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Transportation Energy Conservation Data Book: Supplement IV

D. B. Shonka
P. D. Patterson
A. S. Loebl

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TRANSPORTATION ENERGY CONSERVATION DATA BOOK:

SUPPLEMENT IV

D. B. Shonka
P. D. Patterson
A. S. Loebl

Regional and Urban Studies Section
Energy Division

Prepared for
Data Analysis Branch
Nonhighway Transport Systems and Special Projects
Transportation Energy Conservation Division
Office of Conservation
Energy Research and Development Administration

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ABSTRACT

This document is the fourth in a series of supplements to the Transportation Energy Conservation Data Book: Edition I. The Data Book series is being compiled and published by Oak Ridge National Laboratory (ORNL) under contract with the Transportation Energy Conservation (TEC) Division of the Energy Research and Development Administration (ERDA). Data on transportation characteristics, energy consumption, and other related variables are presented in tabular or graphic form. For the user's reference, a glossary, a bibliography, energy conversion factors, and an index to information presented in Supplement IV are provided.

Some of the specific items presented on transportation modal characteristics include fleet vehicular stock data, automobile choice and ownership characteristics, information describing commuting and long distance travel patterns, new car sales by market segment, electric vehicle production, and statistics on bicycle stock and usage. Transportation energy demand projections in general, and in detail for the marine sector, are presented, as well as sales-weighted miles per gallon figures by weight of automobile, model year, and automobile producer. Other transportation-related information included in Supplement IV are a graphic presentation of President Carter's tax/rebate schedule, a comparison of the nominal and real price of gasoline, and a descriptive list of the current safety standards. Finally, detailed data on the U.S. total population and its migration patterns are presented.

The second edition of the TEC Data Book will update and integrate the information provided in Edition I and the Supplements. The planned date of publication for this document is October, 1977.

TRANSPORTATION ENERGY CONSERVATION DATA BOOK:
SUPPLEMENT IV

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Support for this project is provided by the Division of Transportation Energy Conservation of the Energy Research and Development Administration Office of Conservation.

Introduction

This document is the fourth in a series of supplements to the Transportation Energy Conservation Data Book: Edition I. The Data Book series is being compiled and published by Oak Ridge National Laboratory (ORNL) under contract with the Transportation Energy Conservation (TEC) Division of the Energy Research and Development Administration (ERDA). The purpose of the TEC Data Book is to provide the TEC staff with an updated, desk-top reference which is both comprehensive and accurate in its presentation of statistical information on the major transportation modes, their respective energy consumption patterns, and other pertinent factors influencing performance in the transportation sector.

Edition I.5, issued in May, 1977, represented a compilation and updating of the materials presented in Edition I and Supplements I and II. It is intended that Edition I.5 supercede those previous documents. The second edition of the TEC Data Book will update and integrate the information provided in Edition I.5 and Supplements III and IV. The planned date of publication for this document is October, 1977.

This supplement is organized on a chapter-by-chapter basis which corresponds to the organization of Edition I (see p. 114 for the Table of Contents for Edition I). Also, descriptive text accompanies most of the data presented.

Chapter I, "Transportation Characteristics," and Chapter 5, Sec. 5.7, "Alternate Fuels," are highlighted in Supplement IV. Detailed discussions of the topics covered in those two chapters are presented. A list of references is included at the end of each chapter. In addition, a general bibliography complete with annotations is provided for

all references cited in the supplement as well as for other related publications. A glossary is included which contains relevant terms not defined in the original TEC Data Book. Finally, an index to the data presented in Supplement IV is included.

Supplement IV presents statistical information on a variety of topics. Chapter 1 documents recent growth in three areas: motor vehicle fleets (p. 13), light-weight trucks for personal transportation (p. 23), and bicycles (p. 42). Data taken from a study conducted at Harvard University describe household automobile ownership patterns in 1970 (pp. 19, 25, 26, 27, and 28), while the automobile market dynamics study prepared by Arthur D. Little, Inc. (p. 17), provides predictions of automobile ownership patterns for new cars to be purchased between June 1976 and 1981 by persons who bought cars in 1976. Special emphasis is placed on the size mix of cars, a significant determinant of fuel consumption. A series of tables is also presented on commuting characteristics in selected metropolitan areas (pp. 21, 22) and for long-distance travel (pp. 29, 30).

Section 1.5 examines fuel consumption for the various elements of the marine transportation industry. The figures presented are derived from an ERDA-funded study conducted by Booz, Allen, and Hamilton. This particular study is unique in that the fuel consumption is estimated for all U.S. waterborne commerce regardless of the point of marine fuel purchase or the country of vessel registration.

Most of the data presented in Chapter 2 is for 1976 and updates the figures, tables and figures on energy consumption that were presented in previous volumes. A table of baseline transportation energy consumption

projections currently used by TEC/ERDA is also presented on p. 50, and a graph indicating the relationship between automobile fuel economy and weight of the automobile is shown on p. 54. The "Government Regulation" Section in Chapter 4 includes a discussion of the measures which President Carter supports in his National Energy Plan for achieving a 10% reduction in gasoline fuel consumption by 1985. This includes a graphic display of the tax/rebate schedule. In addition, information is presented on currect safety standards and emission factors.

Chapter 5 deals with the concept of alternate fuels. The alternate fuels available for transportation purposes are delineated, and the strengths and weaknesses of each alternative are discussed in detail. Statistics presented in Chapter 6 document some of the recent demographic trends of the U.S. population. Among the data presented are changing age distributions, migration patterns, and regional location. Finally, a set of basic energy conversion factors, as well as some conversion tables, are presented in Chapter 7, "Reference Materials."

Recently, the staff at ORNL conducted a survey of the Data Book user community to determine its usefulness and to solicit suggestions for improvements. Overall, response to the Data Book series was favorable. We especially appreciated the substantive comments that we received and would like to thank all those who responded to the questionnaire or who sent separate letters of comment. Efforts will be made to incorporate the many useful comments and suggestions into future volumes.

Currently, the majority of the statistics contained in the Data Books are taken from published sources and each table or figure is

referenced accordingly. Although the data may be reformatted for presentation, the basic data is compiled from a variety of sources. Consequently, neither ORNL nor ERDA can endorse the validity or consistency of the statistics presented.

Chapter 1

Characteristics of Transportation Modes

Chapter 1

The energy used by the transportation sector is a function of the types of vehicles used and the amount and type of use to which they are put. The types of vehicles in the automobile stock are determined largely by new-car buyers. Each year a sizeable number of new cars are purchased by businesses and government rather than by individuals. Data in this chapter show the currect number of fleet automobiles by type of fleet operator, some Federal government fleet detail, and the size classes of cars bought by fleet owners. The Data Analysis Branch in TEC is currently funding the development of an automobile purchase model that takes these fleet purchases into account.

The distribution by size of automobiles purchased by the entire driving public is shown for the last seven years, and information relating to size of cars to be purchased is also provided. It has been established that the size of automobiles affects the fuel economy attained on the road. In general, small trucks used for passenger travel have lower fuel economy than the average automobile. Data are presented that show the recent large sales of light-duty trucks. The automobile purchase model being developed for TEC is also examining the purchase of light-duty trucks by households.

Most cars are purchased by multi-car households; therefore, TEC has funded basic analysis into how two-car households choose the smaller of their two cars. It was found (p. 25) that in 1970, the predominant mix was one regular-sized car and one compact car (22.3% of the two-car households). Very few two-car households had two compact cars (5.8%). A logit model was developed to explain the choice of the smaller car

in two-car households using demographic data associated with the households. Some very interesting results of this model are shown on pages 26 and 27.

The outputs of the transportation sector are frequently difficult to generalize and can be viewed in many different ways. Page 11 shows the 1975 and DOT's forecasted 1990 expenditures for the transportation sector from three different viewpoints: passenger vs freight, automotive vs nonautomotive, and interstate vs state/local vs international.

The automobile is the largest energy user within the transportation sector, and it is usually implicitly assumed that all autos are owned by individuals. However, data on page 13 indicate that over 10 million automobiles (over 10% of the entire automobile population) are owned by companies or governments. These are called fleet vehicles, and the fastest growing category of fleet vehicles is that of leased automobiles. Non-Federal government automotive fleet vehicles have actually declined in number over the last ten years.

The Federal government fleet of motor vehicles (p. 14) numbers over 420 thousand, about 75% of which are trucks. Thirty-seven percent of these vehicles belong to the military, 27% to the postal service, and 36% to civilian agencies such as the General Services Administration, which lends cars to other agencies. Among the civilian agencies, ERDA has the fifth largest fleet. TEC is conducting fuel economy tests with some of the vehicles at ERDA's Nevada Operations Office.

Fleet auto purchases accounted for over 11% of the auto sales in 1975 (p. 15). ORNL is currently sponsoring a study of the factors that determine the type of automobiles bought by fleet operators and their

respective uses. Surprisingly, fleet sales are not concentrated in the luxury and large-auto classes. 1976 fleet sales accounted for over 15% of total sales in each of the compact, intermediate, and standard automobile classes. Fleet sales comprised less than 5% of the total sales for sports cars and imported cars.

Sales of intermediate-sized automobiles exceeded the sales of full-sized automobiles in 1975 for the first time (p. 16). Initial automobile sales of subcompacts and compacts in 1977 indicate relative declines.

Some of this sales reversal for small cars was anticipated by a survey in 1976 (p. 17) that indicated that over half of the persons who purchased small cars in 1976 do not plan to replace that car with another small car when a replacement is needed. Conversely, about 86% of the purchasers of large cars plan to replace their large car with another large car. Apparently loyalty to small cars has not reached the level enjoyed by the larger models. As might be expected, higher gas mileage is the most-often-cited reason for purchasing a small car, and comfort is the dominant reason for a large-car selection (p. 18).

While many automobiles are not owned by households, many trucks are owned by households. Approximately one in five households owns one or more trucks (p. 20). Regional variations in truck ownership are large, with the West having about three times the ownership rate of the Northeast (in 1974). But between 1970 and 1974, households owning trucks grew 32% in the Northeast, as compared with a 19% growth in the national percentage.

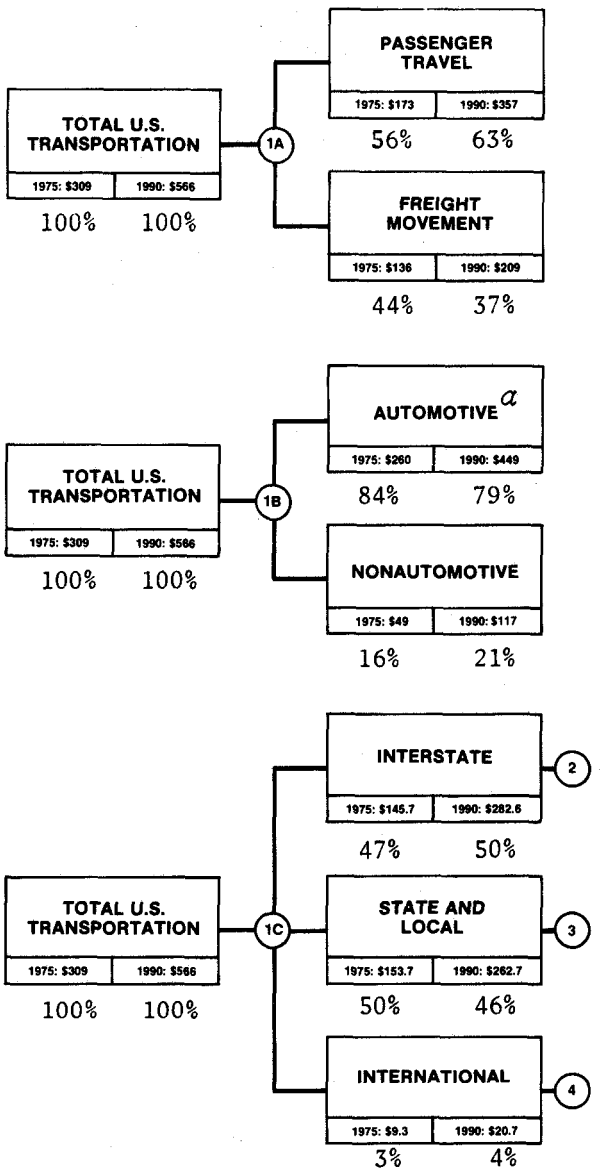
A surprisingly high percentage of trucks is used for commuting to work in certain metropolitan areas (p. 22). The phenomenal growth

in light-duty truck sales (most trucks being purchased for personal use) is shown on page 23. Whereas about one light-duty truck was purchased for every seven autos purchased in 1965, the rate of sales had increased to about one in three in 1976. The character of these light trucks has changed over the past decade as well. In 1965, 3.7 times more trucks under 6,000 pounds were sold than trucks in the 6,000 to 10,000 pound class. By 1976, there were 11% more of the heavier light-duty trucks sold.

Section 1.1

Overview

THE TREE CHART BELOW SHOWS THREE ALTERNATE WAYS OF VISUALIZING THE COMPONENTS OF U.S. TRANSPORTATION AND OF DIVIDING THE TOTAL U.S. TRANSPORTATION BILL FOR 1975 AND PROJECTED TO 1990 BY DOT.



The U.S. Transportation Bill[b] in 1975 and Projected to 1990.
(in billions of 1975 dollars)

[a]The transportation bill indicates what the nation pays in its market for transportation. For commercial transportation, it is the sum of the revenues of the operators. For private transportation, it is the sum of costs associated with ownership and operation.

[b]In this dicotomy, an automobile refers to a personal vehicle operated by the user at the user's discretion, and usually owned (or leased or rented) by the user. This definition covers all privately owned or leased automobiles plus motorcycles, light trucks used for personal transportation, vans and recreational vehicles, and corporate fleets and rental cars.

Source: U.S. Department of Transportation, Office of the Secretary, National Transportation Trends and Choices (to the Year 2000), Washington, D.C., January 12, 1977, pp. 35 and 85.

Section 1.2

Highway

OVER THE PAST TEN YEARS THE FLEET USE OF AUTOMOBILES HAS GROWN ONLY ABOUT 20%, BUT SOME OF THE SUBCATEGORIES OF FLEET USE HAVE SHOWN VERY LARGE GROWTH. FOR EXAMPLE, FLEETS OF 25 OR MORE AUTOS LEASED BY BUSINESSES GREW 113%, FLEETS OF 10 TO 24 AUTOS LEASED BY BUSINESS GREW 210%, AND THE TAXI FLEET GREW ABOUT 42%. CONVERSELY, BUSINESS-OWNED FLEETS DECLINED IN SIZE, SMALL FLEETS OF 4 TO 9 AUTOS DECLINED 11%, AND THE GOVERNMENT FLEET DECLINED 4%.

THE TRUCK FLEET GREW ABOUT 143% OVER THE PAST TEN YEARS. THE NUMBER OF LEASED TRUCKS IS FOUR TIMES LARGER THAN THE NUMBER OF DAILY RENTAL TRUCKS AND IS GROWING AT A FASTER RATE.

Motor Vehicle Fleets in the U.S. by Type of Business
(in thousands)

	1966	1976	Percent change 1966-1976
Automobiles			
Total number in fleets of 4 or more	8,710	10,403	19.4
Business fleets - 25 or more	1,590	2,333	46.7
Salesman or company owned	755	555	-26.5
Fleet leased	835	1,778	112.9
Business fleets - 10-24 cars	964	1,924	99.6
Owned	503	496	-1.4
Leased	461	1,428	209.8
Fleets - 4-9 cars	4,604	4,116	-10.6
Other fleets	1,552	2,030	30.8
Government[a]	660	635	-3.8
Utilities	374	508	35.8
Taxi	142	202	42.3
Other	376	685	82.2
Trucks	379	920	142.7
Daily rental	74	155	109.5
Leasing	305	765	150.8

[a]Includes to some extent all governmental levels. The fleet size and composition by governmental level (i.e. local, state, and federal) was not available from the original source at the time of publication.

Source: E. J. Bobit (ed.), Automotive Fleet, Vol. 16, No. 6, Bobit Publishing Company, Glenview, IL, April 1977, p. 22.

THE FIVE LARGEST CIVILIAN AGENCIES IN TERMS OF MOTOR VEHICLE OWNERSHIP ARE SHOWN IN THE TABLE BELOW: ERDA IS THE FIFTH LARGEST OWNER. OVER A FOURTH OF ERDA'S VEHICLES ARE AT THE NEVADA OPERATIONS OFFICE. UNDER A TEC CONTRACT, A TEST FLEET OF OVER 300 VEHICLES AT LAS VEGAS IS BEING USED TO TEST A COMBINATION OF TRAINING AND/OR DRIVER AID DEVICES TO DETERMINE EFFECTIVE METHODS TO INCREASE THE MPG'S OBTAINED ON GOVERNMENT OPERATED VEHICLES.

Federal Fleet of Motor Vehicles, Worldwide (FY 1975)

Agency	Number of vehicles	Percent of total vehicles
Total	420,784	100
Military	156,441	37.2
Army	65,937	15.7
Postal Service	115,133	27.4
Civilian	149,210	35.5
General Services Adm.	72,102	17.1
Agriculture	29,477	7.0
Interior	11,601	2.8
Justice	9,830	2.3
ERDA	9,399	2.2
Nevada Operations Office TEC	2,426	0.58
Test Fleet	331	0.08

Source: General Services Administration, Federal Motor Vehicle Fleet Report, Washington, D.C., July 1976.

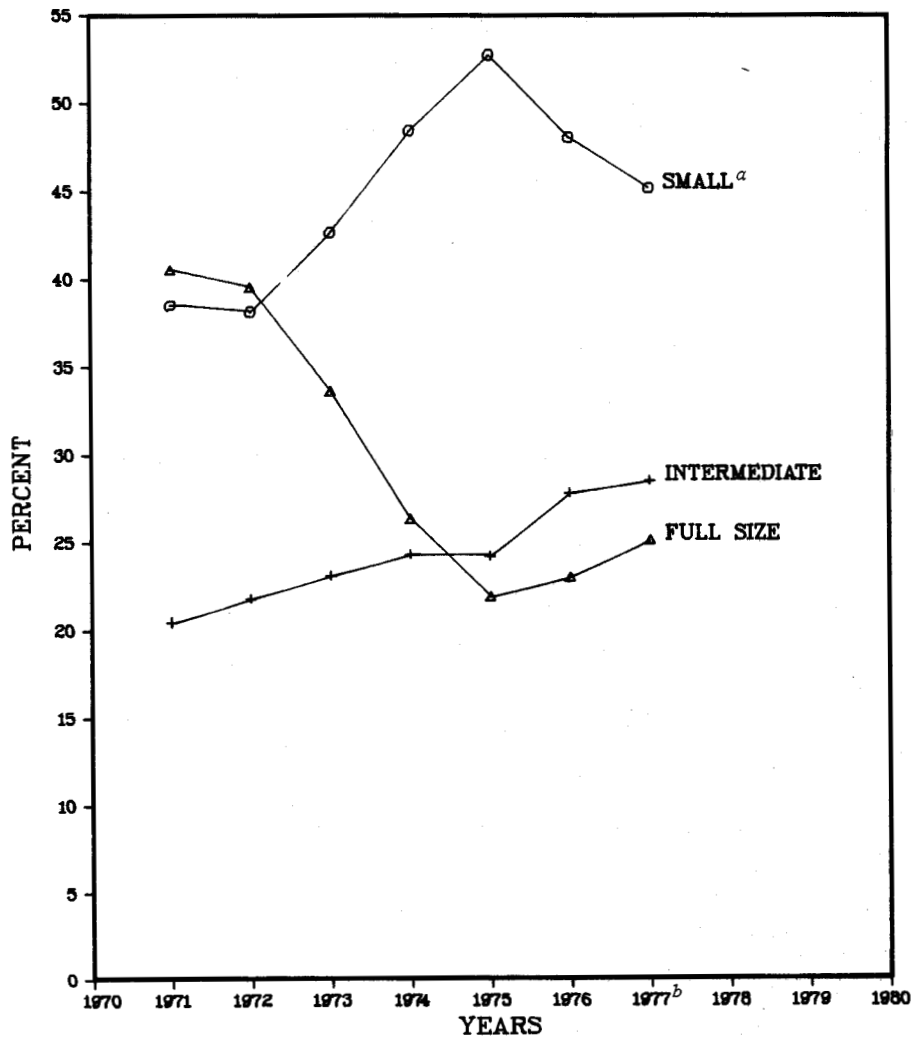
CONTRARY TO POPULAR BELIEF, THE NEW AUTOMOBILE FLEET IS NOT CHARACTERIZED BY LUXURY AND LARGE MODELS. THE SHARE OF NEW FLEET AUTO SALES IN THE STANDARD, INTERMEDIATE, COMPACT, AND OTHER CATEGORIES IS HIGHER THAN THE RESPECTIVE TOTAL RETAIL SHARES. NOTE THAT VERY FEW FLEET SALES ARE OF IMPORTED AUTOS.

Comparison of Retail Sales and Fleet Sales by Vehicle Type,
1976 Model Year
(thousands of sales)

	Total Retail Sales	Fleet Sales	Fleet as Percent of Total
Total	9,599	1,127	11.7
Luxury (e.g. Cadilac)	495	54	10.9
(%)	5.2	4.8	
Large (e.g. Chrysler)	890	54	6.1
(%)	9.3	4.8	
Standard (e.g. Ford)	911	145	16.0
(%)	9.5	12.9	
Intermediate (e.g. Cutlass)	2,566	398	15.5
(%)	26.7	35.3	
Compact (e.g. Volare)	1,846	279	15.1
(%)	19.2	24.8	
Subcompact (e.g. Pinto)	743	87	11.7
(%)	7.7	7.7	
Sports (e.g. Mustang II)	673	27	4.1
(%)	7.0	2.4	
Other (e.g. Sportsman)	119	16	13.5
(%)	1.2	1.4	
Domestic	8,243	1,060	12.9
(%)	85.9	94.1	
Imports & others	1,355	66	4.9
(%)	14.1	5.9	

Source: E. J. Bobit (ed.), Automotive Fleet, vol. 16, no. 6, Bobit Publishing Company, Glenview, IL, April 1977.

AS THE GRAPH BELOW INDICATES, THE TREND IN THE EARLY 1970'S WAS TOWARD INCREASED SALES OF SMALL AUTOMOBILES AT THE EXPENSE OF FULL-SIZE AUTOMOBILES. IN 1976, THIS TREND REVERSED ITSELF AND THE MARKET SEGMENT PERCENTAGE FOR FULL SIZE AUTOMOBILES INCREASED.



Percent New Car Registrations by Market Segment[c].

[a]Small includes subcompacts, compacts and imports.

[b]Based on distribution of sales for January through March.

[c]The market segment breakdowns were determined by Ward's classification scheme which is based on car size and merchandising intent. Ward's classification of individual car-lines differs slightly from that of the Environmental Protection Agency (EPA), which classifies cars according to their interior size only. (See page 106 for comparison).

Sources: H. A. Stark (ed.), Ward's Communications Inc., Ward's 1976 Automotive Yearbook, 38th ed., Detroit, Michigan, 1976; Ward's Automotive Reports, Vol. 52, No. 2, January 10, 1977; Ward's Automotive Reports, Vol. 52, No. 15, April 11, 1977.

A RECENT SURVEY INDICATES THAT OWNERS OF SMALL CARS ARE LEAST LIKELY TO REPLACE THEIR SMALL CARS WITH ONES OF THE SAME SIZE, AND OWNERS OF LARGE CARS MOST LIKELY TO DO SO. THEREFORE, ENCOURAGING FUEL EFFICIENCY THROUGH MORE EFFICIENT MODELS IS A TWO-PRONGED PROBLEM: PROMOTING THE SHIFT IN PURCHASE OF SMALL CARS AND THEN MAINTAINING THIS SIZE SWITCH.

Size Loyalty Between New Car Purchase and Projected Replacement

Estimated size of new car to be purchased between June 1976 and 1981	Size of 1976 new car purchase		
	Small	Medium	Large
Small	49%	9%	7%
Medium	16	47	6
Large	35	32	86
Other (van/truck)		2	1
	100%	100%	100%
Percent replacing their 1976 car next	43%	60%	65%

Source: Arthur D. Little, Inc., Attachment 1, Study of Automobile Market Dynamics: Final Test of Consumer Responses, Cambridge, Mass., November 1976, p. 23.

FROM THE ABOVE TABLE, WE SEE THAT 35% OF THE PEOPLE WHO BOUGHT SMALL CARS IN 1976 PLAN THEIR NEXT PURCHASE TO BE A LARGE CAR, WHEREAS ONLY 7% OF THE PEOPLE WHO BOUGHT LARGE CARS IN 1976 PLAN TO BUY SMALL CARS BETWEEN NOW AND 1981.

THE TABLE BELOW GIVES CHARACTERISTICS OF NEW CARS TO BE PURCHASED BETWEEN JUNE 1976 AND 1981 AS INDICATED IN A SURVEY OF NEW CAR OWNERS WHICH WAS CONDUCTED BY ARTHUR D. LITTLE, INC. FOREIGN CARS ARE EXPECTED TO COMPRISE OVER HALF THE SMALL NEW CAR PURCHASES, BUT ONLY 4% OF THE LARGE NEW CAR PURCHASES. SMALL CARS ARE MORE LIKELY TO BE ASSOCIATED WITH COMMUTING AND ARE EXPECTED TO TRAVEL THE FURTHEST. THE REASONS FOR PURCHASE ARE CLEARLY DIFFERENTIATED BY CAR SIZE. WHILE FUEL ECONOMY IS PREDOMINANT FOR SMALL CARS, ALMOST HALF OF THE LARGE CAR BUYERS EMPHASIZE COMFORT. ECONOMICAL OPERATION IS SECOND IN IMPORTANCE FOR SMALL CARS, WHILE "THE RIGHT SIZE FOR MY FAMILY" IS SECOND IN IMPORTANCE FOR LARGE AND A CLOSE THIRD (AFTER "GOOD GAS MILEAGE") FOR MIDSIZE CARS.

Expected Characteristics of New Cars to be Purchased Between June 1976 and 1981 and Reasons for Size Selections

	New car		
	Small	Medium	Large
Origin			
Foreign, %	54	22	4
Domestic, %	46	78	96
Average years to purchase	3.53	3.69	3.57
Average mpg	25.05	21.01	16.86
Average yearly miles traveled	15,300	13,480	14,180
Use, %			
Business	13	18	15
Commuting	61	53	47
Family errands	31	31	36
Vacations/trips	12	11	24
Other	3	3	3
Reasons for selecting, %			
Comfortable	8	34	49
Right size	28	37	37
Like its looks	29	36	30
Good gas mileage	55	38	15
Doesn't cost too much to run	43	25	11
Holds the road	18	20	21
Right price range	28	20	15
Experience	14	14	24

Source: Arthur D. Little, Inc., Attachment 1, Study of Automobile Market Dynamics: Final Test of Consumer Responses, Cambridge, Mass., November 1976, p. 26.

ALTHOUGH 1970 DATA SHOW THAT 17.7% OF THE U.S. HOUSEHOLDS DID NOT OWN AN AUTOMOBILE, MANY OF THESE HOUSEHOLDS DID OWN A TRUCK. IN FACT, 10.9% OF THE TRUCK-OWNING HOUSEHOLDS DID NOT OWN AN AUTOMOBILE. AT THE OTHER EXTREME, OVER A FIFTH OF THE HOUSEHOLDS THAT OWNED A TRUCK ALSO OWNED 2 OR MORE AUTOMOBILES.

Auto Ownership Characteristics of Households
Owning Trucks, 1970

	Number of autos owned, by percent			
	0	1	2 or more	Total
Household who own				
Pickups	13.7	65.9	20.4	100.0
Vans	2.9	62.8	34.3	100.0
Jeeps	3.9	65.3	30.8	100.0
All truck owners[a]	10.9	66.9	22.2	100.0
All households	17.7	53.6	38.7	100.0

[a]Note that some households may own two different kinds of trucks. These show up in figures for both types.

Source: A study, The Demand for Automobiles: An Analysis, prepared for the Energy Research and Development Administration by J. P. Leape, Harvard University, Cambridge, Mass., April 1977, p. 80. (Original source: Survey Research Center, Survey of Consumer Finances, Michigan: University of Michigan, Institute for Social Research, 1970).

IN 1974, THE PERCENTAGE OF HOUSEHOLDS THAT OWNED TRUCKS VARIED FROM A LOW OF ABOUT 10% IN THE NORTHEAST TO A HIGH OF ABOUT 29% IN THE WEST, WHILE THE NATIONAL AVERAGE WAS ABOUT 20%. PICKUP TRUCK AND TOTAL TRUCK OWNERSHIP BY HOUSEHOLDS INCREASES WITH INCOME UP TO THE $15,000 TO $20,000 BRACKET AND THEN DECLINES SUCH THAT THE HOUSEHOLDS WITH INCOMES OF OVER $25,000 OWN ABOUT AS MANY PICKUPS AS THE HOUSEHOLDS EARNING $7,500 TO $10,000.

Percentage Household Truck Ownership in 1970 and 1974

	1970	1974	% change
Region:			
Northeast	7.5	9.9	32
North Central	16.2	19.6	21
South	20.8	23.0	11
West	23.3	28.6	23
Income:			
Under $3,000	7.6	8.9	17
4,000 — 4,999	10.9	12.2	12
5,000 — 7,499	14.2	16.2	14
7,500 — 9,999	16.6	19.4	17
10,000 — 14,999	22.0	25.2	15
15,000 — 19,999	22.5	27.1	20
20,000 — 24,999	19.0	24.3	28
25,000 and over	16.9	20.1	19
All households	16.9	20.1	19

Source: U.S. Department of Commerce, Bureau of the Census, Selected Data from the 1973 and 1974 Surveys of Purchases and Ownership, Washington, D.C., July 1976.

BEGINNING IN 1975, A GROUP OF QUESTIONS ON TRAVEL TO WORK WERE ADDED AS A SUPPLEMENT TO THE CENSUS BUREAU'S ANNUAL HOUSING SURVEY (AHS). THE TRAVEL TO WORK SUPPLEMENT IS INCLUDED FOR THE METROPOLITAN AREA SAMPLE WHICH COMPRISES ABOUT 60 METROPOLITAN AREAS TO BE SURVEYED OVER A THREE-YEAR PERIOD. THE DATA PRESENTED BELOW REPRESENT RESULTS OBTAINED FROM THE FIRST CYCLE, WHICH SURVEYED 21 OF THE 60 METROPOLITAN AREAS.

86% OF JOB COMMUTERS IN THE 21 METROPOLITAN AREAS USE PRIVATE CARS OR TRUCKS, 12% USE PUBLIC TRANSPORTATION, AND 2% USE MOTORCYCLES, BICYCLES OR OTHER MEANS. MORE JOB COMMUTERS IN THESE AREAS (18%) ARE CAR-POOLING BY PRIVATE VEHICLE TODAY THAN ARE RIDING IN ALL FORMS OF PUBLIC TRANSPORTATION COMBINED (12%). HOWEVER, 68% OF ALL OF THESE WORK COMMUTERS DRIVE ALONE BY PRIVATE VEHICLE.

Major Mode of Transportation to Work for 21 Standard Metropolitan Statistical Areas[a] (SMSA's), 1975

Mode	All workers		Median distance from home to work (in miles)
	Number	Percent	
All workers	12,931		
Not working at home	12,356		7.5
Workers using vehicles	11,650	100	8.0
Auto or truck[b]	10,040	86	8.0
Auto	9,153	79	7.9
Truck	887	8	8.7
Drives alone	7,877	68	7.7
Carpool	2,100	18	9.1
Sharing driving	731	6	12.5
Driving others	541	5	9.1
Riding with someone	829	7	6.6
Public transportation[c]	1,432	12	8.9
Bus or streetcar	1,018	9	7.0
Subway or elevated	177	2	10.1
Railroad	224	2	24.4
% change in use, 1970-1975		22	
Other means[d]	179[e]	2	3.1[f]
Bicycle	86[e]	1	
Walking only	605	5[g]	0.6[e]
Working at home	219	2[g]	
Mode not reported	457	4[g]	6.7

[a]This table is based on preliminary data from the first four months (April-July) of the DOT Travel to Work Supplement to the Annual Housing Survey (AHS) Year II SMSA sample. The user is cautioned that the figures here are for only one-third of the final sample, may contain seasonal biases and have only had simplified weighting procedures applied. Final results will be reported in Winter 1977.
[b]Includes a small number of workers using auto or truck but not specifying type of riding arrangement.
[c]Includes workers using taxicabs.
[d]Includes workers using motorcycles and all other means besides those listed.
[e]Indicates relative sampling variability of the data; standard error is between 5 and 10%.
[f]Indicates relative sampling variability of the data; standard error is between 10 and 25%.
[g]Percent of all workers.

Source: U.S. Department of Commerce, Bureau of the Census, The DOT Travel to Work Supplement to the Annual Housing Survey, Washington, D.C., November 1976, Tables 1, 2, and 4.

DATA FOR 1975 FROM 21 SELECTED METROPOLITAN AREAS SHOW A SURPRISINGLY HIGH USAGE OF TRUCKS FOR COMMUTING, PARTICULARLY IN WESTERN AREAS.

Use of Trucks in Urban Commuting

Metropolitan area	Trucks as a percent of all vehicles used to commute to work
San Bernardino	18
Portland (Oregon)	16
San Antonio	15
Colorado Springs	15
San Diego	12
Kansas City	11
New Orleans	10
Atlanta	10
Rochester, N.Y.	9
San Francisco	9
Columbus, Ohio	8
Cincinnati	8
Newport News	8
Miami	7
Springfield, Mass.	6
Madison	6
Philadelphia	6
Hartford	5
Milwaukee	5
Patterson, N.J.	4
Chicago	3
All 21 SMSAs	8

Source: U.S. Department of Commerce, U.S. Bureau of the Census, The DOT Travel to Work Supplement to the Annual Housing Survey, November 1976.

OVER THE PAST QUARTER CENTURY, ANNUAL DOMESTIC AUTO SALES HAVE INCREASED ABOUT 27%, WHEREAS TRUCK AND BUS SALES HAVE RISEN 122%. MOST OF THE GROWTH IN TRUCK SALES IS DUE TO THE RAPID INCREASE IN THE SALES OF LIGHT-WEIGHT TRUCKS (UNDER 10,000 POUNDS GROSS VEHICLE WEIGHT). THE MAJORITY OF THESE TRUCKS ARE PURCHASED BY HOUSEHOLDS FOR PERSONAL TRANSPORTATION USE.

Motor Vehicle Factory Sales from Domestic Car Manufacturers
(in millions)

Year	Passenger cars	Trucks and buses	Trucks & buses as % of cars	Light weight trucks			
				6000 lb & less	As % of cars	6,000–10,000 lb	As % of cars
1950	6.67	1.34	20				
1955	7.92	1.25	16				
1960	6.67	1.19	18				
1965	9.31	1.75	19	1.06	11.4	.29	3.1
1966	8.60	1.73	20	1.02	11.9	.30	3.5
1967	7.44	1.54	21	.90	12.1	.29	3.9
1968	8.82	1.90	22	1.14	12.9	.39	4.4
1969	8.22	1.92	23	1.12	13.6	.41	5.0
1970	6.55	1.69	26	.95	14.5	.40	6.1
1971	8.58	2.05	24	1.20	14.0	.49	5.7
1972	8.82	2.45	28	1.41	16.0	.58	6.6
1973	9.66	2.98	31	1.74	18.0	.76	7.9
1974	7.33	2.73	37	1.54	21.0	.73	10.0
1975	6.71	2.27	34	.98	14.6	.96	14.3
1976	8.50	2.98	34	1.25	14.7	1.39	16.4

Sources: Motor Vehicle Manufacturers Association, Motor Vehicle Facts and Figures '76, Detroit, Michigan, pp. 15 and 16; Motor Vehicle Manufacturers Association, Statistics Department, Report FS-4, Detroit, Michigan, February 23, 1977.

LIGHT-WEIGHT TRUCK SALES WERE 15% OF AUTO SALES IN 1965, AND ROSE TO 31% OF AUTO SALES IN 1976. TO THE EXTENT THAT HOUSEHOLDS HAVE SUBSTITUTED LIGHT-WEIGHT TRUCKS FOR AUTOMOBILES, THEY ARE OFFSETTING SOME OF THE FUEL ECONOMY GAINS THAT HAVE BEEN ACHIEVED AS A RESULT OF THE SHIFT FROM LARGE TO MIDDLE-SIZED AUTOS OVER THE PAST FIVE YEARS. THIS OFFSETTING FUEL PENALTY IS ACCENTUATED BY THE FACT THAT THE HEAVIER, LESS FUEL-EFFICIENT, LIGHT-WEIGHT TRUCKS HAVE BEGUN TO OUTSELL THE MORE FUEL EFFICIENT LIGHT-WEIGHT MODELS.

SOME FACTORS IMPACTING ON FUEL EFFICIENCY OF LIGHT-WEIGHT TRUCKS

AIR POLLUTION CONTROLS – AS OF MODEL YEAR 1977, THE SMALL, DOMESTIC, LIGHT-WEIGHT TRUCKS (UNDER 6,000 POUNDS) REQUIRED CATALYTIC CONVERTERS AND UNLEADED GASOLINE. THE LARGER LIGHT-WEIGHT TRUCKS (6,000 TO 10,000 POUNDS) DID NOT REQUIRE EITHER. THESE FUEL PENALTIES FOR THE SMALLER LIGHT-WEIGHT TRUCKS MAY BE INFLUENCING THE TREND TOWARD THE LARGER LIGHT-WEIGHT TRUCKS (SEE P. 23).

4-WHEEL DRIVE – LIGHT-WEIGHT TRUCKS WITH 4-WHEEL DRIVE USE MORE FUEL PER MILE (ALL OTHER THINGS BEING EQUAL) THAN 2-WHEEL DRIVE TRUCKS. AS SEEN FROM THE TABLE BELOW, THERE IS A GROWING TREND TOWARD 4-WHEEL DRIVE IN THE LARGER LIGHT-WEIGHT TRUCKS.

Percent of Light-Weight Trucks with 4-Wheel Drive

	Under 6,000 lb	6,000 to 10,000 lb
1974	19	17
1975	17	27
1976	17	28

Source: Motor Vehicle Manufacturers Association, New Truck Retail Sales and Stocks by G.V.W. Groups and Body Type, RS-3s (December 1976), Detroit, Michigan.

IN 1970, ACCORDING TO THE TABLE BELOW, 39% OF HOUSEHOLDS THAT OWNED TWO CARS (I.E. TWO-CAR HOUSEHOLDS) OWNED AT LEAST ONE COMPACT CAR AND MOST OF THESE HOUSEHOLDS OWNED A REGULAR-SIZE CAR AS A SECOND CAR. ONLY 6% OF TWO-CAR HOUSEHOLDS OWNED TWO COMPACT CARS. STATION WAGONS WERE THE LARGEST CAR FOR 20% OF THE TWO-CAR HOUSEHOLDS.

Vehicle Size Combinations of Two-Car Households, 1970

Size of smallest car	Size of largest car				
	Compact	Intermediate	Regular	Station wagon	Total
Compact	5.8	6.4	22.3	4.8	39.3
Intermediate		2.9	11.9	2.9	17.7
Regular			20.5	11.4	41.9
Station wagon				1.1	1.1
Total	5.8	9.3	64.7	20.2	100.0

Source: A study, The Demand for Automobiles: An Analysis, prepared for the Energy Research and Development Administration by J. P. Leape, Harvard University, Cambridge, Mass., April 1977, p. 58. (Original source: Survey Research Center, Survey of Consumer Finances, Michigan: University of Michigan, Institute for Social Research, 1970.)

ACCORDING TO SURVEY ANALYSIS PERFORMED FOR ERDA USING 1970 HOUSEHOLD AUTOMOBILE OWNERSHIP PATTERNS, THE PREPONDERANCE OF TWO-CAR HOUSEHOLDS OWN EITHER A STANDARD-SIZE CAR OR STATION WAGON AS THEIR LARGER AUTOMOBILE. A MODEL DEVELOPED BY USING THIS DATA SHOWS THAT SELECTION OF THE SECOND CAR VARIED WITH TYPE OF HOME, COMMUTING DISTANCE, INCOME, NUMBER OF DRIVERS IN FAMILY, AND EDUCATION. FOR EXAMPLE, 46% OF THE TWO-CAR HOUSEHOLDS THAT LIVED IN SINGLE-FAMILY HOMES FIVE MILES FROM THE CENTRAL BUSINESS DISTRICT OF A LARGE CITY, EARNING $10,000 PER YEAR, WITH TWO ADULT DRIVERS, AND A HOUSEHOLD HEAD WITH A B.A. DEGREE, OWNED A COMPACT CAR. THE PERCENTAGE INCREASED TO 77% IF THE HOUSEHOLD LIVED IN A MULTI-UNIT DWELLING AND DECREASED TO 34% IF THE HOUSEHOLD HEAD DID NOT HAVE A COLLEGE DEGREE.

Choice of Smaller Car for Two-Car Households (%)

	Foreign compact	Domestic compact	Intermediate	Regular	High-priced regular
Nominal households[a]	16.3	30.0	18.9	34.0	0.7
If these households did not live in single family homes	23.2	54.3	13.5	6.4	2.5
If these households lived 15 miles from the center of the city	21.2	32.3	18.8	20.9	0.9
If these households earned $20,000 per year	18.2	27.6	17.4	35.3	1.4
If the head of these households did not have a B.A. degree	13.9	20.0	19.7	42.5	3.9

[a]Two adult drivers, income equals $10,000, head has B.A., live in single-family dwelling 5 miles from CBD.

Source: A study, The Demand for Automobiles: An Analysis, prepared for the Energy Research and Development Administration by J. P. Leape, Harvard University, Cambridge, Mass., April 1977, p. 169. (Original source: Survey Research Center, Survey of Consumer Finances, University of Michigan, Institute for Social Research, 1970.)

