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16. Abstract

The study is designed to address one phase of a detailed study on energy consumption by selected public transit systems in the United States. Although there are a number of factors that influence energy consumption, particular attention is given to energy-related studies in areas such as energy conservation and transportation planning, alternative fuels, public policy issues, energy consumption studies, alternatives and related programs.

This document focuses on the first task of a study designed to analyze and assess existing energy conservation programs in public transit and measures employed for achieving maximum efficiency and increased mobility in urban areas. The task undertaken for this study involved the identification and review of pertinent literature, documented reports, and other survey data on energy-related issues and how they impact the urban transportation planning process and fuel consumption.

The form of the bibliography and its accompanying annotations is intended to provide a guide to a particular area of interest; some direction relative to various types of energy consumption/conservation measures employed by public transit systems; and other alternatives for fuel conservation. It is not intended that every available reference by included. Only those studies within the general framework of the study, as described, have been included.

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Southwest Region University Transportation Center

Review of Energy- Related Studies: A Selected Bibliography

by

Laurence F. Jones
Angelo State University

and

Shirley Seaborn
Center for Transportation Training and Research
Texas Southern University

Texas Southern University
3100 Cleburne
Houston, Texas 77004

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Abstract

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I. INTRODUCTION

The purpose of this document is to provide the reader with a comprehensive reference source of important reports, books and manuscripts that deal with energy conservation and related programs in the urban transportation sector. There are several reasons why this document was produced. First, it was difficult to find ample references that included major research undertakings about urban mass transit energy conservation programs under a single cover. Second, in many instances, a survey of the related literature indicated the importance of updating on-going research, academic articles and books already published. There is also the need to develop comprehensive data on energy conservation programs and alternative fuels.

The time span covered in this bibliography is the early 1970's through the latter part of the 1980's. It should be noted that the beginning date was not a result of some arbitrary judgment. On the contrary, it was during this period that a renewed interest in energy conservation arose, due in part to petroleum shortages and increases in the cost of petroleum.

This bibliography includes government and academic publications. One of our major goals was to include annotations for each source. Because of the large number of article listings and the very specific nature of some titles, however, we have abbreviated several annotations. Additionally, we have attempted to develop a fairly complete treatment of the most widely available books and articles in the field of energy conservation and urban transportation. In an undertaking of this magnitude, however, it is virtually impossible to include all the writings and reports. Thus, it is highly possible that some books and articles have not been included. Updates of relevant information will be included in future editions of this document.

II. ENERGY-RELATED STUDIES

A. Energy Conservation and Transportation Planning

Alberts, Barry S. **Incorporating Energy Conservation into the Transportation Planning Process: Mid-Sized Areas.** In cooperation with Urban Mass Transportation Administration and the U. S. Department of Energy, March 1983.

This report describes methods used by mid-sized Metropolitan Planning Organizations (MPOs) to incorporate energy conservation initiatives into their urban transportation planning programs. Based on a study of nine of these MPOs, Alberts found that because of the travel and spatial patterns characteristic of these areas, energy conservation strategies that proved successful in larger MPOs were not as effective in the mid-sized MPOs. Therefore, these smaller MPOs attempted to identify several network alternatives while encouraging ridesharing alternatives.

Atherton, T. J. and J. H. Suhrbier. "Urban Transportation Energy Conservation:" **Case City Applications of Analysis Methodologies Final Report Volume III.** Prepared by: Cambridge Systematics, Inc. Cambridge, Massachusetts, October 1979.

The purpose of this report was to analyze energy conservation strategies implemented in Denver,Co., Fort Worth, Tx., and San Francisco,Ca.,. Specifically, a set of disaggregate travel demand methodologies were used to analyze the unique transportation conditions of each of the three areas. As a result, separate case studies focusing on the application and implementation of the travel demand methodologies revealed several ways that energy consumption and transportation policy initiatives could be generalized in other locales.

Barker, William G. and Lawrence C. Cooper. **Review of Energy Related Transportation Planning in the North Region.** Arlington, Texas, January 1979.

This paper concluded that the Metropolitan Planning Organization (MPO) could be a vital player in the implementation of national transportation and energy policies at the regional and local levels of government. Specifically, the paper detailed the public transportation policy implementation efforts of the North Central Texas

Council of Governments, the MPO for the Dallas-Fort Worth area. The paper examined the technology, planning, management, and external interactions, experienced by the Council in providing guidance for its members and constituency.

Barker, William G., et.al. **Transportation Energy Contingency Planning: Taxi and School Bus Use in Dallas-Fort Worth**. Prepared for Office of Planning Assistance Urban Mass Transportation Administration, Washington, D C, August 1982.

This paper discusses the impact of gasoline price increase on public transportation and the possibility of using school buses and taxicabs to support public transportation energy contingency plans. The report concluded that certain taxicab operations and school buses would benefit the public during fuel shortages provided that there was a profit incentive for private owners and reciprocal support for school districts.

Berry, D. S., et.al. **Metropolitan Plan Making: an Analysis of Experience with the Preparation and Evaluation of Alternative Land Use and Transportation Plans**. Monograph Series No. 4, Philadelphia: Regional Science Research Institute, 1970.

This document presents comparative cost and performance analyses of various modes and methods of urban transportation. Included are discussions about transit operations and equipment, cost efficiency measures, and recent innovations in the field.

Bixby, Ronald, et.al. **New York State Transportation Energy Contingency Planning. Research for Transportation Planning**, Albany, New York, January 1981.

This report presents the major findings and conclusions of a New York state transportation energy contingency planning study. The study presents information about the impacts of energy emergencies and the more promising actions and strategies that can be taken to alleviate those impacts. The major purpose of the report is to assist ongoing state and local emergency planning activities conducted by public and

private transportation providers. A secondary purpose is to educate the public about ways to cope with transportation energy problems and concerns.

Boyle, Daniel K. **Transportation Energy Contingency Planning: Quantifying the Need for Transit Actions.** Office of Planning Assistance, Urban Mass Transportation Administration, Washington, D C, January 1983, pp. 109.

This report provides a simple method that can be used by transit engineers to react to peak-hour transit capacity problems resulting from energy shortfalls. Through the use of a Capacity Problem Index developed from the responses of 45 transit agencies, Boyle provides transit professionals with a tool that can be used when analyzing various energy scenarios to use during energy crises.

