interest rates to the new car's fuel efficiency, sales of the more fuel-efficient new cars could be stimulated.

Gas-guzzler taxes, as another type of pricing mechanism, would reduce the demand for relatively fuel-inefficient cars. However, because such taxes do not discriminate among different types of users, **a** disproportionate share of the taxes could be paid by those who are most constrained to using large vehicles. An equity argument can be made for excepting certain classes of drivers in a tax program (e.g., taxis, hearses), Income support programs could aid in the cases of financial hardship; and tax proceeds could be used to fund these relief measures.

Both purchase subsidies and taxes may additionally and at least temporarily strain the revenue position of U.S. automakers because they are the principal suppliers of large cars, but subsidies could strengthen their long-term position due to increased car sales.

If Congress wishes to avoid discrimination against large cars (which are inherently less fuel efficient than small cars), purchase taxes or subsidies could be based on the fuel efficiency of a given model relative to other models within the same size or market class. This type of approach would lead to numerous cases where less fuel-efficient cars are taxed at lower rates or subsidized at higher rates than the more fuel-efficient ones, but it would create a demand for cars with less powerful engines and technologically improved cars (as opposed to simply smaller ones) and it would not favor imports in most cases.

Bounties

Another way to use purchase pricing mechanisms to stimulate rapid fleet turnover to higher fuel economy is by offering a gas-guzzler bounty. Bounties could be designed, as examples, as full payment for a trade-in, or as a payment upon proof of scrappage of a fuel-inefficient car. Because consumers are relatively unresponsive to changes in prices,[21] the bounty would have to be large to induce significant increases in sales of more fuel-efficient cars. For example, if a value of **–0.3** is assumed for the price elasticity of demand for new cars, then for total new car sales to rise by 10 percent, net prices would have to fall by one-third. Since the average new car costs about $8,000 in 1980-81, a bounty of about *$2,700* would be necessary on average to raise new-car sales by 10 percent. Since many used cars have market values under $2,700, this scheme would be profitable for the owners of used cars. However, it would be costly both to the Government and to potential buyers of used cars.

The bounty price would become the effective minimum used-car market price and all used-car prices would be proportionately increased. Because bounties distort existing relationships and operations of both the new and used car markets, bounties would be difficult to design and implement efficiently. Unless bounties were tied to high-fuel-efficiency car purchases, they might neither help manufacturers nor lead to significant fuel savings.

Registration Taxes

Car registration taxes represent another demand-side stimulus. These taxes would affect the owners of all automobiles, and they could be explicitly tied to fuel efficiency or some surrogate measure* to encourage replacement of fuel-inefficient cars. However, they would make auto ownership more expensive regardless of the amount and nature of the travel, and they would work towards reducing demand for autos in the long run. By effectively lowering consumer income, registration taxes would also disproportionately

[21] **"Motor Vehicle Demand Models: Assessment of the State of the Art and Directions for Future Research, " prepared by Charles Rivers Associates, Inc., for U.S. Department of Transportation, April 1980.**

***One possible measure would be ton miles/gallon (e.g., how much a vehicle weighs per rate of fuel use), Several foreign countries already have registration taxes that depend on automobile weight and/or engine size.**

affect low-income groups. * In addition, a registration policy implies State action, and consistent, concerted implementation may be difficult to achieve.

An important possible side effect of all demand-side stimuli which have the effect of reducing large-car demand is that only those domestic manufacturers with a clear competitive advantage in producing large cars will continue to serve this shrinking market. This reorientation of domestic production would be consistent with long-term international trends towards corporate consolidation and a standardized "world car. "

Methanol

Promoting the use of methanol as an automobile fuel is likely to require coordination of supply and demand stimuli. A limited supply of methanol, however, is currently available from the chemical industry. * *

Automotive uses of fuel methanol are principally in a blend (with cosolvents) in gasoline or in engines designed or converted to use straight (neat) methanol. Because many automobiles now on the road cannot accept methanol-gasoline blends with more than 1 to 3 percent methanol, the blend market for methanol is currently quite limited (less than 50,000 B/DOE); but the potential market could be expanded if incentives were provided to make new cars compatible with higher percentage blends. This would also add flexibility with respect to matching supply and demand, which would help to avoid methanol fuel shortages and gluts. The use of blends could be encouraged through direct subsidies and through approval of methanol by EPA as a blending agent in gasoline.

Demand for fuel methanol can also be stimulated with incentives to convert captive fleets*** (current fuel consumption by larger fleets is about **0.6** MMB/DOE[22]) to methanol. Captive fleets are currently more attractive for neat methanol use than privately owned cars because fleets often have their own fuel storage and pumping facilities, which can be converted to methanol at the same time as the fleet conversion.

Introduction of vehicles for general use which are fueled with neat methanol probably will require coordinated planning to ensure that neat methanol is available at service station pumps at about the same time or before the vehicles appear for sale. However, if this fuel supply problem can be solved (see supply stimuli below) and methanol is available at prices (per Btu) comparable to gasoline, it is likely that some auto manufacturers will supply alcohol-fueled vehicles without Government incentives.