THIS SAME MODEL INDICATED THAT ONLY 66% OF HOUSEHOLDS LIVING IN A SINGLE FAMILY DWELLING IN THE SUBURBS, EARNING $10,000 PER YEAR, WITH TWO ADULT DRIVERS, OWNED TWO AUTOMOBILES. HOWEVER, THIS PERCENTAGE INCREASED TO 72% IF THE HOUSEHOLD INCOME INCREASED 50%. ALSO NOTE BELOW THAT 12% OF THESE NOMINAL HOUSEHOLDS WERE USING TRUCKS FOR THEIR PRIMARY MEANS OF TRANSPORTATION.

Distribution of Automobile Ownership (%)

	None	One	Two	Three or more
Nominal household[a]	4.0	23.0	66.4	6.6
If these households lived in the Central City of a large large metropolitan area	15.4	27.6	53.1	3.8
If these households had a 50% larger income ($15,000 per year)	1.8	18.7	71.8	7.7
If these households did not live in a single family house	10.6	43.7	39.7	4.8
If a third adult driver joined these households	1.2	10.0	69.8	19.0
If these households owned a truck	11.8	43.7	39.7	4.8

[a]Two adult drivers, income equals $10,000, live in single-family dwelling in the suburbs.

Source: A study, The Demand for Automobiles: An Analysis, prepared for the Energy Research and Development Administration by J. P. Leape, Harvard University, Cambridge, Mass., April 1977, p. 162. (Original source: Survey Research Center, Survey of Consumer Finances, University of Michigan, Institute for Social Research, 1970.)

GENERALLY, A HOUSEHOLD IS MORE LIKELY TO PURCHASE A NEW CAR RATHER THAN A USED CAR AS THE HOUSEHOLD INCOME INCREASES, THE AGE OF THE HOUSEHOLD HEAD INCREASES, AND IF THE HOUSEHOLD HAS ONLY ONE CAR. NOTE IN THE TABLE BELOW THAT ONLY 1 IN 10 CARS IS BOUGHT USED BY A HOUSEHOLD EARNING OVER $15,000 (IN 1970), WITH THE HEAD BETWEEN THE AGES OF 55 AND 64, AND WITH ONE CAR. CONVERSELY, ONLY 1 IN 10 CARS IS BOUGHT NEW BY A HOUSEHOLD WITH LESS THAN $5,000 INCOME AND THE HEAD BETWEEN THE AGES OF 25 AND 34.

Percent of Cars Purchased New, by Age of Household Head, Income and Number of Cars Owned

Income	No. of autos owned	Age of head of household						
		24	25–34	35–44	45–44	55–64	65+	All ages
Up to $5,000	1	26.6	11.5	11.5	33.3	35.3	49.1	34.3
	2							36.0
$5–$10,000	1	30.1	40.0	29.9	36.5	65.2	76.6	49.6
	2	30.6	29.2	28.2	29.0	29.4	65.5	32.2
$10–$15,000	1		60.6	51.8	59.4	77.1	85.7	72.7
	2	34.5	43.8	44.1	51.1	41.3	72.7	46.6
$15,000+	1		54.8	69.6	78.4	90.9	88.9	74.1
	2		49.4	51.5	56.2	63.5	75.0	55.7
All incomes		33.9	44.3	44.1	49.9	54.7	63.8	48.4
Average age of vehicle		4.87	4.99	5.28	5.01	5.34	5.82	5.19

Source: A study, The Demand for Automobiles: An Analysis, prepared for the Energy Research and Development Administration by J. P. Leape, Harvard University, Cambridge, Mass., April 1977, p. 107. (Original source: Federal Highway Administration, The Nationwide Personal Transportation Study, Reports No. 1-11, Washington: 1972–1974.)

ACCORDING TO DATA COMPILED BY THE U.S. TRAVEL DATA CENTER, LONG DISTANCE TRIPS (I.E. GREATER THAN 100 MILES) WERE SHORTER IN TERMS OF THE MILES PER TRIP AND HAD A HIGHER LOAD FACTOR (I.E. PERSONS PER TRIP) IN 1974 THAN IN 1972. IN 1975, HOWEVER, THIS TREND WAS REVERSED WITH THE MILES PER TRIP SURPASSING THE 1972 AVERAGE BY 4% AND AIR TRAVEL INCREASING BY 15%. THIS DECLINE IN TRAVEL ACTIVITY BETWEEN 1972 AND 1974 AND THE CORRESPONDING INCREASE FROM 1974 TO 1975 MAY REFLECT A TRAVEL RESPONSE TO THE 1973 OIL EMBARGO AND ITS SUBSEQUENT LIFTING IN 1974. THE TABLE BELOW PROVIDES THE CHARACTERISTICS OF THE TRIPS DURING THIS PERIOD BY MODE AND REGION.

Average Characteristics of Travel Involving 100 Miles or More: 1972, 1974, and 1975[a]

	1972	1974	1975
All travel			
Persons per trip	1.94	2.11	2.01
Miles per trip	806	791	820
Nights per trip	3.88	4.06	3.97
Auto/truck travel			
Persons per trip	2.11	2.32	2.16
Miles per trip	657	650	678
Nights per trip	3.24	3.63	3.50
Air travel			
Persons per trip	1.29	1.36	1.36
Miles per trip	1891	1878	2182
Nights per trip	7.57	6.53	7.60

Characteristics of Average Trip by Region of Destination: 1972, 1974, and 1975[a]

Region of destination[b]	Persons per trip			Miles per trip			Nights per trip		
	1972	1974	1975	1972	1974	1975	1972	1974	1975
New England	2.0	2.2	2.1	674	686	707	3.9	4.2	3.8
Eastern Gateway	1.8	2.4	2.0	724	592	680	3.5	6.2	3.9
G. Washington County	1.9	2.0	2.0	645	593	681	3.2	3.7	3.1
South	1.9	2.0	2.0	974	959	985	4.4	4.3	4.4
Great Lakes County	2.0	2.3	2.1	628	662	660	3.0	3.2	3.2
Mountain West	2.0	2.2	2.1	1006	976	1055	4.1	4.0	4.2
Frontier West	2.1	2.0	2.0	801	819	737	3.1	3.2	3.8
Far West	1.9	2.1	1.8	1160	1138	1260	3.8	4.0	4.4
Outside U.S.	1.8	2.0	1.9	NA	NA	NA	11.5	7.8	7.9

NA — Not available.

[a]A "trip" is defined as travel to a place 100 miles or more away from home and return, whether or not an overnight stay is involved. Every time one or more members of a household travel together, a trip is recorded.

[b]See map on page 108 for regional boundaries.

Source: U.S. Travel Data Center, 1975 National Travel Survey: Full Year Report, Washington, D.C., 1976, pp. 3, 8, 9, and 18.

THE DISTRIBUTION OF PERSON TRIPS BY REGION OF ORIGIN AND DESTINATION REFLECTS THAT THE GREAT LAKES COUNTRY IS THE MOST TRAVEL-INTENSIVE REGION IN THE U.S. THE FRONTIER WEST REGION EXPERIENCED THE GREATEST INCREASE IN POPULARITY AS A DESTINATION OVER 1974, FOLLOWED BY THE SOUTH AND THE NEW ENGLAND REGIONS, RESPECTIVELY. THE EASTERN GATEWAY, FAR WEST, AND MOUNTAIN WEST REGIONS REGISTERED THE GREATEST DECLINES IN POPULARITY AS DESTINATIONS.

Distribution of all Person-Trips by Region[a] of Origin and Region of Destination, 1975, 1974 and 1972

	Region of Origin			Region of Destination		
	1975	1974	1972	1975	1974	1972
New England	5.0%	4.3%	5.6%	5.3%	4.4%	5.5%
Eastern Gateway	8.0	9.9	8.2	5.9	7.4	5.5
G. Washington Country	11.0	12.1	10.0	10.2	11.0	9.4
South	18.2	14.3	16.3	20.4	16.9	19.2
Great Lakes Country	24.9	23.3	24.7	21.3	21.0	20.5
Mountain West	3.7	6.3	4.7	4.6	6.2	4.9
Frontier West	15.9	13.5	14.8	16.0	13.1	14.6
Far West	13.3	16.3	15.7	12.8	16.0	15.6
Outside U.S.	NA	NA	NA	3.7	4.0	4.0

[a]See map on page 108 for regional boundaries.

Source: U.S. Travel Data Center, 1975 National Travel Survey: Full Year Report, Washington, D.C., 1976, p. 17.

FIFTY-SEVEN PERCENT OF ALL TRIPS FROM PLACE OF RESIDENCE TO PLACE OF EMPLOYMENT IN THE U.S. ARE 9 MILES OR LESS ACCORDING TO THE ANNUAL HOUSING SURVEY: 1974. THIS PROPORTION DROPS TO 48% WITHIN THE NON-CENTRAL CITY PART OF THE SMSA, WITH 38.5% OF THE TRIPS BEING 10 TO 29 MILES. CONVERSELY, COMMUTING DISTANCE WITHIN CENTRAL CITIES IS GENERALLY LOWER WITH 62.9% OF THE TRIPS BEING 9 MILES OR LESS. OUTSIDE SMSAS, 48.4% OF HOME-TO-WORK TRIPS ARE 4 MILES OR LESS. THE TABLE BELOW PROVIDES HOME-TO-WORK TRIP DISTANCES AND TRAVEL TIMES FOR EACH OF THESE CATEGORIES.

Characteristics of Home-to-Work Trips Taken
by Household Heads,[a] 1974
(percentage of occupied housing units)

	Total	Inside SMSA			Outside SMSA
		Total	In central cities	Not in central cities	
Total occupied housing units	50,639	35,470	15,377	20,093	15,168
Distance from home to work					
Owner and renter occupied	100.0	100.0	100.0	100.0	100.0
Less than 1 mile	13.4	9.0	9.5	8.5	23.6
1 to 4 miles	23.1	22.3	28.2	17.9	24.8
5 to 9 miles	20.5	23.2	25.2	21.6	14.4
10 to 29 miles	30.2	34.0	28.2	38.5	21.3
30 to 49 miles	5.1	4.5	2.4	6.1	6.5
50 miles or more	1.9	1.2	0.9	1.5	3.4
Other[b]	5.8	5.8	5.6	5.9	6.0
Travel time from home to work					
Owner and renter occupied	100.0	100.0	100.0	100.0	100.0
Less than 15 minutes	38.4	32.3	33.7	31.1	52.7
15 to 29 minutes	29.8	33.6	34.8	32.6	20.9
30 to 44 minutes	15.5	17.6	16.3	18.6	10.6
45 to 59 minutes	5.8	6.3	5.5	6.9	4.5
1 hour to 1 hour and 29 minutes	3.8	3.9	3.8	4.1	3.6
1 hour 30 minutes or more	1.2	0.9	0.9	1.0	1.9
Other[b]	5.5	5.4	5.0	5.7	5.8
Median travel time	19	21	20	21	15

[a]Limited to heads who reported having a job the week prior to enumeration.

[b]Other includes no fixed place of work or not reported categories.

Source: U.S. Department of Commerce and U.S. Department of Housing and Urban Development, Annual Housing Survey: 1974, United States and Regions, Part A - General Housing Characteristics, Washington, D.C., August 1976, p. 6.

THE NUMBER OF MILES TRAVELED BY THE AVERAGE RECREATIONAL VEHICLE IN 1974 VARIED FROM A HIGH OF 11,500 MILES FOR A VAN CONVERSION (THIS VALUE IS VERY CLOSE TO THE MILES DRIVEN BY THE AVERAGE AUTOMOBILE) TO A LOW OF ONLY 2,150 MILES FOR A CAMPING TRAILER.

Average Miles Traveled Per Recreational Vehicle, 1974

Van conversion	11,500
Mini-Motorhome	7,600
Motorhome	6,900
Truck Camper	4,650
5th Wheel	3,150
Travel Trailer	2,400
Camping Trailer	2,150

THE NON-MOTORIZED RECREATIONAL VEHICLES REQUIRE A MOTOR VEHICLE TO TOW THEM. THE AUTOMOBILE IS USED IN LESS THAN HALF THE CASES FOR TOWING TRAVEL TRAILERS AND CAMPING TRAILERS.

Method of Towing Non-Motorized Recreational Vehicles (percent)

	Travel trailer	Camping trailer	5th wheel	Truck camper
Automobile	43	47		
Station Wagon or Van	23	41		
Pickup or Other Truck	23	5	93	90
Other/No Answer	11	7	7	10
Total	100	100	100	100

Source: Indiana State University, Bureau of Business Research, 1974 Recreational Vehicle Consumer Study, Recreational Vehicle Industry Association, Chantilly, Va., 1974.

EXCEPT FOR ESTABLISHED TYPES OF ELECTRIC VEHICLES - FORKLIFTS AND GOLF CARS - PRODUCTION, WHEN RELATED TO SHARE-OF-MARKET, IS EXPECTED TO REMAIN LOW DURING 1977.

THE FIGURES BELOW ARE ONLY ESTIMATES - BASED ON RESPONSES FROM MANY ELECTRIC VEHICLE AND COMPONENTS MANUFACTURERS.

IN THE U.S., CONVERSIONS TO ELECTRIC AUTOMOBILES PRESENTLY EXCEED AUTOMOBILES BUILT ORIGINALLY AS ELECTRICS.

Estimated Electric Vehicle Production, 1977

	Australia	Canada	France	Germany	Italy	Japan	Sweden	United Kingdom	USA
Burden carriers - (except forklifts) in-plant, both riding & walking types	NA	900	300	100	400	1,800	450	1,800	4,800
Bikes - all types having battery power, 2 & 3 wheels	NA	180	500	2,400	120	140	550	110	600
Boats - all sizes, battery-driven	NA	NA	NA	NA	NA	NA	NA	10	100
Buses - on-the-road, 10 or more passengers	NA	NA	40	20	NA	25	NA	20	40
Forklifts - less than 6,000 lbs. capacity	NA	300	NA	5,000	1,400	8,000	1,800	9,200	17,000
Forklifts - 6,000 lbs. or more capacity	NA	40	NA	1,000	400	1,500	300	1,000	4,200
Golf cars - all types	120	600	NA	200	100	400	NA	NA	22,000
Passenger cars - on-the-road, more than 1,000 lbs. curb weight (with batteries)	NA	40	120	NA	300	60	10	200	400
Passenger cars - all types, (including conversions) made by individuals for own use	50	50	60	NA	70	NA	40	100	1,100
Personnel carriers - in-plant type, 1 or more persons (not golf cars)	NA	440	100	120	100	60	200	180	2,200
Truck and/or vans - on-the-road, all body styles, less than 1,000 lb. load capacity (including driver)	NA	NA	240	50	30	50	NA	260	600
Trucks and/or vans - on-the-road, all body styles, 1,000 lbs. or more load capacity (including driver)	NA	NA	80	20	NA	20	10	1,600	40
Traction batteries - including industrial, golf car, others	NA	6,000	18,000	22,000	14,000	32,000	NA	54,000	84,000

NA - Not available.

Source: Electric Vehicle News, Vol. 6, No. 2, Westport, Conn., May 1977.

1975 Major Intercity Bus Routes.

Source: U.S. Department of Transportation, Office of the Secretary, National Transportation Trends and Choices (to the Year 2000), Washington, D.C., January 12, 1977, p. 142.

Section 1.5

Water

THE OCEAN SHIPPING SECTOR (I.E. FOREIGN TRADE) CONSUMED 80% OF THE ESTIMATED 2.95 QUADS OF ENERGY USED BY THE MARINE TRANSPORTATION INDUSTRY IN 1974, ACCORDING TO A RECENT STUDY CONDUCTED UNDER AN ERDA CONTRACT (SEE TABLE BELOW).

Productivity and Energy Consumption Summary of the Marine Transportation Industry, 1974

Type of marine transportation	No. of vessels	Tons of cargo moved (millions)[a]	Energy consumed (quads)	Percent of total energy consumed
Ocean	4,774	654.9	2.360	80.0
Great Lakes	692	175.3	0.052	1.8
Inland waterways	2,404	535.8	0.089	3.0
Coastal	1,934	213.0	0.112	4.0
Offshore	620		0.064	2.2
Pleasure craft	7,400,000		0.241	8.2
Fishing and misc.	90,300		0.032	0.8
Total	7,500,740	1,579	2.950	100.0

[a]Measured in long tons.

Source: Booz, Allen and Hamilton Inc., Energy Use in the Marine Transportation Industry — Task I — Industry Summary, Energy Research and Development Administration, Division of Transportation Energy Conservation, Washington, D.C., January 11, 1977, p. I-5. (Draft).

CURRENTLY ONLY ABOUT 19% OF THE ENERGY CONSUMED FOR FOREIGN SHIPPING IS ACTUALLY PURCHASED IN THE U.S.; 81% IS PURCHASED ABROAD. OVER 90% OF THE TOTAL ENERGY CONSUMED IS USED BY VESSELS REGISTERED UNDER FOREIGN FLAGS BUT ENGAGING IN U.S. COMMERCE (SEE TABLE BELOW). CONVENTIONAL ESTIMATES OF ENERGY USE BY THE MARINE SECTOR OF THE U.S. HAVE NOT TAKEN THESE FACTS INTO ACCOUNT.

Point of Purchase of Marine Fuel (in quads)

Trade	Point of purchase					
	U.S.		Overseas[a]		Total	
	Quads	Percentage	Quads	Percentage	Quads	Percentage
Domestic	.37	63	.22	37	.59	100
Foreign[b]	.44	19	1.92	81	2.36	100
U.S. flag	.09	43	.12	57	.21	100
Foreign flag	.35	16	1.80	84	2.15	100
Total	.81	27	2.14	73	2.95	100

[a]Also includes fuels unaccounted for.

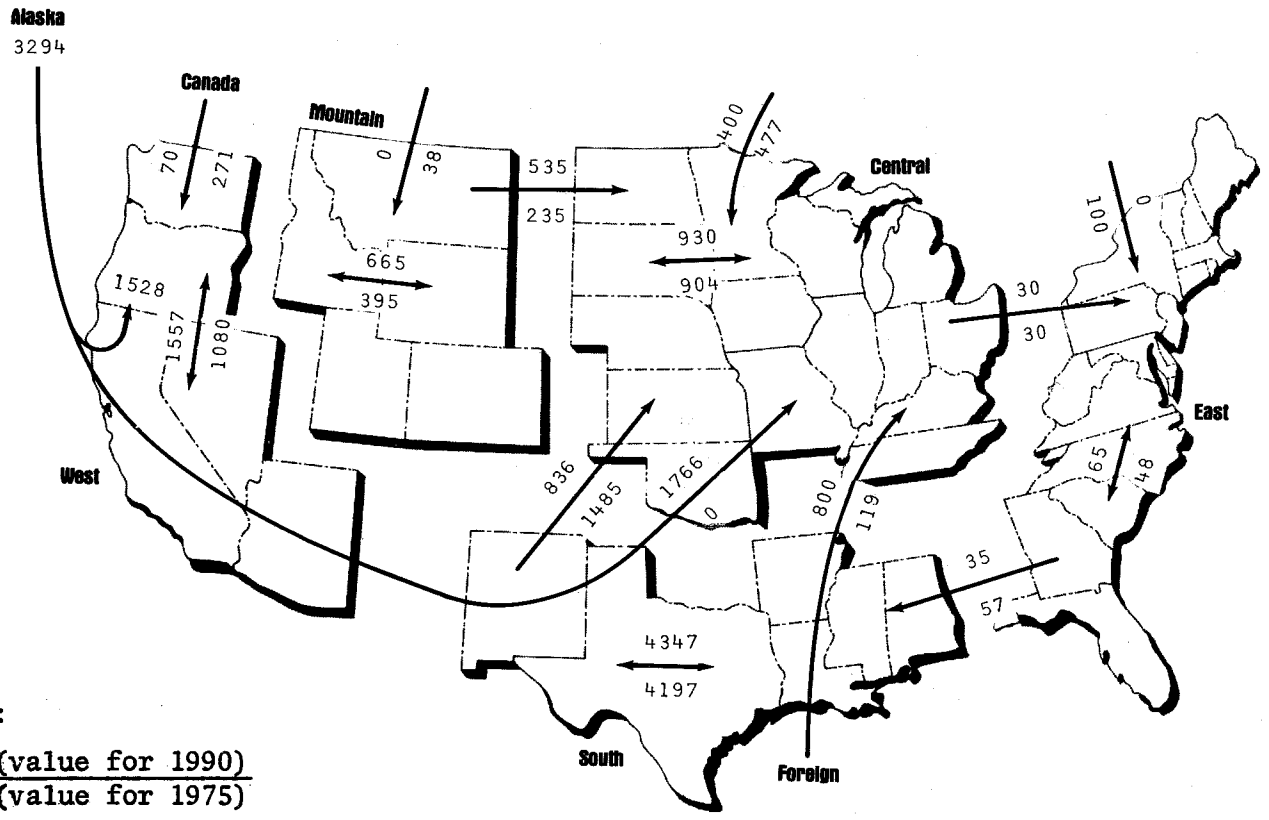
[b]Trade conducted by the ocean shipping sector.

Source: Booz, Allen and Hamilton Inc., Energy Use in the Marine Transportation Industry — Task — Industry Summary, Energy Research and Development Administration, Division of Transportation Energy Conservation, Washington, D.C., January 11, 1977, p. I-10. (Draft). (Original source: U.S. Department of Commerce, Bureau of the Census, Bunker Fuels.)

A CHANGE IN THE BUYING PATTERN INDICATED ABOVE COULD SIGNIFICANTLY INFLUENCE TOTAL U.S. ENERGY DEMAND AND CONSUMPTION. FOR EXAMPLE, ALL ALASKAN OIL MUST BE TRANSPORTED ON U.S. SHIPS. THEREFORE, IT IS EXPECTED THAT DOMESTIC ENERGY USE WILL INCREASE. ALSO, IF THESE U.S. SHIPS "FUEL UP" (BUNKER) AT U.S. PORTS, THE TOTAL ENERGY USE IN THE U.S. WILL INCREASE.

Section 1.6

Pipeline

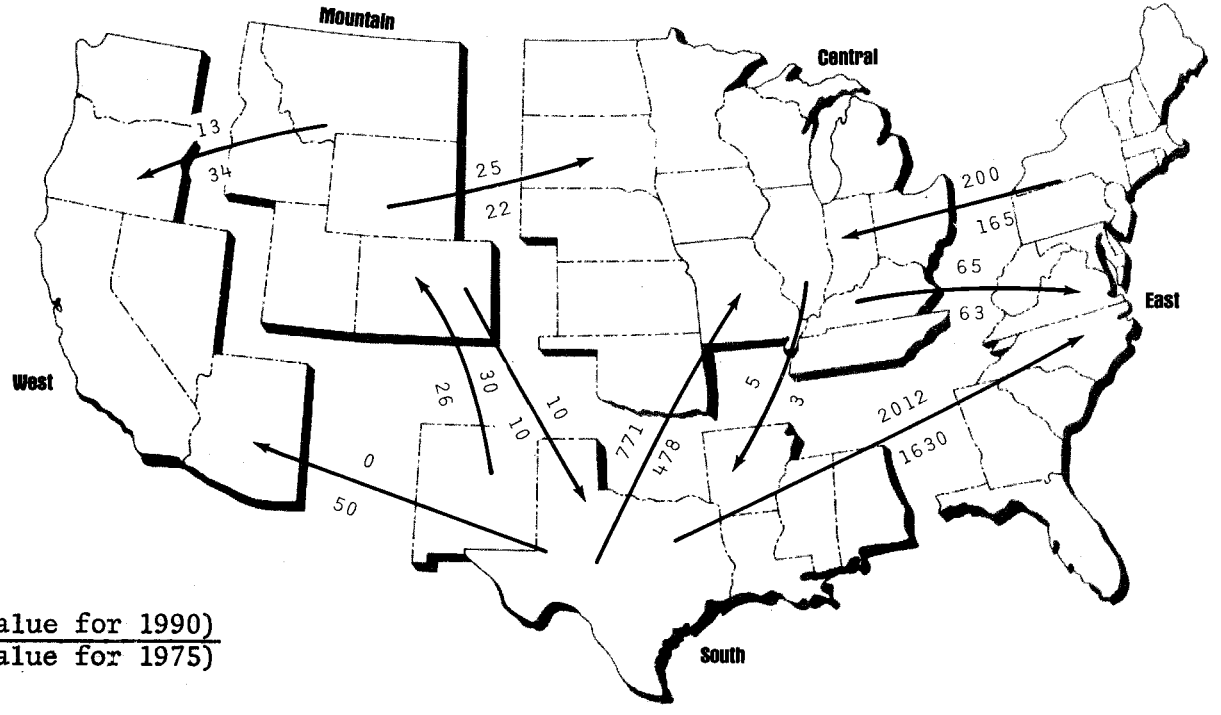


Note:

400 (value for 1990)
477 (value for 1975)

Pipeline Transfers of Crude Oil, 1975 and 1990.
(hundred barrels per day)

Source: U.S. Department of Transportation, Office of the Secretary, National Transportation Trends and Choices (to the Year 2000), Washington, D.C., January 12, 1977, p. 296.

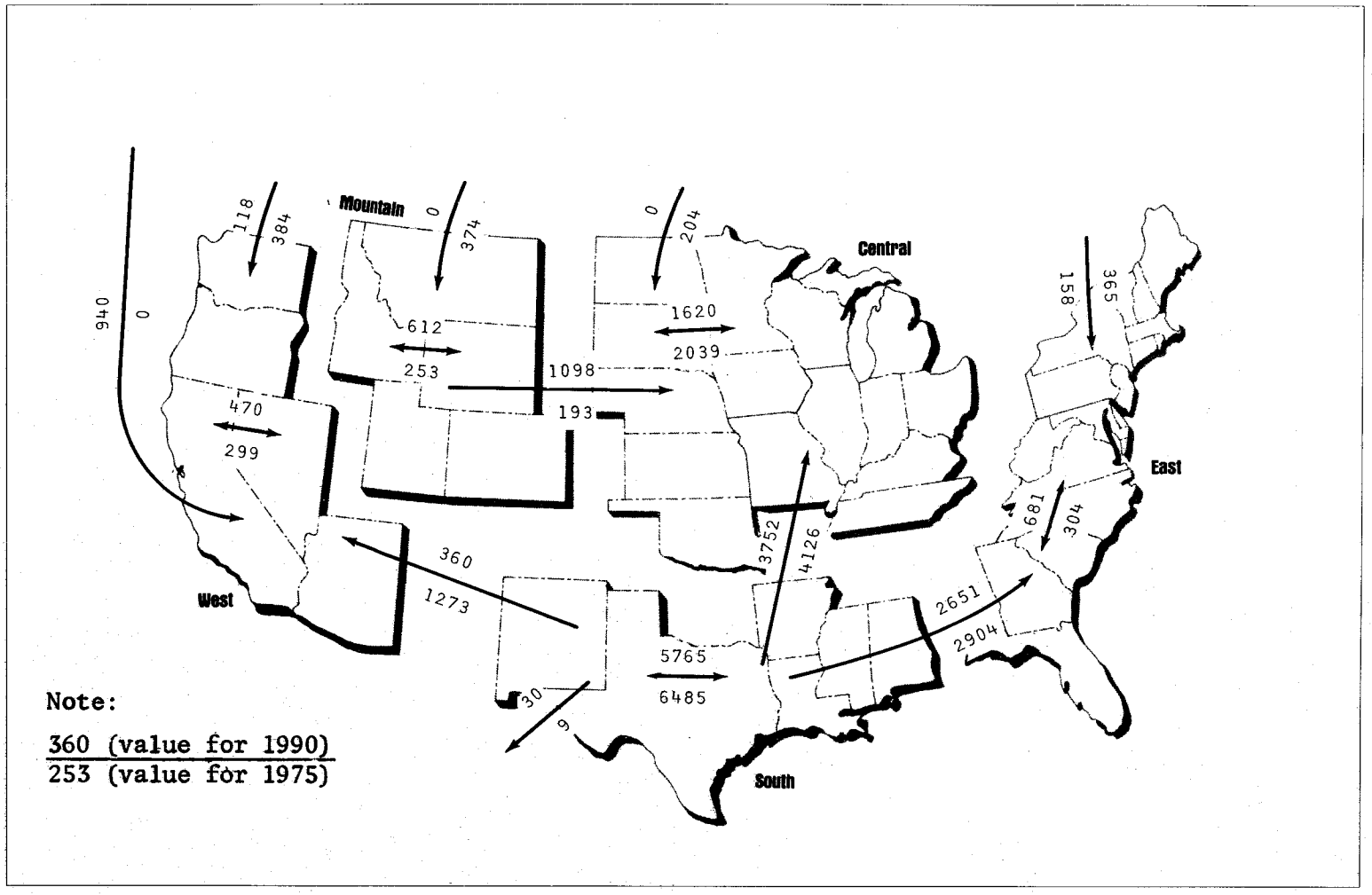


Note:

771 (value for 1990)
478 (value for 1975)

Pipeline Transfers of Petroleum Products, 1975 and 1990.
(thousand barrels per day)

Source: U.S. Department of Transportation, Office of the Secretary, National Transportation Trends and Choices (to the Year 2000), Washington, D.C., January 12, 1977, p. 298.



Pipeline Transfers of Natural and Synthetic Gas, 1975 and 1990.
(billion standard cu. ft. per year)

Source: U.S. Department of Transportation, Office of the Secretary, National Transportation Trends and Choices (to the Year 2000), Washington, D.C., January 12, 1977, p. 294.

Section 1.7

Non-Motorized Vehicles

THE NUMBER OF BICYCLES IN USE AND THE ESTIMATED NUMBER OF USERS FOR THE PAST FIFTEEN YEARS ARE INDICATED BELOW. THE TOTAL NUMBER OF BICYCLES NEARLY DOUBLED FROM 1960 TO 1968 AND PEAKED IN 1973 AT 15.3 MILLION. ALTHOUGH FEWER BICYCLES WERE MANUFACTURED IN 1975 (DUE MAINLY TO INVENTORY REDUCTIONS AMONG WHOLESALERS AND RETAILERS), THE NUMBER OF BICYCLES IN USE AND THE NUMBER OF USERS IS AT AN ALL-TIME HIGH.

U.S. Manufactured and Imported Bicycles
(millions per year)

Year	Domestic shipments	Imports	Total U.S. and imported	Bikes in use[a]	Estimated users[a]
1960	2.6	1.1	3.8	23.5	35.2
1965	4.6	1.0	5.7	32.9	49.3
1968	6.0	1.5	7.5	42.3	63.4
1969	5.1	2.0	7.1	47.7	71.5
1970	5.0	1.9	6.9	50.0	75.3
1971	6.6	2.3	8.9	53.1	79.6
1972	8.8	5.1	13.9	61.2	91.9
1973	10.1	5.2	15.3	70.0+	100.0+
1974	10.1	4.0	14.1	75.0+	100.0+
1975	5.6	1.7	7.3	75.0+	100.0+

[a]Bikes-in-use estimate is based on an estimated bike "life" multiplied by a unit sales factor. Rentals and other multiple-use situations are calculated into the "Estimated users" estimates.

Source: W. F. Gay, U.S. Department of Transportation, Transportation Systems Center, Summary of National Transportation Statistics, Cambridge, Mass., June 1976, p. 108. (Original source: Bicycle Manufacturers Association of America, Inc., Washington, D.C.)

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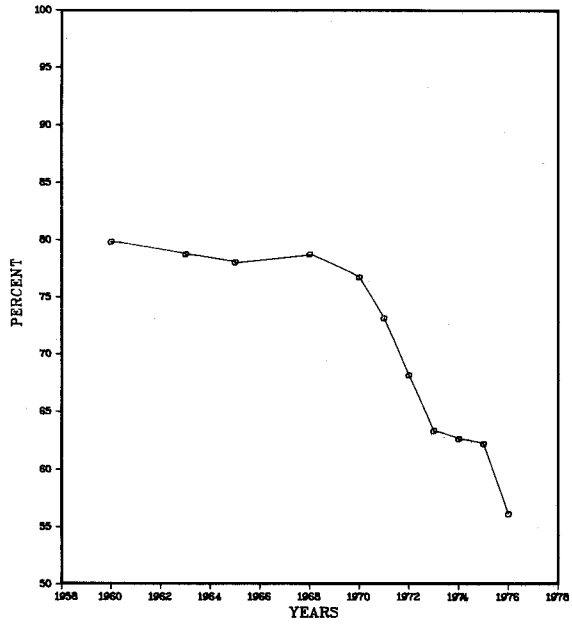
Chapter 2
Energy Characteristics

Section 2.1
Energy Consumption

INCREASING U.S. DEPENDENCE ON FOREIGN OIL IS POINTED OUT DRAMATICALLY IN THE FIGURES BELOW WHICH INDICATE U.S. PETROLEUM PRODUCTION AS A PERCENT OF CONSUMPTION.



U.S. Petroleum Production as Percent of Consumption.

U.S. Petroleum Production and Consumption
(billions of barrels of oil)

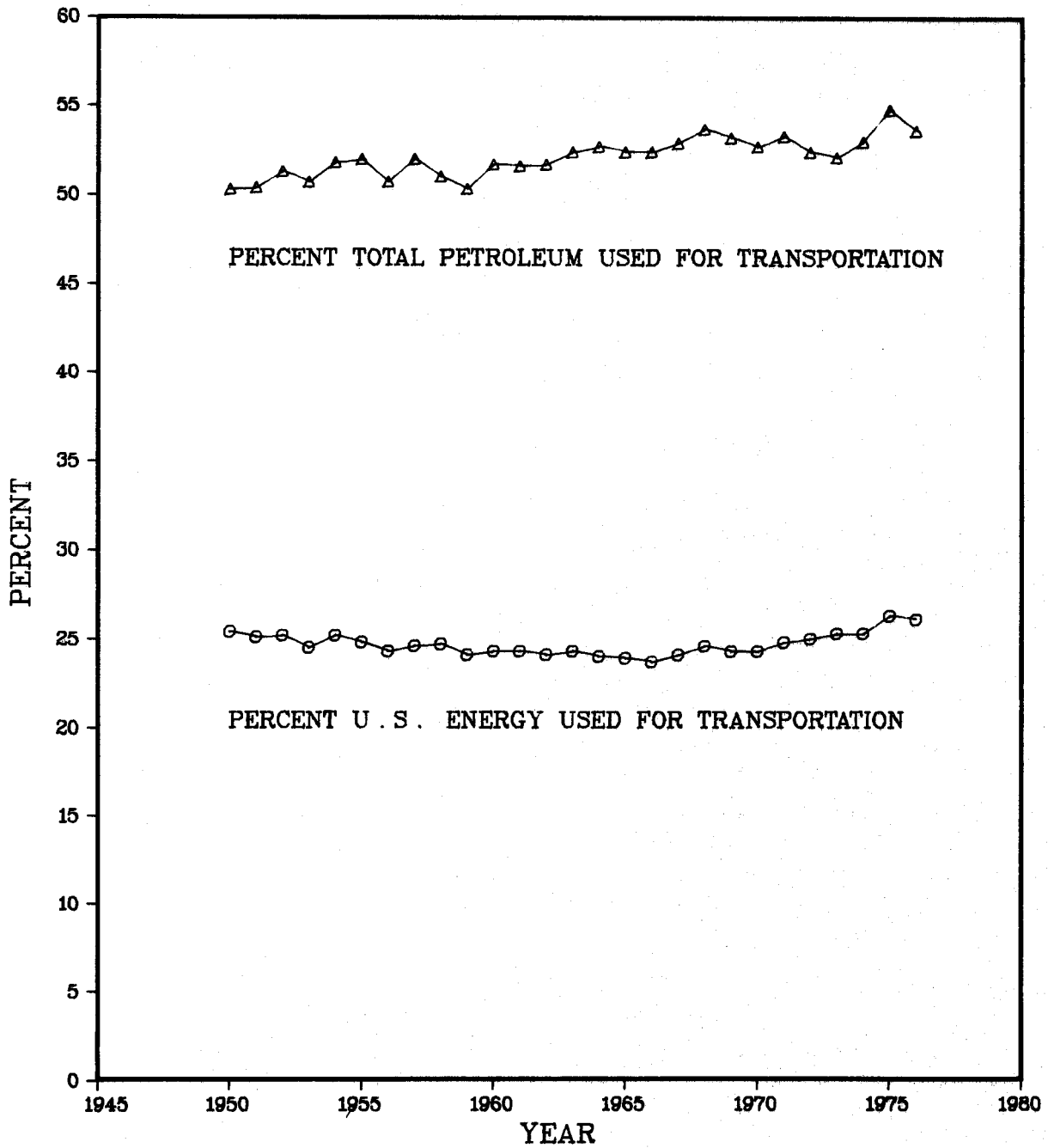
	Production[a]	Consumption	% production of consumption
1960	2.92	3.66	79.8
1963	3.15	4.00	78.7
1965	3.29	4.22	78.0
1968	3.88	4.93	78.7
1970	4.12	5.37	76.7
1971	4.07	5.57	73.1
1972	4.09	6.01	68.1
1973	4.00	6.32	63.3
1974	3.85	6.15	62.6
1975	3.70	6.95	62.2
1976	3.56	6.35	56.1

[a]Includes crude oil petroleum, condensate, and natural gas liquids.

Sources: H. Enzer, W. Dupree, and S. Miller, U.S. Department of the Interior, Energy Perspectives: A Presentation of Major Energy Related Data, Washington, D.C., February 1975; U.S. Department of the Interior, Bureau of Mines, Annual U.S. Energy Use Up in 1976 (News Release), Washington, D.C., March 14, 1977.

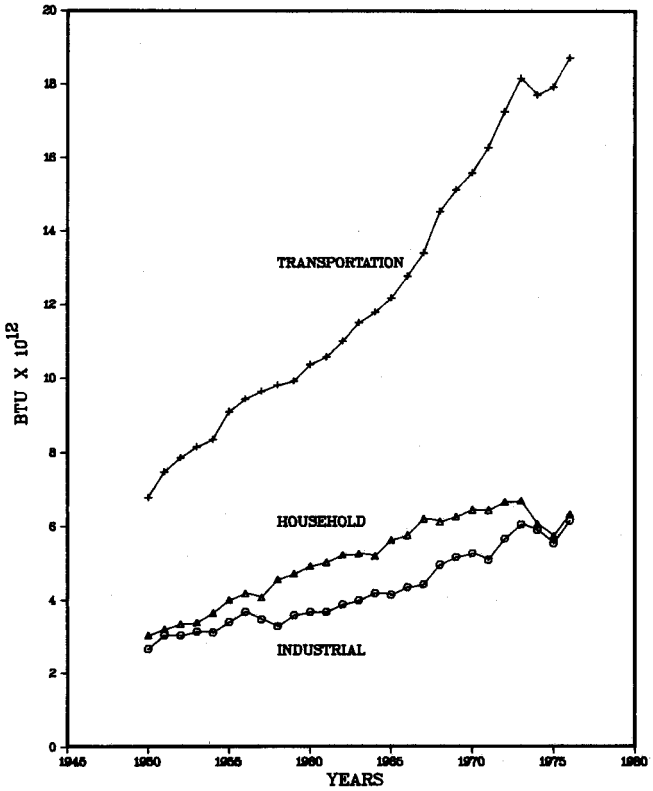
IN 1976 TRANSPORTATION ACCOUNTED FOR APPROXIMATELY 26% OF THE GROSS NATIONAL ENERGY CONSUMPTION AND ALMOST 54% OF THE PETROLEUM CONSUMED.

ENERGY CONSUMPTION BY TRANSPORTATION



Sources: W. F. Gay, U.S. Department of Transportation, Transportation Systems Center, Energy Statistics, Cambridge, Mass., August 1976, p. 108; U.S. Department of the Interior, Bureau of the Mines, Annual U.S. Energy Use Up in 1976 (News Release), Washington, D.C., March 14, 1977.

Petroleum Consumption by Sector



Petroleum[a] Consumption by Sector, 1950 through 1976
(trillion Btu)

Year	Household and commercial			Industrial			Transportation[b]	Transportation as percent of total	Electrical generation	Other	Total input
	Fuel use	Nonfuel use	Total	Fuel use	Nonfuel use	Total					
1950	2,603	435	3,038	2,213	453	2,666	6,785	50.3	662	337	13,488
1960	4,189	734	4,923	2,674	1,008	3,682	10,372	51.7	564	526	20,067
1970	5,371	1,082	6,453	3,252	2,015	5,267	15,592	52.7	2,087	215	29,614
1971	5,331	1,108	6,439	3,196	1,898	5,094	16,286	53.3	2,543	207	30,570
1972	5,531	1,137	6,668	3,553	2,135	5,668	17,264	52.4	3,114	233	32,966
1973	5,425	1,264	6,689	3,819	2,240	6,059	18,164	52.1	3,656	283	34,851
1974	4,896	1,165	6,061	3,690	2,217	5,907	17,720	53.0	3,480	246	33,414
1975	4,688	1,141	5,747	3,521	2,114	5,544	17,933	54.8	3,239	278	32,742
1976[e]			6,333			6,166	18,733	53.6	3,479	227	34,938

[e]Estimate.

[a]Petroleum products refined and processed from crude oil, including still gas, liquefied refinery gas and natural gas liquids.

[b]Includes bunders and military transportation.

Sources: W. F. Gay, U.S. Department of Transportation, Transportation Systems Center, Energy Statistics, Cambridge, Mass., August 1976, p. 108; U.S. Department of the Interior, Bureau of the Mines, Annual U.S. Energy Use Up in 1976 (News Release), Washington, D.C., March 14, 1977.

THE DATA ANALYSIS BRANCH (DAB) OF TEC/ERDA HAS THE RESPONSIBILITY FOR PROVIDING BASELINE (BEFORE ERDA CONSERVATION) TRANSPORTATION ENERGY PROJECTIONS. THE FOLLOWING TABLE INCLUDES THE PROJECTIONS DEVELOPED JUDGMENTALLY BY DAB AS OF MAY 1977. SUGGESTED IMPROVEMENTS OR CHANGES IN THESE PROJECTIONS ARE WELCOMED.