Creighton, R. L. **Urban Transportation Policy. Urbana**: University of Illinois Press, 1970.

This book discusses the characteristics of urban transportation while examining travel characteristics and theory, the planning process, land use, and various methods of data collection.

Dale, Charles W. **Procedure for Estimating Highway User Costs. Fuel Consumption and Air Pollution**, Washington, D C, U. S. Department of Transportation, Federal Highway Administration, March 1980.

This document presents a set of manual techniques that can be used to estimate impacts on transportation and mobility due to signalization and intersection improvements. The study also looks at post implementation evaluation procedures for traffic related actions.

Dare, Charles E.A. **Transportation Energy Contingency Plans For Rural Areas and Small Communities. A Report To The Ozarks Regional Commission**, Ozarks, Missouri, December 1981.

Based on a comprehensive review of transportation fuels contingency planning and several surveys administered to local government officials and rural residents, this study offered several recommendations about the strategies that could be

implemented to reduce gasoline consumption in rural areas and the institutional arrangements required for coping with a transportation fuels shortage. Specifically, the study suggested that regional commissions be established to serve as focal points between local and state transportation policymakers.

Department of Energy. **A Technology Assessment of Productive Conservation in Urban Transportation**, Washington: 1980.

This study is concerned with energy conservation in public transit and the impact of current technology.

Erlbaum, Nathan S. and William C. Holthoff. **Incorporation of Energy Analysis in the Transportation Improvement Program Process. Planning Division New York State Department of Transportation**, Albany, New York, August 1983.

The analysis of 92 energy conservation projects and studies showed that public fuel expenditure in the state of New York could be reduced by almost 6 million gallons. The study also showed that an annual savings of almost 60 million gallons could be realized in the private sector due to improvements in vehicular design and usage.

Federal Energy Administration. **Project Independence and Energy Conservation: Transportation Sectors**, Vol 2, (Nov. 1974).

This report looks at various transportation modes and their impact on energy conservation.

Graves, Charles H., and others. **Energy Impacts of Transportation Systems Management Actions. Transportation Data and Analysis Section**, New York State Department of Transportation, Office of Planning Assistance, Urban Mass Transportation Administration, October 1981.

The purpose of this document is to provide procedural guidance when implementing transportation related activities. The procedures discussed in the document are designed to appeal to a variety of user groups in that they require minimum data input and analysis.

Gross, Janis, M. **Forecasting Energy Impacts of TSM Actions: An Overview, Preliminary Research Report 156.** Albany: New York State Department of Transportation, 1979.

This report summarizes the findings of a study that evaluated energy savings efforts of New York state transportation managers during the fuel crisis of the late 70's. Both direct energy savings and energy costs of construction and maintenance were quantified and evaluated for a number of TSM tactics.

Hartgen, David T. **New York's Perspective on Transportation Energy Contingency Planning.** Planning Division New York State Department of Transportation, Albany, New York, April 1982.

This study examined the responses of New York consumers to the 1979 energy crisis. The study also assessed the effectiveness of public transportation energy contingency plans and public efforts to maintain mobility through transit initiatives.

Hartgen, David T. **Transportation Energy Overview: Emphasis on New York State. Planning and Research Bureau**, New York State Department of Transportation, Albany, NY, 1979.

This paper summarizes the work of New York state transportation engineers concerning energy consumption and conservation. The paper also looks at gasoline usage by trip purpose, public attitudes toward conservation, and changes in travel behavior during the energy crisis of 1973-1974. Possible conservation actions and their potential are also reviewed.

Indian National Council of Governments. **Energy Contingency Study. Urban Mass Transportation Administration**, Washington, D C , June 1981.

This study presents several alternatives to Tulsa transportation engineers in the event of fuel shortages. Specifically, maintaining the current system despite fuel shortfalls, improving the existing system with faster and more fuel efficient service, expansion of service, and service readjustments, are discussed. Additionally, current fuel consumption levels and vehicle conditions in Tulsa County are described.

Kannel, E. J., et.al. "Transit Energy Strategy Planning: Service Supply Adjustments", **Institute of Transportation Engineers,** Journal Vol. 54, No. 9, September 1984, pp. 9-11.

The purpose of this report is to provide transportation engineers with a set of transit vehicle supply strategies that could be used in combination with local energy conservation programs for fixed route bus systems. The report provides parameters that could be used to help engineers and planners in their assessment of ridership patterns and fuel saving alternatives.

Kocis, Michael A., and others. **Issues For Developing State Emergency Conservation Plans. Research for Transportation Planning**, Albany, New York, August 1980.

This paper describes the key components of a state level energy emergency conservation plan development process, and concomitant issues critical to responding effectively to future fuel supply emergencies. The paper emphasizes alternative mobility options and the need for consumers to use those alternatives in their own self-interest.

Krzyczkowski, Roman, et.al. **Joint Strategies for Urban Transportation, Air Quality, and Energy Conservation.** INTERPLAN Corporation, Washington, 1974.

This paper examines several ways to enhance the quality of our air and to conserve energy in public transportation.

Mordecal, John M. **Scenario Planning: Energy Considerations in the Long Range Urban Transportation Planning Process.** Prepared by Baltimore Regional Planning Council, Office of Highway Planning, Federal Highway Administration, Office of Planning Assistance, Urban Mass Transportation Administration, Washington, D C, May 1983.

This report documents an 18-month study designed to test a prototype scenario analysis process that could be used during energy emergencies. The process allows consideration of the interaction of energy issues with transportation as well as other planning concerns such as land use, technological change, and economic development.

Municipality of Metropolitan Seattle (METRO). **Transportation Energy Management: Fuel Conservation in the Transit Revenue Fleet**. Office of Planning Assistance: Urban Mass Transportation Administration, February 1984.

This manual is a practical guide to reducing fuel consumption in the transit revenue fleet. It is written for maintenance and cost efficiency issues. The manual describes concrete, low-cost steps that can be taken to yield modest, yet significant, fuel and budget savings.

Municipality of Metropolitan Seattle (METRO). **Transportation Energy Contingency Planning: Financing Emergency Transit Services With Temporary Fare Surcharges.** Office of Planning Assistance, Urban Mass Transportation Administration, Washington, D C, December 1982.