Sector-Specific Supply Stimuli—Subsidies and Guarantees

Supply-oriented stimuli–in the form of direct subsidies, grants, and loan, price, and purchase guarantees–are methods for quickly providing visible and directed sector-specific support to industries and firms.[23] These stimuli, by shifting a portion of the costs and risks to the Government, can provide a temporary inducement to firms to accelerate investments (i.e., to the auto industry to increase fuel economy and to the synfuels industry to accelerate production). Supply-oriented stimuli can also be structured so as to minimize or alleviate costly side effects associated with the investment or stimulus. The rationale is that market-driven business practices would not provide, at the time required, nationally desirable output levels.

Sector-specific, supply-oriented policy measures share the disadvantages described earlier that are associated generally with any sector-specific policy approach. In addition, they could put direct pressure on the Federal budget. De-

***other fees that could discourage fuel use by all drivers include commuter taxes, car-pooling incentives, and parking fees.**

****Total U.S. methanol production, which comes from natural gas and residual fuel oil, corresponds to about one *50,000* B/DOE synfuels plant or about 1.5 billion gal of methanol per year.**

*****A captive fleet is a fleet of cars or trucks owned and operated by a single business or Government entity and often used primarily in a localized area with central refueling facilities also owned and operated by the fleet owner.**

[22]The Department of Energy ("Assessment of Methane-Related Fuels for Automotive Fleet Vehicles," DOE/CE/50179-1, vol. 2, pp. 5-23, February 1982) has estimated that automobile fleets of 10 or more, truck fleets of 6 or more, and bus fleets consume about 0.6 MMB/D of gasoline and about 0.4 MMB/D of diesel. Replacing all of the gasoline would require about 20 billion gal of methanol per year.

[23]See An Assessment *of Oil Shale* *Technologies,* OTA-M-118 (Washington, D. C.: U.S. Congress, Office of Technology Assessment, June, 1980).

tailed analysis is required to ensure that policies and programs do not perpetuate inefficient operations, that production changes and other efficient innovations are not being discouraged, and that targeted manufacturers are not benefiting inequitably. A major implementation problem is in linking of payment with performance: to ensure that supply-oriented mechanisms promote oil displacement, they would need to be contingent on savings or production performance. Ideally, a detailed study of the many factors that determine fuel use could illuminate how much stimulation would be required to reduce oil imports and how such measures would affect the Nation's energy bill. In practice, however, any such study is likely to have numerous shortcomings and inaccuracies.

Loan Guarantees and Grants

The principal sector-specific supply-oriented policy mechanisms are loan guarantees, price and purchase commitments, and direct grants. Of these, grants are the most advantageous for investors, since they are a form of direct assistance. Grants for improving auto fuel efficiency and producing synfuels may be unpopular because both alternatives are sponsored by the private sector and have profit-generating potential. Objections to direct grants could be offset somewhat if the Government purchased equity in the companies with the money.

Loan guarantees are also advantageous to investors because they allow investors to reduce their financial exposure in case of default. Unlike grants which require that the Government appropriate funds immediately, loan guarantees require Government payment only in the event of a company's default. Loan guarantees have been applied to both the auto and synfuels industries. In the case of autos, loan guarantees were administered by the Government to the Chrysler Corp. when it judged that the costs of **not** intervening would be unacceptable from a national viewpoint. These loan guarantees represent a break with historic policy. No direct aid had previously been given because the industry as a whole was profitable and there was a reluctance both on the part of the Government to subsidize the private sector (except under unusual circumstances) and on the part of the private sector to accept Government support and related conditions.

Three policy complications also would arise when considering subsidizing domestic auto manufacturers:

1. determining the eligibility of foreign firms that establish production subsidiaries in the U.S. (e.g., Volkswagen of America, Honda);
2. compliance with GATT provisions; and
3. the treatment of auto suppliers. *

Loan guarantees are administered by SFC under ESA for the synfuels industry. These guarantees have been justified on the basis that the costs and technical risks of synfuels production are so great that, in the absence of loan guarantees and other supply-oriented stimulation, private investment would be slow in coming. With the large (75 percent) guaranteed loans that are possible under ESA, investments in synfuels appear to be attractive. * * industry has generally favored Government support in the form of loan guarantees to stimulate investment, and OTA believes that this is an effective way of making synfuels investments financially attractive.[24] Because of general inflation and steady increases in the estimated costs of synfuels projects, however, the funds currently available to SFC and the limitation of about $3 billion in aid per project may not be adequate to support the number of projects originally envisioned or allow a full 75-percent loan guarantee for the larger projects.

***Although many suppliers will have to invest to accommodate automotive change, it may be most efficient to subsidize only manufacturers, who would in turn, fund suppliers as appropriate, for two reasons: first, the amount of U.S. supplier investment (and to a lesser degree U.S. manufacturer investment) depends on the amount of outsourcing and the degree to which foreign supplies are used; and second, it is easier to deal with the handful of manufacturers than the thousands of suppliers they may use.**

****The 61 proposals received by SFC in its first general solicitation are a preliminary confirmation of this. These proposals reflect the variety of approaches considered viable by private industry: 14 oil shale projects, eight tar sands (including heavy oil) projects, one coal-oil mixture project, one solid-fuel additive from coal project, and one hydrogen-from-water project. Of course, general economic conditions, as well as the price of imported oil, will also have a major impact on the decisions of private investors. These conditions will, in turn, heavily influence the terms that SFC is able to negotiate as it seeks to employ the funds available to it.**

[24] Ibid.

