ENERGY OUTLOOK
James L. Johnston, Standard Oil Company (Indiana)

The relationship between gross national product and energy demand (called income elasticity by economists) is changing. Before the oil shocks both grew together in precentage terms, with the growth in oil demand being greater than gross national product.

During the period of the oil shocks demand responses to income changes declined sharply.

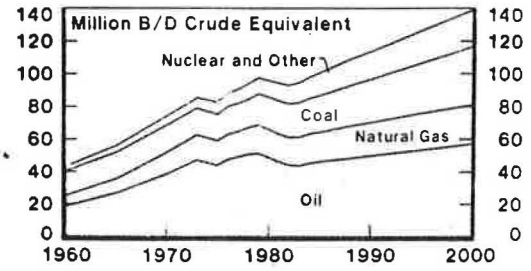
Looking to the future, we expect demand responses to improve, but at growth rates below the percentage increases in national income.

Table 1. Free world real GNP and energy growth rates.

	%/Year		
	1960-73	1973-82	1982-2000
Real GNP	5	2.5	3.5
Energy Demand	5	1	2
Oil Demand	7	(1)	1.5

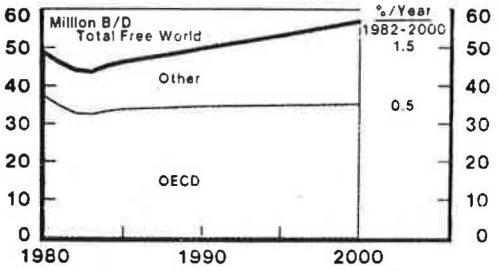
As a result of the oil shocks, energy consumption is expected to grow at a slower pace than it did from 1960 to 1970. Overall consumption from 1982 to the year 2000 will increase at a rate of 3.4 percent per year. The percentage increases will be small for oil (1.4 percent per year) and gas (2.1 percent per year). They will be larger for coal (3.2 percent per year), nuclear (5.0 percent per year) and the catch-all category of hydro, solar and other (2.9 percent per year).

Figure 1. Free world energy consumption.



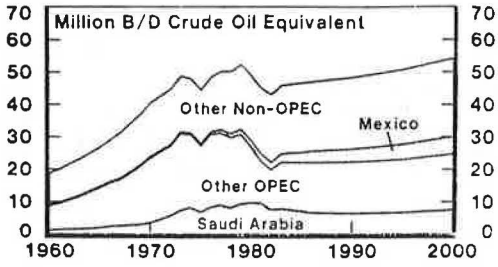
Projection of free world oil consumption shows that industrialized Organization for Economic Cooperation and Development (OECD) countries will grow at a modest rate of 0.5 percent per year, while the overall rate will be 1.5 percent per year. The implication is that the principal growth in oil consumption will occur in developing countries where the potential for conservation is small.

Figure 2. Free world oil consumption.



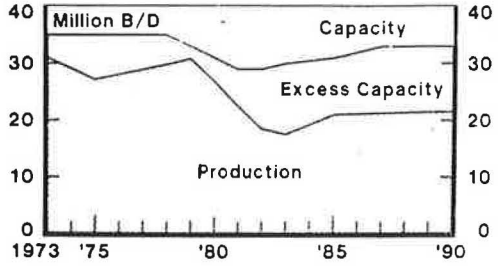
The growth in world oil supply from 1982 to the year 2000 will be a modest 1.7 percent per year. The rates from industrialized OECD countries will probably be negative, while the developing countries will increase their consumption in the range of 2.4 to 3.8 percent per year. In all cases the growth rates will be less than the experience before the oil shocks.

Figure 3. Free world oil supply.



