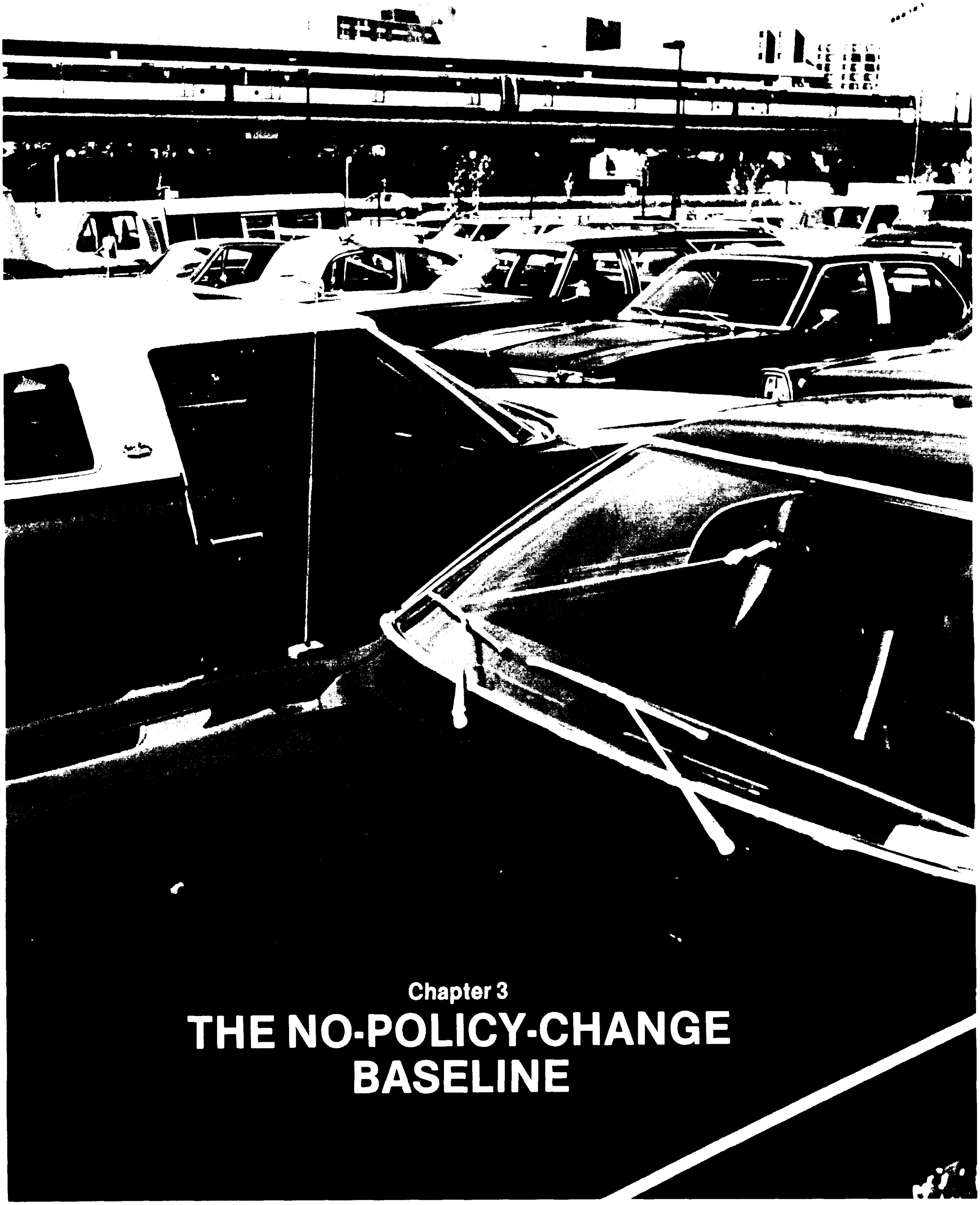

Chapter 3

THE NO-POLICY-CHANGE BASELINE

Chapter 3.- THE NO-POLICY-CHANGE BASELINE

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THE NO-POLICY-CHANGE BASELINE

CHAPTER 3

SUMMARY

The no-policy-change baseline, or Base Case, serves as a reference for evaluation of policy alternatives affecting the future automobile transportation system. The Base Case is a projection of automobile system characteristics and use under the assumption that current Federal Government policies and programs are continued in substantially their present form until 2000. This provides a baseline for comparing the effects and impacts that could result from pursuing alternatives to present policy.

Base Case projections of some of the more important features of automobile system characteristics and use for 1985 and 2000 are shown in table 13. For comparison, corresponding figures are shown for 1975 which was selected as the base year for this study.

One of the significant projections is that, although the number of automobiles and automobile vehicle miles traveled (VMT)[1] will continue to rise, fuel consumption will remain roughly constant. To counter rising purchase

[1] All VMT figures in this report refer to automobile VMT unless otherwise stated.

Table 13.—Summary of Base Case Projections

	1975	1985	2000
Mobility			
Automobiles in operation (millions)	95	118	148
Automobile vehicle miles traveled (trillions)	1.03	1.43	1.80
Urban auto travel in congested conditions (percent)	10	14	24
Transit vehicle miles traveled (billions)	2.0	2.3	3.0
Transit ridership (billions)	5.6	6.5	6.5
Energy			
Fleet fuel economy (miles per gallon)[a]	13.6	19.4	24.6
Automobile fuel demand (MMBD)	5.0	4.8	4.8
Petroleum imports (MMBD)	7.4	10.0	8.8[b]
Environment			
Automobile air pollutant emissions (millions of tons per year)			
Carbon monoxide	69.3	32.6	27.3
Hydrocarbons	7.9	3.5	2.9
Oxides of nitrogen	4.0	2.7	2.9
Safety			
Highway fatalities (thousands)[c]	46.0	58.4	64.0
Highway fatality rate (per 100 million miles)	3.4	3.1	2.8
Cost **and capital**			
New car sales (millions)[d]	8.6	13.1	16.4

[a] Fuel economy under actual driving conditions; EPA certification procedures yield estimates 10 to 20 percent higher
[b] Assumes 2.75 MMBD domestic production of alternate fuels.
[c] Includes pedestrians.
[d] 18-percent imports.

costs and fuel prices, motorists are expected to switch to smaller, more fuel-efficient cars. By 1985, 70 percent of new car purchases will be small cars, compared to a little under 50 percent today.

Despite the increased number of vehicles on the road, the national aggregate of air pollutants from automobiles will drop sharply from 1975 levels as a greater part of the fleet is equipped with mandated emission control equipment.

Another direct result of the increase in automobiles and VMT will be growing congestion on highways, particularly in urban areas. The typical urban driver in 2000 will encounter congested conditions about one-quarter of the time, or 21/z times more often than today.

Death and injury rates in automobile crashes are projected to decrease steadily from now to 2000 as a result of improved occupant protection and vehicle crashworthiness. However, the absolute number of deaths and injuries will increase. For example, highway-related deaths are expected to reach **64,000** per year by **2000,** compared to 46,000 in 1975.

Providing there is not a severe restriction of the supply of petroleum or alternate fuels, automobiles will continue to be the dominant mode of personal transportation through the year 2000. The Federal transit assistance programs assumed for the Base Case will result in a 16-percent increase in ridership by 1985, but the effect on automobile VMT will be negligible.

RATIONALE

The Base Case is a projection of automobile system characteristics and use over the next **25** years, based on the assumption that present Federal policies and programs will continue. The Base Case thus allows the results expected of current policy in light of evolving demographic, economic, and social trends. It provides a quantified baseline for evaluation of alternatives, and it highlights policy issues that may arise through pursuit of present policies.

The Base Case has several important applications in this study:

- Frame of Reference: The Base Case provides a series of reference points for comparing the effects and impacts of policy alternatives with conditions that would prevail in the absence of such policies.
- **Analytic** Tool: By providing a common set of assumptions and projections, the Base Case helps assure that analyses of policy options are consistent and that expected effects are compared systematically. The Base Case also contributes to policy definition by specifying a plausible economic and social climate in which policies must function.
- Yardstick for Current Policies: A number of Federal policies and programs relating to the automobile transportation system are now in force or are scheduled to be phased in over the next few years. The Base Case helps to define the nature and magnitude of the changes being brought about by these policies.
- Guide to Policy Alternatives: Projections of future conditions in the Base Case help to identify problems that could occur and ways to avoid or mitigate adverse impacts.

The Base Case is not a prediction of a most probable future. There is no intent to assert that the outcomes described in the Base Case will inevitably occur or are likely to occur. Conditions change in unforeseen ways, and Government policies would almost certainly not remain static over a period as long as 25 years. Instead, the Base Case is an analytic device that extrapolates the effects of present Government policies in light of anticipated changes in social and economic conditions.

Neither is the Base Case a “Do-Nothing” policy. The Federal Government already has many policies and programs affecting the automobile transportation system. All of these are assumed to remain in force or to be extended according to presently established schedules. It is for this reason that the Base Case has also been called the No-Policy-Change Baseline, to emphasize that it is a continuation of those policies now deemed appropriate for the automobile transportation system.

The Base Case was developed from assumptions and trend extrapolations for three classes of variables:

1. Population growth and distribution,
2. Economic conditions, and
3. Federal Government policy.

Population characteristics are important factors in the future automobile transportation system. The number of people of various ages and their location will determine the general demand for personal transportation (by automobile or other means) and the distribution of this demand between urban and rural areas and by geographic region. Macroeconomic factors are also major determinants of automobile system characteristics and use. The economic state of the country will have a powerful influence both on the automobile and the highway industry in general and on the resources that individuals will have to spend for personal transportation. The policies of the Federal Government will set the regulatory climate for the industry and will affect the cost and availability of personal transportation. Federal Government policy will also play a major part in determining the direction in which automobile technology will evolve over the remainder of this century.

These three classes of variables, combined with descriptive models of the structure and function of the system, serve as the basis for projections of future automobile characteristics and use. The demographic and economic conditions described below and their effects on automobile transportation are assumed to occur for the Base Case and for each of the policy alternatives treated later in this report.[2] Assumed demographic and economic factors have been held constant to allow comparison of the particular effects of policy options with the common reference of the Base Case.

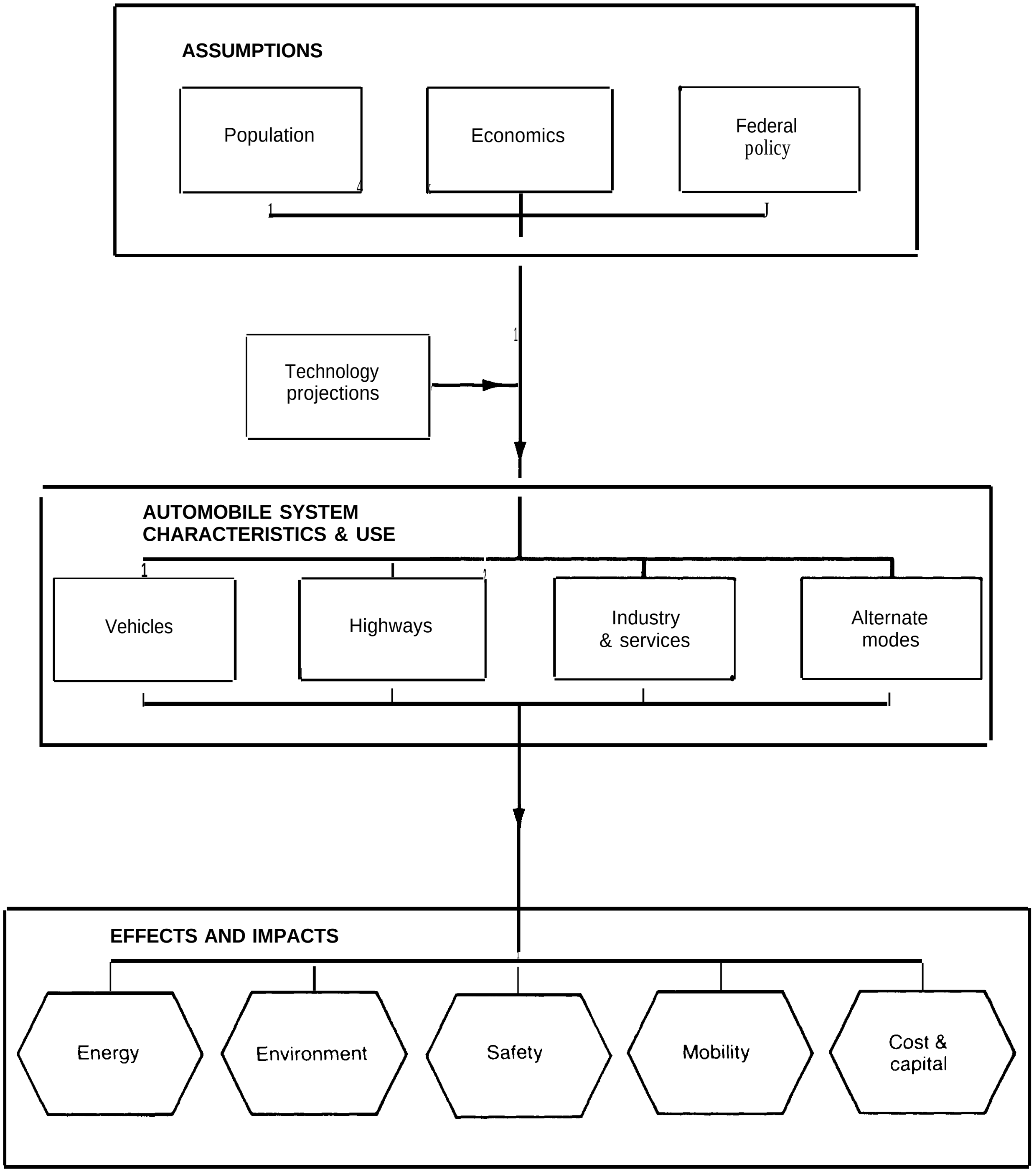
[2]Many of the projections presented in this report are based on the contractor reports of System Design Concepts/Energy and Environmental Analysis and Stanford Research Institute. Source references for these works are given as "Sydec/EEA" or "SRI."

Table 14.—Summary of Base Case Assumptions (dollar amounts in constant 1975 dollars)

Assumptions	1975	1985	2000
Demographic			
Population (millions)	214	233	250
Licensed drivers (millions)	130	151	177
Economic			
Gross national product ($ trillion)	1.52	2.22	3.72
Average income[a] ($ thousand)	5.03	6.72	10.07
World oil price (dollars per barrel)	13.00	16.50	25.60
Gasoline price (cents per gallon)	56	77	121
Policy			
New car fuel economy[b] (mpg)	—	27.5	27.5
New car emission standards (grams per mile)			
Carbon monoxide	28.0	3.4[c]	3.4
Hydrocarbons	3.0	0.41[c]	0.41
Oxides of nitrogen	3.1	1.0[cd]	1.0
Highway program funding[e] ($ billion)			
Capital expenditure	14.3	11.2	7.0
Maintenance	13.9	17.0	21.2
Total	28.2	28.2	28.2
Transit program funding ($ billion)			
Federal assistance	1.51	2.64	2.64
State and local contributions	1.71	2.70	4.90
Total	3.22	5.34	7.54

[a]Disposable personal income per capita.
[b]EPA certification values. Actual mileage on the road is assumed to be 10 to 20 percent lower.
[c]Standards will take effect for the 1981 model year.
[d]A waiver for diesels of 1.5 grams per mile is assumed for 1981-83.
[e]All levels of government.
[f]Includes maintenance, police, administration, planning, and debt service.
[g]Excludes fare-box revenues.

Figure 6.—Derivation of the Base Case



FUTURE POPULATION CHARACTERISTICS

The size and distribution of the future population will have a significant influence on the automobile transportation system. As population grows, so will the demand for personal transportation, the number of licensed drivers, the number of automobiles, and the benefits and problems associated with the automobile.

Population Growth

The population growth assumptions selected for this study are Bureau of the Census' Series II forecasts. The most important assumption is the completed cohort fertility rate of 2.1 (the average number of children women are expected to have).

Mortality is the other important factor shaping the population projection. A person born in 1930 had a life expectancy of 59.7 years.[4] In 1975, life expectancy was 72.7. By 2050, it will be 76.5.[5] With these assumptions, the population is projected to grow from 213.5 million in 1975 to 232.9 million in 1985, and 260.4 million by 2000.[6]

Not only will the population in 2000 be about 22 percent greater than in 1975, it will also be older. The median age in 1975 was 29 years. By 2000, it is expected to be nearly 36. As shown in table 15, a greater proportion will be of driving age. Those 65 and over, who are less likely to drive, will number about 32 million, an increase of 42 percent from 1975.

Population Distribution

The trend toward more urbanization is assumed to continue. The percentage of the population living in urban areas will increase from 61 percent in 1975 to 68 percent in 2000. Central city population will continue to grow in absolute terms but will decline as a percentage of total urbanized area population as more people live in the suburbs. The rural population will decline in both number and percentage.[7] (See table 16.)

Households

As defined by the Bureau of the Census, a household is comprised of all persons who share common living quarters. In addition to the traditional family, a person living alone or a group of unrelated persons living together also constitutes a household. Based on the Series II projections, the number of households is expected to grow from 71.7 million in 1975 to 87.2 million in 1985 and 109.4 million in 2000. At the same time, household size will grow smaller, from an average of 3.0 persons in 1975 to 2.4 persons in 2000.[8]

[3] U.S. Department of Commerce, Bureau of the Census, *Projections of the Population of the United States: 1977 to 2059*, Series P-25, Number 704, July 1977.

[4] U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States: 1976* (Washington, D.C.: U.S. Government Printing Office, 1976), p. 60.

[5] U.S. Department of Commerce, Bureau of the Census, *Projections of the Population. . .*, p. 18.

[6] These estimates assume 100 males to 105 females.

[7] System Design Concepts, Inc, Energy and Environmental Analysis, Inc., and The Institute for Safety Analysis, Inc., *Technology Assessment of Changes in the Use and Characteristics of the Automobile*, Contractor Report, prepared for U.S. Congress, Office of Technology Assessment (Washington, D.C.: System Design Concepts, January 1978), p. III-11. (Hereinafter cited as *Sydec/EEA*.)

[8] Ibid., p. III-15.

Table 15.—Size and Age of the Future Population (millions)

	1975		1975		1975	
	Number	Percent	Number	Percent	Number	Percent
Total	213.5		232.9		260.4	
15 and over.	159.9	74.9	181.2	77.8	203.3	78.1
65 and over.	22.4	10.5	27.3	11.7	31.8	12.1
Median age.	28.8		31.5		35.5	

SOURCE: U.S. Department of Commerce, Bureau of the Census, *Projections of the Population of the United States: 1977 to 2059*, table 8

Table 16.—Future Distribution of U.S. Population (millions)

	1975		1985		2000	
	Number	Percent	Number	Percent	Number	Percent
Total population	213.5		232.9		260.4	
Urbanized area population	130.1	60.5	149.0	64.0	177.0	68.0
(Central city)	(66.7)	(31.2)	(70.6)	(30.3)	(75.7)	(29.0)
(Suburban)	(63.4)	(29.7)	(78.4)	(33.7)	(101.3)	(38.9)
Small urban area population	29.6	13.9	30.3	13.0	31.3	12.0
Rural population	53.8	25.2	53.6	23.0	52.1	20.0

[a]Areas of 50,000 or more population.
[b]Urban places of 2,500 to 50,000 population.
SOURCE: *Sydec/EEA*, p. III-9.

