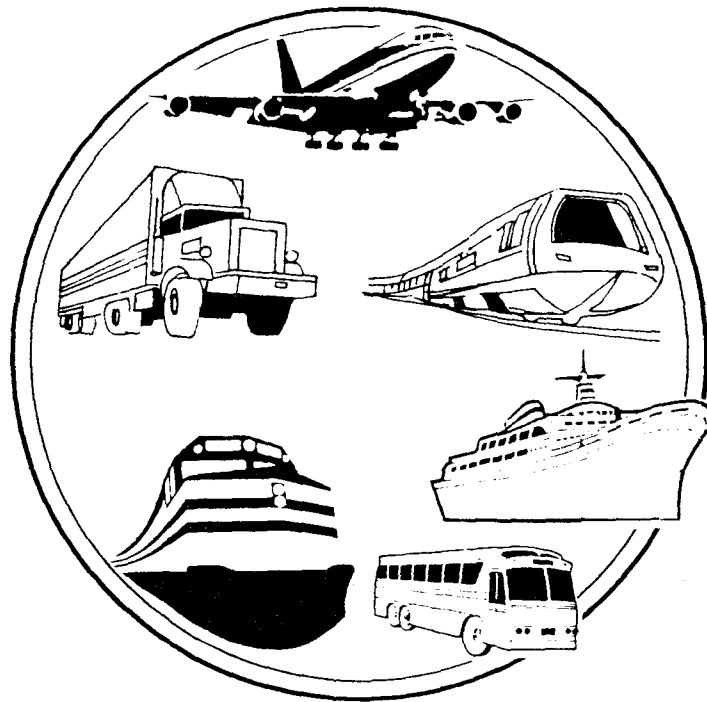


U.S. Department
of Transportation

Transportation and The Environment: An Annotated Bibliography



Federal Railroad Administration
Office of Policy
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Moving America

To jobs...To homes...To market



INTRODUCTION

This annotated bibliography is the result of an effort by the Office of Policy, Federal Railroad Administration, to determine the extent to which models had been developed that permit comparisons among transportation options as to environmental impacts.

The bibliography covers recent publications that describe or offer insights into environmental effects of transportation systems and how public policies are addressing transportation-related environmental issues.

The citations are organized by specific environmental media. However, a single transportation system or event may result in multiple environmental considerations. Therefore, the media boundaries are not exclusive, and the reader should consult citations under related categories as well. All articles and reports have been published in English unless otherwise noted.

The bibliography was compiled by an Environmental Task Force within the Office of Policy, Office of Economic Analysis, Federal Railroad Administration. The Task Force was directed by Marilyn (Mickey) Klein. Key contributing staff members were Stephen Grimm, Alexandra Newcomer, and John Paoella. Questions or comments may be directed to Ms. Klein at (202) 366-0358.



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1. Air Quality Issues

Transportation is a major contributor to air pollution, with motor vehicles accounting for a large share of nearly all the major pollutants found in the atmosphere. The Clean Air Act Amendments of 1990 (CAAA) tighten emission standards for motor vehicles and require increased use of alternative fuels and transportation control measures to reduce or limit highway vehicle use in the more serious non-attainment areas, which do not meet national air quality standards. The CAAA also require the Environmental Protection Agency to set emission standards for new locomotives and new locomotive engines by 1995.

Although the Intermodal Surface Transportation Efficiency Act of 1991 strongly reinforced the CAAA requirements through its planning requirements and flexible funding provisions, technical uncertainties, conflicting goals, cost-effectiveness considerations, and long-established behavioral patterns make achievement of air quality standards a tremendous challenge.

1. Searching for Solutions, A Policy Discussion Series, Transportation and Air Quality, U.S. Department of Transportation, Federal Highway Administration (FHWA), Office of Policy Development, No. 5, Washington, DC, August 1992.

This report summarizes a 1991 FHWA seminar on key issues in air quality and transportation planning, supplemented by a paper by Greig Harvey and Elizabeth Deakin, adding the perspective introduced by the 1991 Intermodal Surface Transportation Efficiency Act, which was in legislative proposal at conference time. The paper concludes that significant reductions in mobile source emissions through reductions in travel would be hard to achieve without a fundamental change in U.S. policy towards transportation pricing and land use.

2. Air Quality Programs and Provisions of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), a brochure prepared by the U.S. Department of Transportation, Federal Highway Administration, Washington, DC, August 1992.

The ISTEA complements the CAAA by providing funding and the flexibility to use it in ways that will help improve air quality through the development of a balanced, environmentally sound, intermodal transportation program. The introduction, by Federal Highway Administrator T.D. Larson, states that ISTEA funding and changes in transportation patterns alone cannot solve the problem. Greater mobile source emission reductions, particularly in the more serious nonattainment areas, will have to come from reducing the use of the automobile for all trips, including non-work trips.

3. The Challenges of Transportation and Clean Air Goals, Dr. Arnold M. Howitt and Dr. Alan Altshuler, Associate Director and Director, respectively, of the Taubman Center for State and Local Government, John F. Kennedy School of Government, Harvard University, for the U.S. Department of Transportation, June 1992.

The Clean Air Act Amendments of 1990 and the Intermodal Surface Transportation Efficiency Act of 1991 are likely to bring about significant changes in urban transportation planning, spending, and regulatory practice over the next few years. Together, these laws require the states to achieve the nation's clean air goals according to strict deadlines and to make air quality the top priority of transportation policy. In addition, they give states and localities unprecedented opportunity to use federal transportation funds flexibly. The paper elaborates on key issues DOT faces under the new legislation.

4. Southern California Accelerated Rail Electrification Program Report, Executive Summary and Five Volumes, prepared for the Southern California Regional Rail Authority, Los Angeles, CA, May 1992.

This report was prepared to respond to the South Coast Air Quality Management Plan, which dictates a 17% reduction in rail-related emissions by the year 2000, and a 90% reduction by the year 2010. The report provides cost estimates, a projected schedule, and a financial plan for reducing rail-related emissions in Southern California through electrification. It also addresses technical, policy, and institutional issues that require resolution.

5. Report to Congress on Railroad Emissions: A Study Based On Existing Data, Environmental Protection Agency, Standards Development and Support Branch, Ann Arbor, MI, (prepared in 1990 prior to passage of the Clean Air Act Amendments of 1990, released in 1991) 1991.

The report addresses the environmental impact of railroad emissions, potential emission reduction techniques and their costs and cost-effectiveness, and existing state and local regulations.

6. New Approaches to Urban-Scale Transportation Emissions Modeling Under a New Clean Air Act, C.L. Saricks; A.D. Vyas, Argonne National Lab., IL, funded by the U.S. Department of Energy, Washington, DC, 1991.

Techniques of estimating (and forecasting) emissions from transportation sources in specific urban areas have not progressed significantly in ten years. This paper identifies possible ways for state and regional planners to improve estimation of mobile source emissions without the need for substantially more resources than those needed to comply with requirements of the 1990 Clean Air Act Amendments, and by using tools and data sources that are already "on the shelf."

7. Energy and Environmental Issues 1991, Transportation Research Record, No. 1312, Transportation Research Board, National Research Council, Washington, DC, 1991.

The papers in this Record deal with a variety of environmental issues associated with the building and operation of transportation facilities. Papers discussing transportation and air quality include: Preparation of Highway Vehicle Emissions Inventories; Managing Trucks for Air Quality: Current Works in Progress; Sensitivity Analysis for Land Use, Transportation, and Air Quality; Pricing of Air Pollution in the Swedish Transport Policy; Transportation and Urban Air Pollution Policies for Developed and Developing Countries; and other papers. Two of these are described below:

"Preparation of Highway Vehicle Emission Inventories," John H. Suhrbier, Samuel T. Lawton, and Joseph Moriarty, Cambridge Systematics, Inc., pp. 42-49.

In this paper, existing highway vehicle emission inventory practices are assessed in 15 urban areas throughout the country, and these existing capabilities are compared with recommended EPA guidance. Existing approaches are often deficient in their estimation of highway vehicle speeds, and measurements use methodological approaches used for national-level emissions inventories. Institutional problems, such as funding limitations, institutional fragmentation, lack of available technical expertise, and a high level of staff turnover, present greater obstacles to satisfactory mobile source emission inventories than any technical limitations.

"Managing Trucks for Air Quality: Current Work in Progress," Chris Nelson and Sarah Siwek (South Coast Air Quality Management District), Randall Guenster (California Air Resources Board), and Kelly Michelson (Lockheed Information Management Services Co.), pp. 50-58.

Although truck traffic constitutes a relatively small portion of the total traffic volume, truck operations are a significant contributor to mobile source emissions in urban areas, particularly nitrogen oxides. This paper reviews the history of truck-related transportation control measures and current transportation control measures under consideration in California. The paper also reviews the uncertain effects of proposed measures, suggesting that emission reduction effects from truck traffic control measures are difficult to estimate, given the current state of modeling. The impact that truck traffic control measures will have on air quality and the economics of goods distribution require further study.

8. Transportation Planning Requirements of the Federal Clean Air Act Amendments (CAAA) of 1990: A Highway Perspective, James M. Shrouds, Chief, Noise and Air Quality Branch, U.S. Department of Transportation, Federal Highway Administration, Washington, DC, 1991.

This paper provides a highway perspective on, and an overview of, the key transportation planning requirements of the CAAA of 1990 that transportation planners must address.

9. Steering a New Course, Transportation, Energy, and the Environment, Deborah Gordon, Union of Concerned Scientists, Washington, DC, 1991.

Worsening congestion will soon make transportation an even more tedious, aggravating exercise than it already often is; dependence on foreign oil will make supplies increasingly unreliable and expensive. Without innovative strategies to reduce the number of miles driven, cars and trucks will continue to pollute air, water, and land. The book surveys policy options and provides a master list of policy recommendations for each level of government.

10. Energy and Environmental Factors in Freight Transportation, Dr. A. M. Khan, Carleton University, Ottawa, Canada, prepared for Transport Canada, Ottawa, Ontario, Canada, July 1991.

This study produces energy efficiency and environmental impact estimates for the freight transportation system in Canada. The effects of likely future traffic growth and the implications of selected scenarios for energy and environmental impacts are also assessed. The study found that in the year 2010, if 10% of tonne-kilometers were to be shifted to rail, a total of 864 million litres of diesel fuel would be saved (6.0% of petroleum-based fuels required for 2010 in freight transportation). Reduction in emissions would parallel fuel savings.

11. Energy and Environment 1990: Transportation-Induced Noise and Air Pollution, Transportation Research Record, No. 1255, Transportation Research Board, National Research Council, Washington, DC, 1990.

Includes essays on Transportation Noise (see Noise section), as well as papers on Comparisons of Emissions of Transit Buses Using Methanol and Diesel Fuel; Energy-Related, Environmental, and Economic Benefits of Florida's High-Speed Rail and Maglev Systems Proposals; as well as several other papers.

12. Alternatives to the Automobile, Transport for Livable Cities, Marcia D. Lowe, Worldwatch Paper 90, Worldwatch Institute, Washington, DC, 1990.

Traffic congestion and air pollution plague all major cities, and oil dependence makes economies vulnerable. A new, more rational approach to transportation is needed, one that puts the automobile in its rightful place as one among many options for travel.

13. Traffic Congestion, Trends, Measures, and Effects, Report to the Chairman, Subcommittee on Transportation and Related Agencies, Committee on Appropriations, U.S. Senate, U.S. General Accounting Office, Washington, DC, 1989.

In this overview of the traffic congestion problem, GAO found that there has been little empirical investigation of the effects of traffic congestion, although some relationships between congestion and higher business costs, poorer air quality, and behavior change are generally thought to hold. GAO suggests that while FHWA is taking aggressive steps to assess the present and future magnitude of traffic congestion, additional attention to this area is warranted.

2. Noise Pollution Issues

The Noise Control Act of 1972 established the Environmental Protection Agency's noise program, of which transportation was a major focus. The Act's goal was to promote an environment free from noise pollution and its adverse effects on public health and welfare.

The Noise Control Act required EPA to identify and prescribe noise sources in commerce; to submit to the Federal Aviation Administration regulatory proposals for controlling airport and aircraft noise; and to issue regulations limiting noise from interstate rail and motor carriers for Department of Transportation enforcement. The Act also required EPA to finance research and to provide technical assistance to state and local governments on noise abatement methods.

The EPA's noise control program has been unfunded since 1982, leaving the statute and regulations intact, but signifying a decreased level of enforcement, technical assistance, and noise research. However, noise pollution continues to be an issue in airport expansion and highway construction, and will be a consideration as the technology for high speed rail is developed.

1. Recommendations for Acoustical Test Facility for Maglev Research, Carl Hanson, Harris Miller Miller & Hanson Inc., prepared for U.S. Department of Transportation, Federal Railroad Administration, Washington, DC, (Final report pending), Task 4, Draft Report, September 1992.

Concludes that a comprehensive acoustical test program should be an integral part of any full scale testing program undertaken as part of U.S. maglev development. Benefits of an acoustical testing program would be a quieter maglev system and an enhanced understanding of aeroacoustic sources and aerodynamic drag associated with high speed surface transportation systems. Examines gaps in research to be filled by acoustical testing, as well as testing approaches to define maglev noise and vibration sources and to investigate mitigation methods.

2. Noise Criteria for High Speed Maglev Trains, Carl Hanson, Harris Miller Miller & Hanson Inc., prepared for U.S. Department of Transportation, Federal Railroad Administration, Washington, DC, Final Report: Task 2, September 1992.

Presents information on the criteria recommended for use in evaluating the noise impact from high-speed maglev systems. These criteria describe the noise environment considered acceptable for specific land uses, depending on the ambient noise. These recommendations are based on the best available data related to transportation systems with noise characteristics similar to high speed maglev. The conclusions are considered based on circumstantial evidence until more definitive methods can be verified.

3. Federal Agency Review of Selected Noise Analysis, Federal Interagency Committee on Noise (FICON), Washington, DC, August 27, 1992.

This report is the product of the 1990 Federal Interagency Committee on Noise (FICON), formed to review Federal policies governing the assessment of airport noise impacts. The FICON review examined the manner in which noise impacts are determined and described; the range of Federal Aviation Administration mitigation

options; and the relationship of the FAA regulatory process to the National Environmental Policy Act. The report makes technical conclusions on the DNL (Day-Night Average A-Weighted Sound Level) noise exposure metric, and the impact of airport noise on health and welfare, environmental degradation/impact, land use planning and public education. FICON policy recommendations are outlined.

4. Preliminary Design Guidelines for Noise Control on High-Speed Maglev Trains, Carl Hanson, Harris Miller Miller & Hanson Inc., prepared for U.S. Department of Transportation, Federal Railroad Administration, Washington, DC, (Final Report pending), Task 3, Draft Report, June 1992.

This report provides noise and vibration guidelines for assessment and design for the new maglev technology. Because mature or unused existing transportation corridors are being considered for alignments of maglev systems and these corridors pass through suburban and urban areas in close proximity to residential buildings and other noise sensitive sites, noise mitigation measures should be designed into the new systems.

5. "Noise Levels for U.S. Certificated and Foreign Aircraft," Advisory Circular No. 36-1F, U.S. Department of Transportation, Federal Aviation Administration, Washington, DC, June 5, 1992.

The Federal Aviation Administration's regulatory program for airplane noise requires the quantifying of airplane noise levels. This circular provides noise level data for certificated aircraft, and offers a common noise level reference for potential future reductions.

6. Noise Sources of High Speed Maglev Trains, Carl Hanson, Harris Miller Miller & Hanson Inc., prepared for U.S. Department of Transportation, Federal Railroad Administration, Washington, DC, Final Report: Task 1, May 1992.