This report addresses the issue of providing needed funds to pay for increases in the cost of fuels during fuel shortfalls. It also looks at ways to ensure that there is enough fuel to support the demand for expanded service that is expected during energy emergencies.

Municipality of Metropolitan Seattle (METRO). **Emergency Fuel Reserve Storage Planning: A Guidebook for Transit Managers**. Seattle, Washington, December 1982.

This guidebook presents a model that can be used by transit managers to assess their fuel reserve capacity while suggesting a minimally acceptable level of fuel reserves. It also presents alternatives for those managers who want to upgrade their emergency fuel programs. Lastly, it presents a framework for evaluating reasonable fuel reserve alternatives.

Municipality of Metropolitan Seattle (METRO). **Transportation Energy Management Transit Operator Facilities Volume I: Office Guide. Office of Planning Assistance**, Urban Mass Transportation Administration, Washington, D C, September 1982.

This report presents a practical plan for developing and implementing a six-part energy conservation program that consists of: an energy conservation team; an energy profile: a walk-through survey; implementation of low-cost operating and maintenance

operations; evaluation of energy conservation measures; and the establishment of a permanent conservation program.

Municipality of Metropolitan Seattle (METRO). **Transportation Energy Management Transit Operator Facilities Volume II: Field Guide. Urban Mass Transportation Administration**, Office of Planning Assistance, Washington, D C, September 1982.

This report focuses on data collection and on site surveys as ways to provide step-by-step instructions for developing and energy conservation program for transit facilities.

Municipality of Metropolitan Seattle (METRO). **Transportation Energy Management: Current Transit Operator Activities. Office of Planning Assistance**, Urban Mass Transportation Administration, Washington, D C, September 1982.

This report describes the results of a national survey of energy management activities undertaken by 100 transit systems in the United States and Canada. Survey participants reported on the activities in five areas: energy crisis contingency planning; energy conservation in bus maintenance facilities; energy conservation for petroleum fueled bus fleets; energy conservation awareness programs; and fuel supply and price protection strategies.

Ontario Ministry of Transportation & Communication. **Energy Conservation Through Travel Demand Management.** Canadian Transportation Energy Management Program Downsview Ontario M3M 1J8 Canada, Ontario Ministry of Energy, Canada, March 1983.

This report presents various planning and management alternatives that can be used to alleviate transit woes. For example, this report suggests that transit problems can be alleviated through the efficient use of public land and the implementation of innovative parking strategies and zoning practices.

Plotkin, Steven E. "The Road to Fuel Efficiency in the Passenger Vehicle Fleet". **Environment.** July-August 1989, pp. 18.

This article examines several ways to increase fuel efficiency in public transit fleets.

Public Technology, Inc. **Energy Contingency Planning.** Washington, D. C., Government Printing Office, 1981.

This document provides an overview of general considerations faced by local government and transit agency officials when developing contingency plans for petroleum shortages.

Puerto Rico Management & Economic Consultants, Inc. **Energy Emergency Contingency Plan For The Metropolitan Bus Authority. Metropolitan Bus Authority Rio Piedras**, Puerto Rico, November 1979.

This report addresses two questions: How can bus authorities move more passengers during energy emergencies and how can they economize on fuel requirements? To respond to these questions, the report includes analyses of energy-related problems while presenting various ways to economize on the use of fuel.

Ridgeway, James. **Energy Efficient Community Planning: A Guide to Saving Energy and Producing Power at the Local Level.** Emmaus, PA, The JG Press, Inc. 1979.

This report presents an overview of how local governments can devise appropriate and constructive solutions to the energy problems facing their communities. Included are detailed case studies of several communities such as Davis, CA, Hartford, CT and Northglenn, CO.

Riviera, Archie M., and Jeannette. "Transit Bus Energy Efficiency and Productivity", **Bus Equipment Selection Handbook**. Washington, D C, July 1982.

The purpose of this report is to give transit property managers a tool that can be used to evaluate energy consumption based on factors such as the terrain, operating speed, and number of stops per mile. Simulations were used on different types of bus routes using sample data on bus characteristics collected from manufacturers in an

effort to compare energy efficiency versus performance under different operating conditions.

Salvucci, Frederic, Charles Carlson, Brian Day, and David Gletner. **Transportation Energy Contingency Strategies.** U. S. Department of Transportation, Washington D C, 1980.

The purpose of this report is to provide technical support to state and local governments when facing energy shortfalls. The report describes the planning and organizational process, reviews specific actions to be taken, and presents a model case study of the contingency planning process.

Southeastern Pennsylvania Transportation Authority. **Contingency Planning For Energy Emergencies.** Urban Mass Transportation Administration, Washington, D C, September 1984.

This report examines alternative ways to expand public transit capacity during fuel emergencies. It specifically analyzed how rolling stock, routes, schedules, personnel, facilities, public information, rates, ridership and finances would be effected by specific contingency measures. The study concluded that to meet energy shortfalls and expected increases in transit demand, all levels of government needed to interact and cooperate.

U. S. Department of Energy. **Energy Audit Workbook for Bus Stations. Assistant Secretary for Conservation and Solar Applications and Office of State and Local Programs,** Washington, D C, September 1978.

This workbook gives public transportation managers a functional tool that can be used to analyze energy consumption. It also gives the manager a set of alternatives that can be used to conserve energy.

Witheford, David K., et.al. **Zoning, Parking, and Traffic.** Saugatuck, Conn., ENO Foundation for Transportation, 1972.

This book analyzes the impact of zoning controls on traffic. Also included are chapters that deal with land use controls.

Withowski, J. M., et.al. "Urban Transportation Planning Under Energy Constraints", **Transportation Research Record 707**. Transportation Research Board, Washington D C, 1979, pp. 1-5.

This short report examines the change in direction many urban transportation planning departments have undertaken because of energy and fuel constraints.

B. Alternative Fuels

Bloch, Arnold J. **Alternative Fuels for Buses: Current Assessment and Future Perspectives**. U. S. Department of Transportation, Urban Mass Transportation Administration, Polytechnic Institute of New York, May 1984.

