Chapter I

Summary of Major Findings and Study Approach

PURPOSE OF THE STUDY

This final report presents the results of a study entitled Energy, the Economy, and Mass Transit which was sponsored by the Office of Technology Assessment (OTA). The United States Senate Committee on Appropriations requested that the study be undertaken on behalf of its Transportation Subcommittee.

Responding to increasingly serious energy and economic conditions the Committee asked the Office of Technology Assessment to examine the following basic issues:

- How would future changes in the supply of energy (and energy prices) affect transit patronage, the Federal transit program, and the transit industry?
- What roles could transit play in a program to offset a severe recession or depression?
- How would the economy and urban transit be affected if transit funds were sharply reduced as part of a general anti-inflationary program?

The study was designed to provide answers to these questions and to evaluate the ways in which Federal policy and programs relate to and are affected by national energy and economic policy, Although the study's major concern was with short to medium, rather than long-term conditions, some of the policies discussed have long-term implications. The study had the following objectives:

- To evaluate the impact of alternative future economic conditions on the public transit sector.
- To evaluate the impact of alternative future energy conservation measures or shortages on the public transit sector.
- To define alternative transportation policies for responding to various economic and energy conditions,
- To assess how effectively these transportation policies respond to the economic and energy conditions, and to appraise the capacity of Federal and local governments to carry out the effective policies.

This study is related to An Assessment of Community Planning for Mass Transit, a project which the Office of Technology Assessment initiated in July of 1974. The primary objective of that project was to evaluate the process by which U.S. metropolitan areas make decisions about the development or modernization of rail transit systems. In early December 1974, after much of the field work had been done in the nine metropolitan areas[1] examined by the study, OTA'S consultants, Skidmore, Owings & Merrill and System Design Concepts, Inc. were asked to undertake this additional work on the relationships between energy, the economy, and mass transit. Each study has benefitted from work done on the other.

This final report, which contains the detailed results of this study, was preceded in June 1975 by a Summary Report which is also available from the Office of Technology Assessment.

SUMMARY OF MAJOR FINDINGS

The report summarizes a number of findings regarding recent trends in the transit industry, the effects of current economic and energy conditions on the use of transit, and the relative merits of adopting alternative transportation strategies to increase transit use and achieve energy conservation objectives. The major findings are highlighted below.

Recent Trends in the Transit Industry

- Transit ridership declined each year from the end of World War II to 1972. A large number of factors contributed to this decline. These include: increasing affluence and automobile

IAtlanta, Boston, Chicago, Denver, Los Angeles, Minneapolis, San Francisco, Seattle, and Washington, D,C.

ownership; improved highway access to plentiful cheap land; increased suburban development (with more scatteration and lower densities than preauto era city development); segregation of land uses in suburban areas; lack of improvements to transit; deterioration of the quality of transit service; increases in the real dollar costs of transit; and decreases in the real dollar costs of automobile ownership and operation.

. The decline in transit ridership halted in **1973.** The last three months of that year all showed increases over the previous year. Ridership in 1974 was up almost 6 percent over 1973. This reversal appears to have been due primarily, but not exclusively, to the gasoline shortage.

. Another factor in the recent reversal is that transit fares have generally decreased in real dollar terms over the last 4 years, reversing the post World War II national trend in fares. Fares have been held relatively constant with some actual decreases, due largely to public takeovers of systems and decisions to assume public responsibility for operating losses. The recent real dollar fare decreases, together with some overall service improvements, contributed to the 1973-74 reversal in the decline of transit.

● Recent evidence indicates, that an end to the gasoline shortage, together with the recession and nearly constant fares, have resulted in stable transit ridership in 1975 compared with 1974.

Effects of Economic Conditions on Mass Transit Ridership

. Relatively large changes in the unemployment rate produce relatively small changes in transit ridership. For example, an increase in the unemployment rate from **5** percent to **9** percent causes a decline in transit ridership of "about 2-1/2 percent. In absolute terms, this means that an increase in unemployment from about 4.6 to 8.4 million persons, results in a decline of less than 400,000 average daily transit trips.

. Reduction in personal income during a recession or depression causes no significant shift of travel from automobile to transit in the short term.

. The primary effect of economic downturns on personal travel is to decrease work trips by both auto and transit. Households in which the head-of-household is unemployed will make about as many trips for non-work purposes as households in which the head-of-household is employed.