Licensed Drivers

Automobile use is closely related to the number of licensed drivers. Projections of licensed drivers in the future population were developed from analysis of trends in the percentage of individuals with licenses in each age-sex cohort. Between 1975 and 2000, the percentage of male licensed drivers is expected to remain stable at roughly 90 percent of all males of driving age. For women, however, the proportion of licensed drivers in the population of driving age is expected to climb steadily from the present 71 percent to 83 percent by 2000. For the population as a whole, the number of licensed drivers will grow by 37 percent. (See table **17.**)

Table 17.—Projections of Population and Licensed Drivers

	1975	1985	2000
Total population (millions)	214	233	260
Driving age population (millions)			
Men	77	87	97
Women	83	94	106
Total	160	181	203
Licensed drivers (millions)			
Men	71	78	89
Women	59	73	88
Total	130	151	177
Licensed drivers as percentage of driving age population			
Men	92%	90%	91%
Women	71	77	83
Total	81	83	87

SOURCE: Sydec/EEA, p. III-69

MACROECONOMIC ASSUMPTIONS

Civilian Labor Force

Two major factors affecting economic growth are the size of the labor force and labor productivity. Currently, the civilian labor force is growing more rapidly than the population.[9] The percentage of working males is relatively stable, but the percentage of women in the labor force is increasing markedly. In 1970, 43 percent of women aged 16 and over were in the labor force. This proportion is expected to grow to 51 percent by 1990.[10] Based on these trends, the civilian labor force of 92.6 million in 1975 is projected to grow to 105.6 million in 1985 and 122.9 million in 2000.[11] Unemployment is assumed to decline from 8.5 percent in 1975 to 5.0 percent by 1985 and to remain at that level through 2000.

[9]U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract* . , pp. xiii-xviii.

[10]U.S. Department of Labor, Bureau of Labor Statistics, *New Labor Force Projections to 1990*, Special Labor Force Report 197 (Washington, D.C.: U.S. Government Printing Office, 1977).

[11]*Sydec/EEA*, pp. III-19 to III-21.

Growth in the productivity of the labor force had averaged about 3 percent per year until the early 1970's, when it dropped below 2 percent. Annual labor productivity growth is assumed to return to around 3 percent for the period 1985-2000.

Gross National Product

The Base Case assumes continued economic growth through **2000.** The gross national product (GNP) is projected to rise from $1.5 trillion in 1975 to $3.7 trillion by **2000** (in 1975 dollars).[12] (See table 18.) These figures represent an annual GNP growth rate of 3.5 percent—roughly equivalent to the average annual rate between 1960 and 1975, The GNP growth projection assumes a labor force increase of 1.2 percent annually to 1985 and 1.0 percent thereafter, and an assumed labor productivity growth of 3 percent.

Table 18.—Summary of Macroeconomic Assumptions for the Base Case[a]

	1975	1985	2000
Gross national product (billions)	$1,516	$2,218	$3,716
GNP growth rate (percent)	3.4[b]	3.5	3.5
Disposable personal income (billions)	$1,081	$1,564	$2,620
DPI growth rate (percent)	3.6[b]	3.5	3.5
DPI/GNP	0.71	0.71	0.71
DPI/capita	$5,025	$6,717	$10,068
Consumer price index	161.2	261.7	471.3
CPI growth rate (percent)[c]	4.1[b]	5.0	4.0

[a]Dollar amounts are in 1975 dollars.
[b]1960-75 annual average.
[c]CPI growth rate was 9.1 percent for 1974-75.
SOURCES: U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States*, 1976; Projections from *Sydec/EEA*, pp. III-19 and III-20.

Disposable Personal Income

Disposable personal income (DPI)—income after taxes and social insurance payments—represents how much money people have for personal expenditures, including automobiles and travel. Based on an analysis of historical data, it is assumed that the ratio of DPI to GNP will be 0.71 for the period 1975-2000. This value is consistent with the recent trend. Using this ratio, it is projected that DPI will grow from $1.08 trillion in **1975** to **$2.62** trillion in **2000.** DPI per capita will double in constant dollars—from $5,000 to $10,000 during this period.[13]

Inflation

There is great uncertainty in long-run projection of prices because of the unpredictable effects of inflation. In the past 10 years there have been large fluctuations in the Consumer Price Index (CPI). For example, inflation reached 11 percent in **1974** but dropped to about 6 percent per year by 1977. Recently, however, the CPI has begun to rise again. (See figure 7.)

Since the main concern in this study is with long-term trends, no attempt has been made to forecast the magnitude and timing of short-term variations. For the Base Case, it is assumed that inflation—as a long-term average—will decline to about **5** percent per year by 1985 and then to 4 percent per year by 2000. Under these assumptions, the CPI would rise from the 1975 value of 161 to 262 in 1985 and 471 in 2000. However, since DPI will be growing more rapidly than the CPI, the net effect will be that consumers will have about twice as much to spend (in constant dollars) in **2000** as they do today.

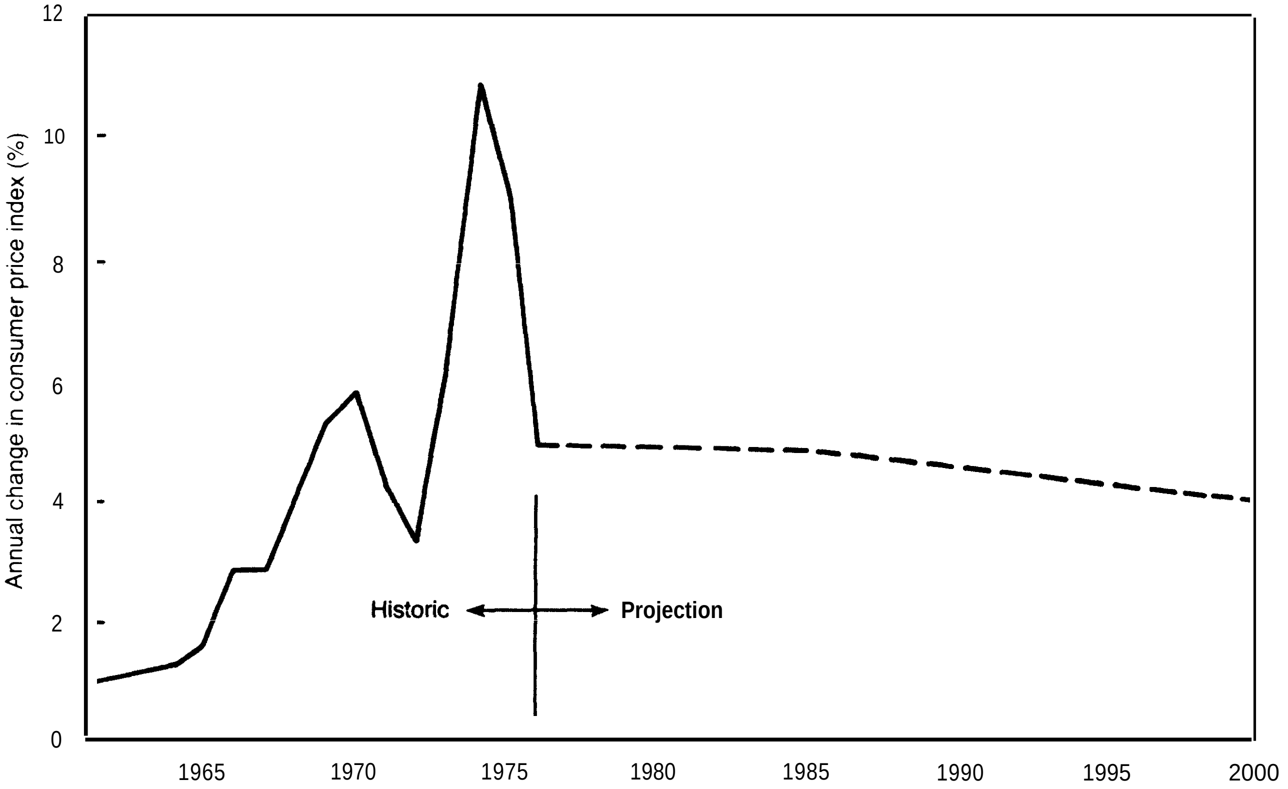
TECHNOLOGY PROJECTIONS

Chapter 10 contains a detailed discussion of prospective changes in automobile technology. This section presents a summary of the assumed changes in technology that have been incorporated in the Base Case.

[12]To remove the effects of inflation and allow direct comparison of economic changes, monetary values are expressed in constant 1975 dollars and so noted throughout this report.

[13]*Sydec/EEA*, pp. III-19 and III-20.

Figure 7.—Annual Change in Consumer Price Index



SOURCES: U.S. Dept. of Commerce, Bureau of the Census, *Statistical Abstract of the United States*, 1977, p. 478. Projections from Sydec/EEA. p. III-16.

Automobiles

Weight Reduction and Materials Substitution

It is assumed that domestic manufacturers will continue their current downsizing program, which is expected to be completed by 1981. Downsizing and a shift of consumer preference to smaller cars will lead to a reduction in average automobile weight of about 1,000 pounds. The basic elements of downsizing are materials substitution to reduce weight and significant body restyling to shed weight while maintaining interior and trunk room. The use of plastics and aluminum will increase, while the use of steel and cast iron will be reduced. Lighter cars will also permit the use of smaller engines and other components.

Fuel Economy

It is expected that the Environmental Protection Agency (EPA) goals for fuel economy—27.5 mpg[14] for new cars in 1985 and thereafter—will be attained. [15] As a result, fuel consumption for the automobile fleet as a whole is projected to average 19.4 mpg in 1985 and 24.6 mpg by **2000.** For comparison, the fleetwide average for 1975 is estimated at 13.5 mpg,

[14]As measured by EPA certification procedures. The fleetwide averages stated here are assumed to be under actual driving conditions.

[15]Fuel economy improvements beyond 27.5 mpg are possible. They have not been assumed for the Base Case, but they are considered under energy policy options in chapter 5.

Automobile Emissions

It is assumed for the Base Case that automobile manufacturers will be able to meet the emission standards specified in the 1977 Clean Air Act Amendments. A waiver on the nitrogen oxides (NO_x) standard (from 1.0 gram per mile to 1.5 grams per mile) would be granted for diesels from 1981 to 1983, but thereafter, it is assumed that diesels would meet the 1.0-gram-per-mile standard.

Safety

New automobiles will meet the Federal Motor Vehicle Safety Standards. It is assumed that passive restraints will be phased into all new cars over the period 1982-84 at *a* cost of about $200 per car.

Transmission and Drivetrain

The most significant changes expected in this area are:

- Lockup torque converters for automatic transmissions,
- More manual transmissions,
- More front-wheel-drive vehicles, and
- Improved lubrication.

Engines

The Base Case assumes that no new engines will achieve extensive commercialization before 2000, but that substantial modifications will be made to what is currently available. The spark-ignition engine is assumed to predominate, but the percentage of diesels will rise to 10 percent of new car sales in 1985 and 25 percent by 2000. It is assumed that the diesel will have a more difficult time meeting the NO_x standard and will be granted a waiver to 1.5 grams per mile for 1981 through 1983. After 1984, the diesel is assumed to meet the 1.0-gram-per-mile standard and any particulate standards that may be imposed.

Some of the more significant improvements expected in spark-ignition engines are:

- Stratified charge (single or auxiliary chambers),
- Turbocharging,
- Wider use of fuel injection,
- Microprocessors to control air-fuel mixture more closely, and
- Greater use of aluminum.

The Base Case assumes that other types of engines, even if proven successful in research, will not achieve substantial market penetration by 2000.

Fuels

Petroleum is assumed to be the main source of automotive fuel through 2000. Production of alternative fuels[16] will be limited but might reach 2.75 MMBD by 2000 under the most favorable circumstances. The use of methanol or gasoline-methanol blends is uncertain and has been given low probability for the Base Case. Electric vehicles will not constitute a significant part of the passenger car fleet, but may have increased use as delivery vehicles after 1985.

Highways

The basic elements of highway construction and design are not assumed to change significantly by 2000. Some improvements in pavement durability and skid resistance are expected to occur.

Modifications in the technology of highway operation may occur, particularly in urban areas. The technology is available for wider implementation of Transportation Systems Management (TSM) techniques such as high-occupancy vehicle lanes and ramp metering. Signing and traffic control signal systems are also expected to be improved by 2000.

Public Transportation

Buses will remain the backbone of urban public transportation. Minor improvements in comfort and ride quality are expected. There will be improvements in accessibility for the handicapped and elderly, since a major part of the urban bus fleet is expected to be equipped for their use by 1990.

There will be some shift in emphasis from heavy rail to light rail for new urban rail transit systems. Only a very small number of cities will

[16] The term "fuels" includes all substances that can be burned in automobiles. Fuels such as alcohol, alcohol blends (gasohol), and synfuels (from oil shale or coal) are considered alternatives to conventional petroleum.

start building new systems before 2000. However, the 8 to 10 systems that now exist or are under construction will be completed, expanded, or modernized. Technological advances beyond the San Francisco and Washington, D. C., systems are not foreseen.

Automated Guideway Transit (AGT) will see only limited application. It is assumed that four AGT systems will be operating by 1985 under the Urban Mass Transportation Administration (UMTA) Downtown People Mover Demonstration Program. After 1985, a few others may be put in operation, but they are not assumed to represent a significant substitute for other modes of personal transportation.

Intercity buses, which now serve more communities than any other public mode of transportation, are expected to remain the principal alternative to the automobile for trips between cities or between rural areas and cities. No major changes in bus technology are assumed for the Base Case.

BASIC PATTERNS OF AUTOMOBILE OWNERSHIP AND USE

From the assumptions set forth so far, it is possible to project some of the basic features of automobile ownership and use. These features form a pattern that can serve as a point of departure for examining the expected effects and impacts of current policies under base case conditions. (See table 19.)

Two of the more significant aspects of the future new car market expected in the Base Case will be a long-term trend of increasing sales and a marked shift to smaller cars. The number of autos in the fleet will continue to rise and at a rate slightly higher than population growth. The number of vehicles per licensed driver will increase from the present **0.73** to **0.84** by **2000.**

Federally mandated fuel economy standards will probably have more influence on the type of automobile in the fleet than any other current policy. To meet the tighter fuel economy standards, manufacturers will offer smaller, lighter vehicles and more diesels.

Table 19.—Base Case Automobile Ownership and Use

	1975	1985	2000
Annual new car sales (millions)	8.6	13.1	16.4
Percent of small cars[a]	46	66	66
Percent of diesels	—	10	25
Total automobiles in operation (millions)	95	118	148
Automobiles per licensed driver	**0.73**	**0.78**	**0.84**
Automobile vehicle miles traveled (trillions)	**1.03**	**1.43**	**1.80**
Automobile vehicle miles traveled per licensed driver	**7,900**	9,500	10,200
EPA fuel economy standards (mpg)	None	27.5	27.5
Auto fuel consumption (MMBD)	5.0	4.8	4.8

[a]Includes subcompact, compact, and small luxury cars

ENERGY PROJECTIONS

Historically, the growth of the automobile transportation system has been aided by an abundant and inexpensive supply of petroleum, a condition that is expected to change markedly by **2000.** The Base Case assumes that the supply of petroleum will be reduced and that other sources of energy will have to be found. The price and availability of energy—from petroleum or alternate sources—will be powerful influences on future automobile characteristics and use.

No attempt is made in the Base Case, or elsewhere in this study, to deal with the broad national problems of energy supply and demand. These include the prospects for sustaining or increasing domestic and foreign petroleum production, conservation of petroleum or substitution of alternate sources by nontransportation users, and reallocation of supply across and within domestic economic sectors. These issues are fundamental to national energy policy and will clearly affect the future of the automobile, but they lie beyond the scope of this assessment.

The Base Case concentrates on projecting energy consumption by the automobile system and the energy supply needed to satisfy this demand. Broader projections of supply and demand for the economy as a whole cannot be ignored, since they are inextricably bound to the automobile system. However, they are incorporated in the Base Case only to the extent necessary to define the context in which the automobile system will have to operate.

Energy Policy and Assumptions

The Base Case projections of energy consumption by the automobile system rest on the following assumptions:

- The automobile fleet will continue to depend on petroleum as its primary fuel to the year **2000.**
- The diesel engine will be the only alternative to the spark-ignition engine to obtain a significant market share through **2000.**
- The number of electric vehicles in use by **2000** will be insignificant in terms of petroleum conservation unless there is a breakthrough in battery technology. No such breakthrough is assumed for the Base Case.
- Any transition to alternate fuels will not come about as a result of Federal Government subsidy of the production and use of such fuels.
- The new car fuel economy standard will be **27.5** mpg for the 1978- model year and thereafter until 2000.

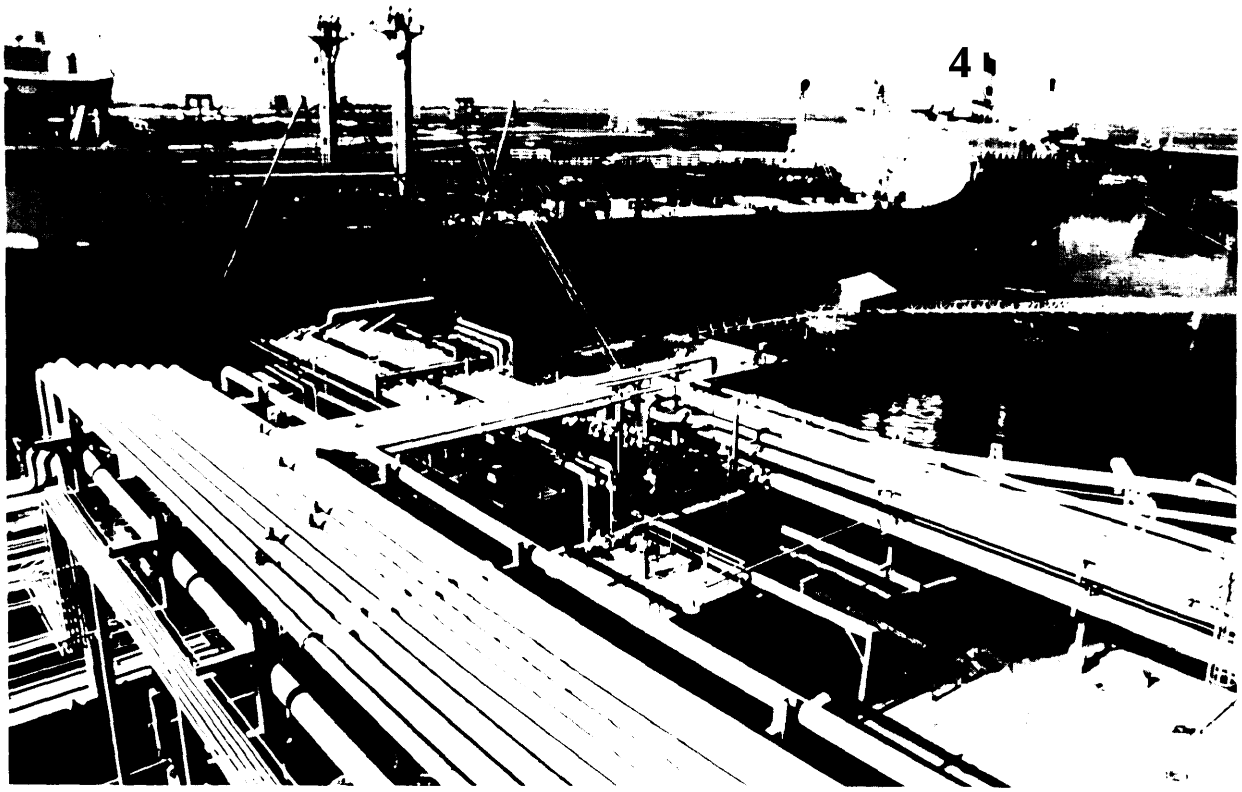


Photo Credit: U.S. Department of Energy

- Domestic manufacturers will meet these standards through vehicle downsizing, materials substitution, and other energy efficiency improvements.[17]
- Smaller cars will make up an increasingly greater share of the fleet.
- There will be no change in the degree of enforcement of the 55-mph speed limit.
- The Federal Government will continue to control the price of gasoline,
- Gasoline taxes will rise so as to keep revenues at their present level in constant dollars.
- No graduated excise (gas guzzler) taxes on automobiles will be imposed by the Federal Government.
- There will be no oil embargo or abrupt interruption of supply.