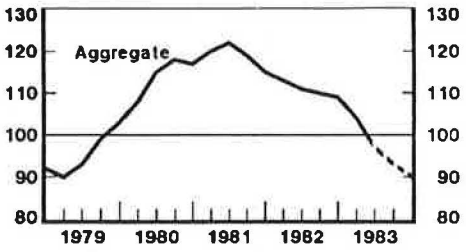
Capacity to produce in recent years has declined due to natural factors and also because of the Iranian Revolution and the Iran-Iraq War. Output has declined even more because of the 1979-1982 recessions and because of conservation. Organization of Petroleum Exporting Countries (OPEC) excess capacity is approaching 70 percent of production, suggesting for the time being that OPEC will have reduced ability to push up prices. However, if renewed hostilities in the Iran-Iraq War resulted in the sustained closing of the Strait of Hormuz, then prices would indeed rise. Barring such a supply emergency, crude oil prices should remain stable and perhaps decline in real (inflation-adjusted) terms.

Figure 4. OPEC crude production versus capacity.



The bad news is that should an oil shock occur, precautionary stocks are too low. Several reasons cause this. First, conservation is more prevalent at the post-shock higher prices. Second, the recession has reduced consumption and with it the need for inventories. Third, since interest rates are still high, the cost of tieing up investment in precautionary stocks is also high.

Figure 5. Free world oil inventories (ex strategic) days supply index (1975-78 = 100).



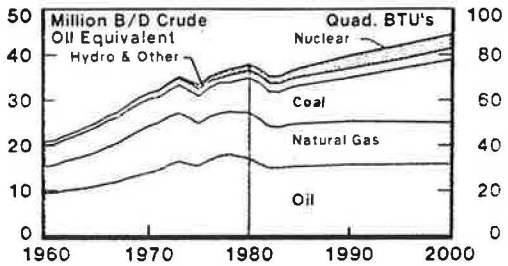
Domestic economic forecasts underlying the aviation fuels outlook are consistent with other macroeconomic estimates, such as those from Data Resources Inc.

Table 2. August 1983 macroeconomic forecast (annual percentage change).

	1982	1983	1984	1985
REAL GNP	-1.9	2.8	5.0	4.0
GNP DEFLATOR	6.0	4.6	5.0	6.0
UNEMP. RATE	9.7	9.8	8.8	8.0

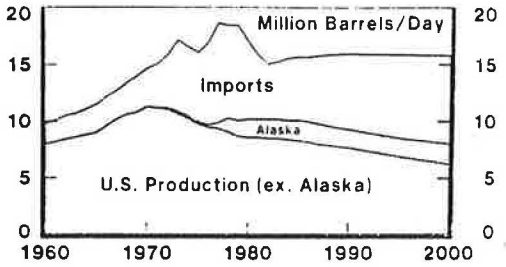
Domestic demand for oil and natural gas is expected to be essentially flat until the year 2000. The growth in demand is expected to concentrate on coal and nuclear energy, and only there if important environmental and waste disposal problems are resolved at a reasonable cost. If not demand pressure from substitution could be exerted on oil, putting upward pressure on the price. This situation will be aggravated if the full supply potential is thwarted because of the failure to decontrol the wellhead prices of natural gas, given that natural gas and oil are substitutes in several markets.

Figure 6. U.S. energy demand base case.



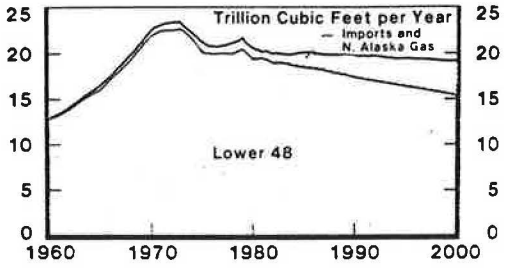
Even under a benign environment for domestic oil exploration and production, dependence on imported oil is expected to grow from now on to the year 2000.

Figure 7. U.S. oil supply.



Similarly, dependence on imported liquified natural gas will grow, especially if incentives are not restored by decontrolling the prices of natural gas. By the year 2000 very little of the domestic supply will come from currently producing properties. Thus, even to maintain modestly declining levels of natural gas production, a great deal of exploratory drilling will have to be done and the amount will be determined by the incentives.