Baseline Transportation Energy Demands
(Before ERDA Conservation Program)

	1975	1985	2000
Background information			
Population (Series II, millions)	213.5	234.1	262.5
GNP (75 $, billions)	1514.2	2137.3	3298.8
Disposable income per capita (75 $)	5062	6694	9902
Transportation demand (billions)			
Automobile (VMT)	1020	1393	1933
Personal truck (VMT)	94	156	241
Other truck (TMT)	600	865	1507
Bus (PMT)	51	83	146
Rail (TMT)	950	1273	1900
Marine (TMT)	615	1126	1536
Pipeline (TMT)	763	775	805
Air (PMT)	159	309	550
Transportation energy (quads)	18.65	20.03	26.38
Automobile (27.5 mpg assumed)	9.44	7.91	8.80
Personal truck	1.04	1.25	1.58
Other truck	2.97	3.80	6.04
Bus	0.09	0.13	0.22
Rail	0.50	0.67	1.00
Marine	0.64	1.15	1.50
Pipeline	1.26	1.28	1.33
Air	1.42	2.50	4.40
Misc (general aviation, military)	1.29	1.34	1.51

Sources: Data Analysis Branch, TEC, ERDA judgments based on — Auto forecast: Jack Faucett Associates Inc., Fuel Economy Policies and Their Effects on Automobile Ownership, Use, and Fuel Consumption, Federal Energy Administration, Washington, D.C., August 1976. Truck forecast: Jack Faucett Associates Inc., Trucking Activity and Fuel Consumption, 1973, 1980, 1985, and 1990, Federal Energy Administration, Washington, D.C., July 1976. Air forecast: Ultrasystems Inc., Examination of the Costs, Benefits and Energy Conservation Aspects of the NASA Aircraft Fuel Conservation Technology Program, November 1975. Other forecasts: International Research and Technology Inc., TECNET Model Run, March and April 1977.

ACCORDING TO FHWA PRELIMINARY ESTIMATES, U.S. MOTOR-FUEL CONSUMPTION EXCEEDED 118 BILLION GAL. IN 1976. THIS REPRESENTS A 5.5% INCREASE OVER 1975. NINETY-SEVEN PERCENT OF THIS TOTAL WAS CONSUMED FOR HIGHWAY USE — WHICH REPRESENTED A 5.7% INCREASE OVER 1975. THREE PERCENT OF THE MOTOR FUELS CONSUMED WERE SPECIAL FUELS (DIESEL, BUTANE, ETC.). THE TABLE BELOW REFLECTS THE REGIONAL MOTOR FUEL CONSUMPTION CHARACTERISTICS.

Regional Total and Per Capita Motor-Fuel Use for 1976

Region	Total motor-fuel use[a] (10^6 gal)	Population[b] (10^6)	Total motor-fuel use per capita (gal/capita)
New England	5,745	12.2	470.9
Middle Atlantic	15,241	37.3	408.6
East North Central	22,355	40.9	546.6
West North Central	11,003	16.8	654.9
South Atlantic	19,565	34.0	575.4
East South Central	8,282	13.7	604.5
West South Central	14,218	21.2	670.7
Mountain	6,631	9.8	676.6
Pacific	15,729	28.7	548.0
Total U.S.	118,769	214.6	572.9

[a]Total motor-fuel use includes highway and nonhighway.

[b]Population is the resident population as of July 1, 1976.

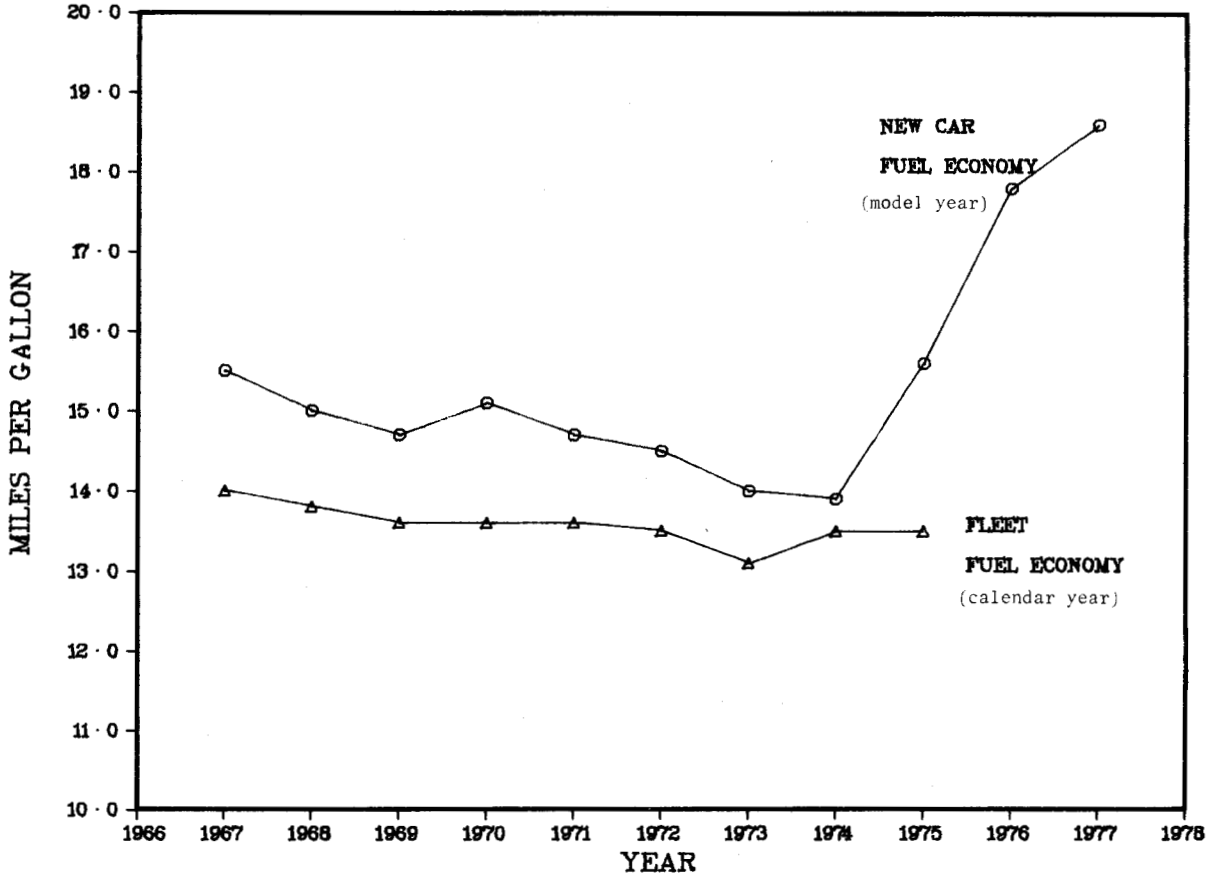
Sources: U.S. Department of Transportation, Federal Highway Administration, Department of Transportation News, FHWA 68-76 (November 4, 1976), Washington, D.C., Table ES-F; U.S. Department of Commerce, Bureau of the Census, Current Population Reports: Population Estimates and Projections, Series P-25, No. 642, Washington, D.C., December 1976, Table 1.

THE RATHER SIZABLE RANGE IN PER CAPITA CONSUMPTION (409 GAL/CAPITA IN THE MID ATLANTIC COMPARED WITH 655 GAL/CAPITA IN THE WEST NORTH CENTRAL) MAY POSSIBLY BE EXPLAINED BY THE VARIATION IN COMMUTING DISTANCE.

Section 2.2

Energy Efficiency

FROM THE 1974 TO 1977 MODEL YEARS, NEW CAR FUEL ECONOMY HAS INCREASED BY 34% (FROM 13.9 TO AN ESTIMATED 18.6 SALES-WEIGHTED MPG). THE GAINS REGISTERED BETWEEN 1974 AND 1976 WERE DUE PRIMARILY TO SYSTEM OPTIMIZATION (I.E., IMPROVEMENTS IN ENGINE DISPLACEMENT/INERTIA WEIGHT COMBINATIONS). FOR 1977, WEIGHT MIX SHIFTS APPEAR TO BE OF PRIMARY IMPORTANCE.

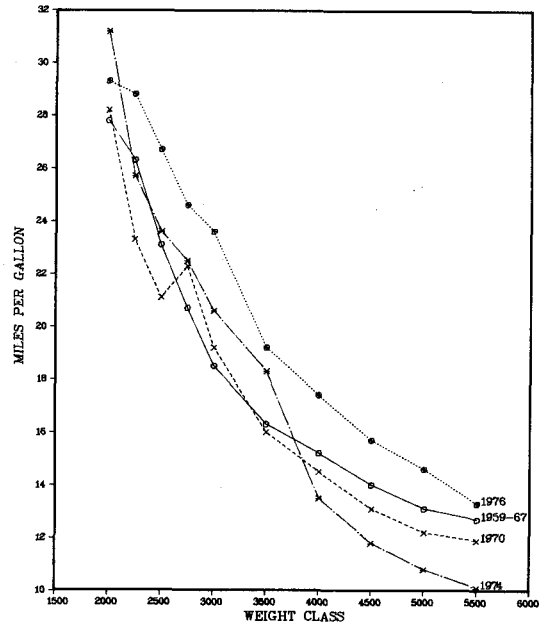


Average Fuel Economy for Automobile Fleet and New Cars.[a]

[a]Based on post-1974 test procedures.

Sources: J. D. Murrell et al., Light Duty Automotive Fuel Economy — Trends Through 1977, SAE paper 760795, presented at the Automobile Engineering Meeting, Dearborn, Michigan, October 18—22, 1976; U.S. Department of Transportation, Federal Highway Administration, Highway Statistics, annual.

THE WEIGHT OF AN AUTOMOBILE IS AN IMPORTANT FACTOR IN DETERMINING ITS FUEL ECONOMY. THE FIGURE AND TABLE BELOW SHOW THE EPA ESTIMATED FUEL ECONOMY (IN MILES PER GALLON) BY INERTIA WEIGHT CLASS FOR MODEL YEARS 1957–1976. THE DIFFERENCE IN FUEL ECONOMY FROM THE LOW AVERAGE MPG TO THE HIGH AVERAGE MPG RANGES FROM A 100% TO A 200% INCREASE FOR MOST OF THE MODEL YEARS. AS THE INERTIA WEIGHT INCREASES, THE FUEL ECONOMY DECREASES.



Automobile Fuel Economy for Various Weight Classes by Model Year.

City/Highway Combined Fuel Economy by Model Year and Weight Class
(miles per gallon)

	Inertia Weight Class									
Model Year	2000	2250	2500	2750	3000	3500	4000	4500	5000	5500
'57-'67 av.	27.8	26.3	23.1	20.7	18.5	16.3	15.2	14.0	13.1	12.7
1968	23.3	24.7	22.3	23.8	18.8	16.0	14.5	13.6	11.2	10.7
1969	26.9	24.5	22.7	20.3	18.6	16.0	14.4	13.6	11.0	13.0
1970	28.2	23.3	21.1	22.3	19.2	16.0	14.5	13.1	12.2	11.9
1971	27.3	25.8	23.3	22.1	17.8	14.7	14.1	12.9	11.6	13.1
1972	27.7	26.4	23.6	24.1	17.4	16.0	13.4	12.9	11.6	11.2
1973	28.7	26.4	23.8	21.1	18.8	16.8	13.0	12.2	11.2	10.4
1974	31.2	25.7	23.6	22.5	20.6	18.3	13.5	11.8	10.8	9.9
1975	31.3	28.1	24.5	22.4	21.6	17.6	15.5	14.6	12.8	12.0
1976	29.3	28.8	26.7	24.6	23.6	19.2	17.4	15.7	14.6	13.3

Source: T. C. Austin, R. B. Michael, and G. R. Service, Passenger Car Fuel Economy Trends Through 1976, Society of Automotive Engineers Paper No. 750957, October 13-17, 1975.

IN 1977 MODEL AUTOMOBILES THERE IS ESTIMATED TO BE A 2.6 SALES WEIGHTED MILES PER GALLON (SWMPG) DIFFERENCE BETWEEN THE HIGHEST AND LOWEST DOMESTIC AUTO PRODUCERS. THERE IS A 10.6 SWMPG DIFFERENCE BETWEEN THE HIGHEST AND LOWEST FOREIGN PRODUCERS.

OF THE DOMESTIC AUTOMOBILE PRODUCERS, FORD MADE THE LARGEST SWMPG IMPROVEMENT BETWEEN 1975 AND 1976, WHEREAS GENERAL MOTORS IS EXPECTED TO MAKE THE LARGEST IMPROVEMENT IN 1977. FOR THE TOTAL NEW CAR FLEET IN 1977, ABOUT EQUAL GAINS ARE EXPECTED TO BE ACHIEVED BY SYSTEM OPTIMIZATION (2.8%) AND BY SHIFTS IN THE WEIGHT MIX (2.6%).

Fuel Economy Changes by Manufacturer: 1976 and 1977

	1975 SWMPG	1976 SWMPG	SWMPG Changes '75—'76	1977[a] SWMPG	SWMPG Changes '76—'77[a]	Allocation of fuel economy changes, '76—'77[a]		
						System optimization only	New engine/ vehicle combinations only	Weight mix shifts
American Motors	19.0	18.3	—3.7%	19.2	+4.8%	—0.6%	+2.6%	+2.8%
Chrysler	15.5	16.5	+6.4%	16.6	+0.5%	+3.3%	—0.1%	—2.7%
Ford	13.6	17.3	+27.2%	17.1	—1.4%	+2.1%	—1.0%	—2.5%
General Motors	15.4	16.7	+8.4%	18.4	+10.4%	+3.2%	+0.7%	+6.5%
BMW	17.7	18.9	+6.8%	20.4	+8.0%	+2.8%	0.0%	+5.3%
Nissan	24.9	26.9	+8.0%	27.1	+0.7%	+0.6%	—1.1%	+1.2%
Porsche	19.8	20.5	+3.5%	19.8	—3.4%	—8.8%	—3.8%	+9.2%
Toyo Kogyo	16.7	21.9	+31.1%	26.1	+19.2%	+8.5%	—1.1%	+11.8%
Toyota	22.2	25.0	+12.6%	28.1	+12.3%	+4.8%	+1.6%	+6.0%
VW	27.4	28.3	+3.3%	30.4	+7.3%	+4.5%	+0.3%	+2.5%
Volvo	19.2	19.4	+1.0%	19.9	+2.9%	+1.6%	0.0%	+1.4%
Audi	24.2	25.2	+4.1%	25.9	+3.0%	—2.7%	0.0%	+5.6%
Fuji	26.5	29.7	+12.1%	30.2	+1.5%	+8.4%	—7.3%	+0.3%
Fleet	15.6	17.6	+12.8%	18.6	+5.6%	+2.8%	+0.2%	+2.6%

[a]1977 SWMPG values are based upon estimates in October 1976 of the sales of various sized autos for each company.

Source: J. D. Murrell et al., Light Duty Automotive Fuel Economy — Trends Through 1977, SAE paper 760795, presented at the Automobile Engineering Meeting, Dearborn, Michigan, October 1976, p. 8.

CHAPTER 2 — REFERENCES

Austin, T. C., R. B. Michael, and G. R. Service, Passenger Car Fuel Economy Trends Through 1976, Society of Automotive Engineers Paper No. 750957, October 13–17, 1975.

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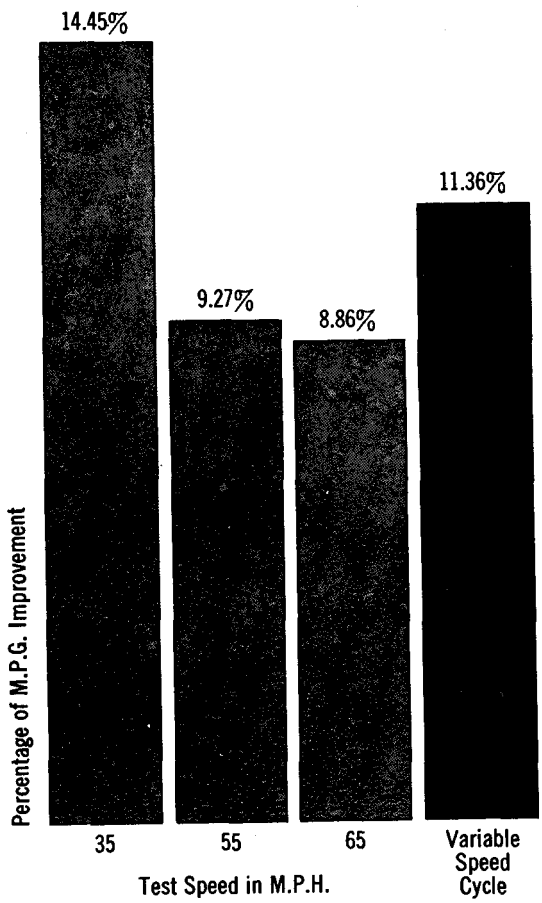
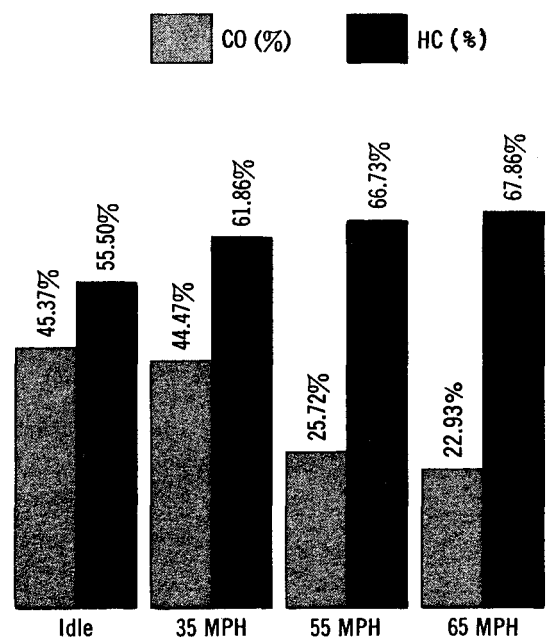
Chapter 3
Conservation Alternatives

Section 3.1
Conservation Measures

ACCORDING TO A RECENT STUDY BY CHAMPION SPARK PLUG COMPANY, VEHICLE CONDITION HAS A CRITICAL BEARING ON FUEL CONSUMPTION AND EMISSIONS. TUNE-UPS WERE SHOWN TO IMPROVE AVERAGE FUEL ECONOMY BY 11.36% AND REDUCE EMISSIONS OF CARBON OXIDES (CO) BY 45.3% AND EMISSIONS OF HYDROCARBONS (HC) BY 55.5%



Fuel Economy Improvement After Tune-up.[a]



Percentage of Emissions Improvement After Tune-up.[a,b]

[a]Based on 216 cars.

[b]Reductions cannot be correlated specifically to Federal Certification Cycle.

Source: Champion Spark Plug Company, Tune-up: Its Effects on Fuel Economy, Emissions and Performance, Toledo, Ohio, 1977, pp. 4 and 5.

CHAPTER 3 — REFERENCES

Champion Spark Plug Company, Tune-up: Its Effect on Fuel Economy, Emissions and Performance, Toledo, Ohio, 1976.

Chapter 4
Government Impacts

Section 4.1

Government Taxes and Expenditures

THE U.S. HAS THE LOWEST TAX RATE ON GASOLINE OF ANY INDUSTRIAL COUNTRY. MOREOVER, MANY COUNTRIES IMPOSE TAXES ON OTHER FUELS, WHEREAS THE U.S. DOES NOT.

Taxes on Fuel as Percent of the Retail Price

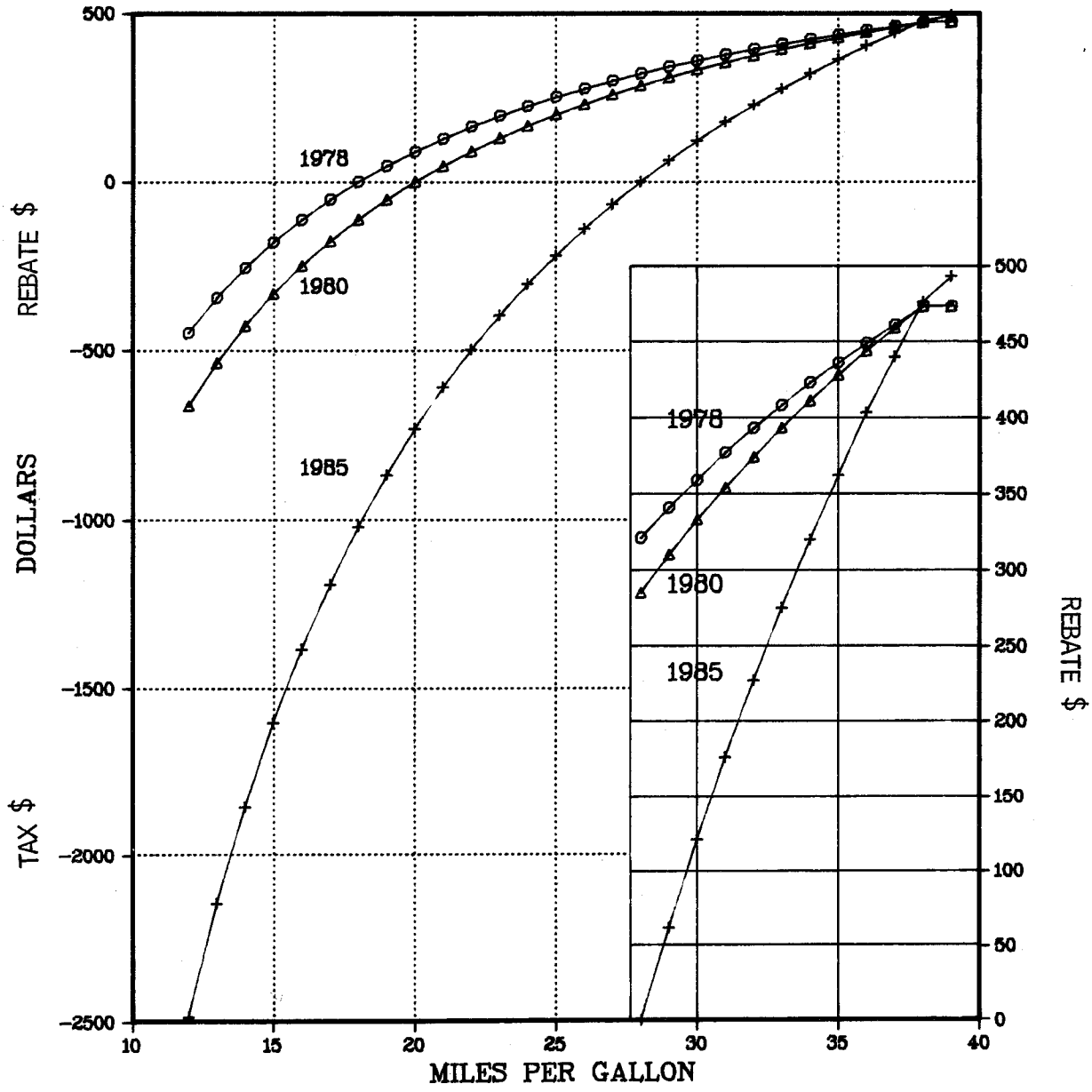
Country	Gasoline	Heating	Heavy fuel	Coal
Italy	64.4	14.6	10.8/12.1	None
Belgium	62.2/60.1	None	None	None
Netherlands	59.7/58.6	13.4	11.9/12.5	7.4
Spain	58.8/43.0	20.0	8.7	1.5
Switzerland	57.7	5.3	8.2	0.2
Sweden	55.0/52.8	12.7/13.0	15.1/13.7	
Germany	54.8/51.0	12.6	None	None
Norway	52.7	None	None	None
Britain	52.7	3.5	4.5	None
Turkey	51.7/56.1	41.0	16.7	None
Ireland	50.0/48.4	None	None	None
Austria	48.5/57.4	23.4	7.4	7.4
Luxembourg				
Denmark	46.0	8.5	8.5	None
Canada	39.4	None	None	None
New Zealand	35.8/33.9			
Japan	30.8	None	None	None
United States	20.5	None	None	None

Source: T. E. Mullaney, "The Administration's Task: Educating the Public on Energy," New York Times, May 3, 1977, p. 63.

Section 4.2

Government Regulations

THE FIGURE BELOW DEPICTS THE GAS TAX AND REBATE SCHEDULE OUTLINED IN PRESIDENT CARTER'S NATIONAL ENERGY PLAN. A GRADUATED EXCISE TAX WOULD BE IMPOSED ON 1978 MODEL AUTOMOBILES AND LIGHT-DUTY TRUCKS WHOSE FUEL ECONOMY FAILS TO MEET THE EXISTING FUEL ECONOMY STANDARDS. GRADUATED REBATES WOULD BE GIVEN FOR VEHICLES WHOSE FUEL ECONOMY SURPASSES THE STANDARD.



Tax/Rebate Schedule for New Cars.

Source: Executive Office of the President, Energy Policy and Planning, The National Energy Plan, Washington, D.C., April 29, 1977.

OTHER ASPECTS OF THE PRESIDENT'S NATIONAL ENERGY PLAN WHICH WILL ASSIST THE GOAL OF ACHIEVING A 10% REDUCTION IN GASOLINE FUEL CONSUMPTION BY THE YEAR 1985 ARE LISTED BELOW.

National Energy Plan

1. Vigorous enforcement of the national 55 mph speed limit by states and municipalities,
2. Imposition of a standby gasoline tax in 1978 if targets for gasoline consumption are not met voluntarily,
3. Beginning analytic work necessary to set mileage standards for cars manufactured beyond 1980 and promulgation of efficiency standards by the Secretary of Transportation for trucks weighing 10,000 pounds or less,
4. Removal of 10% excise tax on intercity buses to encourage expansion in use of this fuel-efficient form of transportation,
5. Increase tax on aviation fuel from 7 to 11 cents a gallon for general aviation purposes and eliminate current 2 cents rebate for motorboat fuel,
6. Require that the Federal government new car fleet exceed the average fuel economy standard by 2 mpg in 1978, and by 4 mpg in 1980 and thereafter, and initiate a Federal vanpooling program for Federal employees,
7. Create a commission to study the national energy transportation system, and
8. Establish an Office of Small-Scale Technologies to fund small, innovative energy research and development projects.

Source: Executive Office of the President, Energy Policy and Planning, The National Energy Plan, Washington, D.C., April 29, 1977.

TRANSPORTATION EMISSION TOTALS FOR EACH OF THE MAJOR AIR POLLUTANTS ARE PRESENTED BELOW. TRANSPORTATION ACCOUNTS FOR ABOUT HALF OF THE TOTAL TONNAGE OF EMISSIONS, BUT TRANSPORTATION EMISSIONS ACCOUNT FOR ONLY A QUARTER OF THE EMISSIONS WHEN THE DIFFERENT POLLUTANTS ARE WEIGHTED BY A SEVERITY FACTOR.

1974–1975 Air Pollutants[a]

Pollutant	1974 national tonnage[b] (millions)	1975 transport tonnage (millions)	Weight used	1974 national weighted	1974 transportation weighted
CO	94.6	73.0	1	94.6	73.0
HC	30.4	13.4	60	1,824.0	804.0
NO_x	22.5	9.4	78	1,755.0	733.2
SO_x	31.4	0.6	23	722.2	13.8
Particulates	19.5	1.0	133	2,593.5	133.0
Total	198.4	97.4		6,989.3	1,757.0
Percent	100	49.1		100	25.1

[a]Since air quality standards for different pollutants have been specified by EPA in different terms (permissible 1-hour, 8-hour, 24-hour concentrations, etc.) and since some states employ different standards, different investigators have arrived at different severity factors, using their own preferred procedures. The spread in the range of severity factors for some pollutants is large.

[b]Statistical Abstract of the United States – 1975.

Source: U.S. Department of Transportation, Office of the Secretary, National Transportation Trends and Choices (to the Year 2000), Washington, D.C., January 12, 1977, p. 28.

TOTAL EMISSIONS OF THE TRANSPORTATION SECTOR HAVE BEEN DECREASING, HOWEVER, LARGELY DUE TO A NUMBER OF GOVERNMENTAL PROGRAMS. EMISSIONS SHOULD CONTINUE TO DECLINE AS MORE OF THE NATION'S AUTOMOBILES MEET THE INCREASINGLY SEVERE EMISSION STANDARDS (SEE SECHEDULE BELOW).

Emission Reduction from Uncontrolled Levels Achieved through Imposition of Federal Standards[a]
(in terms of 1975 federal test procedure)

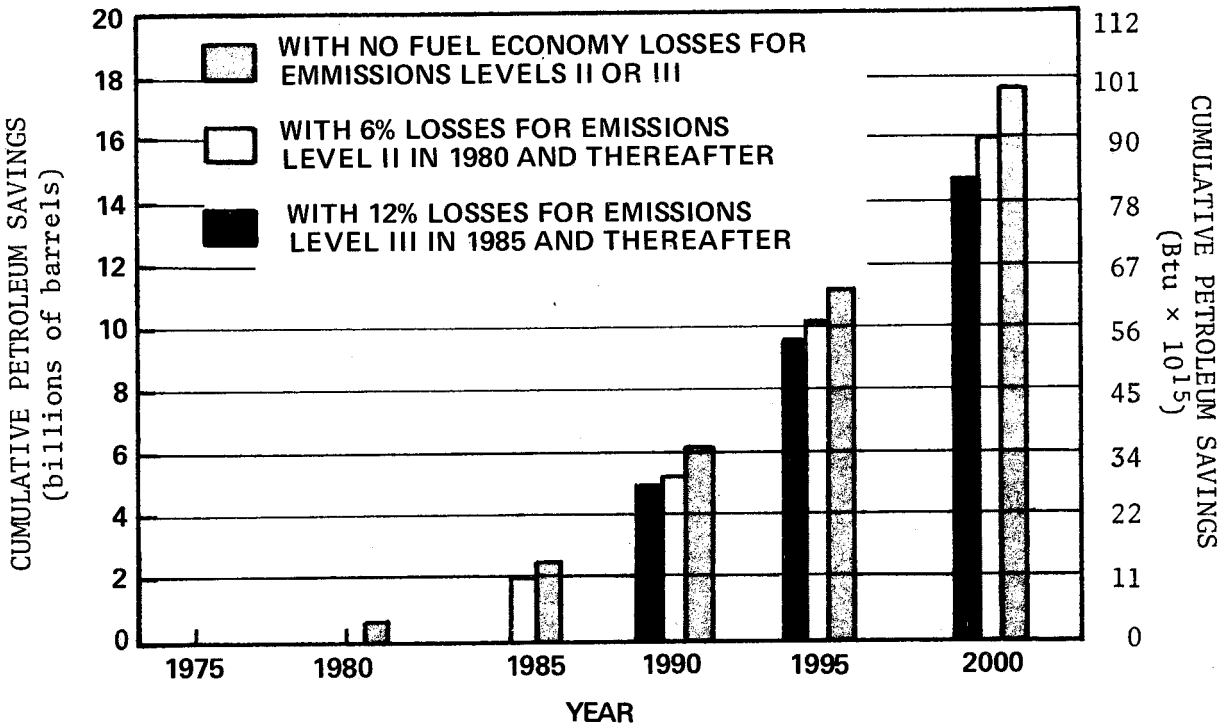
	Hydrocarbons (HC)		Carbon Monoxide (CO)		Oxides of Nitrogen (NO_x)	
	Level (gpm)	% Reduction	Level (gpm)	% Reduction	Level (gpm)	% Reduction
Pre-1968 vehicles (uncontrolled)	8.7		87		3.5	
1970/71 standards (NO_x uncontrolled)[b]	4.1	53	34	61	(4.0)	
1973/74 standards	3.0	66	28	68	3.1	11
National interim standards (1975/76)	1.5	83	15	83	3.1	11
California interim standards (1975/76)	0.9	90	9.0	90	2.0	43
National interim standards (1977)	1.5	83	15	83	2.0	43
Statutory standards (1978) (all states)	0.41	95	3.4	96	0.4	89

[a]Effective September 1976.

[b]No Federal standard for NO_x existed in 1970–71. When HC and CO were controlled to the standard in 1970–71, NO_x increased from pre-1968 uncontrolled vehicles.

Source: Economic Analysis Division, Office of Planning and Evaluation, U.S. Environmental Protection Agency.

THE IMPACT ON FUEL ECONOMY FROM IMPOSING EMISSIONS STANDARDS SIMILAR TO THOSE ON PAGE 67 IS SHOWN BELOW.



Range of Impacts from Implementation of Level II and Level III Emissions Standards on Cumulative Petroleum Savings.[a]

Note: Emissions: Level II: 0.41 HC/3.4 CO/2.0 NO_x (g/mile)
Level III: 0.41 HC/3.4 CO/0.4 NO_x (g/mile)

[a]Estimates are relative to the cumulative savings of the illustrative Otto Engine Scenario No. 2.

Source: Federal Task Force, Motor Vehicle Goals Beyond 1980, Volume 1: Executive Summary, U.S. Department of Transportation, Washington, D.C., September 2, 1976, p. 24. (Draft).

IN 1976 ENVIRONMENTAL CONTROLS ON AUTOMOBILES IN JAPAN WERE MORE STRICT THAN THEY WERE IN THE U.S. THESE DIFFERENCES WILL DECLINE IN 1978 MODEL YEAR AUTOS AS JAPAN MAINTAINS THE SAME LEVEL OF CONTROLS AND AS THE U.S. TIGHTENS THE ALLOWABLE EMISSIONS.

CONVERSELY, MOST EUROPEAN COUNTRIES, SWEDEN, AND AUSTRALIA DID NOT HAVE AS STRONG STANDARDS AS DID THE U.S. IN 1976. FURTHERMORE, THESE COUNTRIES ARE MAINTAINING 1976 EMISSION LEVELS FOR 1978, WHICH MEANS THAT THE POLLUTION ALLOWED RELATIVE TO U.S. AUTOS WILL INCREASE.

Comparison of International Automobile Emissions Standards[a]

		CO	HC	NO_x
Japan	1976	0.23	0.27	0.45
	1978	1.00	1.00	1.00
Europe	1976	4.73	2.90	NA
	1978	20.95	10.81	NA
Sweden	1976	2.58	2.26	1.00
	1978	11.43	8.40	7.60
Australia	1976	5.91	3.44	NA
	1978	26.19	12.80	NA

NA = Not available.

[a]Standards relative to U.S. standards for 1976 and 1978 (March 1977).

Source: Wards Communications Inc., Ward's Engine Update, Vol. 3, No. 8, Detroit, Michigan, April 15, 1977.

Crashworthiness Federal Motor Vehicle Safety Standards (FMVSS) and Notice of Proposed Rulemaking (NPRM) Applicable to Passenger Cars

FMVSS No. 113 — Hood Latch Systems (Docket Nos. 1-17)

FMVSS No. 201 — Occupant Protection in Interior Impact (Docket Nos. 3 and 2-2)-15 mph impact protection

FMVSS No. 202 — Head Restraints - Passenger Cars
Specifies height and strength requirements for head restraints

FMVSS 202 (NPRM) — Seating Systems - Combines FMVSS 202 and and 207, requires higher and stronger seat backs - possible effective date - 1980.

FMVSS No. 203 — Impact Protection for the Driver from the Steering Control Systems (Docket No. 3)

FMVSS 203 → New NPRM will specify 30-mph barrier collision utilizing a Part 572 test device and FMVSS 208 injury criteria.

FMVSS No. 204 — Steering Control Rearward Displacement (Docket No. 3)
New NPRM will add a vertical deflection requirement to the current rearward movement. Effective May 1979.

FMVSS No. 205 — Glazing Materials
Specifies fracture resistance and optical qualities for glazing materials.

FMVSS No. 206 — Door Locks and Door Retention Components
Specifies strength and door retention requirements for vehicle door locks and latches.

FMVSS No. 207 — Seating Systems
Establishes strength and attachment performance requirements.

FMVSS 207 Amendment — See FMVSS 202 (NPRM)

FMVSS No. 208 — Occupant Crash Protection (Docket No. 69-7)
Complete passive protection system or head-on passive protection and lap belt system with 30-mph barrier crash test and specifies injury criteria or lap and shoulder belt protection system with belt warning.

FMVSS No. 209 — Seat Belt Assemblies (Docket No. 69-23)
Specifies strength, corrosion, latching, etc., requirements.

FMVSS No. 210 — Seat Belt Assembly Anchorages (Docket No. 2-14)
Specifies type, strength, and location of anchorages.

FMVSS No. 211 — Wheel Nuts, Wheel Discs, and Hub Caps (Docket No. 3.)
Wheel nuts, discs, and hub caps shall not incorporate winged projections.

FMVSS No. 212 — Windshield Mounting - Passenger Cars
Establish the retention requirements for windshield mountings.

FMVSS No. 214 — Side Door Strength (Docket No. 2-6)

FMVSS No. 216 — Roof Crush Resistance (Docket No. 69-7)

FMVSS No. 219 — Windshield Zone Intrusion (Docket No. 74-21)

FMVSS No. 301 — Fuel System Integrity (Docket No. 73-20)

FMVSS No. 302 — Flammability of Interior Materials
Specifies burn resistance requirements.

Crash Avoidance Federal Motor Safety Standards and NPRM's Applicable to Passenger Cars

FMVSS No. 101 — Control Location, Identification, and Illumination
Requires that essential controls be within reach of the driver and that certain of these controls be identified.

FMVSS No. 102 — Transmission Shift Lever Sequence, Starter Interlock, and Transmission Braking Effect

FMVSS No. 103 — Windshield Defrosting and Defogging Systems
Requires that all vehicles have defrosting systems which will de-ice the windshield area in front of the driver in 20 minutes when the ambient temperature is zero degrees Fahrenheit.

FMVSS No. 104 — Windshield Wiping and Washing Systems
Requires that all vehicles be equipped with 2-speed wipers and washers adequate to help clean the windshield area specified in FMVSS No. 107.

FMVSS No. 105 — Hydraulic Service Brake, Emergency Brake, and Parking Brake Systems
Consists of a series of braking performance tests which evaluate vehicles' braking performance, fade and fade recovery performance, wet recovery performance, partially failed system performance, parking brake performance, and general braking system integrity.

Equipment Requirements —
Emergency Brake System — The brake system shall be so designed that a rupture or leakage-type failure of any single pressure component of the system, except the master cylinder, shall not result in complete loss of brake system function.

Parking Brake System — A parking brake system of a friction type with a solely mechanical means to retain engagement shall be provided.

Emergency Brake System Effectiveness Indication — A red light in view of driver shall indicate a hydraulic-type failure of a partial system.

FMVSS 105a (105-75) — Hydraulic Brake Systems, Docket No. 70-27 (75-11, 75-27), Amendment to FMVSS 105 effective date 1-1-76. Consists of a series of braking performance tests similar to those of FMVSS 105 with changes in performance requirements and some added tests.

Additional Equipment —
Brake warning indicator lamp to signal:
Application of parking brake
Electrical failure in anti-lock or variable proportioning system

FMVSS No. 106 — Brake Hoses
Establishes minimum requirements for brake hoses

FMVSS No. 107 — Reflecting Surfaces
Requires that windshield wiper arms, inside windshield moldings, horn rings, and the frames and brackets of inside rearview mirrors have dull surfaces which will reduce the likelihood of hazardous reflection into the driver's eyes.

FMVSS No. 108 — Lamps, Reflective Devices, and Associated Equipment
Specifies requirements for lamps, reflective devices, and associated equipment for signaling and to enable safe operation in darkness and other conditions of reduced visibility.

Major Amendment of FMVSS No. 108 (Lamps, Reflective Devices, and Associated Equipment)

This proposed amendment of Standard No. 108 will significantly improve the effectiveness and reliability of the lighting systems on motor vehicles.

FMVSS No. 109 — New Pneumatic Tires
Specifies tire dimensions and laboratory-test requirements for bead unseating resistance, strength, endurance, and high-speed performance; defines tire load ratings; and specifies labeling requirements for passenger car tires.

FMVSS No. 110 — Tire Selection and Rims
Specifies requirements for original equipment tire and rim selection for new cars to prevent tire overloading.

FMVSS No. 111 — Rearview Mirrors
Specifies requirements for rearview mirrors to provide the driver with a clear and reasonably unobstructed view to the rear.

Revision to FMVSS No. 111 (Rearview Mirror Systems)

Starting with 1980 model vehicles, this revision to FMVSS No. 111 will improve rearward visibility of passenger cars by approximately 50% over present Federal requirements.

Fields of Direct View
Starting with 1980 model vehicles, this new standard will establish an in-vehicle light transmission test which will improve driver visibility during low ambient light levels.

FMVSS No. 112 — Headlamp Concealment Devices
Specifies that any fully opened headlamp concealment device shall remain fully opened whether either or both of the following occur: (a) any loss of power to or within the device or (b) any malfunction of wiring or electrical supply for controlling the concealment device.

FMVSS No. 114 — Theft Protection
Requires that each passenger car have a key-locking system that, whenever the key is removed, prevents normal activation of the car's engine and also prevents either steering or self-mobility of the car, or both.

FMVSS No. 115 — Vehicle Identification
Specifies requirements for an identification number for all passenger cars to facilitate recognition of unauthorized vehicle use resulting in crashes.

FMVSS No. 116 — Motor Vehicle Brake Fluids
Establishes minimum test requirements for the three kinds of fluids designed to prevent the sale of fluids with unsafe temperature, corrosion inducing and rubber component deterioration characteristics.

FMVSS No. 118 — Power-Operated Window Systems
Requires that power-operated window systems be inoperative when ignition is in an off position or when key is removed.

FMVSS No. 124 — Accelerator Control Systems
Establishes fail-safe and redundant return force requirements for the return of a vehicle's throttle to the idle position when the driver removes his foot from the accelerator control, or in the event of a breakage or disconnection in the accelerator control system.

Damageability, Federal Motor Vehicle Standards and NPRM's Applicable to Passenger Cars

FMVSS No. 215 — Exterior Protection
Requires passenger cars to withstand 5-mph front and rear barrier and pendulum impacts plus 3-mph corner pendulum impacts without damage to the vehicle's safety-related systems such as lights, brakes, suspension system, etc.

Bumper Standard, Part 581

Issued: February 27, 1975

Requires passenger cars to withstand 5-mph front and rear barrier and pendulum impacts without damage to the vehicles' safety related systems and additionally specific limitations on damage to non-safety-related components and vehicle surface areas. Thus the Part 581 rulemaking action includes the FMVSS 215 requirements and adds additional damage limitations which are effective for passenger cars as stated below:

Effective Sept. 1, 1978, limit damage to the bumper face bar and components which attach the face bar to the chassis.