This report summarizes the limited research that has been conducted regarding alternative fuels for public buses. Bloch briefly discusses and evaluates five fuels that have been proposed as possible alternative fuel sources for public bus transit systems: methanol; ethanol; methane, hydrogen, and vegetable oils, The author also presents an assessment of the current developmental status of each fuel and conclusions regarding future research efforts.

Davis, L. R. (Rich). **Methanol--An Alternative**? Washington (etc.) American Public Transit Association, Vol. 4, 44, September 1986.

This study examines concerns about the long-term trends in diesel fuel availability and pricing decisions. It also discusses the advantages and disadvantages associated with diesel fuel.

Hamilton, William. **Electric Cars for Urban Transportation. General Research Corporation, Committee on New Transportation Systems and Technology**, Santa Barbara, California, 1978.

This paper summarizes an investigation of the effects that a large-scale use of electric cars could have on energy use, the environment, and the economy. The widespread use of electric cars would drastically reduce the amount of petroleum consumed for urban transportation while alleviating automotive air pollution and noise.

However, a larger role must be planned for them in order to reap their potential benefits.

Johnson, Michael and William Hamilton. "Petroleum Savings From Auto Electrification". **In Energy Use Management**, Fazzolare, Rocco A. and Craig B. Smith, eds. Pergamon Press, New York: 1977, pp. 633-638.

This paper presents an argument that electric cars can be viable secondary cars in urban households. The authors predict that improvements in batteries and automotive technology should make it possible to develop electric cars having a range of 180 kilometers.

Kim, Y. Y. and Russell G. Thompson. **An Economic Model of New Crude Oil and Natural Gas Supplies in the Lower 48 States.** Governor's Energy Advisory Council, Forecasting and Policy Analysis Division, Austin, Texas, April 1977.

This study developed a model that could be used by researchers to show how the reserves and economics of oil and gas will be effected by wellhead prices, tax provisions, fuel finding rates, and drilling capacities.

Mittal, R. and K. **Energy Intensity of Various Transportation Modes. Energy and Transportation Division**, Aerospace Corporation, Los Angeles, 1978.

This paper is an overview of the existing literature related to the energy intensity of various intra- and inter-city transportation modes, such as automobiles, buses, automated guideway transit systems, vans, heavy- and light-rail transit, airplanes, waterways, and pipelines. Statistical analyses suggested that there was a correlation between energy intensity and the speed, load factor, and type of commodities being moved.

Moulton, David S. and Norman R. Sefer. "Synthesis of Transit Practice", **Diesel Fuel Quality and Effects of Fuel Additives**. Washington, D C, May 1984.

This study presents information about fuel and fuel additives, with a particular emphasis on their use in transit buses. The study reports that while the use of additives is often proposed as a remedy for fuel-related problems, their cost is often prohibitive.

Murphy, Michael and Randall C. Pine. **Training Manual for Methanol Fuel Use in Transit Operations.** Battele Columbus Division, U. S. Department of Transportation, Urban Mass Transportation Administration, July 1988.

The purpose of this manual is to respond to questions about methanol as a fuel, describe relevant properties and explain those factors important to using methanol safely in a transit environment.

North Atlantic Treaty Organization. **International Symposium on Automotive Propulsion Systems,** 1977.

This collection of papers focuses on alternative fuels, components, and engine configurations to reduce exhaust emissions and improve fuel economy. For example, a gas generator has been developed which converts liquid to gaseous fuel by partial oxidation with air. Other initiatives include the use of exhaust valves that result in reductions in fuel consumption and emissions without a loss in power or performance.

White, David M. and Olin B. Clemons. **Coal and Lignite: Mining, Transportation, and Utilization Needs for Texas.** Governor's Energy Advisory Council Forecasting & Policy Analysis Division, Austin, Texas, June 1977.

The purpose of this report is to show how coal can become a major source of energy in public transportation. While the report effectively provides managers with a basic understanding about coal and the technology requirements associated with its development, it is somewhat lacking when it comes to technical sophistication. However, the authors stress that they were more concerned with providing a basic foundation that could serve as an introduction and reference to more detailed studies and reports.

C. Policy And Public Transportation

Bloch, Arnold Jay. **Effects of Oil Deregulation on Public Transportation.** Prepared by Transportation Training and Research Center Polytechnic Institute of New York, In Cooperation with Technology Sharing Program, Office of the Secretary of Transportation, Washington, D C, August 1984.

This report discusses the impacts of oil deregulation on transit systems. Specifically, it addresses the economic uncertainty which has arisen in terms of diesel fuel price and supply during oil supply disruptions. Bloch also identified six alternative methods to reduce this uncertainty for transit systems. He also presented an evaluation of these alternatives against three types of criteria that addressed the breadth, cost, and institutional impacts of each method.

Cabot Consulting Group. **Transportation Energy Contingency Planning: Transit Fuel Supplies Under Decontrol.** Office of Planning Assistance, Urban Mass Transportation Administration, U. S. Department of Transportation, Washington, D C, May 1982.

This paper presents an environmental profile in which transit operators will likely be operating during energy emergencies and fuel shortages. The paper suggests that increased federal regulation of the energy market are warranted to alleviate and address urban transit physical limitations budgetary shortfalls, and the behavior of diesel suppliers.

Hirst, Eric. "Transportation and Energy Future", **Science**, Vol. 192. April 1976, pp. 35-39.

This paper suggests that policies that directly effect automobile ownership and use such as gasoline taxes and fuel economy standards, are much more effective in saving energy than are policies designed to shift travelers to energy-efficient alternatives such as mass transit and carpools. As a result, more attention should be focused on technological means to reduce fuel consumption.

Vuchic, Vukan R. **Urban Public Transportation: Systems and Technology.** Englewood Cliffs, NJ, Prentice-Hall, Inc., 1981.

This book has several chapters that discuss how America's public transportation sector has resisted or neglected efforts to address the energy needs of public modes of transportation. Hence, ways to enhance the energy efficiency of the existing systems either in the short run by changing operations, or in the long run by

changing the rolling stock and design of the infrastructure may have been excluded from many urban transportation programs.

D. Energy Consumption Studies

Bernard, Martin J. III and Sarah J. LaBelle. "Decreasing Urban Travel Energy Usage Through Transit System Management". **In Energy Use Management**, Fazzolare, Rocco A. and Craig B. Smith, eds. Pergamon Press, New York: 1977, pp. 617-624.