Fuel Economy Standards

The most significant Federal policy affecting energy consumption by the automobile system is the 1975 Energy Policy and Conservation Act (EPCA), which sets standards for new car fuel economy between the 1978 and 1985 model years. (See table 20.) Compliance with these standards is determined for each manufacturer separately on the basis of average (sales-weighted) fuel economy of the full line of passenger vehicles sold by that manufacturer during the model year. Beginning in 1980, captive imports (such as Ford Fiesta and Dodge Colt) cannot be included in the manufacturer's average. Therefore, domestically produced automobiles will have to make significant improvements in fuel economy by that time. It is also important to note that the values listed in table 20 are based on a test cycle of combined street and highway driving used by EPA to measure compliance. Estimates of the fuel economy attained under actual driving conditions run 10 to **20** percent Iower.[18]

Table 20.— Fuel Economy Standards Assumed for the Base Case

Model year	Sales-weighted new car fleet average, mpg
1978	18[a]
1979	19[a]
1980	20[a]
1981	22[b]
1982	24[b]
1983	26[b]
1984	27[b]
1985	27.5a
1990	27.5/30.O[c]
2000	27.5/35.O[c]

[a]Mandated by EPCA.
[b]Administratively determined by the Secretary of Transportation.
[c]Fuel economy assumptions for Case A and Case B, respectively

EPCA now sets fuel economy standards only to **1985,** but there is the clear possibility that standards might be raised in the period **1985-2000** as an extension of present policy. To assess the effects of fuel economy standards until **2000,** an alternative set of assumptions was incorporated into the Base Case. In Case A, the standard is maintained at **27.5** mpg from **1985** to 2000. In Case B, the standard is raised to 30 mpg in **1990** and 35 mpg in **2000.** It is assumed that higher fuel economy would be achieved, in part, by a greater use of diesel engines. In Case B, the penetration of the new car market by diesels reaches 40 percent by 2000. Table 21 summarizes the different assumptions for Case A and Case B.

Petroleum Prices

Petroleum demand by the automobile system will be partly determined by price. Based upon an examination of several recent projections of worldwide supply and demand, it is assumed that the price of a barrel of petroleum will rise from the current level of **$13** to **$16.50** by 1985 and to $25.60 by 2000 (all prices in 1975 dollars). ” This is equivalent to an annual in-

[17]Most import manufacturers will have little difficulty meeting the 27.5 mpg standard. A group of manufacturers accounting for 20 percent of all imports may face difficulties, however. *Federal Register* 42, (June 30, 1977): 33549.

[18]U.S. Environmental Protection Agency, Office of Mobile Source Air Pollution Control, Emission Control Technology Division, *Evaluation of the Representativeness of EPA Fuel Economy Estimates*, January 1978, p. 23.

[19]The Energy Research and Development Administration (ERDA) (now DOE) Phase II (Pass III) runs of Market Oriented Planned Programming Study Model as reported by ERDA transportation working group, June 20, 1977 (MOPPS); MIT Workshop on Alternative Energy Strategies (WAES), *Energy: Global Prospects 1985-2000* (New York: McGraw-Hill, 1977; Information from Department of Energy personnel working on the Project Independence Evaluation System (PIES), using model runs 823B72L DO1 HM4U (for 1985) and C829C72L DO1 RE1 U (for 1990), 1977; Electric Power Research Institute, *Fuel and Energy Price Forecast* (Washington, D.C.: Electric Power Research Institute, August 1967).

Table 21.—Alternative Assumptions for Base Case Fuel Economy Standards

		Base Case A	Base Case B
New car fuel economy standards. . . . .“.	1985	27.5 mpg	27.5 mpg
	1990	27.5 mpg	30.0 mpg
	2000	27.5 mpg	**35.0** mpg
Diesel share of new car sales.	1985	10 percent	15 percent
	2000	25 percent	40 percent

[a]EPA certification values

Table 22.—Base Case Petroleum and Gasoline Prices (1975 dollars)

	1975	1985	2000	
			Case A	Case B
World oil price ($/barrel) . . .	$13.ooa	$16.50	$25.60	$25.60
Gasoline price (c/gallon)				
Without tax	44.5¢	65.3¢[b]	109.4¢[b]	109.4¢[b]
State and Federal taxes .	11 .7¢	12.4¢	12.4¢	14.1¢
Pump price.	56.2¢	77.7¢	121 .8¢	123.5¢

[a]Open market price for *new* oil, as of January 1976.
[b]Includes effects of oil equalization tax.
SOURCE: 1975 data, Oak Ridge National Laboratory, *Transportation Energy Conservation Data Book: Edition 2*, prepared for U.S. Energy Research and Development Administration, Office of Conservation, 1977, p. 354.

crease of 3 percent per year in constant dollars.

The price of gasoline (excluding taxes) is also assumed to rise a t 3 percent per year.[20] Gasoline taxes (State and Federal) are assumed to rise at a rate that would keep revenues at the 1975 level in constant-dollar terms. The resulting change in the price of gasoline a t the pump is a rise from **$0.56** per gallon in 1975 to $1.21 per gallon by 2000. (See table 22.)

Automobile Energy Demand

During the *1960's*, fleet fuel economy declined steadily. This trend was reversed by the mid-1970's as a result of domestic manufacturer's efforts to improve fuel economy and the growing popularity of smaller cars, particularly fuel-efficient imports. The estimates prepared for the Base Case, shown in figure **8,** assume that manufacturers will meet the 1985 fuel economy standard of 27.5 mpg.

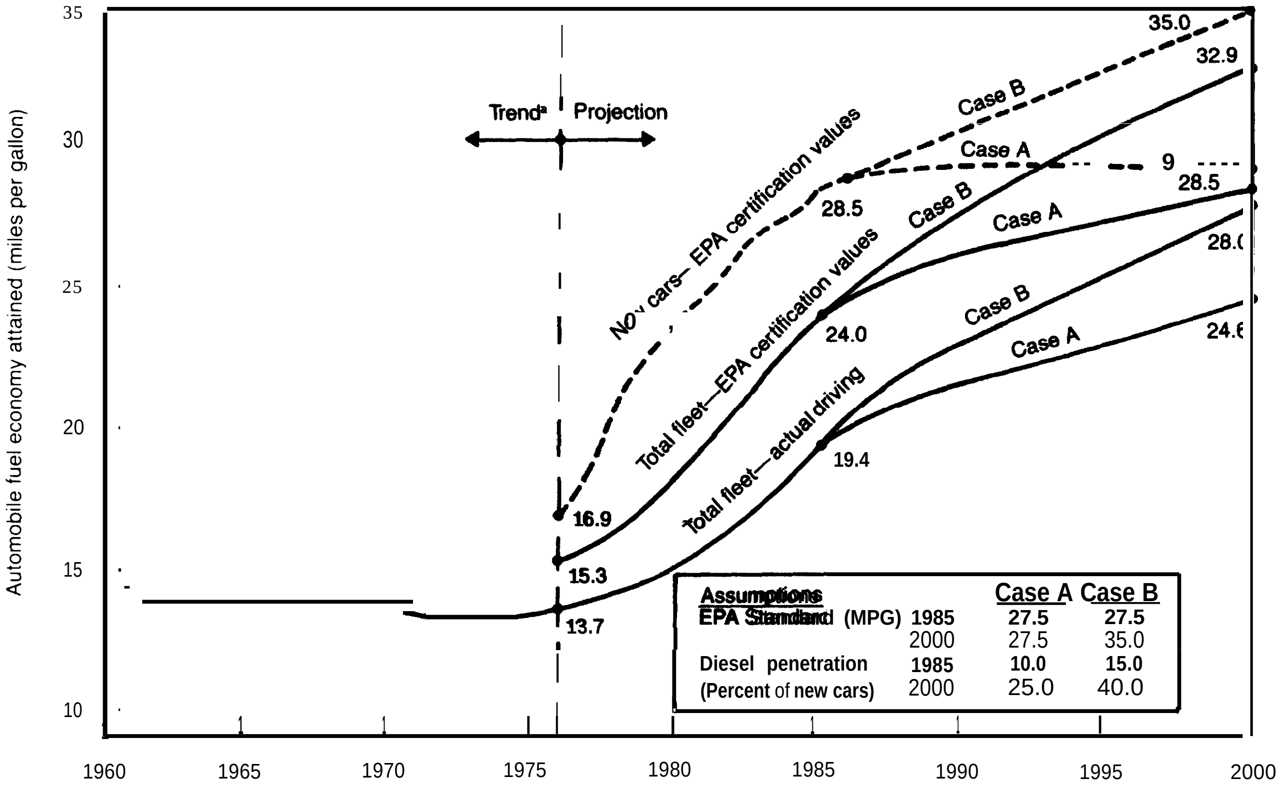
Fuel consumption projections for the Base Case are shown in table **23.** Two measures of fuel economy are shown—the EPA certification values used to determine compliance with EPCA standards and estimates of mpg under actual driving conditions.

Under the Case A assumptions, automobile fuel consumption in 1985 would be **5** percent lower than in 1976. Thereafter, consumption would stay close to the 1985 level, as further fuel efficiency gains would be counterbalanced by rising VMT. However, under Case B, auto petroleum consumption could fall an additional 12 percent by **2000.**[21] Whereas diesel fuel consumption by automobiles is negligible today, it would rise to 18 percent of automobile fuel used by **2000** in Case A and **29** percent in Case B. Between 1975 and **2000,** fuel economy for the fleet as a whole under actual driving conditions is projected to increase **82** percent in Case A and 107 percent in Case B. Since fleet size and VMT are identical for the two cases, the difference is attributable solely to higher fuel-economy standards and the increased use of diesels assumed for Case B.

[20]An oil equalization tax was also included in this computation

[21]Beyond 2000, if fuel economy standards were not to change, if the market penetration of diesels were not to increase further, and, if no new engines were introduced, automobile fuel consumption would again be on the rise in both Case A and B.

Figure 8.—Projection of Base Case Fuel Economy



ªMotorcycle travel Included in fuel economy 1960-64

SOURCES Trend data, Motor Vehicle Manufacturers Association, *Motor Vehicle Facts and Figures* '77, p 62.
Projections, OTA and Sydec EEA, pp. III-101-109

Table 23.—Summary of Base Case Automobile Energy Demand

	1975	1985[a]	2000 Case A	2000 Case B
Automobiles in operation (millions)	95	118	148	148
Automobile VMT (trillions)	1.03	1.43	1.80	1.80
Diesel penetration (percent of new car market)	(b)	10	25	40
New car fuel economy (mpg)				
EPA standard[c]	None	27.5	27.5	35.0
Attained—EPA certification value	15.6	28.5	29.4	35.0
Attained—actual driving	14.0	23.2	25.0	29.8
Fleet fuel economy (mpg)				
Attained—EPA certification value	15.1	24.0	28.5	32.9
Attained—actual driving	13.6	19.4	24.6	28.0
Annual fleet fuel consumption rate (billions of gallons)				
Gasoline	76.0	70.6	60.2	45.7
Diesel	(b)	3.3	13.1	18.7
Total	76.0	73,9	73.3	64.4
Fleet fuel consumption (MMBD)	5.0	4.8	4.8	4.2
Percent of domestic consumption	30.6	23.9	21.4	19.3

[a]The differences between Case A and Case B in 1985 are insignificant.
[b]Insignificant.
[c]The EPA certification value for a particular car is the weighted average of performance in the EPA urban cycle (55 percent weight) and rural cycle (45 percent weight)

Total Domestic Petroleum Demand

The projected consumption of petroleum by the automobile system must be set in the context of the projected unconstrained demand for fuel by the country as a whole in 1985 and 2000. Estimates of unconstrained domestic petroleum demand[22] are presented in figure 9.

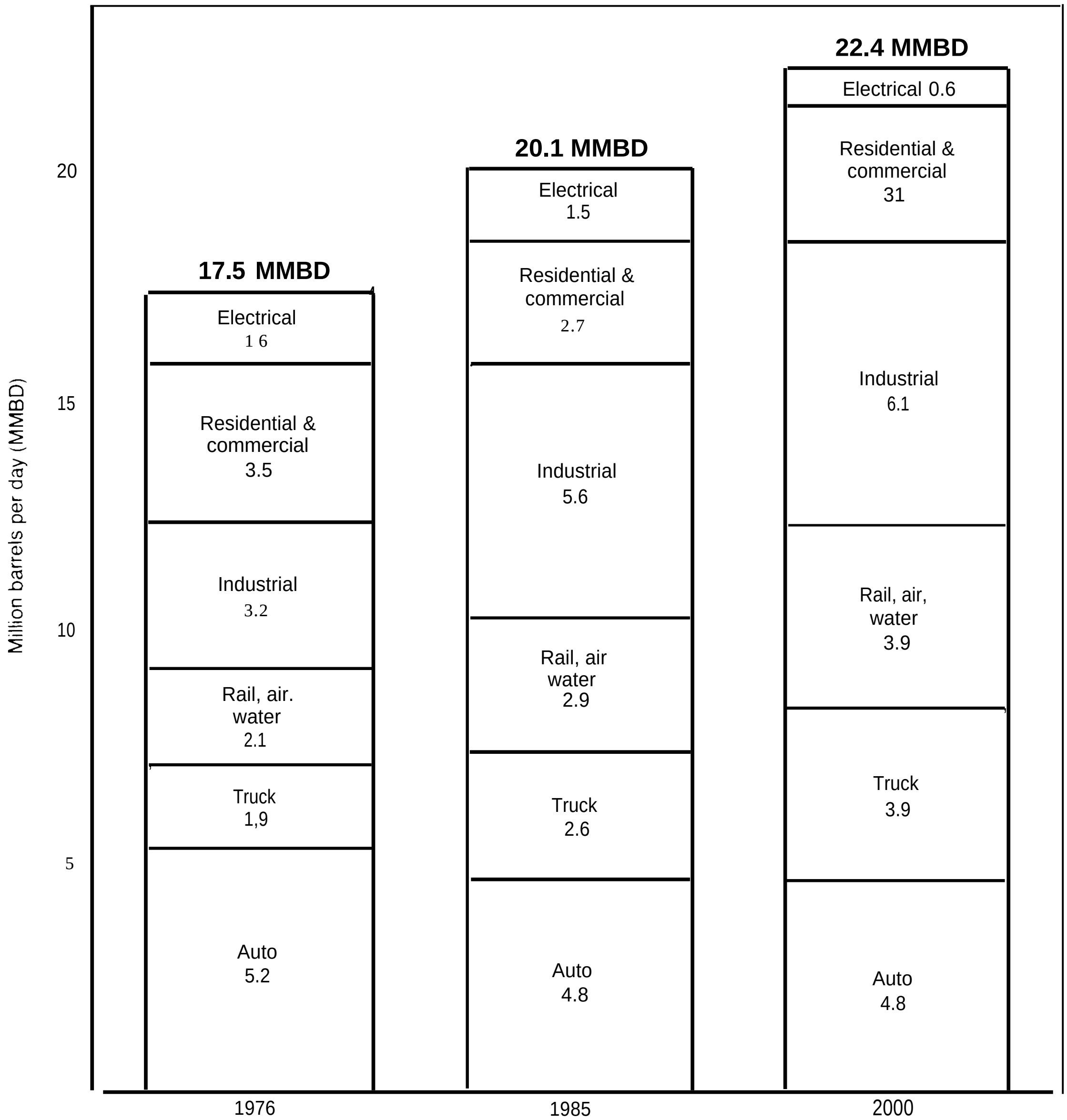
[22]A discussion of the domestic demand estimates is contained in *Sydec/EEA*, pp. III-89 to III-92.

The assumptions made in reaching these estimates are:

- The fuel economy of small trucks will remain unregulated.[23]
- There will be no significant improvements in the fuel efficiency of large trucks.

[23]While this report was in preparation, the National Highway Traffic Safety Administartion promulgated standards for fuel economy of trucks under 8,500 pounds gross vehicle weight. The potential effects of these standards have not been included in this analysis.

Figure 9.—U.S. Petroleum Demand



NOTE: Assumes continuation of 27.5 mpg for new cars beyond 1985.

SOURCE: Sydec/EEA and OTA estimates

- Petroleum consumption by other transportation modes (rail, air, and water) will continue to rise with expansion in the economy and population growth.
- The use of oil by industry will grow with the economy and the inability to expand natural gas supplies. Regulation, such as in the National Energy Plan, which could significantly lower the growth in industrial use has not been assumed for these estimates.
- Demand in the residential and commercial sector will fall slightly by 1985 because of greater use of electricity in new homes and the installation of energy-saving measures by homeowners and businesses. The benefits of these trends will be offset after 1985 by population growth, and consumption in this sector will begin to rise again.
- There will be an increase in the use of coal for generation of electricity.