Reviews basic acoustical terminology, describes the noise sources of maglev, including propulsion noise, mechanical/structural noise, and aeroacoustic noise, and quantifies the environmental noise issue.

7. "Noise Ransom," Railway Gazette International, May 1992.

A tribunal in France ruled the French National Railways must pay Fr200,000 in compensation to a land owner adjacent to the line over which the TGV operates.

8. Environmental Research Needs in Transportation, Transportation Research Circular, Transportation Research Board, National Research Council, pp. 26-35, Washington, DC, Number 389, March 1992.

A compilation of research problem statements representing a consensus of twenty-nine Transportation Research Board committees concerned with the identification and development of operational solutions to environmental issues in transportation, including highway/air/rail noise.

9. "Highway Traffic Noise," Barry Benioff, Fundamentals of Traffic Engineering, W. S. Homburger, editor, Institute of Transportation Studies, University of California at Berkeley, January 1992.

Technical definition of noise, its measurements, effects, sources, with recommendations for estimating road traffic noise, setting noise limits and for controlling traffic noise.

10. Noise Emission of the Swedish X2 High Speed Train, T. Stroem, Statens Provningsanstalt, Boras, Sweden, (Text in Swedish, summary in English), 1991.

Analysis of noise emissions of the Swedish X2 high speed train which started operations in 1990 between Stockholm and Gothenburg. Measurements were taken at 7.5 and 25 meters at speeds between 130 and 200 km/hr. Results indicated that the noise emissions of the X2 train at 200 km/hr is less than that of older trains operating at 160 km/hr.

11. Fighting Noise in the 1990s, A. Alexandre and J. Barde, editors, Organization for Economic Cooperation and Development, Paris, France, 1991.

Discussion of economic aspects, law and legislation for noise control and noise pollution.

12. Comprehensive System-Level Noise Reduction Strategies, W. Bowlby, Vanderbilt University, Vanderbilt Engineering Center for Transportation Operations and Research, Report for U.S. Department of Transportation, Federal Highway Administration and Washington State Department of Transportation (WSDOT), September 1991.

A comprehensive review of state-of-the-art in traffic noise abatement including surveys and a literature search. Discussion of abatement strategies, effective vehicle noise control, land use compatibility programs, and programmatic and administrative issues. Findings include: the demand for noise abatement is increasing; state DOTs need better sources of funds for retrofit noise barrier programs; state and local noise control programs have declined significantly since the end of the U.S. EPA noise program in 1982; truck manufacturers in the U.S. and Europe are successfully meeting their respective noise standards for newly manufactured vehicles. Current Washington State initiatives were also examined. WSDOT has included noise abatement as a priority area in its 1991 Transportation Policy Plan and the legislature developed a Growth Management Act and Growth Strategies Act that call for comprehensive land use plan development by cities and counties. Recommendations to WSDOT include the need for expanded staff, a dedicated source of funds for a phased retrofit abatement program and active involvement in implementation of the two growth acts.

13. Federal Register, U.S. Department of Transportation, Federal Aviation Administration, Washington, DC, "Transition to an All Stage 3 Fleet Operating in the 48 Contiguous United States and the District of Columbia" and "Notice and Approval of Airport Noise and Access Restrictions," September 25, 1991.

The first of these final rules places a cap on the number of Stage 2 airplanes allowed to operate in the United States and provides for a continuing reduction in the population exposed to noise from Stage 2 airplanes. The second rule establishes a program for reviewing airport noise and access restrictions on the operations of Stage 2 and Stage 3 aircraft.

14. Method for Analyzing, Evaluating and Developing Operational Aircraft Noise Abatement Measures in Civil Air Traffic, U. Rottmann, Technische Univ., Berlin, Germany, (Text in German), 1990.

Author indicates there is a lack of knowledge on noise emission side sound pressure levels, and offers a method of predicting the sound emission of departing and landing passenger aircraft based on third-octave noise level histograms while considering aircraft operating procedures, noise characteristics and flight performance, and meteorological and topographic noise propagation conditions.

15. Transit and the Environment, TransVision Consultants Ltd., Victoria, British Columbia, Canada, 1990.

The report situates transit in the environment, evaluates its contribution to reducing air and noise pollution, indicates the constraints to which it is subject, and reviews the contribution which the various forms of transit make to preserving and improving the environment and the quality of life of urban dwellers.

16. En Route Noise Annoyance Laboratory Test: Preliminary Results, D. McCurdy, National Aeronautics and Space Administration, Langley Research Center, Hampton, Virginia, 1990.

Relatively little research has been conducted for en route aircraft noise. To address this need, the author conducted a laboratory experiment to quantify the annoyance of people on the ground to en route noise generated by aircraft at cruise conditions. The objectives were to determine the annoyance prediction ability of noise measurement procedures and corrections when applied to en route noise; to determine differences in annoyance response to en route noise and takeoff/landing noise; and to determine differences in annoyance response to advanced turboprop en route noise and conventional jet en route noise.

17. Energy and Environment 1990: Transportation-Induced Noise and Air Pollution, Transportation Research Record No. 1255, Transportation Research Board, National Research Council, Washington, DC, 1990.

Includes papers on public reaction to low levels of aircraft noise; airport noise insulation of homes surrounding Stapleton International Airport; case study for three dwellings near BWI Airport; control of wheel squeal noise in rail transit cars; atmospheric effects on traffic noise propagation; predicting stop-and-go traffic noise with STAMINA 2.0; feasibility of transparent noise barriers; field testing of the effectiveness of open-graded asphalt pavement in reducing tire noise from highway vehicles; cost of noise barrier construction in the United States; high-speed rail system noise assessment.

18. En Route Noise: NASA Propfan Test Aircraft (Calculated Source Noise), E. Rickley, U.S. Department of Transportation, Transportation Systems Center, Cambridge, MA, April 1990.

This reports on a two-phased joint National Aeronautics and Space Administration (NASA) and Federal Aviation Administration (FAA) program to study the high-altitude, low-frequency acoustic noise propagation characteristics of the Advanced Turboprop (propan) aircraft. FAA/NASA designed a program to obtain noise level data from the propfan test bed aircraft, both in the near field and at ground level to test low frequency atmospheric absorption algorithms and prediction technology to provide insight into the necessity for regulatory measures. The curves of calculated source noise versus emission angle are based on a second order best-fit curve of the peak envelope of the

adjusted ground data. Centerline and sideline derived source noise levels are shown to be in good agreement.

19. Highway Traffic Noise in the United States - Problem and Response, U.S. Department of Transportation, Federal Highway Administration, Office of Environmental Policy, Noise and Air Analysis Division, Washington, DC, August 1990.

Describes the federal-aid highway system and the three-part approach to highway noise abatement, including land use planning and control; source control; and highway project noise mitigation. Describes noise barriers and FHWA noise abatement procedures.

20. Environmentally Sound, M. Smith, Report No. PNR-90776, presented at the Third Annual Conference in Techno-Economic Issues, London, England, August 31, 1990.

Reviews developments made in Stage 2 aircraft since 1989. Discusses: reengined stage 2 aircraft and orders for stage 3 Tay engines to replace Boeing 727 Pratt and Whitney engines; airports' stranglehold on stage 2 operations; hushkits as marginal stop-gap methods; and concern about atmospheric pollution by old engines powering stage 2 aircraft.

21. Inter-Noise 89 - Engineering for Environmental Noise Control; Proceedings of the International Conference on Noise Control Engineering, Poughkeepsie, N.Y., Noise Control Foundation, 1989.

Examines various methods of engineering for noise control

"Airport Noise Impact Analysis Problems," S. Lane, pp. 909-912.

Discussion of CNEL (Community Noise Equivalent Level) as the sole scale for noise evaluation, subsequent erroneously low values of aircraft noise levels, inaccurate data from malfunctioning noise monitor systems, and discrepancies between published noise contours and the airport noise monitor data. Discussion of current noise impact criteria and existing scales, including aircraft event average noise level, LEQ (Long-Term A-Weighted Equivalent Sound Level); SENEL (Sound Exposure Level, or SEL); the speech interference fractional impact; the sleep interference fractional impact, and comparisons between these criteria and the DNEL and LDN (Day-Night Average A-Weighted Sound Level, or DNL) scales.

"Aircraft Noise Annoyance," T. Gjestland, pp. 903-908.

Presentation of recent studies of annoyance due to aircraft noise, assessed in different residential communities and different countries, indicating there may be a difference in community reaction depending on the type of noise source. For any given noise level, twice as many people will be annoyed by aircraft noise as by road traffic noise. Description of an extensive study to assess community reaction to aircraft noise around the Fornebu Airport in Oslo. The results are being used to establish a new model for aircraft noise annoyance and to establish guidelines for the interpretation of Norwegian zoning laws around major airports.

"Airport Noise Control - New Zealand's Radical New Approach to the 'Airnoise Boundary' Principle," P. Dickinson, pp. 685-690.

Discussion of airnoise boundary and proposed compatible land use zoning. Airlines are required to balance aircraft type and noise generation with time and direction of flights.

"Fifteen Years of Noise Control at Logan International Airport," L. Coleman, pp. 665-670.

Discussion of noise control at Logan Airport, including establishment of a noise office in the Department of Aviation at Logan, promulgation of strict noise regulations, expansion of noise monitoring and complaint processing systems, and initiation of studies leading to improved flight tracks, runway preference rules, and sound proofing programs. The program has caused a 60 percent reduction in the population exposed to a day-night sound level exceeding 65 dB.

22. "Use of FAA's Nationwide Airport Noise Impact Model," S. Albersheim, paper delivered for Proceedings of the International Conference on Noise Control Engineering, Newport Beach, CA., 1989.

Describes the Nationwide Airport Noise Impact Model (NANIM), which makes it possible to assess nationwide the number of people affected by aircraft noise. The model, based on the Integrated Noise Model for determining the day-night average sound level (DNL) noise contours for aircraft operations, enables analysis of various policy alternatives to control and mitigate aircraft noise.

23. Transportation Noise: Federal Control and Abatement Responsibilities May Need to be Revised, Report to Congress, U.S. General Accounting Office, Washington, DC, October 1989.

Report examines the phaseout of the Environmental Protection Agency Noise Program and its current activities and role. Describes efforts to control and abate aircraft, railroad, and traffic noise, and the federal role in transportation noise control and abatement. Recommends alternatives Congress may consider if it wishes to change the federal transportation noise role.

24. Reduction of Aircraft Noise in Civil Air Transport by Optimization of Flight Tracks and Takeoff and Approach Procedures, U. Rottmann, Technische Univ., Fachgebiet Flugfuehrung und Luftverkehr, Berlin, Germany, (Text in German, summary in English), August 1989.

Analysis of optimal design of operational flight procedures for effective noise pollution reduction. Designs include power cutback during approach and takeoff, extension of distance between sound source and sound receiver, and diminution of sound impact time. Five takeoff and three landing procedures are examined for acoustic effects. Sound emission is computed by NOISIMSIS (NOISE Impact Simulation System), a simulation system created to consider aircraft type sound emission characteristics and performance data and differing meteorological conditions. Data from the Frankfurt Airport were used to develop a plan for operational noise abatement.

25. Research on Noise and Environmental Issues, Transportation Research Record, No. 1176, Transportation Research Board, National Research Council, Washington, DC, 1988.

Includes nine papers on highway noise and noise abatement measures.

26. The Williamsburg Conference on Noise Research; A Technical Conference to Develop a Plan of Needed Noise Research, Society of Automotive Engineers, July 1985.

Discussion of the need for standardized measurement and test procedures for all types of vehicles; the problem of site variability; and the inadequate data on real-world equipment application.

27. Analysis of Highway Construction Noise, U.S. Department of Transportation, Federal Highway Administration Technical Advisory, March 13, 1984.

Provides information on the analysis of highway construction noise to ensure that potential construction noise impacts are given adequate consideration during highway project development.

28. Federal Register, Railroad Noise Emission Compliance Regulations, U.S. Department of Transportation, Federal Railroad Administration, Washington, DC, December 23, 1983.

Revises the Federal Railroad Administration's noise enforcement procedures to encompass the railyard noise source standards published by the Environmental Protection Agency in 1980.

29. Federally Coordinated Program of Research and Development in Highway Transportation, Annual Progress Report Fiscal Year 1982, U.S. Department of Transportation, Federal Highway Administration, Washington, DC, 1982.

Discussion of pollution reduction and environmental enhancement and social and economic concerns in highway development and improvement. Discussion of noise abatement.

30. "Assessment of Traffic Noise - Investigations on the Annoyance Effect, on Road and Railway," International Railway Congress Association, pp. 13-22, January 1982.

Investigates the subjective feelings of persons affected by transportation noise as well as the objective intensity of the sound. Study found that people assess rail traffic noise more favorably than traffic noise at similar noise intensities. This finding was incorporated into the setting of emission levels for transportation in Germany.

31. Handbook for the Measurement, Analysis, and Abatement of Railroad Noise, U.S. Department of Transportation, Federal Railroad Administration, Office of Research and Development, Washington, DC, January 1982.

This handbook provides an introduction to acoustics, and describes the required measurement and analysis procedures and available abatement techniques to meet railroad noise regulations.

32. Foreign Noise Research in Surface Transportation, 1978-1981, Environmental Protection Agency, Washington, DC, May 1981.

Identification of foreign research projects in surface transportation noise abatement.

33. Report to Congress on the Evaluation of the EPA Revised Railroad Noise Regulation Source Standards, U.S. Department of Transportation, Washington, DC, June 1980.

This analysis of EPA's proposed regulations describes their economic and financial impact on the railroad industry and recommends modifications to EPA's adoption of a final rule.

34. Federal Register, Environmental Protection Agency, Noise Emission Standards for Transportation Equipment; Interstate Rail Carriers, January 4, 1980.

Final rulemaking which established noise emission standards for four railyard noise sources pursuant to Section 17 of the Noise Control Act of 1972, 42 U.S.C. 4916.

35. "Noise - The Quiet Revolution," J. Fleming, Journal of Institution of Municipal Engineers, January 1980.

Discussion of noise insulation legislation in Scotland, pertaining to insulation of properties adjacent to highways.

36. The Impact of Noise Pollution, A Socio-Technological Introduction, George Bugliarello and Ariel Alexandre, Pergamon Press, 1978.

An overview of the socio-technological aspects of noise, the effects of noise on health, surface transportation noise, aircraft noise, and the political economy of noise.

37. Noise Control: Handbook of Principles and Practices, edited by David M. Lipscomb and Arthur C. Taylor, Jr., Van Nostrand Reinhold Co., 1978.

Handbook on noise assessment, definition, measurements, noise control, environmental assessment of noise, and noise control legislation. Includes the following articles:

"Aircraft and Airport Noise," William C. Sperry, pp. 206-247.

Discussion of noise sources and control and the consideration of noise control as a system concept utilizing source control as applied to the engine and airframe; path control as applied to flight procedures; receiver control; and land-use control, consisting of the development or modification of airport surroundings for maximum noise-compatible usage. Discusses population impact and the history of legislative and regulatory activities.

"Highway and Rail Traffic Noise," Edwin G. Ratering, pp. 248-278.

Examines the scope of traffic noise, the contribution of trucks to traffic noise, vehicular component hardware development for control of engine-related truck noise, noise test standards for trucks, and noise control of existing truck fleet. Also examines the contributors to low-speed and high-speed automobile noise and railroad noise and its components - locomotive noise and wheel/rail noise. Locomotive noise is generated by the engine exhaust system, the cooling fans, engine structure vibration, and car body vibration. Wheel/rail noise can be attenuated by continuous welding of rail joints, grinding wheels, grinding rails, and car modifications, such as vibration damping devices.