Effective Sept. 1, 1979, limit damage to the bumper face bar to dents of ⅜ inch and limit bumper set to ¼ inch.

Federal Standards to Improve Safety.

Source: U.S. Department of Transportation, Office of the Secretary, National Transportation Trends and Choices (to the Year 2000), Washington, D.C., January 12, 1977, p. 105.

CHAPTER 4 — REFERENCES

Executive Office of the President, Energy Policy and Planning, The National Energy Plan, Washington, D.C., April 29, 1977.

Federal Task Force, Motor Vehicle Goals Beyond 1980, Vol. 1: Executive Summary, U.S. Department of Transportation, Washington, D.C., September 2, 1976.

Mullaney, T. E., "The Administration's Task: Educating the Public on Energy," New York Times, May 3, 1977, p. 63.

U.S. Department of Transportation, Office of the Secretary, National Transportation Trends and Choices (to the Year 2000), Washington, D.C., January 12, 1977.

Ward's Communications Inc., Ward's Engine Update, Vol. 3, No. 8, Detroit, MI, April 15, 1977.

Chapter 5

Energy Supply

Section 5.4

Prices

THE PRICE THAT CONSUMERS HAVE HAD TO PAY FOR GASOLINE AT THE PUMP HAS INCREASED GRADUALLY OVER THE PAST THREE YEARS (SEE THE TABLE BELOW).

Price of Gasoline at the Pump
(cents per gallon)

	Regular	Premium	Unleaded
1974	52.8	56.0	53.6
1975	56.2	60.3	58.8
1976	58.7	63.9	62.9

Source: J. Gaynor (ed.), Federal Energy Administration, National Energy Information Center, Monthly Energy Review, Washington, D.C., April 1977.

HOWEVER, WHEN THESE PRICES ARE ADJUSTED FOR INFLATION (AS MEASURED BY THE CONSUMER PRICE INDEX), THE REAL PRICE OF REGULAR AND PREMIUM GASOLINE IS SEEN TO HAVE ACTUALLY DECLINED.

Real Price of Gasoline
(1976 cents per gallon)

	Regular	Premium	Unleaded
1974	61.2	64.9	62.1
1975	59.7	64.0	62.4
1976	58.7	63.9	62.9

Source: Calculated by the Data Analysis Branch, Transportation Energy Conservation, Energy Research and Development Administration.

Section 5.7

Alternate Fuels

In 1976, three fourths of the Nation's energy needs were met by crude oil and natural gas. This dependence upon these two energy resources developed largely because of their seemingly abundant supply and the fact that they are clean burning and easily transported and stored. However, since our production of these fuels is declining they are expected to supply a smaller portion of the energy needs in the future. As domestic reserves of these two fossil fuels dwindle, the level and price of imports of crude oil and natural gas are expected to climb. Thus, the substituability of energy sources has become a technological and economic, social and political issue. The primary questions yet to be answered are not whether this substitution will occur, but rather, when and in what form it will occur (see p. 82). Because over 95 percent of transportation in the U.S. currently relies on petroleum - based fuels, the question of alternative fuels has particular significance for the sector. It is clear that while gasoline blends offer a short term extension to the solution of the problem of petroleum shortage, alternative fuels will be required as long term solutions. The use of these alternative fuels will necessarily require extensive and costly engine redesign.

The period of transition to alternative liquid fuels for transportation will be one in which it will be necessary for the U.S. to determine the optimum balance between increasing petroleum reserves and moving aggressively in the effort to build large-scale commercial plants for oil recovery from shale oil and for coal conversion by gasification and liquefaction. (See p. 83). Coal and oil shale are two of this Nation's most abundant fossil energy resources. The technologies for converting coal into synthetic liquid and gaseous fuels and for extracting oil from oil shale are getting increasing attention because of the potential for reductions in dependence on foreign sources. In addition, biomass conversion - converting municipal and agricultural wastes into synthetic fuels - could become a small but locally useful energy source and, accordingly, interest is being focused on its development.

The sheer magnitude of the task of substantial replacement of U. S. liquid-petroleum-derived fuel production appears to indicate a time frame of more than two decades (see p. 84). Those fuels most likely to have a

major role for the transportation sector in the time period 1975 to 2000 in terms of gasoline and distillate replacement (see p. 86) include:

- Shale-rock-derived liquids
- Coal-derived liquids
- Methanol (methyl alcohol) as a product of coal conversion
- Methanol and ethanol (ethyl alcohol) derived through other processes
- Hydrogen

For smaller, personal transportation vehicles, on-vehicle storage problems may prevent the use of such fuels as hydrogen, liquid-petroleum gas, and reformed fuels to supplement petroleum. However, for the larger mass transit vehicles (specifically buses) a conversion to these fuels has considerable near term potential. Because tar sand reserves in the United States are small, research into the development of this resource is not being pursued in the U. S. at present. Electricity-powered vehicles will not be considered under this alternative fuels discussion.

As discussed in Supplement III, Chapters 5 and 6, domestic supplies of petroleum already fall short of U. S. demand for liquid fuels. In 1976, this shortfall was 7.2 million barrels per day (bbl/day) or 47.2% of total consumption.[1] With plausible growth in demand and a decline in domestic oil production, the shortfall may be as large as 18 million bbl/day by the year 2000. Of this shortfall, about 6 million bbl/day can be attributed to the automotive market (cars, trucks, and buses).

Substitution of alternative energy supplies from other than petroleum sources is almost nonexistent in the transportation sector today. The utilization of alternative fuels and energy sources for transportation is in a developmental stage and will mature toward the end of the century In feasibility studies[2,3] of alternative fuels, similar conclusions on the timing of availability and use have been reached.

Near Term (1975-85): Gasoline from oil shale, distillate oils from oil shale or coal and alcohol/gasoline blends are likely to become available.

Mid Term (1985-2000): Gasoline from distillate oils, and methanol from coal are likely to become available at increasing rates.

Far Term (Beyond 2000): Gasoline from coal or oil shale, distillate oils from coal or oil shale, methanol from coal, and hydrogen are likely to represent major sources.

Information on alternative fuels available to the Transportation Energy Conservation Division from its research program indicates that the domestic resources large enough and most likely to replace petroleum for transportation are coal and oil shale. The economics of large-scale commercial plants for shale oil and coal gasification and liquefaction will determine if their products will be processed to make transportation fuels and/or if they will replace certain petroleum fractions now in non-transportation use which could be more economically processed into transportation fuels. Biomass is not expected to provide a significant fraction of necessary fuel, and the use of hydrogen as a fuel source still poses significant technical and economic problems. Although tar-sand-derived liquids are presently being produced outside the U. S., estimates of ultimate reserves indicate that tar sand potential is only approximately 2% that of coal and 8% that of oil shale (see p. 85).

Manufacturing technology is well in hand for alcohol as a fuel source, and problems (enumerated below) associated with motor vehicle engine design and fuel storage are under study. Volatility and phase stability problems are yet to be resolved, and the supply of either ethanol or methanol is likely to be the pacing factor. Feasible blends of gasoline and alcohol include a mixture of 10 to 15% methanol with gasoline. Technical problems include the instability of the mixture at temperature extremes, phase stability at low temperatures, vapor lock at higher temperatures, starting problems and separation of water from alcohol at different temperatures (which affects carburization).

Current research and development on alcohol-gasoline blends focuses upon reagent grade alcohol. Fuel combinations and/or blends will most likely be formulated for specific locales and seasons. From a performance perspective, there is no significant advantage or disadvantage with respect to fuel economy or regulated emissions of alcohol/gasoline blends. There may be some variation due to leaning effects and an increased level of aldehyde, particularly, formaldehyde emissions. The emission levels

that would be reached are within safe limits; however, the emissions could be catalytically reduced if necessary.

In addition to alcohol blends, straight alcohol seems a possible fuel alternative. Within this fuel class, methanol is the most feasible alternative given the economic constraints of other alcohols and the available biomass. Advantages of methanol over gasoline include a high octane rating, which allows for compression ratio increases (thus fostering better thermal efficiency and improved fuel economy), (see p. 88), lower NO_x emissions (see p. 89) and lower lean mixtures which improves thermal efficiency and further decreases nitrous oxide and unburned fuel emissions. Despite this combination of high compression, lean operation, and vehicle cost reductions resulting from fewer emission control devices, methanol-fueled vehicles continue to experience specific losses in power per unit of fuel input. This results from the fact that the Btu content per unit volume of methanol is only half that of gasoline. This fact (i.e., that twice as much fuel per unit of work is required) presents a significant problem to the use of 100% methanol as fuel in the transportation sector. Additional problems include difficulty in starting at temperatures below 10°C and the detailed engine modifications which are required (see p. 90).

Ethanol, like methanol, provides another possible source for blending with gasoline. An ethanol/gasoline blend seems to exhibit better characteristics in general. However, distillation from crop residue and excess grains would provide only marginal quantities useful in local or regional markets.

As discussed earlier, synfuels development from oil shale represents a major potential for alternative fuels development. Synfuels are similar to petroleum crudes, but they tend to be more aromatic (lower in hydrogen content); they also contain more sulphur and bound nitrogen, some of which could be removed during conventional processing, with the remainder requiring special processing for removal (see p. 91).

Synfuels, as is the case with alcohols, are not expected to provide better fuel economy. Because of the compositions themselves, and because 35 to 40% of the fuel or equivalent energy is consumed in processing,

the overall fuel energy efficiency is well below present limits, resulting in significant expense to the consumer.

In general, direct coal synfuel provides a poorer grade liquid fuel for transportation use than petroleum because it is very aromatic, contains bound nitrogen which is not readily removed, and may contain more sulfur and oxygen. These, however, can be removed in an added step in the production process. When converted directly to liquid, the derived fuels exhibit heavy oil characteristics similar to bunker oil and must be hydrogenated to be suitable for transportation uses. An alternative to hydrogenation of these heavy oils for transportation use is coal conversion to methanol and methanol conversion to gasoline. This alternative appears to be practical under present technology. Although liquid fuels have been made in pilot and experimental plant operations, there has not been any automotive fuel made of sufficient quality and quantity to conduct meaningful research into its potential.

Liquid fuels from oil shale and coal exhibit significant phase stability and overall thermal efficiency problems. Because of the abundance of coal, however, the low quality of liquid fuels and the expense of upgrading can be counteracted if a systems approach is taken. This approach focuses upon the establishment of a fuel-engine relationship which can handle the fuel like a petroleum distillate.

As previously discussed, hydrogen represents a longer-term fuel alternative for the transportation sector. The major problem with the use of hydrogen as a fuel centers upon its unavailability in large quantities at competitive prices, and logistics of supply and storage. Initial uses of hydrogen fuels are more likely to occur in sectors other than the transportation sector (particularly as a natural gas supplement), and transportation use will likely not develop extensively for 30 years. Hydrogen as a fuel, however, has a strong appeal because it is clean-burning. However, when it is used in the internal combustion engine at stoichiometric proportions it will produce high emissions of nitrogen oxides because of high combustion temperatures. Hydrogen has a low flammability limit and can, therefore, be operated in very lean mixtures (at which point emissions fall off significantly). At these mixtures, levels of power output also fall off and, therefore, a suitable compromise

must be determined. In fact internal combustion engines have been adapted to use hydrogen fuel with favorable results.

Improved efficiency can also be expected with hydrogen used as a fuel, but claims vary widely. Until an engine is designed and tested specifically for hydrogen, the extent of efficiency improvements (probably in the order of 25% or more) are still a matter of conjecture. The most severe technical problem with regard to highway vehicle use of hydrogen as a fuel are the extreme requirements of the available technologies for on-vehicle fuel storage. (The best available techniques require four times the volume and 2 1/2 times the weight of gasoline storage for an equivalent amount of energy.)

[1]U.S. Department of the Interior, Bureau of Mines, Annual U.S. Energy Use Up in 1976 (News Release), Washington, D.C., March 14, 1977.

[2]F. H. Kant et al., Feasibility Study of Alternative Fuels for Automotive Transportation, U.S. Environmental Protection Agency Report EPA-460/3-74-009 (3 volumes) June 1974.

[3]J. Pangborn and J. Gillis, Alternative Fuels for Automotive Transportation - A Feasibility Study, U.S. Environmental Protection Agency Report EPA-460/3-74-012 (3 volumes) July 1974.

PREDICTIONS OF WHERE AND AT WHAT PACE A TRANSITION FROM CRUDE-OIL-DERIVED FUELS TO SYNTHETICALLY DERIVED FUELS WILL OCCUR ARE DIFFICULT TO MAKE. RESULTS OF TWO STUDIES ARE SHOWN BELOW. WHILE SIGNIFICANT EMPIRICAL DIFFERENCES EXIST, BOTH OF THESE STUDIES SHOW THAT SYNTHETIC FUELS COULD MAKE ONLY A MINOR CONTRIBUTION TO TOTAL AUTOMOTIVE SUPPLIES THROUGH 1985. THEY WOULD HAVE, HOWEVER, THE POTENTIAL TO BECOME A MAJOR FACTOR IN SUBSEQUENT YEARS.

Predictions of Synthetically Derived Fuels[a,b]

	1980	1985	2000
Alternate fuel[c] study		800,000 bbl/day (U.S.)	6,000,000 bbl/day (U.S.)
National Petroleum[d] Council	100,000 bbl/day (U.S.)	500,000 bbl/day (U.S.)	
	400,000 bbl/day (Canada)	1,000,000 bbl/day (Canada)	
	300,000 bbl/day (Latin America)	800,000 bbl/day (Latin America)	

[a]Many of the predictions regarding synfuel development were developed in 1974 and earlier. They assumed a concerted early impact which has not yet materialized. Therefore, many 1985 and 2000 predictions may be jeopardized.

[b]In early 1974, U.S. automotive fuel consumption approximated 6,000,000 bbl/day.

[c]F. H. Kant et al., Exxon Research and Engineering Company, Feasibility Study of Alternate Fuels for Automotive Transportation, Final Report, U.S. Environmental Protection Agency, Washington, D.C., June 1974.

[d]M. W. Nichols, National Petroleum Council, "Balancing Requirements for World Oil and Energy," Chemical Engineering Progress, Vol. 70, No. 10, Washington, D.C ., October 1974, pp. 36–48.

THE SCENARIO SHOWN BELOW WAS PREPARED IN AN ATTEMPT TO DEPICT THE MAXIMUM RATE AT WHICH A SYNTHETIC FUELS INDUSTRY COULD BE IMPLEMENTED.

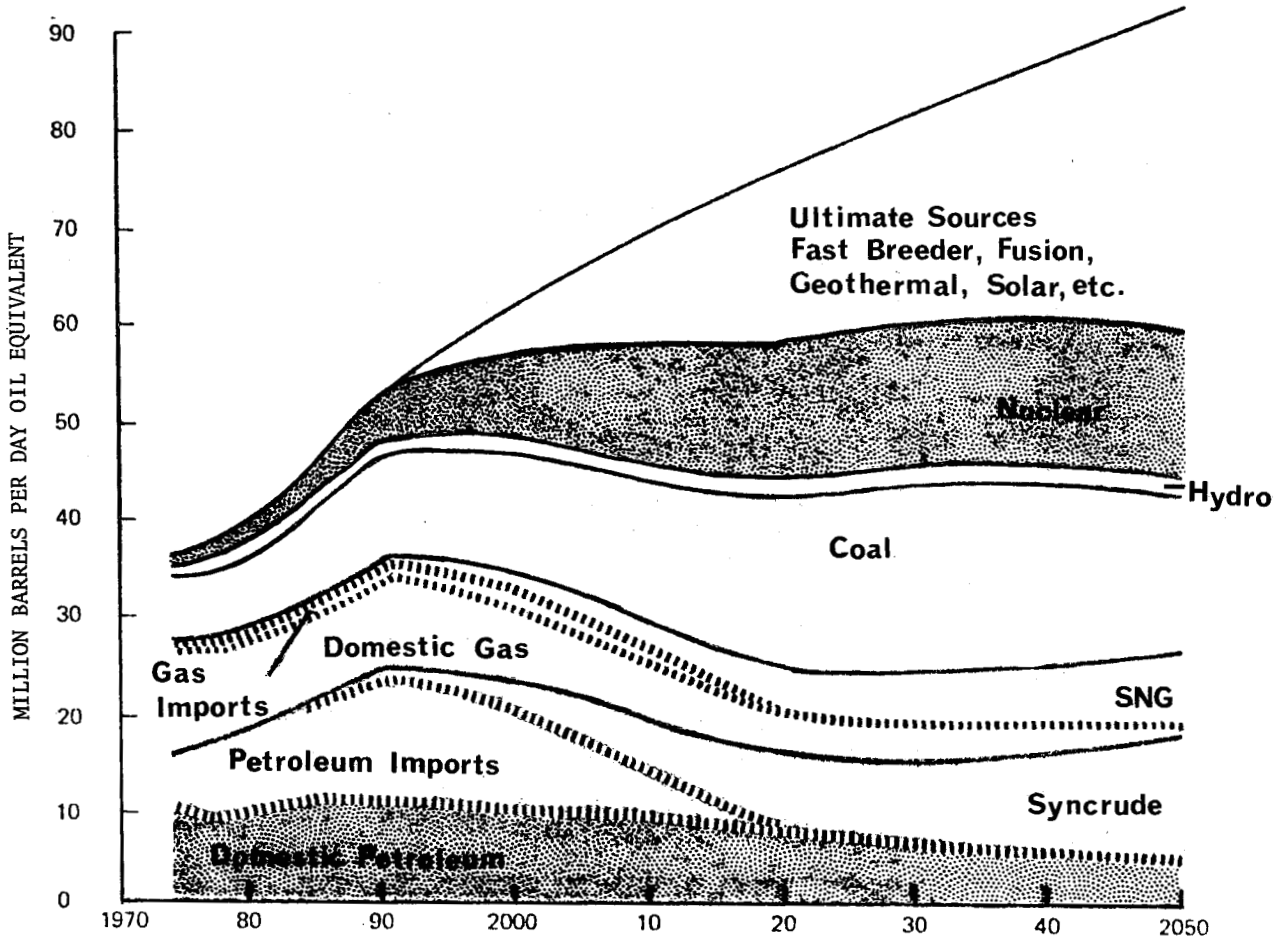
Maximum Credible Implementation Scenario
Synfuel Production Schedule
(million bbl/day)

	Year				
	1980	1985	1990	1995	2000
Syncrude from oil shale	0.1	0.5	1.5	2.0	2.0
Methanol from coal[a]	0.05	0.3	1.0	2.5	4.0
Syncrude from coal	0.0	0.09	0.5	1.5	4.0
Total	0.15	0.89	3.0	6.0	10.0

[a]Oil-equivalent energy.

Source: E. M. Dickson et al., Stanford Research Institute, Impacts of Synthetic Liquid Fuel Development, Volume I — Summary 76-129/1, Energy Research and Development Administration and U.S. Environmental Protection Agency, Washington, D.C., 1976, p. 33.

ALTHOUGH SYNTHETIC CRUDES WILL REPRESENT AN INSIGNIFICANT PORTION OF THE LIQUID FUEL MARKET IN 1985, THESE SYNTHETIC CRUDES COULD REPRESENT MORE THAN 5% OF THE LIQUID FUEL MARKET BY 1990. AT THIS LEVEL, THESE ALTERNATE FUELS WILL BEGIN TO HAVE A NOTICEABLE EFFECT ON TRANSPORTATION FUELS.



U.S. Energy Supplies.

Source: R. F. Wilson and W. T. Tierney, Texaco Inc., "Future Transportation Fuels — Optimization of the Vehicle-Fuel-Refinery System," presented at the American Petroleum Institute 41st Midyear Meeting, Refining Division, Los Angeles, CA, May 10—13, 1975.

THE ULTIMATE POTENTIAL OF TAR SANDS AS A PETROLEUM SUBSTITUTE IS MUCH LOWER THAN THAT OF COAL OR SHALE. ESTIMATES OF ULTIMATE RESERVES INDICATE THAT THE TAR SAND POTENTIAL IS ONLY APPROXIMATELY 2% THAT OF COAL AND 8% THAT OF OIL SHALE. TAR SANDS HAVE A LOWER POTENTIAL THAN THAT OF PETROLEUM CRUDE. AS SEEN IN THE TABLE BELOW, THE MAJORITY OF TAR SAND DEPOSITS ARE LOCATED IN CANADA (APPROXIMATELY 80%) AND VENEZUELA (APPROXIMATELY 20%).

Tar Sand Reserves

Location	In-place reserves (10^6 barrels)
Canada	711,000
Venezuela	200,000
Madagascar	1,800
U.S.A.	2,100
Albania	400
Rumania	25
U.S.S.R.	25

Source: W. F. Taylor and H. J. Hall, Exxon Research and Engineering Company, Future Synthetic Fuels, U.S. Department of the Army, Washington, D.C., September 1975, p. 56.

THE COMPATIBILITY OF TAR SAND CRUDE WITH PRESENT PETROLEUM TECHNOLOGY IS BETTER THAN THAT OF SHALE ROCK OR COAL-DERIVED CRUDES. THE TECHNOLOGY AVAILABLE TO PROCESS HEAVY PETROLEUM CRUDE OIL CAN BE USED TO PROCESS TAR-SAND-DERIVED CRUDE.

A BROAD OUTLINE OF THE ANALYSIS OF THE EXXON RESEARCH AND ENGINEERING COMPANY ENTITLED FEASIBILITY STUDY OF ALTERNATE FUELS FOR AUTOMOTIVE TRANSPORTATION AND ITS CONCLUSIONS ARE SHOWN BELOW.

Fuels and Selection Factors Considered

The fuels selected for preliminary analysis were as follows:

Coal liquids (gasoline or distillate)
Shale liquids (gasoline or distillate)
Methanol
Ethanol
Higher oxy compounds
Hydrogen
Methane
Ammonia
Hydrazine

The criteria used in the evaluation of these fuels were as follows:

Economic Criteria

Cost of production and distribution
Operating cost (in vehicle)

Technical Criteria

Technological status
Production efficiency
Environmental impact in production

Performance Criteria

Compatibility with engines
Toxicity
Safety
Driver acceptability — convenience
Environmental impact during use
Efficiency of use

Strategic Criteria

Fuel shift and entry compatibility
Resource availability
International considerations

The analysis identified the following synthetic fuels as the most feasible and practical fuels of the future:

- Shale-derived gasoline
- Shale-derived distillate
- Coal-derived gasoline
- Coal-derived distillate
- Methanol as a product from gasified coal

Source: W. F. Taylor and H. J. Hall, Exxon Research and Engineering Company, Future Synthetic Fuels, U.S. Department of the Army, Washington, D.C., September 1975, pp. 8 and 9.

THE MOVE TO ALTERNATE FUELS POSES MANY PROBLEMS SUCH AS DIFFERENT MATERIAL HANDLING REQUIREMENTS FROM PETROLEUM AND THESE MUST BE MET IN CONJUNCTION WITH THE DEVELOPMENT OF THE PROCESSES REQUIRED TO PRODUCE THE SYNTHETIC CRUDES. HOWEVER, ONCE IN THE CRUDE STAGE THE MATERIAL CAN THEN PRESUMABLY BE PROCESSED IN MUCH THE SAME WAY AS IN TODAY'S PETROLEUM REFINERIES.

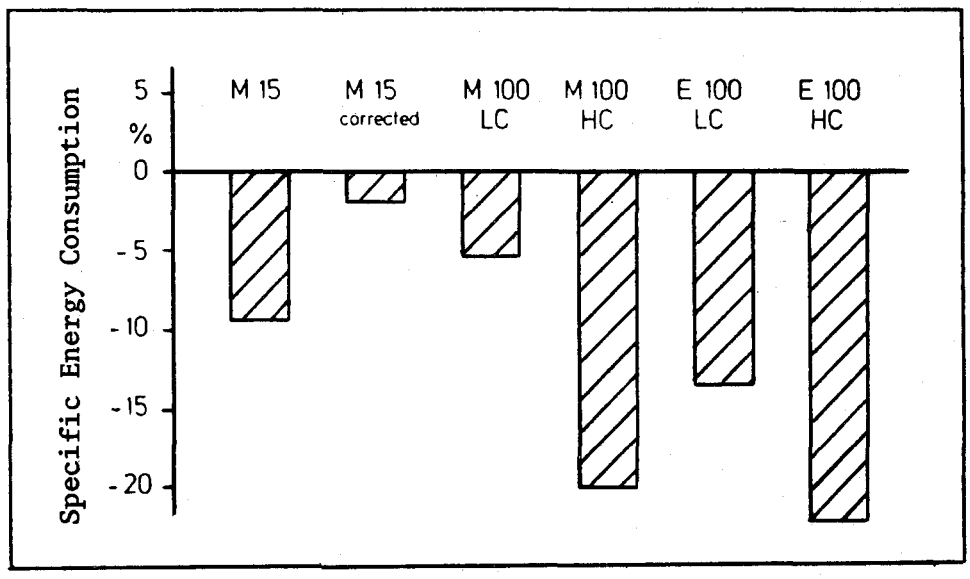
Raw Material Characteristics and Disposable Solids
for a 100,000 bbl/day U.S. Refinery

	Raw material crude/ton (gal per day)	Raw material/ 100,000 bbl/day crude (tons per day)	Waste solids/ 100,000 bbl/day crude (tons per day)
Oil	285	14,800	NIL
Coal	126	33,300	3,300
Shale	25	168,000	152,500
Tar sands	26	161,000	143,200

Note: The largest currently operating coal mine in the U.S. is capable of producing 20,250 tons per day of solids.

Source: R. F. Wilson and W. T. Tierney, Texaco Inc., Future Transportation Fuels — Optimization of the Vehicle-Fuel-Refinery System, presented at the American Petroleum Institute 41st Midyear Meeting, Refining Division, Los Angeles, CA, May 10—13, 1975

THE FIGURE BELOW SHOWS SPECIFIC CONSUMPTION AT FULL LOAD OF ENGINES USING ALCOHOL FUEL COMPARED TO A PRODUCTION GASOLINE ENGINE. TAKING INTO ACCOUNT THE LOSS OF POWER CAUSED BY A LEANER MIXTURE, ENGINES USING M 15 FUEL WILL CONSUME APPROXIMATELY 7% LESS FUEL (WITH NO ENGINE ADJUSTMENTS FUEL ECONOMY IS REALIZED AS A RESULT OF LEANING EFFECTS). THE DECREASE OF ENERGY CONSUMPTION IN ENGINES RUNNING ON PURE ALCOHOL CORRESPONDS APPROXIMATELY TO THE INCREASE IN POWER OUTPUT.

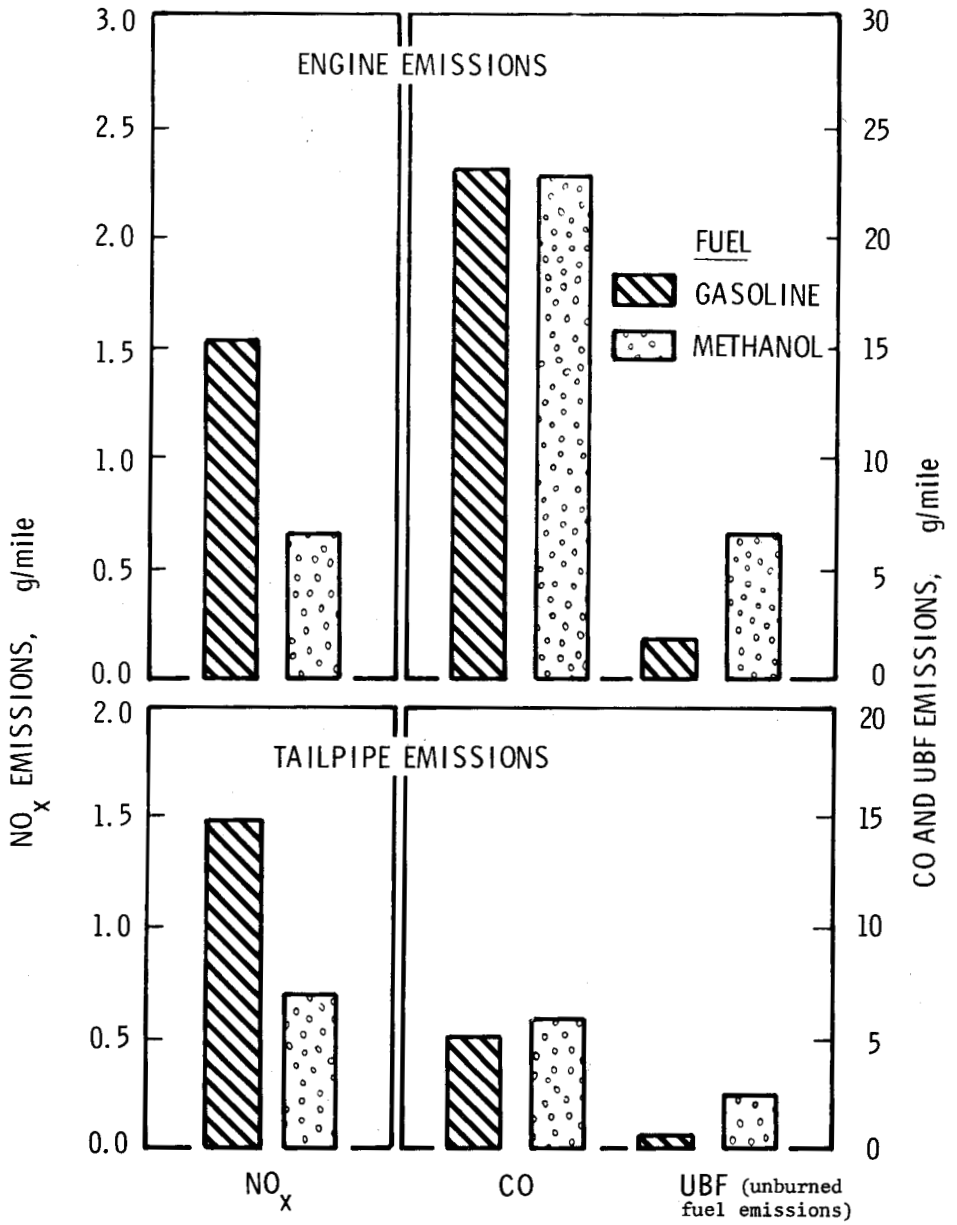


Decrease of Energy Consumption in Comparison to Production Gasoline Engines, Maximum Power.

M 15 15% methanol, 85% gasoline
M 100: 100% methanol
E 100: 100% ethanol, technical quality (containing 5% water)
LC : low-compression engine
HC : high-compression engine

Source: W. E. Bernhardt, A. Koenig, W. Lee and H. Menrad, Volkswagnewerk AG, Recent Progress in Automotive Alcohol Fuel Application, presented at the Fourth International Symposium on Automotive Propulsion Systems, Washington, D.C., April 17–22, 1977, p. 9.

UNDER THE TEST PROCEDURES EMPLOYED BY GENERAL MOTORS RESEARCH LABORATORIES, ONLY NO_X EMISSIONS WERE SIGNIFICANTLY REDUCED WITH THE USE OF METHANOL.



Comparison of Gasoline and Methanol-Engine and Tailpipe Exhaust Emissions.[a]

[a]Emissions from each car were measured using the Federal Test Procedure. 1975 cars were equipped with electronic fuel-injected systems and with production spark timing and catalytic converters. Average equivalence ratios equaled 0.96.

Source: N. D. Brinkman, General Motors Research Laboratories, Vehicle Evaluation of Neat Methanol — Compromises Among Exhaust Emissions, Fuel Economy, and Driveability, presented at the Fourth International Symposium on Automotive Propulsion Systems, Washington, D.C., April 17—22, 1977, Figure 5.

THE LIST OF THE CHANGES REQUIRED FOR A CHANGEOVER TO GASOLINE-METHANOL BLENDS IS LESS LENGTHY THAN THE LIST OF MODIFICATIONS REQUIRED FOR A CHANGEOVER TO PURE METHANOL. IN CASE OF A CRISIS IT WOULD BE POSSIBLE TO STRETCH THE SUPPLY OF GASOLINE AVAILABLE BY ADDING METHANOL TO FUEL USED IN EXISTING VEHICLES.

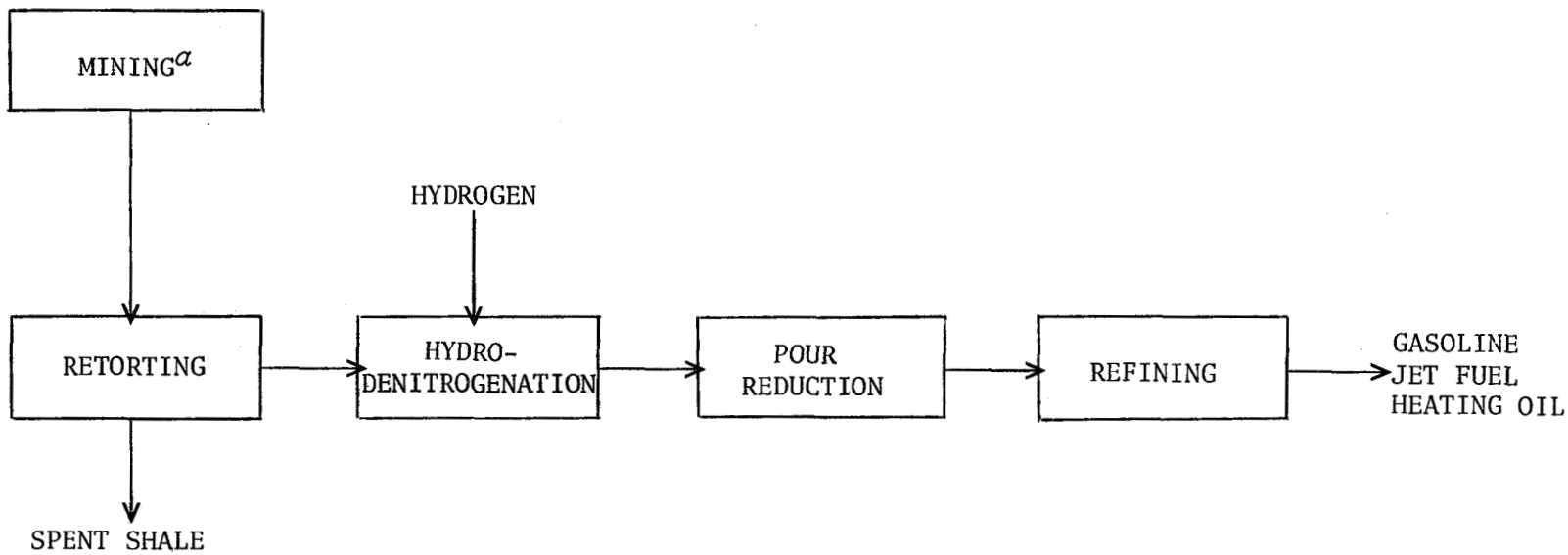
Necessary Modifications to the Internal Combustion Engine Due to the Use of Methanol Fuels

	Pure methanol	15% methanol 85% gasoline
Mandatory	Methanol resistant components	Methanol resistant components
	Changes in the carburation device	
	Cold-starting device[a]	
Recommendable	Enlarged tank Stepped-up intake air heating	Modified carburation device adjustment
Possible	Higher compression ratio	

[a]Unnecessary, if a methanol fuel containing low boiling components is employed.

Source: W. E. Bernhardt, A. Koenig, W. Lee and H. Menrad, Volkswagenwerk AG, Recent Progress in Automotive Alcohol Fuel Application, presented at the Fourth International Symposium on Automotive Propulsion Systems, Washington, D.C., April 17–22, 1977, p. 20.

EXCEPT FOR A LARGE (2,500 TON/DAY) SCALE PLANT IN OPERATION IN BRAZIL SINCE 1970, NO OTHER FREE WORLD COMMERCIAL PROCESSING PLANTS FOR THE TREATMENT OF OIL SHALE ARE IN OPERATION. (THE PARAHO PROJECT IS OPERATING EXPERIMENTALLY AT ANVIL POINTS, COLORADO, AND OCCIDENTAL PETROLEUM IS PREPARING A MODIFIED IN-SITU RETORTING PROCESS.) A GENERALIZED PROCESSING SCHEME IS SHOWN BELOW.



Shale Oil Processing Sequence.

[a]Used in above-ground retorting and as a prelude to modified in-situ retorting, but not used for in-situ retorting.

Source: W. F. Taylor and H. J. Hall, Exxon Research and Engineering Company, Future Synthetic Fuels, U.S. Department of the Army, Washington, D.C., September 1975, pp. 37 and 38.

CHAPTER 5 — REFERENCES

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Chapter 6
Transportation Demand

Section 6.1
Population Determinants

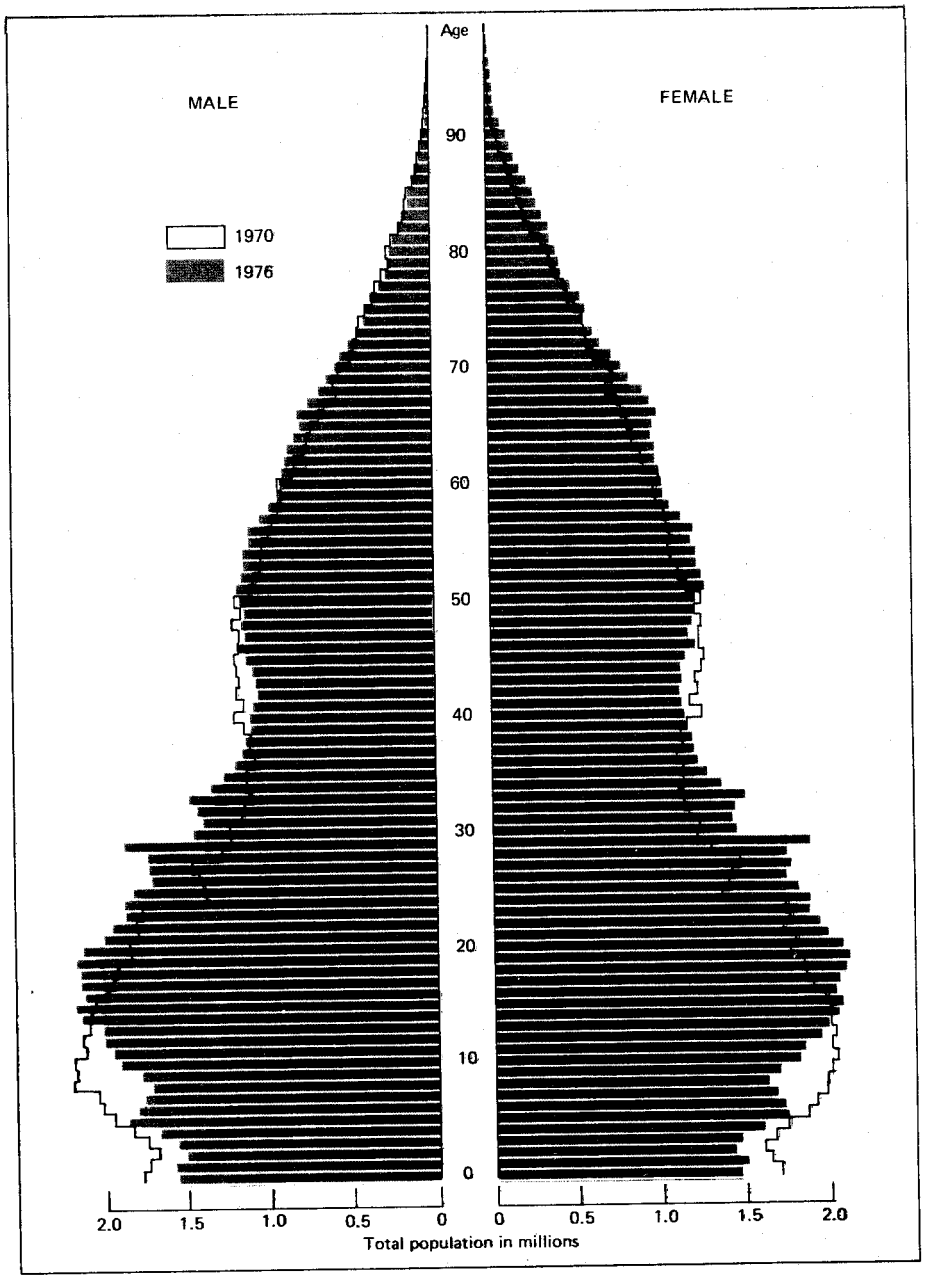
Preliminary Estimates of the Resident Population[a] of the U.S. by Age, Region, and Division: July 1, 1976 (in thousands)

Region/division	Percent distribution	Resident population	Under 5 years	5 to 17 years	18 to 44 years	45 to 64 years	65 years and over	14 years and over
U.S., total	100.0	214,659	15,339	49,851	82,835	43,700	22,934	166,365
Regions								
Northeast	23.1	49,503	3,108	11,215	18,551	10,969	5,659	38,953
New England	5.7	12,221	753	2,822	4,667	2,579	1,400	9,597
Middle Atlantic	17.4	37,282	2,355	8,393	13,884	8,390	4,259	29,356
North Central	26.9	57,739	4,130	13,709	22,141	11,536	6,223	44,580
East North Central	19.1	40,934	2,964	9,785	15,803	8,226	4,157	31,492
West North Central	7.8	16,805	1,166	3,924	6,338	3,310	2,066	13,088
South	32.1	68,855	5,248	16,069	26,659	13,539	7,344	52,952
South Atlantic	15.8	33,990	2,449	7,753	13,245	6,837	3,707	26,404
East South Central	6.4	13,661	1,070	3,250	5,200	2,670	1,473	10,438
West South Central	9.9	21,204	1,729	5,066	8,214	4,032	2,164	16,110
West	18.0	38,562	2,852	8,860	15,487	7,655	3,710	29,877
Mountain	4.6	9,833	845	2,390	3,874	1,846	880	7,442
Pacific	13.4	28,729	2,007	6,470	11,613	5,809	2,830	22,455

[a]Includes Armed Forces personnel residing in each region/division.