Purchase and Price Guarantees

Purchase and price guarantees protect investors by ensuring that products can be sold at a price equal to or greater than the minimum guaranteed, regardless of market conditions. But unless the price is set at extremely high levels, these incentives do not ensure against losses that occur if initial estimates are wrong with respect to cost, price, production volume, or product quality. These guarantees are most appropriate when market demand and price are the major uncertainties (and are expected to be "too low"), where commodities are homogeneous, and when commodities have a value to the Government in use or resale. They could, however, distort relationships among producers and consumers; they can be administratively complex, and they do not reduce investors' financial exposure in the case of poor performance.

Purchase and price guarantees have generally not been considered viable for the auto industry because of the differentiation of its products and the complexity of manufacturer-dealer-consumer relationships.

Although purchase and price guarantees do not address the central technical uncertainties of synfuels production, they may nevertheless be useful in conjunction with other incentives. Provisions for price guarantees and purchase commitments are included in the 1980 synfuels legislation.

Subsidies and guarantees can lead to large annual investments by the Government. For example, given that 6 to 8 million cars are produced domestically each year, subsidies of several hundred dollars per car for fuel-economy improvements (which corresponds to the investments needed to make the necessary changes) could require annual expenditures of several billion dollars.

To illustrate the magnitude of subsidy that could be necessary through a price guarantee to accelerate synfuels production, assume that crude oil costs $40/bbl, that synfuel from a newly opened 50,000 B/DOE plant requires a $10 subsidy for each barrel of oil replaced, and that synfuels production costs follow general inflation. if the real price of oil were to escalate by 2 percent per year, the synfuel would have to be subsidized for 11 years at a total cost of about $1 billion. If the real price of oil escalates at 4 percent per year, the period of subsidization and the total cost would be half as large. Similarly, a 1-percent real inflation rate for oil would double the duration and magnitude of the subsidy. Thus, price guarantee subsidies can reach levels that are a significant fraction of the investment initially needed to build the plant.

The Government could, however, require repayment of a subsidy if the manufacture of fuel-efficient cars or the production of synfuels became profitable without subsidies.

Methanol

The supply incentives mentioned above and those described under "demand stimuli" are probably adequate to encourage production of methanol from coal for use by the chemical market and some captive fleets of automobiles, and, possibly, as blends in gasoline. However, additional supply incentives may be necessary to encourage the use of methanol in automobiles which are not part of a captive fleet.

Once significant quantities (probably more than 0.1 to 0.2 MMB/DOE) of methanol are being used in captive fleets and, possibly, in gasoline blends, it may be possible to offer methanol for sale to the public in enough places to make ownership of a methanol-fueled vehicle practical for individuals. Incentives can be offered to owners of methanol-fueled captive fleets, who have their own methanol storage and pumping facilities, to sell methanol to the public. Incentives can also be given to service station owners who sell methanol blends to install methanol storage tanks and blend the methanol with gasoline at the pump. They could then sell straight methanol, as well.

Many owners of captive fleets probably cannot be easily induced to offer methanol for sale, because it would not be related to their other business activities and would be tantamount to entering the service station business. Similarly, very large economic incentives may initially be necessary to induce service station owners to install methanol facilities, because the investment would not lead to a near-term increase in sales.

On the other hand, it could be mandated that any supplies of methanol used for Government-owned captive fleets be made available for public sale. And some captive fleet and service station owners would be willing to offer methanol to gain an early market share or for the financial incentives offered by the Government. If these monetary and nonmonetary incentives were adequate, methanol could compete directly with gasoline and diesel fuel as an automobile fuel.

Regulations on Output

One of the most direct policy mechanisms for promoting alternatives that can displace oil imports is regulation. Regulations are a common, if controversial, form of Government intervention in the economy. Although their effects can be felt economywide, regulations are typically directed at specific industries or products. In general, they would target the supply aspects of oil import alternatives. Measures could also be designed to target consumers (e.g., the 55-mph speed limit, end-use fuel restrictions in the stationary sector), but the Government has traditionally been reluctant to mandate changes in consumer behavior and habits.

Regulations can be designed for two major purposes. First, they can serve to protect the public from the side effects caused by the conduct of industrial activities. These effects include impacts on the environment, health, and safety which are discussed in the next section. Regulations can also be used to determine outputs directly—the level of consumption or production of fuels–if the market is unable to ensure desirable levels.

The auto industry has been regulated in the United States in the areas of emissions, safety, and more recently fuel economy. The major Government program mandating fuel-efficiency increases is the CAFE standards. Whether or not to increase these standards beyond levels set by current legislation for 1985 and beyond may be a major upcoming decision before Congress.

Effectiveness of the CAFE standards in spurring fuel economy improvements is controversial, An important feature of these standards is that they are effective only if they force manufacturers to do more than consumers demand. This increases the investment risks since, although regulations can affect the supply of fuel-efficient cars, they do not directly influence purchases. Through the 1970's consumers failed to demonstrate a consistent demand for fuel economy, * and the CAFE standards probably increased fuel efficiency above what the market would have achieved. And recent data (fall 1981) show that, in fact, the proportion of relatively large cars sold has once again increased compared with the number of smaller cars sold.