. The effects of a recession or depression on transit operators is relatively mild. Because a high proportion of the loss in ridership that occurs during a prolonged economic downturn develops during the peak period, it may be possible to reduce operating costs by cutting back on peak period operations. However, other factors, such as labor agreements or public pressure, may limit the size of the reductions that actually could be achieved.

Employment Effects on Investment in Mass Transit

. Investment in transit results in about 80 man-years of employment per million dollars invested. This includes the full multiplier effect of the investment. This approximate level of employment is achieved whether the investment is in bus or rail rolling stock, construction of new fixed guideways, or through increases in transit operations. Another study has indicated that mass transit construction generates 3 percent more employment than highway construction per million dollars invested.

. Increased investment in transit operations can generate additional employment within a few months, and the purchase of new buses or rail cars can generate new jobs within a year, However, it is not likely that increased expenditures on rapid transit construction will have significant employment effects within 2 years due to the long lead time required for planning, design, financing, etc.

. Investment in improved transit operations will result in local employment gains. Investment in buses or new rail cars will tend to distribute employment effects nationally rather than locally.

. Investment in fixed guideway construction "has very localized employment effects. Evidence from Washington and Atlanta indicates that about 2 percent of the total metropolitan

employment could be traced to fixed guideway construction.

Capacity of Transit Industry To Respond to Increased Investment in Transit

- Transit rolling stock manufacturers can rapidly increase production output if demand requires. The transit fleet could be doubled nationally within 5 years if a firm commitment were made to do so.
- Manufacturers of bus rolling stock are handicapped by the tendency for rush orders to be concentrated at the end of the fiscal year due largely to the way in which grant approvals are administered by Urban Mass Transportation Administration (UMTA). This may restrict competitive bidding and affect prices adversely.
- Prices of rolling stock are adversely affected by the lack of standardized specifications. There are nearly 1,600 options available for transit buses (not including interior and finish options), which could account for up to **25** percent of the purchase price of a **$60,000** bus.

Relationship of Energy to Mass Transit

- Transit's share of total energy consumption is very low, Mass transit and intercity buses consume only 1 percent of the total energy consumed by transportation in the United States. Automobiles in urban areas consume **34.2** percent of total transportation energy. The percentage of urban passenger transportation fuel that autos consume is **98** percent.
- The energy efficiency of transit also is higher than automobiles. A transit bus with **30** passengers is six times as efficient as the auto which carries an average of 1,4 people.
- The energy efficiency of heavy rail transit systems is high. However, the construction of fixed guideway systems consumes a great deal of energy. Construction of the Bay Area Rapid Transit (BART) system consumed **44** percent of the energy the system will use over the next 50 years.
- During the recent oil embargo, it appears that most people continued to use the automobile for work trips and basic shopping trips but cut back on discretionary travel rather than maintaining their previous levels of mobility by shifting to transit.
- Between 1950 and **1970** auto transportation increased its share of total energy consumption. This was due primarily to increases in the vehicle fleet, and secondarily, to increases in the average miles driven per vehicle and decreases in average fuel consumption efficiency.
- Despite the increase in the number of "small cars" bought by the public after 1965, and a decrease in the number of "standard" (large) cars, the average amount of fuel consumed per mile has continued to increase. This trend can be attributed to an emphasis on auto performance and later to the mechanisms used by manufacturers to comply with Federal regulations for auto exhaust emissions. Prior to the 1975 models, these mechanisms resulted in increased fuel consumption per mile in each engine category. This more than offset the declining average engine and auto size in the auto fleet as a whole.

Current Trends in Metropolitan Areas' Use of UMTA Funding

- The vast majority of the Section 5, Formula Grant funds provided under the National Mass Transportation Act (NMTA) of 1974, is being programed for operating assistance rather than capital grants. This is true despite the fact that a minimum of a 50 percent local match is required as compared to 20 percent for capital grants and despite the requirement for provision of reduced fares for the elderly and handicapped. The trend is due to rapidly increasing operating costs, local commitments to maintain fares and to improve service, as well as the desire of local officials to maximize total Federal grants by obtaining capital grants from the regular discretionary capital grant program,
- In the event of a critical gasoline shortage in the future, metropolitan transit operators may have difficulty providing immediate increases in capacity even if large amounts of emergency funds were to be provided. Generally, metropolitan areas do not have "emergency" plans for such eventualities, and without such

plans, local operators may be confronted with excessive costs for such factors as overtime wage payments,

- UMTA can respond to substantial short-term increases in Federal transit expenditures if given adequate support for expanded administrative operations.