Source: U.S. Department of Commerce, Bureau of the Census, Current Population Reports: Population Estimates and Projections, Series P-25, No. 646, Washington, D.C., February 1977, p. 2.

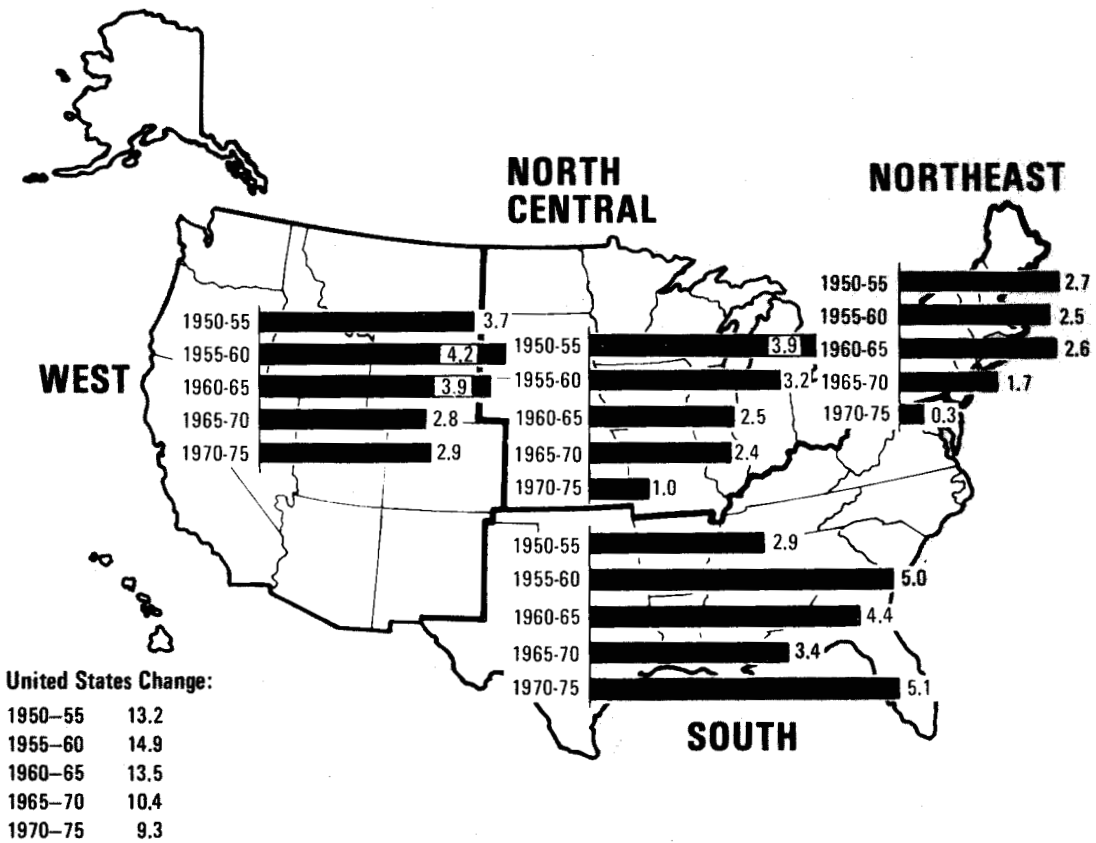
POPULATION SINCE 1970 HAS CHANGED IN TERMS OF AGE DISTRIBUTION. THE U.S. POPULATION IS AGING. AS INDICATED IN THE POPULATION PYRAMID BELOW, THE FASTEST GROWING GROUP BETWEEN 1970 AND 1976 WAS BETWEEN 18 AND 34 YEARS OF AGE.



Distribution of the Total Population, by Age and Sex: April 1, 1970 and July 1, 1976.

Source: U.S. Department of Commerce, Bureau of the Census, Current Population Reports: Population Estimates and Projections, Series P-25, No. 643, Washington, D.C., January 1977, Tables 1 and 5.

THERE HAS BEEN A SIGNIFICANT CHANGE IN REGIONAL POPULATION TRENDS SINCE 1970. THE SOUTH HAS REPLACED THE WEST AS THE FASTEST GROWING REGION, AND IS NOW ATTRACTING ALMOST TWICE AS MANY NET MIGRANTS AS THE WEST.



Population Change for 5-Year Periods
by Region: 1950 to 1975.
(change in millions)

Source: U.S. Department of Commerce, Bureau of the Census, Current Population Reports: Population Estimates and Projections, Series P-25, No. 640, Washington, D.C., November 1976.

THE CURRENT REGIONAL GROWTH PATTERN INDICATED ON PAGE 97 HAS BEEN AFFECTED BY A DECIDED SHIFT IN NET MIGRATION FLOWS SINCE 1970 BETWEEN THE METROPOLITAN AND NONMETROPOLITAN SECTIONS OF THE NATION. SINCE 1970, THERE HAS BEEN A SHARP UPTURN IN NET IN-MIGRATION FOR THE NATION'S NON-METROPOLITAN AREAS. THIS HAS BEEN ACCOMPANIED BY A SIZABLE DOWNTURN IN NET IN-MIGRATION FOR THE METROPOLITAN SECTOR. THE MAJOR CHANGE HAS BEEN IN THE MIGRATION PATTERNS OF THE VERY LARGE METROPOLITAN AREAS — THOSE SMSAS WITH 1970 POPULATION OF 1.5 MILLION OR MORE.

Net Migration by Metropolitan Status: 1960—1974
(in millions)

Area	Net migration	
	1960—1970	1970—1974
Large metropolitan	4.2	—1.2
Other metropolitan	2.2	1.7
Nonmetropolitan	—3.2	1.5
Total	3.2	2.0

AS A RESULT OF THE INCREASED NONMETROPOLITAN NET MIGRATION, EACH REGION'S NONMETROPOLITAN COUNTIES ARE GROWING FASTER THAN IN THE 1960'S IN SPITE OF SIZABLE DECLINES IN THE AVERAGE ANNUAL CHANGE DUE TO NATURAL INCREASE (I.E., BIRTHS).

Average Annual Percent Change for Regions
by Metropolitan Status: 1960—1974

Region	Average annual percent change	
	1960—1970	1970—1974
Northeast		
Large metropolitan	1.0	—0.3
Other metropolitan	1.3	0.5
Nonmetropolitan	0.8	1.4
North Central		
Large metropolitan	1.2	—0.1
Other metropolitan	1.3	0.6
Nonmetropolitan	0.3	0.8
South		
Large metropolitan	2.9	1.8
Other metropolitan	1.6	1.7
Nonmetropolitan	0.3	1.3
West		
Large metropolitan	2.5	0.5
Other metropolitan	2.5	2.6
Nonmetropolitan	0.9	2.2

Source: U.S. Department of Commerce, Bureau of the Census, Current Population Reports: Population Estimates and Projections, Series P-25, No. 640, Washington, D.C., November 1976, p. 3.

Section 6.2

Economic Characteristics

THE NORTHEAST REGION OF THE U.S. IS SIGNIFICANTLY DIFFERENT FROM THE REST OF THE NATION WITH RESPECT TO PERCENT OF EXPENDITURES ON TRANSPORTATION, VEHICLE PURCHASES, GASOLINE PURCHASES (I.E., ALL LOWER), AND OTHER TRANSPORTATION PURCHASES (I.E., HIGHER). THIS MAY REFLECT A MUCH HIGHER USAGE AND DEPENDENCE ON PUBLIC TRANSPORTATION MODES IN THE NORTHEAST.

Percent of Family Consumption Expended on Transportation as a Function of U.S. Region, 1972

	Total	Northeast	North Central	South	West
No. vehicles per family	1.5	1.4	1.6	1.5	1.5
Vehicle ownership, %	82	76	85	81	85
Family income, $	10,770	11,334	11,040	9,828	11,191
Family consumption,[a] $	7,414	7,996	7,273	6,803	7,877
% of income	68.8	70.5	65.9	69.2	70.4
Transportation, $	1,516	1,418	1,597	1,501	1,546
% of consumption	20.4	17.7	22.0	22.1	19.6
Vehicle purchases, $	675	556	738	708	680
% of consumption	9.1	7.0	10.1	10.4	8.6
Gasoline, $	327	298	332	337	339
% of consumption	4.4	3.7	4.6	5.0	4.3
Other operating, $	385	410	384	349	414
% of consumption	5.2	5.1	5.3	5.1	5.3
Other transportation, $	55	93	50	36	47
% of consumption	0.7	1.2	0.7	0.5	0.5

[a]Data represent only those expenditures collected in the interview survey, not the total of all family expenditures.

Source: U.S. Department of Commerce, Bureau of Labor Statistics, Consumer Expenditure Survey Series, Report 455-3, Washington, D.C., 1976, pp. 34–38.

A SUMMARY OF ANNUAL BUDGETS FOR A FOUR-PERSON FAMILY AT THREE LEVELS OF LIVING IN THE URBAN U.S. IN AUTUMN 1976, AND THE PERCENT INCREASE IN THE BUDGETS SINCE 1975 ARE PRESENTED BELOW. CONSUMPTION COSTS ROSE BY APPROXIMATELY 5% IN THE LOWER BUDGET AND 6% IN THE INTERMEDIATE AND HIGHER BUDGET. THE LARGEST INCREASES AMONG COMPONENTS OCCURRED IN TRANSPORTATION, HOMEOWNER COSTS, AND MEDICAL CARE.

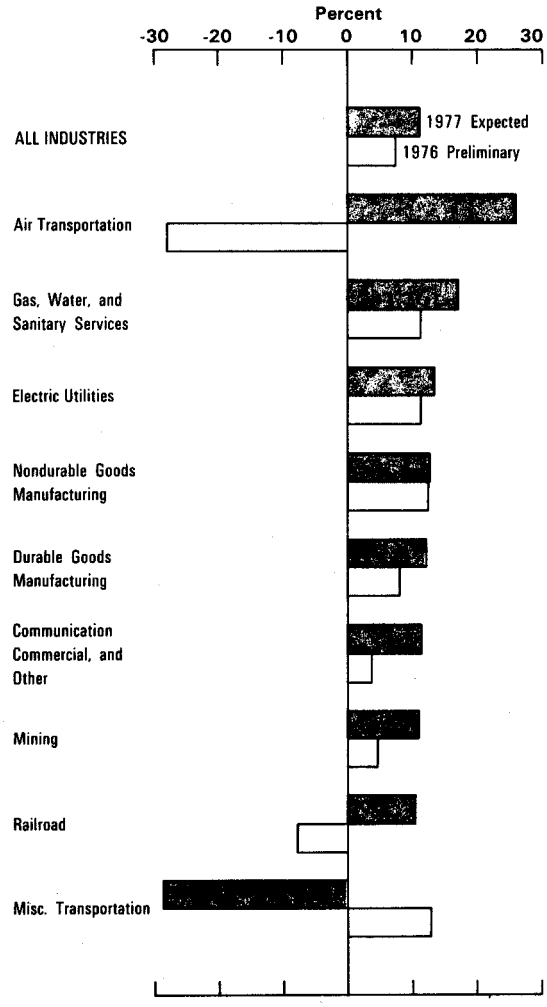
Autumn 1976 Urban Family Budgets and Percent Change Since 1975[a]

	Lower budget	% Δ 1975-1976	Intermediate budget	% Δ 1975-1976	Higher budget	% Δ 1975-1976
Total budget	$10,041	4.7	$16,236	6.0	$23,759	6.6
Total family consumption	8,162	4.7	12,370	5.5	17,048	5.6
Food	3,003	1.7	3,859	0.8	4,856	0.8
Housing	1,964	5.8	3,843	8.8	5,821	8.7
Transportation	767	9.3	1,403	9.7	1,824	10.0
% of total	9.4		11.3		10.7	
Clothing	799	3.6	1,141	3.5	1,670	3.5
Personal care	265	6.9	355	7.3	503	7.0
Medical care	896	9.5	900	9.5	939	9.6
Other family consumption	468	4.7	869	4.6	1,434	4.6
Other items	451	3.4	731	4.3	1,234	4.4
Taxes and deductions	1,429		3,134		5,476	
Social security and disability	604	4.7	898	7.7	911	8.3
Personal income taxes	825	5.6	2,236	8.7	4,565	10.5

[a]The budgets represent the costs of three hypothetical lists of goods and services that were specified in the mid-1960s and updated annually. These budgets are for a precisely defined urban family of four: a 38-year-old husband employed full time, his non-working wife, a boy of 13, and a girl of 8. After about 15 years of married life, the family is settled in the community and the husband is an experienced worker.

Source: U.S. Department of Labor, Bureau of Labor Statistics, Autumn 1976 Urban Family Budgets and Comparative Indexes for Selected Urban Areas, USDL: 77-369, Washington, D.C., April 27, 1977.

BUSINESS PLANS TO SPEND $135 BILLION ON NEW PLANTS AND EQUIPMENT IN 1977, 11.3% MORE THAN IN 1976. THE 1977 SPENDING PLANS INDICATE ADVANCES FOR ALL MAJOR MANUFACTURING AND NONMANUFACTURING INDUSTRIES EXCEPT "OTHER TRANSPORTATION." THE LATTER REFLECTS A DECLINE IN OUTLAYS FOR THE TRANS-ALASKA PIPELINE. AIRLINES PLAN A 26% INCREASE, FOLLOWING 4 YEARS OF DECLINES. RAILROADS PLAN A 10 1/2% INCREASE; THEIR SPENDING DECLINED 8% LAST YEAR. "OTHER TRANSPORTATION" PLANS A 29% DROP THIS YEAR, AS CONSTRUCTION OF THE TRANS-ALASKA PIPELINE IS COMPLETED.



Plant and Equipment Expenditures: 1977.

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, 57, No. 1, Washington, D.C., January 1977, p. 20.

EVEN THOUGH TOTAL EMPLOYMENT IN TRANSPORTATION AND RELATED INDUSTRIES DID NOT GROW AT AS FAST A RATE AS TOTAL U.S. EMPLOYMENT, THERE WERE SEVERAL CATEGORIES OF TRANSPORTATION EMPLOYMENT (FOR EXAMPLE - AIR SERVICE, AUTOMOTIVE RETAILERS AND WHOLESALERS, AND SERVICES) THAT GREW FASTER THAN THE NATIONAL AVERAGE.

U.S. Employment in Transportation and Related Industries
(number of persons employed,
in thousands)

	1960	1970	1975	1976	1960-1976%Δ
Transportation service					
Air	191	351	362	370	93.7
Bus-intercity and rural	41	43	39	40	2.4
Local transport	101	77	69	69	- 31.7
Railroads	885	627	538	528	- 40.3
Oil pipeline	23	18	17	17	- 26.1
Taxi	121	107	83	77	- 36.4
Trucking and trucking terminals	770	998	996	1,009[a]	31.0
Water	232	215	190	197	- 15.1
Totals	2,364	2,436	2,294	2,230	- 5.7
Transportation equipment manufacturing					
Aircraft and parts	646	669	514	484	- 25.1
Motor vehicles and equipment	829	914	892	948	14.4
Railroad equipment	43	51	52	43	0.0
Ship and boat building and repair	141	17,170	194	214	51.8
Other transportation equipment	33	111	115	141	327.3
Totals	1,692	1,915	1,767	1,830	8.2
Transportation related industries					
Automotive and accessory retail dealers	807	996	1,076	1,116	38.3
Automotive wholesalers	215	320	367	380	76.7
Automotive services and garages	251	384	400	447	78.1
Gasoline service stations	453	614	616	627	38.4
Highway and street construction	294	331	297	299	1.7
Petroleum Refining	311	333	380	397	27.7
Other industries:					
Truck drivers and deliverymen	1,418	1,356	1,325	1,319	7.0
Shipping and receiving clerks	240	359	419	431	79.6
Totals	3,989	4,693	4,880	5,016	25.7
Government transportation employees					
U.S. Department of Transportation[b]	38	66	73	74	94.7
Highway employees — state and local	532	607	604	600	12.8
Post office	83	104	98	94	13.3
Other[c]	18	12	13	13	- 27.8
Totals	671	789	788	781	16.4
Total transportation employment	8,716	9,833	9,729	9,857	13.1
Total employed civilian labor force	65,778	78,627	84,783	87,845	33.5
Percent transportation of total	13.3	12.5	11.5	11.2	

[a]November 1976 data.

[b]1970 data include all of DOT; 1960 data only include Federal Aviation Administration.

[c]Includes ICC, CAB, Maritime Administration, Railroad Retirement Board, and Coast Guards.

Sources: Transportation Association of America, Transportation Facts and Trends, 12th ed., Washington, D.C., July 1976, p. 23; Transportation Facts and Trends, Quarterly Supplement, Washington, D.C., April 1977, p. 23. [Basic source: C.L. Green (ed.), G.P. Green (ed.), and J.A. McCall (ed.), U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings, Washington, D.C., monthly.]

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Chapter 7

Reference Materials

1977 CAR SIZE CLASSIFICATION BY WARD'S AND THE ENVIRONMENTAL PROTECTION AGENCY (EPA)[a]

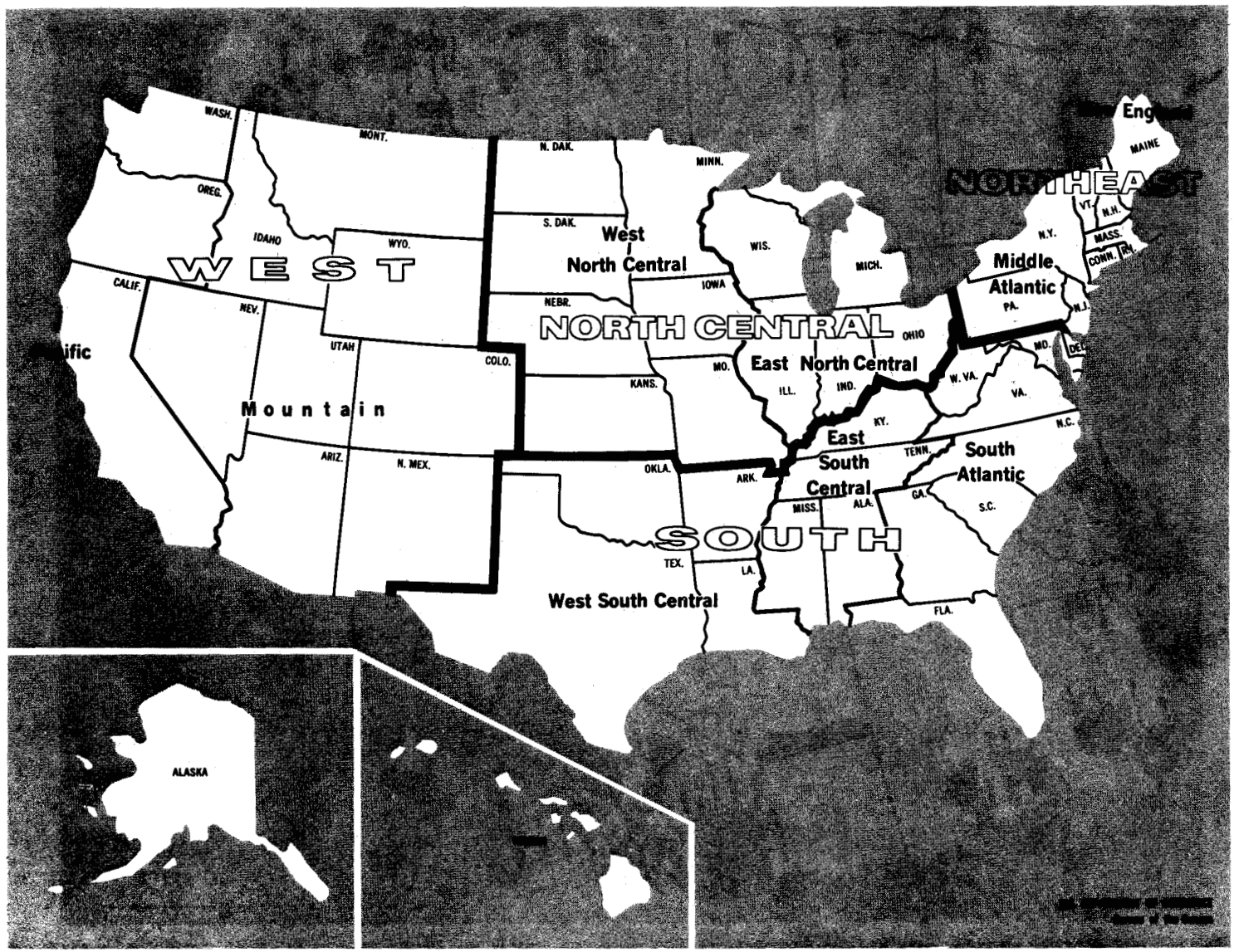
Ward's Classification
(based on wheel base size and merchandising intent)

Subcompact	Compact	Intermediate	Full-size
Astic (28)	Aspen (20)	Century (20)	Buick (18)
Bobcat (30)	Camaro (19)	Charger SE (15)	Cadillac (16)
Chevette (36)	Comet (20)	Chevelle (Malibu) (19)	Chevrolet (19)
Corvette (16)	Firebird (20)	Cordoba (15)	Lincoln (15)
Gremlin (23)	Granada (20)	Cutlass (20)	LTD (17)
Monza (28)	Maverick (20)	Fury (19)	Mark IV
Mustang II (26)	Monard (20)	Grand Prix (19)	Marquis (15)
Pacer (20)	Nova (20)	LeMans (20)	Olds (19)
Pinto (30)	Omega (21)	LTD II (17)	Pontiac (20)
Starfire (28)	Skylark (20)	Matador (17)	Rivera (17)
Sunbird (30)	Ventura (24)	Monte Carlo (17)	T. Bird (17)
Vega (28)	Volare (20)	Seville (16)	

EPA's Classification
(based on interior volume of car)

Subcompact	Compact	Mid-size	Large
Astic (28)	Aspen (20)	Century (20)	Cadillac (16)
Bobcat (30)	Granada (20)	Charger SE (15)	Chevrolet (19)
Camaro (19)	Grand Prix (19)	Cordoba (15)	Chrysler (14)
Chevette (36)	Hornet (20)	Cougar (17)	Delta 88 (20)
Comet (20)	Monard (20)	Cutlass (20)	Electria (17)
Firebird (20)	Monte Carlo (17)	Eldorado (14)	Ford (17)
Gremlin (23)	Nova (20)	Fury (19)	Grand Fury (15)
Maverick (20)	Omega (21)	LeMans (20)	LeSabre (20)
Monza (28)	Pacer (20)	LTD II (17)	Lincoln (15)
Mustang II (26)	Seville (16)	Malibu (19)	Matador (17)
Pinto (30)	Skylark (20)	Monaco (19)	Mercury (15)
Starfire (28)	T. Bird (17)	Mark V (15)	Monaco (15)
Sunbird (30)	Ventura (24)		Olds 98 (18)
Vega (28)	Volare (20)		Pontiac (20)
			Rivera (17)
			Toranado (15)

[a]EPA's certified miles per gallon (mpg) are indicated in parentheses.



Census Regions and Geographic Divisions of the U.S.

Source: U.S. Department of Commerce, Bureau of the Census.

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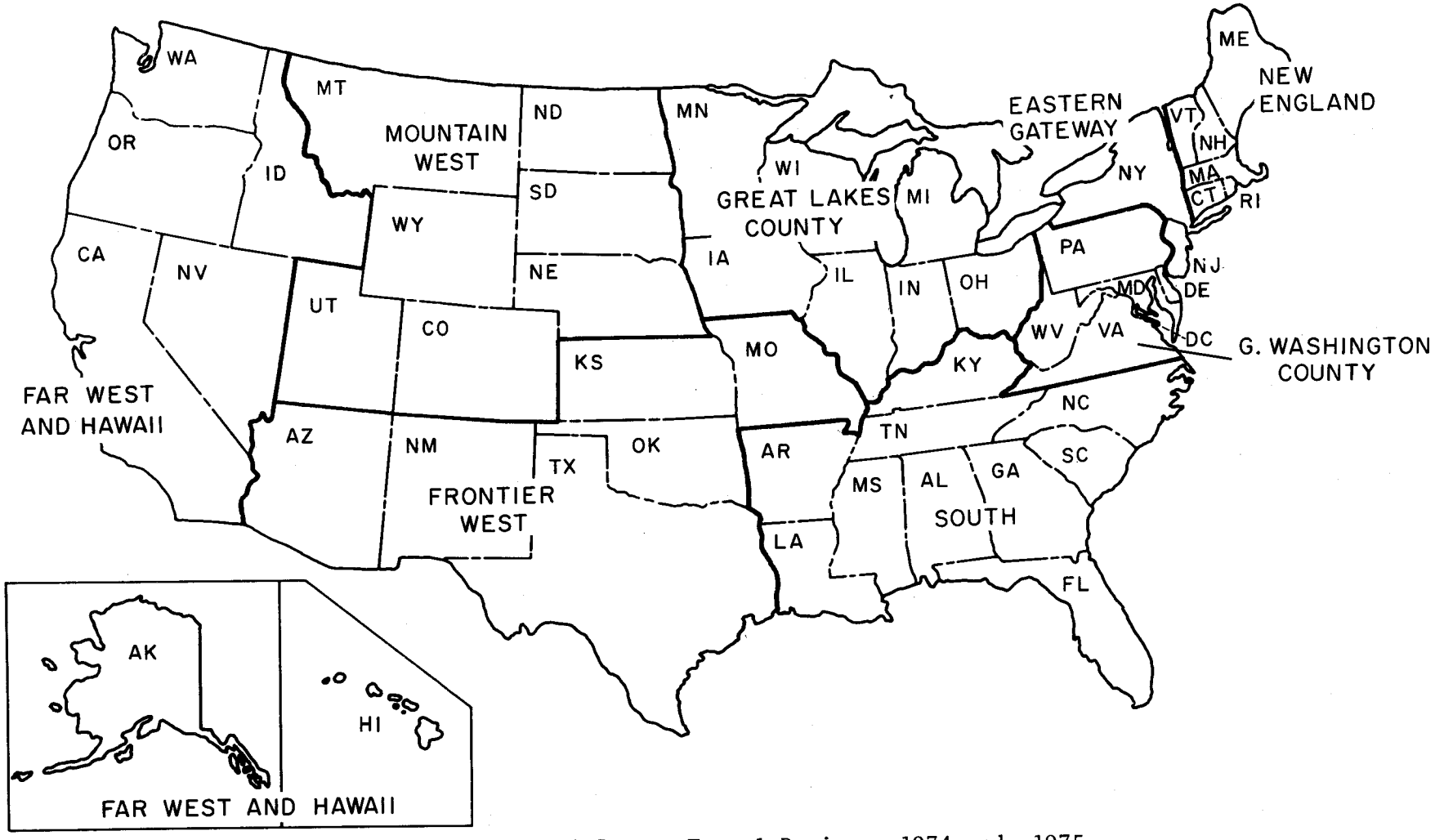

National Travel Survey Travel Regions, 1974 and 1975.

Source: U.S. Travel Data Center, 1975 National Travel Survey: Full Year Report, Washington, D.C., 1976, p. C-1.

Metric Unit Prefixes

Amount	Multiples and submultiples	Prefixes	Means
1000000000000	10^{12}	tera	One trillion times
1000000000	10^{9}	giga	One billion times
1000000	10^{6}	mega	One million times
1000	10^{3}	kilo	One thousand times
100	10^{2}	hecto	One hundred times
10	10	deka	Ten times
0.1	10^{-1}	deci	One tenth of
0.01	10^{-2}	centi	One hundredth of
0.001	10^{-3}	milli	One thousandth of
0.000001	10^{-6}	micro	One millionth of
0.00000001	10^{-9}	nano	One billionth of
0.000000000001	10^{-12}	pico	One trillionth of
0.000000000000001	10^{-15}	femto	One quadbillionth of
0.000000000000000001	10^{-18}	atto	One quintillionth of

Source: The American Society of Mechanical Engineers, ASME Orientation and Guide for Use of SI (Metric) Units, 6th ed., New York, May 1, 1975, p. 6.

Energy Conversion Table

To convert from ↓ To →	Multiply by		
	Joule	Btu	Millions of barrels of oil per day
Joule (J)	1.000	0.948×10^{-3}	0.464×10^{-18}
Btu	1.055×10^{3}	1.000	0.489×10^{-15}
Millions of barrels of oil/day	2.156×10^{18}	2.044×10^{15}	1.000
W-s (watt-second)	1.000	0.948×10^{-3}	0.464×10^{-18}
W-h (watt-hour)	3.600×10^{3}	3.413	1.669×10^{-15}
kW-h (kilowatt hour)	3.600×10^{6}	3.413×10^{3}	1.669×10^{-12}
Ft-lb (foot-pound force)	1.356	1.285×10^{-3}	0.628×10^{-18}
Hp-hr (horsepower hour)	2.685×10^{6}	2.545×10^{3}	1.245×10^{-12}
Calorie (international table)	4.187	3.969×10^{-3}	1.941×10^{-18}
erg	1.000×10^{-7}	0.948×10^{-10}	0.464×10^{-25}
Quad	1.055×10^{18}	1.000×10^{15}	0.489

Source: R. H. Romer, Amherst College, Energy - An Introduction to Physics, Appendix A, W. H. Freeman and Company, San Franciso, CA, 1976.

Energy Units and Associated Conversion Factors

1 Joule (J) =	1 calorie (cal) =
0.239 cal	4.184 J
9.485×10^{-4} Btu	3.968×10^{-3} Btu
2.778×10^{-7} kWhr	1.162×10^{-6} kWhr
9.485×10^{-10} MBtu	3.968×10^{-9} MBtu
1.157×10^{-11} MWd	4.843×10^{-11} MWd
3.169×10^{-14} MWyr	1.326×10^{-13} MWyr
9.485×10^{-19} Quads	3.968×10^{-18} Quads

1 British thermal unit (Btu) =[a]	1 kilowatt-hour (kWhr) =
1054 J	3.6×10^{6} J
252 cal	8.604×10^{5} cal
2.929×10^{-4} kWhr	3413 Btu
10^{-6} MBtu	3.413×10^{-3} MBtu
1.22×10^{-8} MWd	4.167×10^{-5} MWd
3.341×10^{-11} MWyr	1.141×10^{-7} MWyr
10^{-15} Quads	3.413×10^{-12} Quads

1 million Btu (MBtu) =	1 megawatt-day (MWd) =
1.054×10^{9} J	8.64×10^{10} J
2.52×10^{8} cal	2.065×10^{10} cal
10^{6} Btu	8.195×10^{7} Btu
292.9 kWhr	2.4×10^{4} kWhr
0.0122 MWd	81.95 MBtu
3.341×10^{-5} MWyr	2.738×10^{-3} MWyr
10^{-9} Quads	8.195×10^{-8} Quads

1 megawatt-year (MWyr) =	1 Quad =
3.156×10^{13} J	1.054×10^{18} J
7.542×10^{12} cal	2.52×10^{17} cal
2.993×10^{10} Btu	10^{15} Btu
8.766×10^{6} kWhr	2.929×10^{11} kWhr
2.993×10^{4} MBtu	10^{9} MBtu
365.2 MWd	1.22×10^{7} MWd
2.993×10^{-5} Quads	3.341×10^{4} MWyr

Other units of energy:

1 erg = 10^{-7} J
1 foot-pound (ft-lb) = 1.356 J
1 therm = 10^{5} Btu
1 horsepower-hour (hp-hr) = 0.746 kWhr = 2.686×10^{6} J
1 watt-second = 1.000 J
1 Q[b] = 10^{3} Quads

[a] International table.

[b] Often used when discussing extremely large quantities of energy. This unit of measure is often mistaken for the Quad. However, the Quad is equal to one milli-Q or 10^{-3} Q.

Source: R. H. Romer, Amherst College, Energy — An Introduction to Physics, Appendix A, W. H. Freeman and Company, San Francisco, CA, 1976, p. 557.

HEAT VALUES FOR HYDROCARBON FUELS CAN BE GROSS OR NET (HIGH OR LOW). THE GROSS VALUE INCLUDES THE HEAT IN THE WATER VAPOR IN THE COMBUSTION PRODUCTS, WHEREAS THE NET DOES NOT.

THE CONVENTIONAL HEAT VALUES EMPLOYED IN ENERGY CALCULATION ARE THE GROSS VALUES. (THE DIFFERENCE BETWEEN GROSS AND NET VALUES IS ABOUT 2%.)

THE GROSS HEAT VALUE FOR GASOLINE AND OTHER TRANSPORTATION FUELS VARIES SLIGHTLY AS A FUNCTION OF REGION OF THE COUNTRY AND SEASONAL CLIMATIC VARIATIONS. THE GROSS HEAT VALUES BELOW HAVE BEEN CALCULATED BY AVERAGING HEAT VALUES PROVIDED BY SEVERAL ORGANIZATIONS.

Gross Heat Values for Transportation Fuels

	Btu/gal
Automotive gasoline	124,000
No. 1 diesel oil and kerosene	135,100
No. 2 diesel oil	138,800
No. 6 fuel oil	149,300
Liquid propane	91,600
AVGAS (100 motor octane)	118,400
Aviation jet fuel (commercial)	133,200

Source: The Aerospace Corporation, Survey and Selection of Fuel Heat Values for Use in Transportation Studies, Interoffice memo, Los Angeles, Calif., January 1977.

Conversion Factors for "Short," "Long," and Metric Tons[a]

	Pounds (lb)	Kilograms (kg)
Short ton	2000	907.2
Long ton	2240	1,016
Metric ton (t or tonne)	2205	1,000

[a]Coal resources and supplies are generally measured in "short tons" (2000 lb). Marine foreign commerce is generally measured in long tons whereas marine domestic commerce is measured in short tons. Most other energy resources that are measured in tonnage utilize the "metric tonne" which is 10% greater than the "short ton."

Units of Length and Associated Conversion Factors

1 foot (ft) =	1 meter (m) =
0.3048 m	3.281 ft
1.894×10^{-4} statute mile	6.214×10^{-4} statute mile
1.646×10^{-4} nautical mile	5.400×10^{-4} nautical mile
1 statute mile =[a]	1 nautical mile =[b]
5280 ft	6077 ft
1609 m	1852 m
0.87 nautical mile	1.151 statute mile

[a]Statute miles are the conventional unit of measurement for highway travel.

[b]Nautical miles are occasionally used for measuring air and water travel distances.

Source: R. H. Romer, Amherst College, Energy - An Introduction to Physics, Appendix A, W. H. Freeman and Company, San Francisco, CA, 1976, p. 559.

Fluid Flow Rates and Conversion Factors

1 gallon per day =	1 acre-foot per year =	1 cubic foot per minute (ft^3/min or cfm) =
1 gal/day	892.2 gal/day	1.077×10^4 gal/day
1.121×10^{-3} acre-ft/yr	1 acre-ft/yr	12.07 acre-ft/yr
9.283×10^{-5} ft^3/min	8.282×10^{-2} ft^3/min	1 ft^3/min
1.547×10^{-6} ft^3/sec	1.38×10^{-3} ft^3/sec	1.667×10^{-2} ft^3/sec
4.381×10^{-8} m^3/sec	3.909×10^{-5} m^3/sec	4.719×10^{-4} m^3/sec
10^{-9} bgd	8.922×10^{-7} bgd	1.077×10^{-5} bgd
1 cubic foot per second (ft^3/sec or cfs) =	**1 cubic meter per second (m^3/sec)=**	**1 billion gallons per day (bgd)=**
6.463×10^5 gal/day	2.282×10^7 gal/day	10^9 gal/day
724.4 acre-ft/yr	2.558×10^4 acre-ft/yr	1.121×10^6 acre-ft/yr
60 ft^3/min	2119 ft^3/min	9.283×10^4 ft^3/min
1 ft^3/sec	35.31 ft^3/sec	1547 ft^3/sec
2.832×10^{-2} m^3/sec	1 m^3/sec	43.81 m^3/sec
6.463×10^{-4} bgd	2.282×10^{-2} bgd	1 bgd

Source: R. H. Romer, Amherst College, Energy — An Introduction to Physics, Appendix A, W. H. Freeman and Company, San Francisco, CA, 1976, p. 558.

TRANSPORTATION ENERGY CONSERVATION DATA BOOK: EDITION I.5

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Romer, R. H., Amherst College, Energy — An Introduction to Physics, Appendix A, W. H. Freeman and Company, San Francisco, CA, 1976.