The arguments for extending CAFE standards beyond 1985 are inconclusive. To the extent that CAFE standards are met through sales of smaller cars, as opposed to purely technological changes, U.S. manufacturers must increasingly compete with imports for the small-car market. Increasingly stringent fuel economy standards could, therefore, result in higher import levels if domestic manufacturers are unable to increase their competitiveness in this market, despite the product changes they have made. Post-1 985 standards are also likely to require additional capital for more rounds of redesigning and retooling. But post-1985 standards could result in important fuel savings to the Nation, especially if the demand for fuel-efficient cars remains sluggish. Additional demand stimuli may also be necessary, depending on national and international conditions, to ensure that fuel-efficient cars are bought.

In considering the effects of CAFE standards it is important to recognize that CAFE standards do not distinguish among average efficiency increases that result from: 1) technological improve-

The drop in demand for fuel efficiency and the resurgence in large-car demand in the mid to late 1970's led manufacturers to petition (unsuccessfully) NHTSA to lower CAFE standards for the early 1980's because sluggish sales of fuel-efficient cars made necessary investments appear especially costly and risky. Market trends in the 1970's also led manufacturers to concentrate initially on improving fuel economy for relatively large cars rather than on developing new small-car designs. Manufacturers attributed their expectation to exceed voluntarily the 1985 CAFE standard of 27.5 mpg to renewed, strong demand for fuel economy arising from the 1979 oil crisis and increases in gasoline prices. This increase in demand and current industry efforts to raise fuel economy recently led NHTSA, which administers the CAFE program, to terminate rulemaking with respect to post-1 985 average fuel-economy improvements *(Fed. Reg. 22243,* Apr. 16, 1981). A petition from the Center for Auto Safety that requested NHTSA to continue rulemaking was also subsequently denied *(Fed. Reg. 48383,* Oct. 1, 1981 *).

ments, 2) consumers' purchasing the more fuel-efficient cars in each size class, and 3) consumers purchasing smaller cars. Depending on market demand, success of technical developments and auto manufacturers' financial positions and capital stock, CAFE standards could be met through various mixes of the three (see table 8). Consequently, without special provisions it probably is impossible to establish conventional CAFE standards which simultaneously: 1) are effective (i.e., increase new-car fuel efficiency above what market forces would dictate), and 2) do not promote the sales of small imported cars. Separate fuel-efficiency standards for each automobile size or market class could significantly reduce the indirect promotion of small-car sales; however, this would greatly reduce automobile companies' flexibility in responding to the regulations.

The NSPP sets targets for synfuels production but the mandating of synfuels output has not been of central congressional interest. The major difficulty associated with developing synfuels stems from technical uncertainties which, in turn, affect the likely cost at which synfuels initially will be produced. in addition, contributions to oil import savings from synfuels would not be made incrementally (as with increasing automobile fuel efficiency) but rather depend on the proper functioning of large-scale facilities. As experience and knowledge is gained, it may become possible to establish realistically achievable production levels if the Government desires an assured level of synfuels supply.

Table 8.—Potential Average New-Car Fuel Efficiency in 1995

Car size class	Fuel efficiency of average model (mpg)[a]
Large	30-45
Medium	45-60
Small	60-75

Size mix of cars sold	Average new-car fuel efficiency (mpg)[a]
1961 size mix[b]	40-50
Moderate shift to small cars[c]	45-60
Large shift to small cars[d]	50-65

a All mpg figures rounded to nearest 5 mpg. Mpg refers to the composite consisting of 55 percent EPA city cycle and 45 percent EPA highway cycle.
b 1981 sales: 47 percent large cars, 48 percent medium-sized cars, and 5 percent small cars.
C 1995 sales: 20 percent large cars, 55 percent medium, 25 percent small.
d 1995 sales: 5 percent large cars, 45 percent medium, 50 percent small.

SOURCE: Office of Technology Assessment.

One possible form of regulation would be to stipulate that a certain percentage of the output from domestic oil producers be synfuels. However, this provision would be unworkable for small oil producers, so it would have to be targeted at the larger oil companies. Similar problems arise with regulations aimed at refiners or retailers. Furthermore, because refining and retailing are considerably less profitable than gas and oil production, regulations aimed at the former might induce some of the companies that are vertically integrated to abandon refining rather than to incur the added costs and risks. For these reasons, it would probably be very difficult to administer mandates on synfuel content.

Other Effects

Environment, Health, and Safety

Both increased automobile fuel efficiency and synthetic fuels production have the potential for creating large-scale environmental, health, and safety hazards. A principal rationale for policy intervention is the general past failure of private markets to internalize these other effects in investment decisions and operating practices. Policies to protect the public have tended to take the form of regulations that govern known or anticipated impacts through performance standards or control specifications.