"Preparation of Noise Control Legislation," Janet F. Pawlak, pp. 279-324.

Discussion of components of community noise control legislation, including such issues as property line or receiving land use sound levels and preemption of local communities' authority to regulate certain noise sources.

38. Laboratory and Community Studies of Aircraft Noise Effects, D. Stephens, Langley Research Center, National Aeronautics and Space Administration, Virginia, September 1978.

Program to determine the effects of noise as a public health problem examines community and passenger acceptability. The community acceptance research includes subjective response studies of single and multiple aircraft overflights as well as longer term community noise exposure. Emphasis is on the development of indices which quantify annoyance. The passenger acceptance research determines acceptable levels of interior noise and vibration for passenger and crew comfort.

39. Noise-Con 77 Proceedings, 1977 National Conference on Noise Control Engineering, edited by George C. Maling, Jr., Noise Control Foundation, New York, N.Y., 1977.

Examines government programs of transportation noise control, and the environmental impact of noise created by air and surface transportation systems. Papers consider cost-effectiveness analysis and safety and economic considerations in tire noise control and the noise environments created by rail transit systems and aircraft. Includes the following articles:

"Noise From High Speed Trains in the Northeast Corridor," Carl E. Hanson, pp. 129-135.

Analysis of the site specific Environmental Impact Statement for the Northeast Corridor Improvement Project may show that certain specific locations will require noise control measures, but the Preliminary EIS concludes the noise environment from high speed trains in the Northeast Corridor will show an improvement in future years because of the use of quiet electric locomotives, the elimination of diesel locomotives, the elimination of jointed rail, and the elimination of grade-crossings and associated whistle-blowing.

"Wheel/Rail Noise: The State-of-The-Art," Paul J. Remington, pp. 257-280.

Reviews the present state of knowledge of the characteristics of at-grade wheel/rail noise, the mechanisms that produce it, experimental confirmation of those mechanisms, and techniques for its control.

"Internal Combustion Engine Exhaust Muffling," Malcolm J. Crocker, pp. 331-358.

Exhaust noise is the predominant noise source of the internal combustion engine. Reviews the existing theories in muffler design, recent advances, and problems to be resolved.

"The FHWA Highway Traffic Noise Prediction Model - Manual Method," Jerry A. Reagan, pp. 181-185.

This noise prediction model is based upon a concept of adjustments, including adjustments for real traffic flows, finite length roadways, and shielding.

"Aircraft Flyover Noise Prediction," William E. Zorumski, pp. 205-222.

Examines the prediction techniques for turbofan-powered aircraft and the sources of noise, including jet noise, fan noise, combustion noise, and airframe noise. Describes propagation prediction methods, source shieldings, and atmospheric and ground attenuation.

"Some Advances in Design Techniques for Low Noise Operation of Propellers and Fans," Richard E. Hayden, pp. 381-396.

Reviews advances in the reduction of noise from fans and propeller installations through a combination of proper installation, control of the aerodynamic environment, and use of advanced blading concepts.

"Locomotive In-Cab Noise - Towards a Standardized Measurement Methodology," Robert M. Clarke, pp. 431-442.

Describes program in which the Federal Railroad Administration, the Association of American Railroads, and the National Bureau of Standards collected locomotive in-cab noise level data in order to develop a simplified stationary test procedure to yield data that correlated with crew exposure and noise level data for typical operational duty cycles. Program also provided data for development of Occupation Safety and Health Administration hearing conservation regulations.

40. In-Service Performance and Costs of Methods to Control Urban Rail System Noise, Test and Evaluation Plan, U.S. Department of Transportation, Transportation Systems Center, April 1977.

Report details the methods and equipment used to collect data on both acoustic performance and costs of four noise control methods to reduce wheel/rail noise in rail rapid-transit systems (resilient wheels, damped wheels, wheel truing, and rail grinding).

41. Highway Noise: A Guide to Visual Quality in Noise Barrier Design, Randolph Blum, prepared by The Organization for Environmental Growth, Inc. for the U.S. Department of Transportation, Federal Highway Administration, Washington, DC, 1976.

An extensive review of aesthetics in the design process, visual design principles, design concepts, and the application of principles to highway noise abatement.

42. Aviation Noise Abatement Policy, U.S. Department of Transportation, Office of General Counsel, Washington, DC, November 1976.

DOT recommendations to reduce aircraft noise, considering the constraints of technology, productivity and financing. Clarifies federal government responsibility to reduce aircraft noise at the source, to promote safe operational procedures that lessen the impact of noise on populated areas and to promote positive efforts to attain compatible land use in areas adjacent to airports.

43. Reassessment of Noise Concerns of Other Nations, C. Modig, editor, Informatics, Inc., Environmental Protection Agency, Washington, DC, August 1976.

Overview of noise abatement programs of other countries, including laws, regulations, guidelines, criteria, research, and governmental organization.

44. Background Document for Proposed Medium and Heavy Truck Noise Regulations, Environmental Protection Agency, Washington, DC, National Technical Information Service, October 1974.

45. Background Document: Environmental Explanation for Proposed Interstate Rail Carrier Noise Emission Regulations, Environmental Protection Agency, Washington, DC, June 1974.

This report describes in detail the railroad industry, railroad noise sources, procedures to measure railroad noise, and the environmental and economic effects of the EPA's proposed regulations.

46. Background Document/Environmental Explanation for Proposed Interstate Rail Carrier Noise Emission Regulations, Environmental Protection Agency, Washington, DC, March 1974.

Document includes data base for the regulation; railroad noise sources; summary of what proposed regulations will require; enforcement considerations; economic effects of a retrofit program; environmental effects of proposed regulations; selection of the proposed regulations.

47. Report on Aircraft - Airport Noise, Environmental Protection Agency, Washington, DC, July 1973.

Discussion of adequacy of Federal Aviation Administration flight and operational noise controls; adequacy of noise emission standards on new and existing aircraft; recommendations on the retrofitting and phaseout of existing aircraft; implications of identifying and achieving levels of cumulative noise exposure around airports.

48. Consideration of Environmental Noise Effects in Transportation Planning by Governmental Entities, L. Mayo, George Washington University, National Technical Information Service, Washington, DC, December 1972.

Paper explores environmental effects of the development of the Interstate Highway System and the increase in automotive vehicles, and the evolution of the regulatory structure relating to aircraft noise.

49. Transportation Noise and Noise from Equipment Powered by Internal Combustion Engines, Environmental Protection Agency, Washington, DC, December 31, 1971.

Comprehensive handbook on noise sources in both commercial and recreational transportation with extensive discussion of the internal combustion engine.

50. Public Hearings on Noise Abatement and Control Held at New York, New York, October 21-22, 1971, Transportation Noise (Rail and Other); Volume VI, Environmental Protection Agency.

Report on hearing concerning metropolitan noise, and control measures related to subways, airports, and highways, with attention to the noise effects on humans.

51. Noise Pollution and the Law: The Noise Crisis, D. Anthrop, Hein Company, June 1970.

Discussion of motor vehicle and aircraft noise sources and abatement principles.

3. Oil Pollution Issues

The Oil Pollution Act of 1990 (OPA 90), amended the Water Pollution Control Act and created a comprehensive prevention, response, liability, and compensation regime for dealing with oil pollution from vessels and facilities. OPA 90 substantially increased Federal oversight of oil transportation by setting new requirements for vessel construction and operation, crew licensing, and manning; by mandating contingency planning; enhancing Federal response capability; broadening enforcement authority; increasing penalties; and creating a new research and development program. A one billion dollar trust fund, financed by a five cent per barrel fee on imported oil, is available to cover cleanup costs and damages not compensated by the spiller, whose financial responsibility requirements were significantly increased under OPA 90.

Federal responsibilities directed toward prevention of oil spills rest primarily with the U.S. Environmental Protection Agency; the Minerals Management Service, U.S. Department of the Interior; and the Maritime Administration, the U.S. Coast Guard, and the Research and Special Programs Administration of the U.S. Department of Transportation. Potential oil pollution from landside railroad facilities is regulated by the Coast Guard if navigable waters are involved or by the EPA. The Research and Special Programs Administration is developing regulations on facility response plans applicable to the transportation of oil and hazardous substances for pipelines, motor carriers, and railroad tank cars. These regulations will be issued under sections of the Federal Water Pollution Control Act (33 U.S.C. 1321) and the Hazardous Materials Transportation Act (49 U.S.C. 1804) to satisfy the statutory directives of OPA 90 for oil spill emergency response plans.

1. International Oil Pollution R & D Abstract Database, U.S. Interagency Coordinating Committee on Oil Pollution Research, preliminary issue, printed for distribution at the International Oil Spill Research & Development Forum, Tysons Corner, Virginia, June 1992.

Narrative database of abstracts provided by research managers prepared under Title VII of the Oil Pollution Act of 1990 which established the Interagency Committee to develop a comprehensive program of oil pollution research, technology development, and demonstration. Project research categories include bioremediation, burning, chemical countermeasures, decision support, disposal/storage, effects, fate, mechanical recovery, prevention, and surveillance/remote sensing.

2. Oil Pollution Research and Technology Plan, United States Interagency Coordinating Committee on Oil Pollution Research, Report to Congress, April 24, 1992.

OPA 90 established an Interagency Coordinating Committee on Oil Pollution Research to develop a comprehensive program of research, technology development, and demonstration among Federal agencies, in cooperation with industry, universities, research institutions, state governments, and other countries. This report identifies the following priority areas to be addressed by the Interagency Committee: prevention; spill response planning and management; spill response, fate and effects; and restoration. The proposed project descriptions range from vessel structural design to advanced electronic systems, to protection of migratory birds. The major focus of the project plan is on oil spill prevention, response and mitigation.

3. Lessons of the EXXON VALDEZ, R. Steiner and K. Byers, National Sea Grant Coll. Program, Silver Spring, MD, 1991.

An essay on prevention and control of oil spills, with a summary of environmental and biological effects of the spill accompanied by information on state and federal research, an overview of oil spill containment and cleanup technology, and a summary of significant state and federal legislative action.

4. Safety in Petroleum Movement: Is Enough Being Done to Protect the Environment, B. Bialas, Naval Postgraduate School, Monterey, California, December 1991.

The thesis investigates whether sufficient efforts are being taken to provide safety in petroleum movement. Current practices in spill prevention and cleanup are identified and recommendations made.

5. Performance of Oil Industry Cross-Country Pipelines in Western Europe: Statistical Summary of Reported Spillages, 1990, Y. Barriol, CONCAWE, The Hague, Netherlands, November 1991.

This report reviews the performance of oil industry cross-country pipelines in Western Europe. It covers an oil pipeline network of 19,350 km, and analyzes reported spillage incidents by cause and effectiveness of clean-up. In 1990, there were three reportable spillage incidents, resulting in gross spillage of 582 cubic meters, or 0.00009 percent of the total volume transported. Third party damage continues to be the largest cause of oil loss from pipelines in Western Europe.

6. Coast Guard: Oil Spills Continue Despite Waterfront Facility Inspection Program, K. Mead, U.S. General Accounting Office, Washington, DC, October 1991.

Statement of Kenneth Mead before the Subcommittee on Oversight and Investigations and the Subcommittee on Coast Guard and Navigation, Committee on Merchant Marine and Fisheries, U.S. House of Representatives.

7. Update on Implementation of the Oil Pollution Act of 1990, Volume 1, Numbers 1 through 4, February - September 1991.

This series of bulletins provides updated information on the Environmental Protection Agency's implementation of the various provisions of the Oil Pollution Act of 1990, including development and enforcement of regulations and policies.

8. Coast Guard: Oil Spill Liability Trust Fund Not Being Used to Pay All Allowable Costs, U.S. General Accounting Office, Washington, DC, August 1991.

9. Tanker Spills: Prevention by Design, National Research Council, Washington, DC, February 1991.

The study, prompted by the March 1989 grounding of the EXXON VALDEZ in Prince William Sound, Alaska, focused on how alternative tank vessel (tanker and barge) designs might influence the safety of personnel, property, and the environment, and at what cost. In selecting designs to be considered, the committee included certain operational options that might minimize the oil spilled in an accident. The study did not consider means of averting accidents, altering the form of cargo, or responding to oil spills.

10. Pollution From Pipelines: DOT Lacks Prevention Program and Information for Timely Response, U.S. General Accounting Office, Washington, DC, January 1991.
11. Oil Spill Contingency Planning: National Status. A Report to the President, Department of Transportation, Office of the Secretary, Washington, DC, October 1990.

The report examines the Nation's oil spill preparedness and response system, including the Federal government's National Response System and state, local and industry contingency planning, and addresses key environmental and health concerns, including the potential for contamination of the food chain.

12. Marine Accident Report - Grounding of the U.S. Tankship EXXON VALDEZ on Bligh Reef, Prince William Sound, Near Valdez, Alaska, March 24, 1989, National Transportation Safety Board, Bureau of Accident Investigation, Washington, DC, July 1990.

The report explains the grounding of the tanker and examines safety issues, including the vessel's navigation watch, the role of human factors, manning standards, the company's drug/alcohol testing and rehabilitation program, vessel traffic service, and oil spill response.

13. Unregulated Potential Sources of Groundwater Contamination Involving the Transport and Storage of Liquid Fuels: Technical and Policy Issues, J. Davis, Argonne National Laboratory, Argonne, Illinois, National Technical Information Service, Springfield, Virginia, August 1989.

Discussion of environmental aspects, such as effect on groundwater through oil pollution of water by oil storage tanks.

14. The Exxon Valdez Oil Spill: A Report to the President, Environmental Protection Agency, Washington, DC, National Technical Information Service, May 1989.

Report by Samuel Skinner, Secretary, U.S. Department of Transportation and William Reilly, Administrator, Environmental Protection Agency, prepared by the National Response Team.

15. "Spilled Petroleum in the Subsoil: Problems, Remediation, and Costs," F. Pita, Proceedings of the American Railway Engineering Association, Vol. 88, pp. 134-158, 1987.

16. Guidance and Procedures for Administering and Enforcing the Oily Waste Reception and Facility Program, U.S. Coast Guard, Washington, DC, 1985.

Discussion of law and legislation relating to oil pollution of the seas.

4. Hazardous Materials Issues

Our society benefits from the chemical, nuclear, electrical and petroleum industries, which require hazardous materials in their production and also produce hazardous wastes. Although the probability of an accidental release while transporting hazardous materials is very low, there is justifiable concern that hazardous materials be transported in the safest manner possible, since a release can be catastrophic for a community and the environment. Accidental releases with catastrophic results do in fact occur, as is evidenced by the July 14, 1991 spill of a herbicide into the Sacramento River, when a tank car ruptured during a derailment in Dunsmuir CA. Issues currently being addressed are equipment reliability, alternative routings, modal choice, and the adequacy of emergency response.

1. Code of Federal Regulations 49, Parts 100 to 177, Subchapter C - Hazardous Materials Regulations.
2. "Environmental Impacts of a Modal Shift," M. William Newstrand, Marine and Intermodal Transportation: Freight Movement and Environmental Issues, Transportation Research Record, No. 1333, Transportation Research Board, National Research Council, pp. 9-12, Washington, DC, 1992.