Policy Initiatives for Increasing Transit Ridership and Achieving Energy Conservation Objectives

- The UMTA Formula Grant program provides an opportunity for the achievement of new short-term national objectives. If UMTA had the authority to vary the Federal share, which now stands at 50 percent, it could use increases in the Federal share as an incentive for localities to initiate programs to achieve national objectives. These programs could include immediate, non-capital intensive actions for improving the efficiency and effectiveness of urban transportation,
- Pure transit improvement strategies and economic incentives for transit use (including no fare transit) can be very effective in attracting increased ridership, but they are ineffective by themselves in substantially reducing national energy consumption.
- Total elimination of the transit fare would cause a 60 percent to 80 percent increase in transit ridership. This increase in ridership could be accommodated by about a 40 percent increase in the size of the transit fleet. The cost of no fare transit would be about $5 billion per year in 1974 dollars.
- Maintaining peak-hour fares at their current levels and totally eliminating off-peak fares would increase total transit ridership by about 40 percent. This increase in ridership could be accommodated with no significant increase in the size of the transit fleet. Off-peak no fare transit would require about 1 billion **(1974)** dollars over current levels of operation assistance.
- It is likely that without complementary auto restraints, less than 50 percent of the riders attracted to transit by fare reductions would otherwise have been automobile drivers.
- Automobile energy conservation strategies of various kinds are much more effective than any transit incentive strategies in reducing oil consumption. In particular, gasoline taxes or other actions which would raise the price of gasoline by 50 percent would result in a reduction of about one million barrels per day of gasoline consumption—more than ten times the reduction resulting from a maximum pure-transit strategy for oil conservation. (The maximum pure-transit strategy considered included no-fare transit and a doubling of the transit fleet by 1980.).
- However, in comparison with its impact on energy consumption, the impact of a 50 percent increase in the price of gasoline on transit ridership is relatively slight, causing a less than 10 percent increase. This is because the primary response of motorists to gasoline price increases is to purchase more fuel-efficient automobiles rather than alter their travel behavior, at least through 1980. In the long term there are limits in the extent to which energy consumption can be decreased through improvements in auto fuel economy.
- An auto restraint actlon-such as a $1.50/day increase in the price of commuter parking in those areas where auto commuters could most easily shift to transit—has a far greater effect on transit ridership than does a 50 percent increase in the price of gasoline. A large part of this shift could come from elimination of employer subsidies for parking so that employees would pay free-market rates.
- In terms of energy saved per new rider attracted, generating additional ridership through auto restraints is more than twice as efficient as generating additional ridership through transit incentives,
- Transit ridership increases generated through auto restraint actions alone would have a negative impact on transit agency finances, since riders hip increases would occur primarily in the peak period, As a result, required increases in rolling stock would be proportionally greater than ridership increases generated through transit incentive strategies.
- New rolling stock required to handle the increase in peak period ridership associated with auto restraint actions would stand idle or

make runs nearly empty in the off-peak period. Auto restraint actions should be combined with incentives to off-peak transit use (such as off-peak fare reductions) to enable more efficient use of the transit fleet.

- A combined strategy incorporating both transit incentives and auto restraints is the most effective strategy to promote energy conservation without lowering the efficiency (measured in passengers per vehicle) of the transit fleet.

- Opportunities exist for financing major transit improvements through revenue generated by auto restraints. For example, no-fare transit service coupled with a doubling of the transit fleet nationally could be financed by the taxes generated from about a 150! gas tax increase applied only in metropolitan areas. This tax could be applied nationwide and be refunded in rural areas, The national application of this tax would tend to decrease gasoline consumption nationally without imposing a financial hardship on rural residents.

- Any major indiscriminate auto use restraint policy will cause substantial hardships, particularly for those low and moderate income households who must use autos for work trips and other necessary travel. This burden can be substantially eliminated by taking all of the following actions: (a) applying the major auto restraints only in metropolitan areas, ('b) placing the strongest auto restraints in areas where high quality transit service is available as a substitute, and (c) substantially improving the quality of transit service and the incentives for its use.

- Achieving major increases in the use of transit and reducing energy consumption has long-run implications for national land use and urban growth policy. Existing patterns of metropolitan growth are not conducive to the achievement of these goals, and recent studies by the Council on Environmental Quality indicate that substantial savings in energy consumption could be achieved by fostering less scattered patterns of metropolitan settlement.