Apart from fuel efficiency, the auto industry is regulated in the areas of emissions and safety. Emissions standards require that each vehicle–and automobile safety standards require that each of certain vehicle parts-meet minimum performance standards. (By contrast, fuel-economy standards are for fleet averages.) There are proposals before Congress to delay, modify, or eliminate over 30 automotive-related environmental and safety regulations.[25]

A potential threat to the public from size and weight reduction of vehicles used to increase fuel efficiency is decreased automotive safety. The basic policy issue is whether the Government should act to help prevent future highway fatalities if consumer demand for safety does not result

[25] See Gwenell Bass, "The U.S. Auto Industry: The Situation in the Eighties," CRS issue brief No. IB81054, Sept. 30, 1981.

in adequate safeguards. * Regulatory policy could, as examples, reconsider the passive restraint program (rulemaking for that program was terminated by NHTSA although a recent U.S. Court of Appeals ruling has reinstated the program, at least for the moment), mandate the use of safety belts, strengthen crashworthiness design standards, or maintain or tighten speed limits. Other types of programs could provide for stricter driver licensing standards and improved road maintenance and traffic control, support R&D, and provide for driver safety education. Another potential adverse effect is the air quality impact of a large increase in diesel-powered autos. Policy alternatives include more stringent particulate and NO_x emission regulations for diesel engines and Government assistance in diesel health effects research and emissions control development.

Potential environmental and worker-related problems associated with synthetic fuels development (e. g., contamination of drinking water, release of cancer-causing agents and other hazardous pollutants, highly visible plant upsets, obnoxious odors, and localized water availability conflicts) are substantial and have considerable potential for arousing strong public opposition. There are also elements of the present synfuels development strategy that appear to increase the potential for adverse impacts. These elements include the proposed siting of some synfuels demonstration plants close to heavily populated areas, research budget cuts at EPA and the proposed dismantling of DOE, the current policy to shift environmental management responsibilities to State and local agencies without a concomitant shifting of resources, and an industry environmental control program that appears reluctant to commit resources to currently unregulated pollutants and that may be overconfident about the performance of integrated control systems.**

"Manufacturers may not pursue safety for fear that the added cost will dampen market demand. In most cases safety has not been a strong selling point in automobiles in the past.

***"In apparent response to their confidence that adequate environmental control of synfuels plants will involve only "fine tuning" of existing control technologies, developers have passed up some opportunities to test out control systems on demonstration plants. For example, Exxon feeds the wastes from its Baytown, Tex., EDS plant into a neighboring refinery rather than developing and testing specific controls for the plant. In OTA's opinion this increases the risk of unforeseen problems at the first large-scale plants. Such problems appear quite possible given the differences between the conditions under which proposed control systems have been used previously (in chemical plants, refineries, etc.) and the expected conditions in synfuels plants.**

Finally, the multiplicity of pollutants associated with synfuels production and the difficulty of detecting and evaluating some of the potential impacts (e.g., long-term cancer impacts from low-level exposures), coupled with the above factors, leads to a strong concern about the adequacy of future regulation of a synfuels industry.

Government actions targeted at the potential risks of synthetic fuels development may be an important factor in assuring that the risks are properly measured and in causing the private sector to account for these risks. A problem the Government faces, however, is that premature adoption of rigid standards could ultimately act to stifle innovation or force suboptimal environmental decisions. Also, the capital-intensive nature of the industry leaves it vulnerable to delays caused by shifts in environmental requirements or standards that ultimately prove unattainable.

The existence of these problems places a premium on an intensive research program and a round of demonstration plants, that include full environmental control systems, to avoid surprises and provide timely information for intelligent regulation. Also, the impact of an environmental surprise might be minimized by choosing isolated sites and requiring particularly strict controls for the first round of plants, thus minimizing the actual impact suffered from excessive discharges or other problems.

The vulnerability of synfuels plants to scheduling delays has also generated pressures on Congress and State legislatures to streamline environmental permitting for energy facilities. Although it is too early to assess recent streamlining efforts at both the Federal and State levels, considerable improvement appears possible **without** a **full-**scale Energy Mobilization Board.[26] In most cases, regulatory delays are important only to the extent they delay construction starts or require changes in plant design; otherwise, all necessary permits are likely to be obtained before significant construction investment has been made. Delays after construction has started could, however, be costly. A 3-year delay, for example,

[26]Congressional **Research Service,** ''Synfuels **From Coal and the National** Synfuels **Production Program: Technical, Environmental, and Economic Aspects. "**

could increase synfuels product costs by 20 percent or more. In addition, the risk that retrofitting may be required will remain until synfuel processes have been proven and both emissions and products extensively tested. Formulating regulatory policy entails an assessment of the full range of regulatory costs to industry versus the possible costs arising in the absence of policy. At present these complex tradeoffs are often determined in a lengthy, case-by-case process based on judicial interpretations.

policy alternatives to regulation include effluent charges and pollution vouchers. Although such mechanisms have a strong theoretical basis, there is a general lack of practical experience in using them. Also, the toxic pollutants of most concern in synfuels production cannot safely be traded off among sources the way pollutants such as SO_2 and NO_x can be.

There are two additional levels for policy involvement. First, Congress could decide to increase the environmental capabilities of responsible regulatory agencies. One specific option is to target resources for specific State and local environmental agencies, as was done under the Clean Air Act in the early 1970's. As a part of this option, Congress may also wish to investigate the effects of the programmatic changes and budget reductions for synfuels environmental research and control system development at EPA and DOE.