This paper compares water transportation with rail and trucks. The author theoretically transfers cargo from four regularly scheduled vessel movements to rail and trucks, then calculates the effects upon fuel consumption, exhaust emissions, accidents, and other effects of the modal shift. This analysis attempts to demonstrate some of the potential environmental costs of a modal shift from water. Modal impact factors used for the analysis are somewhat dated and the emission factor was an aggregate. The modal impact factors used indicate that water transportation is the most fuel efficient and produces the least amount of emissions on a ton-mile basis. Modal impact factors also indicate trucks obtained 60 ton-miles per gallon compared with 204 ton-miles per gallon for rail. While emissions measured by pounds per gallon are about twice as high for rail as for trucks, when measured on a ton-mile basis, rail produces .0034 pounds per ton-mile and trucks produce .0052 pounds per ton-mile.

3. Cargo Tank Rollover Protection, National Transportation Safety Board, Special Investigation Report Hazardous Materials Accident Report, Washington, DC, 1992.

As a result of several cargo tanker accidents on the highways, NTSB conducted this investigation on cargo tank rollover protection. The safety issues discussed are: the adequacy of DOT regulations concerning the design and performance of rollover protection devices, the effectiveness of cargo tanker design and construction oversight, and the adequacy of accident reporting and data collected by DOT.

4. Proposals For the Road Traffic, Training of Drivers of Vehicles Carrying Dangerous Goods: Regulations 1991, Health and Safety Commission, London, England, 1991.

This document contains proposals for regulations for the training of drivers of road vehicles carrying dangerous goods, including explosives and radioactive materials. The regulations are necessary to implement in England the provisions of a European Directive imposing requirements for training, examinations, and certification.

5. Assessing the Risk of Transporting Hazardous Materials by Aircraft: A Case Study, M. J. Davis and L.A. Haroun, Argonne National Lab., IL, 1991.

This risk assessment involves the transport of PCBs by aircraft.

6. Freight Transportation: Truck, Rail Water, and Hazardous Materials, Transportation Research Record, No. 1313, Transportation Research Board, National Research Council, Washington, DC, 1991.

Includes several articles. The most informative are:

"State and Local Issues in Transportation of Hazardous Materials: Toward a National Strategy," M. Abkowitz, P. Alford, A. Boghani, J. Cashwell, E. Radwan and P. Rothberg, pp. 49-54.

This paper presents findings of a recent conference whose objective was to identify effective methods for managing hazardous materials transportation within the evolving national system. The conference was organized into five major themes: community preparedness and response; evaluating and communicating risk; routing and citing considerations; data collection and information management; and inspection and enforcement.

"Benefit-Cost Evaluation of Using Different Specification Tank Cars to Reduce the Risk of Transporting Environmentally Sensitive Chemicals," C.P.L. Barkan, T.S. Glickman and A.E. Harvey. pp. 33-43.

This paper presents an analytical approach to quantifying the benefits and costs of transporting specific chemicals in tank cars. The results indicate that reduced liability would result from using a specific type of tank car, which more than offsets the increased capital and operating costs required.

7. "A Probability Model To Assess the Risk of Railroad Accidents Involving Radioactive Material," H.B. Spraggins, J. Ozment, and P. Fanchon, Transportation Research Forum, Journal of the Transportation Research Forum, Vol. 32, No. 1, 1991.

This paper identifies issues relevant to rail route risk analysis and presents a probability model of a train accident involving nuclear materials via movement by mixed train or dedicated train.

8. Hazardous Materials on Board, C. Hild, Alaska Sea Grant Coll. Program, Fairbanks, 1991.

This book contains sections on the introduction to hazardous materials, common hazardous materials, confined spaces, personal protective equipment, hazardous spills on board, label and law, and references.

9. Motor Carriers of Hazardous Materials: Who Are They? How Safe Are They?, L.N. Moses and I. Savage, Northwestern University Department of Economics, 1991.

Using a database of 13,000 government audits of motor carriers, this paper investigates whether trucking firms that haul hazmat differ from firms that do not haul hazmat. The investigation found that the haulers of hazmat were larger and less safe than non-hazmat carriers.

10. Overturn of a Tractor-Semitrailer (Cargo Tank) With the Release of Automotive Gasoline and Fire, Carmichael, California February 13, 1991, National Transportation Safety Board, Hazardous Materials Accident Report, Washington, DC, 1991.

This report reviews the overturn of a cargo tanker and the subsequent fire. It discusses the following safety issues: the lack of DOT standards concerning manhole covers on motor vehicle tanks, the adequacy of California highway standards, the effectiveness of the carrier's evaluation of driver training and performance, and the lack of post-accident toxicological testing.

11. "Purchasing Hazardous Waste Transportation Service: Federal Legal Considerations," J.M. Sharp, R.A. Novack, M.A. Anderson, American Society of Transportation and Logistics Transportation Journal, Vol. 31 No. 2, pp. 4-14, December 1991.

This paper attempts to acquaint the purchaser of hazmat transportation with environmental statutes and gives a framework for compliance with these laws.

12. "Highway Transportation of Hazardous Materials," TranSafety, Incorporated, Road Work Safety Report, Vol. 1, No. 6, December 1991.

This study attempts to analyze the existing exposure and accident data pertaining to highway transportation of hazmat and summarizes the present knowledge and practices related to highway safety, design, traffic operations, and incident management.

13. "Some Hazmat Facts," TranSafety, Incorporated, Transafety Reporter, Vol. 9, No. 11, November 1991.

The paper discusses a Federal Highway Administration report, "Present Practices of Highway Transportation of Hazardous Materials".

14. "Factors of Risk Assessment For Transporting High-Level Radioactive Waste and Spent Fuel by Dedicated Train vs Regular Train," in Proceedings of the Thirty-third Annual Meeting, Transportation Research Forum, New Orleans, Louisiana, October 31-November 2, 1991.

This paper identifies some of the risk concerns of the directive involving dedicated and regular train movement of nuclear materials and presents a model of risk which could be used to assess those risks.

15. Hazardous Materials: 1990 Transportation Uniform Safety Act-Status of DOT Implementing Actions, U.S. General Accounting Office, Washington, DC, November 1991.

This report discusses the status of DOT's implementation of The Hazardous Materials Transportation Uniform Safety Act of 1990 (HMTUSA).

16. Inspection Programs Improvements Are Under Way to Help Detect Unsafe Tankers, U.S. General Accounting Office, Washington, DC, October 1991.

This report was prepared in response to Congressional inquiry concerning the Coast Guard's inspection program for tankers carrying oil and other hazardous cargo. This report indicates that the Coast Guard has begun to improve its inspection program.

17. "Technical Committee on Road Tunnels," XIX World Road Congress, Marrakesh, Permanent International Association of Road Congress, Paris, France, September 22-28, 1991.

This is a committee report which treats several topics including an analysis of risk resulting from the transit of hazardous materials.

18. Transportation Safety: Information Strategy Needed For Hazardous Materials, U.S. General Accounting Office, Washington, DC, September 1991.

This report was conducted to determine whether key initiatives to improve longstanding hazardous materials information shortcomings were successful, and whether any strategy guides DOT in directing the information management and technology resources devoted to its hazmat mission. Findings: DOT is unable to use information effectively to evaluate activities or support safety accruing from its inspections and enforcement activities; and DOT has no directives outlining Department-wide Hazmat information management responsibilities.

19. "Second Toxic Spill in Two Weeks Brings SP, Railroads Under Scrutiny," Traffic World, No. 6, Vol. 227, August 5, 1991.

This article discusses the two recent accidents on the SP involving hazardous materials and the transportation of hazmat by rail.

20. Proceeding of Hazmat Transport '91, A National Conference on the Transportation of Hazardous Materials and Wastes, Northwestern University, Evanston Transportation Center, Evanston, Illinois, June 17-19, 1991.

This volume documents the proceedings of a national conference on the transportation of hazardous materials and waste, held at Northwestern University. The conference was a neutral forum at which many viewpoints were aired and original research findings presented. The following papers were given at the conference:

"The Hazardous Materials Transportation Uniform Safety Act of 1990: The U.S. Department of Transportation Perspective," Travis P. Dungan, Administrator, Research and Special Programs Administration, U.S. Department of Transportation.

This is a summary of the requirements of the statute as it relates to DOT and an overview of hazmat transportation.

"The Rail Perspective on Hazardous Materials Transportation," James A. Hagen, Chairman of Conrail.

This paper addresses the key issues of hazmat transportation by rail, in particular, Conrail.

"Behind Human Error Accidents," John K. Lauber, National Transportation Safety Board.

This paper describes several accidents from the viewpoint of operator performance and professional standards, management commitment to safety, and operator training and human factors outside the vehicle.

"Data Requirements for the Development of a Quantitative Risk Assessment Model for Rail Transportation of Hazardous Materials," Christopher P.L. Barkan, Manager, Environmental and Hazardous Materials Research Division, Association of American Railroads.

This paper states that while rail has a relatively good safety record, it is in the interest of the public and industry that improvements in hazmat transportation safety be as effective and efficient as possible. To that end, Barkan discusses the efforts of the rail, tank car and chemical industries, which are working to develop a quantitative risk assessment model for rail transportation of hazmat.

"The Law and Economics of Hazardous Materials Transportation: Regulating Harm by Administrative Agency and by Tort Liability," Thomas S. Ulen and Charles Kolstad.

This paper discusses the authors' views on how best to achieve the socially optimal amount of precaution, while regulating the transportation of hazmat.

"U.S. Department of Transportation Report on Mandated Studies and Regulatory Procedures to Date," Alan I. Roberts, Associate Administrator for Hazardous Materials Safety, U.S. Department of Transportation, Research and Special Programs Administration.

This paper discusses the status of DOT legislatively mandated studies and regulatory procedures.

21. Flows of Selected Hazardous Materials By Rail, F. Beier, et al. U.S. Department of Transportation, Research and Special Programs Administration, Volpe National Transportation Systems Center, Final Report for September 1987-April 1991, Washington, DC, May 1991.

This study looks at rail traffic in 1986 and is designed to characterize the flow of selected hazardous materials and show their geographical distribution.

22. Transportation of Hazardous Materials by Rail, National Transportation Safety Board, Washington, DC, Adopted May 16, 1991.

For this study, the Safety Board conducted a study of 45 selected railroads.

23. "New Hazmat Regulation," Railway Age, pp. 44-45, April 1991.

This article questions the cost-benefit from new hazmat regulations in light of a record which is characterized as good.

24. "Revitalizing the Circuitry," Hazardous Cargo Bulletin, Vol. 12, No. 1, January 1991.

This article presents highlights of papers presented on a conference on tank containers entitled Tank Frans 90 in Berlin on October 17-19, 1990. Papers were presented on the topic and other issues, such as quality control, tank cleaning, transport of dangerous substances through the Channel Tunnel, road vs rail, liability, and safety.

25. "Critics say federal haz-mat data bank is useful, but falls short of filling need," Traffic World, p. 64, March 11, 1991.

This article finds that the Hazardous Materials Information Exchange does provide useful information. However, this data bank is just a good beginning, and it should include additional information, i.e., information on worst-case accident scenarios.

26. Transportation of Hazardous Material 1989, Transportation Research Record, No. 1245, Transportation Research Board, National Research Council, Washington, DC, 1990.

Includes several articles. The most informative are:

"Comparison of Risk Measures for the Transport of Dangerous Commodities by Truck and Rail," by F.F. Saccomanno, J.H. Shortreed, M. Van Aerde, and J. Higgs, pp.1-13.

In this paper, the risks of transporting dangerous commodities by truck and by rail are expressed by four constituent elements: accident rates; spill probabilities in an accident situation; hazard areas for different classes of damage; and expected impacts on population and environment along a specified road or rail corridor. The findings indicate that regardless of the material being shipped or the underlying transportation conditions, trucks reflect higher accident rates than rail; for most tanker systems, the probability of release in an accident situation is higher on rail than truck; the expected impacts for damage to population and property associated with rail transport of dangerous goods are lower than for trucks.

"Characteristics of Accidents and Incidents in Highway Transportation of Hazardous Materials," by D.W. Harwood, E.R. Russell and J.G. Viner, pp. 23-33.

This paper focuses on the role of traffic accidents as a cause of severe hazardous materials incidents. Conclusions: about 99% of fatalities and 96% of injuries involving trucks carrying hazardous materials are not related to the hazmat release. Approximately 11% of hazmat incidents that occur on public highways are caused by traffic accidents, and about 99% of the fatalities and injuries in accidents involving hazmat-carrying trucks result from the physical collision.

"Minimizing Derailments of Railcars Carrying Dangerous Commodities Through Effective Marshaling Strategies," by F.F. Saccomanno and S. El-Hage, pp.34-51.

This paper presents a procedure for establishing and evaluating the effectiveness of alternative marshaling and buffering strategies for positioning special dangerous commodity cars.

"Bicriterion Routing Scheme for Nuclear Spent Fuel Transportation," by Shin-Miao Chun and Paul Der-Ming Cheng, pp. 60-64.

The objective of this paper is to develop an automated system to evaluate the trade-off between transportation cost and potential population at risk under different nuclear spent fuel transportation strategies. The authors believe that by combining sophisticated algorithms with graphical representation of the network, the methodology allows the trade-offs among non-inferior paths to be understood more quickly and more fully.

27. Transportation of Hazardous Material 1990, Transportation Research Record, No. 1264, Transportation Research Board, National Research Council, Washington, DC, 1990.

Includes several articles, the most informative are:

"Evaluating Routing Alternatives for Transporting Hazardous Materials Using Simplified Risk Indicators and Complete Probabilistic Risk Analyses," by William R. Rhyne; "Truck Accident Rate Model for Hazardous Materials Routing," by D.W. Harwood, J.G. Viner and E.R. Russell; "Fatality Risk Curves for Transporting Chlorine and Liquefied Petroleum Gas by Truck and Rail," by F.F. Saccomanno, J.H. Shortreed, and R. Mehta; "Restricting Hazardous Materials Routes on the Nation's Railroads: Some Considerations for Regulatory Analysis," by T.S. Glickman.

28. Planning for Future Waste Storage and Transport Requirements, G.M. Holter, M.R. Shay and D.L. Stiles, Battelle Pacific Northwest Labs., Richland, WA, 1990.

This paper discusses that any planning should take into account the storage and transport capabilities that will be required to properly manage the wastes, from the point of generation through to their ultimate disposal.

29. Radioactive and Hazardous Materials Transportation: What Local Officials Are Telling Us, J.A. Walker, G.E. Ruberg, and S.H. Denny, Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, 1990.

This paper summarizes the results of a 1989 meeting of US Department of Energy representatives with over twenty local officials from cities and counties around the country.

30. "Modeling Equity of Risk in the Transportation of Hazardous Materials," R. Gopalan, K.S. Kolluri, R Batta and M.H. Karwan, Operations Research, Vol. 38. No. 6. November-December 1990.

This paper develops and analyzes a model to generate an equitable set of routes for hazardous material shipments. Its objective is to determine a set of routes that will minimize the total risk of travel and spread the risk equitably among the zones of the geographical region in which the transportation network is embedded.

31. Present Practices of Highway Transportation of Hazardous Materials, D.W. Harwood and E.R. Russell, Midwest Research Inst., Kansas City, MO, May 1990.

This report summarizes the art of safe management of hazardous materials transportation by highway.

32. Proceedings of the National Conference on Hazardous Materials Transportation, St. Louis, Missouri, concerned with "State and Local Issues in Transportation of Hazardous Waste Materials: Towards a National Strategy," May 14-16, 1990.

This volume documents the proceedings of a national conference on the transportation of hazardous materials held in St. Louis, Missouri, May 14-16, 1990. The following papers were given at the conference:

"Evaluation of Hazardous Material Transportation By Rail," W.H. Oderwald, M.A. Sontag.