This paper presents several demand shift strategies that can be used to conserve energy in public transportation.

Boyce, D. E., et.al. **Energy Consumption of Journey to Work With and Without a Suburban Transit System.** Transportation Research Record 689, Transportation Research Board, Washington, D C, 1978.

The purpose of this report was to present the findings of a study that was designed to analyze the energy consumption of transportation systems during the peak hours of commuter travel.

Boyle, Daniel K. **The Effect of Small-Scale Transit Improvements on Saving Energy. Preliminary Research Report 153,** Albany, New York, State Department of Transportation, 1979.

This study examined the energy effects of small-scale transit improvements in New York state's eight metropolitan areas. Policy initiatives were analyzed to determine the effects on ridership, mode shift, and energy savings. The energy costs associated with the development, implementation, and operation of the initiatives were also studied.

Campbell, M. E. "The Energy Outlook for Transportation in the United States." **Traffic Quarterly** 27 (April 1973): pp. 183-210.

This paper looks at energy consumption trends and predicts the impact that energy-related problems will have on both the private and public sectors.

Congressional Budget Office. **A Technical Note on the Potential Savings of Petroleum by Different Modes of Urban Transportation**. U. S. Government Printing Office, December 1979.

This government-sponsored study presents the results of research efforts designed to demonstrate the potential savings of petroleum consumption associated with different modes of urban transportation.

Congressional Budget Office. **Urban Transportation and Energy: The Potential Savings of Different Modes.** U. S. Government Printing Office, September 1977.

This study used an energy requirements model to focus on the difference between gross resource input and net energy requirements for various modes of travel. The paper concluded that rail systems were one way to more efficiently consume public transit energy resources.

Coyle, John, Edward J. Bardi, and Joseph L. Cavinato. **Transportation**, 3rd Edition, NY, West Publishing Co., 1990.

Much of this book discusses transportation energy consumption. In particular, much time is spent comparing the energy consumption and efficiency of various modes of transit. Additionally, the authors posit several alternatives for improving the energy efficiency of transportation vehicles.

Fels, Margaret F. "Comparative Energy Costs of Urban Transportation Systems". **Transportation Research**, Vol. 9, (1975), pp. 197-208.

This report examines energy consumption and costs associated with different types of transportation systems.

Fels, Margaret F. "Energy Evaluation of Urban Modes and Systems: It all Depends on How You Measure It". **In Energy Use Management**, Fazzolare, Rocco A. and Craig B. Smith, eds. Pergamon Press, New York: 1977, pp. 625-632.

This paper identifies pitfalls often encountered in energy analysis. Additionally, requirements for the energy assessment of an urban area's transportation system are summarized.

Fels, Margaret F. "Suburb-to-Suburb Intercity Travel: Energy, Time and Dollar Expenditures". Princeton University, Department of Civil Engineering Research Report # 76-TR-10, June 1976.

This report examines the time, energy, and dollar costs associated with intercity travel. Additionally, it discusses ways to alleviate those costs.

Fraize, W. E., and others. "Energy Primer: Selected Transportation Topics", **Energy Requirements for Passenger Ground Transportation Systems**, Denver, Colorado, September 1973.

This study differs from other investigations of the energy efficiencies of transportation modes in that it calculates the energy consumed by one traveler using a variety of modes for a variety of trip types, rather than emphasizing overall modal energy use. In the study three types of trips were analyzed: the intraurban commute; the suburban to urban commute; and the intercity trip.

Goss, W. P., et.al. "Transportation and Energy--A Future Confrontation." **Transportation 1**, November 1972, pp. 265-290.

This study examines the problems that energy shortages will have on future transportation needs. It also suggests that to alleviate these problems, transit engineers and decisionmakers must reevaluate current energy needs and consumption patterns.

Hamels, D., and Verlag R. Oldenbourg. **Advanced Calculation of Train Movements and Energy Consumption of a Rapid Transit Line With and Without Regenerative Braking Within the DC System,** Elektrische Bahen, Vol. 82, No. 8, New York, New York, August 1984.

This study used digital computers to determine the impact that rail speed, the topology of track circuits, and power surges, had on the energy consumption of rapid transit lines in Washington, D C. The analysis also revealed that energy savings could be obtained through the use of regenerative braking techniques.

Hitz, John S. **Performance Analysis of Intercity Ground Passenger Transportation Systems.** Department of Transportation, Springfield, VA, 1976.

This paper analyzes intercity ground transit systems in an effort to identify the most optimal mode for urban movement.

Hoel, Lester A. **Public Transportation, Problems and Opportunities.** Department of Transportation, Springfield, VA, 1977.

This paper discusses several public transit problems such as mobility, energy consumption, and environmental impacts. It also presents several ways to alleviate the problems discussed throughout the paper.

Holden, WHT., and others. **Rapid Transit Time and Energy Requirements (Abridgement).** Transportation Research Board, Washington, D C, November 1980.

This study presents the results of an analysis undertaken to compare the trade off between time and energy in the propulsion of a rapid transit train. The study concludes that while faster schedules consume more energy, they also reduce other operating costs and are an important factor when trying to increase ridership. Thus, in the long run, more energy will be conserved through increased rail ridership.

Holm, John L., ed. **Energy: Production, Consumption, and Consequences.** National Academy of Engineering, Washington, D C, 1990.

In this book, experts from diverse fields examine the evolving structure of the energy system, explore the changing patterns of supply and demand, offer insights into the forces driving the changes, and discuss energy planning strategies. Also covered are: the vulnerabilities in the energy system in the United States such as the uncertain role of alternative fuels; the influence of technological change; and the increasing importance of the environmental aspects of energy systems.

Lave, Charles A. "The Energy Loss From Downtown People Movers". **In Energy Use Management,** Fazzolare, Rocco A. and Craig B. Smith, eds. Pergamon Press, New York, 1977, pp. 639-644.

This paper presents the argument that rapid transit systems such as BART in San Francisco should not have been built if energy conservation was the primary goal.

Mudge, Richard R. "A Framework for Evaluating Energy Savings From Urban Transportation". **In Energy Use Management**, Fazzolare, Rocco A. and Craig B. Smith, eds. Pergamon Press, New York, 1977, pp. 431-435.