Secondly, environmental concerns could be integrated directly into financial support decisions —i.e., of SFC. Although some would claim that this latter option is redundant given current environmental legislation, there are nevertheless many concerns (e.g., siting) which are not well-addressed by existing laws. In addition, the protection of SFC investments would be well-served by an ability to influence environmental planning. SFC has not yet moved aggressively to build a technical capability for the environmental assessment of projects it will support.

The availability of water resources may pose special problems for policy because of the present controversies surrounding the allocation and use of increasingly scarce supplies.[27] How conflicts are resolved in areas where users presently or could potentially compete for water will have important implications for the distribution of costs and benefits to all water users, especially since the costs of procuring water are likely to be small (in comparison with other costs) for the synfuels industry. Present water policies and planning mechanisms are fragmented and generally inadequate to assess water availability and plan for future water needs on a consistent, comprehensive, and continuous basis. Because of the magnitude, diversity, and nationwide distribution of water resource problems and because the outcome of water-resource allocation conflicts will have local, State, regional, and National impacts, the Federal Government has an important role to play in improving water resource management practices in cooperation with the States. Major policy issues include the resolution of uncertainties surrounding water rights and future water needs and the definition of responsibilities, objectives, and priorities for water planning and allocation. Legislation pending before Congress (e.g., S.1095 and H.R. 3432, which both call for the dismantling of the U.S. Water Resources Council) seeks to redefine the respective responsibilities of Federal and State Governments and to clarify the role of regional and local interests in managing water resources.

Social Adjustment Assistance

Increasing automobile fuel efficiency and developing a synfuels industry will result in social costs and benefits which are side effects, i.e., effects that are external to the transactions made between consumers and producers. The movement of capital and labor as a result of industrial change (i.e., restructuring, contraction, or growth) will have implications not only for the character of the labor market but also, consequently, for lifestyles and standards of living.

[27] For further discussion of these issues see *An Assessment of Oil Shale Technologies,* **OTA-M-118 (Washington, D. C,: U.S. Congress, Office of Technology Assessment, June 1980); and** *A Technology Assessment of Coal Slurry Pipelines, OTA-E-60* **(Washington, D. C., U.S. Congress, Office of Technology Assessment, March 1978).**

in the auto industry, the major social effects are related to job losses resulting from structural adjustment. In the synfuels industry, the major social externalities are related to new employment and result from large, rapid and fluctuating population growth in some areas where the industry may locate. Government policy may be important both for easing those social adjustments that the market does not address and for ensuring that associated costs do not fall disproportionately on particular groups. Social-adjustment assistance in this country has generally been limited in the past to sectors affected by international trade and to several programs focusing on regional adjustment.

Labor market dislocations are of primary importance to the Nation because of the penetration, numbers, and dispersion of auto-related jobs throughout the economy as well as the geographic concentration of auto production jobs. Restructuring of the industry for improved international competitiveness, productivity, and fuel efficiency is resulting in what is likely to be a long-term decline in auto-related employment.

The problem of unemployment in the auto industry could be addressed by policy measures that seek to ease the adjustment of firms, workers, and communities to changing economic conditions. Policy options include, as examples: relocation assistance, support of retraining programs and training institutions, local content provisions, manpower training vouchers for targeted individuals, plant-closing restrictions, tax incentives to other industries (or regions) to attract displaced workers, and community aid programs (e. g., to diversify local economies).

Some assistance has been available under the Trade Act of 1974 provisions and through Housing and Urban Development, the Economic Development Administration, and other Government agency programs. These programs have generally been limited in scope and funding and have generally required evidence of economic distress (i.e., they are not preemptive). They are also candidates for curtailment under proposed Federal budget cuts. Note that because employment displacement depends in part on labor costs, automobile-related employment levels will also vary with the degree to which autoworkers accept changes in compensation and work rules, behavior which is not generally subject to direct Federal policy initiatives.

Major social side effects arise from synfuels development because the communities which absorb the large, rapid population increases (a portion of which is only temporary) are vulnerable to institutional and social disruptions. These externalities could constrain synfuels development by generating public opposition to synfuels and by adversely affecting worker productivity. The principal policy issues relate to who will bear the costs of managing and mitigating these disruptions and how up-front capital can be made available to finance necessary public facilities and services. Those who view social impacts as the price of regional development emphasize the responsibilities of State and local governments working with private developers. Those who associate local impacts primarily with the pursuit of national energy objectives call for a continued and expanded Federal role.

There are also many questions of equity that arise in allocating resources among different areas, because of the large variations in the magnitude and character of adverse impacts and the resources available to cope with these impacts. An acceptable assistance program must deal with the problem that some of the shortages of impact-mitigation resources are caused by limitations on planning and borrowing powers imposed by local and State governments themselves.