TABLE 1

ALTERNATIVE ENERGY AND ECONOMIC FUTURES SELECTED FOR ANALYSIS OF IMPACT ON TRANSIT INDUSTRY

Type of Alternative Futures	Assumed Conditions
I. Economic Conditions:	
A. Recession	Unemployment averaging 8% for 1975, 7% in 1 of the 5-year period. Duration--36 months peak to ness cycle (24 months decline, 12 months recovery).
B. Depression	Unemployment averaging 9% for 1975, 11% for 1976, 9% for 1977, 6% for 1978 through 1980. Duration—48 months peak-to-peak of the business cycle (30 months decline, 18 months recovery).
II. Energy conditions:	
A. Decreaee=hIIId	Decline in total oil consumption of of 1 million bbls/dayt by January 1976. Some cuts in imports (cuts of 10-20% of 1975 level of imports by Januarv 1978) 1977-50 growth in oil consumption: 3%/year.
B. Demaee-wderate	Decline in total oil consumption of 3 million bbls/day by January 1977. Cut in imports equal to 50-70% of the 1975 level of imports by January 1977, 1978-80 growth in oil consumption: 1.5%/year.
c. Decrea-vefe	Decline in total oil consumption of 6 million bbls/day by January 1980. Imports cut equal to 100% of the 1975 level.

SOURCE: 88~d on S.O.M./SyDec Work Program prepared for OTA on December 9, 1974, but revised for February Progress Report to reflect deepening recession and more peasfmistlc forecasts generally being made by othera, and further revised to reflect changing conditions and final needs of the study in April and May.

FLOW DIAGRAM-CONCEPTUAL APPROACH TO THE ANALYSIS OF ALTERNATIVE FUTURE ECONOMIC AND ENERGY CONDITIONS AND THEIR RELATION TO MASS TRANSIT