This paper describes the application of the data bases utilized in the model, along with an explanation of the function and philosophy of the Princeton Transportation Network Model. This model is used by shippers, receivers, and manufacturers to evaluate current and proposed rail routings.

"Flows of Hazardous Materials Through States By Rail," R.C. Hannon and P. Zebe.

This paper presents information on the tonnages of hazardous materials passing through each of the contiguous 48 states and DC by rail.

"Computer-Assisted Risk Assessment of Dangerous Goods Transportation for Haute-Normandie," S. Lassarre, K. Fedra, and E. Weigkricht.

This is software based on a geographical information system to manage, treat and represent statistical and geographical data related to the evaluation of risk of transport on a road network in a 600 sq. km. area in France.

"StatGen/StateNet and DOT Guidelines: Tools for Highway Routing of Hazardous Materials," J.W. Cashwell, J.D. Brogan, and C.M. Erickson.

This presentation discusses the latest update of the StateGen/StateNet model, its structure and routing algorithm, which contains the codified USDOT Guidelines for Highway Route Controlled Quantity Shipments of Radioactive Materials.

"Societal-Individual Risks for Hazmat Transport," F.F Saccomanno, J.H. Shortreed.

This paper considers the risks associated with the transport of hazmat by truck and rail from two perspectives: society in general and the individuals residing adjacent to the route.

"A Risk and Vulnerability Assessment Approach for Selected Routes: A Case Study of Hazardous Waste Transportation in Arizona," K.D. Pijawka, A.E. Radwan, and J.A. Soesilo.

This study's objective was to provide an approach to selecting routes to a proposed hazardous waste treatment and storage facility, based on a risk and vulnerability assessment.

"A Community-Focused Routing and Citing Model for Hazardous Materials and Wastes," G. List and P. Mirchandani.

This is a model that shippers, carriers, and policy-makers can use to analyze routing problems for hazmat or routing and siting problems for wastes.

"Assessing Community Safety for Hazardous Materials Transport," C-K. Chiang, E.J. Cantilli, and S.T. Ying.

This paper describes a computer model developed to assess the safety of a community through which hazmat will be transported. The model is predictive and can be used even in the absence of a past history of incidents.

"Canadian Database Development as a Support Tool To Transport Risk Assessment," D.A. Learning.

This paper provides details on the databases the Risk Management Branch has available to assess accident trends and exposure to dangerous goods, and introduces a costing model under development to further enhance risk management.

"Hazardous Materials Data: A Federal Perspective," R.C. Hannon.

This paper discusses the evolution and current status of the Hazardous Materials Incident Report System maintained by RSPA.

"Risk Management in the Transportation of Dangerous Goods--the Influence of Public Perception--a Discussion," M.K. Matthews.

This paper discusses an example of how public perception of risk can unduly influence the proper response to effective risk management in the transportation of dangerous goods.

"Dangerous Goods Emergency Response: The Western Australian Experience," K. Price.

This paper is a general overview of the experience of the State of Western Australia in the management of hazmat transportation.

"State Legislative Concerns Relative to Federal Hazardous Materials Transportation Regulations," J.B. Reed.

This paper indicates that states have asserted their authority in regard to regulations of hazmat transport where they believe there are inadequate or declining Federal efforts. States' interests include, inspection, enforcement, emergency response and routing.

33. Hazardous Materials Flow By Rail, U.S. Department of Transportation, Research and Special Programs Administration, Final Report, Washington, DC, March 1990.

This report is a quantitative overview of the movement of hazardous materials by rail in the U.S. The data used is a hazardous materials rail waybill sample developed at TSC from the 1983 Waybill Sample.

34. Collision and Derailment of Montana Rail Link Freight Train with Locomotive Units and Hazardous Materials Release, Helena, Montana February 2, 1989, National Transportation Safety Board, Railroad Accident Report, Washington, DC, December 6, 1989.

This report reviews the accident on Montana Rail Link and discusses various related safety issues, i.e., train operations, maintenance of airbrake system in extreme cold weather, oversight of employee preparedness, tank car performance, and documentation of hazmat shipments.

35. Guideline for Applying Criteria to Designate Routes for Transporting Hazardous Materials, U.S. Department of Transportation, Research and Special Programs Administration, Final Report, Washington, DC, July 1989.

These guidelines were prepared to assist state and local officials in analysis of alternate routes to be used by highway vehicles transporting hazmat.

36. Transport of Radioactive Material by Air, Proposal for a Revision of the Regulation, C. Devillers, and C. Ringot, CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses (France), January 1989.

This paper states that the regulations should be modified in such a way that the packages used for the air transport of radioactive material presenting a high level of potential danger be designed to fulfill their safety function for a large fraction of the conditions likely to be encountered in an aircraft accident.

37. In-Flight Fire, McDonnell Douglas DC-9-83, N569AA, Nashville Metropolitan Airport Nashville, Tennessee, February 3, 1988, National Transportation Safety Board, Hazardous Materials Incident Report, Washington, DC, September 13, 1988.

This report reviews an in-flight fire involving undeclared and improperly packaged hazmat and the procedures followed by the crew and airline.

38. Basic Facts About the Transport of Packaged Radioactive Products, Amersham International Ltd. (England), 1987.

This pamphlet details the regulations that apply to transport of radioactive materials and outlines the precautions to be taken, along with what should be done if a package of radioactive materials is damaged and how packages of radioactive materials can be recognized.

39. Truck Transportation of Hazardous Materials - A National Overview, Dominic J. Maio, U.S. Department of Transportation, Research and Special Programs Administration, Transportation Systems Center, Final Report, Washington, DC, December 1987.

This report's objective was to provide regulators and policy-makers with: an estimate of the national volume of hazardous chemicals and petroleum products transported in trucks, a profile of the truck fleet that carries hazmat, and a geographical distribution of this transport activity.

40. Handling and Management of Hazardous Materials and Waste, by Theodore H. Allegri, Sr., Chapman and Hall, New York, 1986.

Discusses the Resource Conservation and Recovery Act which authorized the EPA to perform specific functions to assess and manage hazardous wastes, including the setting of standards for the transportation of hazardous wastes. Enumerates federal regulations concerning the loading and unloading of hazardous materials.

41. "Institutional issues affecting the transport of hazardous materials in the United States: Anticipating strategic management needs," S.A. Carnes, Oak Ridge, TN, Hazardous Materials, No. 13, 1986.

This article attempts to discuss the complex and dynamic institutional environment in which hazardous materials are transported. The article summarizes the institutional environment in which hazardous materials are transported and identifies related institutional issues.

42. Transportation of Hazardous Materials, U.S. Congress, Office of Technology Assessment, U.S. Government Printing Office, Washington, DC, July 1986.

This study was requested by the Senate Committee on Science, Commerce, and Transportation to determine whether major safety problems exist in the transportation of

hazardous materials that should be addressed through legislation, and whether appropriate technology exists that could improve this essential portion of our nation's commerce. OTA's study is a comprehensive assessment of the regulations, information systems, container safety, and training for emergency response and enforcement.

43. Transportation of Hazardous Materials: State and Local Activities, U.S. Congress, Office of Technology Assessment, U.S. Government Printing Office, Washington, DC, March 1986.

This report is in response to a Senate request that OTA undertake a study of the transportation of hazardous materials. This study summarizes Federal programs and identifies three major areas of state and local government concern: prevention and enforcement activities; emergency response and training; and planning and data gathering. It outlines related issues, describes methods by which jurisdictions are responding to these issues, and documents the concerns that the Federal government could address.

44. Barge Collisions, Rammings and Groundings: An Engineering Assessment of the Potential for Damage to Radioactive Material Transport Casks, B.L. Hutchison, Glosten Associates, Inc. Seattle, WA, January 1986.

This study was performed to gain insight into each of these types of accidents, with particular attention to those processes that possess potential for causing structural damage to the casks.

45. "What's New in Hazardous Material Transportation?", Traffic Management, pp. 78-83, Volume 24, No. 11, November 1985.

This article discusses current issues in hazmat transportation, i.e. uniformity of regulations and federal pre-emption, DOT's role in the hazmat program, and international regulations. This article suggests that uniformity of regulations and federal pre-emption is necessary, in addition to more leadership at DOT, to protect the interests of US shippers from foreign regulators.

46. Transportation of Radioactive and Hazardous Materials: A Summary of State and Local Legislative Requirements for the Period Ending December 31, 1984, N.P. Knox, L. F. Goins and P.T. Owen, John Ludwigson (ed.), U.S. Department of Energy, Information Research and Analysis Information Resources Organization, Oak Ridge, TN, September 1985.

This report summarizes 513 adopted US state and local laws that affect the transportation of radioactive materials.

47. Transportation of Hazardous Material: Planning and Accident Analysis, Transportation Research Record, No. 977, Transportation Research Board, National Research Council, Washington, DC, 1984.

Includes several articles, the most informative is:

"A Survey of Foreign Hazardous Materials Transportation Safety Research Since 1978," by M.E. Wright and T.S. Glickman, pp. 39-43.

This is a survey of truck, rail, and air transportation concerning vehicle and container technology, emergency response technology, traffic flow and accident information, risk assessment, and policy analysis regarding operations, emergency planning, and regulations.

48. Assessing the Release and Costs Associated With Truck Transport of Hazardous Wastes, Office of Solid Waste, Environmental Protection Agency, 1984.

This study estimates the release from and the costs of the truck transport of hazardous waste. This report contains these estimates for bulk and container shipments. Perhaps the most important result of this study is that the release rates associated with transporting hazardous wastes by truck appear to be as large as the potential releases at treatment and disposal sites.

49. "Derailments and Release of Hazardous Materials," by Theodore S. Glickman and Donald B. Rosenfield, Management Science, Volume 30, Number 4, pp. 257-277, April 1984.

Models were used to assess the risks of hazardous materials releases in train derailments. The results of a model indicated that: the chances are high (95%) that no one will be killed when a derailment release accident takes place.

50. Community Teamwork: Working Together to Promote Hazardous Materials Transportation Safety. A Guide for Local Officials, Cambridge Systematics, Inc., Cambridge, MA, May 1983.

This Guide is designed to provide ideas on how to develop a hazardous materials transportation safety program at the most economical cost.

51. "The Ten Most Critical Issues in Hazardous Materials Transportation," Transportation Research Circular, Transportation Research Board, National Research Council, Number 219, Washington, DC, July 1980.

While somewhat dated, this paper identifies ten major issues associated with the transportation of hazardous materials. Most of the issues presented in this 1980 paper are still major issues today.

52. Regulation of the Movement of Hazardous Cargoes, David M. Baldwin, National Cooperative Highway Research Program, Transportation Research Board, National Research Council, Washington, DC, May 1980.

These guidelines were prepared to assist State and local officials in analysis of alternate routes to be used by highway vehicles transporting hazmat.

5. Land Use Issues

Land use and transportation systems are inextricably linked together. Historically, transportation facilities have been constructed to foster land development, often without any consideration for adverse environmental impacts. However, new or expanded transportation facilities, which require a substantial amount of land, are increasingly difficult to build because of their direct and indirect environmental effects on communities and the landscape. Moreover, public recognition of declining environmental quality (particularly air quality), increasing congestion, and the role of transportation in shaping development patterns, has begun to focus attention on the need to integrate transportation and land use planning.

Rail freight and passenger service, including commuter service, operating over existing tracks or within existing transportation corridors, can complement or substitute for more environmentally intrusive modes in some corridors. Unfortunately, the role of rail service in an integrated approach to transportation and land use planning does not appear to be widely recognized. However, the Intermodal Surface Transportation Efficiency Act of 1991 contained provisions strengthening the urban planning process. The process must now include additional considerations such as land use, intermodal connectivity, and transit service enhancement.

1. "Automobile Subsidies and Land Use: Estimates and Policy Responses". Mark E. Hanson, Journal of the American Planning Association, Vol. 58, No. 1, pp. 60-71, 1992.

The article estimates the magnitude of long-term automobile subsidies and discusses how they encouraged a pattern of urban/suburban sprawl.

2. Land Use In Commuter Rail Station Areas: Analysis and Final Report, METRA and the Northeastern Illinois Planning Commission, 1992.

The report focuses on enhancing the land use at Chicago area commuter rail stations and includes descriptions of nine prototypical rail stations (including the current rail service, access characteristics, and land use patterns) and concludes by suggesting land use and developmental guidelines, goals and objectives for six station prototypes. The report is accompanied by a companion color brochure of the six prototype stations.

3. "Transit-Sensitive Suburban Land Use Design: Results of a Competition," Edward Beimborn; Harvey Rabinowitz; Charles Mrotek; and Shuming Yan; Public Transit Research: Management and Planning, Transportation Research Record, No. 1297, Transportation Research Board, National Research Council, Washington, DC, pp. 116-124, 1992.

The paper presents an analysis of the extent to which public transit was included in the over 250 submissions to the International City Design Competition. The authors found that the competitors explicitly evaluated public transit in only 43 percent of the proposals, and bus, park-and-ride, or commuter rail were seldom considered as options. The authors concluded that the state of the art incorporating public transit into land use design is poor, and that unless this view is changed, little future change from the current auto dominated suburbs can be expected.

4. "Impacts of Transit Facilities on Land Use," Institute of Transportation Engineers Technical Committee 6Y-38, ITE Journal, Vol. 62, No. 1, pp. 37-39, January 1992.

The article reviews the full committee report on an analysis of the impact that urban transit can have on land use with the impacts of the Toronto, Washington, DC, San Francisco, Buffalo and Atlanta systems viewed in detail.

5. "A PRT Deployment Strategy to Support Regional Land Use and Rail Transit Objectives" J.B. Schneider, Transportation Quarterly, V46, pp. 135-53, January 1992.

The article discusses strategic metropolitan scale land use planning and outlines a strategy that will allow those interested in conventional rail and personal rapid transit (PRT) to join forces and work together to increase transit's share of the urban mobility market.

6. Special Report 231, Transportation, Urban Form, and the Environment, Transportation Research Board, National Research Council, Washington, DC, 1991.

This report contains the papers and workshop reports from a December 9-12, 1990 conference that focused on the complexity of interactions between transportation, land use and environmental impacts. The conference participants suggested areas where research is required to better understand the interactive relationships.

7. Shaping Cities: The Environmental and Human Dimensions, Marica D. Lowe, Worldwatch Institute, Washington, DC, October 1991.

The paper suggests that the way cities physically evolve and the way their development is planned have profound impacts on the environment. The paper looks at urban planning in other countries and discusses the relationships between land use and efficient transport.

8. The New Suburb: Final Report, Harvey Rabinowitz, Edward Beimborn, University of Wisconsin, Milwaukee, WI, prepared for U.S. Department of Transportation, Urban Mass Transit Administration, Washington, DC, July 1991.

The report presents a historical background for transit use and suburban development and examines two groups of development projects, the first a group of ten exemplars that are analyzed for transit potential and the second, a group of 250 entries submitted in the International City Design Competition. Based on their analysis the authors believe that while some progress towards integrating transit into suburban developments has occurred, most metropolitan areas not yet affected by suburban air pollution and congestion will continue to rely on the automobile.

9. Guidelines for Transit-Sensitive Suburban Land Use Design, Edward Beimborn, Harvey Rabinowitz, University of Wisconsin, Milwaukee, WI, prepared for U.S. Department of Transportation, Urban Mass Transit Administration, July 1991.

The report provides market based guidelines for planning and designing public transit sensitive land use patterns. The use of transit corridor districts (TCD) that separate transit- and auto-oriented land uses is advanced and a prototype TCD with implementation guidelines is described. Transit-sensitive land use would be enhanced by increasing densities near transit routes and emphasizing pedestrian and bicycle access.