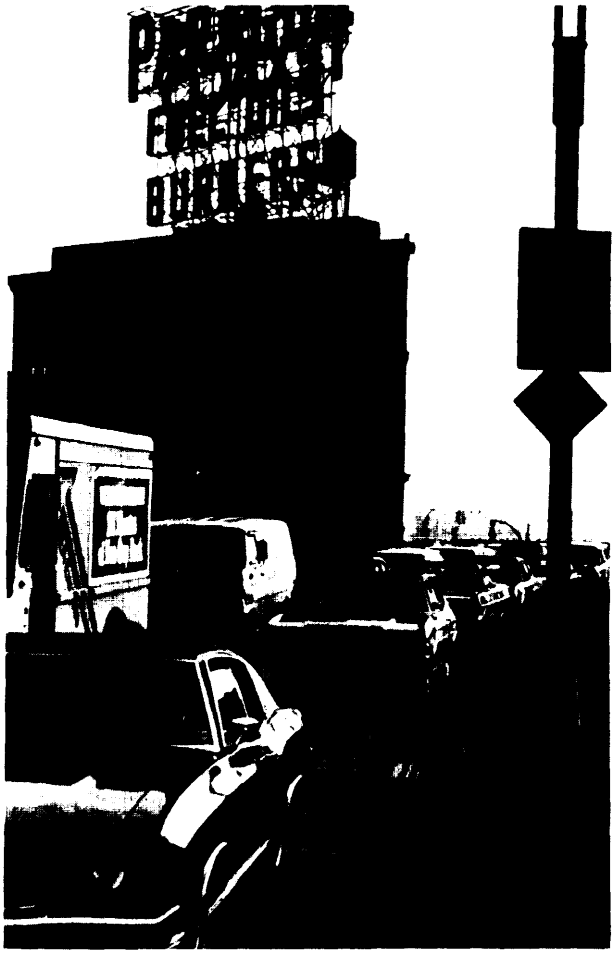


Photo Credit: Sydec

Domestic Fuel Supply

The supply of conventional petroleum from domestic sources is assumed to rise slightly through 1985 with the introduction of production from the Alaskan North Slope. North Slope oil production is expected to reach a maximum of 2 MMBD and hold steady at that rate until 2000. This would raise the total domestic supply to 10.1 MMBD in 1985. Beyond 1985, the supply from the lower 48 States (including the Outer Continental Shelf) is expected to taper off, declining to a production of 5 MMBD by 2000. Thus, the total domestic supply in 2000 would be only 7 MMBD, or about 30 percent of the total unconstrained demand. To meet the domestic demand of 22.4 MMBD in 2000, it would be necessary to find 15.4 MMBD of fuel, either as petroleum imports, alternative fuels or equivalent electrical energy from nonpetroleum sources. (See figure 10.)

Alternate Energy Sources

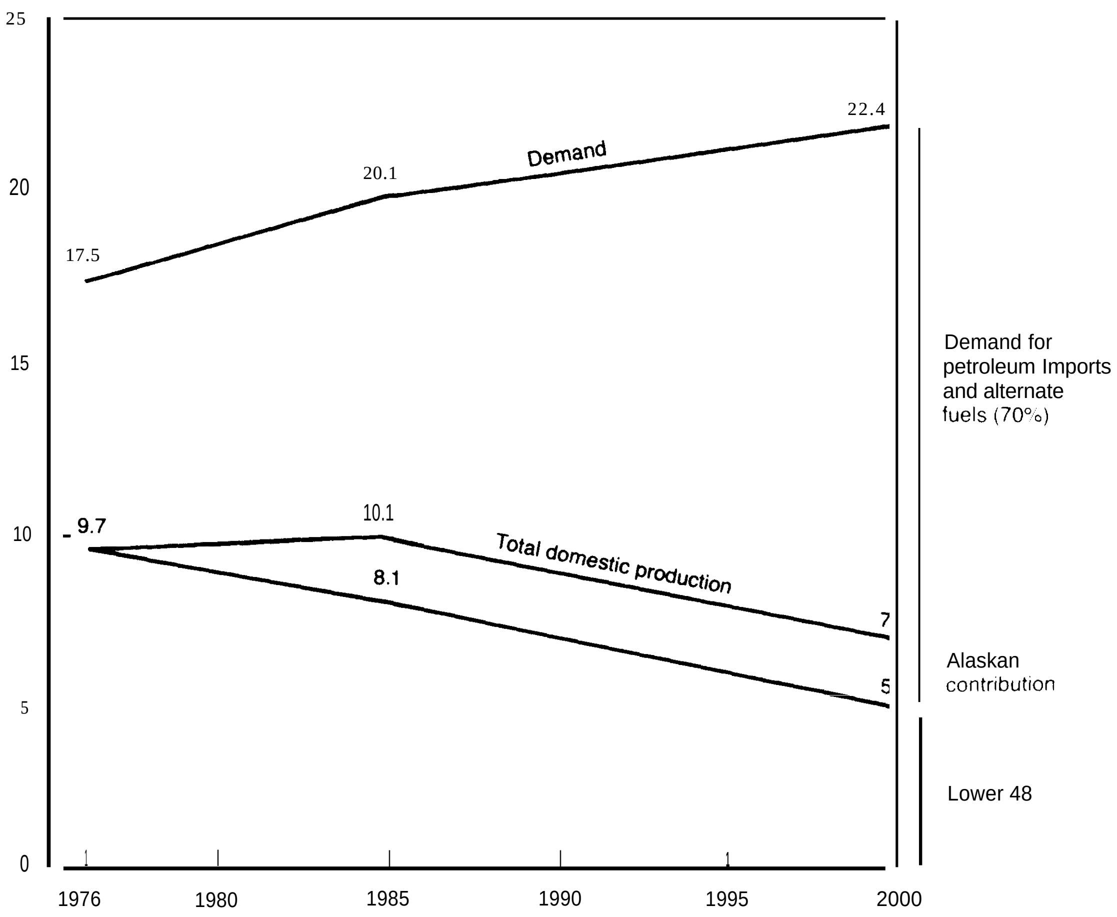
There are a number of resources that can be used to produce motor fuels similar to conventional gasoline or diesel fuel. These fall into four general categories.

1. Synthetic liquid fuels (synfuels),
2. Alcohol fuels,
3. Electricity, and
4. Fuel cells using hydrogen, hydrazine, or blended fuels.

Synthetic fuels and alcohol or alcohol blends are assumed to be the most likely alternate automobile energy sources by 2000. No significant production of synthetic fuels is foreseen before 1985. By 2000, however, technical and economic factors point to production of liquid fuels from oil shale and coal. Extensive commercialization of alcohol fuel (ethanol or methanol) is inhibited at present by economic factors. However, the disparity between alcohol and conventional petroleum prices is expected to be reduced by the mid- to late-1990's. [24]

[24] For a discussion of alternate fuel prospects see Stanford Research Institute International, *Potential Changes in the Use and Characteristics of the Automobile*, Contractor Report, prepared for U.S. Congress, Office of Technology Assessment (Menlo Park, Calif.: SRI International, January 1978), appendix C, and *Sydec/EEA*, pp. III-56 to III-61.

Figure 10.— U.S. Petroleum Supply and Demand (MMBD)



SOURCE: Adapted from *Sydec/EEA*, p. III-2

The Electric and Hybrid Vehicle Act calls for the demonstration of 200 vehicles by 1979 and **7,500** by **1984.** [25] The major obstacle to the use of electric power for automobiles is the development of improved batteries that can perform better than the present lead-acid battery, which is considered unacceptable in terms of performance, range, and weight, No major breakthrough in battery technology is assumed for the Base Case, and it is expected that the market penetration of electric vehicles (while it might reach as much as 10,000 vehicles per year by 2000) will cause negligible changes in national petroleum consumption.

[25] *Electric and Hybrid Vehicle Act, Statutes at Large* 90, 1260 (1976), *U.S. Code*, vol. 15, sec. 2501-1514, vol. 42, sec. 2451 and 2473, as amended by *The ERDA Authorization Act of 1978*, P.L. 95-238, 95th Congress, 2nd Session, Feb. 25, 1978, S. 1340, Title VI; *Sydec/EEA*, pp. III-103 to III-106.

Fuel cell technology for automotive application is still in its infancy and is not expected to be an important alternative to fossil fuels by **2000.**

World Petroleum Supply and Demand

The Base Case projections of U.S. fuel consumption indicate that the combined unconstrained demand of all sectors will exceed domestic supply by as much as 10 MMBD in 1985 and *over* 15 MMBD by **2000.** There is grave doubt on technical, political, and economic grounds that the level of petroleum imports needed to meet this shortfall could be, or should be, reached or sustained.

In **1976,** the combined demand of the World

Outside Communist Area (WOCA) nations, including the United States, was 49.4 MMBD. Of this, OPEC supplied 30.7 MMBD, and the United States supplied 10.1 MMBD. (See table 24.) In order to meet the demand of **84** MMBD projected for WOCA in **2000,** OPEC production would have to increase to **62** MMBD, about double current production.[26] The ability of the OPEC nations to double the rate of petroleum production over the next two decades is technically doubtful. OPEC (principally Middle Eastern) reserves are generally estimated to be large enough to fulfill such a world demand, but it is not certain that it is physically possible to pump oil from the fields at a rate of **62** MMBD. There is also doubt that present production, transportation, and refining facilities could be expanded as rapidly as necessary. Analysis performed in connection with this study indicates an optimistic value of **56** MMBD and a pessimistic value of **34** MMBD. A middle estimate of 45 MMBD was thought to be realistic in terms of portraying background world petroleum supply for the Base Case. However, this figure is an assumption more than an estimate and could still be too high on purely technical grounds .27

Even if it is assumed that the technical problems of production could be surmounted, there remains doubt about the economic feasibility of an OPEC production rate in the range of **50** to **60** MMBD. The OPEC nations may conclude that their petroleum is more valuable" to them in the ground as a future resource than it is on the immediate market. OPEC already has difficulty in making efficient use of present petroleum revenues. For economic reasons, the OPEC nations—severally or collectively—may choose to husband production to keep pace with their ability to utilize capital, especially since deferred production may lead to greater future profits.

The Base Case assumptions about world petroleum supply are also extremely sensitive to international political factors. The United States now uses more energy per capita than any other major country,[28] and the rest of the world is

[26]This assumes that the Communist nations do not become net importers of petroleum by that time. The eventuality that the Communist Bloc would become competitors for WOCA petroleum was explored in a recent CIA report, which concluded that the probability was high. U.S. Central Intelligence Agency, *The International Energy Situation: Outlook to 1985*, ER 77-102400, April 1977.

[27]More detail on the assumptions underlying these estimates can be found in *Sydec/EEA*, p. III-93.

[28]U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract. . . .*, p. 881.

Table 24.—World Petroleum Supply and Demand (MMBD)

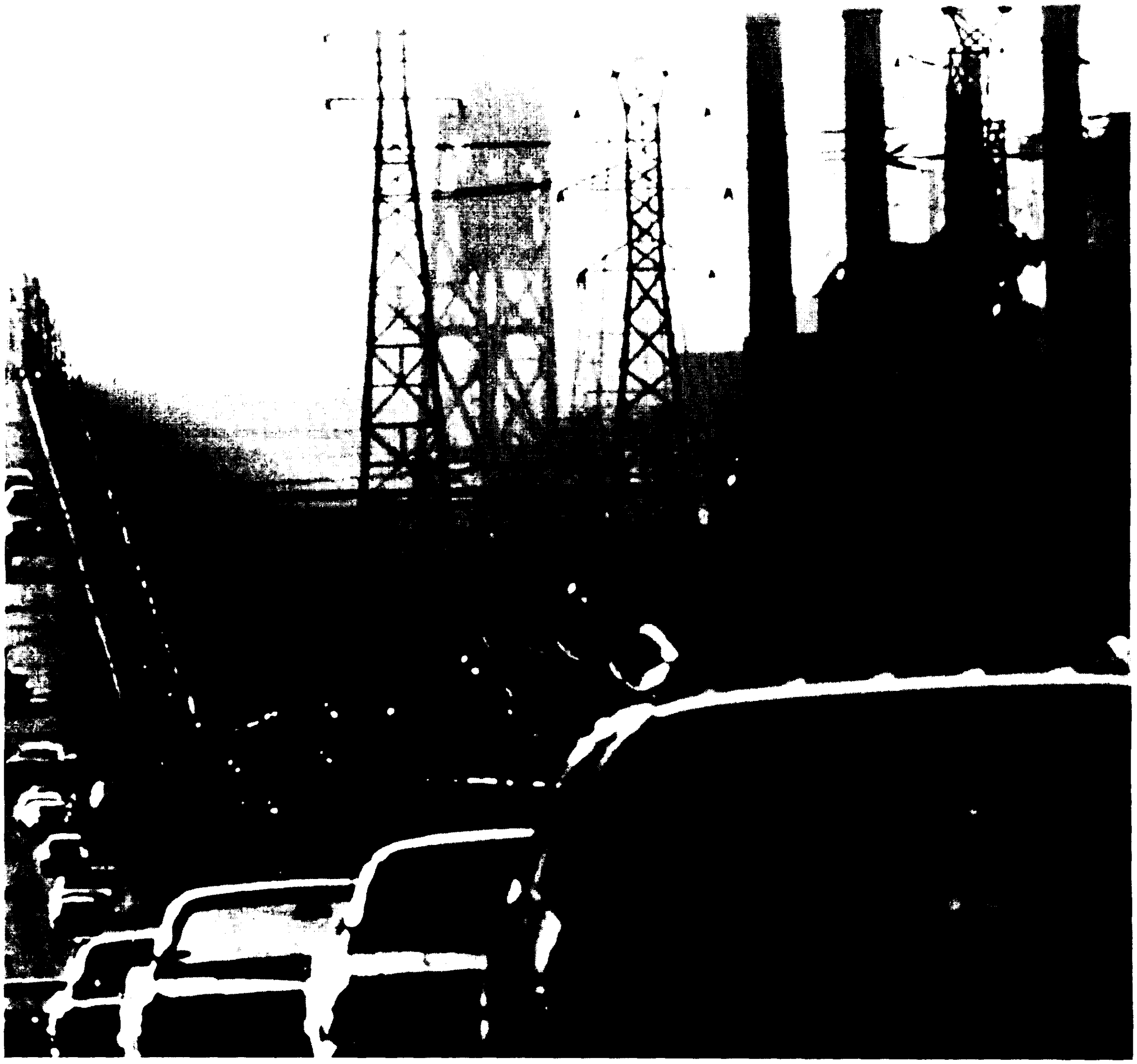
	1976	1985	2000	
			Case A	Case B
Domestic demand				
Automobile	5.2	4.8	4.8	4.2
Other transportation	4.0	5.5	7.8	7.8
Other sectors	8.3	9.8	9.8	9.8
Total domestic	17.5	20.1	22.4	21.8
Other WOCA[a]	31.7	41.0	62.0	62.0
Total WOCA demand	49.4	61.1	84.4	83.8
Domestic supply				
Lower 48 and OCS[b]	10.1	8.1	5.0	5.0
Alaska	—	2.0	2.0	2.0
Total domestic	10.1	10.1	7.0’	7.0’
OPEC	30.7	38.0	45.0	45.0
Other WOCA	6.7	13.0	15.0	15.0
Total WOCA supply	47.5	61.1	67.0	67.0

[a]World Outside Communist Area
[b]Outer Continental Shelf
[c]Excludes Base Case alternate fuels estimate of 2.75 MMBD
SOURCES: WOCA data, U.S. Central Intelligence Agency, *The International Energy Situation: Outlook to 1985*, April 1977
CPEC Data, U.S. Department of Energy, *Monthly Energy Review*, January, 1978.

conscious of this extravagance. The future inability of the United States to conserve energy (especially petroleum) could lead to serious political disagreement with other WOCA nations on how to share the available level of OPEC petroleum, whatever it may be. Within the OPEC nations, there are additional political pressures that might militate against satisfying WOCA (or U. S.) demand.

From the viewpoint of the U.S. economy, the present level of imports has already damaged the U.S. position on balance of payments. Increasing the percentage of imports to between 55 and 70 percent by 2000 (depending upon whether 2.75 MMBD of alternative fuels can be produced) may prove to be a burden that the United States cannot sustain for either economic or political reasons.

Thus, the fundamental conclusion to be drawn from the Base Case projections of energy demand for the United States as a whole and for the automobile system in particular is that the Nation faces the possibility of a severe shortage of petroleum before **2000.** The automobile will still be a major user of petroleum at that time, and a determination will have to be made as to how much further to reduce automobile fuel consumption.



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ENVIRONMENTAL PROJECTIONS

Environmental protection has been a focal point of Federal Government policy since the **1960's.** An important, and often controversial, feature of this policy has been the effort to reduce or mitigate the effects of widespread and intensive automobile use. Heaviest emphasis has been placed on control of automobile emissions and environmental impacts of highways, but other effects–noise, disposal of solid and liquid wastes, and water contamination—deserve attention.

Air Quality Policy and Assumptions

The Clean Air Act of 1970 (Public Law 91-614) and its amendments provide for control of six forms of atmospheric pollutants—carbon monoxide, nitrogen dioxide, photochemical oxidants, hydrocarbons, suspended particulate matter, and sulfur dioxide. Of these, all but the last two are emitted by automobiles in significant quantities. The current standards for automobiles, established in the 1977 amendments to the Clean Air Act, apply to emissions by new cars through the 1981 model year. The standards specify the permissible levels of carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NO_x) that an automobile may emit per mile over its useful life (defined as 50,000 miles). The standards and the schedule for their attainment are shown in table 25.

Table 25.—Automobile Emission Standards for the Base Case

	Standard (grams/mile)		
Model year	**CO**	HC	NO_x
1975	15	1.5	3.1
1976 -79	15	1.5	2.0
1980	7	0.41	2.0
1981-83 (spark-ignition)	3.4	0.41	1.0
1981-83 (diesels)	3.4	0.41	1.5
1984-2000 (all vehicles)	3.4	0.41	1.0

For the Base Case, it is assumed that the 1981 standards remain in force until 2000. During the period 1981-83, when automobile NO_x standards will be 1.0 gram per mile, it is assumed that diesels are granted a waiver to 1.5 grams per mile to allow time for improvement in diesel emission control technology. It is further assumed that by **1983,** these improvements will have been effected and that thereafter all automobiles (whether powered by a diesel or a spark-ignition engine) will be able to meet the 1.0 gram-per-mile standard.

An important factor in estimating future automobile emissions is the rate at which emission control devices deteriorate in use. The current certification procedure is based on an estimated average level of emissions over the useful life of the vehicle, which is defined as 5 years or **50,000** miles. For this study, the deterioration rates assumed are the January **1978** estimates issued by EPA. These estimates cover not only the 50,000-mile certification period, but the full life of the car.[29] The emission rates assumed for other mobile sources and stationary sources are also those currently estimated by EPA.[30]

The Clean Air Act Amendments provide for the application of an inspection and maintenance program for vehicles in use in areas where National Ambient Air Quality Standards for carbon monoxide or oxidants are not expected to be attained by **1982.**[31] To date, few such programs have been instituted under the Act, and the Base Case assumes that none will be mandated by the Federal Government by **2000.**[32]

Air Quality Projections

Base Case projections of automobile emissions are shown in table **26. CO,** HC, and NO_x emissions are expected to decline from current levels by 1985, and further still by 2000. The greatest reductions are in CO and HC emissions

[29] U.S. Environmental Protection Agency, Office of Transportation and Land Use Policy, "Memorandum on Revised Mobile Source Emission Factors," January 1978.

[30] U.S. Environmental Protection Agency, Office of Air and Waste Management, *Automobile Emission Control—The Development Status, Trends, and Outlook as of December 1976.* A Report to the Administrator prepared by Emission Control Technology Division, Mobile Source Air Pollution Control, April 1977; U.S. Environmental Protection Agency, Office of Air and Waste Management, Office of Air Quality Planning and Standards, *Compilation of Air Pollutant Emission Factors,* Part A, AP-42, 3rd edition, August 1977.

[31] *Clean Air Act of 1970. Statutes at Large* 91, 745 (1970), *U.S. Code,* vol. 42, sec. 7502 (August 1977).