This paper describes a framework that categorizes the major components of urban transportation energy consumption. It also describes how this framework has been applied by the Congressional Budget Office and summarizes the results of similar analyses by other researchers.

North Central Texas Council of Governments. **Local Economic Impacts of Transportation Fuel Consumption: Derivation of Procedure and Planning Manual.** Prepared for Federal Highway Administration, Urban Mass Transportation Administration, in cooperation with U. S. Department of Energy, Arlington, Texas, January 1984.

This report is intended to be used by state and local/regional transportation planners when estimating the economic impacts of public transportation fuel consumption.

Smith, Donald. "Public Transportation: PATH as an Energy Conserver". **In Energy Use Management,** Fazzolare, Rocco A. and Craig B. Smith, eds. Pergamon Press, New York, 1977, pp. 419.

This paper concludes that energy conservation cannot be satisfied with a one-for-one substitution of transit trips for auto trips, whatever the mode. Instead, the need to make trips should be reduced; trips should be shortened when they have to be made; and more productive corridors for the easier substitution of energy efficient public transportation for trips made by private modes must be provided.

Stunz, M. S. and E. Hirst. "Energy Conservation Potential of Public Transit", **Transportation Research Record 599.** Transportation Research Board, Washington, D C, 1976, pp. 46-51.

This study concludes that the automobile accounts for 60% of all fuel consumption in the United States while public transit systems use only one percent. However, unless public acceptance and the use of public transit systems dramatically increases, public transit will not be an important contributor for reducing petroleum consumption.

Wagner, F. "Energy Impacts of Urban Transportation Improvements", in Levinson and Weant (eds)., **Urban Transportation; Perspectives and Prospect.** ENO Foundation For Transportation Inc., Westport, CT, 1982, pp.168-177.

This essay primarily examines the impacts that improved urban transit systems have had on energy consumption.

E. Transportation Use During Energy Emergencies

Boyle, Daniel K. **Transit Use and Gasoline Shortages.** Research for Transportation Planning, Albany, New York, October 1981.

This study focused on 66 urbanized areas during the second and third quarters of 1979 in an effort to examine the relationships between gasoline supplies and transit ridership during the 1979 energy crisis. Although Boyle found that the shortfall in gasoline supplies led to an increase in public ridership in many of the areas in the study, factors he developed to depict the overall role of transit in alleviating the impact of the 1979 energy crisis suggested that the transit role was minor. Based on these findings, Boyle was pessimistic about the impact of public transit in alleviating the problems associated with energy emergencies.

Brunso, Joanna M., et.al. **Equity Impacts of Gasoline Shortages and Price Rises.** Planning Division New York State Department of Transportation, Albany, New York, August 1982.

This report analyzed the travel patterns of New York households during the 1979 energy crises and during the early days the state was subjected to increases in gasoline prices. The study suggested that the consumers' residential location and economic status were important for explaining their response to energy constraints. The report concluded by suggesting ways that government and state agencies could assist consumers to maintain their mobility and maximize energy conservation despite energy emergencies.

Charles River Associates Incorporated. **Fuel Supply Limitations and Passenger Travel: Scenario Identification.** Prepared for National Cooperative Highway Research Program Transportation Research Board National Research Council, Washington, D C, September 1979.

This paper addresses possible fuel market conditions through the year 2000 while providing estimates of fuel prices and the impact of auto ownership and government intervention on the transit fuel market. It also suggests that there is a need for cooperation between the levels of government to price and allocate gasoline supplies in order to alleviate problems associated with disruptions in our oil supplies.

Crowell, W., and others. **Transportation During The Next Energy Crisis: The Special Problems of Small Urban Areas.** Transportation Training & Research Center, Office of the U.S. Department of Transportation, Urban Mass Transportation Administration, Brooklyn, New York, June 1981, pp. 78.

The purpose of this study was to provide local government officials in urban areas having a population under 50,000 with special assistance in the planning and implementation of transportation energy contingency plans. The financing, institutional problems, mobility needs and specific problems, associated with several plans are assessed in an effort to provide the transit decisionmakers in these communities with a practical guideline that could be used when considering and selecting transit alternatives.

Hartgen, David T. and Alfred J. Neveu. **The 1979 Energy Crisis: Who Conserved How Much?** Research For Transportation Planning, Albany, New York, April 1980.

This study involved a New York statewide survey of over 1500 residents to determine actions taken during the 1979 energy crisis and to ascertain what actions would be taken should gasoline pump prices reach $1.50 per gallon and should there be a 20% shortfall in fuel supplies. The survey revealed that New Yorkers reduced their gasoline usage by 6% through various ways: carpooling, increased public transit usage, reduced travel, and the purchase of more fuel efficient transportation. Additionally, differences were observed based on age, income, auto ownership and the

location of the respondents.

Hennigan, Martha E. and Alfred J. Neveu. **Quick Assessment of Local Area Impacts Resulting From National Energy Shortages.** Albany, New York, August 1984.

This paper presents a method that can be used to estimate local area impacts of national energy shortages. Using data from the 1977 National Personal Transportation Study, it examines the potential travel impacts of fuels shortages occurring in six different-sized urban areas under seven different energy futures. These futures were defined by level of fuel supply shortfalls, the government actions taken to offset shortfalls, and by whether long-range conservation actions were taken. The study concludes that this latter action was most effective in reducing fuel use. These actions included the purchase of more fuel efficient cars and relocation closer to the work place.

Neveu, Alfred J. **Adjusting Highway Travel Forecasts For The Effects of Fuel Shortages and Price Rises.** Planning Division New York State Department of Transportation, August 1983.

This report presents a set of procedures that can be used to adjust travel forecasts to reflect changes in fuel supplies, fuel prices, and fuel efficiency.

Neveu, Alfred J. **The Sensitivity of Work and Non-Work Travel To Energy Shortages or Price Rises.** Albany, New York, July 1981.

This report presents the results of a consumer survey of public responses to the 1979-1980 energy crisis. Thus, it presents ways that the public responded to the crisis. It was found that most of the respondents reacted to the emergency by purchasing more fuel efficient vehicles.

Sacco, John F. "Transportation Energy Conservation and Demand", **Impact of The Energy Shortage On Travel Patterns and Attitudes.** Washington, D C, 1976.