10. The Renaissance of Rail Transit in America, Regional Planning Association, New York, New York, June 1991.

The report describes the types and locations of existing rail transit in the U.S. and abroad, profiles nine North American transit systems developed in the post WWII period, and provides data supporting the expanded use of existing rail transit and development of new systems. Land use and its link to transportation, particularly rail transit, is highlighted, and the future potential of rail transit and station development is emphasized.

11. "Suburban Congestion: Recommendations for Transportation and Land Use Responses," Thomas F. Humphrey, Transportation, V16, No.3, pp. 221-40, 1989/90.

The paper highlights congestion problems and solutions and discusses short and long term approaches, including transportation actions where there are opportunities for better utilization of existing systems.

12. "Dealing with Congestion from a Regional Perspective: The Case of Massachusetts," Michael D. Meyer, Transportation, V16, No.3, pp. 197-219, 1989/90.

In this paper, the author argues that, in many cases, congestion is a widespread problem that must be viewed from a regional and programmatic perspective and emphasizes four policy areas including managing land use.

13. "Regulating Traffic by Controlling Land Use: The Southern California Experience," Martin Wachs, Transportation, V16, No.3, pp. 241-56, 1989/90.

The paper examines four transportation growth management strategies in Los Angeles, suggests many recent proposals have been hastily enacted, and recommends devoting more resources to monitoring and evaluation and to the development of new analytical tools.

14. A Guide to Land Use and Public Transportation for Snohomish County, Washington, The Snohomish County Transportation Authority, December 1989.

The report describes the promotion of public transportation-compatible land uses such as zoning ordinances, transportation management plans, and residential development site designs. The report presents: criteria to judge compatibility of land use and transit; community planning goals and policies; and work sheets to determine whether or not a particular development is compatible with public transportation.

6. Water Pollution and Wetlands Issues

Traditional water quality concerns have focused on bacterial contaminants, oxygen depleting wastes and sediment loads from human activities, and priority is now being given to toxic substances as well. The source of this pollution tends to originate from point sources, primarily industry and sewage treatment facilities. Increasing attention is now being paid to non-point sources such as the run-off of water from urban areas and agriculture. However, the transportation sector's role in water pollution does not appear to be well defined or understood.

Concerns over wetlands has primarily focused on the loss of wetland acreage from the construction of highway projects and the conversion of wetlands to agricultural use.

1. U. S. Environmental Protection Agency Research Program on the Environmental Impacts and Control of Highway Deicing Salt Pollution, Environmental Protection Agency (EPA), Risk Reduction Engineering Lab, Cincinnati, OH, 1992.

Salt-laden runoff from streets, highways, and storage facilities can result in damage to public water supplies, ponds, lakes and surface streams, roadside soil, vegetation and trees, and infrastructure and vehicles. This paper outlines the results of several 1970s studies on highway-deicing impacts characterization and control conducted by the EPA's research program on urban stormwater and combined sewer overflow pollution control.

2. "Measuring the Economic Value of Water Quality: The Case of Lakeshore Land," Donald N. Stiennes, The Annals of Regional Science, V26, pp. 171-76, 1992.

The paper discusses the difficulty economists and others have had in valuing water quality using hedonic methods. The author suggests that the economic value may be attached to a perceived (as opposed to actual) measure of water quality.

3. "Our Disappearing Wetlands," John G. Mitchell, National Geographic, pp. 3-45, October, 1992.

This article presents an overview of the importance of wetlands and highlights the loss of 300,000 acres of wetlands each year.

4. Maintenance Guidelines for Accumulated Sediments in Retention/Detention Ponds Receiving Highway Runoff, Final Research Report, Performed by University of Central Florida, Department of Civil Engineering and Environmental Sciences for the U.S. Department of Transportation, Federal Highway Administration, Washington, DC, September 1990.

The report details a two year study investigating sedimentation rates and heavy metal enrichment and leaching from accumulated bottom sediments in nine Florida highway runoff detention/retention ponds.

5. "The Imperatives of Nonpoint Source Pollution Policies," Peter Rogers and Alan Rosenthal, Journal of Water Pollution Control Facilities, V60, No. 11, pp 1912-1921, 1988.

The article provides an overview of nonpoint source water pollution, water policy decision-making, and a matrix evaluation of nonpoint source pollution control policies.

7. Related Environmental Issues

While many recent publications may be readily categorized by environmental topic, some are sufficiently broad in scope as to apply to a wide range of transportation related environmental issues. The following list of publications fits this description and contains information on a wide range of topics including future options in transportation technology, national overviews of environmental impacts, and broad, in-depth discussions/descriptions of transportation and the environment.

1. Earth in the Balance: Ecology and the Human Spirit, Senator Al Gore, Houghton Mifflin Company, Boston, New York, London, 1992.

Senator (now Vice President) Gore addresses environmental issues that involve the earth's ecology, population trends, appropriate technology, and environmental education. He believes that the severity of the environmental crisis requires a bold and visionary response to bring the earth back into balance.

2. New Technology Options for Transit in California, Institute for the Future, sponsored by California Department of Transportation, Division of New Technology, Materials, and Research, 1992.

The report identifies new transit technology options and systems and makes recommendations as to transit initiatives in California including: auto disincentives (price-by-use systems); education on transit's value; and the need for coordinated transit and land use planning.

3. New Technology Options for Transit in California: Internal Appendix, Institute for the Future, sponsored by California Department of Transportation, Division of New Technology, Materials, and Research, 1992.

The appendix provides detailed information on the characteristics and emerging future technologies of various passenger transit technologies, including: light rail; rapid rail; commuter rail; personal rapid transit; etc.

4. Public Transportation, Edited by George E. Gray and Lester A. Hoel, 2nd Ed, Prentice Hall, Englewood Cliffs, New Jersey, 1992.

This text is a reference work that deals with all transit modes including commuter rail, bus, rapid rail, paratransit and ridesharing; it contains 25 chapters by various experts dealing with all areas of public transportation including: history; systems and technologies; alternatives; planning; management and operations; policy considerations; and the future of public transport.

5. Fundamentals of Traffic Engineering, Wolfgang S. Homburger, James H. Kell, David D. Perkins, Institute of Transportation Studies, University of California at Berkeley, 1992.

This text contains basic information on highways and traffic engineering, as well as data on other transportation modes, energy consumption and environmental impacts.

6. Flexible Funding Opportunities for Transit, U.S. Department of Transportation, Federal Transit Administration, Washington, DC, 1992.

The Intermodal Surface Transportation Efficiency Act (ISTEA) established flexible funding opportunities for highway and transit use. This report reaffirms the need for collaborative multimodal planning and summarizes the necessary steps, presents a broad overview of the Surface Transportation Program, including the flexible funding distribution and eligibility criteria, describes the flexible funds programs, and presents a state-by-state breakdown of the FY 1992 flexible funding opportunities.

7. "Commuter Rail Comes to Los Angeles," David Lustig, Trains, pp. 34-36, November 1992.

The start of Metrolink commuter rail operations in the Los Angeles area is described, including routes, equipment and service. The service operates over existing freight lines and when complete will eventually consist of 60 stations and 400 miles of track and will serve six counties in the Los Angeles area.

8. "Commuter Rail Traffic Increases With a Pitch to Keep Air Clean," Metro Magazine, Vol. 88, No. 5, pp. 47-52, September/October 1992.

The value of commuter rail service in reducing air pollution has become a marketing opportunity for the commuter authorities in the tri-state New York, New Jersey, Connecticut area. Recent significant service and facility improvements have increased on-time performance and have allowed the authorities to offer employers innovative programs, such as coordinating train schedules and local bus service (in Westchester County and the Bronx), and, in Greenwich, CT, a coordinated train-van shuttle between train stations and the central business district.

9. High-Speed Passenger Ground Transportation: An Analysis, Marc D. Latman, Northeast Midwest Congressional Coalition, September 1992.

This study states that the federal government has historically contributed only limited resources to the development of high-speed rail transportation. Growing concern over traffic congestion and the environment has prompted new interest in this mode of travel. This study suggests that the installation of a high-speed ground transportation system in the U.S. will relieve congestion, help state economies, and lessen environmental degradation.

10. Travel Behavior Issues in the 90s, based on data from the 1990 National Personal Transportation Survey (NPTS) and the 1985 and 1989 American Housing Surveys (AHS), Alan Pisarski, for the U.S. Department of Transportation, Federal Highway Administration, Office of Highway Information Management, Washington, DC, July 1992.

Drawing on data from the NPTS and the AHS, this report provides a selective review of changes in the amount, purpose, and mode of personal travel, as related to various demographic and geographic factors.

11. New Perspectives in Commuting, based on early data from the 1990 Decennial Census and the 1990 National Personal Transportation Study, Alan Pisarski, for the U.S. Department of Transportation, Federal Highway Administration, Office of Highway Information Management, Washington, DC, July 1992.

The 35 percent increase in persons driving alone to work from 1980-1990 (an increase of about 22 million persons) exceeded the number of new workers. All commuting alternatives to the single-occupant vehicle declined in share. Transit ridership remained at about 6 million riders from 1980 to 1990. Rail-related travel gained in absolute terms, but its gains did not balance declines in bus ridership. The report reviews state and selected metropolitan area travel patterns.

12. "Chicago's \$5-Billion Plan," Railway Age, Vol. 193, No. 6, pp. 43-44, June 1992.

The article discusses the Regional Transit Authority's Future Agenda for Suburban Transportation (FAST) plan to improve commuter rail service (including grade crossing elimination) and system expansion (including a circumferential route). The FAST plan responds to a variety of environmental concerns, most notably congestion, air pollution and energy consumption, by targeting infrastructure improvements and expansions to areas where improved operational flexibility will increase train speeds and reduce transit times, making the automobile a non-competitive commuting option.

13. Public Transportation in the United States: Performance and Condition, Report to Congress, U.S. Department of Transportation, Federal Transit Administration, Washington, DC, June 1992.

The report provides an overview of public transportation in the U.S., data and information on how the cost of mass transportation has changed over the past two years, and future capital investment needs seen in terms of different projected levels of mass transportation service.

14. The Going Rate: What it Really Costs to Drive, James J. MacKenzie, Roger C. Dower, and Donald D.T. Chen, World Resources Institute, Washington, DC, June 1992.

The Institute's study estimates costs of \$300 billion per year to the environment and to society as a whole that are only partly covered by user fees and taxes. Some of the costs identified are: road construction and maintenance; highway patrols, traffic management, parking enforcement, traffic accident response teams, police work on auto accidents and thefts; free commuter parking; air and noise pollution; and the security costs of importing oil. Suggested measures to redress the balance include higher fuel taxes, road pricing at heavy use times, reforming employer-paid parking, and raising charges on truckers, as well as long-term changes in zoning laws to encourage greater residential population density, making public transportation a more viable option.

15. Searching for Solutions, A Policy Discussion Series: Exploring the Role of Pricing as a Congestion Management Tool, U.S. Department of Transportation, Federal Highway Administration (FHWA), Number 1, March 1992.

The report summarizes a July 23, 1991 FHWA seminar that provided participants an opportunity to discuss a variety of policy issues related to congestion pricing, i.e. direct charges for roadway use varying by time, location, occupancy, etc. in response to level of service, environmental or cost recovery policy objectives. Included are the views and comments of many participants, and, while no overall consensus on congestion pricing

emerged, there was general agreement that revenues must be well thought out and presented in advance, compensation for those adversely affected must be addressed early in the planning process, and reasonable alternatives to priced roads must be available.

16. Financing High-Speed Rail and Maglev Systems in Europe, Japan, and the United States: Implications for Systems Financing in Florida, Dr. Thomas A. Lynch, Center for Economic Forecasting and Analysis, Florida State University, Tallahassee, Florida, for the Florida Department of Transportation, January 1992.

The study compares public transportation financing and subsidies in Western Europe and North America and develops a profile of significant public transportation policies and other differences between the U.S. and Canada and Western Europe that may influence prospects for successful deployment of interurban high-speed rail systems in Florida. The report includes a chapter on The Need to Include Environmental Externalities in the Development of Transportation Systems.

17. Environmental Research Needs In Transportation, Transportation Research Circular, Transportation Research Board, National Research Council, Number 389, March 1992.

This document is the product of many individuals and organizations concerned with the identification and development of operational solutions to environmental issues in transportation. It provides guidance to financial sponsors, such as governmental agencies, research institutions, the industry and the academic community, in allocating scarce resources for the development of functional solutions to environmental problems in all modes of transportation.

18. Edge City, Life on the New Frontier, Joel Garreau, Doubleday, New York, NY, 1991.

In this book Mr. Garreau describes the growing phenomenon of white collar office and shopping complexes on the peripheries of large cities. He organizes his book around nine geographical areas to illustrate broad patterns of development. While he reports that edge cities are popular because they are easily accessed by car and avoid the problems of cities, he also suggests that peripheral office markets and thriving downtowns can be mutually beneficial.

19. The Federal Role in Urban Mass Transportation, George M. Smerk, Indiana University Press, Bloomington, IN, 1991.

The book surveys historical governmental policies for mass transportation, discusses how the availability of mass transportation facilities influenced urban areas, and suggests how it can be used in the future to improve circulation in urban and metropolitan areas, creating a more appealing urban environment.

20. Steering a New Course: Transportation, Energy and The Environment, Deborah Gordon, Union of Concerned Scientists, Island Press, Washington, DC, 1991.

Worsening congestion will soon make transportation an even more tedious, aggravating exercise than it already often is; dependence on foreign oil will make supplies increasingly unreliable and expensive. Without innovative strategies to reduce the number of miles driven, cars and trucks will continue to pollute air, water, and land. The book surveys policy options and provides a master list of policy recommendations for each level of government.

21. The Renaissance of Rail Transit in America, A Report by the Regional Planning Association, New York, NY, 1991.

The report assesses nine North American rail systems developed since World War II, as well as systems abroad, and concludes that around the world, public transit ridership is higher than in the U.S. because of: 1) land use policies; 2) cost of driving; 3) national infrastructure finance policies; and 4) local government structure. The report suggests that the nation needs the same long-term commitment to an efficient metropolitan transportation system as was made to the Interstate Highway System nearly forty years ago.

22. Special Report 233, In Pursuit of Speed: New Options for Intercity Passenger Transport, Conducted by the Transportation Research Board, National Research Council, sponsored by the U.S. Department of Transportation, Washington, DC, 1991.

This study of intercity passenger transport concludes that high-speed (200 mph) trains are feasible and could relieve airport and highway congestion. Environmental benefits of high-speed trains may include a reduction in air emissions. However, because of differences in the characteristics of high-speed rail, highway and air transportation noise, it is unclear whether high-speed rail would reduce or increase ambient noise levels.

23. Transportation and Tax Policy, Deborah Gordon and Harriet Parcels, The Campaign for New Transportation Priorities, CNTP Policy Series, No. 2, Washington, DC, 1991.

This paper argues that Federal tax laws fail to promote energy efficiency in transportation. Low gasoline prices and subsidized parking at work encourage solo driving, and Federal policies subsidize big trucks to the detriment of more energy-efficient railroads. Changes in Federal tax laws are recommended.

24. Super-Trains, Solutions to America's Transportation Gridlock, Joseph Vranich, St. Martin's Press, New York, NY, December 1991.

This book describes high-speed rail developments in Europe, as well as efforts to introduce high-speed ground transportation in the U.S. It discusses how high-speed trains can reduce energy consumption and oil dependency, pollution, global warming, land use consumption, airport congestion, and noise.