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SUPPLEMENT IV

SELECTED BIBLIOGRAPHY WITH ABSTRACTS

The entries are alphabetical by personal author or by corporate author if there is no personal author

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American Institute of Chemical Engineers
Eleventh Intersociety Energy Conversion Engineering Conference Proceedings. Volumes I and II
Conference held at the Sahara Tahoe Hotel, State Line, Nevada, on September 12-17, 1976, 2,011 p.
1976
Sponsor: American Institute of Chemical Engineers
Abstract: These annual conferences focus on engineering applications in non-conventional energy conversicn. Approximately 250 papers were presented in this eleventh conference, which emphasized efficiency of energy conversion, energy conservation, and exploration and exploitation of primary energy sources. Volume I includes papers on these subject areas: Advanced Auto Propulsion, Advanced Concepts, Alternative Fuels, Biomedical Power, Brayton Cycles and Expanders, Coal and Oil Shale Utilization, Electric Vehicles, Electrochemical Power, Energy Conservation and Storage, Geothermal Energy, Heat Pipes, and Hydrogen Energy Systems. Papers contained in Volume II deal with these topics: MHD and Other Topping Cycles, Nuclear Power, Rankine Cycle Power, Solar Power, Space Power, Stirling Cycle Engines, Thermoelectrics, Thermionics, Urban Energy Management, and Wind Power. Also included in these proceedings are abstracts of papers from the 1973, 1974, 1975, and 1976 Conferences; a Subject Index; and an Author Index. Several papers on advanced auto propulsion, electric vehicles, and stirling cycle engines are abstracted separately. (BYB)
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Anonymous
Alternative Aircraft Powerplants
Automotive Engineering, 84(7), pp. 54-57; article based on SAE Paper 760536, "Alternative Concepts for Advanced Energy Conservation Transport Engines," presented at the Air Transportation Meeting, May 18-20, 1976, New York City
Jul 1976
Abstract: As in other sectors of the economy, the air transportation industry is under pressure to make fuel economy improvements. This article summarizes a recent evaluation of these alternative aircraft powerplants concepts: heat exchanger cycles, unconventional arrangements (e.g., geared fans), and turboprops. Evaluation of the potential benefits of these powerplants is made in terms of fuel consumption and direct operating costs. (BYB)

Anonymous
Alternative Powerplants and Energy Conservation
Automotive Engineering, 84(3), pp. 32-33, 68; article based on a paper presented at the Energy Transportation Forum of the Society of Automotive Engineers Automobile Engineering and Manufacturing Meeting, Detroit, Oct. 15, 1975
Mar 1976
Abstract: Although some of the alternative automobile engines under study (gas turbine, Stirling, Rankine, diesel, electric, hybrid, stratified-charge, and Wankel powerplants) offer benefits from decreased fuel consumption, the total life-cycle cost of the vehicle and its fuel should be the main consideration in deciding which system should be used. The internal combustion engine (ICE) has become an increasingly efficient user of gasoline since its introduction. Each alternative engine at this time is inferior to the conventional ICE in at least one vital area, and most of these deficiencies are in areas related to consumer acceptance. The investment risks of marketing an alternative engine would have a substantial impact on any firm's economic well-being. Likewise, marketing a new fuel for a new powerplant (such as a "broadcut distillate fuel" requiring less refining than gasoline) would entail a large investment risk. The Federal government may alter the situation in favor of an alternative engine by exerting pressure to force a rapid conversion to the alternative or by supporting a major R & D program. (BYB)

Anonymous
Electric Vehicle Development
Automotive Engineering, 84(8), pp. 39-43; article based on four papers presented at the Fourth International Electric Vehicle Symposium, Dusseldorf, Aug. 31-Sept. 2, 1976, and re-presented at Convergence 76, Dearborn, Sept. 20-22, 1976
Aug 1976
Abstract: Recent developments in electric vehicles are described in this article. The battery-powered electric vehicle has been limited by its operating range for the last 50 years. Although batteries have been improved, they are still the main constraint. Operating range is being improved through vehicle design--use of lighter materials, decreases in aerodynamic drag, reductions in spin losses by using better bearings and gears, and lower rolling resistance through the use of radial tires. Range is dependent on the battery and on vehicle operation. Improvements in range have been achieved by doubling the ratio of battery weight to gross vehicle weight from 25 to 50%, by removing peak currents from the battery, and by regenerative braking. Although maximizing the range has been emphasized, increasing the range will make the car more attractive up to the point where intracity driving needs are satisfied. Further increases will not make the car more marketable until it can reach the range of intercity travel and replace the conventional car. Energy storage devices under study include the main propulsion lead/acid battery package, the nickel/cadmium battery, flywheel energy storage, and the battery/flywheel combined. A recent development in control, the chopper (interrupted control method in which the voltage can be varied over an infinite range), has improved efficiency. The compact passenger car developed by Toyota Motor has a maximum speed of 95 kmh or more, acceleration performance of 2.3 sec or less from standstill to 30 kmh, and a driving range of 180 km at a constant speed of 40 kmh. (BYB)

Anonymous
A Hybrid Vehicle for Fuel Economy
Automotive Engineering, 84(5), pp. 16-19, 44-45; article based on SAE paper 760121 presented at Society of Automotive Engineers Annual Meeting, Detroit, Feb. 23-27, 1976
May 1976
Abstract: A gasoline/electric parallel hybrid drive train is proposed to increase fuel economy of vans, buses, and large passenger cars, while meeting 1975-76 Federal emissions standards by using external controls. Computer simulation studies and dynamometer tests on a prototype system indicate that a 30 to 100% improvement in fuel economy can be realized. Problems with this hybrid vehicle include high initial cost, reduced driving range at very low speeds, and reduced capability to supply vehicle auxiliaries at standstill. Development premises are listed, the system and its operation are described, and results of dynamometer tests are detailed. (BYB)

Appleby, A.J.; Jacquelin, J.; Pompon, J.P.
Charge-Discharge Behavior of the C.G.E. Circulating Zinc-Air Vehicle Battery
Laboratoires de Marcoussis, France
Paper No. 770381, presented at the International Automotive Engineering Congress and Exposition, Cobo Hall, Detroit, Michigan, February 28 - March 4, 1977, 12 p.
1977
Sponsor: Society of Automotive Engineers
Abstract: The primary unit of the C.G.E. zinc-air electric vehicle battery has been described in previous publications. It consists of a constant cross-section tubular fuel cell using zinc powder in circulating 12 N KOH solution. All the reaction product (zincate) is maintained in colloidal solution. The system is capable of life-times in excess of 1,800 hours and will be of low cost. The present paper deals with the technical aspects of recharge of the system, which, in contrast to the primary cell, is still in the laboratory engineering stage. The limitations of the system are discussed and the overall performance based on different parameters is given. A number of different economic options are examined. (7 references) (auth)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 $2.75

Argonne National Laboratory, 9700 S. Cass Ave., Argonne, IL 60439
High-Performance Batteries for Off-Peak Energy Storage and Electric-Vehicle Propulsion. Progress Report for the Period April - June 1976
Report No. ANL-76-81, 61 p.
Jul 1976
Sponsor: Energy Research and Development Administration
Abstract: This report describes the research and management efforts of the program at Argonne National Laboratory (ANL) on lithium/metal sulfide batteries during the period April-June 1976. These batteries are being developed for energy storage on utility networks and for electric-vehicle propulsion. The present cells, which operate at 400-450 degrees C, are vertically oriented, prismatic cells with a central positive electrode of FeS or FeS2, two facing negative electrodes of lithium-aluminum alloy, and an electrolyte of molten LiCl-KCl. Electrodes and cells are being fabricated by several industrial firms under contracts with ANL. These firms are also participating in development of fabrication methods that are amenable to mass production. Cells produced under the first contracts are being tested and evaluated--as single cells and as two- and three- cell batteries. New electrode and cell designs are being developed and tested at ANL, and promising designs will be incorporated in the industrially fabricated cells. The concepts receiving major attention include the fabrication of electrodes in the uncharged state (positive electrodes of Li2S and Fe and negative electrodes of porous aluminum), the use of carbon-bonded current-collector structures in the positive electrode, the fabrication of electrodes by hot-pressing active materials and electrolyte, and the use of additives to improve electrode and cell performance. In cooperation with industrial firms, efforts are also under way to develop improved cell feedthroughs and electrode separators. Design work is in progress on a 30-kW-hr battery for a small four-passenger vehicle; this effort includes design calculations and setting specifications for the vehicle. Other battery engineering work is directed to the development of monitoring and cycling equipment and battery components. Cell chemistry studies in support of electrode and cell development include the wetting of materials by molten LiCl-KCl and potentiometric measurements on metal sulfide phases. Work is continuing on the development of alternative secondary cell systems with calcium-, magnesium-, or sodium-based negative electrodes. (auth)
Availability: NTIS

Balachandran, S.
Energy Statistics: A Guide to Sources
University of Illinois, Urbana-Champaign, Library
Council of Planning Librarians Exchange Bibliography No. 1065, 51 p.
Jun 1976
Abstract: Books and periodical publications providing statistical data on energy have in recent years mushroomed tremendously, in response, no doubt, to the increasing demand from people involved in research on various aspects of energy. This publication is an attempt to compile a selected and annotated guide to 162 national and international sources of statistics covering all forms of energy such as coal, electricity, natural gas, nuclear power, petroleum, solar and other miscellaneous types. While each of these forms are dealt with separately and in considerable detail, the first section covers composite sources, i.e. sources whose coverage extends to all forms of energy. Within each section, the arrangement is strictly alphabetical. Other useful features of this guide are a subject index and directory of publishers. (from Introduction)
Availability: Council of Planning Librarians, P.O. Box 229, Monticello, IL 61856 $5.00

Balachandran, S.
Energy Statistics: An Update to Bibliography No. 1065
University of Illinois at Urbana-Champaign, Library
Council of Planning Librarians Exchange Bibliography No. 1247, 22 p.
Mar 1977
Abstract: Citations to 80 publications containing energy data are presented in this bibliography. The types of statistics covered in each source are described. A subject Index is provided. (BYB)
Availability: Council of Planning Librarians, P.O. Box 229, Monticello, IL 61856 $2.00

Bernhardt, W.E.; Koenig, A.; Lee, W.; Menrad, H.
Recent Progress in Automotive Alcohol Fuel Application
Volkswagenwerk AG, Wolfsburg, Federal Republic of Germany
Paper presented at the Fourth International Symposium on Automotive Propulsion Systems, April 17-22, 1977, Washington, DC, 28 p.
1977
Abstract: Developments in automotive alcohol fuel application are described in this paper. Ethanol can be produced from plant materials through the photosynthesis process. Although ethanol is a renewable source, it is very costly, about two times the price of methanol. Currently methanol is manufactured from natural gas, heavy residues, or naphtha, using a method that first produces a carbon monoxide - hydrogen mixture called synthesis gas. Methanol is then synthesized from this synthesis gas at elevated pressure and temperature with a catalyst. Alcohols can be introduced as automotive fuels in two ways: (1) pure alcohol can be mixed with lead-free or low leaded low octane rated regular gasoline (the preferred method); or (2) pure alcohols can fuel modified vehicles. Results of vehicle tests are reported for: (1) a test fleet of 45 vehicles using a 15 Vol.% methanol mixture; (2) a test fleet of five vehicles using straight methanol (M 100) or methyl fuels (M 90 - M 95); and (3) a Volkswagen durability test in Brazil using straight ethanol in three test cars. As a result of engine bench tests, Volkswagen Research has developed several vehicle prototypes. Because methanol and methanol blends vary from gasoline in some properties that affect its use as an automotive fuel, vehicles using methanol fuels have to be modified. The price of methanol is calculated to be 30% higher than the value of methanol as an alternative to gasoline. Because the price of ethanol is much higher than that of methanol, it is uneconomical to introduce ethanol even as a fuel component (except in some countries that cannot produce a domestic fuel). (7 references) (BYB)

Billings, R.E.
Hydrogen Fuel in the Subcompact Automobile
Billings Energy Research Corp., Provo, UT 84601
Paper No. 760572, presented at the Fuels and Lubricants Meeting, St. Louis, Missouri, June 7-10, 1976, 12 p.
1976
Sponsor: Society of Automotive Engineers
Abstract: Recent advances in hydrogen energy technology have made possible the consideration of a subcompact automobile utilizing metal hydrides, or powdered hydrogen storage, and a low cost electrolyzer for vehicle recharging. Basic considerations of the metal hydride automotive system are discussed regarding various vehicular prototypes. Particular emphasis is placed on a hydrogen minicar application. Utilizing a low cost electrolyzer and utility grid electricity for vehicle recharging, it is possible to make a comparison of the metal hydride hydrogen engine system with other electric vehicles on the basis of storage weight, vehicle range, and cost of operation. (19 references) (auth)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 $2.75

Bobit, E.J. (ed.)
Automotive Fleet
Bobit Publishing Co., 1155 Waukegan Rd., Glenview, IL 60025
Monthly journal
Monthly
Abstract: As a monthly management magazine for car and light truck fleet operators, this journal provides articles and news relevant to vehicle fleet businesses. Regular features in each issue are included on current gasoline prices; calendar of events; fleet news; lease/rental situation; light truck, van, and recreational vehicle news; new products; and used car prices. A special industry report with results of a lease-rental survey is provided biennially. Another special issue contains the annual fleet Fact Book featuring statistics; a fleet directory; a fleet auto guide, with information on state automobile insurance, registration, and tax facts, 1976 fleet car specifications, Automotive Fleet's Association Guide, and National Auto Auction Association; a leasing/rental directory; and a directory of fleet-minded dealers. (BYB)
Availability: Editorial and Executive Offices, Bobit Publishing Co. $10.00 per yr.; $1.00, single copy; $5.00, special issues

Booz, Allen & Hamilton Inc., 4733 Bethesda Ave., Bethesda, MD 20014
Energy Use in the Marine Transportation Industry. Task I - Industry Summary
Draft report, 99 p.
11 Jan 1977
Sponsor: Energy Research and Development Administration, Division of Transportation Energy Conservation, Non-Highway Transport Systems
Abstract: The objective of Task 1 of this energy study of ship transportation systems is to analyze the marine transportation industry in terms of equipment, costs, operating profiles, and energy consumption. The operating or service sectors of the marine transportation industry are identified (ocean shipping sector, Great Lakes sector, the coastal shipping sector, the offshore sector, the inland waterways sector, fishing and miscellaneous sector, and recreational boats); the numbers and types of vessels are determined; and their operating characteristics and energy consumption are detailed. The study encompasses all powered waterborne craft except fixed offshore production platforms and ships owned or operated by a government agency. The marine transportation industry consumes 2.95 Quads of energy per year, which represents 15% of the energy used for all transportation services. The ocean shipping sector accounts for 80% of marine transportation energy requirements. At the most 35% of the energy needed by marine transportation is purchased domestically. This report is organized into eight chapters, with the first chapter providing an introduction and summary. Chapters Two through Eight describe each of the industry sectors in terms of population, operating profiles, energy consumption, typical or generic vessels, costs, and cargo movements. The depth of coverage for each sector varies due to availability of data and its importance as an energy consumer. Appendices are included on: Marine Fuel Consumption Calculations, Essential Trade Routes, Conversion Factors, and Merchant Vessels of the U.S. (39 references) (BYB)

Brennand, J.
Refinement of Electric Car Performance Estimates
General Research Corp., P.O. Box 3587, Santa Barbara, CA 93105
Internal Memorandum No. IM-2046, 58 p.
Aug 1976
Sponsor: Energy Research and Development Administration
Abstract: To resolve discrepancies in lead-acid battery efficiencies derived in an earlier General Research Corporation Electric Car Impact Study, a detailed simulation of electric vehicles, called ELVEC, was developed. In addition to the Fractional Utilization battery model used in the previous study, two more models were incorporated in ELVEC. One of the new models allows battery recuperation during idle periods of a driving cycle. A detailed battery charging model was also included. Simulations with ELVEC of vehicle/driving cycle combinations previously studied revealed reasonable agreement with overall range and energy efficiencies, although battery charger efficiency was much lower than had been previously assumed (70% versus 97%). Average motor/driveline efficiencies of 72% were calculated by ELVEC for both a two-passenger/residential and a four-passenger/metropolitan vehicle/driving cycle combination. The previous study had assumed fixed values of 63% and 72% for comparable measures. ELVEC simulations resulted in battery efficiencies of 76-77% for a 110% recharge for Residential, Metropolitan, and Federal driving cycles, compared with 46% for the previous study. (17 references) (auth)

Brinkman, N.D.
Vehicle Evaluation of Neat Methanol - Compromises Among Exhaust Emissions, Fuel Economy, and Driveability
General Motors Research Laboratories, Fuels and Lubricants Dept., Warren, MI 48090
Paper presented at the Fourth International Symposium on Automotive Propulsion Systems, Washington, DC, April 17-22, 1977, 79 p.
1977
Abstract: Two cars, one carbureted and the other fuel injected, were modified to burn neat methanol. Exhaust emissions, fuel economy, and driveability were measured and compared to those obtained with gasoline in the unmodified (production) cars. Since acceptable driveability and durability were obtained only with the fuel injected car, it was used to investigate the spark timing and equivalence ratio settings which would give an acceptable compromise among exhaust emissions, fuel economy, and driveability. Average equivalence ratios of 0.96 to 0.62 and spark timings from best power to 15 degrees retarded were studied. With spark timing set for best power and the average equivalence ratio for maximum fuel economy (0.83), driveability was acceptable and CO and NOx emissions met the 1977 standards. However, the unburned fuel (UBF) emissions exceeded the 1977 standards for hydrocarbons (HC), even though the car was equipped with a catalytic converter. At 0.83 average equivalence ratio, NOx emissions were reduced below the statutory standard (0.4) by retarding spark timing; however, driveability and fuel economy deteriorated. (31 references) (auth)

Bush, W.V.
Cost of Fuels for Fuel Cell Automobiles
Shell Development Co.
Paper No. 770380, presented at the International Automotive Engineering Congress and Exposition, Cobo Hall, Detroit, Michigan, February 28 - March 4, 1977, 16 p.
1977
Sponsor: Society of Automotive Engineers
Abstract: The cost of operation projected for a fuel cell automobile could be as much as 1-2¢/mi less than for a comparable internal combustion engine car or an all-battery car, assuming energy raw material cost equilibrated at 10$/bbl crude oil equivalent. Fuel cost is a small but significant element in total operating cost. Therefore, the projected cost advantage of the fuel cell automobile increases with increasing cost of fossil fuel, because of the higher energy efficiency projected for the fuel cell automobile. (14 references) (auth)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 $2.75

Champion Spark Plug Co., Toledo, Ohio 43661
Tune-Up: Its Effect on Fuel Economy, Emissions and Performance
11 p.
1976
Abstract: This report presents results of a test project which examines engine condition and maintenance habits of existing vehicles and the effect of tune-up and spark plug replacement on fuel economy, emissions, and performance. Assuming that the 5,666 vehicles tested are typical of those operating in the U.S., most cars are not receiving proper maintenance. When cars needing a tune-up were tuned properly, they averaged an 11.36% improvement in fuel economy. New spark plugs alone accounted for an average 3.44% fuel economy improvement. Carbon monoxide emissions declined an average of 45.37% after a complete tune-up, and hydrocarbon emissions fell 55.5%. After changing plugs only, HC emissions were reduced by 24.33%. Of all the cars tested, 41% exceeded the CO and HC emissions limits set by New Jersey, and almost 1 car in 20 was a gross emitter. The 1975 and 1976 models were much cleaner than older cars. Car owners' responses to a questionnaire indicated that poor car maintenance also results in substandard performance that affects safety, starting dependability, and general operation. A periodic mandatory emissions inspection program such as the one proposed by the Environmental Protection Agency is recommended. (BYB)

Collins, M.; Morecraft, L.
Applicability of Existing Regional Data to National Impact Analysis for Urban Electric Cars
General Research Corp., P.O. Box 3587, Santa Barbara, CA 93105
Internal Memorandum No. IM-2045, 69 p.
Jun 1976
Sponsor: Energy Research and Development Administration
Abstract: Previous electric car impact studies have focused on regional impacts. Some attention has been given to national impacts of regional use but little has been done to evaluate the national impacts of national use. The purpose of this task is to set forth methods for deriving national impacts from the regional data and methodologies developed to date. Two models are proposed for estimating the national impact of electric cars on energy consumption and air pollution. The models use computerized data bases available from the Federal Power Commission (FPC), the Environmental Protection Agency (EPA), and the Edison Electric Institute to generate electric power load profiles, estimates of future emissions, and future electric power capacity and fuel consumption. The usefulness of regional data developed to date for Los Angeles, Philadelphia and St. Louis urban areas as a base for national projections is also investigated. It is found that only 17.6% of all electric power utilities in 1980 will have a fuel mix similar to the utilities serving Los Angeles, Philadelphia, or St. Louis. ... Therefore, national projections of fuel consumption for generating recharge electricity cannot be based solely on the fuel mixes of the utilities serving the three regions previously investigated. A preliminary analysis of utility estimates of the mix of fuels available to recharge electric vehicles during off-peak hours indicates that electric vehicles will have a significant impact on crude oil consumption. ... The relationship of urban area characteristics to pollution emissions and air quality is found to be too complex to permit clustering cities in terms of air pollution impact. ... Data from the 1974 National Transportation Study depicting existing 1972 and planned 1990 transportation environments in a sample of urbanized areas is presented and reviewed. (24 references) (auth, abstract modified.)

Crow, R.T.; Ratchford, B.
An Econometric Approach to Forecasting the Market Potential of Electric Automobiles
Electric Power Research Institute, Palo Alto, CA
Published in "Proceedings of the Workshop on Energy Demand" (EN-5861), W.D. Nordhaus, ed., International Institute for Applied System Analysis, Laxenburg, Austria, Report No. CP-76-1, CONF-7505110, pp. 3-42
1976
Abstract: The technique of forecasting the demand for new goods is applied to the market potential of electric automobiles. Model inputs emphasize consumer buying habits, the most recent market observations, and the omission of length and width as a determinant of comfort and luxury. Results indicate that the main determinants are purchase price, "brand name identification," acceleration time, and front and rear leg room, although the latter was not confirmed in the sub-compact sample. In spite of recent advertising efforts, gasoline mileage appears to have only minor influence on consumer choice. Potential electric car sales are greater for an established manufacturer than for a new maker. (20 references) (DCK)

Curry, J.P.
Case Studies of Transit Energy and Air Pollution Impacts
De Leuw, Cather and Co., 1201 Connecticut Ave. NW, Washington, DC 20036
Report No. EPA-600/5-76-003, PB-253211, 197 p.
May 1976
Sponsor: U.S. Environmental Protection Agency, Office of Research and Development, Office of Energy, Minerals and Industry
Abstract: The paper summarizes analysis of the energy consumption and air pollution impacts of eight case studies of new or improved transit services. The case studies include (a) areawide bus service improvement programs involving route extensions, increased frequencies, new lines, demand responsive service, and fare reductions; (b) new corridor exclusive busway service on the Shirley Highway and San Bernardino Freeway; and (c) new rail transit service in the Philadelphia-Lindenwold corridor. Probabilistic models were developed for each of these three service improvement scenarios to account for key travel demand and transportation system factors affecting energy consumption and air pollution impact levels. Results showed that low patronage response to areawide bus improvements as well as diversion from prior bus service, carpools, etc. and extensive auto access to corridor systems reduce expected energy and air pollution gains and may, under certain conditions found in four case studies, result in possible energy use increases. Additionally, it was found that auto use for corridor system access may worsen air quality conditions in suburban areas in the vicinity of corridor transit terminal locations. (49 references) (auth)
Availability: NTIS

Curtis, R.L.
Applicability of Safety Standards to Urban Electric Cars
General Research Corp., P.O. Box 3587, Santa Barbara, CA 93105
Internal Memorandum No. IM-2038, 46 p.
May 1976
Sponsor: Energy Research and Development Administration
Abstract: The effects of Federal Motor Vehicle Safety Standards (FMVSS) were investigated for typical two- and four-passenger subcompact electric cars with advanced lead-acid batteries. The direct weight of safety equipment added to these electric cars is pyramided not only by the chassis components required for support, braking, etc.--which would be required by any car--but also by the additional propulsion and batteries required to maintain an already marginal performance. With safety equipment weighing what it now does, the current FMVSS will account for 27% of the two-passenger electric car's curb weight and 37% of the four-passenger car's weight. Future FMVSS will increase these fractions to 47% and 64%. The operating costs will be increased by 2.3 cents per mile for the two-passenger car and by 4.4 cents per mile for the four-passenger car. Future standards will increase these costs to 3.9 and 7.7 cents per mile. Strict enforcement of the FMVSS with the current safety equipment weights will thus seriously jeopardize the feasibility of electric cars until breakthroughs in battery and safety equipment weight occur. However, it may be inappropriate to apply the same safety standards to all vehicles. ... The accident environment of the electric car operated in urban areas only is shown to be different from that of the general vehicle population. The total benefit to society for the elimination of all urban-area accidents would be only 2.8 cents per vehicle mile. Thus, both the economics and the accident environment can justify relaxation of the FMVSS as an expedient in the near-term development of the electric car. (15 references) (auth)

Dickson, E.M.; Steele, R.V.; Hughes, E.E.; Walton, B.L.; Zink, R.A.; Miller, P.D.; Ryan, J.W.; Simmon, P.B.; Holt, B.; White, R.K.; Harvey, E.C.; Cooper, R.; Phillips, D.F.; Stoneman, W.C.
Impacts of Synthetic Liquid Fuel Development--Automotive Market (Assessment of Critical Factors). Volume I. Summary. Volume II
Stanford Research Institute, Menlo Park, CA 94025
Report No. PB-255994, EPA-600/7-76-004A, ERDA--76-129/1, SRI Project EGU-3505, 117 p. for Volume I; Report No. PB-255995, EPA-600/7-76-004B, 867 p. for Volume II
May 1976
Sponsor: U.S. Environmental Protection Agency, Office of Research and Development; Energy Research and Development Administration, Division of Transportation Energy Conservation
Abstract: This study assesses the impacts of the development of synthetic liquid fuels from coal and oil shale; the fuels considered are synthetic crude oils from coal and oil shale and methanol from coal. Key issues examined in detail are the technology and all of its resource requirements, net energy analysis of the technological options, a maximum credible implementation schedule, legal mechanisms for access to coal and oil shale resources, financing of a synthetic liquid fuels industry, decision making in the petroleum industry, government incentive policies, local and national economic impacts, environmental effects of strip mining, urbanization of rural areas, air pollution control, water resources and their availability, and population growth and boom town effects in previously rural areas. (GRA)
Availability: NTIS; also available at GPO $1.85 under ERDA No. ERDA-76-129-1 for Volume I, $8.98 for Volume II

Drysdale, F.R.; Calef, C.E.
The Energetics of the United States of America: An Atlas
Brookhaven National Laboratory, National Center for Analysis of Energy Systems, Biomedical and Environmental Assessment Division, Upton, NY 11973
Report No. BNL 50501, 444 p.
Sep 1976
Sponsor: Energy Research and Development Administration
Abstract: A description of the United States' energy system is presented in the form of thirty-one maps and eight major tables. The county has been chosen as the basic unit for reporting estimations of many energy, demographic and economic variables. The variables include production of all fuels (including hydroelectricity), uses of fuels and electricity broken down by sector and end-use, existing and planned electricity generation capacity, refinery capacities, and emissions of air pollutants from fuel use. Calculations and assumptions used to make county level energy estimates are described in detail. (21 references) (auth)
Availability: NTIS

Energy Research and Development Administration, Division of Transportation Energy Conservation, Washington, DC
Highway Vehicle Systems, Contractors Coordination Meeting. Eleventh Summary Report
Report No. CONF-761028, TEC 77/001, meeting held in Ann Arbor, MI, October 18, 19 and 20, 1976, 382 p.
1977
Abstract: The purpose of these meetings is to promote technical progress in designing highway vehicles that consume less energy. Contractors, staff consultants, prospective contractors, and other experts discussed trends in requirements, the status of current programs, and plans for future programs. Summaries of the presentations are organized into these main categories: preliminary and keynote presentations by ERDA, the National Aeronautics and Space Administration, and the Department of Transportation; vehicle systems program, including transmissions, accessory drive, variable displacement engines, and combustion programs; heat engine developments, including diesel engines, gas turbines, and Stirling engines; heat engine and materials technology programs; and alternative fuels utilization program. Appendix A provides a list of the over 425 attendees and the 169 organizations represented. Appendix B lists the advanced vehicle displays exhibited at the Meeting. (BYB)
Availability: GPO $4.40

Energy Research and Development Administration, Division of Transportation Energy Conservation, Alternative Fuels Utilization Branch, Washington, DC 20545; Mueller Associates Inc., 1900 Sulphur Spring Rd., Baltimore, MD 21227
Alternative Fuels Utilization Report
Periodic publication, approximately 8 p.
Abstract: This publication serves as a medium for information exchange among researchers in alternative fuels utilization and provides a stimulus for further research on the use of these fuels for transportation. The first edition, published April 1977, contains a feature article describing the alternative fuels program of the Division of Transportation Energy Conservation of ERDA and its sponsored activities on alcohol fuels. Also included in this publication are current news notes on industry, government actions, and international happenings related to alternative fuels. Recent publications and upcoming conferences that may be of interest to researchers and others in the field are announced. (BYB)

Enzer, H.; Dupree, W.; Miller, S.
Energy Perspectives: A Presentation of Major Energy and Energy-Related Data
U.S. Dept. of Interior
213 p.
Feb 1975
Abstract: Data are presented on the world and United States energy reserves and recoverable reserves. Energy consumption data are also presented--in some cases from 1950 to the present. The data for the United States reserves and consumption are more detailed than those for the world. Supply, production, and consumption data are presented by energy source and by consuming sector for the United States. Some future projections on consumption and production are included, as well as some projected environmental impacts on land, air, and water by increased energy production. (BLM)
Availability: GPO $3.10, Stock No. 024-000-00812-6

Escher, W.J.D.
Hydrogen-Via-Electricity: A Candidate Transitional Transportation Energy System Concept
Energy Research and Development Administration, Office of Conservation, Division of Transportation Energy Conservation, Washington, DC
Report No. ERDA 77-13, ETA Report PT-67, TEC-77/001, 98 p.
Sep 1976
Abstract: There is an expressed need to move transportation off oil. However, the strategic alternatives for creating a non-petroleum energy base for transportation are all long-term, extremely costly systems (hydrocarbon synfuels, electricity, hydrogen energy), each having technical and socio-economic limitations and constraints which will govern their relative contributions. To "preserve the options" while conducting positive steps to obviate the possibility of energy shortfalls affecting transportation in the meanwhile, a "transitional transportation energy" systems approach may be needed. A candidate concept, "Hydrogen-via-Electricity" (HVE) is described in terms of criteria for such a system, and also related to each of the strategic alternatives to establish compatibility. If implemented, the HVE Concept has the near-term potential for supporting a certain fraction of the energy needs of the following transportation subsectors: railroads, intercity trucking, urban and intercity buses, and selected fleet vehicle systems. (43 references) (auth)
Availability: NTIS

Escher, W.J.D.; Ecklund, E.E.
Recent Progress in the Hydrogen Engine
Escher Technology Associates; Energy Research and Development Administration
Paper No. 760571, presented at the Fuels and Lubricants Meeting, St. Louis, Missouri, June 7-10, 1976, 16 p.
1976
Sponsor: Society of Automotive Engineers
Abstract: Developments in the energy and environmental sectors have awakened interest in hydrogen-fueled internal combustion engines. Based on a 50-engine survey of recent U.S. research and demonstration activities, the technical status of hydrogen engines is summarized. A comparative hydrogen/conventional-fuel orientation is maintained in assessing basic fuel property, engine power and efficiency, emissions and general operating characteristics. Key theoretical and experimental results, and correlations where evident, are noted. Engine problem areas and their solutions are discussed, accompanied by some thoughts toward future development possibilities and supporting research needs. (14 references) (auth)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 $2.75

Executive Office of the President, Energy Policy and Planning, Washington, DC
The National Energy Plan
126 p.
29 Apr 1977
Abstract: The President's proposed National Energy Plan is described in this document, which includes chapters on: the Origins of the U.S. Energy Problem; the Continuing Crisis; Principles and Strategy of the National Energy Plan; Conservation and Energy Efficiency; Oil and Natural Gas; Coal, Nuclear, and Hydroelectric Power; Nonconventional Sources and Energy Research; the Role of Government and the American Public; and the National Energy Plan and the Future. In the transportation sector, the Plan suggests incentives to reduce consumption (e.g., an excise tax on new automobiles with low fuel efficiencies, a standby gas tax, fuel efficiency standards and an excise tax and rebate system for light-duty trucks, and removal of Federal excise tax on intercity buses). To enable more efficient energy use in buildings, the Plan calls for a tax credit on approved residential conservation measures, a utility program to insulate homes with payment made through monthly bills, expansion of the weatherization program for low-income households, etc. Government policies for oil and gas are aimed at providing for prices that stimulate development of new fields and a more rational pattern of distribution, while preventing windfall profits. Industries and utilities are encouraged to convert from oil and gas to coal and other fuels. Along with promoting increased coal use, the Administration will try to achieve continued improvement in environmental quality. The President's policy on nuclear power is to defer any U.S. commitment to advanced nuclear technologies that are based on the use of plutonium. The country has the option of relying on light-water reactors to provide nuclear power. ERDA's nuclear waste management program has been enlarged to encompass development of technologies for long-term storage of spent fuels. The Administration is strongly in support of developing technologies to use nonconventional resources. (BYB)
Availability: GPO, Stock No. 040-000-00380-1

Faucett (Jack) Associates Inc., 5454 Wisconsin Ave., Chevy Chase, MD 20015
A Classification of the Transport Vehicle Stock for Use in National Energy Analysis
Report No. JACKFAU-77-159-1
9 Feb 1977
Sponsor: Energy Research and Development Administration
Abstract: This report examines each of the transportation modes to determine how the vehicle stock of each can most appropriately be characterized for purposes of transport sector energy analysis. This examination balances considerations of vehicular data availability, fuel economy similarity, functional similarity, relative importance among transport fuel users, and analytic efficiency. The number and variety of units in the nation's vehicle fleet is enormous, and it is recognized that developing a manageable characterization of this fleet necessarily involves losing accuracy about some of its parts. Nevertheless, in charting the long-term use of the nation's fuel, many issues require a broad, transport-sector-wide perspective prior to more detailed, mode-specific analysis. The classification developed here is designed to aid in developing such sector-wide perspective on transport fuel use. The vehicle classes chosen for this classification include 10 categories in rail transportation, 2 categories in urban mass transit, 2 categories in bus transportation other than transit, 5 water transportation categories, 9 air transportation categories, 8 automobile categories, 16 truck categories, and 5 pipeline categories. These categories form the basic frame of reference upon which will be applied developing stock, activity, and fuel-use projections for this study. (from summary)

Faucett (Jack) Associates Inc., 5454 Wisconsin Ave., Chevy Chase, MD 20015
Trucking Activity and Fuel Consumption: 1973, 1980, 1985 and 1990
Final Report, 81 p.
13 Jul 1976
Sponsor: Federal Energy Administration
Abstract: This report provides an in-depth analysis of the base year data development and projections of trucking activity and fuel consumption. Descriptions of existing sources of information, data reliability, methodological procedures and assumptions, historical trends, and comparisons with other estimates are presented in great detail. Both the data base and forecasts are estimated in a highly disaggregated fashion. Trucking activity measures include the number of trucks, vehicle miles travelled, average load carried, and total ton-miles, each differentiated by truck size class, area of operation and fuel type. In addition, the historical measures for 1973 are detailed by major use--personal transportation, for-hire and other private. Base year fuel consumption rates on a miles per gallon basis are also developed according to the same vehicle size, area of operation and fuel type classification and are consistent in the aggregate, with the most reliable information available on truck fuel consumption. A baseline forecast of fuel consumption is made by applying the detailed base year fuel economy estimates to the detailed projections of vehicle miles travelled. This forecast provides a framework whereby success of the voluntary industry/government fuel economy improvement program can be measured. This information is organized into three sections of the report. Section I presents the estimation methodology and statistical tables of the detailed trucking activity measures for 1973. Section II covers the forecast of trucking activities for 1980, 1985, 1990 and includes an extensive explanation of the procedures employed in the derivation. Section III develops the detailed truck fuel economy estimates and presents the baseline forecast of fuel consumption. (13 references) (from Overview)

Faucett (Jack) Associates Inc., 5454 Wisconsin Ave., Chevy Chase, MD 20015
Fuel Economy Policies and Their Effects on Automobile Ownership, Use, and Fuel Consumption
Report No. JACKFAU-76-137-8, 118 p.
Aug 1976
Sponsor: Federal Energy Administration
Abstract: This analysis explores the additional gains in fuel conservation, as well as the consequences on travel and auto ownership, which are expected to result from enactment of Federal policies designed to promote more fuel-efficient automobiles. Three families of policies are explored: manipulation of gasoline prices, imposition of fuel economy standards, and establishment of fuel economy-based excise taxes and rebates. In all, 21 policy alternatives reflecting different variations of these measures are examined, and the projected impacts on auto sales, fuel economies, prices, ownership, scrappage, travel, and fuel consumption are shown in a table, which presents comparative results for the policies for 1985 and 2000. This analysis indicates that significant additional savings in automotive fuel consumption can be realized through Federal policy action, but that there may also be undesirable side effects on mobility and auto ownership associated with some policies. The forecasts presented here are based upon an analytic model of automobile demand and the motor vehicle manufacturing industry. ... The key findings are as follows: gasoline price manipulations (such as might be achieved through gasoline excise tax increases) could bring significant reductions in fuel consumption; ... fuel economy standards appear to offer the greatest gain in petroleum conservation relative to the associated losses in mobility and auto ownership; ... and excise taxes also have the capability to reduce automotive petroleum consumption with minimal damage to auto sales or mobility, but they do not appear to yield fuel savings as great as those produced by the policy alternatives which incorporate standards. (from Conclusion)

Federal Energy Administration, National Energy Information Center, Washington, DC 20461
Directory of Federal Energy Data Sources: Computer Products and Recurring Publications
Report No. PB-254163, FEA/B-65/219, 84 p.
May 1976
Abstract: The purpose of this directory is to announce two major types of Federally-sponsored energy-related information: energy information on magnetic tape and recurring publications which contain energy-related numerical data. The information on magnetic tape is primarily in the form of data files. However, there are also computer programs, data base reference services, and mathematical models. The items are listed under broad subject categories. The citations include title, responsible agency, dates of coverage, accession number, availability information, and abstract. Each entry is indexed by subject, originating agency, and accession number. (from Foreword)
Availability: NTIS

Federal Task Force on Motor Vehicle Goals Beyond 1980, Washington, DC
The Report by the Federal Task Force on Motor Vehicle Goals Beyond 1980. Volume 1. Executive Summary. Volume 2. Task Force Report
Draft report, 30 p. in Volume 1; 279 p. in Volume 2
2 Sep 1976
Sponsor: Executive Office of the President, Energy Resources Council
Abstract: Written by a task force with representatives from several Federal departments and agencies, this draft report examines motor vehicle fuel economy goals beyond 1980 which are compatible with environmental, safety, and economic objectives. Decisions on the automobile beyond 1980 involve balancing such factors as consumer preferences, government regulation, and manufacturing and finance requirements. It is concluded that, with adequate industry involvement and reasonable government regulation, the U.S. can save four million barrels of oil per day by 1995. This fuel savings would represent a 40 to 50% reduction in projected automobile fuel consumption, a 25 to 40% reduction in projected light truck fuel consumption, and a 30% reduction in projected commercial vehicle fuel consumption. The actual fuel savings are dependent on the rate of introduction of new fuel-economical cars. A move toward more compact, properly-designed, lighter-weight automobiles is not expected to increase automobile occupant fatalities and injuries. However, implementation of a higher safety level would increase car weight and cost. The impact of emissions controls on fuel economy is estimated. The average cost per mile of automobile transportation will decrease with the transition to lighter, more fuel-economical cars. An earlier draft report was published in July 1976. (BYB)

Finegold, J.G.
Hydrogen: Primary or Supplementary Fuel for Automotive Engines
California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA
Paper No. 760609, presented at the West Coast Meeting, Jack Tar, San Francisco, California, August 9-12, 1976, 16 p.
1976
Sponsor: National Aeronautics and Space Administration; Society of Automotive Engineers
Abstract: Hydrogen, gascline, and mixtures thereof were compared as fuels for lean-burn engines. Hydrogen for the mixed fuels tests was generated by partial oxidation of gasoline. Hydrogen combustion yielded the highest thermal efficiency at any NOx level. Gasoline yielded the second highest thermal efficiency for NOx levels greater than or approximately equal to two gm/mi. For lower NOx levels and high vehicle inertia weights, progressively more hydrogen supplementation was the second most efficient system. For vehicle inertia weights below 5000 lbm (2300 kg), the statutory NOx standard (0.4 gm/mi) could be met with one lb/hr (0.13 g/s) hydrogen supplementation. (4 references) (auth)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Dr., Warrendale, PA 15096 $2.75

Fox, H.G.
Potential Applicability of a Lead-Acid Battery Powered Two-Passenger Electric Car
General Research Corp., P.O. Box 3587, Santa Barbara, CA 93105
Internal Memorandum No. IM-2042, 63 p.
Jun 1976
Sponsor: Energy Research and Development Administration
Abstract: This paper assesses the potential applicability of a two-passenger electric car. Information regarding the applications of two-passenger electric cars sold recently in the United States was assessed, as were the results of market analyses, customer surveys, and testing reports. Operational costs are estimated for the two-passenger car characterized in an earlier study, and compared with costs of the four-passenger electric car from the same study and conventional internal-combustion automobiles. Nationwide estimates of potential applications and markets, and levels of market penetration, are then developed for both electric cars. (17 references) (auth)

Frederick, F.P.; Moore, J.F.; Bonner, J.S.; Dickson, J.C.; Karvelas, L.P.
The Impact of Automotive Fuel Changes on the U.S. Refining Industry: An Economic/Technological Assessment
Bonner and Moore Associates Inc., 500 Jefferson Bldg., Houston, TX 77002
Report No. ERDA-76-40, FE-2216-1, v.p.
15 Nov 1975
Sponsor: Energy Research and Development Administration
Abstract: This study examines the economic and technological effects which would occur within the U.S. refining industry if, by the year 2000, the U.S. automotive fleet should require: more gasoline than currently projected; less gasoline than currently projected; or fuels other than gasoline--namely, diesel fuel or a "broadcut" fuel composed of crude fractions within a very broad boiling range. The investigation was conducted by imposing various fuel demand forecasts (1975 through 2000) upon a mathematical model of the U.S. refining industry. Study results indicate that: (1) existing refining technology will not allow the U.S. refining industry to meet the demand imposed by introduction of an all-diesel auto fleet; (2) demands for "broadcut" fuel could be met, but the varying characteristics for this fuel would create fuel marketing and auto fuel system problems; and (3) all of the fuel demand patterns studied have measurable and important economic impacts on the refining industry. These impacts, however, are overshadowed by the effect which varying automotive fuel requirements have on the U.S. demand for crude oil. ... A special study under slightly different fuel demand patterns is reported in Addendum 1 to the report. (auth, abstract modified)
Availability: NTIS

Gay, W.F.
Summary of National Transportation Statistics
U.S. Dept. of Transportation, Transportation Systems Center, Kendall Square, Cambridge, MA 02142
Annual report, Report No. PB-252410, DOT-TSC-OST-75-18, 160 p. for June 1975 report; Report No. DOT-TSC-OST-76-11, 120 p. for June 1976 report
Jun 1975; Jun 1976
Sponsor: U.S. Dept. of Transportation, Office of the Secretary, Assistant Secretary for Policy Plans and International Affairs
Abstract: These periodic reports are compendiums of selected national-level transportation statistics. Included are cost, inventory, and performance data describing the passenger and cargo operations of the following modes: air carrier, general aviation, automobile, bus, truck, local transit, rail, water, and oil pipeline. The report includes basic descriptors of U.S. transportation, such as operating revenues and expenses, number of vehicles and employees, vehicle-miles and passenger miles, etc. As the name implies, these reports are summaries of a larger data base, consisting of time-series collected from a variety of government and private statistical handbooks. In the 1975 and 1976 editions, the selected data cover the periods 1963 through 1973 and 1964 through 1974, respectively. (GRA)
Availability: GPO $5.05, Stock No. 050-003-00220-8 for 1975 report; GPO $1.85, Stock No. 050-000-00118-1 for 1976 report

Gay, W.F.
Energy Statistics - A Supplement to The Summary of National Transportation Statistics
U.S. Dept. of Transportation, Transportation Systems Center, Kendall Square, Cambridge, MA 02142
Annual reports, Report No. PB-238767, DOT-TSC-OST-74-12, 156 p. for Aug 1974 report; Report No. PB-252612, DOT-TSC-OST-75-33, 168 p. for Aug 1975 report; Report No. DOT-TSC-OST-76-30, 144 p. for Aug 1976 report
Aug 1974; Aug 1975; Aug 1976
Abstract: These reports are compendiums of selected time-series data describing the transportation, production, processing, and consumption of energy. The statistics have been assembled from a wide variety of sources, such as the U.S. Department of the Interior, the Interstate Commerce Commission, and the American Petroleum Institute. These reports are divided into three main sections. The first, entitled "Energy Transport", contains such items as the revenues and expenses of oil pipeline companies, number and capacities of U.S. tank ships, and the total crude oil transported in the U.S. by method of transportation. The second section, entitled "Reserves, Production, and Refining", reveals the growth over time of the U.S. oil and natural gas reserves, refinery capacity, and yields. Trends in the demand for fuel and power are displayed in the third section, entitled "Energy Consumption". Throughout this part, the transportation sector is emphasized. Included are the gasoline and oil costs of automobiles of different sizes, the consumption of petroleum by type of product, the energy intensiveness of the air carriers, the electrical energy consumed by the local transit industry, and other important statistics describing the supply and demand for energy. (Auth)
Availability: NTIS for Aug 1974 and Aug 1975 Supplements; GPO $2.00, Stock No. 050-000-00122-9 for Aug 1976 Supplement

Gaynor, J. (ed.)
Monthly Energy Review
Federal Energy Administration, National Energy Information Center, Washington, DC 20461
Monthly publications, approximately 90 p.
Monthly
Abstract: Monthly statistics are presented on crude oil and refined products, natural gas, coal, electric utilities, nuclear power, energy consumption, resource development, energy prices, and international petroleum consumption and crude oil production. Tables provide data on production, price, imports and exports, stocks, demand, and development of fossil fuels and refined petroleum products. The section on electric utilities looks at net power production, fuel consumption, stocks, and sales. An examination of nuclear power includes data on power plant operations, the status of nuclear power plants, U.S. uranium enrichment, nuclear power generation by major non-communist countries, and the nuclear fuel cycle. Feature articles on energy concerns appear in various issues, e.g., articles on the price of oil, on propane, and on trends in U.S. petroleum imports. (BYB)
Availability: NTIS

General Electric Co., Corporate Research and Development, Schenectady, NY
Demonstration of an Inductor Motor/Alternator/Flywheel Energy Storage System
Report No. COO-4010-1, 46 p.
28 Sep 1976
Sponsor: Energy Research and Development Administration, Chicago Operations Office
Abstract: This quarterly report covers the work on Task 1, "Establish Specification for Inductor Motor/Alternator/Flywheel and Conduct Tradeoff Analyses." Vehicle propulsion concepts utilizing flywheel energy are described. Analyses are presented for sizing an inductor motor/alternator/flywheel for application to a 3000 pound vehicle. Component tradeoffs are included for the inductor motor/alternator drive, the solid state inverter/rectifier, the control circuit, and a composite flywheel. Design specifications for the machine are established and a test plan defined. (from Summary)
Availability: NTIS

