

percent of operating expenses prior to the 1973 oil embargo.

FUEL EFFICIENCY AND CONSERVATION

In the past five years, the airlines have become increasingly more efficient in conserving their use of petroleum resources with the purchase of more fuel-efficient aircraft and with operational improvements. Passenger load factors have increased from 52 percent to 63 percent. Also, the average number of seats per aircraft and stage lengths have increased. Other improvements have included (a) reducing cruise speed, (b) expanding use of flight simulators, (c) increasing the use of computerized flight planning, (d) developing sophisticated monitoring systems to identify aircraft that may be using excess fuel, and (e) shutting down one or more engines for taxiing maneuvers before takeoff and after landing.

Since 1973, the number of airline passengers has increased by about 100 million, or 49 percent, while airline fuel consumption has increased by only 5 percent. For 1980, total airline fuel consumption is expected to remain at the 1979 level of 11.2 billion gal. During the period 1973-1979, passenger miles per gallon, the best efficiency measure for jet fuel use, increased by 43 percent—from 17.5 passenger-miles/gal in 1973 to an estimated 25 passenger-miles/gal in 1979.

1973-1974 SHORTAGE—IMPACT AND ACTIONS

The OPEC oil embargo during the latter part of 1973 had a serious impact on the airlines and the travel industry. Relative to airline traffic, there was a certain amount of diversion from the automobile to the airplane as a result of the gasoline shortage. Domestic airline passenger traffic increased 7 percent in the first quarter of 1974, largely as a result of this diversion from automobile use. Domestic intercity travel by all modes of transportation was down about 4 percent in early 1974. For all of 1974, domestic air travel was up about 3 percent, compared to a decline of about 2 percent for all transportation modes.

As a result of the jet fuel shortage, the airlines dropped nearly 2000 flights/day in early 1974. These flight

reductions averaged 1100/day for all of 1974. During that year, the airlines averaged about 13 000 flights/day, compared to 14 000 flights/day in 1973. With this reduction in capacity, the airlines had to furlough about 15 000 employees in 1974.

With the decrease in flights in 1974 and the increase in traffic, passenger load factors increased. The load factor in 1974 amounted to 55 percent, compared to 52 percent in 1973.

POSSIBLE FUTURE ACTION

The airlines in the future are likely to pursue increasing efficiency as part of their role in the nation's conservation efforts. The purchase of more fuel-efficient aircraft will also help in energy conservation efforts and provide operational improvements.

Airline industry capital requirements for new equipment during the 1980s are estimated at \$87 billion, including passenger- and freight-carrying aircraft. During the past decade, capital investment by the airlines amounted to \$17 billion and in the 1960s, \$10 billion.

The industry will need an average annual corporate return on investment of 13-15 percent to meet the \$87 billion in capital requirements from 1980 to 1990. In 1979, the industry's return on investment was less than 8 percent.

The airlines and other public transportation modes must receive adequate supplies of fuel during tight supply situations because they constitute the basic network of the nation's transportation system. In addition, public passenger transport accounts for only about 10 percent of total transportation-related petroleum consumption.

In the event of future major disruptions in energy supply, such as another embargo, it is hoped that ways could be found to ensure adequate jet fuel supplies to avoid curtailment of airline services. Nevertheless, we must be prepared for reductions in airline services should they prove necessary. Only through the combined cooperation and efforts of all concerned, including carriers, travelers, and shippers of all modes, can the transportation industry meet the national energy challenges of the future.

Energy Needs of the Commuter Airline Industry

Commuter Airline Association of America

The combination of airline deregulation, the uncertain availability and price of automotive fuels, and the surging public demand for air travel have spurred the growth of the commuter airline industry beyond its wildest dreams of just a few years ago. As a result, commuter airlines are gearing up to implement better service, with greater frequency to more communities than ever before.

It might appear that the Airline Deregulation Act of 1978 brought about a near revolution in U.S. air service. It has not. The role of commuter airlines in providing short-haul, hub-spoke air transportation as a replacement for departing certificated jet air-carrier service has long been established. In the 12 years prior to the Airline Deregulation Act, commuter air carriers successfully replaced service at 140 of the 172 cities that were suspended from the certificated air-carrier schedules. Since deregulation, that commuter replacement figure has increased by another 60 cities.

What the deregulation act did provide was a mechanism to allow this change in air service on a rational basis. The Airline Deregulation Act contained important provisions that (a) guaranteed the provision of minimum levels of air service for the next 10 years; (b) established a replacement mechanism that assures an orderly transition in air-carrier service; (c) allowed commuter air carriers to operate

aircraft with a capacity of up to 60 seats, important because the commuter replacement service can be provided in aircraft properly matched to the size of the replacement market demand; and (d) provided key economic incentives to commuter airlines, such as equipment loan guarantees, joint fares, and subsidy where needed—provisions long available to other segments of the air-carrier industry.

Under deregulation, commuter airlines will assume an even more significant proportion of local and feeder air service than ever before. The economics of short-haul transportation make it increasingly difficult for air carriers that use large jet-transport aircraft to profitably serve such markets. On the other hand, commuter airlines with frequent schedules use aircraft matched to the market density and can continue to provide convenient replacement air service in those markets abandoned by trunk- and local-service carriers.