Current policies to deal with the social impacts of energy development are unable to address consistently and comprehensively the cumulative impacts arising from the large-scale, rapid-growth situations that characterize synfuels development. Government policies could be directed at either energy development generally or synfuels production specifically, and could provide, as examples: financial aid, technical assistance, growth management planning assistance, regulation (e.g., with respect to siting, phasing, pacing, monitoring), lending and borrowing assistance, or taxing provisions. The various forms of technical and financial assistance for growth management are

examined in detail in previous OTA studies.[28 29 30 31] All relevant Federal programs have been targeted for substantial budget reductions, or elimination, in fiscal year 1982 under proposals submitted to Congress by the present administration.[32]

The development of a synfuels plant will lead to the creation of new jobs in construction and engineering. Technically qualified personnel should be available for most of these jobs. However, a shortage of experienced chemical process engineers and project managers could arise, causing costly mistakes and production delays. The overall number of chemical process engineers, for example, would have to increase by about one-third by the mid to late 1980's to accommodate an optimistic level of synfuels plant construction.

The Federal Government could encourage the education of engineers by providing financial support for facilities, equipment, retraining programs, scholarships, and the hiring and retraining of faculty. Training in skills needed for complex project management could similarly be stimulated. The auto industry would also benefit from programs to train engineers if the industry pursued extensive development efforts domestically.

[28] *An Assessment of Oil Shale Technologies,* Op. cit.
[29] *The Direct Use of Coal,* OTA-E-86 (Washington, D. C.: U.S. Congress, Office of Technology Assessment, April 1979).
[30] *Management of Fuel and Nonfuel Minerals in Federal Land,* OTA-M-88 (Washington, D. C.: U.S. Congress, Office of Technology Assessment, April 1979).
[31] *Assessment of Development and production Potential of Federa/Coal Leases,* OTA-M-150 (Washington, D. C., U.S. Congress, Office of Technology Assessment, December 1981).
[32] Congressional Research Service, "Energy Impact Assistance Legislation, " issue brief No. 1679022, Sept. 9, 1981.

CONCLUSIONS

Both increasing automobile fuel efficiency and synfuels production have economic and noneconomic risks and external costs. The decision to pursue either, or both, alternatives–as well as to pursue the third major technical alternative of fuel switching and conservation in stationary uses of petroleum—depends on the desired rate and level of oil import displacement and what the Nation is prepared to spend to achieve its oil-displacement goals.

The availability and cost of capital are especially important for the automobile and synfuels industries, since they are both capital-intensive. General economic conditions affect consumer confidence and purchasing power. Among the policies mentioned in this chapter are general tax policies and special taxing provisions which would encourage capital formation and stimulate industrial innovation economywide.

The rate at which automobile fuel efficiency can be increased and a synfuels industry developed are also affected by factors that are specific to each alternative. Contributions to oil-import displacement from increased automobile fuel efficiency depend critically on consumer demand for fuel-efficient cars. Government actions to stimulate demand are a direct way to help ensure that fuel-efficient cars are bought and, in turn, that they will be produced. Demand-oriented measures that appear promising and that deserve further analysis include registration, purchase, and fuel taxes and purchase subsidies. Supply incentives, depending on their nature, could help manufacturers pay for the investments necessary to increase fuel efficiency, especially if there is an absence of strong demand for either cars in general or fuel-efficient cars in particular. In the case of weak demand for efficiency, increasing CAFE standards beyond the 1985 level may help to ensure continued oil import displacement. However, the increased cost of the efficiency increases could reduce new-car sales and thereby reduce the potential savings. In general, a combination of demand and supply incentives would be the most effective means of promoting more efficient fuel use in automobiles. This would contrast with past policy, which has been aimed largely at producers.

The success of synfuels development in displacing oil imports hinges on the resolution of major technical uncertainties associated with as yet un-

proven processes. private investments are likely to be accelerated once processes are demonstrated in commercial-scale units—provided the processes are economically competitive sources of fuels. The high costs and other risks associated with demonstration projects are likely to necessitate Government support if synfuels production is to become a significant fuel source by the end of the century.

Other policy considerations for displacing oil imports are applicable generally to planning in a world of uncertainty. First, flexible and nonspecific policy interventions provide both public and corporate decision makers with the maximum opportunities to adjust internally to changing economic and technical circumstances. Secondly, periodic reviews and adjustments can help prevent prematurely locking the Nation into technical choices that discourage a continuing search for better methods, although too much flexibility can lead to ad hoc programs.

A long-term, stable policy commitment to oil import displacement, and to alternatives for displacing imports, is essential in order to send clear signals about Government intentions and promote mutual confidence in any public-private relationship. In the past, the Government has sometimes sent conflicting signals. For example, concurrent Government programs were in place, on the one hand, to encourage automobile fuel economy with CAFE standards and, on the other hand, to discourage fuel conservation with price controls on oil which helped to keep the price of gasoline low. *

Increased automobile **fuel** economy and synfuels production contribute in different ways to the Nation's energy security. The advantages of automobile fuel efficiency include the following: 1) through conservation, it directly eliminates the **need** for oil imports in the Nation's highest petroleum-consuming sector; 2) after large numbers of fuel-efficient vehicles have been sold, the **fuel** savings does not depend on the operation of a few large plants, and there will continue to be fuel savings even if particular vehicles perform below standards; 3) it does not result in a net reduction of natural energy resources and thus preserves options for future generations; and 4) although there are long leadtimes for commercializing new products in the auto industry, savings are already occurring as technologies are diffusing into the consumer market. However, if market and/or Government pressures for increased automobile fuel efficiency damage the U.S. auto industry, there will be repercussions throughout the economy.