The purpose of this study was to determine the effect of the energy shortage of 1974 on the suburban area. Data from several nationwide surveys and selected

transit operations were used to achieve this purpose.

Schueftan, Oliver and Raymond H. Ellis. **Federal, State and Local Responses to 1979 Fuel Shortages.** Washington, D C, February 4, 1981.

This report describes the actions taken by several urban transit managers to address the 1979 energy crisis. Common emergency actions identified in the study included: the expansion of public information and marketing distribution systems; the emergency expansion of ridesharing services; the rehabilitation and use of reserve fleet buses; the implementation of minimum fuel purchase restrictions; and the monitoring of transit ridership so that buses could be shifted to the most heavily used routes.

Smith, Wilbur. "The Energy Crisis Today: A Perspective", in Levinson and Weant (eds.), **Urban Transportation: Perspectives and Prospects,** ENO Foundation for Transportation Inc., Westport, Ct., 1982, pp. 80-86.

This article describes several ways to preserve energy. For example, adjustments to energy conservation, the stock piling of fuel, the substitution of other energy sources for oil, and the acceptance of reasonable regulations that effect the efficient use of energy, were discussed.

F. Special Studies

Butz, J. R. Mattil. **Evaporative Coolers for Transit Buses Design, Development, Testing and Evaluation.** The Regional Transportation District, U. S. Department of Transportation, Urban Mass Transportation, June 1983.

This document discusses the efforts of regional transportation engineers in Denver, CO, who were testing evaporative cooling systems in urban transit coaches. Based on the results of the engineers, UMTA funding was provided to develop a prototype evaporative cooling system that could be used throughout the public transit system. Test results showed that, in low humidity climates, this technology affords an opportunity to provide passenger comfort while realizing energy savings and decreased maintenance costs well below that of conventional mechanical air conditioning.

Cabot Consulting Group. **Transportation Energy Management Fuel Futures**. Office of Planning Assistance, Urban Mass Transportation Administration, February 1983.

This report provides guidance on the use of fuel futures trading to lock in the price of fuel against volatile market changes. The paper suggests that through futures trading transit agencies can reduce pricing problems while ensuring that necessary fuel supplies are maintained during an energy emergency.

Colpitts, K. **Conference Report: Efficient Intermodal Travel--The Reality or Myth:** Opening Comments By Kay Colpitts. Transportation Research Circular, Washington, D C, September 1983, pp. 2-4.

The purpose of this study was to identify ways to alleviate America's mobility and congestion problems. Similar to many reports, Colpitts concluded that our dependence on the private automobile is one of the major contributors to these problems. Colpitts suggests that one way to provide increased mobility to our citizens is to find ways to make multimodal trips more attractive to travelers.

Erlbaum, Nathan S., and others. **Automotive Energy Forecasts: Impacts of Carpooling, Trip Changing, and Auto Ownership.** Albany, New York, December 1977.

Based on household surveys, this study concluded that carpooling and trip chaining policies would result in a 10% savings in fuel expenditures. The study also suggests that "carpool coordinators" and "transportation auditors" be used to monitor the program and help achieve predicted savings.

Gluck, J. S. and Read, M. "Transportation and Energy--A Future Confrontation." **Transportation 1**, (November 1972).

The purpose of this article is to present the findings and recommendations of the Military Traffic Management Command Transportation Engineering Agency concerning ways to alleviate traffic congestion while decreasing fuel consumption. The basic approach of the article is to present economical ways to increase roadway capacity and reduce traffic demand through transportation system management and basic traffic

engineering actions.

Hartgen, David T., et.al. **Initial and Subsequent Consumer Response To Gasoline Shortages.** Albany, New York, October 1983.

This paper reviews consumer responses to U. S. gasoline shortfalls in 1973-1974 and 1979. Survey results showed that reductions in non-work travel through trip combining and less frequent travel were used to address fuel problems during the former period. On the other hand, the modal response to fuel savings techniques in 1979 was the purchase of more energy efficient automobiles. The paper also showed that there was an increase in the overall awareness for energy conservation by consumers.

Hartgen, David T. **What Will Happen To Travel In The Next 20 Years?** Research For Transportation Planning, Albany, New York, August 1980.

The purpose of this study was to develop a baseline projection of travel and energy use for New York state for the period 1975-1995: a projection that is adjusted to account for major shifts in household and population trends; the economy; urbanization; and automobile ownership. Factors found to explain increases in travel included increased car efficiency, population growth, increases in suburbanization, and increases in automobile ownership. Energy prices, embargoes, inflation, and unemployment, were factors that were found to explain reduction in travel. Additionally, despite these factors, travel is projected to continue to grow despite reduction in gasoline consumption and periodic supply shortfalls.

Hennigan, Martha E. and Alfred J. Neveu. **Access Mode: Circuitry of Travel and Energy Usage.** Albany, New York, February 1983.

Transit service, park and ride lots, and carpooling programs are often used to promote transportation energy conservation. Traditionally, however, evaluations of these programs have neglected the energy expenditures necessary to access the various

options. This report attempts to rectify this neglect by analyzing and calculating the costs associated with these energy expenditures. The report suggests that the energy used to gain access to many of these services can reduce direct line-haul transit energy savings by 30 to 50 percent.

Janarthanan, N. and Schneider, J. **Reducing the Energy Requirements of Suburban Transit Services by Route and Schedule Redesign.** Transportation Research Board, Washington, D C, November 1984.

This paper explores several ways to redesign an existing transit service in an effort to reduce its energy requirements without substantially reducing the quality of service. Specifically, the study showed that energy consumption could be reduced through the improved scheduling of vehicles, reductions in deadheading, and the design of more efficient routes. Through the testing of seven alternative designs it was shown that the energy requirements of the Bellevue, Wa. transit agency could be reduced by almost 56% without a substantial reduction in the level and quality of service.

Linhares, Al, et.al. **Transportation Energy Activities of the U. S. Department of Transportation,** Washington, D C, February 1981.

This report provides a summary of current DOT sponsored energy related research, technical assistance, planning activities, and information sources. Additionally, information concerning Transportation System Management, transit performance, staggered work hours, priority techniques for HOV vehicles, and ridesharing, is presented

Reichart, K. "Improving Urban Mobility Through Better Transportation Management". U. S. Department of Transportation, FWHA Urban Planning Division, (May 1975).