FUEL COSTS

The most significant new element in this changing service pattern has been the incredible rise in the cost of fuel. No one could have foreseen, even several years ago, that the enplane (i.e., to board) price of jet fuel would increase so dramatically. That increase measured some 80 percent

during 1979 alone, and this kind of price increase may continue this year. With this increase in the price of jet fuel has come the stark reality that short-haul jet transportation in those market segments of 150 miles or less simply has become uneconomic, no matter how high the average load factors. Yet those markets do not necessarily have low passenger densities. They include, for example, American Airlines suspending its flights between Dallas-Fort Worth to Oklahoma City, TWA dropping Wichita-Kansas City schedules, and United Airlines eliminating service in a number of substantial California markets, such as Bakersfield, Visalia, Fresno, Merced, Santa Barbara, and Sacramento. Nor is an end to this trend in sight. As the price of fuel increases, so do the stage lengths that continue to be profitable for jet air-carrier service.

AIRPORT SERVICE AND MARKET IMPACT

Commuter air carriers serve 819 U.S. airports. Nearly 400 of the U.S. airports receiving regularly scheduled air service are dependent on commuters for that service. One-quarter of all scheduled flights in 1979 was performed by commuter air carriers. Commuters are increasingly being relied on by the U.S. Civil Aeronautics Board (CAB) to meet the essential air transportation needs of the nation's small cities, which are guaranteed service for a period of 10 years by the Airline Deregulation Act. The CAB is mandated to guarantee continued air service at these points and, in every instance to date, is relying on commuter air carriers to provide such service. In order to meet these mandated public-service needs, it is essential that commuter air carriers have sufficient fuel to provide the increased service expected of them. Commuters, however, are not being allocated their current requirements. In fact, allocations range down to 60 percent of their 1978 allocation base. Thus, airline deregulation and the service mandated to small cities by the Airline Deregulation Act are being jeopardized by the lack of fuel.

The market impact of a special allocation of current

requirements for commuter air carriers would be negligible. As a form of efficient mass transportation, the commuter air carriers offer the traveler the direct benefit of both energy and time savings. In 1979, commuter airlines carried more than 12 million passengers and 545 million pounds of cargo, up 22 percent and 35 percent, respectively, over comparable 1978 statistics. In doing so, they consumed only 0.7 percent of all aviation fuel. When compared to the other modes of transportation, this fuel translates into only 0.06 percent of all fuel used for passenger transportation purposes.

Commuters also use fuel-efficient aircraft. Given a 100-mile stage length, the average commuter aircraft attains 51.8 seat-miles/gal of fuel when all seats are occupied. The most efficient commuter aircraft, the Shorts SD 330, attains a figure of 58.3 seat-miles/gal of fuel. These figures are all the more impressive when compared to the average jet airliner, which, on average, attains a comparable figure of 31.8 seat-miles/gal over a 400-mile stage length. In comparison, the average commuter aircraft is 61 percent more efficient than the larger aircraft.

The wide geographic dispersion of the points served by commuter air carriers and the small size of aircraft used in the service make it infeasible for commuters to tanker (carry) fuel from one point to another. Thus, it is important that fuel be available at all points for commuters. The Commuter Airline Association of America estimates that commuter air carriers will need about 80 million gal of jet fuel this year, about 20 percent more than in 1979, and about 35 million gal of aviation gasoline, an increase of 15 percent over last year.

Commuter air carriers provide a mass transportation service to otherwise isolated small cities. The market impact of fuel allocation on them would be slight. Their service is provided in fuel-efficient aircraft. Unless these carriers receive sufficient fuel, the essential air transportation program mandated by the Airline Deregulation Act is in danger, as well as airline deregulation in general.

Effect of a Sudden Fuel Shortage on Freight Transport in the United States: An Overview

John N. Hooker

Rock oil was a curiosity in 1870—a time when the U.S. economy was powered by coal, wood, wind, water, and muscle (1). In 1977, oil and its distillates provided 49 percent of our energy and natural gas, 26 percent. During the period 1950-1975, petroleum's share rose from 40 to 46 percent, and consumption rose from 1.0 million to 2.6 million m³/day (6.5-16.3 million bbl/day) (2).

To satisfy our thirst for oil, we have slipped into a dependence on foreign sources for which it is difficult to find a parallel in our history. The hard necessity of maintaining proper relations with some of our suppliers has become the anvil on which our foreign policy is shaped. Our vulnerability has forced us to compromise our principles in many instances. Our dependence on oil has reached the point where it would be foolish not to consider the potential effect of a sudden reduction in our foreign supply. The difficulty, of course, is that we import 45 percent of our crude oil and that 79 percent of this comes from OPEC nations (3). Some 43 percent of these imports is supplied by

nations of the Middle East, a part of the world that is traditionally unstable and becoming more unstable. It is true that a cutback in foreign production would probably be mollified by the same determination to secure petroleum that got us into this predicament. But a relatively small perturbation of supply can precipitate a large disruption of distribution.

This paper will examine the potential effects of a sudden supply disruption on freight transport in particular. The paper discusses what freight transport is like, especially as it relates to the use of energy; it is important to understand where the energy goes and what affects the level of its consumption. It then sets out some of the main conservative responses transport firms might make to a shortage, with a rough indication as to their potential effectiveness. Modal shifts and opportunities within these modes are examined, and suggestions about whether and how our knowledge in these areas can be improved are made.