[32] The potential benefits of a nationwide mandatory inspection and maintenance program are examined in chapter 6 as one of the policy alternatives for environmental improvement.

Table 26.—Projected Base Case Automobile Emissions

Pollutant	1975 Million tons/ year	1985 Million tons/ year	1985 Percent of 1975	2000 Million tons/ year	2000 Percent of 1975
Carbon monoxide	69.3	32.6	47	27.3	39
Hydrocarbons[a]	7.9	3.5	44	2.9	37
Nitrogen oxides	4.0	2.7	68	2.9	73
Particulates[b]	0.38	0.08	21	0.25	66
Lead[c]	0.15	0.04	27	0.03	20

[a] Includes crankcase emmissions and fuel system evaporative losses
[b] Total suspended particulate matter
[c] Based on projected gasoline consumption and the present EPA schedule for phasing out lead additives
SOURCE: *Sydec/EEA*, p. III-13

(over 60 percent for each by **2000). NO$_x$** emissions are expected to decline by **1985** but to rise again by **2000** as a result of the growing use of diesels.

Projections of particulate emissions are sensitive to the proportion of diesels in the fleet. Particulate emissions would drop by three quarters between **1975** and **1985,** but would climb back as diesel penetration increases.

It should be noted that all types of vehicle emissions reach the lowest levels in the mid-*1990's*. Assuming a 13-year vehicle turnover, almost all of the vehicles on the road at that time will be of a vintage designed to meet the currently programmed standards. As travel increases, the reductions due to lower vehicle emissions are offset by increased VMT.

A projection of aggregate emissions from all sources was prepared using EPA data on emissions from nonautomotive mobile and stationary sources. (See figure 11.) Automobiles are expected to account for only minor fractions of CO, HC, and NO$_x$ emissions from all sources by **2000.** The improvement due to control of automobile emissions will be offset by a much slower decrease (and in some cases an increase) in emissions from other sources. As a result, air quality is not anticipated to reach the levels specified by National Ambient Air Quality Standards in many areas of the country by **1985** and **2000.**

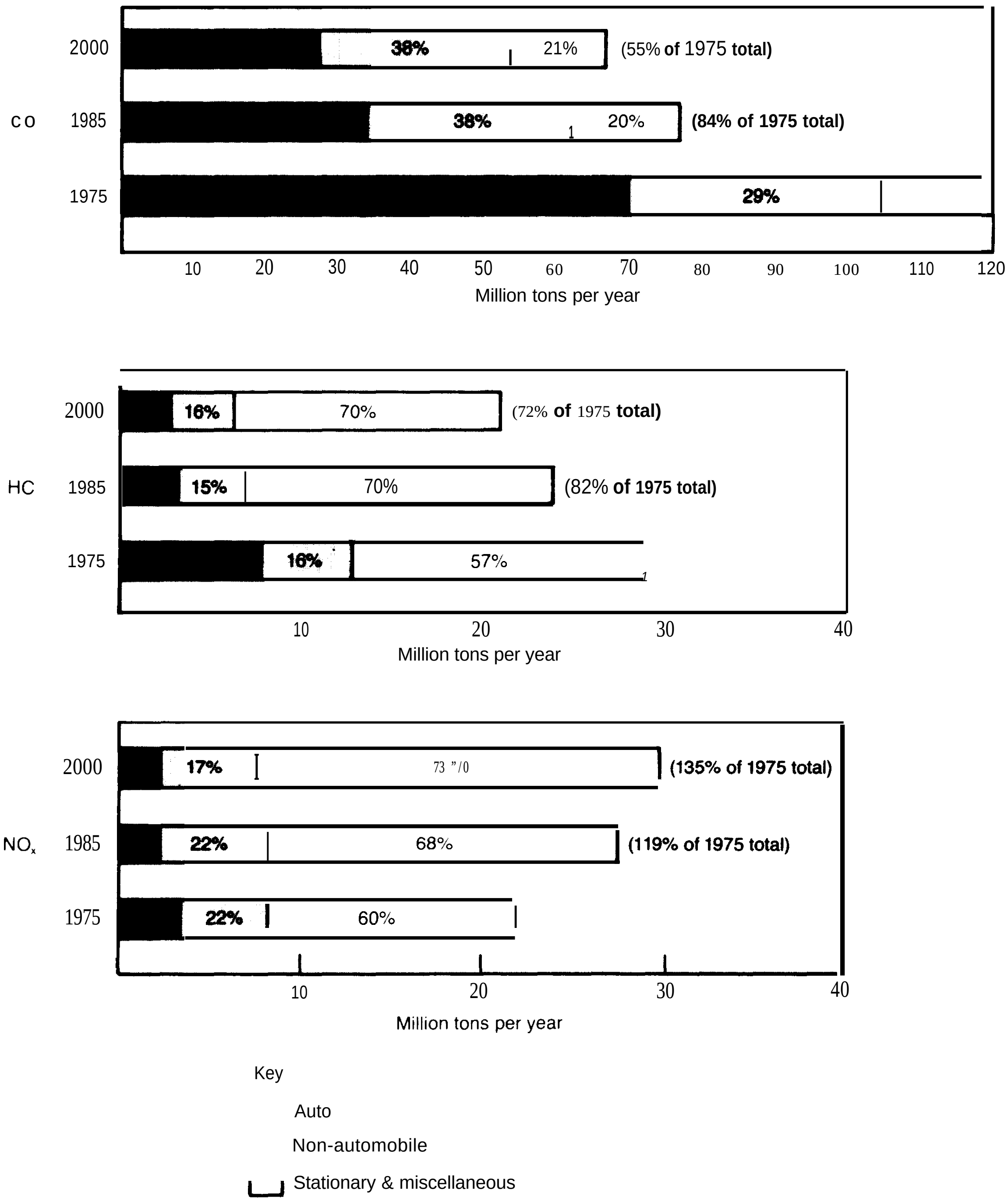
Table 27 indicates the number of Air Quality Control Regions (AQCRs) where violations of air quality standards are projected for 1985 and 2000. Violations of the 8-hour CO standard (10 mg/m^3) in **2000** are expected to fall to about one-third the 1975 level. Extreme violations (twice as high as the permissible level) show the most dramatic decrease, falling from **25** in **1975** to 2 in **2000.** Violations of the oxidant standard **(160** µg/m^3 in a l-hour period), although expected to show some decline, will continue to be high. It is projected that the oxidant standard

Table 27.— Projected Violations of Air Quality Standards, Base Case

Pollutant	1975	1985	2000
Carbon monoxide			
Number of AQCRs[a] exceeding standard[b]	43	34	22
Number of AQCRs exceeding 2X standard	25	3	2
Total violations	68	37	24
Oxidants			
Number of AQCRs exceeding standard[c]	49	46	41
Number of AQCRs exceeding 2X standard	20	11	8
Number of AQCRs exceeding 3X standard	8	2	3
Number of AQCRs exceeding 4X standard	7	3	2
Total violations	84	62	54

[a] AQCR: Air Quality Control Region. There are 247 AQCRs in the United States and its territories.
[b] The CO standard used here is 10 mg/m^3 in an 8-hour period.
[c] *The Oxidant standard is 160 µg/m^3 in a 1-hour period.*
SOURCES: 1975 data, U.S. Environmental Protection Agency, *Monitoring and Air Quality Trends Report. 1974*. February 1976. Data were modified when more recent and accurate information was available.
Projections, *Sydec/EEA*, III-120.

Figure 11 .—Projected Base Case Emissions by Source, 1975-2000



SOURCE: Sydec EEA, p. III-119

will be violated in about **25** percent of the AQCRs in 1985 and in slightly over 20 percent of the AQCRs in **2000.** However, as shown in figure 11, the principal contributors to the high levels of oxidants will be stationary sources (about 70 percent). Of the remainder, automobiles will account for about one-third, or roughly 10 percent of the total.

Figure 12 shows projected cumulative population exposure to CO and oxidants in 1985 and 2000. The number of people exposed to CO concentrations above the standard is expected to decline sharply by 1985, and further still by 2000. The projection for oxidants, however, shows only marginal improvement between 1975 and 2000. Although the number of AQCRs in violation of the oxidant standard will decrease, the population in the areas that remain in violation will increase. The net result is that by **2000,** the number of people exposed to hazardous concentrations of oxidants is expected to be about the same as today. Obviously, not every person in a given AQCR will be exposed to exactly the same level of pollutants and for the same duration. The projections shown in figure 12 are only approximations, but they do indicate the magnitude of the air pollution problem that is expected to persist.

Other Environmental Projections

Base Case projections of environmental impacts were limited to air quality, the most significant environmental concern in the future development of the automobile system. No attempt was made to develop estimates of other types of environmental impacts. However, the Base Case does include general projections of other environmental trends that are expected to result from continuation of present policies.

Noise

Efforts to control motor vehicle noise have followed two approaches—control of the source (the vehicle itself) and highway planning and design standards for noise abatement, EPA has established noise standards for medium and heavy trucks, which call for the noise level to be reduced to 75 dBA (decibels absolute) by 1983. EPA has announced its intent to issue regulations for motorcycle and bus noise during **1978.** EPA is now evaluating noise test data for automobiles, which may become candidates for regulation by the 1980's. The Federal Highway Administration (FHWA) has established design noise levels for highways, and assessment of noise impacts is a regular part of the planning and approval process for federally assisted highway projects.

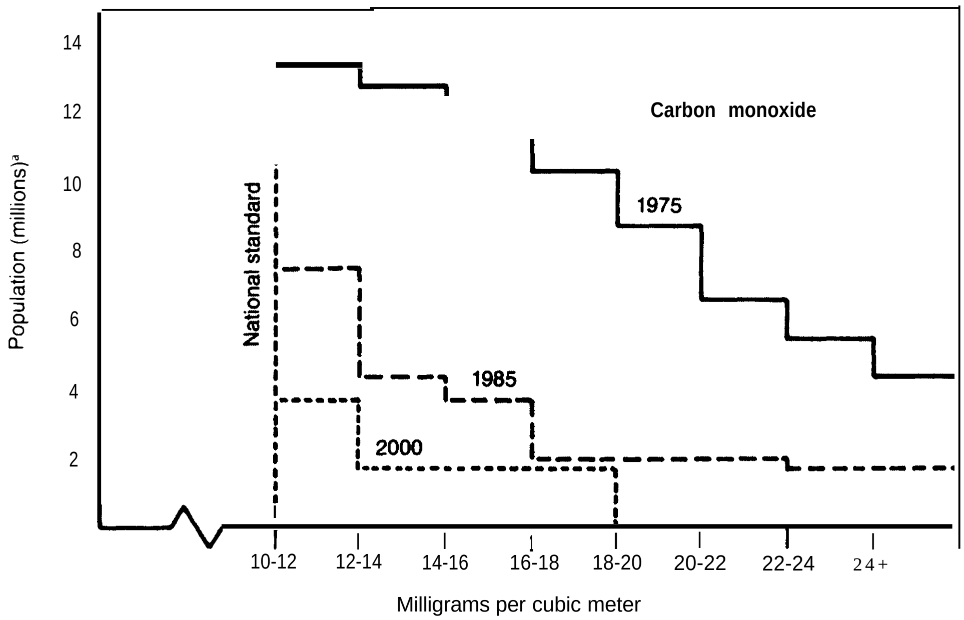
In the Base Case, noise conditions are not expected to change substantially in the short term. However, in the long term and for specific communities with severe automobile congestion, motor vehicle noise could reach levels that require Federal or local government intervention, either to control noise sources or to restrict the conditions of motor vehicle use. The quieting of medium and heavy trucks under EPA regulation will reduce traffic noise levels in many areas, particularly where commercial truck use is concentrated and on arterial routes carrying significant truck traffic. Restricting bus engine noise will reduce sound levels in central business districts and in residential neighborhoods along bus routes. However, these reductions will be partially offset by the increased volume of truck and bus use forecast under Base Case conditions.

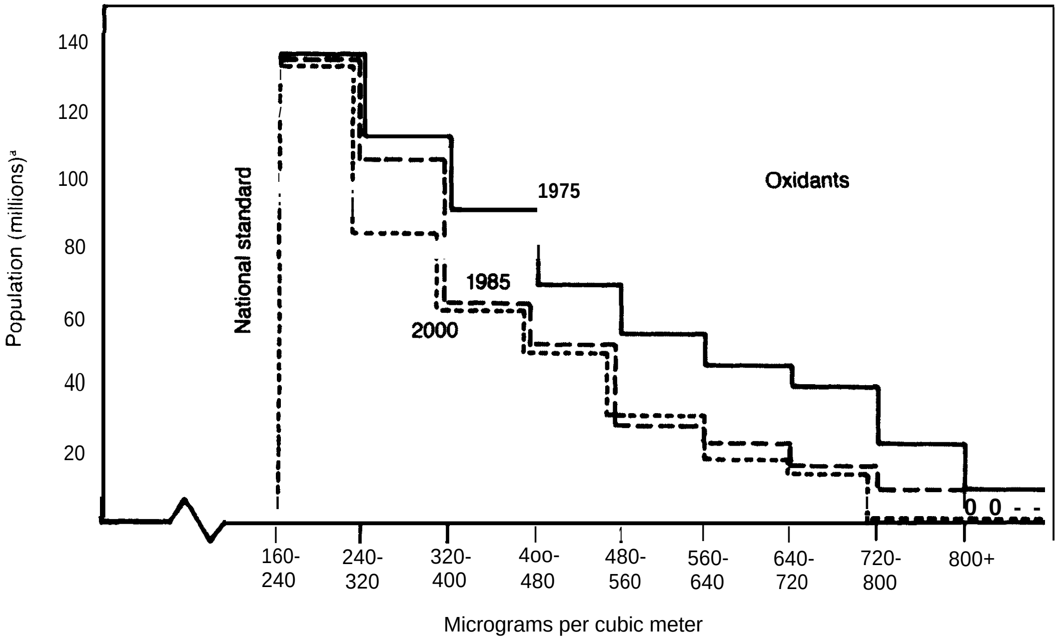
It appears that automobile noise will not become so severe that stringent controls will have to be imposed. For the automobile traffic volumes projected in the Base Case, automobile noise is not expected to rise significantly above present levels or to become a general environmental problem. Continuing attention to noise impacts in highway planning and to noise abatement measures in highway design will combine to improve noise conditions in many areas in the future.

Solid Waste

The problem of disposing of solid wastes from automobiles (including scrap vehicles and commonly replaced parts) varies with the size of the fleet and the weight and composition of the vehicles. In the Base Case, the automobile fleet is projected to increase approximately 50 percent by the year 2000. Assuming that the scrappage rate remains about as it is now, the number of vehicles to be salvaged or otherwise disposed of will reach 11 million per year by the end of

Figure 12.—Estimated Population Exposed to Air Pollution, Base Case





[a]Population in Air Quality Control Regions exposed to above-standard levels of air pollutants. For CO, populations of AQCRs were divided by 10 to account for the localized effect of CO.

SOURCE: *Sycfec EEA,* p 111-120,

the century. However, because of the downsizing trend, the total weight of scrapped vehicles will increase by only **20** to **30** percent.

An important part of the downsizing program is the substitution of lightweight alloys, aluminum, and plastics for iron and steel. Table 28 illustrates the material composition of present and future automobiles, By 1990, the ferrous metal component is expected to decrease; aluminum, plastic, and nonmetallic components are expected to increase. Difficulty in the recovery or disposal of these nonferrous components may tend to increase the problem of how to handle solid wastes from the automobile in an environmentally acceptable manner.

Table 28.—Change in Materials Used in a Typical Automobile

Material	Percent 1975	Percent 1990
Steel	61	54
Cast iron	16	8
Aluminum	3	12
Other metal	4	3
Plastics	4	9
Other nonmetal	12	14

SOURCE: Automotive News, *Automotive News 1976 Market Data Book Issue* Apr. 28, 1976. Original data from International Research and Technology Corporation

The diesel engine is heavier than the conventional spark-ignition engine. Although some weight reduction would be possible in diesel automobiles, the engine weight is expected to keep the diesel auto heavier than a conventional auto. There is expected to be little substitution for steel and cast iron in the diesel engine, and processes for recovering these metals are expected to remain in use.[33]

Two other components may pose special problems—the catalyst materials in catalytic converters, and batteries. Problems with the latter could become much more significant if electric vehicles begin to be used in significant numbers.

Water Quality

Both highway construction and use cause water quality impacts. So, too, does the disposal of liquid wastes from automobiles (spilled fuels, Lubricants, coolants, battery acid). Since these impacts vary principally as a function of local conditions, no national projections of water quality have been attempted for the Base Case.

Water pollution from automobiles or highway runoff has not been the subject of major control efforts, In most areas, discharges from industrial facilities and sanitary sewage systems pose much greater water pollution problems than automobiles and highways. However, as these major sources come under stricter control, attention may shift to highway runoff and automobile liquid wastes—both of which will be increasing as a result of more highway mileage, more vehicles, and more VMT.

The composition of water pollutants from the automobile transportation system is not expected to change greatly in the next **25** years. However, there are two possible exceptions. First, there could be a change in the type and amount of certain pollutants due to the increasing number of diesel vehicles on the roads. Second, the increasing use of electrically powered vehicles may create problems due to spillage or disposal of battery acids. At this time, only limited information is available on the nature and magnitude of the problems of treating and disposing of these liquid wastes.

Highways and the Community

One of the impacts of the highway program is the disruption caused by the displacement of homes and businesses. To indicate the amount of community disruption, estimates were made of the displacements of residences, businesses, farms, and nonprofit organizations. (See table **29.**) The methodology relating these displace-

Table 29.— Projected Displacements Due to Highway Construction, Base Case

	Average annual displacements: Actual 1971-75	Projected 1985	Projected 2000
Residential units	10,800	5,500	4,300
Businesses	2,500	1,800	1,600
Farms	200	200	160
Nonprofit organizations	100	80	70

SOURCE Sydec *EEA* p III 191

[33] Sydec EEA, p. III-129

ments to Federal highway expenditures took into account both the cyclical nature of these statistics and projected long-term averages. As the rate of capital spending decreases in real dollars, fewer miles of new highways will be constructed, and displacements are expected to decline on an average basis. The rate of residential units displaced yearly will decline to about **40** percent of today's rate by **2000.** Other indicators will also decline, but not as much.

SAFETY PROJECTIONS

Safety Policy and Assumptions

The safety of the automobile system of the future will depend upon changes in the design of automobiles, in the design of the highway system, and in the performance of drivers, as well as on changes in the amount and distribution of driving exposure (VMT). Of the large number of possible Federal policies that would bring about such changes, either alone or in combination, the most significant new policy included in the Base Case is the assumed introduction of passive occupant restraints in automobiles.

Passive restraints are assumed to be introduced in new cars according to the schedule recommended by the Secretary of Transportation:

- All large cars sold in 1982 will be equipped with passive restraints.