25. Neglect of Rail and Intermodal Facilities, Intercity Passenger Transportation, The Campaign for New Transportation Priorities, CNTP Policy Series No. 5, Washington, DC, August 1991.

Increased Federal funding of intercity passenger rail service and intermodal facilities is needed to alleviate costly airport and highway congestion, rising dependence on foreign oil, and environment pollution. Flexibility to use gas tax revenues for rail service expansion and intermodal terminals and earmarking a gas tax penny for Amtrak are recommended.

26. Atlas of United States Environmental Issues, Robert J. Mason and Mark T. Mattson, Macmillan Press, New York, NY, 1990.

The atlas contains state by state, city-by-city multi-media environmental data, including land use, forestry, coastal zone management, air quality, water quality, noise and light pollution, solid wastes, and energy, with issue overviews and selected specific area case study data.

27. The Greening of Urban Transport: Planning for Walking and Cycling in Western Cities, Edited by Rodney Tolley, Bellhaven Press, London, England, 1990.

This is a collection of international essays focusing on the need for urban planners to encourage "green modes" (walking and cycling) of transportation within cities and contains four sections that: address the principles and issues of green transport; discuss the practice of green transport planning; cite examples of successful traffic restraint and exclusion; and review present conditions and future possibilities.

28. National Transportation Strategic Planning Study, U.S. Department of Transportation, U.S. Government Printing Office, Washington, DC, 1990.

This study, comprising 17 chapters and 6 appendixes, provides an overview of the Nation's transportation system and identifies future investments required to maintain and develop our infrastructure. The contents of the study were used to support the "National Transportation Policy Statement," issued by the Department in March 1990.

29. Transport Policy and the Environment, European Conference of Ministers of Transport, ECMT Ministerial Session, OECD, 1990.

Includes two papers pertaining to pricing of transportation:

"Urban Traffic Management," David Bayliss, United Kingdom.

A discussion of methods of restraining traffic, including physical restraint of traffic, rationing and permitting systems, road pricing, and parking restraint.

"Economic Aspects," Werner Rothengatter, Germany.

Discussion of environmental policy measures to encourage users to choose the transport mode with the minimal impact on the environment. Policies include regulation, pricing, investment, organization, and marketing and advertising policies.

30. "Building New Rail Markets," William D. Middleton, Railway Age, Vol. 191, No. 11, pp. 31-53, November 1990.

Washington, D.C. area commuters are increasingly using commuter rail services as an alternative to traveling over crowded highways in the sprawling metropolitan area. Maryland's MARC system of three lines is the fastest growing commuter rail operation in the U.S., and northern Virginia will soon have its own commuter service operating.

31. CONEG High-Speed Rail Regional Benefits Study, A Report on the Benefits to the Region of Improved Passenger Rail Service Between Boston and New York, prepared by Parsons Brinckerhoff Quade & Douglas, Inc., Cambridge Systematics, Inc., and the Regional Science Research Institute for the Coalition of Northeast Governors, High-Speed Rail Task Force, Washington, DC, October 1990.

This study identified operational and passenger transportation benefits, and environmental and economic benefits that would accrue to the region as a result of improved Amtrak service between Boston and New York City. With three-hour travel times, diversion of trips from air and highway travel will help reduce fuel consumption and air pollution. The study estimates that 18,250 air shuttle flights and 114 million passenger miles annually would be diverted to rail.

32. Transit 2000 - Managing Mobility: A New Generation of National Policies for the 21st Century, American Public Transit Association, Transit 2000 Task Force, Washington, DC, 1989.

The report recommends that transportation policies and programs at the Federal level must be changed and service delivery at the state and regional level redefined if we are to preserve and enhance mobility. As a Nation, we must make a commitment to reduce dependence on the automobile and increase the share of travel demand on convenient high-occupancy shared ride services of all kinds.

33. Special Report 220, A Look Ahead - Year 2020 Proceedings of the Conference on Long-Range Trends and Requirements for the Nation's Highway and Public Transit Systems, conducted by the Transportation Research Board, sponsored by the U.S. Department of Transportation, Federal Highway Administration, American Association of State Highway and Transportation Officials, the Association of Regional Councils, and the Transportation Alternatives Group, Transportation Research Board, National Research Council, Washington, DC, 1988.

This volume includes papers and responses presented in conference sessions on: Economic Growth and Vitality; Demographics and Life-Style; Energy and Environment; Future Development Patterns; Commercial Freight Transportation; Personal Mobility; New Technology and Communications; and Resources and Institutional Arrangements.

34. Urban Mass Transportation Research Information Service Selections pertaining To: The Cost of Traffic Congestion, Washington, DC, May/June, 1988.

A compilation of abstracts of papers on such topics as: Congestion Pricing of Public Transport; Peak - Period Traffic Congestion: A State-of-the-Art Analysis and Evaluation of Effective Solutions; Analysis of Peak Period Traffic Congestion with Elastic Demand; Road Pricing: Some Further Comments; Road Pricing - Some of the More Neglected Theoretical and Policy Implications; Behavioral Impacts of Flexible Working Hours; Technical Methods for Road Pricing; Road Pricing: The Economic and Technical Possibilities (The Smeed Report); Implementing a City Congestion-Pricing Demonstration: Overcoming the Hurdles; Effects of Parking Costs on Urban Transport Modal Choice.

8. Energy Issues

The United States consumes about 25% of the world's petroleum, with transportation accounting for nearly two-thirds of U.S. use each year. While oil use in other sectors of the economy has decreased, transportation consumption continues to grow. Highway vehicles consume 73% of all energy used in transportation. In high-density corridors, commuter rail and intercity rail passenger and freight service may be more energy efficient than motor vehicles, while serving the same purposes.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) calls for the development of an intermodal transportation system that is economically efficient and environmentally sound and moves people and goods in an energy efficient manner. Many of the programs that can be funded through the ISTEA's Congestion Mitigation and Air Quality Improvement Program, as well as other ISTEA programs, will also increase energy conservation and efficiency. Also, alternative fuels being developed to reduce air pollution may increase engine efficiency. Further research is needed on engine performance, emissions, and maintenance, using alternative fuels, as well as on the energy implications of various transportation control measures.

1. Methodology for Freight Transportation Energy and Emission Studies, A.M. Khan, for the Canadian Society for Mechanical Engineering Forum, June 1-4, 1992, Montreal, Canada, June 1992.

This paper describes methodological advances in the estimation of freight transportation energy and emissions. The overall methodological framework is covered and a comparative examination of a number of recent studies is presented.

2. Transportation Energy Data Book: Edition 12, S.C. Davis, M.D. Morris, Oak Ridge National Laboratory, Oak Ridge, Tennessee, prepared for the U.S. Department of Energy, Washington DC, March 1992.

This publication is a statistical compendium prepared and published by Oak Ridge National Laboratory (ORNL) under contract with the Office of Transportation Technologies in the Department of Energy (DOE). Designed for use as a desk-top reference, the data book represents an assembly and display of statistics and information that characterize transportation activity, and presents data on other factors that influence transportation energy use.

3. "Report of the 24th Annual Joint Conference of the ENO Transportation Foundation, Board of Directors and Board of Advisors," D. Knight, Eno Foundation for Transportation, Incorporated, Transportation Quarterly, Vol. 46, No. 1, pp. 3-17, January 1992.

This day-long debate had as its theme: "Mobility, Environment and Energy--Impossible?" The discussion focused on two research programs undertaken in 1991 through the auspices of the Foundation, entitled "Transportation and Energy" and "Transportation and the Environment." Both studies will be published in 1992.

4. Energy Efficiency, Developing Nations, and Eastern Europe: A Report to the U.S. Working Group on Global Energy Efficiency, M.D. Levine, A. Gadgil, S. Meyers, J. Sathaye, J. Stafurik, Bechtel National, Inc., Arlington, Virginia, sponsored by the Agency for International Development, Office of Energy, Washington, DC, 1991.

The report describes a number of insights gained from efforts to promote energy efficiency that have been pursued in developing countries in recent years, and details some of the ways to move towards a more efficient energy future.

5. Assessment of Costs and Benefits of Flexible and Alternative Fuel Use in the U.S. Transportation Sector, Technical Report Seven: Environmental, Health, and Safety Concerns, U.S. Department of Energy, Office of Policy, Planning and Analysis, Washington, DC, 1991.

This report addresses questions of energy security and fuel availability, but covers a wide range of issues, examining environmental, health, and safety concerns associated with a switch to alternative and flexible fuel vehicles.

6. The Texas Transportation Energy Data Book, Southwest Region, University Transportation Center, Texas Transportation Institute, Texas A&M University, College Station, Texas, 1991.

The Texas Transportation Energy Data Book is a statistical data base which contains information regarding the transportation energy characteristics of Texas, comparing transportation statistics of Texas with seven other comparable states. The report furnishes information about alternative fuels and new energy saving technology.

7. "Comparison of Emissions and Energy Use for Truck and Rail," W.G. Blevins, A.W. Gibson, Transportation Association of Canada Conference, Vol. 4, Conference Proceedings, 1991.

This paper examines a variety of railway technologies and truck configurations, representative of the range of equipment in service, covering a representative route across Canada. The conclusions are that railways can move competitive traffic at a fuel saving typically in the range of 65 to 70 percent compared with trucks, and that this advantage will be largely maintained in the future, even in the face of extreme truck configurations such as turnpike doubles.

8. Trucks and Energy Use: A Review of the Literature and the Data in Canada, F.P. Nix, Ontario Trucking Association, Rexdale, Ontario, Canada, August 1991.

There are some who say that, because railways are more energy efficient than trucks, government should do something to encourage a shift of freight from trucks to rails. This report argues that a recent study from Transport Canada, which claims that large amounts of energy could be saved in Canada if there were a major shift of traffic from trucks to the railways (Kahn, 1991), is flawed, because it uses energy used per tonne-kilometre of freight as the basis for comparing. According to the author, "Anybody can prove that a train can move a tonne of freight one kilometre under most circumstances with less fuel than a truck, especially if the train in question is a unit train of coal moving over a long distance and the truck in question is picking up or delivering consumer products in an urban area."

9. Are We Running Out of Oil?, C.J. DiBona, Highway Users Federation for Safety and Mobility, Washington DC, July 1991.

Charles J. DiBona, President and Chief Executive Officer of the American Petroleum Institute (API), addressed more than 260 delegates to the 1991 Highway Transportation Congress, sponsored by the Highway Users Federation. In this address, an overview on petroleum energy, Mr. DiBona voices his opposition to fuel conservation, arguing that oil reserves are infinite and opposing alternative fuels on the grounds that they will be more expensive. Mr. DiBona calls for development of oil resources in locations other than the Middle East.

10. Energy and Environmental Factors in Freight Transportation, A.M. Khan, A.K. Socio-Technical Consultants, Ottawa, Canada, for Transport Canada, Economic Research Branch, Ottawa, Ontario, July 1991.

This study produces energy efficiency and environmental estimates for the freight transportation system in Canada, with emphasis on intercity transportation. The effects of likely future traffic growth and selected scenarios are also assessed. The study found that at the aggregate national level, rail freight is the most efficient user of energy (in tonne-km terms) and air freight is the most inefficient. On a per tonne-km basis, truck service by Class I and Class II for-hire carriers uses more than three times the fuel required by railway freight and domestic marine.

11. Rail Vs. Truck Fuel Efficiency: The Relative Fuel Efficiency of Truck Competitive Rail Freight and Truck Operations Compared in A Range of Corridors, Abacus Technology Corp., Chevy Chase, Maryland, for the U.S. Department of Transportation, Federal Railroad Administration, Office of Policy, Washington, DC, April 1991.

The report evaluates the fuel efficiency of rail freight operations relative to competing truckload service. The findings are based on computer simulations of rail and truck freight movements between the same origins and destinations, based on actual rail and truck operations. Data was provided by U.S. Class I and regional railroads and by large truck fleet operators. Rail achieved from 1.4 to 9 times more ton-miles per gallon than competing truckload service. The study included consideration of rail circuitry, fuel used in rail switching, terminal operations, and truck drayage (for rail).

12. Forecast of Transportation Energy Demand Through the Year 2010, M.M. Mintz, A.D. Vyas, Argonne National Laboratory, Argonne, Illinois, April 1991.

This report documents the process used to forecast transportation activity and energy demand through the year 2010. It was developed by the Center for Transportation Research at Argonne National Laboratory under contract to the Office of Transportation Technologies under the Assistant Secretary for Conservation and Renewable Energy of the U.S. Department of Energy.

13. Transport Coordination, N. Krarup, Copenhagen, Denmark, March 1991.

An investigation, based on questionnaires, of the potential for economic savings and energy conservation, if firms coordinate transportation of their goods instead of having their own individual transportation. The calculated reduction of energy consumption was estimated to be 50%, with a 27% reduction in transport.

14. Transport Energy Conservation Policies for Australian Cities: Strategies for Reducing Automobile Dependence, P. Newman, J. Kenworthy, T. Lyons, Murdoch University, Australia, 1990.

Discussion of transport energy conservation policies for Australian cities has been expanded and developed, based on the authors' previous book, Cities and Automobile Dependence: An International Sourcebook. New evidence confirms that the more automobile-dependent cities were in 1960, the more they became by 1980. Toronto is an exception, not showing the downward density and public transport trends evident in the other cities and providing a model for Australian cities in the next two decades. Other Canadian cities (Montreal, Edmonton, Calgary and Vancouver) were also shown to be more like European than US/Australian cities.

15. Energy Consumption and Conservation Potential: Supporting Analysis for the National Energy Strategy, U.S. Department of Energy, Washington, DC, December 1990.

This report presents a detailed assessment of the conservation potential in the end-use energy sectors of the U.S. economy. Increased conservation is achieved in the transportation sector, by increasing the penetration of more efficient alternatively fueled vehicles. The principal finding of this study is that for the same level of energy services (heating, cooling, etc.) that are enjoyed today by residential, commercial, and industrial users, and with modest reduction in vehicle travel, if specific technologically based conservation initiatives are successful, and can be placed into service in every sector and end-use energy system, then significant energy savings could be achieved over the next 40 years. Further work is necessary to quantify the costs and benefits of these savings in each sector.

16. National Transportation Statistics, Annual Report, 1990, J. Kelley, Transportation Systems Center Research and Special Programs Administration, Cambridge, Massachusetts, sponsored by the U.S. Department of Transportation, Office of Budget and Programs, Washington, DC, July 1990.

This report is a compendium of selected national transportation, and transportation-related, energy data from a wide variety of government and private sources. The data illustrate transportation activity for the major transportation modes - air, automobile, bus, truck, local transit, rail, water, and pipeline. Basic descriptors such as operating revenues and expenses, number of vehicles and employees, vehicle and passenger-miles, and passenger and freight operations, are included. Transportation trends in performance, safety, and motor vehicle sales, production, and costs are also presented. Supplementary sections include Transportation and the Economy and Energy in Transportation, which is divided into Energy Consumption, Energy Intensiveness, Energy Transport, and Energy Supply and Demand.

17. Energy Policy: Developing Strategies for Energy Policies in the 1990s, U.S. General Accounting Office, Washington, DC, June 1990.

The information contained in this report updates and supplements the information in a previous 1988 General Accounting Office report and discusses continuing concerns about several energy issues, including energy consumption, increased dependence on imported oil from Persian Gulf sources that are more likely to be interrupted, uncertainty over the adequacy of future electric generating capacity, and concern for the potentially adverse environmental effects of energy consumption. In addition, the President's initiative to develop a national energy strategy is discussed.