General Services Administration, Federal Supply Service, Office of Transportation and Public Utilities, Motor Equipment Management Division, Washington, DC 20406
Federal Motor Vehicle Fleet Report
Annual reports for fiscal years ending June 30, 1962 through June 30, 1975, Report No. FPMR 101-38.1 for 1972 through 1975 reports; Report No. FPMR 101-38.101 for 1964 through 1971 reports; reports prior to 1972 report are entitled "Annual Motor Vehicle Report"
Jan 1963; Feb 1964; Feb 1965; Feb 1966; Feb 1967; Feb 1968; Feb 1969; Mar 1970; Mar 1971; Mar 1972; Mar 1973; Apr 1974; Mar 1975; Jul 1976
Abstract: The Federal Motor Vehicle Fleet Report is compiled and published each fiscal year by the General Services Administration (GSA). Issued for more than 30 years, the report is designed to provide essential statistical data concerning worldwide Federal motor vehicle fleet operations. The data reported was supplied to GSA by all Federal agencies operating motor vehicles in the United States and overseas. ... Statistical data on fleet changes, acquisition costs, rental vehicles, and operating and maintenance costs, have been summarized for the 420,784 vehicles of the Federal fleet. For the purposes of this report, the following types of vehicles are classified as fleet vehicles: sedans of all types, station wagons, ambulances, buses, trucks, and truck tractors. The report does not include data on trailers, trailer-vans, motorcycles, firetrucks, trucks with permanently mounted special equipment, special purpose vehicles, or military (tactical) design motor vehicles. Review of the data in this report will assist Government agencies in evaluating the effectiveness of the operation and management of their individual vehicle fleets. (from Foreword to 1975 Report)

Gross, S.
Review of Candidate Batteries for Electric Vehicles
Boeing Aerospace Co., Seattle, WA 98124
Energy Conversion, an International Journal, 15(3/4), pp. 95-112
1976
Sponsor: Seattle City Light
Abstract: Short summaries are presented of most of the battery systems that can be considered for electric vehicles. Many little known systems are included, some with little or no experimental background, and thus are worth considering for future research. Electric vehicle battery requirements are postulated, and based on these requirements the battery candidates are evaluated for their near-term and long-term prospects. (206 references) (auth)

Hagey, G.;. Hamilton, W.
The Future Role of Electric Land Transportation in the United States
Energy Research and Development Administration; General Research Corp.
Paper No. 760118, presented at the Automotive Engineering Congress and Exposition, Detroit, Michigan, February 23-27, 1976, 12 p.
1976
Sponsor: Society of Automotive Engineers
Abstract: Electrification of land transportation, primarily automobiles, will be important to conserve petroleum before the year 2000. Even with existing battery technology, electric cars would be adequate for significant urban use as second cars, and with advanced batteries they could do much more, bringing about large petroleum savings in cities relying on coal or nuclear electric power, plus modest improvement of air quality. Overall costs of auto operation would be increased, however, and availability of some battery materials is limited. (8 references) (auth)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 $2.75

Hamilton, W.
Representative Future Batteries for Urban Electric Cars
General Research Corp., P.O. Box 3587, Santa Barbara, CA 93105
Internal Memorandum No. IM-2049, 76 p.
19 Aug 1976
Sponsor: Energy Research and Development Administration
Abstract: From a literature review and contacts with battery developers, three battery types are selected as representative of the range of possibilities for future urban electric cars: advanced lead-acid, nickel-zinc, and lithium-aluminum/metal sulfide. Energy and power density, efficiency, life, and cost are projected for each as a basis for calculating impacts of future urban use of electric cars. In comparison with similar projections made several years ago, these representative batteries span a narrower range of performance and offer longer life. The prospects for lead-acid battery relative to other types are especially improved. The electric car impact affected most significantly, life-cycle cost, would be substantially reduced for lead-acid and nickel-zinc batteries because of reduced battery depreciation charges. (76 references)

Hamilton, W.
Electric Car Impact Assessment, Phase I: Preparation for National Analysis
General Research Corp., P.O. Box 3587, Santa Barbara, CA 93105
Internal Memorandum No. IM-2055, 60 p.
Aug 1976
Sponsor: Energy Research and Development Administration
Abstract: Existing regional impact studies were reviewed as a basis for national impact projection. These studies projected impacts of electric car use on energy, air quality, and the economy in three different urban regions: Los Angeles, St. Louis, and Philadelphia. Though these regions span a wide range of possibilities, the diversity of other urban regions in the U.S. was found to be so great that impacts previously calculated cannot accurately be extrapolated to a national total. Adequate data are readily available in machine-readable form, however, to facilitate development of a national aggregate from energy and air quality impact projections made individually for each large urban region. Data sources and data processing procedures for this purpose were planned. Furthermore, the regional results appear unsuitable for a national impact assessment because they are outdated. Prospects for future storage batteries have shifted towards longer operating life, together with relatively higher performance and lower cost for the near-term lead-acid system. Prospects for a viable electric car have thus been enhanced. The growth planned by electric utilities, on the other hand, has recently slowed drastically, so that the availability of nuclear and other non-petroleum sources of electric power for recharging electric cars will be reduced relative to that projected in the regional studies. Finally a two-passenger, limited-performance electric car is now being merchandized with considerable success, pointing to new possibilities for economical, low-impact electric cars not considered in the regional studies. Preparations for the national impact assessment also included refinement of modeling and performance estimates for electric cars, consideration of the applicability of safety standards to electric cars, and impact analyses for an urban region uniquely suited to electric cars: Honolulu, Hawaii. (6 references) (auth)

Hannon, B.
Energy, Labor, and the Conserver Society
University of Illinois, Center for Advanced Computation, Urbana, IL 61801
Technology Review, pp. 47-53 (Mar/Apr 1977)
Mar/Apr 1977
Abstract: This article describes a "conserver society" which realizes that there is a limit to the availability of low-cost energy and plans not only for energy shortages, but also for economic stability, full employment, and equity. The technical, social, and economic problems that would result in the U.S. becoming a conserver society are discussed. The relationship between the three basic inputs to production--capital, labor, and energy--is examined. In planning for energy shortages, the society would have to increase its flexible, renewable resources, labor and capital, to make up for shortages of nonrenewable resources, energy. With zero economic growth the U.S. can have full employment by raising the price of energy relative to wages (through taxes and rationing). Therefore, reduced energy use implies less material wealth. A major problem of the conserver society is in providing and maintaining an equitable distribution of reduced energy and material flows. This society must also use its energy efficiently by matching energy quality and quantity exchanges in production processes. Residential and commercial structures should locate near production, and electric power plants should be smaller in size. Cities of the conserver society would be more independent, more diverse, and smaller than today's. Using an energy and employment impact model, a type of input-output model, changes that will reduce energy demand and increase employment under conditions of income equilibrium are determined (e.g., changing from plane to train, from throwaway to refillable beverage containers, from car to train, from owner-operator truck to class 1 freight train, from car to bus, from new highway construction to personal consumption, from car to bus or bicycle, from plane to car or bus, from moderate to spartan kitchen, etc.). (16 references) (BYB)

Harhay, W.C.; Bozek, J.
Baseline Test Data for the EVA Electric Vehicle
Electric Vehicle Associates; National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
Paper No. 769069 presented in the "Eleventh Intersociety Energy Conversion Engineering Conference Proceedings" (EN-6381), (conference held at the Sahara Tahoe Hotel, State Line, Nevada, on September 12-17, 1976), pp. 404-410
1976
Abstract: Two electric vehicles from Electric Vehicle Associates were evaluated for ERDA at the Transportation Research Center of Ohio. The vehicles, loaded to a gross vehicle weight of 3750 pounds had a range of 56.3 miles at a steady speed of 25 mph and a 27.4 miles range during acceleration deceleration tests to a top speed of 30 mph. Energy consumption varied from 0.48 kw-hr/mi. to 0.59 kw-hr/mi. (auth)
Availability: American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 $90.00 for entire proceedings

Hattori, S.; Yamaura, M.; Kimura, S.; Iwabuchi, S.
A New Design for the High-Performance Sodium-Sulfur Battery
Yuasa Battery Co., Ltd.
Paper No. 770281, presented at the International Automotive Engineering Congress and Exposition, Cobo Hall, Detroit, Michigan, February 28 - March 4, 1977, 12 p.
1977
Sponsor: Society of Automotive Engineers
Abstract: This paper describes a new design for the sodium-sulfur battery employing a new cell construction including a new method to join the solid electrolyte tube with the sodium reservoir made of metal, and an improved composition of the cell case to solve the problems of premature cell destruction and capacity decrease associated with a conventional design. As a result a higher and more stable performance of the new design than that of a conventional design has been shown through various evaluation tests. (5 references) (auth)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 $2.75

Hundemann, A.S. (ed.)
Electric Automobiles: Citations from the Engineering Index Data Base
National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22161
Report No. NTIS/PS-76/0561, v.p.
Jul 1976
Abstract: Citations in this bibliography are from worldwide research covering the design of electric automobiles, vans, buses, and hybrid vehicles. Included are studies on lead-acid, zinc-air, lithium-sulfur, and nickel-cadmium batteries; fuel cells; drive trains; and chassis construction. (Contains 284 abstracts) (GRA)
Availability: NTIS

I.P. Sharp Associates Limited, Suite 1400, 145 King Street West, Toronto, Ontario M5H 1J8
Aviation Newsletter
Periodic newsletter, approximately 20 p.
Abstract: This newsletter reports on activities of I.P. Sharp Associates (IPSA) in the aviation data base field. IPSA offers a timesharing service in 50 cities throughout North America and Europe, allowing users to connect their terminals directly into IPSA's mainframe computer. The Aviation Data Base occupies over 200 million bytes of on-line storage and is expected to grow. New documents and data bases, as well as personnel, and other changes are described. (BYB)

Institute of Electrical and Electronic Engineers Inc., Vehicle Technology Group, Automotive Electronics Committee, 345 East 47th St., New York, NY 10017
Proceedings of International Conference on Automotive Electronics and Electric Vehicles (Convergence)
IEEE Catalog No. 76CH1146-0 VT, SAE Catalog No. P-68, conference held at Hyatt Regency Dearborn and Ford Motor Company Proving Ground, Dearborn, Michigan, September 20-22, 1976, 134 p.
1976
Sponsor: Society of Automotive Engineers; Electric Vehicle Council; Institution of Electrical Engineers; Energy Research and Development Administration; University of Michigan
Abstract: Experts in automotive electronics and electric vehicles presented 25 papers at this conference in these sessions: Automotive Electronics Tutorial, Automotive Electronics, Electric Vehicles, Automotive Electronics, Automotive Electronics--A New Horizon (a panel discussion), Emerging Technology, and Electrical Vehicle Demonstration. Session III on electric vehicles includes the following papers: "Development of Electric Vehicles at Toyota"; "Electric Delivery Vans Above the 45th Parallel in North America"; "Development of a High Performance and Light Weight Hybrid Flywheel/Battery Powered Electric Vehicle"; "The Computer Simulation of Automobile Use Patterns for Defining Battery Requirements for Electric Cars"; and "Comparison of Electrical Drives for Road Vehicles." The last section of these proceedings contains data on 27 electric vehicles, including information on the propulsion motor, controller, propulsion battery, auxiliary battery, vehicle weight, off-board charger, on-board charger, axle, body, frame, brakes, vehicle size, performance, seat, springs, steering, tires, cargo space, and price of each vehicle. (BYB)

Johnson, R.T.; Riley, R.K.; Dalen, M.D.
Performance of Methanol-Gasoline Blends in a Stratified Charge Engine Vehicle
University of Missouri, Mechanical Engineering Dept., Rolla, MO
Paper No. 760546, presented at the Fuels and Lubricants Meeting, St. Louis, Missouri, June 7-10, 1976, 12 p.
1976
Sponsor: Society of Automotive Engineers
Abstract: A series of driveability and chassis dynamometer tests were performed using various blends of methanol and gasoline in a stratified charge engine vehicle. The vehicle used was a 1975 Honda Civic CVCC. This vehicle is powered by a prechamber type stratified charge spark ignition engine. The basic intent of this effort was to characterize how methanol-gasoline blends behave in a prechamber stratified charge engine vehicle. ... General conclusions are that the CVCC vehicle tested suffered only slight degradation in driveability using a 10% methanol-gasoline fuel, and vehicle emissions and fuel economy are not significantly changed by use of the 10% methanol blend. (20 references) (auth, abstract modified)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 $2.75

Kant, F.H.; Cahn, R.P.; Cunningham, A.R.; Farmer, M.H.; Herbst, W.; Manny, E.H.
Feasibility Study of Alternative Fuels for Automotive Transportation. Volume I. Executive Summary. Volume II. Technical Section. Volume III. Appendices
Exxon Research and Engineering Co., P.O. Box 45, Linden, NJ 07036
Report No. EPA-460/3-74-009-a, PB-235581, 26 p. for Vol. I; Report No. EPA-460/3-74-009-b, PB-235582, 234 p. for Vol. II; Report No. EPA-460/3-74-009-c, PB-235583, 140 p. for Vol. III
Jun 1974
Sponsor: U.S. Environmental Protection Agency, Office of Air and Waste Management, Office of Mobile Source Air Pollution Control, Alternative Automotive Power Systems Division
Abstract: Feasible and practical options to petroleum-derived automotive fuels are identified and evaluated for the 1975-2000 time period. Feasible alternative fuels are liquids produced from coal and oil shale--gasoline, distillates, and methanol. In-depth analyses of these alternative fuels are presented, including cost, performance, and marketing analyses, and a discussion of information gaps and research needs. Initial production of these petroleum-type fuels will begin within five to seven years. These fuels will probably begin to be used in conjunction with petroleum. It is highly probable that alternative fuels or blend components can be developed that can utilize the existing distribution and marketing system for petroleum-based fuels. These alternative fuels may all be manufactured at a cost range projected for petroleum fuels, and shale fuels may even be lower in cost. Large-scale production of shale oil will most likely be constrained for environmental reasons, rather than for economic considerations. Possible product quality problems of these synthetic alternatives can be handled by blending them with petroleum or with each other. Methanol from coal is a feasible automotive fuel for a modified spark ignition engine, for gas turbines, and for fuel cells. If used in the near future, methanol would first have to enter the market as a blend with gasoline. Data on product quality and performance of fuels from coal and shale, alone and in blends, are insufficient. In addition, research is needed in these areas: in-situ recovery of shale oil, hydrogen production for coal liquefaction, selective removal of sulfur, nitrogen, and oxygen from coal and shale, coal gasification plus methanol synthesis, large-scale demonstration of disposal of spent shale and reclamation of surface-mined coal areas, effects of alternative fuels on the economy, and water availability in the Western states. (179 references) (BYB)
Availability: NTIS

Kant, F.H.; Cunningham, A.R.; Farmer, M.H.
Effects of Changing the Proportions of Automotive Distillate and Gasoline Produced by Petroleum Refining
Exxon Research and Engineering Co., P.O. Box 45, Linden, NJ 07036
Report No. EPA-460/3-74-018, 49 p.
Jul 1974
Sponsor: U.S. Environmental Protection Agency, Office of Air and Waste Management, Office of Mobile Source Air Pollution Control, Alternative Automotive Power Systems Division
Abstract: This study examines the effects of changing the proportions of automotive distillate fuel and gasoline produced by refining petroleum. It provides a partial answer to whether a shift to increased distillate production, that would be necessary if there were a widespread use of vehicles requiring distillate fuel, would result in significant improvements in resource utilization. Calculations for a grass-roots refinery, that would come on stream in the 1990-2000 time-frame, indicate that the maximum theoretical energy saving is about 2% of the crude oil charged when approximately equal quantities of automotive distillate and gasoline are produced. Savings in refinery investment and manufacturing cost would be achieved, too. However, the external impacts of major changes in gasoline/distillate ratio need to be analyzed to establish the practicality of moving in the direction of equal quantities of distillate and gasoline. The impact on petrochemicals and other industries may be substantial. (4 references) (GRA)
Availability: NTIS

Klein, M.
An Analysis of Electric Vehicle Mission, Design, Energy Impact and Cost
Energy Research Corp., Danbury, CT 06810
Paper No. 769064 presented in the "Eleventh Intersociety Energy Conversion Engineering Conference Proceedings" (EN-6381), (conference held at the Sahara Tahoe Hotel, State Line, Nevada, on September 12-17, 1976), pp. 377-381
1976
Abstract: A review of vehicle use patterns reveals that an electric vehicle capable of achieving a 75 mile range on a typical city driving cycle would fulfill the requirements of the second car in multi-car families at a minimal disruption to trip freedom. There are currently 30 to 40 million multiple car families and the penetration of this segment of the transportation market by electric vehicles would have significant beneficial effects on the type and quantity of energy consumed within the United States. For the 75 mile mission and a compact size vehicle, a critical battery energy density exists in the 30 to 35 watt hour per lb. range. The nickel-zinc battery systems appear to be the leading contender to fulfill the mission requirement of a 75 mile range vehicle. For the scenario of coal to liquid synthetic fuel to internal combustion engine vehicle vs. coal to electric energy to electric vehicle, a two to one energy savings is possible by the electric route. The use of approximately 15 million such vehicles in the United States would reduce our liquid petroleum imports and consumption by one million barrels a day. (2 references) (auth)
Availability: American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 $90.00 for entire proceedings

Leape, J.P.
The Demand for Automobiles: An Analysis
Harvard University, Cambridge, MA
Thesis, 178 p.
Apr 1977
Sponsor: Energy Research and Development Administration, Transportation Energy Conservation Division
Abstract: The aim of this study on the demand for automobiles is to determine and analyze the fundamental elements of the household's automobile ownership decision by correlating supply characteristics with attributes of the household. These factors in the household consumption decision are concentrated on: the number of cars owned, their size, and whether they were bought new or used. This study analyzes data collected in two surveys: the Nationwide Personal Transportation Survey, conducted for the Federal Highway Administration in 1969-70; and the Survey of Consumer Finances, conducted by the University of Michigan Survey Research Center in 1970. Analysis of these data includes examination of the role of certain household characteristics (e.g., income, size, and location) in determining the household's automobile ownership decisions. These correlations are assessed through cross-tabulations of the data and multiple linear regressions. Based on these assessments, predictive models of the individual choice problems are developed through the multinomial logit technique. (14 references) (BYB)

Liddle, S.G.
An Analytical Study of the Fuel Economy and Emissions of a Gas Turbine-Electric Hybrid Vehicle
General Motors Corp., Research Laboratories, Detroit, MI
Paper No. 760122, presented at the Automotive Engineering Congress and Exposition, Detroit, Michigan, February 23-27, 1976, 16 p.
1976
Sponsor: Society of Automotive Engineers
Abstract: A study was made to determine the effect of hybrid operation on the fuel economy and emissions of a vehicle using a gas turbine engine, a continuously variable transmission, and an electric power storage system. Both series and parallel hybrids were considered in a 1815 kg vehicle. To facilitate this study, a computer program was written which modeled the vehicle and, using experimental data, computed its fuel consumption and emissions over the 1972 FTP driving cycle, starting with a fully warmed up engine. This study indicates that, under certain conditions, the fuel consumption or emissions of the hybrid vehicle may be reduced as compared to its non-hybrid counterpart, but under other conditions, they may be increased. It is not possible to reduce fuel consumption and all of the emissions simultaneously. The reduction of one pollutant is usually accompanied by an increase in one of the others. The extent of the reduction or increase experienced with hybrid operation depends on the particular type of hybrid and on the engine operating conditions. ... It must be concluded that the hybrid vehicle does not automatically guarantee lower fuel consumption or emissions. (11 references) (auth, abstract modified)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 $2.75

Liles, A.W.; Fetterman, G.P., Jr.
Selection of Driving Cycles for Electric Vehicles of the 1990's
Exxon Enterprises Inc., Florham Park, NJ
Paper No. 769066 presented in the "Eleventh Intersociety Energy Conversion Engineering Conference Proceedings" (EN-6381), (conference held at the Sahara Tahoe Hotel, State Line, Nevada, on September 12-17, 1976), pp. 390-395
1976
Abstract: Even with significant market penetration (10%), electric vehicles (EV's) in the 1990's will operate in a world dominated by internal combustion engine (ICE) vehicles. Consequently, they must be capable of mixing freely in the traffic patterns generated by ICE vehicles. This paper considers various driving cycles developed to fit today's ICE vehicle driving patterns and analyzes their fit with the 1990 traffic patterns anticipated for three particular EV applications. Selection of the most appropriate cycle permits realistic determination of the road power and energy requirements necessary for the design and evaluation of advanced EV battery and power train systems. (auth)
Availability: American Institute of Chemical Engineers, 345 47 St., New York, NY 10017 $90.00 for entire proceedings

Little (Arthur D.) Inc., Acorn Park, Cambridge, MA 02140
Attachment 1. Study of Automobile Market Dynamics: Final Test of Consumer Responses
Report No. 78542-06, 77 p.
Nov 1976
Sponsor: U.S. Dept. of Transportation, Transportation Systems Center
Abstract: This document reports on work done on Task 5 (Final Test of Consumer Responses) of a study of automobile market dynamics, which examines policies the Federal government might implement to reduce gasoline consumed by passenger automobiles during the period 1976 through 1980. The study determines how each policy option would affect the number of cars sold; the distribution of sales among small, medium, and large cars; the distribution between cars manufactured by foreign and domestic companies; and the gross revenues from these car sales. The purpose of Task 5 was to provide data on these impacts and to furnish statistical inputs to a computer model. A total of 705 new car buyers were interviewed, covering these topics: the reference car, the new car that will be purchased between June 1976 and 1981; the replaced car, that car which would be replaced by the reference car; a second car owned by household; various proposed scenarios; background information about the respondent's household; and estimated and observed odometer readings. The scenarios developed for this study are: (1) a base case; (2) the gasoline tax case; (3) the excise tax case, in which new luxury cars would have an excise tax of $100 added to the price of the car; (4) the regulation case, in which Congress would require manufacturers to achieve a sales-weighted average of cars with better fuel economy. Survey results show that forecasts of new car sales distributions differ depending on the scenario. Forecasts of new car sales from 1976 to 1980 are presented. Sales of small and medium-size cars are expected to increase while large car sales diminish, particularly in the gas tax scenario. Foreign car sales are also projected to rise under these scenarios, at the expense of domestic car sales. (BYB)

Luchter, S.; Renner, R.A.
An Assessment of the Technology of Rankine Engines for Automobiles
Energy Research and Development Administration, Division of Transportation Energy Conservation, Washington, DC
Report No. ERDA-77-54, 97 p.
Apr 1977
Abstract: During the past 7 years, much work has been accomplished in advancing the development of the Rankine-powered automobile. This report is intended to be a critical review of the work, with emphasis on the Federal government's development program. The information is presented in four major parts. The section on the state of the art in 1970 describes where the technology was prior to the government development program. The section describing the program initiated within the Environmental Protection Agency and concluded by the Energy Research and Development Administration presents an overview of the components and systems. A third section describes the work done during this same period by other government agencies and by private developers. Finally, the state of the art as it exists today is presented. The major conclusions of the report are that the Rankine engine can provide very low emissions, that the fuel economy is not competitive with spark-ignition or projected alternative engines at this time, and that there is some evidence that a variety of fuels could be easily utilized in Rankine engines. (66 references) (auth)
Availability: GPO $2.30, Stock No. 060-000-00055-7

Malliaris, A.C.; Withjack, E.; Gould, H.
Simulated Sensitivities of Auto Fuel Economy, Performance and Emissions
U.S. Dept. of Transportation, Washington, DC
Paper No. 760157, presented at the Automotive Engineering Congress and Exposition, Detroit, Michigan, February 23-27, 1976, 20 p.
1976
Sponsor: Society of Automotive Engineers
Abstract: The subject is treated on the basis of detailed engineering test data regarding components and parameters of 1975 autos. The applicability of the simulation approach is examined by extensive comparisons with integrated vehicle test results. It is found that fuel economy, for the EPA driving schedules, is adequately simulated with 5% to 10% uncertainties. Uncertainties of the same magnitude are also encountered in performance simulations. Larger uncertainties are evident in the simulation of emissions. NOx prediction has an uncertainty up to 25% but no significant bias, while CO and HC are very substantially over-predicted and under-predicted respectively. Excepting HC and CO, several applications are made in the evaluation of sensitivities to various auto components and parameters. Evaluations are made of changes in auto weight, engine displacement and rear axle ratio, considered individually and in combinations. Drivetrain changes are also evaluated for three speed automatic transmissions. These include individually or in combinations: a wider range of gear ratios, the addition of a fourth gear and various schemes of torque converter lock-up. (14 references) (auth)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 $2.75

Marketing Services Inc., 965 E. Jefferson, Detroit, MI 48207
Automotive News Market Data Book (Formerly Almanac)
Annual publication, v.p.
1973; 1974; 1975; 1976; 1977
Abstract: These annual reference issues of Automotive News contain statistics and information on the automotive industry. Data are included on U.S. new cars and trucks sales, registration, imports, retail prices, specifications, and equipment and options. U.S. and Canadian automobile production is covered as is used cars sales and used cars in operation. Financial data on the automobile industry are provided, and U.S. and foreign top executives in the industry are listed. A section is included in the 1976 issue on the industry government policies affecting car manufacture. (BYB)
Availability: Marketing Services Inc., 1973 $9.00, 1974 $7.00, 1975 $9.00, 1976 $10.00, 1977 $12.50

Motor Vehicle Manufacturers Association of the United States Inc., 320 New Center Bldg., Detroit, MI 48202
Motor Vehicle Facts & Figures '76
Annual report, 104 p.
1976
Abstract: Two annual publications, "Automobile Facts and Figures" and "Motor Truck Facts," are combined into this single annual publication, which presents all of the data contained in both predecessor publications. An overview of the activities of the U.S. motor vehicle industry in 1975 is provided. The bulk of the report consists of statistics on: 1) Production/Registration, with tables on facilities of motor vehicle manufacturers, factory sales, optional equipment installations, production, recreational vehicles, registrations, retail sales, and retirement; 2) Use and Owners, including information on drives, emissions, energy consumption, farm vehicles, fleets, government ownership, highway fatalities, highways, intercity travel, personal transportation, purchasers, purpose of usage, school bus transportation, shipments of goods, and vehicle miles of travel; and 3) Economic Impact, providing statistical data on businesses, employment, exports and imports, financing, gross national product contribution, highway trust fund, materials consumption, payrolls, personal consumption expeditures, sales, sizes and weights, and taxes. (BYB)
Availability: Statistics Dept., Motor Vehicle Manufacturers Association, 320 New Center Building, Detroit, MI 48202

Motor Vehicle Manufacturers Association of the U.S. Inc., 320 New Center Building, Detroit, MI 48202
New Truck Retail Sales and Stocks by G.V.W. Groups and Body Type (Including Imports of U.S. Manufacturers)
Monthly publication, series RS-3S, 2 p.
Monthly
Abstract: Four tables are provided in this monthly publication: Total New Truck Retail Sales and Stocks for the current month, and for the current month and previous months in the calendar year; and New Truck Retail Sales and Stocks of 4 X 4 Trucks for the current month, and for the current month and previous months in the calendar year. The trucks are categorized by weight, type, and manufacturer. (BYB)
Availability: Stanley Roe, Motor Vehicle Manufacturers Association, 320 New Center Building, Detroit, MI 48202 (if requested on a business letterhead)

Mullaney, T.E.
The Administration's Task: Educating the Public on Energy
New York Times, p. 63, (May 3, 1977)
3 May 1977
Abstract: The public's reaction to President Carter's energy policy, with its emphasis on conservation, is noted in this article, and energy conservation efforts in the U.S. are assessed. The New York Times/CBS survey of public reaction to Carter's energy program shows that while 58% of those surveyed approved the President's handling of the energy problem, only 45% concurred with his assessment of the seriousness of the situation. A large majority were opposed to higher taxes and increased oil and gas prices. The Administration faces a difficult public education effort. Although the U.S. has made gains in energy efficiency, it lags behind other leading nations and has not come near its own potential, according to an International Energy Agency report. A Conference Board report points out that the relatively low energy prices in the U.S. are largely due to relatively low taxes (in comparison to other leading Western nations). In order to cut down energy consumption, the public and business sectors must be properly motivated and given conservation incentives proposed by the Administration. The U.S. may also have to deal with the impact of energy conservation on economic growth. (BYB)

Murrell, J.D.; Pace, R.G.; Service, G.R.; Yeager, D.M.
Light Duty Automotive Fuel Economy Trends Through 1977
U.S. Environmental Protection Agency, Washington, DC
Paper No. 760795 presented at the Automobile Engineering Meeting, Dearborn, Michigan on October 18-22, 1976, 20 p.
1976
Sponsor: Society of Automotive Engineers
Abstract: The fuel economy data compiled by the U.S. Environmental Protection Agency (EPA) have been analyzed to determine the trends in passenger car fuel economy beginning with model year 1958. Light duty truck fuel economy has been examined beginning with the 1976 model year. This paper adds the 1977 model year data to the historical trend and concentrates on the comparisons between the 1976 and 1977 models and the 1977 California and 49-state fleets. Calculation procedures have been used cn the passenger car data which allow the changes in fuel economy due to system optimization, new engine/vehicle combinations, and weight mix shifts to be determined separately for individual manufacturers and the fleet as a whole. The passenger car fleet consists of the 13 manufacturers which were certified by September 13, 1976. Seven manufacturers comprise the light duty truck fleet. (5 references) (auth)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Dr., Warrendale, PA 15096

National Aeronautics and Space Administration, Washington, DC 20546
NASA Aircraft Fuel Conservation Technology Program Task Force Report
Draft report, v.p.
1975
Abstract: In response to a request by the Senate Committee on Aeronautics and Space Science, NASA has developed a comprehensive program plan (described in this report) for aeronautical technology improvement. The goals of this program are to improve the efficiency of air transportation fuel use while minimizing adverse environmental impacts of air transportation. This task force report first details the background of the fuel shortage with respect to the airline industry. The NASA Aircraft Fuel Conservation Technology Program is described, including technological aspects, development schedule, and resource requirements. Six major programs are defined in three sections: (I) Propulsion--engine component improvement, fuel conservative engine, and turboprop; (II) Aerodynamics--fuel conservative transport and laminar flow control; and (III) Structures--composite primary aircraft structures. Potential fuel savings resulting from implementation of each technology are estimated. With intense industry and government efforts, a 40 to 50% reduction is possible in the amount of fuel consumed per unit of passenger travel. (BYB)

Nichols, M.W.
Balancing Requirements for World Oil and Energy
National Petroleum Council, Washington, DC
Chemical Engineering Progress, 70(10), pp. 36-48 (Oct. 1974)
Oct 1974
Abstract: The U.S. and world problem of balancing energy supply and demand is addressed in this article, which draws upon the National Petroleum Council's study entitled "U.S. Energy Outlook." The relationship between the U.S. and the world energy situation is treated. With domestic consumption of petroleum products greatly exceeding domestic production, the U.S. needs to increase production while decreasing demand through more efficient use of energy. The NPC study has concluded that existing reserves along with undiscovered resources in the non-Communist World are sufficient to meet energy needs through 1985. Non-Communist World petroleum supplies will begin to tighten during the 1971 to 1985 time period. The cost of locating, developing, and supplying oil will probably rise sharply over this time period. The U.S. energy resource potential could sustain higher production rates for all fuels. Recommendations to increase future U.S. energy supplies are made. Tables are included on: Projections of U.S. Total Energy Demand Under Three Different Sets of Assumptions; Non-Communist Foreign Population and Energy and Oil Consumption; Potential Developable U.S. and Non-Communist Foreign Liquid Hydrocarbon Capacity; Western Hemisphere Liquid Hydrocarbon Supply--Oil Consumption Balance (1960-1985); Oil-in-Place Resources; Recoverable Gas Supply; Underground Coal Reserves and Production; Surface Coal Reserves and Production; and Domestic Resources of Uranium as Estimated by AEC--January 1, 1972. (BYB)

North Atlantic Treaty Organization, Committee on the Challenges of Modern Society
Fourth International Symposium on Automotive Propulsion Systems
Symposium held in Washington, DC on April 17-22, 1977, 5 volumes and several individually bound papers, v.p.
1977
Sponsor: Energy Research and Development Administration, Office of Conservation, Division of Transportation Energy Conservation
Abstract: The purpose of this fourth international symposium was to exchange the most up-to-date technical and scientific information on the development and demonstration of energy-efficient, low-polluting vehicles. The proceedings are printed in five volumes and several individual papers not bound in the volumes. Sessions were included on Gas Turbines, Alternative Fuels, Diesel Engines, Stirling and Rankine Engines, Electric and Hybrids, Stratified Charge Engines, Spark Ignition Improvements, Automotive Emissions, Powertrain Components, and Vehicle Improvements. (BYB)
Availability: Supply of published volumes has been exhausted. Author preprints may be available

O'Connell, L.G.; Rubin, B.; Behrin, E.; Borg, I.Y.; Cooper, J.F.; Wiesner, H.J.
The Lithium-Water-Air Battery: A New Concept for Automotive Propulsion
Lawrence Livermore Laboratory, University of California, Livermore, CA 94550
Report No. UCRL-51811, 38 p.
1 May 1975
Sponsor: Energy Research and Development Administration
Abstract: The lithium-battery described in this report represents a new class of batteries. A modification of this battery, the lithium-water-air battery, is also discussed. The latter provides high specific energy and specific power and thus is a candidate power source for electric vehicle propulsion. The utilization of this battery class for such a purpose is examined. The report includes other possible batteries in this class. (auth)
Availability: NTIS $4.00

Pangborn, J.B.; Donakowski, T.D.
Hydrogen Automotive Fuel: Production and Delivery
Institute of Gas Technology
Paper No. 760568, presented at the Fuels and Lubricants Meeting, St. Louis, Missouri, June 7-10, 1976, 12 p.
1976
Sponsor: Society of Automotive Engineers
Abstract: Today's principal and cheapest source of hydrogen in the United States, steam-reformed natural gas, does not have attractive prospects in the far-term future. Alternative procedures or processes therefore are in various phases of research and development. Hydrogen can be produced by the electrolysis of water, and production of hydrogen from coal and water is under study. Thermochemical, photochemical, and biochemical procedures are being researched as long-term routes to hydrogen. Feasibility studies indicate the possibility of long-distance transmission of hydrogen gas via pipeline. Local distribution of hydrogen fuel presents a major problem that requires investigation and development. Technically and economically, other synthetic fuels, such as liquid hydrocarbons from coal or oil shale, are favored alternative automotive fuels for the mid-term future. (20 references) (auth)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 $2.75

Panzer, J.
Fuel Economy Improvements Through Emissions Inspection/Maintenance
Exxon Research and Engineering Co.
Paper No. 760003, presented at the Automotive Engineering Congress and Exposition, Detroit, Michigan, February 23-27, 1976, 12 p.
1976
Sponsor: Society of Automotive Engineers
Abstract: A study was carried out that permitted determination of the impact of annual emissions inspection/maintenance on fuel economy. When 50% of a car population was rejected for high emissions and tuned up, the estimated gain in fuel economy among the rejected cars was 13%. This effect was calculated by quantifying the effects of individual engine malfunctions on fuel economy and applying the results statistically to a car population whose distribution of malfunctions was known. The approach used permitted calculation of fuel economy effects when distributions of some car characteristics, driving patterns, and engine malfunctions are known. The results apply only to pre-1975 cars. It was found that repairs carried out to correct only emissions should produce about three-quarters of the fuel economy benefit achieved by a complete tune-up. When deterioration between annual inspections was considered, and 50% of the car population was rejected for high emissions, the net gain in fuel economy among the rejected cars was about 7.5%, which was significant at the 95% confidence level. The net gain in fuel economy among rejected cars was not statistically significant at rejection rates lower than 30%. When the effect of repairing the 50% highest emitters was spread over the total car population, the estimated 2% fuel economy benefit was not significant. (13 references) (auth)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 $2.75

Purdue University, Institute for Interdisciplinary Engineering Studies, Opportunity and Risk Analysis Team, PU, Potter Center, West Lafayette, IN 47907
Electric and Hybrid Vehicle Research, Development, and Demonstration Act (PL-94-413) Bibliography
Preliminary Report, 27 p.
28 Mar 1977
Sponsor: Energy Research and Development Administration
Abstract: Over 130 publications on electric and electric hybrid vehicles are referenced in this bibliography. Citations are included for books; documents; papers; reports; journal, newspaper, and magazine articles; and task reports. This bibliography will be updated and revised periodically. (BYB)
Availability: R.E. Goodson, Purdue University, Institute for Interdisciplinary Engineering Studies, Opportunities and Risk Analysis Team, Potter Center, West Layfayette, IN 47907

Schultz, W.J.; Miesiak, C.E.; Hamilton, A.E.; Larkinson, D.E.
Credibility of Diesel Over Gasoline Fuel Economy Claims by Association
Perkins Engines Inc.
Paper No. 760047, presented at the Automotive Engineering Congress and Exposition, Detroit, Michigan, February 23-27, 1976, 16 p.
1976
Sponsor: Society of Automotive Engineers
Abstract: Recent economic and environmental developments, such as the fossil fuel shortage, have improved the potential for the use of diesel engines as the power plant for small commercial vehicles and possibly certain passenger cars. Many variables affect fuel economy comparisons. Most of these variables can be associated with either the vehicle design or operation. The objectives of this paper are to relate fuel economy claims with a variety of cycles, to show how some of these claims can be justified, and to show how some of the more impressive diesel over gasoline economy claims relate more to the real world than comparisons based on EPA (Environmental Protection Agency) and SAE (Society of Automotive Engineers) cycles. (12 references) (auth, abstract modified)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 $2.75

Scott, H.W.
Energy--Past, Present, and Future
Paper No. 760402, presented at the Earthmoving Industry Conference, Central Illinois Section, Peoria, Illinois, April 26-28, 1976, 8 p.
Apr 1976
Sponsor: Society of Automotive Engineers Inc.
Abstract: The purpose of this paper is to discuss primarily the critical events of the past years that have affected the petroleum industry. By doing so, it shows the state of affairs now and what must be done in order to see that everyone, particularly the United States, has sufficient energy for the future. (auth)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Dr., Warrendale, PA 15096

Sheridan, D.C.; Bush, J.J.; Kuziak, W.R., Jr.
A Study of the Energy Utilization of Gasoline and Battery-Electric Powered Special Purpose Vehicles
General Motors Corp., Research Labs
Paper No. 760119, presented at the Society of Automotive Engineers' Automotive Engineering Congress and Exposition held in Detroit, Michigan, February 23-27, 1976; paper published in "The Advisability of Regulating Electric Vehicles for Energy Conservation (PB-260667), pp. H24-H40
1976
Abstract: In order to compare the efficiency of utilization of the Earth's fossil energy resources (petroleum and coal) by battery-electric and gasoline powered special-purpose urban vehicles, an analytic study was conducted. The guidelines of this study restricted it to three special-purpose cars that are smaller and have lower performance than conventional subcompact cars and a delivery van. The vehicle power train components represent demonstrated current technology. The most important guideline of the study required the performance levels and load carrying capacity of the gasoline and electric-powered vehicles to be the same. The results of the study indicate that a lead-acid battery powered, two-passenger shopper vehicle with a 40 km range consumed about 90% more petroleum per kilometer of driving than does its spark ignition engine powered counterpart. With coal as the prime source, they consume about the same amount of energy. Increases in desired range, performance and vehicle size beyond that of the shopper increase the electric vehicle energy consumption with respect to the gasoline powered version. The position of the electric vehicle is improved with respect to the gasoline vehicle by the development of advanced batteries, increased electric component efficiencies and an actual electric vehicle mass less than assumed due to a reduced mass compounding factor. An aspect related to the conventionally powered vehicle that tends to reduce the advantage over the electric is a potential efficiency penalty of the spark ignition engine due to its small size. Incorporation of these considerations into the study produce results more favorable for the electric version. (17 references) (auth, abstract modified)
Availability: NTIS for PB-260667

Simpson, F.B.; Swope, D.R.; Lofthouse, J.H.; Henriksen, D.L.
A Guide for the Conversion to and Maintenance of Hydrogen-Fueled, Spark-Ignited Engines
Idaho National Engineering Laboratory; Billings Energy Research Corp.
Report No. TREE-1036, 31 p.
Jan 1977
Sponsor: Energy Research and Development Administration, Idaho Operations Office
Abstract: In recent years there has been much research on the operation of internal combustion engines using hydrogen fuel. Many different paths have been explored in attempts to eliminate the problems found by early researchers and devise a workable engine and fuel storage system. In the 1930's there were many engines putting out useful work using hydrogen, either as the fuel or as a fuel supplement, in Germany and possibly elsewhere. However, due to certain problems and circumstances, including the damage to German industry in World War II, hydrogen as a fuel fell into disuse. This paper is presented as a guide to one approach to the conversion of an internal combustion engine to hydrogen fuel. It includes knowledge gained from the authors' own experiences and from the study of the work of others. It discusses the safety aspects, conversion, operation, and maintenance of the engine. It is hoped that this guide will be useful to those beginning work in the field of hydrogen engines and that it might suggest areas for further research. (16 references) (auth)
Availability: NTIS

Society of Automotive Engineers Inc., 400 Commonwealth Dr., Warrendale, PA 15096
SAE Handbook, 1977. Part 1. Materials, Parts and Components. Part 2. On-Highway Equipment, Off-Highway Equipment
Annual report in 2 volumes, approximately 2000 p.
1977
Abstract: Published annually, this textbook of the automotive industry includes 890 SAE standards, recommended practices, and information reports. The handbook, which contains over 70 years of surface vehicle product practices in the U.S., specifies materials, components, hardware, safety, and performance through explanatory text, tables, charts, and engineering drawings. Part One covers materials and hardware and is organized into these broad categories: Ferrous Metals; Nonferrous Metals; Nonmetallic Materials; and Threads, Fasteners, and Common Parts. Part Two includes documents on on- and off-highway vehicles with sections on: Electrical Equipment and Lighting; Powerplant Components and Accessories; Emissions; Passenger Cars, Trucks, Buses, and Motorcycles; Off-Highway Vehicles; and Marine Equipment. Many of the reports included in this handbook are referenced by Federal and state governments in their regulations. (BYB)
Availability: Society of Automotive Engineers, Inc., Dept. 327, 400 Commonwealth Dr., Warrendale, PA 15096 $65.00 set