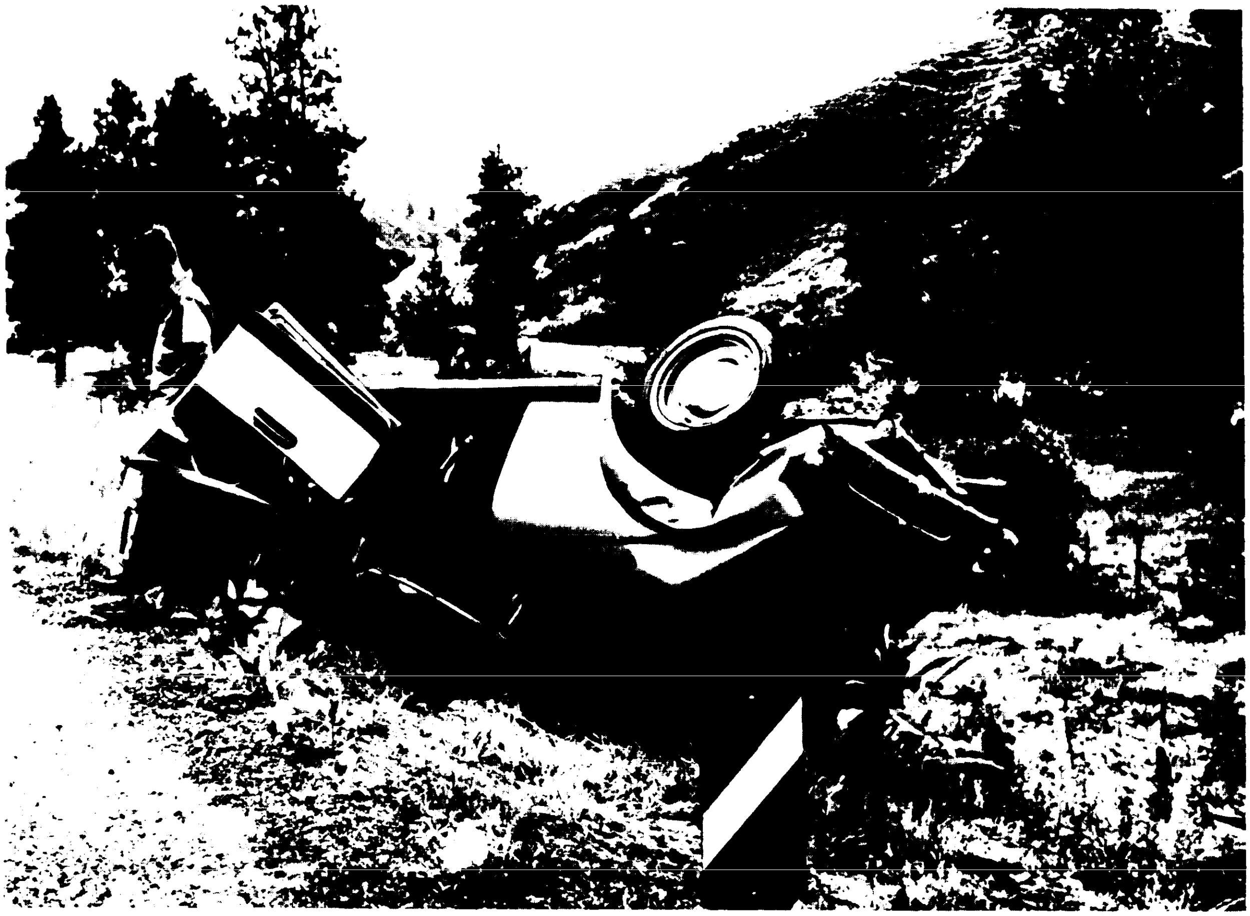


Photo Credit U S Department of Transportation

- All intermediate cars sold in **1983** will have passive restraints.
- All cars sold in **1984** and after will have passive restraints.[34]

Estimates of the cost of the air cushion restraint system or its equivalent vary widely. The Department of Transportation forecasts a cost of $112 per vehicle for production in quantity. Ford and General Motors estimates are $193 and $235, respectively. [35] For the Base Case, it was assumed that air bags would add $200 to the price of a new car.

The existing Federal Motor Vehicle Safety Standards that have been incorporated in current new car designs are assumed to remain in effect in the future. These standards have been adopted over a period of several years and include requirements for specific safety-related equipment and performance specifications for vehicle design elements. The changes being brought about by these regulations are assumed to affect most of the auto fleet by 1985. The Base Case also assumes that other Federal automobile and highway safety programs will continue, but at current levels of funding and effectiveness. These include:

- Alcohol and drug use countermeasures,
- Improved driver skills and awareness,
- Enforcement of the 55-mph speed limit,
- Roadside hazard and grade-crossing elimination,
- Improved highway design and control systems,
- Improved emergency medical services,
- Improved crashworthiness, and
- Automobile safety inspections.

Projected Fatalities and Injuries

The most important factor affecting crash rates between now and 2000 will be the growth in VMT. Generally speaking, fatalities and injuries will increase in direct relation to the number of vehicles on the road and the amount of travel. Other contributing factors will be the increase in urban congestion and the growing proportion of small cars in the fleet. Two factors could have a countervailing effect. A greater proportion of travel is expected to occur on the Interstate System, which is designed for a high level of safety. The introduction of passive restraints in all new passenger cars after 1984 will help reduce deaths and lessen the severity of injury.

These factors were taken into account in developing the Base Case projections of deaths and injuries which are presented in table 30. These values fall within the range of estimates obtained in other recent studies of future highway and automobile safety.[36]

From table **30,** it can be seen that the number of crashes increases proportionately with VMT. The number of deaths and injuries in 2000 are expected to be about 40 percent greater than in 1975. However, the rate of growth will be only about half that of VMT. The growth in the number of fatalities is illustrated in figure 13.

Table 30.—Base Case Traffic Safety Projections

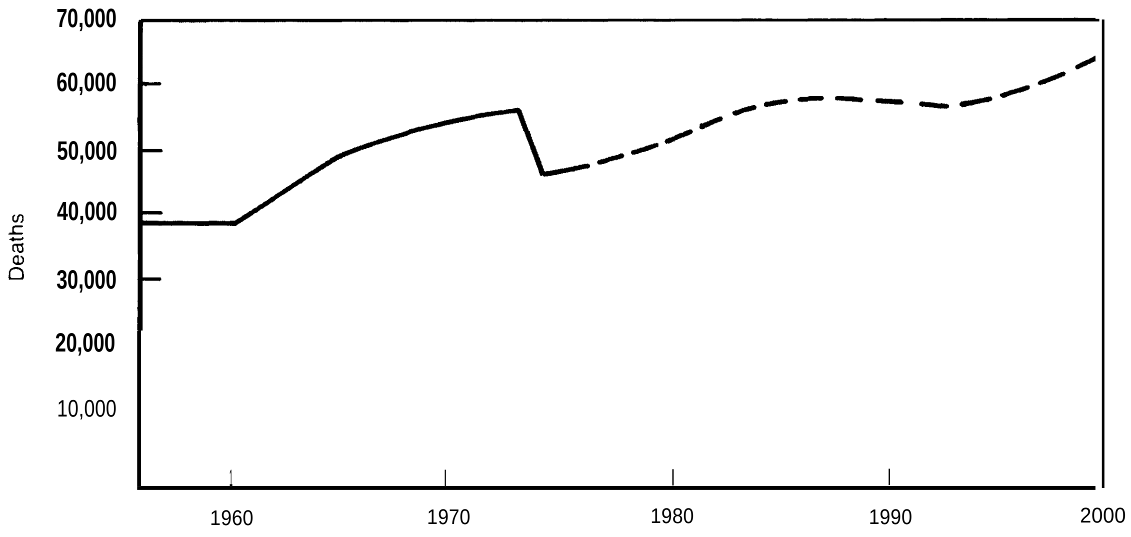
	1975	1985	2000
VMT (trillions)[a]	1.33	1.84	2.32
Traffic crashes (millions)[b]	16.5	22.9	28.8
Total injuries (millions)	4.0	5.0	5.5
Debilitating injuries (millions)[c]	1.8	2.2	2.5
Fatalities (thousands)	46[d]	57	64
Fatality rate per 100 million VMT	3.4	3.1	2.8

[a]Includes all types of vehicles.
[b]Includes all crashes on public roadways involving automobiles, trucks, motorcycles, bicycles, buses, and pedestrians.
[c]An injury that restricts normal activity for at least 1 day after the accident.
[d]Of the 46,000 fatalities in 1975, 27,500 were auto occupants.
SOURCES: 1975 VMT, Motor Vehicle Manufacturers Association, *Motor Vehicle Facts and Figures '77*, p. 62. Other 1975 data, National Safety Council, *Accident Facts, 1976*, p. 40. Projections by OTA.

[34]*Federal Register*, (June 30, 1977): 33534-33570.
[35]U.S. Department of Transportation, National Highway Traffic Safety Administration, *Economic Impact Assessment Amendment to Federal Motor Vehicle Safety Standard No. 208 (Occupant Crash Protection)*, July 1977.

[36]Hans Joksch, *Analysis of the Future Effects of the Fuel Shortage and Increased Small Car Usage Upon Traffic Deaths and Injuries*, prepared for U.S. Department of Transportation, Office of the Assistant Secretary for Systems Development and Technology (Hartford, Conn.: Center for the Environment and Man, Inc., January 1976); U.S. Department of Transportation, National Highway Traffic Safety Administration, *National Highway Safety Forecast*, September 1976; U.S. Department of Transportation, *The Report By the Federal Task Force on Motor Vehicle Goals Beyond 1980*, volumes I-III (Washington, D.C.: U.S. Government Printing Office, 2 September 1976).

Figure 13.—Motor Vehicle Deaths, 1975 to 2000



SOURCE: OTA projection using Base Case VMT adjusted for total vehicle travel

The fatality rate per 100 million miles of travel is expected to decline from 3.4 to 3.1 between now and 1985 and to 2.8 by 2000. The major contributing factor will be the introduction of passive occupant restraint systems beginning in 1982. By 2000, virtually all cars on the road will be equipped with such devices.

HIGHWAY PROJECTIONS

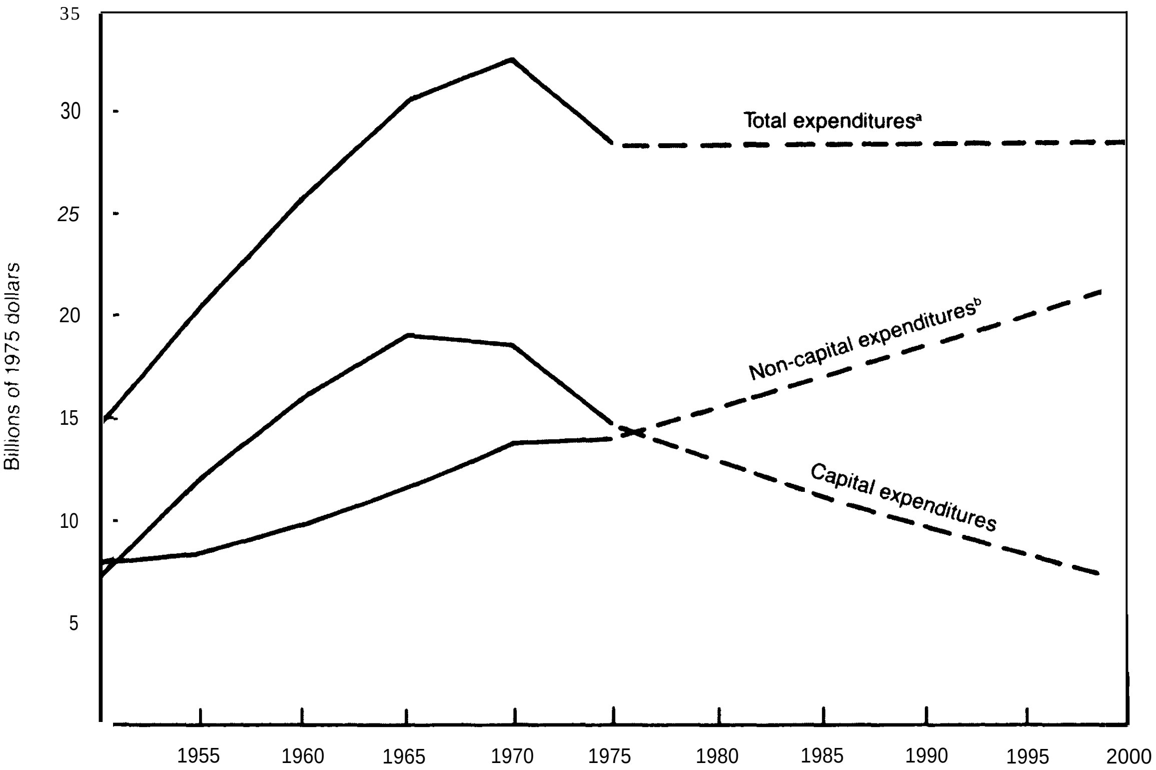
Assumed Highway Expenditures

Since 1960, total highway expenditures by all levels of government have been relatively stable in constant dollars. However, the distribution of these expenditures between capital improvements and noncapital expenses has been shifting. Capital expenditures have declined steadily to approximately half of the total. (See figure **14.**)

For the Base Case, it is assumed that the trend will continue and that noncapital items, especially maintenance, will constitute a growing share of highway expenditures by Federal, State, and local governments. Specifically, the Base Case assumptions on highway expenditures are as follows:

- Total highway spending by all levels of government will remain constant in real dollars from 1975 to **2000.**
- Capital expenditures, as a proportion of total expenditures, will continue to drop by 1 percent per year from **50** percent in **1975 to 25** percent in **2000.**
- Maintenance and other noncapital items will continue to increase 1 percent per year as a proportion of total highway costs.
- The Interstate System will be completed by 1990, using about $38 billion of the cumulative $257 billion (1975 dollars) capital expenditures for the period 1976-2000.
- The Highway Trust Fund and other financing mechanisms will continue in their present form.
- To qualify for Federal assistance, urban area plans will have to include provisions for Transportation System Management (TSM), but no special funding category will be created for this purpose.

Figure 14.—Future Highway Expenditures Assumed for the Base Case



[a] Expenditures by Federal, State, and local governments
[b] Includes maintenance, administration, police, planning, research, and debt service
SOURCE Sydec *EEA, III-33*

- Federal matching shares in all categorical grant programs will not change.
- There will be no new sources of funding for transit within the highway program.
- Technically, there is no Federal funding now available to States for maintenance. However, some of the Federal assistance classified as capital is authorized for resurfacing, rehabilitation, and restoration of roads and bridges. Federal aid for these "3-R" activities is assumed to continues[17]

Table 31 is a summary of the highway expenditures assumed for the Base Case.

Table 31 .—Assumed Highway Expenditures, Base Case

Item	Expenditures (billions, 1975 dollars)		
	1975	1985	2000
Capital outlay.	14.3	11.2	7.0
Maintenance	7.1	8.7	10.8
Other (administration, police, debt).	6.8	8.3	10,4
Total	28.2	28.2	28.2

SOURCE 1975 data, Motor Vehicle Manufacturers Association, Mofor Veh/c/e *Facts and F(gures '77,* p 89

Assumed Highway Taxes and Revenues

The primary source of funds for Federal and State highway programs has been the gasoline tax. In 1976, $12.6 billion was collected from this source by all levels of government. Other sources include tolls, parking fees, property taxes, and general fund appropriations. Table 32 summarizes the sources of revenue for highway purposes in 1975.

Approximately two-thirds of all highway revenues in 1975 came from direct user charges. However, fuel tax revenues, which make up a large share of such direct charges, have been

[17] For the Base Case, the current level of 3-R assistance is considered expenditure for capital improvement. Projected increases in 3-R assistance are treated as noncapital items.

Photo Credit: U.S. Department of Transportation

declining slightly in real terms since 1970. (See figure 15.) While the amount of driving (and hence fuel tax revenues) has begun to increase again since the dip caused by the 1973-74 oil embargo, it is expected that automobile gasoline consumption will level off in the 1980's because of mandated fuel economy improvements. (Under Case B assumptions on fuel economy, automobile fuel consumption would actually decline.)

To support a constant level of highway expenditure through 2000, it is assumed that taxes on gasoline and diesel fuel would be increased as needed to maintain revenues at their present level. The assumed fuel consumption and taxes are listed in table 33. Other sources are assumed to provide the same proportion of revenues as in 1975.

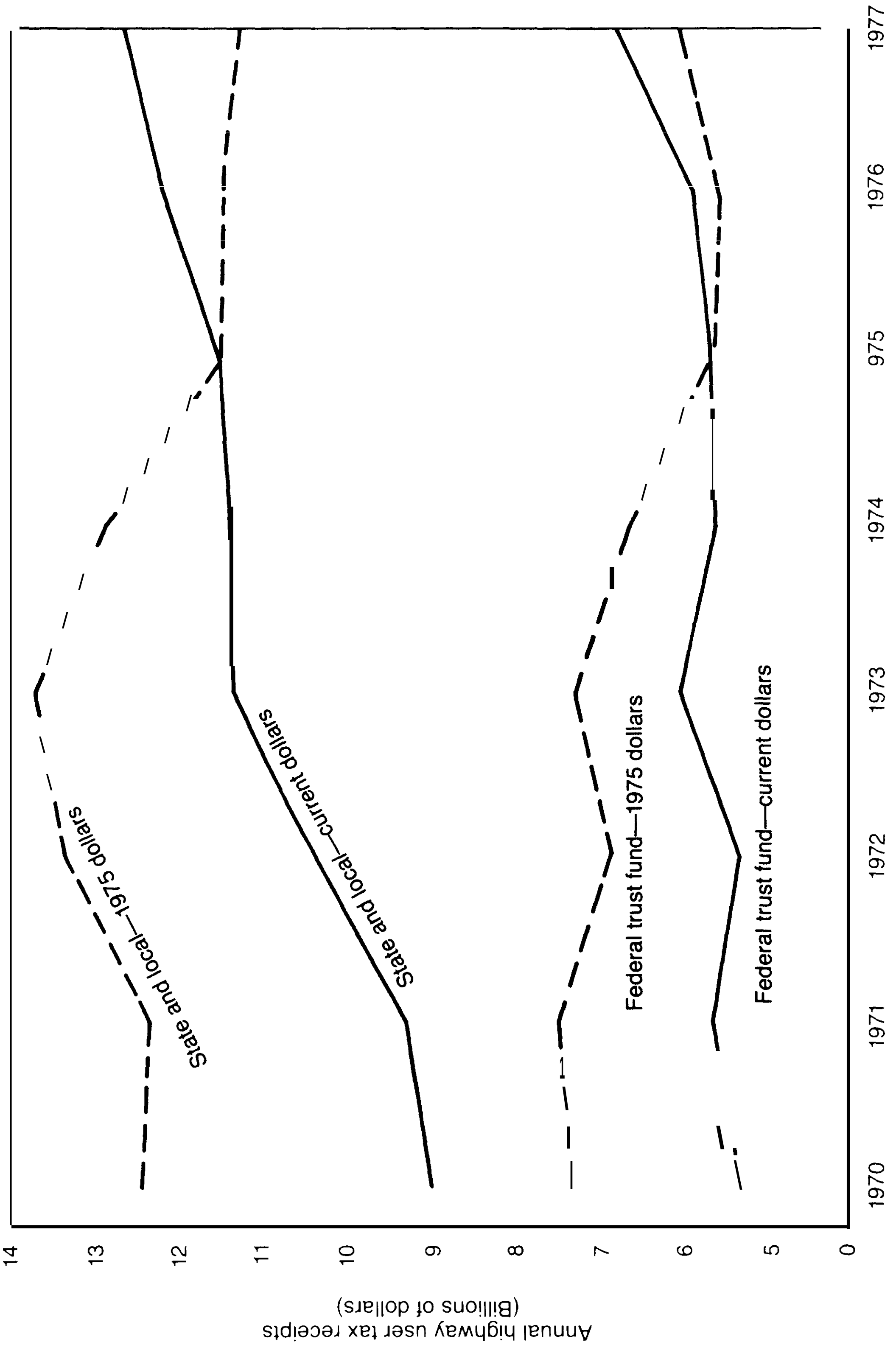
Table 32.—Highway Revenue Sources, 1975 (millions)

Receipts	Amount	Percent
Highway user taxes		
Federal trust fund revenues	$ 5,699	19.9
State and local	11,542	40.3
Tolls	1,263	4.4
Parking fees	120	0.4
Subtotal	$18,624	65.0
Other taxes and fees		
Property taxes and assessments	1,662	5.8
General fund appropriations	4,077	14.2
Miscellaneous taxes and fees	408	1.4
Subtotal	6,147	21.5
Other income[a]	3,877	13.5
Total receipts	$28,648	100.0

[a]Includes income from investments and bond issue proceeds

SOURCE: Motor Vehicle Manufacturers Association, Motor Vehicle Facts and Figures '77, pp 85-89

Figure 5.—Recent Trends in Highway User Tax Receipts



SOURCE: Motor Vehicle Manufacturers Association, *Motor Vehicle Facts and Figures '77*, p. 89.