18. Annual Bulletin of Transport Statistics for Europe, 1990, United Nations, Volume 40, New York, NY, April 1990.

The purpose of this annual bulletin is to provide basic data on transport and related trends in European countries, Canada and the United States. This publication is purely statistical, and its scope comprises the rail, road, and inland waterway sectors, container transport, goods loaded and unloaded at sea ports, transport by oil pipeline, and international goods transport by various modes of transport and commodity group. The data refer to length of networks, number, capacity and power of vehicles and internal and international traffic and transport. General information on the consumption of energy in transport is included.

19. Iowa at the Crossroads: 1990 Iowa Comprehensive Energy Plan, K.D. Sibold, P.S. Cale, K.M. Poulson, L. Dombrowski, R. Martin, L. Smith, Iowa Department of Natural Resources, Des Moines, Iowa, January 1990.

This publication examines Iowa's consumption of energy and the economic and environmental impacts of energy use. The 1990 Comprehensive Energy Plan provides recommendations for energy policies that will assist in meeting the state's economic and environmental objectives. In addition, to show the technical and programmatic potential for carrying out the recommendations, an appendix of current energy program case studies is included.

20. Cities and Automobile Dependence: An International Sourcebook; Peter Newman and Jeffrey Kenworthy, Gower Publishing Co., Aldershot, England, 1989.

A study of urban form, transport, and energy use in 32 cities in North America, Europe, Asia, and Australia.

21. Transportation Energy, Transportation Research Record No. 1155, Transportation Research Board, National Research Board, Washington, DC, 1987.

This publication includes several articles concerning energy and transportation.

9. International Issues

The European Community is seeking to achieve "sustainable mobility," to allow transportation to fulfill its economic and social role while containing its harmful effects on the environment. Some countries are developing approaches to take account of the external effects of transportation by imposing externality charges through road pricing, gas taxes, kilometer taxes, and landing charges. The EC framework will require a coordinated examination of environmental standards and enforcement and other guidelines to accomplish their goals. There is as yet no common strategy.

1. Transport Policy Decision made by the German Government in 1992, Verkehrsnachrichten, published by the Federal Transport ministry, Bonn, August/September 1992 (German only), obtained from Dr. Andreas Kuechel, Transportation Counsellor, Embassy of the Federal Republic of Germany.

"Priority for the railroad" is the basic principle of the decisions made by the German Federal Cabinet on July 15, 1992, which is also reflected in the transport budget for 1993 and the masterplan for the transport infrastructure. Goals of the German policy are to achieve a comprehensive, environmentally-friendly transportation system, to meet the increased demand for transportation services caused by the unification of Germany, the single European market, and the opening of the Central and Eastern European countries. The centerpieces of this policy are a quality-improved and capacity-enlarged rail passenger and freight system, the development of freight centers to interlink rail and road freight traffic, improved intermodal service, and better usage of the inland waterway system.

Emphasis is being placed on rapid improvement of the linkage between East and West Germany, both with high-speed rail and road improvements. Airport capacity will be expanded to handle international flights, and the long-term goal is to eliminate all flights under one hour where high-speed ground transportation is available. Motor vehicle emissions must be substantially reduced, and airport noise is being addressed. Taxes and fees will be used as incentives and disincentives for modal shifts. To encourage modal shifts, rail is receiving first priority for investment. In 1993, for the first time, investments in the rail system will exceed the investments in the federal highway network.

2. "The Environment-Mobility Dilemma," Rail International Proceedings, Session C, Workshop 17, Brussels, June/July 1992.

This panel discussed the need to shift more traffic to environmentally benign modes and ways to measure the environmental and social impacts of transportation. Several papers are described below:

"The Environment-Mobility Dilemma," a paper by the Chairman of the above panel, Dr. Hans Lindenbaum (Austria).

This paper points out that to prevent mobility from endangering health and the environment, railways need to be attractive for people, goods, and for the environment. Dr. Lindenbaum notes that the advent of the TGV in France and the ICE in Germany has drawn attention from the remainder of the rail system. He urges greater attention to improving the environment and service of the rest of the rail network.

"A Solution Based on Market Principles," Lars Hansson (Sweden).

This paper points out that in the 1980s, there was increasing focus on the quality of mobility of different transport modes and the environmental impact of transportation. Externality charges, internalizing environmental effects, will allow appropriate tradeoffs to be considered.

"Environmental Problems in the Transport Sector and Concepts Proposed for their Solution," Werner Rothengatter (Germany).

Dr. Rothengatter suggests a pricing policy for the different transport modes, with the modes with the highest intrinsic environmental costs having to pay the highest extra charges-- through road pricing, fuel taxes, or by paying for environmental certificates.

"Mobility and the Environment," Antonio Tamburrino (Italy).

Dr. Tamburrino discusses the concept of "environmentally sustainable mobility." He points out the need to obtain exhaustive scientific data on environmental effects and to develop a sound evaluation of economic, social, and environmental costs and benefits, activating a public decisional process to build consensus on these.

3. Transport and the Environment in Finland, Statistics Finland, for the Ministry of Transport and Communications, Helsinki, Finland, June 1992. (English edition, which is an abridged version of the more comprehensive Finnish report.)

The goal of this report is to provide a comprehensive picture of the relationship between transportation and environmental issues in Finland. The report contains statistics, estimates, and projections, research results, and information on aspects of transport policy and legislation. One development objective for the next few years concerns the pricing of environmental damage attributable to traffic.

4. "Environmental Quality and Transport Policy in Europe," Veli Himanen, Peter Nijkamp, and Juraj Padjen, Transportation Research, Part A, Policy and Practice, V26A, pp. 147-57, March 1992.

The paper discusses the relationship of transport policy and environmental quality/sustainability, suggests that transport policy can improve environmental conditions if it decreases VMT, auto production and ownership, and increases the use of technological measures for cleaning exhaust gases. Four scenarios (status quo, traffic restraint, redistribution of demand, and reduction of demand) are analyzed and compared.

5. Financing Public Transport: How Does Britain Compare?, Steer Davies Geare, for Bow Group, Centre for Local Economic Strategies, Eurotunnel, Railway Industry Association, Transport 2000, London, March 1992.

Compared with other EC countries, in Britain there has been a long period of underinvestment in public transport, and by 1991, Britain spent less per capita on rail infrastructure than any other EC country apart from Greece and Ireland. Among other recommendations, the report calls for a national framework for public transport assessment, so plans can be formulated in an equivalent manner to the national roads program.

6. Green Paper on the Impact of Transport on the Environment, A Community Strategy for Sustainable Mobility, Commission of the European Communities, Brussels, February 1992.

This paper provides an assessment of the overall impact of transport on the environment and presents a common strategy for "sustainable mobility," which should enable transport to fulfill its economic and social role while containing its harmful effects on the environment. The report identifies critical issues relating to pollution and noise standards, truck size and weight, speed limits, energy consumption, land use, congestion, and the risks inherent in transporting dangerous goods, and measures that could take better account of the external costs of transportation are cited. The goals are to encourage and improve the more environmentally friendly modes (especially rail freight, intermodal, barge, rail passenger systems) and to make efficient use of existing capacity.

7. Freight Transport and the Environment, European Conference of Ministers of Transport (ECMT), ECMT May 1991 International Seminar, prepared in Cooperation with OECD, Paris, France, 1991.

In the past 20, years growth in European freight transport has occurred primarily on highways, with 75 percent of the growth attributed to increased length of haul. At the seminar, three papers that presented the European perspective emphasized the importance and effect freight transport has on the environment, both today and in the future. Additional papers were presented detailing technical changes that may reduce future adverse emission and noise impacts from all modes. The inclusion of the appropriate environmental costs in transport pricing was a theme widely discussed.

8. Energy and Environmental Issues 1991, Transportation Research Record, No. 1312, Transportation Research Board, National Research Council, Washington, DC, 1991.

Includes several articles. The most informative are:

"Transportation and Urban Air Pollution Policies for Developed and Developing Countries", by Alan J. Krupnick.

Improvements in urban air quality remain elusive in large cities throughout the world, including those in the U.S., where efforts have continued over 20 years to reduce emissions from vehicles and other sources. Germany, the Netherlands, Norway, and Sweden have until recently taxed clean cars (those using catalytic converters) less than others, or reduced their annual vehicle fees. EC-wide vehicle emission standards, which will be somewhat less strict than those in the U.S., will make such differentiation unnecessary.

"Pricing of Air Pollution in the Swedish Transport Policy," Lars Hansson.

Swedish transportation policy has radically changed during the last decade. In 1979, the principle of a social marginal cost responsibility for road and rail traffic was introduced, taking into account social costs for traffic accidents. In 1988, an essential part of the new Transport Policy Act was the principle of internalizing some of the traffic emissions. These were then explicitly considered in infrastructure charges for road and rail traffic and for domestic aviation. Negative external effects taken into account are traffic accidents, air pollution, noise disturbance, and congestion, through gas taxes, kilometer taxes, rail charges, and landing charges. Some of these charges have already been adopted by Parliament.

9. Transport in a Fast Changing Europe, Group Transport 2000 Plus, Brussels, Belgium, 1990.

This report was prepared by the working group, Transport 2000 Plus, formed in association with the Commission of European Communities, to examine the medium and long-term transportation and communication problems of the European Community. It highlights the crisis facing the European transportation system once the single market becomes a reality. Unless the pending crisis is addressed by the political sector, the transport system is likely to become paralyzed, resulting in economic slowdown and increased damage to the environment. The report included discussion of transportation's negative environmental effects, including land use, energy consumption, noise and vibration, visual intrusions, and air pollution.

The report recognizes that a balance must be struck between the environmental imperative and ramifications for economic growth. Any policy introducing environmental improvements more quickly than actually necessary, with a severely reduced GNP as a result, would be just as damaging as the too-little-too-late approach. Recommendations for action include a Euro bonus system that would tax petroleum products, a European infrastructure fund, as well as other alternatives.

10. Transport Policy and the Environment, European Conference of Ministers of Transport (ECMT), ECMT 1989 Ministerial Sessions, prepared in Cooperation with OECD, Paris, France, 1990.

This report includes the following chapters: The Interface Between Transport and the Environment; Transport Trends of Environmental Significance; Noise; Air Pollution; Regulations and Standards (exhaust emissions and noise emissions) in OECD countries; and Conclusions. The report considers how the comparative environmental advantages of alternative modes to private motorized transport can best be used and suggests that a combination of direct and indirect measures, including improvement of urban railways, along with charges or restrictions as disincentives to car use might be most effective. Any such actions will require political will and a major information campaign. For interurban traffic, the ECMT adopted a resolution that recommends making railway, inland waterway, and combined transport as efficient and commercially oriented as possible, with improved cooperation at the international level. It also recommends that any proposals to harmonize taxes and charges in international road freight transport should take into account the environmental damage caused by such traffic.

11. Transport in Cities, Brian Richards, Architecture Design and Technology Press, London, U.K., 1990.

British architect and transportation planner Brian Richards describes practical and attractive transportation alternatives that have worked in cities around the world. Drawings, diagrams and photographs illustrate ways to reduce auto trips through such strategies as auto-free pedestrian zones, road pricing and permit programs, busways, light rail, subways, intermodal connections, parking restrictions and water commuting.

12. Railways, Environment and Transport Quality, A collection of Expert Papers prepared for the International Transport Workers' Federation, London, U.K., February 1990.

Growing demand for mobility, especially in the international movement of people and goods, poses the question of whether this demand can be satisfied without causing irreparable damage to local environments and the global environment. Political decisions with respect to transport are now closely scrutinized, and transport has become more important on the political agenda. The Railwaymen's Section introduction to the group of papers suggests that

intervention and positive action are required in the supply of basic infrastructure and to insure the development of transport modes which cause the least damage. "For too long the railways' ability to respond to the increasing demand for transport has been restricted by lack of investment in modern infrastructure by comparison with other transport modes. Past failure to attribute to the other modes their full external costs led to the misconception that the other transport modes were a "cheaper" option.

The seven papers included are entitled: The Energy Consumption of Various Transport Systems; The Environmental Impacts of Transport; Comparative Accident Costs of Transport Modes; Railways and the Public; The Transport Planner's View; The Railway Manager's View; and the Transport Politicians View. Abstracts of several of these are presented below:

"Railways and the Public," J. Sivardiere, General Secretary of the National Federation of Transport Users, France, included in Sub-Theme 2: Safety and Quality of Service.

Railways under government-imposed financial constraints are frequently obligated to put financial profitability before public service considerations. Improvements in service speeds on non-high speed (non-TGV) lines are needed as are improvements in: station facilities; maps; information availability; passenger comfort; and personnel attitudes. Efficient, convenient modal transfers (including adequate station parking) are essential, and the railways must make information on such transfers readily available.

"The Transport Planner's View," A. Nilsson, Swedish State Railways, included in Sub-Theme 3: Transport and the Environment - A Balanced Policy.

In Sweden, the 1988 Transport Policy Decision established that transport charges were to cover total (variable and fixed) socio-economic costs and that these costs were to be the responsibility of the user. The Swedish National Railways has developed an estimate of the total 1986 socio-economic costs of motor transport indicating that the heavy goods transport by road generates SEK 4.5 and 5.5 billions in costs while the charges and taxes paid by this transport segment total only SEK 2 billions. Once the public and decision-makers understand the railways' advantages, the author believes railways will be the transport mode of the future.

"The Railway Manager's View," J. Higgins, Republic of Ireland, Railway Consultant, Ireland, included in Sub-Theme 3: Transport and the Environment - A Balanced Policy.

The rapidly developing concern for environmental standards and energy conservation has expanded the opportunity for railroad transport, particularly in light of the approaching European Economic Community (EEC) single market. Railroads offer large advantages over roadways in: safety, congestion, pollution, noise, land use, and energy consumption. Policy makers should judge all modes using the same assessment criteria and must be encouraged to support railways, both in terms of revenues and investment. However, in order to gain the support of policy makers, the railroads must redouble their efforts to improve their performance and recognize that anachronistic transport systems supported by public charity belong to the past.

"The Transport Politician's View," G. Whitlam, Prime Minister of Australia 1972-75, included in Sub-Theme 3: Transport and the Environment - A Balanced Policy.

Increasingly, the relationship between transport and the environment is being addressed by governments in an integrated and comprehensive approach, matched by a consistent determination to create environmentally and financially sustainable solutions. This paper

considers the scope of a pro-environment transport policy and considers the role that rail could play in ameliorating transport induced environmental problems and the role of government in facilitating this. While each mode's unique advantages should be encouraged, while conserving resources and ensuring that a mode is not inefficiently under- or over-utilized, the principle that each mode be required to bear its environmental cost should be applied. The article discusses rail's environmental advantages in terms of energy efficiency, pollution, safety and consumption of space.

13. Second Transport Structure Plan, Transport in a Sustainable Society, Second Chamber of the States, General Session 1989-1990, the Netherlands.

This paper, submitted to the Parliament as a Cabinet Document, sets out the relationship between transportation and the environment and the policy of the sustainable environment. The Netherlands is working within the European Community (EC) to achieve a situation whereby a larger share of the real environmental cost is passed on to the user. They will continue developing effective transportation options and negative incentives, raising the variable cost of motoring through congestion pricing and higher gas taxes.

14. Transportation and the Environment, Organisation for Economic Cooperation and Development, Paris, France, 1988.

This report includes sections on: An Overview on Transport and the Environment; The Impacts of Road Transport on the Environment; Assessment of Innovations in Urban Transport Management; and An Assessment of Technical Changes to Reduce Air Pollution and Noise Emissions from Motor Vehicles.