Society of Automotive Engineers Inc., 400 Commonwealth Dr., Warrendale, PA 15096
Electric Vehicle Test Procedure--SAE J227a: SAE Recommended Practice
Report of Electric Vehicle Technical Committee approved March 1971 and last revised Feb. 1977, printed in SAE Handbook 1977, Part 2, pp. 27.07-27.12
1977
Abstract: In order to allow performance characteristics of electric vehicles to be cross-compared on a common basis, this SAE recommended practice establishes uniform procedures for testing electric battery powered vehicles that can be driven on public and private roads. The tests deal with the total vehicle system, not subsystems and components. Test conditions and instrumentation are described, and the data to be recorded for all tests are identified. Tests covered by this document are: range at steady speed, vehicle range when operated in a selected driving pattern, acceleration, gradeability limit, gradeability at speed, vehicle road energy consumption, vehicle energy economy, and deceleration. (BYB)

Stalb, R.
The Influence of Alternative Electrical Energy Growth Rates on Impacts of Future Use of Electric Cars in Three Metropolitan Areas
General Research Corp., P.O. Box 3587, Santa Barbara, CA 93105
Internal Memorandum No. IM-2047, 79 p.
20 Aug 1976
Sponsor: Energy Research and Development Administration
Abstract: This study reassesses estimates made in two previous General Research Corporation studies of the availability of electrical energy for the large-scale use of electric cars in the Los Angeles, St. Louis, and Philadelphia metropolitan areas. The study was made necessary because of recent rapid changes in projected future demand for electricity in almost all areas of the country. It was shown that in the past two to three years there has been a substantial reduction in the power company projections of the rate of growth in the demand for electricity in all three regions. There is evidence, however, that these projections are not consistent with each other and that considerable uncertainty exists. This uncertainty must naturally be reflected in any estimates of the energy available for automotive use. In this and in previous studies the energy for electric car recharge is assumed to come from the late-night "troughs" in the power companies' daily load profiles. It was shown that the problems associated with assuring that recharge occurs only at off-peak hours are such that there can be no assurance that the large-scale use of electric cars will not require an increase in installed generating capacity. ... The effect on petroleum usage in each area was determined assuming that electric cars replace, to varying degrees, the conventional internal-combustion-engine automobiles now in use. (8 references) (auth, abstract modified)

Stark, H.A. (ed.)
Ward's 1976 Automotive Yearbook
Ward's Communications Inc., 28 West Adams, Detroit, MI 48226
Thirty-Eighth Edition, Ward Communications, Inc., Detroit, MI, 360 p.
1976
Abstract: Developments in the automotive industry in 1975 are treated in this annual publication. Separate sections are included on Industry Trends, Imported Vehicles, Recreational Vehicles, Materials and Processes, Tires, Production, Retail Sales, Used Cars, Registrations, Canadian Report, Car Manufacturers, Truck Manufacturers, and Construction/Farm Equipment Manufacturers. This Yearbook also contains a Supplier Directory, listing suppliers and some divisions of a corporation with their addresses, phone numbers, officers, and products; and a Product Guide, which lists products in alphabetical order with names of manufacturers below each product name. An Advertisers' Index and an Information Index are provided. (BYB)
Availability: $25.00

Stark, H.A. (ed.)
Ward's Automotive Reports
Ward's Automotive Reports, 28 W. Adams St., Detroit, MI 58226
Weekly publication, approximately 8 p.
Weekly
Abstract: News events in the automotive industry are reported on in this periodical. Included is information on automobile imports, industry output, car and truck sales, car stocks, automotive production, the automobile market, etc. Labor and related industry news are also reported on. Each issue contains the Ward's Production Estimates and Statistics, a table providing weekly and monthly data on the production levels of individual car models. (BYB)
Availability: Subscription $225 per year; 1976 Index, $35; 1977 Monthly Cumulative Index, $50

Storment, J.O.; Wood, C.D.; Mathis, R.J.
A Study of Fuel Economy and Emission Reduction Methods for Marine and Locomotive Diesel Engines
Southwest Research Institute, Dept. of Engine and Vehicle Research, P.O. Drawer 28510, San Antonio, TX 78284
Report No. PB-246725, DOT-TSC-OST-75-41, CG-D-124-75, DOT-TSC-USCG-75-2, 107 p.
Sep 1975
Sponsor: U.S. Coast Guard, Office of Research and Development; U.S. Dept. of Transportation, Office of the Secretary, Office of the Assistant Secretary for Systems Development and Technology, Office of Systems Engineering
Abstract: This interim report presents the results of the first phase of a two-part program to investigate methods of improving fuel consumption and reducing exhaust emissions for in-service diesel engines used as prime movers in locomotives and several classes of Coast Guard vessels. The engines are large, medium-speed units with individual cylinder displacements in excess of 150 cubic inches and power ratings from 2000 to 4000 brake horsepower. The study that is the subject of this report utilizes information that was obtained from the technical literature and from interviews of engine manufacturers, railroads, and engineering staffs of Coast Guard vessels. Several methods were investigated for their potential to reduce fuel consumption and emissions, within the constraint of maintaining adequate locomotive and vessel operating flexibility and engine life. These methods included the retrofit engines with existing state-of-the-art components (e.g., injectors, governor, turbocharger) of improved design, the adjustment of injection timing, and changes in engine operating modes (speed-power points). The effects of engine wear and maintenance on fuel consumption and emissions were investigated, as were the effects of ambient air properties (temperature, pressure, humidity). The conclusions reached at the end of Phase I of the program resulted in several recommendations for additional investigation or evaluation by actual testing in Phase II. (40 references) (GRA)
Availability: NTIS

Taylor, W.F.; Hall, H.J.
Future Synthetic Fuels: A Scientific and Technical Applications Forecast
Exxon Research and Engineering Co., Government Research Laboratory, Linden, NJ 07036
Report No. AD-A014 947, 148 p.
Sep 1975
Sponsor: U.S. Dept. of Defense, Army, Office of the Chief of Research, Development and Acquisition
Abstract: This scientific and technical application forecast (STAF) reviews the broad problem of the impact on the U.S. Army of the use of synthetic fuels (defined as a non-petroleum derived fuel) over the time period of 1975 to 2000. The STAF is divided into three basic parts. The first part involves a forecast of which synthetic fuels will have a major impact in the time period under study. In the second part of the STAF, those alternate fuels identified as the most feasible synthetic fuels in the future were subjected to detailed analyses. The third part of the STAF consists of the identification of a number of areas which appear to offer promise for fruitful R & D in the synthetic fuel area. (452 references) (auth)
Availability: NTIS

Tierney, W.T.; Johnson, E.M.; Crawford, N.R.
Energy Conservation: Optimization of the Vehicle-Fuel-Refinery System
Texaco Inc., Beacon, NY 12508
Paper No. 750673 presented at the Fuels and Lubricants Meeting, sponsored by the Society of Automotive Engineers, held in Houston, Texas on June 3-5, 1975, 28 p.
Jun 1975
Abstract: Studies of several options available for future vehicular transportation powerplants have strongly indicated that it is necessary to optimize the vehicle, its fuel and the refinery as a total system. It is the purpose of this paper to report the relative miles of transportation that can be obtained from a barrel of crude oil by using different types of engines and fuels. This concept is not new. The energy required to manufacture fuels has always been supplied by using part of the energy in the crude oil. However, the importance of the concept is compounded when one considers that large quantities of gasoline are lost due to processing requirements for producing unleaded gasoline octane numbers while concurrently, automotive emission controls and safety regulations increase gasoline consumption. Both of these effects cause a reduced efficiency in the use of crude oil. The only true measure of the impact on energy usage caused by changes in refinery operations and vehicular modifications is to relate the miles of transportation obtained to the energy available in the crude oil. This concept accounts for both the energy needed for fuel manufacture and the energy needed to propel the vehicle. The options that have been studied are: (1) use of leaded gasoline in an internal combustion engine, (2) use of unleaded gasoline, (3) maximum use of diesel engines, (4) maximum use of the direct injection stratified charged engine, and (5) maximum use of gas turbine engines. It will be shown that the engine-fuel option chosen will have a large effect on the crude oil imports required which, in turn, will have a substantial impact on the United States domestic economy and balance of payments. Furthermore, the choice of the wrong option could seriously restrict the number of vehicles that could be operated if world-wide crude oil availability should become limited in supply. (27 references) (auth)

Tierney, W.T.; Wilson, R.F.
Adequate Future Transportation Demands Vehicle-Fuel-Refinery System Optimization Today
Texaco Inc., Beacon, NY
Paper presented at the 19th meeting of the American Petroleum Institute with the Automotive Industry, Southfield, Michigan, January 29, 1976, 32 p.
1976
Sponsor: American Petroleum Institute, Fuels and Lubricants Committee
Abstract: The critical shortage of petroleum resources in the United States as a source of transportation fuels for the future is reviewed briefly. This establishes the well recognized basis for concern with the viability of U.S. transportation systems in the future. It is suggested that the vehicle, its fuel, and the refinery be considered as a total system which must be optimized in order to provide for the most efficient utilization of our crude oil and subsequent synthetic-based fuels. To present the benefits to be derived from such studies, two series of cases are presented on the basis of applying known vehicle fuel economy efficiencies to various transportation fuel product slates obtained from computer runs established to simulate a typical refinery. The first series of runs shows the relative fuel quantities available when a given refinery is so operated as to maximize the production of specific fuels. These fuels are leaded gasoline, taken as the base case; 91 Research Octane Number lead free fuel; diesel fuel; and a broad range distillate product. These are then considered for use in gasoline, diesel, stratified charge, and turbine engines. The second series of runs considers the more stringent refining situation of providing a fixed amount of transportation as well as a fixed total U.S. volume of certain important so-called protected products. In view of the known limits on future crude oil reserves, the substitution of synthetic fuels from such sources as oil shale, tar sands, and coal is briefly discussed. The impact of the relative availability of petroleum industry investment capital is then briefly reviewed since it will have an impact on future transportation fuel supply. (8 references) (auth)

Transportation Association of America, 1101 17th St., N.W., Washington, DC 20036
Transportation Facts and Trends
Published annually, with quarterly supplements, Twelfth Edition (1975)
Jul 1976
Abstract: The purpose of these annual booklets is to illustrate the importance of transportation to the U.S. and to discuss transportation trends. The reports consist of a compilation of tables and graphs presenting data on all phases of transportation, including freight and passenger bills for the nation, shipments by manufacturing establishments, intercity and overseas travel, employment, earnings, taxes, investments, expenditures, demand, and government agencies. (MPG)

U.S. Congress, Washington, DC
Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976, Public Law 94-413, 94th Congress, H.R. 8800
Public Law 94-413, H.R. 8800, 12 p.
17 Sep 1976
Abstract: This law authorizes a Federal RD&D program in ERDA to promote electric vehicle technologies and to demonstrate the commercial feasibility of electric-powered vehicles. Research and development are called for in related areas: (1) energy storage technologies, including batteries and their potential for convenient recharging; (2) vehicle control systems and overall design for energy conservation, e.g., the use of regenerative braking; (3) urban design and traffic management to promote maximum energy savings in transportation and minimum transportation-related environmental degradation; and (4) vehicle design, with emphasis on durability, length of lifetime, ease of repair, and interchangeability and replacement of parts. Provisions are included to assure that small businesses have an opportunity to participate in this program. Guarantees of loans are provided to encourage commercial production of electric and hybrid vehicles. To promote the use of electric-powered vehicles by Federal agencies, these agencies are authorized to perform a study on the feasibility of using electric vehicles and to introduce these vehicles into their fleets as soon as possible. Up to $30 million are appropriated for the fiscal year ending September 30, 1977 to carry out the purpose of this Act. (BYB)

U.S. Dept. of Commerce; U.S. Dept. of Housing and Urban Development, Washington, DC
Annual Housing Survey: United States and Regions. Part A - General Housing Characteristics
Current Housing Reports Series H-150-73A for 1973 data; Current Housing Reports Series H-150-74A for 1974 data, v.p.
Jul 1975; Aug 1976
Abstract: Statistics are presented on general housing characteristics from the Annual Housing Survey for the U.S. by inside and outside standard metropolitan statistical areas and each of the four geographical areas (Northeast, North Central, South, and West). Information is provided on the size and composition of the housing inventory, the characteristics of its occupants, and changes in the inventory resulting from new construction and from losses. Statistics are based on information from a sample of housing units, collected by personal interview. Contained in this publication are an introduction; a summary of findings with text tables; Appendix A, which describes the geographic area classifications and provides definitions and explanations of the subjects covered in this report; and Appendix B, which presents information on sample design, estimation, and accuracy of the data. (BYB)
Availability: GPO $3.20 for 1973 Survey; $4.35 for 1974 Survey

U.S. Dept. of Commerce, Bureau of the Census, Washington, DC
Statistical Abstract of the United States, 1975; 1976
Annual publication, National Data Book and Guide to Sources, 96th Annual Edition, 1050 p. for 1975 Abstract; 97th Annual Edition, 1049 p. for 1976 Abstract
1975; 1976
Abstract: Statistical data are included in the following categories: population; vital statistics, health, and nutrition; immigration and naturalization; education; law enforcement, federal courts, and prisons; area, geography, and climate; public lands, parks, recreation, and travel; labor force, employment, and earnings; national defense and veterans affairs; social insurance and welfare services; income, expenditures, and wealth; prices; elections; federal government finances and employment; state and local government finances and employment; banking, finance, and insurance; business enterprise; communications; power; science; transportation - land; transportation - air and water; agriculture; forests and forest products; fisheries; mining and mineral products; construction and housing; manufactures; distribution and services; foreign commerce and aid; outlying areas under the jurisdiction of the United States; comparative international statistics; and metropolitan area statistics. (DCM)
Availability: GPO $10.50 (cloth), Stock No. 0324-01049-6; $8.00 (paper), Stock No. 0324-01050-0 for 1975 Edition; $10.50 (cloth), Stock No. 003-024-01173-5; $8.00 (paper), Stock No. 003-024-01174-3 for 1976 Edition

U.S. Dept. of Commerce, Bureau of Economic Analysis, Washington, DC
Survey of Current Business
v.p.
Monthly
Abstract: Each monthly report provides comprehensive coverage of business and economic conditions including national income and balance of payment statements. In-depth articles on various economic subjects are also included. Weekly supplements provide advance information on selected data. (EBH)
Availability: GPO $48.30 annual subscription including weekly supplements

U.S. Dept. of Commerce, Bureau of the Census, Washington, DC
Selected Data from the 1973 and 1974 Surveys of Purchases and Ownership
62 p.
Jul 1976
Abstract: The Surveys of Purchases and Ownership were conducted in the fall of 1973 and 1974 as supplements to the Annual Housing Survey. Data are presented on consumer ownership, availability, and purchases of automobiles and major household items. Socio-economic factors affecting ownership and purchases of cars and appliances are surveyed (e.g., income, age of head of household, race and Spanish origin, location of residence, and tenure of housing unit). Data collected from the 1973 and 1974 Surveys of Purchases and Ownership are to be published in an issue of "Consumer Buying Indicators," Series P-65 in the Current Population Report Series. (BYB)

U.S. Dept. of Commerce, Bureau of the Census, Population Division, Washington, DC
The DOT Travel to Work Supplement to the Annual Housing Survey
Draft, v.p.
Nov 1976
Sponsor: U.S. Dept. of Transportation
Abstract: Preliminary data from the Travel to Work Survey, part of the Annual Housing Survey as of 1975, are presented in this draft report. Twelve tables are provided: (1) Major Mode of Transportation to Work, for 21 SMSA's (standard metropolitan statistical areas) and Specified SMSA Groups: 1975; (2) Change in Commuter Use of Public Transportation for 21 SMSA's and Specified SMSA Groups: 1970-1975; (3) Median Time Taken to Get to Work by Major Mode of Transportation, for 21 SMSA's and Specified SMSA Groups: 1975; (4) Median Distance from Home to Work by Major Mode of Transportation, for 21 SMSA's and Specified SMSA Groups: 1975; (5) Mode of Transportation to Work Last Year by Current Mode, for 21 SMSA's: 1975; (6) Mode of Transportation to Work Last Year by Percent Using Current Modes, for 21 SMSA's: 1975; (7) Workers Commuting by Truck and Other Selected Modes, for 21 SMSA's: 1975; (S-1) Major Mode of Transportation by Time Taken to Get to Work, San Francisco-Oakland SMSA: 1975; (S-2) Major Mode of Transportation by Distance from Home to Work, San Francisco-Oakland SMSA: 1975; (S-3) Work Trips of Specified Lengths of Time, and Percent Distribution by Mode, San Francisco SMSA: 1975; (S-4) Work Trips of Specified Distance, and Percent Distribution by Mode, San Francisco SMSA: 1975; and (S-5) Commuter Miles and Commuter Minutes Traveled Daily from Home to Work, by Major Mode of Transportation, San Francisco SMSA: 1975. Data in these tables are based on weighted but not fully edited data taken from the first four months (April - July 1975) of interviews and may vary from final tabulations based on the entire 12 month sample. Final edited results should be available during the first half of 1977. (BYB)

U.S. Dept. of Commerce, Bureau of the Census, Washington, DC
Current Population Reports: Population Estimates and Projections. Estimates of the Population of the United States, by Age, Sex, and Race: July 1, 1974 to 1976
P-25 Series, No. 643, 26 p.
Jan 1977
Abstract: This report presents estimates of the population of the United States by single years of age, sex, and race for July 1, 1974 to 1976 and for April 1, 1970, the date of the most recent census. Estimates are shown for the total population including Armed Forces overseas, the resident population, and the civilian population. (from Introduction)
Availability: GPO $0.65; series subscription $56 annually

U.S. Dept. of Commerce, Bureau of the Census, Washington, DC
Current Population Reports: Population Estimates and Projections. Estimates of the Population of States, by Age: July 1, 1975 and 1976 (Advance Report)
P-25 Series, No. 646, 6 p.
Feb 1977
Abstract: This report contains estimates of the resident population of States by broad age groups for July 1, 1975 and provisional estimates for July 1, 1976. The 1975 estimates supersede the provisional 1975 estimates published in Current Population Reports, Series P-25, No. 619. The age groups shown are: under 5 years, 5 to 17 years, 18 to 44 years, 45 to 64 years, and 65 years and over, plus the cumulative age groups 14 years old and over, 18 years and over, and 21 years and over. (from introduction)
Availability: GPO $0.35; series subscription $56 annually

U.S. Dept. of Commerce, Bureau of the Census, Washington, DC
Current Population Reports: Population Estimates and Projections. Estimates of the Population of States with Components of Change: 1970 to 1975
P-25 Series, No. 640, 30 p.
Nov 1976
Abstract: This report contains annual estimates of the population of States for 1970 to 1975 and components of population change for the 1970-75 period. Also included is a detailed description of the estimating procedures used to develop these estimates together with a discussion of their limitations. A discussion of recent trends in population growth for regions and States is presented. Special emphasis is placed on the effects of the declining birth rate and the out-migration from the nation's very large metropolitan areas on the population totals for individual States. (from introduction)
Availability: GPO $0.75; series subscription $56 annually

U.S. Dept. of Commerce, Bureau of the Census, Washington, DC
Current Population Reports: Population Estimates and Projections. Revised 1975 and Provisional 1976 Estimates of the Population of States, and Components of Change, 1970 to 1976
P-25 Series, No. 642, 6 p.
Dec 1976
Abstract: This report presents revised estimates of the population of States for July 1, 1975 and provisional estimates for July 1, 1976 for the resident and the civilian population. Estimates of the components of population change for the period 1970 to 1976 are shown for both populations. The 1975 estimates shown here supersede provisional 1975 numbers published in Current Population Reports, Series P-25, No. 640. (from introduction)
Availability: GPO $0.35; series subscription $56 annually

U.S. Dept. of Interior, Bureau of Mines, Division of Petroleum and Natural Gas, Washington, DC 20241
Mineral Industry Surveys: Supply, Demand, and Stocks of All Oils by P.A.D. Districts and Imports to the United States, by Country
Monthly, quarterly, and annual reports, v.p.
Abstract: Data on the production, supply, demand, imports, and stocks of crude oil, natural gas liquids, and petroleum products are reported in these periodic publications. Tables are provided on: Supply, Demand, and Stocks of All Oils by P.A.D. District; Supply, Demand, and Stocks of Crude Oil, Natural Gas Liquids, and Petroleum Products by Product by P.A.D. District; and Imports of Petroleum Products and Crude Oil into the U.S. (BYB)

U.S. Dept. of Interior, Bureau of Mines, Washington, DC
Annual U.S. Energy Use Up in 1976
Bureau of Mines News Release, annual report, 11 p.
14 Mar 1977
Abstract: Energy consumption data for 1976 are reported in this publication. Total energy use rose 4.8% during 1976 from 1975, reversing the two year decline. Household and commercial sectors used 7.3% more energy than in 1975, largely due to colder weather. Primary energy consumed for electric power generation also rose 5.6%. The transportation sector used 4.2% more energy than in 1975, with gasoline consumption up 4.5%. Increased trucking activity was responsible for an estimated 7.3% rise in distillate fuel consumption. Energy consumption in the industrial sector increased 3.3%. Tables provide the following information: Apparent Consumption of Primary Energy Resources and Selected Related Products; U.S. Consumption of Energy Resources by Major Sources and Consuming Sectors; Domestic Supply and Demand for Coal; Domestic Supply and Demand for Natural Gas; Domestic Supply and Demand for Petroleum; Petroleum Consumption, by Major Product and Major Consuming Sector for 1975 and for 1976; U.S. Net Trade, Mineral Fuels. (BYB)

U.S. Dept. of Labor, Bureau of Labor Statistics, Washington, DC 20212
Consumer Expenditure Survey Series: Interview Survey, 1972 and 1973
Report series 455
1976
Abstract: The latest Consumer Expenditure Survey, completed in June 1974, covered the civilian noninstitutional population over a period of 2 years (1972 and 1973). This Survey is a comprehensive source of detailed information on family expenditures and income that can be classified by socio-economic and demographic characteristics of U.S. families (e.g., income, family size, region, age of family head, race of family head, education of family head, housing tenure, family composition, and type of area). The Survey is comprised of two separate components: (1) a diary survey and (2) an interview panel survey in which families reported information to interviewers quarterly over a 15-month period. The sample for the Survey includes about 10,000 families. In these Interview Survey reports average yearly expenditures on these purchases are surveyed: food, alcoholic beverages, tobacco, housing, house furnishing and equipment, clothing, transportation (vehicle purchases, vehicle finance charges, vehicle operation, gasoline, and other transportation), health care, personal care, recreation, personal insurance and pension, and gifts and contributions. (BYB)
Availability: Bureau of Labor Statistics, Washington, DC 20212

U.S. Dept. of Labor, Bureau of Labor Statistics, Washington, DC
Autumn 1976 Urban Family Budgets and Comparative Indexes for Selected Urban Areas
Bureau of Labor Statistics News, annual report, (USDL: 77-369) 20 p.
27 Apr 1977
Abstract: This annual report estimates three hypothetical annual family budgets and the comparative indexes that are used to compare the cost of these budgets in 39 selected urban areas. Changes in prices and personal taxes between autumn 1975 and autumn 1976 are accounted for in this update. In autumn 1976 the U.S. average cost of the lower budget for an urban family with four members was $10,041; average cost of the intermediate budget was $16,232; and the higher budget, $23,759. Tables provide information on: Summary of Annual Budgets for a Four-Person Family at Three Levels of Living, Urban United States, Autumn 1976; Percent Change in Four-Person Family Budgets, Autumn 1975 to Autumn 1976; Annual Consumption Budgets for Selected Family Types, Urban U.S., Autumn 1976; Annual Costs of a Lower Budget, Intermediate Budget, and Higher Budget for a Four-Person Family; and Indexes of Comparative Costs Based on a Lower Budget, Intermediate Budget, and Higher Budget for a Four-Person Family. (BYB)

U.S. Dept. of Transportation, Federal Highway Administration, Washington, DC
Highway Statistics: 1974; 1975
Report No. PB-255090, annual publication, 268 p. for 1974 Statistics
1976
Abstract: This annual publication brings together selected statistical tabulations relating to highway transportation in three major areas: 1) highway uses--the ownership and operation of motor vehicles; 2) highway finance--the receipts and expenditures for highways by public agencies; and 3) the highway plant--the extent and changing characteristics of the mileage of public highways, roads, and streets in the Nation. Beginning in 1975, this report is being released in several sections in order to make the information available earlier. Section One of the 1975 Statistics, subtitled "Vehicles, Drivers, and Fuels," contains data on Motor Fuel; Motor Vehicles and Driver Licensing; Highway Usage Characteristics; Federal Fuel and Automotive Taxes, and the Highway Trust Fund; Highway Finance Summaries; Federal Highway Finance and Programs; State Highway Finance; Local Road and Street Finance; Roadway; and U.S. Territories. (EBH)
Availability: GPO $3.90, Stock No. 050-001-00107-1 or NTIS $2.25 for 1974 Statistics

U.S. Dept. of Transportation, Federal Highway Administration, Washington, DC 20590
Department of Transportation News, Federal Highway Administration
Irregularly published news release
Abstract: These news releases from the Federal Highway Administration provide information on highway transportation in the U.S. Tables are included on such subjects as highway construction, fuel consumption, motor vehicle registrations, motor vehicle travel, motor fuel taxes, and gasoline sales. (BYB)
Availability: Federal Highway Administration free

U.S. Dept. of Transportation, Office of the Secretary, Washington, DC
National Transportation Trends and Choices (to the Year 2000)
426 p.
12 Jan 1977
Abstract: As the first multimodal national transportation plan developed by the Department of Transportation (DOT), this document described the Department's tentative view of the future of transportation in the U.S. Following a brief history of transportation, Part A discusses total U.S. transportation--passenger travel and freight movement--with little attention to individual modes of transportation. Part B treats the development and use of the automobile today and in the future. Interstate Transportation (Part C) covers transmodal issues (issues involving more than one mode of interstate transportation) and examines these modes separately: highways, railroads, aviation, marine, and pipelines. Part D, State and Local Transportation, studies factors common to both metropolitan and small urban and rural transportation, as well as topics unique to each area. Metropolitan and nonmetropolitan transportation, as reported by each state, are summarized. U.S.-International Transportation, Part E, includes a discussion of international aviation and international marine transportation. The final part contains these chapters: Alternative Transportation Futures and Contingencies, Technological Possibilities, and The Future of the Planning Effort. A separate mapping appendix is provided with maps on major transportation modes in the U.S. This document does not constitute an official position of the executive branch of the Federal government, but has been developed by DOT as a step in the transportation planning process. (BYB)
Availability: GPO $8.50, Stock No. 050-000-00124-5

U.S. Dept. of Transportation, Federal Aviation Administration, Office of Aviation Policy, Aviation Forecast Branch, Washington, DC 20591
Aviation Forecasts, FY 1977 - 1988, Summary and Briefing Conference
Report No. FAA-AVP-77-16, Conference held on December 2, 1976, at Reston, VA, 283 p.
2 Dec 1976
Abstract: The second annual Federal Aviation Administration Forecast Conference was attended by approximately 250 people from various segments of the aviation community. This report of the proceedings includes all the formal presentations and some representative questions and answers. This Conference, like the previous one, was held for the primary purpose of (1) reemphasizing the importance of accurate data and aviation activity forecasts for Federal Aviation Administration (FAA) planning and budgetary purposes, and (2) stimulating the interchange of ideas between FAA and the aviation community, particularly between the "forecasters" and the "forecast users." (from Foreword)

U.S. Dept. of Transportation, National Highway Traffic Administration, Office of Automotive Fuel Economy, Washington, DC
Data and Analysis for 1981-1984 Passenger Automobile Fuel Economy Standards
v.p.
28 Feb 1977
Abstract: The Data and Analysis for 1981-1984 Passenger Automobile Fuel Economy Standards are presented in separate support documents, as follows: Summary Report; Document 1 - Automobile Demand and Marketing; Document 2 - Automotive Design Technology; Document 3 - Automobile Manufacturing Processes and Costs; and Document 4 - Financial Analysis of the U.S. Automotive Manufacturers. The primary purpose of these support documents is to provide a substantive data base, plus analyses and judgments relevant to the establishment of average fuel economy standards for model years 1981 through 1984, as mandated in Section 502 of the Motor Vehicle and Cost Savings Act, as amended. As required therein, and as discussed in the Notice of Proposed Rulemaking (NPRM) - Docket No. FE 76-1 - Notice 3 issued on February 17, 1977 (42FR 10321), these documents discuss the following factors in determining maximum feasible fuel economy levels for each year in question: technological feasibility; economic practicability; the effect of other Federal motor vehicle standards on fuel economy; and the need of the nation to conserve energy. ... The information and analyses contained in the summary report and supporting documents, especially the uncertainties related to design changes, are preliminary and subject to reevaluations based on further assessment by the automotive industry and other interested parties. (from Preface)
Availability: Limited supply

U.S. General Accounting Office, Washington, DC 20548
Potential for Using Electric Vehicles on Federal Installations. Report of the Comptroller General of the United States
Report No. LCD-76-206, 17 p.
3 Mar 1976
Abstract: Many high-performance conventional vehicles are being used by Federal agencies for tasks which could be handled by lower performance vehicles that offer advantages of reduced costs, energy consumption, and air pollution. This report compares the performance, cost, energy use, and environmental pollution characteristics of electric vehicles with conventional vehicles. (auth)

U.S. General Accounting Office, Washington, DC
Comments on the Administration's Proposed Synthetic Fuels Commercialization Program
Report No. RED-76-82, 34 p.
19 Mar 1976
Sponsor: Energy Research and Development Administration
Abstract: Proposals providing for Federal assistance to aid industry in constructing and operating synthetic fuel commercial demonstration facilities are evaluated in this report, particularly proposals which would provide loan guarantees. ERDA had planned studies to be completed by July 1976 which focused on: undertaking strategy and policy analyses necessary for program implementation; initiating long lead-time activities related to program implementation (e.g., environmental impact statements and program regulations); and informing the public, Congress, states, and others about the proposed program. It is suggested that Congress wait until these studies are completed before enacting legislation authorizing a commercial demonstration program. Congress should, perhaps, require ERDA to delineate and justify the scope and magnitude of Federal assistance needed to carry out the program, and justify the type and number of plants to be constructed. Government aid for stimulating commercialization of synthetic fuel technologies could also be considered within the broader scope of the proposed Energy Independence Authority. (BYB)

U.S. Travel Data Center, 1100 Connecticut Ave. NW, Washington, DC 20036
1975 National Travel Survey: Full Year Report
Annual report, 131 p.
1976
Abstract: Travel activity of U.S. residents during 1975 is summarized in this second annual report. In order to indicate changes in travel behavior over time, the 1975 and 1974 National Travel Surveys attempted to duplicate the 1972 Survey by the Bureau of Census. A quota sample of over 3,000 households was used for the 1975 Survey. The volume of travel grew substantially in 1975 with person-trips numbering over 660 million, or 12% above the 1974 level and 44% above the 1972 level. Person-miles traveled rose 16% over the 1974 level and person-nights away from home rose 14%. The average trip distance lengthened while average travel party size and trip duration declined. This report includes data on overnight accomodations, auto/truck travel, air travel, travel to visit friends or relatives, other pleasure travel, business travel, weekend travel, vacation travel, regional travel patterns, secondary means of transportation, travel agent usage, length of stay at destination, and frequency of dining out. The user of the 1975 data in this report is cautioned "to consider the results as indicators of general orders of magnitude rather than precise representations of fact." (BYB)
Availability: $20.00

Unnewehr, L.E.; Minck, R.W.; Owens, C.
Application of the Ford Sodium-Sulfur Battery in Electric Vehicles
Ford Motor Co., Engineering and Research Staff, Detroit, MI
Paper No. 770382, presented at the International Automotive Engineering Congress and Exposition, Cobo Hall, Detroit, Michigan, February 28 - March 4, 1977, 12 p.
1977
Sponsor: Society of Automotive Engineers
Abstract: The Ford sodium-sulfur battery is evaluated for applications in electric vehicles. The required power and energy ratings of a battery to achieve acceptable performance and driving range for a specific commuter-type vehicle are calculated and discussed. The relative merits of the use of mechanical transmissions and regenerative braking in electric vehicles are explored. Volumes and weights of several battery packages based upon realistic NaS cell designs are calculated, and the thermal management problems of these high-temperature battery packages during the varying power levels required in vehicular applications are discussed. (14 references) (auth)
Availability: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 $2.75

Wager, H. (ed.)
Platt's Oil Price Handbook and Oilmanac
McGraw-Hill Publications Co., 1221 Avenue of the Americas, New York, NY 10020
Annual Publication, McGraw-Hill, Inc., approximately 185 p.
Annual
Abstract: Statistical data on petroleum sales and prices and on happenings that affect petroleum and related markets are contained in these annual Handbooks. Information is organized into these sections: Products Prices in United States (motor gasoline, liquefied petroleum gas, distillates and residual fuel oils, and lubes); U.S. Statistics, including retail gasoline prices in 55 cities, U.S. Bureau of Labor Statistics wholesale price index, and the Independent Petroleum Association of America's average wholesale prices; Crude Oil Prices for U.S. and Canada, Middle East, Africa, Argentina, and Venezuela; and World Products Prices (Other than United States) -"AFM" (Aussenhandelsverband Fur Mineralol E.V.) Barge Quotations; European Bulk Prices and Averages, Cargo Prices, Tanker Rates, and Average Freight Rate Assessments. In addition to a subject index two other indexes are included: Refinery and Terminal Prices Index, which indicates pages on which prices are shown for principal products in specific cities or regions of the U.S.; and Crude Oil Prices Index (U.S. and other). (BYB)
Availability: $75.00 for 51st (1974 Prices) and 52nd (1975 Prices) Editions

Ward's Communications Inc., 28 W. Adams St., Detroit, MI 58226
Ward's Engine Update
Biweekly publication, approximately 8 p.
Biweekly
Abstract: This pericdical provides news on engine research and development, particularly with respect to reciprocating, Wankel, diesel, turbine, Stirling, and steam engines and electric vehicles. In addition to news briefs describing individual automobile companies' R & D progress, the Update reports on related government activities, emissions standards, fuel economy, automotive fuels (including alternative fuels) and fuel additives, industry happenings, and engine components. (BYE)
Availability: Ward's Communications Inc., 28 W. Adams St., Detroit, MI 58226 $136.00 per year

Wilson, R.F.; Tierney, W.T.
Future Transportation Fuels - Optimization of the Vehicle-Fuel-Refinery System
Texaco Inc., Beacon, NY
Presented at the 41st Midyear Meeting of the American Petroleum Institute Refining Department, Century Plaza Hotel, Los Angeles, May 10-13, 1976, 20 p.
1976
Abstract: Current energy demand and supply patterns are reviewed and the availability of energy resources to meet demands in the free world is projected. At current petroleum industry capital investment levels, it is shown that future domestic crude oil production will not be sufficient to significantly reduce the level of petroleum imports. Synthetic fuels from such sources as oil shale, tar sands and coal are also considered as replacements for imported petroleum. It is suggested that conservation coupled with incentives for new petroleum and alternate resource development can substantially reduce the United States dependence on imported petroleum. Since transportation fuels account for a large portion of liquid fuels consumption, it is shown that the vehicle, its fuel, and the refinery (VFR) must be optimized as a total system in order to provide for the most efficient utilization of our crude oil and subsequent synthetic-based fuels. To present the benefits to be derived from optimizing the VFR system, a series of cases is presented on the basis of applying known vehicle fuel economy efficiencies to various transportation fuel product slates obtained from computer runs made to simulate an average U.S. refinery. These runs show the relative fuel quantities available when a given refinery is operated to provide a fixed volume of non-automotive petroleum products and a fixed amount of transportation miles when using gasoline, diesel, broad range fuel, and future concept engines. It is concluded that system optimizations similar to the VFR system study must be more broadly applied between the various energy sources and final use devices to improve conservation in the entire spectrum of energy utilization. (14 references) (auth)
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SUPPLEMENT IV

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Yoshida, Y.; Muto, S.; Imaizumi, T.
Transient Aerodynamic Forces and Moments on Models of Vehicles Passing Through Cross-Wind
Japan Automobile Research Institute Inc., Japan
Paper No. 770391, presented at the International Automotive Engineering Congress and Exposition, Cobo Hall, Detroit, Michigan, February 28 - March 4, 1977, 16 p.
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GLOSSARY

COAL GASIFICATION: The process of converting coal to synthetic gas. Coal is fed into a high-temperature pressurized container along with steam and air or oxygen, and a chemical reaction occurs. A mixture of gases is produced from this reaction. The gases produced include carbon monoxide, hydrogen, and methane, the main constitutent of natural gas. The gases are then cooled and undesirable components, such as carbon dioxide and sulfur, are removed. The raw gas produced at this point is referred to as low-Btu gas or as utility/industry substitute fuel.

COAL LIQUEFACTION: The process of converting coal into a liquid fuel. There are several different processes for producing liquids from coal. Some processes burn coal, condense the resulting gases, and add hydrogen to form a liquid, whereas other processes chemically dissolve coal with hydrogen to form a liquid.

DOMESTIC FLEET: Comprised of the following motor vehicles: sedans of all types, station wagons, ambulances, buses, trucks and truck tractors, registered in the United States, its territories and possessions.

ETHANOL: An alcohol produced by solar energy via the unique process of photosynthesis from plant material (biomass). Since biomass is a renewable energy source suitable for ethanol production by fermentation and distillation, this alcohol has a potential as an automotive fuel. However, the current cost of ethanol fuel is excessive and market prices of ethanol are about two times those of methanol. With crude oil prices continually rising, there is expected to be a possibility of making production cost-competitive by the use of new production technologies.

HYDROCRACKING: A catalytic, high-pressure refining process flexible enough to produce either high-octane gasoline or aviation jet fuel. It proceeds by two main reactions: combining hydrogen with molecules that are too massive and complex for gasoline, and then cracking or breaking them up to the required fuels.

KEROGEN: A bituminous material occurring in oil shale that yields oil when heated. It is formed from algae and sea organisms or from waxy spores and pollen grain.

LIQUID PETROLEUM GAS (LPG): Consists of propane and butanes and is usually derived from natural gas. In locations where there is no natural gas and the gasoline consumption is low, naphtha is converted to LPG by catalytic reforming.

METHANOL: A colorless mobile alcohol of pungent odor and taste. It is produced from natural gas, heavy residues, and naphtha using a process that first leads to a carbon monoxide--hydrogen mixture (synthesis gas). From this synthesis gas, methanol is synthesized at elevated pressure and temperature using an appropriate catalyst. Because of this two-step process, any energy form that can produce hydrogen and carbon monoxide is potentially suitable for the production of methanol. Thus, methanol may be considered as a universal fuel that could be produced from a wide variety of energy sources and materials.

NAPHTHA: Any one of a wide variety of volatile hydrocarbon mixtures. They are sometimes obtained from coal tar, but are more often derived from petroleum. Physical properties vary widely; the initial boiling point may be as low as 80°F and end points may reach 260°C (500°F). The products sold as naphthas find their greatest use as solvents and diluents.

OCTANE RATING: A number that is used to measure the antiknock properties of a liquid motor fuel.

OIL SHALE: A finely grained sedimentary rock composed mostly of clay that contains an organic material called kerogen. When the kerogen is heated to about 482°C (900°F), it is converted to shale-oil and gas. The shale oil that is derived from kerogen is low in sulfur and although it varies in some respects from conventional petroleum, it can be refined into most petroleum products.

POPULATION, CIVILIAN: Represents the resident population minus the Armed Forces stationed in the United States.

POPULATION, RESIDENT: Includes residents of the 50 States and the District of Columbia, but excludes residents of the Commonwealth of Puerto Rico, residents of the outlaying areas under U.S. sovereignty or jurisdiction (principally American Samoa, Panama Canal Zone, Guam, the Virgin Islands of the U.S., and the Trust Territory of the Pacific Islands), and other American citizens (military and civilian) living overseas.

POPULATION, TOTAL: Includes the total population overseas, the resident population, and the Armed Forces stationed in foreign countries, Puerto Rico, and the outlaying areas, but not their dependents.

RETORTING: A heating process that produces shale oil from the organic matter in oil shale. The equipment that is used in this process is called a retort. The rate and nature of the shale oil that is produced depends upon the temperature at which the shale oil is retorted. Most references report retorting temperatures as being 500°C (932°F).

SALES-WEIGHTED MILES PER GALLON: Calculation of a vehicle's fuel economy based on the distribution of sales by different weight classes.

STANDARD METROPOLITAN STATISTICAL AREA (SMSA): A county containing a central city of 50,000 or more plus contiguous counties that are socially and economically integrated with the central city.

SYNCRUDE: Synthetic crude oil suitable for use as a refinery feedstock and for petrochemical production.

SYNTHETIC FUEL: A fuel which does not exist in nature, but which must be manufactured or synthesized. Generably, synthetic fuels are derived from other forms of fossil fuels that are less convenient for consumer use. Synthetic liquid fuels are produced from coal, shale, and tar sands.

SYSTEM OPTIMIZATION: Improvements in engine displacement/inertia weight combinations and combustion limitations for alternate fuels.

TAR SANDS: Geologic deposits of sand and clay which are heavily impregnated with oil.

TRANSPORTATION BILL: Indicates what the nation pays for transportation. For commercial transportation, it is the sum of the revenues of the operators. For private transportation, it is the sum of costs associated with ownership and operation.

VAPOR LOCK: Partial or complete interruption of the flow of fuel to the carbuertor, caused by the formation of bubbles of vapor in the feeding system.

VEHICLE YEARS: The equivalent total years of operation of an agency's fleet. It is calculated by summing the total months of actual operation of all vehicles (or vehicles of a specific type) and dividing by 12.

VOLATILIZATION: The process of converting a chemical substance from a liquid or solid state to a gaseous or vapor state. In the internal combustion engine, this occurs when gasoline is injected into the cylinder and mixed with air just prior to ignition.

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