Table 33.—Automobile Fuel Consumption and Gasoline Taxes

	1975	1985	2000 Case A	2000 Case B
Annual fuel consumption (billion gallons)	76-0	73.3	73.9	64.4
Percent of 1976 consumption	100	96.4	97.2	84.7
Gasoline tax necessary to hold receipts at 1975 level (1975 cents/gallon)	11.7	12.0	12.1	13.8

Projected Highway Travel Speeds and Congestion

The amount of travel, highway speeds, and the level of congestion are indicators of how the highway system serves the needs of motorists. Under Base Case assumptions, total annual vehicle miles traveled by automobiles is projected to increase from 1.03 trillion to 1.43 trillion in **1985** and 1.80 trillion in **2000.** The average annual rate of growth in automobile VMT over the 25-year period is **2.3** percent per year— considerably lower than the 3.8-percent annual rate during 1960-75. The amount of automobile travel per capita also would continue to increase, but at a rate much lower than the 1960-75 trend.

Between 1975 and 2000, VMT on rural roads are expected to increase by 60 percent. Because these roads are now used well below their capacity, it is anticipated that they can accommodate increased demand without affecting travel conditions. Since the projected rural travel growth is expected to be greatest on the higher class roads (for example, a 115-percent increase is forecast for rural interstates), average rural traffic speeds will remain virtually unchanged

In urban areas, where there is already considerable congestion in peak periods, congestion will worsen under Base Case assumptions since road construction is not expected to keep pace with traffic growth. Three main effects are anticipated:

- Peak periods will increase in duration.
- A growing proportion of automobile travel will occur under congested conditions—lo percent in 1975, 14 percent in 1985, and 24 percent in 2000. (See table 34.)
- Average daily speeds will drop on all classes of urban roads, with urban freeway travel in 2000 about 30 percent slower than today. (See figure 16.)

Table 34.—Projected Daily Urban Travel and Congestion

	1975		1985		2000	
	Daily auto VMT (millions)	Percent occurring under congested conditions[a]	Daily auto VMT (millions)	Percent occurring under congested conditions	Daily auto VMT (millions)	Percent occurring under congested conditions
Interstate	288	10	447	18	643	34
Other freeways and expressways	170	11	262	18	382	30
Other principal arterials	465	16	606	21	796	29
Minor arterials	331	8	431	10	564	22
Collectors	150	5	196	7	259	15
Local	230	N.A.	285	N.A.	355	N.A.
Total	1,634	10	2,227	14	2,999	24

[a]Congested conditions occur when the ratio of traffic volume to road capacity is greater than 0.95
SOURCE: *Sydec/EEA*, p.III-78

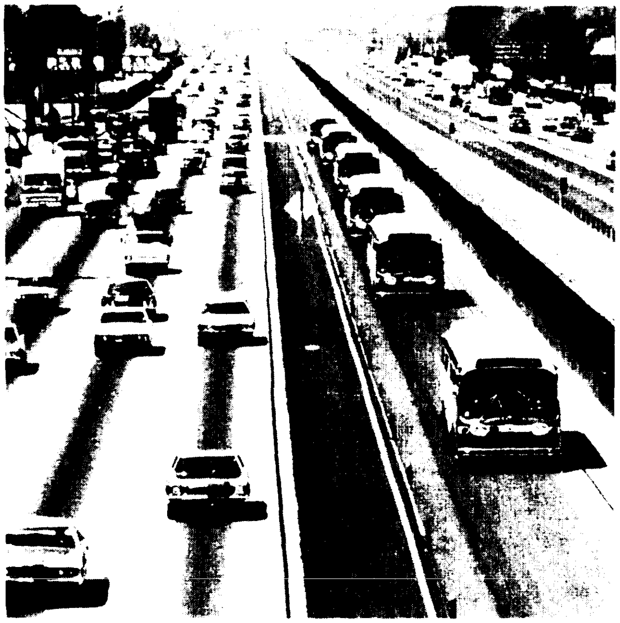
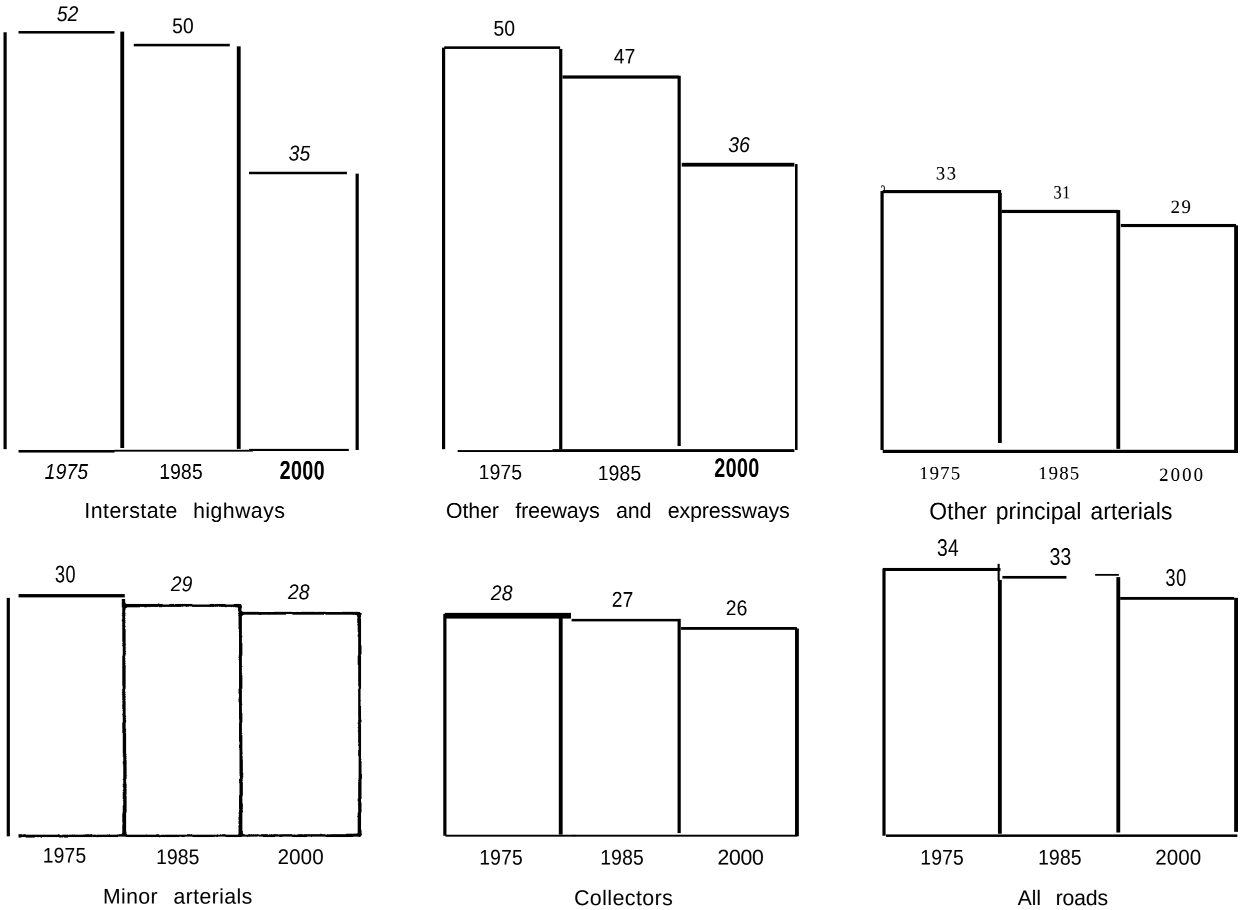


Photo Credit U S Department of Transpor!afjon

Figure 16.—Projected 24-Hour Average Speeds in Urban Areas, Base Case
(Miles per hour)



SOURCE *Sydec EEA,* p III-79

Future Roadway Condition

For the Base Case, it is assumed that noncapital highway expenditures, in proportion to total highway expenditures, will increase 1 percent per year. Assuming that highway maintenance expenses retain their current share of noncapital spending, total maintenance spending by all levels of government would increase from $7.0 billion in **1975** to **$10.5** billion in **2000** **(1975** dollars). This increase does not necessarily mean that the Nation's roads will be in better condition. In considering the impact of these expenditures, the following factors must be taken into account:

- As the highway system continues to expand, there will be more roads to maintain.
- Because VMT are expected to grow faster than the highway system, roads will require more maintenance.
- Highway maintenance costs have been increasing faster than the Consumer Price Index. Although some automation in interstate highway maintenance is expected, there will still be a continuing increase in maintenance costs per lane mile.
- Some of the increasing maintenance requirement will be classified as minor reconstruction and will be eligible for Federal aid.

Quantitative estimates of the future condition of highways and streets have not been attempted for the Base Case. However, given the projected travel demand and the assumed funding for construction and maintenance, it is expected that the condition of roadways will deteriorate considerably over the coming 25 years.

The assumed highway programs for maintenance and capital improvements do not include any appropriations above current levels for bridge repair. At present, there are about 105,000 bridges needing rehabilitation or replacement, at an estimated cost of $23 billion. The 1977 fiscal year Federal funding for this purpose was $176 million per year, drawn from Highway Trust Fund monies. The need to improve the condition of the Nation's highway bridges may diminish the amount of Federal and State money available for other forms of road maintenance and repair between now and 2000.

TRANSIT PROJECTIONS

Assumed Federal Assistance

Section 3 of the Urban Mass Transportation Act of 1964 authorizes UMTA to make grants or loans to assist States and local governments in financing the acquisition, construction, reconstruction, and improvement of mass transportation facilities. The appropriations for this program, which began at **$60** million in 1965, reached $175 million by **1970.**[38] Currently, the 1978 Surface Transportation Act authorizes nearly $1.7 billion. In addition, $400 million are made available to localities that choose to substitute public transit projects for interstate highway segments.[39]

The assumed future Federal program of capital assistance for transit is based on the following considerations:

- There is great uncertainty in future appropriations for this program because Government agencies are budgeted for 1 year at a time and Federal fiscal planning rarely looks as far as 5 years ahead.
- UMTA and DOT support for the capital program is strong, although there has been some question recently about the effectiveness of rail transit.
- The **1978** Surface Transportation Act created a single program for surface transportation and authorized approximately $3.2 billion for FY **1979.** Appropriations under

[38] U.S. Department of Transportation, Urban Mass Transportation Administration, *Urban Mass Transportation Act of 1964 and Related Laws* (Washington, D. C.: U.S. Government Printing Office, 1976), p. 9, footnote 28.

[39] When a State takes advantage of this provision, the highway mileage may be redesignated to another State. The Federal share of the transit project is then appropriated from general revenues. The amount so appropriated may not exceed the amount which would have been spent on the highway segment, nor may it exceed 80 percent of the cost of the substituted transit project. See U.S. Congress, Congressional Budget Office, *Urban Mass Transportation: Options for Federal Assistance*, p. 54, and *U 5 Code*, vol. 23, sec. 103(e)(4).

this Act are programmed to rise to about $3.7 billion by FY 1982,

- The cost of new buses is increasing, partly due to Federal regulations requiring provisions for the elderly and handicapped. These regulations will also affect costs of rail vehicles and stations.
- There are increasing pressures to expand transit systems to conserve energy and reduce air pollution. However, there is some question whether new rail systems will result in overall energy savings .[40]
- UMTA has made formal commitments or commitments in principle to at least six heavy or light rail systems. ”
- UMTA has begun a demonstration program for Downtown People Movers. Although the current budget is only **$220** million, funding for additional systems may be approved if the first four test installations prove successful.
- The cost of bus and rail transit systems is greater than local or State governments can afford on their own. UMTA regards these systems as one of the keys to improving the quality of life in urbanized areas.[42]

Table 35.—Base Case Transit Financing Assumptions (millions, 1975 dollars)

	1975	1985	2000
Federal capital funds[a]	$1,210	$1,710	$1,710
Local matching share[b]	300	430	430
Operating revenue	2,000	1,420	1,420
Operating cost	3,710	4,620	6,820
Operating deficit	1,710	3,200	5,400
Federal operating assistance	300	930	930
Local share of deficit	1,410	2,270	4,470
Total Federal aid[c]	1,510	2,640	2,640
Total local burden[d]	1,710	2,700	4,900

[a]Includes Federal aid for transit projects built in lieu of interstate highways.
[b]Assumed at 20 percent of project capital cost.
[c]Excludes approximately $60 million to $70 million in special projects for the transportation disadvantaged.
[d]Excludes some small transit operations.
SOURCE: *Sydec/EEA*, pp. III-36 to III-40, p. IV-44.

[40]U.S. Congress, Congressional Budget Office, *Urban Mass Transportation. . . .*

[41]U.S. Congress, Congressional Budget Office, *UMTA Funding: Is It Adequate?*, Staff Draft Analysis, March 1977, p. 8.

[42]U.S. Department of Transportation, Urban Mass Transportation Administration, Office of Public Affairs, *Federal Assistance for Urban Mobility*.

In view of these factors, it is assumed for the Base Case that the Federal Government will continue to increase capital assistance for public transit by 10 percent a year in current dollars until 1985, This will result in a 1985 capital assistance program of $1.7 billion (1975 dollars), compared with $1.2 billion in 1975. Between 1985 and 2000, it has been assumed Federal capital assistance for transit will remain at $1.7 billion per year. Assumptions for Federal assistance to public transit are listed in table 35.

The assumed level of Federal assistance would allow the transit fleet to grow by about **46** percent between 1975 and 2000. Fixed guideway miles would increase by 54 percent. (See table 36.)

Table 36. —Base Case Transit Service Levels

	1975	1985	2000
Fixed guideway miles	560	650	860
Rail cars,	10,800	11,800	15,700
Buses	51,500	60,200	75,400
Transit vehicle miles (millions)			
Bus	1,540	1,800	2,260
Rail	450	520	690
Total	1,990	2,320	2,950

SOURCE: 1975 data, American Public Transit Association, *Transit Fact Book* '76-'77 Edition, p.23.

In addition to capital assistance, Federal aid is also provided for transit system operation under section 5 of the Urban Mass Transportation Act—the so-called “Formula Grants Program. ” Funds are allocated to urban areas with populations over 50,000 by a formula weighted according to population and density. These funds may be used either for capital expenditures or for defraying transit operating costs. To date, 94 percent of the grants have been used for operating assistance, and cover about 20 to 25 percent of the annual national transit operating deficit .[43]

Through 1985, the Federal formula grants program is assumed to increase at a rate of 10 percent a year in current dollars and then to remain constant until 2000. However, operating costs will continue to increase because of the service expansion resulting from the capital pro-

[43]U.S. Congress, Congressional Budget Office, *Urban Mass Transportation . . .*, pp. 7 and 53.

gram and because of inflation .[44] As shown in table 35, the annual operating deficit would grow from $1.7 billion in 1975 to $3.2 billion in 1985 and $5.4 billion in **2000.** The assumed $930 million in Federal operating assistance would cover only 17 percent of the deficit by 2000.

Continuance of transit operations would be a major burden on State and local governments. Their contributions to cover operating deficits would triple over the next 25 years—rising from $1.4 billion in 1975 to nearly $2.3 billion in 1985 and $4.5 billion in **2000.** In contrast, local capital expenditures, which are assumed to follow Federal capital aid at a 20:80 matching ratio, would rise only 40 percent—from $0.3 billion in 1975 to $0.43 billion annually between 1985 and 2000. The total annual subsidy required of State and local governments in 2000 would be $4.9 billion.

Projected Transit Ridership

The projections of transit ridership are based on three factors:

1. Changes in fares,
2. Changes in service levels, and
3. Changes in personal income.

For a number of years, transit fares rose gradually in constant-dollar terms. However, Government support for transit in the early 1970's generally stabilized fares. Between now and 1985, average transit fares are assumed to remain at their current-dollar levels (a decrease from 33 cents in 1975 to 20 cents in 1985 in constant-dollar terms). Between 1985 and 2000, average fares are assumed to remain at 20 cents (in 1975 dollars). The effect would be a 40-percent reduction in real fares, which, by itself, would lead to a 16-percent increase in ridership.

As shown in table 36, transit vehicle miles are assumed to increase by 17 percent from 1975 to 1985 and an additional 30 percent by 2000. The effect of this, by itself, would increase transit ridership by 6 percent between 1975 and 1985 and 10 percent more by 2000.

Disposable personal income per capita is assumed to double between 1975 and 2000. Thus, individuals will have more money to spend for automobile transportation and will be able to afford more easily the higher costs of using an automobile as compared to using transit. Additionally, it is expected that the public will attach greater importance to travel time differences than to cost differences between automobiles and transit. The result of increased personal income, by itself, would cause a 15-percent decline in transit travel by the year 2000.

From the combined effects of lower fares, increased service, and higher disposable income, transit ridership is expected to grow from **5.6** billion passengers in **1975** to 6.5 billion passengers in 1985, an increase of 16 percent. Ridership would remain at the 1985 level through 2000. This transit rider increase is expected to have a negligible effect on miles of automobile travel. Despite the increase in ridership, real transit revenues are projected to decline **29** percent in the 1985-2000 period due to the significantly lower transit fares. (See table 35.)

Part of the rationale for Federal involvement in public transportation is concern for the special mobility problems of those referred to as "transit dependent" or "transportation disadvantaged. " Four groups, recognized as having a high degree of dependence on public transportation or poor access to automobiles, are the old, the physically handicapped, the poor, and the young. Estimates of the present and future size of these groups are given in table 37.