This study examines ways to enhance urban mobility through enhanced transportation management.

U. S. Department of Transportation. **Transportation Energy Activities of the U. S. Department of Transportation: A Technical Assistance Directory of Programs, Projects, Contacts, and Conferences.** Washington, D C, U. S. Department of Transportation, 1979.

This is a summary of transportation, energy-related research. It also contains information relevant to transit performance, alternative work schedules, and priority techniques for high-occupancy vehicles.

G. Energy Programs And Texas

Bullard, Diane A. "The Development of Standard Transit Projects for Texas". **Technical Report 2005-IF,** Study #2-10-89-2005, November 1989.

This document reports on the development and progress of several transit projects introduced in Texas cities.

Burnett, Diane and James Chang. **Texas Energy History. Texas Energy and Natural Resources Advisory Council (TENRAC) Energy Policy Division,** Austin, Texas, November 1982.

This publication provides an overview about Texas fuel reserves, fuel production, energy transmission, energy conversion, energy consumption patterns, and the evaluation of energy in Texas. The publication also contains several graphs that compare the energy industry in the United States with the energy industry in Texas.

Christiansen, Dennis L. **Energy and Texas Transportation.** Springfield, Virginia, July 1980.

This report addresses three major topics: the relationship between the economy of Texas and Texas transportation fuel consumption; quantitative data describing the magnitude of the fuel shortfalls that occurred in 1974 and 1979; and potential transportation energy conservation options.

The Governor's Energy Advisory Council. **Provision of Electric Power in Texas: Key Issues and Uncertainties Volume I.** Prepared by the University of Texas at Austin, Center for Energy Studies, Austin, Texas, March 1977.

The purpose of this study is to assess the uncertainties associated with the economic and environmental impacts of various strategies the electric utility sector could use to alleviate energy problems associated with the transportation sector.

H. Transportation Alternatives

Anderson, J. E. **Personal Rapid Transit.** Minneapolis: Institute of Technology, Department of Audio Visual Extension, University of Minnesota, 1972.

This document is a collection of papers that discuss various economic and operating aspects of urban mass transit systems.

Cooper, Lawrence C. and Keith S. Weil. **Direct and Indirect Energy Use Aspects of Park-and-Ride Lots.** Arlington, Texas (undated).

This paper examined the importance of indirect energy expenditures, i. e., energy consumed for material manufacture, hauling, and construction, on direct energy savings of a prototype park-and-ride lot. It develops a procedure to estimate indirect energy requirements of a basic park-and-ride lot and the fuel savings incurred from lot usage by computers.

Kulash, Damian. "Energy Efficiency, Which Mode Which Program?" In Levinson and Weant (eds), **Urban Transportation: Perspectives and Prospects.** ENO Foundation for Transportation Inc., Westport, CT, 1982, pp. 86-96.

This essay examines several programs and alternative modal systems designed to enhance energy efficiency in urban mass transit.

Moran, Katie. **Bicycle Transportation for Energy Conservation.** Washington, D C, U. S. Department of Transportation, 1980.

This study presents information concerning the increased use of bicycles to enhance energy conservation.

Smith, Edward. "An Economic Comparison of Urban Railways and Express Bus Services", **Journal of Transportation Economics and Policy.** London School of Economics, London, January 1973, pp. 20-31.

The purpose of this paper was to compare the total economic cost of urban railways and express bus service.

Talley, Wayne Kenneth. **Introduction to Transportation.** Cincinnati, South-Western Publishing Company, 1983.

This book describes the energy requirements of alternative urban transportation technologies and ways to access their effects on urban transportation fuel consumption.

I. Others

Collings, Amy. **State Bus Fleet Study Documents Fuel Saving Measures.** University of Michigan, April 1990.

A demonstration program conducted in several New Jersey school districts identified 18 fuel cost-saving opportunities for school bus operations that could save the state an estimated $1.6 million in fuel costs.

Kulp, Gretchen, et.al. **Transportation Energy Conservation Data Book: Edition 4; ORNL-5654.** U. S. Department of Energy Regional Energy Information Center, Dallas-Region VI., September 1980.

This document is the fourth edition of the Transportation Energy Conservation Data Book, a statistical compendium compiled and published by the Oak Ridge National Laboratory under contract with the Office of Transportation Programs in the Department of Energy. The book presents statistics and data that characterize transportation activity and other factors that influence the use of transportation energy.

Loebl, A. S. et.al. **Transportation Energy Conservation Data Book: Edition 1: ORNL-5798.** Oak Ridge National Laboratory, Oak Ridge, Tn., 1977.

This document is the first edition of the Transportation Energy Conservation Data Book, a statistical compendium compiled and published by the Oak RidgeNational Laboratory under contract with the Office of Transportation Programs in the Department of energy. The book presents statistics and data that characterize transportation activity and other factors that influence the use of transportation energy.

Patterson, Philip D., and others. **Transportation Energy Conservation Data Book, Edition 3, ORNL-5493.** Regional and Urban Studies Section Energy Division, February 1979.

This document is the third edition of the Transportation Energy Conservation Data Book, a statistical compendium compiled and published by the Oak Ridge National Laboratory. It presents secondary data on transportation characteristics by mode, energy use, and other related variables in tabular and/or graphic form.

"School Transportation". **Executive Educator.** University of Michigan, Nov. 1990.

This journal article on student transportation presents a case study of a school system that recycles buses for safety drills; articles of fuel-saving strategies, the pros and cons of contracting for transportation services and a transportation directory.

III. APPENDICES/BIBLIOGRAPHY

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Berry, D. S., et.al. **Metropolitan Plan Making: An Analysis of Experience with the Preparation and Evaluation of Alternative Land Use and Transportation Plans.** Monograph Series No. 4, Philadelphia: Regional Science Research Institute, 1970.

Boyce, D. E., et.al. **Energy Consumption of Journey to Work With and Without a Suburban Transit System.** Transportation Research Record 689, TRB Washington, D C, 1978.

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Cooper, Lawrence C. and Keith S. Weil. **Direct and Indirect Energy Use Aspects of Park-and-Ride Lots.** Arlington, Texas.

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