Figure 8. U.S. natural gas supply.



Airlines have an outstanding record for conserving on fuel consumption, especially during the oil shocks of 1979 to 1981

Table 3. Available seat miles per gallon of fuel in 1982 (annual growth rate from 1978 to 1982).

PSA	48.4 (7.5%)	CONTINENTAL	43.7 (3.6%)
UNITED	48.3 (5.7%)	EASTERN	43.4 (5.4%)
WESTERN	47.3 (4.1%)	DELTA	43.0 (5.6%)
TWA	46.8 (5.9%)	NORTHWEST	41.5 (2.7%)
PAN AM	45.6 (2.4%)	OZARK	40.6 (7.4%)
FRONTIER	44.9 (5.4%)	REPUBLIC	39.4 (8.0%)
SOUTHWEST	44.2 (4.1%)	PIEDMONT	38.6 (7.7%)
AMERICAN	44.0 (5.4%)	US AIR	35.8 (5.6%)

Sources: Annual reports and CAB Form 41

The difference between the American Oil Company (Amoco) and the Federal Aviation Administration (FAA) forecasts of jet fuel demand reflects the difference in the estimates for revenue passenger miles. Nevertheless, the jet fuel increases are greater than for other fuels like gasoline, ordinary distillate and residual oil.

Table 4. Annual growth rate forecasts.

	1982-85	1985-94
COMMERCIAL JET FUEL		
AMOCO (Aug. 1983)	2.6%	2.3%
FAA (Feb. 1983)	3.4%	2.9%
REVENUE PASSENGER MILES		
AMOCO (Aug. 1983)	6.0%	3.8%
FAA (Feb. 1983)	6.2%	4.7%

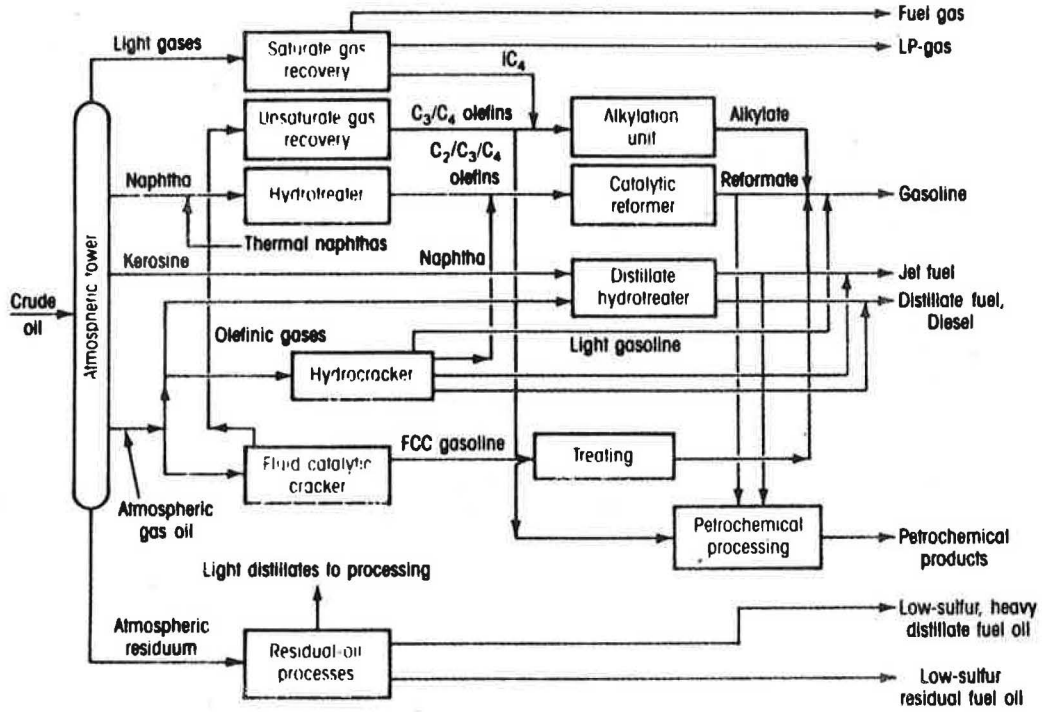
A more detailed breakdown by time period and by type of jet fuel shows that growth in the commercial area will be greater than in the military market.