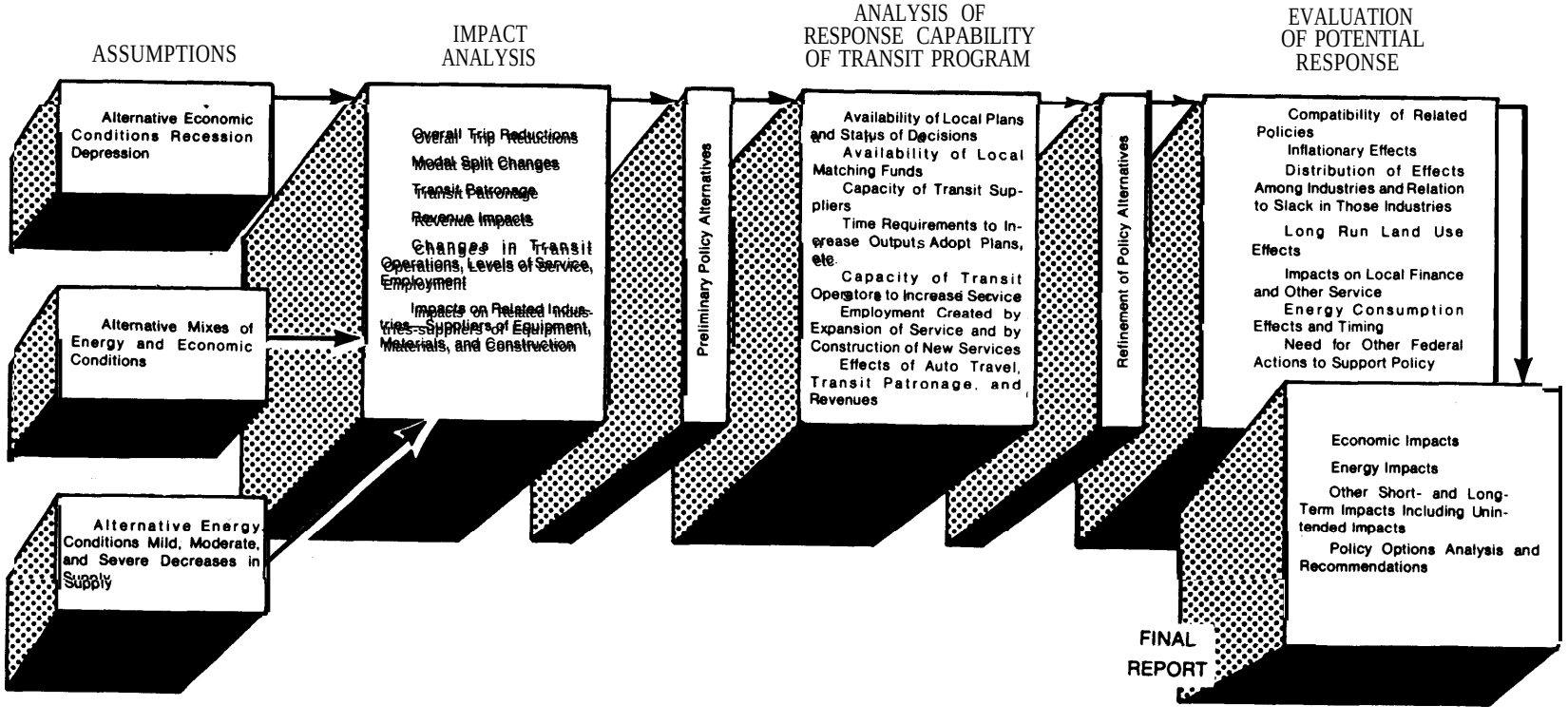

FIGURE 1

APPROACH TO THE STUDY

The study approach involved five major steps plus preparation of the final report. These steps are summarized below as a framework for the following sections of the report. (See Figure I).

The first task was to postulate a range of alternative future conditions for the national economy and the level of national energy supplies. The economic and energy assumptions are shown in Table 1. The economic assumptions were revised during the study to reflect current forecasts, and the assumptions about the reductions in energy consumption range from very short-term reductions, similar to the oil embargo of **1973-74,** to a reduction in consumption approximately six times as great as the embargo and nearly equivalent to the 1973 level of all United States oil imports.

The second task was a thorough analysis of the impacts that these assumed conditions would have on the transit sector. This involved analyses of effects on urban travel patterns, transit operations, and the transit industry.

In carrying out the impact analysis a wide variety of sources were used. A general analysis was made of the economic and energy studies recently issued by the Ford Foundation, the Federal Energy Administration, and the U.S. Department of Transportation,

With regard to urban travel patterns and transit operations, the consultants anaIyzed data on the effects that previous recessions and the recent oil embargo had had on total urban travel, type of travel, choice of mode, and transit usage, revenue, and operations. This analysis was strengthened by a statistical analysis of monthly and quarterly time-series data on national transit ridership in relation to other economic and transportation trends.

In the assessment of the role of the transit industry two types of analyses were undertaken. The first was an input-output analysis to determine the effects that changes in the level of transit investment and operations would have on the level of employment in that sector and related industries. The second was an analysis of the production capacity of major suppliers of transit equipment. These interviews with top management provided insight into the problems confronting the industry and its ability to accelerate production in response to changes in national policy.

The third major step in the study was to analyze the abilities of the Urban Mass Transportation Administration and local metropolitan transit operators to respond to changes in the transit program. A review was made of the current management of the Urban Mass Transportation Administration program from the standpoint of its capacity to administer new responsibilities under the National Mass Transportation Act of 1974 and to increase the scale of the various components of the program,

Metropolitan transportation planning, financing, and implementation capabilities were evaluated in depth as part of the Assessment of Community Planning for Mass Transit. This provided a basic picture of the response capability at the metropolitan level. In addition, a survey was done of the use to which metropolitan areas planned to put the new NMTA formula-grant funds-capital versus operating expenses. Metropolitan experience was also surveyed in terms of the local effects of the recent energy crisis, the recession, and potential capacity of local areas to expand transit operations and/or rates of investment in new equipment and facilities as part of an expanded national program,

The fourth major step involved developing and refining public policy alternatives, This process involved a number of iterations that began in the preliminary stages of the study (as shown in Figure 1).

The range of policy options covered initiatives to increase the use of mass transit as well as to achieve energy conservation objectives, More specifically, these alternatives included service improvements, capital investments in new systems and expansion of existing systems, economic incentives such as fare reductions, fare elimination, or indirect tax incentives, and various automobile pricing and regulatory restrictions designed to encourage shifts from auto to transit. Consideration was also given to long-term policies for land use and urban growth.

The fifth major phase of the study was to evaluate these policy initiatives. This evaluation considered the experiences of communities throughout the country which had implemented similar policies and programs. It involved a preliminary comparative assessment of the effectiveness of alternative actions or combinations of actions, and an evaluation of the means for implementing these actions. The results of this evaluation provided the basis for comparing the potential advantages and disadvantages of alternative policies.

This report is the product of completing this five-step approach.