The principal national security advantage of synfuels production is that it may provide long-term strategic insurance against sustained shortfalls. Rapid and successful deployment could conceivably serve to reduce the rate at which oil import prices increase and thus help to reduce inflation. The vulnerability of the synfuels alternative is related to the complexity of technical controls, the high risks and costs of failure, potentially hazardous environmental side effects, institutional barriers to deployment, and, in some cases, the geographic concentration of facilities.

Because increasing auto fuel efficiency and synfuels development are both capital-intensive, each will incur major economic penalties if facilities function below capacity. However, because the "normal" rate of capital turnover is likely to be lower in the synfuels than the auto industry, synfuels production will be more limited in adapting to changing demands.

Developing a long-term, coordinated, and comprehensive energy policy will be an incremental process. A prime objective is to choose a least cost mix of options for reducing oil imports. Because investment costs (per barrel per day of oil saved or replaced) for the various options considered in this report for the 1990's are highly uncertain, yet appear to be comparable in magnitude, the judgment of relative costs will depend largely on value assessments of the various externalties of pursuing each option.

***U.S. policies in the 1970's also implicitly encouraged oil use for stationary purposes (e.g., Federal curtailment policy for natural gas).**

APPENDIX 3A.–POLICY OPTIONS TO REDUCE STATIONARY OIL USE

Conservation

1. **Tax credits for investments in conservation:**
   - Ž **Current 15-percent credit for investments by homeowners–single-family and 4-unit or less multifamily.**
   - **10-percent tax credit** for energy efficiency or renewable resource investments by industry.
2. Residential Conservation Service:
   - Utility audit service for homeowners.
   - Proposed extension to include apartment and commercial buildings.
3. Subsidized loans to homeowners to finance conservation investments:
   - Currently the purpose of the Solar and Conservation Bank.
   - Private savings and loan institutions also offer below-market loans for conservation in some cases.
4. Targeted tax credits (20 percent) for investments in energy efficiency by industry:
   - Currently proposed in legislation now before Congress.
   - Tax credit in addition to current credits.
5. State public utility commission actions to encourage conservation efforts by utilities:
   - Allowance of conservation investments in the rate base of utilities (proposal).
   - Permission to sell saved energy to private investors (proposals).
   - Allowing utilities to set up separate companies to **provide conservation services—now occurs in some cases,**
6. **Legislating standards and/or information:**
   - Appliance efficiency standards–labeling of appliances.
   - Building standards–currently prescriptive standards through the minimum property standards of the Department of Housing and Urban Development.
   - Building energy performance standards are legislated but currently not enforced.
   - Efficiency standards for industrial electric motors were proposed but never enacted.

Fuel Conversion

1. Prohibition on oil use by utility boilers and large industrial boilers:
   - Principal focus of the Fuel Use Act.
   - Goal to eliminate use of oil by 1990.
2. Financial assistance for utilities to convert from oil to coal:
   - Ž State commissions have allowed New England Electric Co. to secure a “loan” from their customers to pay for an oil-to-coal conversion.
   - Federal legislation proposed to provide loan guarantees for these conversions was never passed and is not likely to be pursued now.
3. Legislation to remove regulatory restrictions on use of natural gas by industry:
   - Currently part of several proposals to encourage conversion to natural gas.
   - Current regulations (Federal and State) either prohibit or discourage natural-gas use for many applications that now use fuel oil.
4. Environmental regulations affecting coal use in industry:
   - Lowering of emission standards for applications below a certain size.
   - Financial assistance to help install control technologies.

General

1. R&D to increase efficiency of end-use technologies:
   - Promotes general conservation.
   - Can also be directed at developing efficient electric energy using technologies to make the economics of switching to electricity attractive.
2. Tax on oil–either on imports or on specific products such as fuel oil for boilers or space heating:
3. Economic incentives for development of unconventional natural gas:
   - Currently unconventional natural gas is completely deregulated.
   - Tax credits to encourage development of unconventional gas (this is currently not available).

APPENDIX 3B.–ADDITIONAL CRS REFERENCES

The Congressional Research Service has recently published many reports on various aspects of energy policy to which the reader is referred. These reports include the following:

1. Rothberg, Paul, 'Synthetic Fuels Corporation and National Synfuels Policy, " CRS issue brief No. 1681139, Oct. 13, 1981.
2. Chahill, Kenneth, "Low-Income Energy Assistance Reauthorization: Proposals and Issues, " CRS mini brief No. MB81227, Aug. 26, 1981.
3. Abbasi, Susan R., "Energy Policy: New Directions Indicated by the Reagan Administration's Budget Proposals, " CRS mini brief No. MB81222, June 29, 1981.
4. Parker, Larry, Bamberger, Robert L., and Behrens, Carl, "Energy and the 97th Congress: Overview," CRS issue brief No. 1681112, Sept. 15, 1981.
5. Rothberg, Paul, "Synthetic Fuels Corporation, Policy and Technology," CRS mini-brief No. MB79245, July 13, 1979, updated Apr. 20, 1981.