Table 5. Jet fuel consumption estimates, millions bbls. per day (average annual growth rates in parenthesis).

	1982	1985	1990	2000
KEROSENE TYPE	.80 (2.6%)	.87 (2.6%)	.99 (1.4%)	1.13
NAPHTHA TYPE	.21 (2.6%)	.22 (0.4%)	.23 (0.3%)	.24
TOTAL	1.01 (2.6%)	1.09 (2.2%)	1.22 (1.2%)	1.37

Refinery processes have little flexibility to expand the output of kerosene type jet fuel from the initial cuts. Using a hydrocracker at those refineries which have one could augment the supply. However, other valuable outputs from the hydrocracker will compete with jet fuel. Moreover, the solution for maintenance of proper cetane in the distillate pool implies a greater blend of kerosene in the future. All these factors limit the expansion potential of kerosene-type jet fuel.

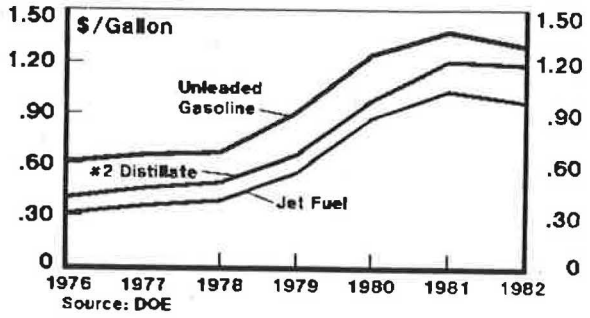
Figure 9. Refinery processes.



Jet fuel price behavior since 1976 appears to be more price sensitive to income changes than other fuels. Presumably this occurs because the income elasticity of air travel is much greater than energy consumption generally, thereby creating a little extra volatility in jet fuel prices.

The major movements in prices are associated with oil shocks, or the absence thereof. In the stable period from 1976 to 1978, jet fuel prices increased at a modest nominal rate of 11-2/3 percent per year. Correcting for inflation using the GNP deflator, brings the rate in real terms down to 5 percent per year. By contrast the oil shock years of 1979, 1980 and 1981 saw nominal increases of almost 37 percent per year and a real increase of 27 percent per year. The recession of 1981 and 1982 produced the first decrease (6 percent in nominal terms) in more than a decade.

Figure 10. Comparison of three retail fuel prices.



While oil economists are constrained from making price predictions for antitrust and other reasons, the FAA is not. They project rising jet fuel prices from 1982 to 1994 at an annual rate of almost 8.5 percent in nominal terms. The increase corrected for inflation by the FAA is on the order of 3 percent per year. These estimates are not inconsistent with the experience in the decade of the 1970s.

However, if the near term recovery is robust, then there could be above average upward pressure on prices given the constraint that jet fuel supply will be able to increase in about the same proportion, as the supply of other refined petroleum products.

PRICE OUTLOOK

Jet fuel production is more or less proportionally linked to the output of other refined products with limited ability to expand relative to other fuels and still meet the rigid specifications.

Income elasticity for air travel (and therefore jet fuel) is higher than for refined products generally -- 2.5 versus 1.0 or less.

With economic recovery, the derived demand for jet fuel could raise its price somewhat faster than the prices of other refined products.

Another oil shock, like a renewed war between Iran and Iraq could push all prices higher. However, it could also stall the economic recovery.

Figure 11. U.S. domestic civil aviation fuel prices.