In each of the first three groups, many of the individuals are in fact quite able to manage their personal travel, either by walking, auto, or public transit. For many of the poor, the high costs of auto ownership preclude this mode as the prime means of travel. In **1974, 84** percent of all households owned a vehicle.[45] In comparison, automobile ownership in households with annual incomes under $3,000 was **46** percent. In households earning between **$3,000** and **$5,000** per year, auto ownership was **64** percent. "

The youngest of the young are parent-dependent, and most would not be allowed to travel far from home without adult supervision. However, those who are over 10 and capable of

[44]The cost per vehicle-mile of transit service is assumed to increase 1 percent per year in constant dollars.

[45]Includes cars, pickup trucks, vans, and recreational vehicles.

[46]Motor Vehicle Manufacturers Association, *Motor Vehicle Facts and Figures '77*, p. 38.

unsupervised travel find that, without public transit, most metropolitan area activities are inaccessible. Travel by the young who are driven by their parents involves costly double round trips, with associated increases in energy consumption, environmental effects, and inconvenience to the driver.

The elderly and handicapped will benefit less from improvements in conventional transit but will continue to receive limited service from various special programs provided for their needs. Since the funding for such programs is assumed to remain constant while the number of elderly will be growing, these special services will meet a diminishing share of their transportation needs.

Base Case transit ridership projections, including those for the transportation disadvantaged, are shown in table **38.**

The preceding estimates are for conventional public transit, which consists of buses, heavy

Table 37.—Transportation Disadvantaged Population (millions)

	1970	1985	2000
Adult *disacdvantaged*			
(over 77)			
Elderly (over 65) not poor			
and not handicapped	10.2	13.4	15.7
Poor(not handicapped)	9.9	11.6	13.0
Handicapped.	17.1	17.1	17.2
Total adult disadvantaged	37.2	43.6	46.9
Total adult population . . .	135.2	170.6	191.4
Percent of adult			
population.	27.5%	25.6%	24.5%
Young population			
(17 and under)			
Handicapped.	0.9	0.9	1.0
Not handicapped	68.8	61.4	68.0
Total young	69.7	62.3	69.0
Total population	204.9	232.9	260.4
Percent of total population .	34.00/.	26.7%	26.5%

SOURCE Adapted from Sydec *EEA* p Ill 42

Table 38.— Projected Annual Transit Ridership, Base Case (millions)

	1970		1985		2000	
	Rides	Percent of total rides	Rides	Percent of total rides	Rides	Percent of total rides
Conventional transit						
Elderly and handicapped						
(not poor)	440	7	520	8	560	9
Poor (over 17, not elderly,						
not handicapped) ... , . .	820	14	1,040	16	1,170	18
Total young[a].	1,390	23	1,360	21	1 , 5 2 0	23
All transportation						
disadvantaged.	2,650	44	2,920	45	3,250	50
Other riders	3,280	55	3,560	55	3,230	50
Total conventional						
riders hip.	5,930[b]		6,480		6,480	
Services for **elderly** *and handicapped*						
Conventional transit.	440	91	520	93	560	93
Special services	40	9	40	7	40	7
Total service	480		560		600	

[a]Excludes school bus riders.
[b]Ridership in 1975 was 5.6 billion.
SOURCE: Adapted from *Syndec/EEA*, p. III-195

rail, and light rail. Two other forms of transit, Automated Guideway Transit and paratransit, were considered in the Base Case. It was concluded that neither would have a substantial effect on automobile use or on transit service in the **1975-2000** period.

Paratransit refers to types of public transportation that do not operate on fixed routes or schedules, and that bridge the gap between the services provided by the private automobile and those of conventional public transit. Paratransit includes taxis, jitneys, dial-a-ride, vanpools, and other shared-ride systems. With the exception of shared-ride systems that are privately organized, most paratransit has a higher cost per ride than conventional transit and requires a heavy subsidy to survive. The Base Case assumes no special Federal funding of paratransit service. Funding of any expansion of paratransit service that might occur under Base Case conditions is assumed to be part of the overall Federal transit assistance described earlier. The aggregate effects of paratransit on automobile and public transportation are anticipated to be minor for the Base Case.

COST AND CAPITAL PROJECTIONS

Automobile Manufacturing and Sales

Sales of new cars are extremely sensitive to the business cycle, to changes in travel demand, and—as observed in 1974—to the availability of gasoline. For the Base Case, no attempt was made to forecast annual fluctuations in sales. Base Case projections were limited to estimating long-term trends in new car sales and in the size of the automobile fleet.

Although new car prices are expected to increase slightly in real terms under Base Case conditions, the impact on sales will be offset by the generally positive trend in the economy as a whole and by relative stability in the combined costs of ownership and operation. As a result, new car sales are projected to increase from 10.1 million in **1976** to 13.1 million in 1985.[47] The average annual increase in the rate of sales during this period would be **2.9** percent (compared was 2.1 percent in the past decade). After 1985, when the growth in population, licensed drivers, and VMT would be somewhat slower, sales are expected to increase at an annual rate of 1.7 percent —resulting in 16.4 million new car sales in **2000. (See** figure 17.)

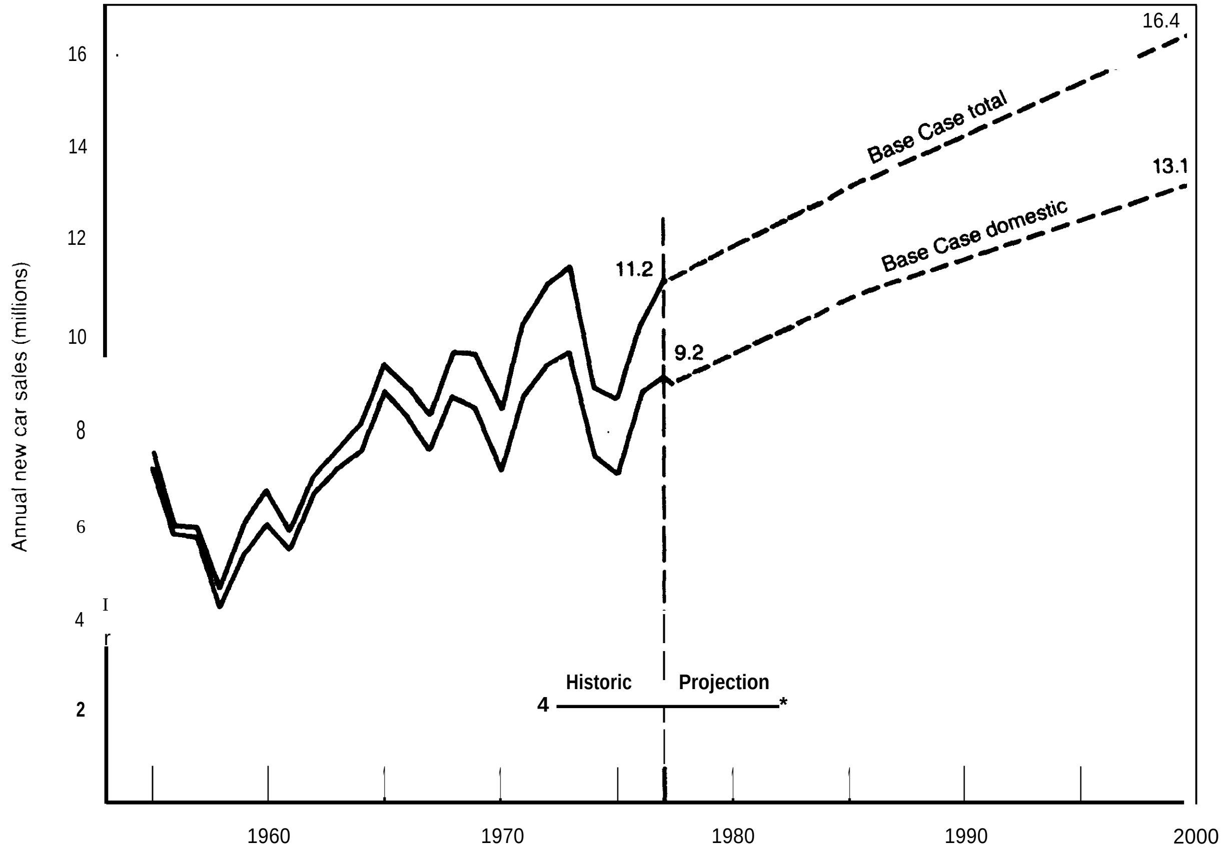
One of the most important developments in automobile technology in the near future—brought about by the influence of the EPCA fuel economy standards—is the expected increase in the number of passenger cars and light trucks equipped with diesel engines. In **1978,** it is expected that about 1 percent of the new cars sold will be diesels. The degree of market penetration by diesels in the **1985-2000** period will depend on a number of factors:

- Public acceptance of the diesel as a substitute for the spark-ignition engine,
- The ability of diesels to maintain their current fuel economy advantage (about **25** percent) over the spark-ignition engine and other propulsion systems,
- Fuel economy standards beyond 1985,
- The ability of diesels to meet NO_x emission standards and the willingness of the Government to grant a waiver until the necessary technology can be developed to control NO_x from diesels,
- The need to control the high level of presently unregulated diesel particulate emissions,
- Public tolerance of odor and smoke from diesel exhaust, and
- The operating cost, reliability, and maintrainability of diesels in large-scale production and use.

Alternative sets of assumptions were made for the Base Case, as summarized earlier in table 21. For the higher fuel economy standard of Case B to be met, a higher penetration of diesels

[47]Sales for 1977 were 11.2 million. Jenny L. King, "Good Year for U.S. Sales," *Automotive News*, Jan. 16, 1978, pp. 2 and 6.

Figure 17.—Base Case New Car Sales Projections (Domestic and total sales)



SOURCES Historic sales, Motor Vehicle Manufacturers' Association, *Motor Vehicle Facts and Figures* '77, p. 21 and Jenny L King, "Good Year for U.S. Sales," *Automotive News*, Jan. 16, 1978, pp. 2 and 6. Projections from *Sydec/EEA*, p. III-24 and III-166

would have to come about—is percent of new car sales in **1985** and 40 percent-in 2000. Also, the waiver provision for the NO_x emission standard would be applied to diesels for the period 1981-83 to encourage their development. The difference in fuel consumption in 2000 between Cases A and B iy 12 to 13 percent.

The penetration of imports" is also important in assessing impacts on domestic auto-related industries. Between 1966 and 1977, imports rose from 7.3 percent to 18.6 percent of domestic sales. " For the Base Case, it is assumed that imports will be about 18 percent of domestic sales from 1978 to 2000.

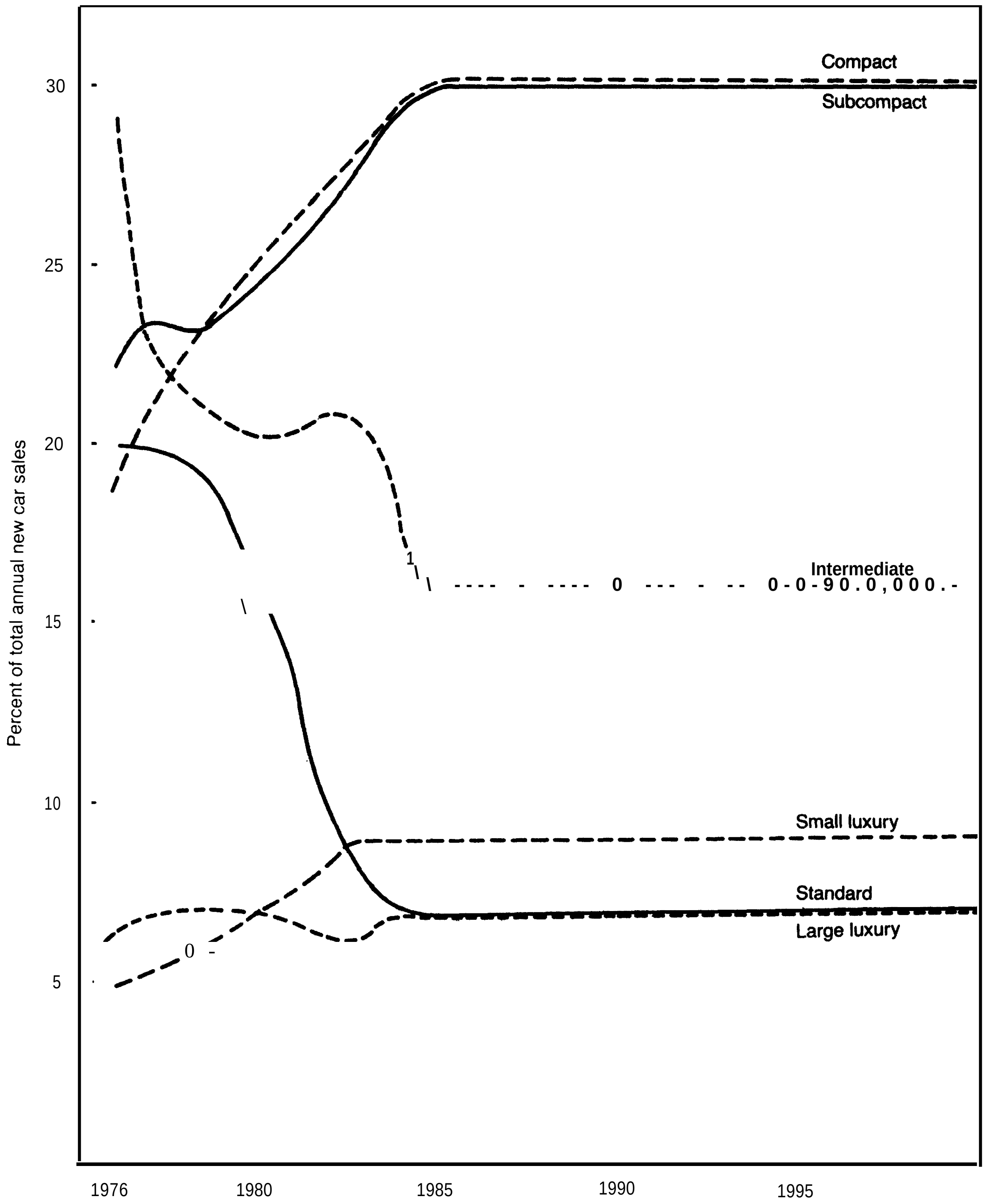
Another important trend is the expected shift in the composition of the auto fleet by size and class. As shown in figure 18 and table 39, small cars (subcompacts, compacts, and small luxury) are estimated to rise significantly as a proportion of the fleet—growing from 46 percent in 1976 to 69 percent in 1985. It **was** not deemed realistic to project any further change in the size-class distribution between 1985 and 2000, Therefore, the 1985 new car market shares were assumed to remain constant to 2000.

For the Base Case, the general projection is that the size of the automobile fleet will continue its steady growth through 2000. The total num-

[4*]Imports are defined as autos manufactured outside the United States, except that Canadian-produced U.S. cars are treated as domestics. In 1976, 826,000 Canadian cars were sold in the United States. *Sydec/EEA*, p. III-186.

[49]Jenny L. King, pp. 2-6.

Figure 18.— Distribution of New Car Sales by Size-Class Base Case



SOURCE: *Sydec/EEA*, Supplementary Report.

Table 39.—Change in the Distribution of Total New Car Sales, Base Case

	Percentage		Volume (thousands)		
	1976	1985[a]	1976	1985	Percent change
Subcompact	22	30	2,225	3,940	+ 77.1
Compact	19	30	1,921	3,940	+ 105.1
Small luxury	5	9	506	1,196	+ 136.4
Intermediate	29	16	2,831	2,111	– 25.4
Standard	20	7	2,022	936	– 53.7
Large luxury	6	7	606	936	+ 54.4
Totals[b]			10,110	13,059	+ 29.2

[a]These percentages are assumed to hold constant from 1985 to 2000 for the Base Case
[b]Columns do not sum because of rounding
SOURCE: *Sydec/EEA*, p. III-169 and Supplementary Report

ber of autos in operation is expected to increase from 95 million in 1975 to 118 million in 1985 and 148 million in 2000. As a consequence, the general picture for the automobile industry (manufacturing, sales, service, fuel distribution, and other auto-related enterprises) is one of sustained growth.

Automobile Manufacturing Revenues

The revenues of domestic automobile manufacturers will be influenced by changes in price, volume, and mix. It is estimated that Government-mandated equipment to achieve fuel economy, emissions, and safety standards will add $400 to $500(in 1975 dollars) to the price of a car by 1985 over the price of a comparable 1976 car. Since the cost of achieving Government standards is assumed to be roughly the same for all cars regardless of size, the effect will be a greater percentage increase for low-priced models than for expensive cars.

It is anticipated that the average revenue per domestic car sale in the United States (including dealer markup and preparation) will not increase in proportion to the volume of sales because of the change in mix. Gross revenues (including dealer markup) are projected to increase from an estimated $42.9 billion in 1976 to $56.0 billion in 1985 in 1975 dollars, with the price of the average new car increasing from $4,988 to $5,224. (See table 40.) This estimate assumes that the relative prices of cars (excluding the impact of Government standards) will remain the same among size classes. However, some of the change in mix represents downsizing, with little or no change in options or interior space. Consequently, the relative prices for downsized cars may be higher. Furthermore, changes in price structure may result from pricing policies designed to reflect consumer demand patterns or to encourage consumers to buy smaller cars in order to meet the corporate average fuel economy standards.

Table 40.— Estimated Gross Revenue[a] From Domestic Car Sales Base Case

	1976		1985	
	Per car sold	Total revenue (million)	Per car sold	Total revenue (million)
Subcompact	$3,600	$ 3,276	$4,083	$ 9,176
Compact	4,200	8,068	4,706	18,540
Small luxury	5,650	1,825	6,126	3,296
Intermediate	4,600	13,023	5,089	10,745
Standard	5,400	11,424	5,888	5,513
Large luxury	8,800	5,333	9,274	8,671
Totals	$4,988	$42,949	$5,224	$55,940

[a]Gross revenue includes dealer markup; amounts are in 1975 dollars
SOURCE: *Sydec/EEA*, pp. III-168 and III-169

Capital Requirements

Production of the kind of automobile dictated by consumer preference and Government requirements will impose major demands on the industry to raise capital for product development and new plant and equipment. No attempt was made to project the total capital requirements of the industry between now and 2000. However, the following partial estimates serve to indicate the probable magnitude of the industry's need for capital.

The U.S. Department of Transportation has estimated the industry investments that would be necessary for various technologies to meet fuel economy standards.[50] The total capital requirement through 1985 is approximately $7.6 billion, or about $1 billion per year. (See table 41.) For comparison, the annual capital investment by the industry for all purposes—annual model change, improvement of plant and facilities, and tooling—averaged about $3.7 billion for the period 1969-76. For the years 1973 and 1974, it averaged about $4 billion annually .51 52

[50]U.S. Department of Transportation, National Highway Traffic Safety Administration, *Data and Analysis 1981-1984 Passenger Automobile Fuel Economy Standards*, Summary Report, Feb. 28, 1977, pp. 33-50.

[51]An industry estimate of total capital requirement for the period 1978-1985 is $78 billion, about $10 billion per year. However, it is not known how much of this is spending required to meet Government regulations. Robert W. Irwin, "Big Four Spending Jacked Up Again by 41% to $78 Billion," *Automotive News*, June 5, 1978, p. 1.

[52]*Sydec/EEA*, pp. III-168 and 169.

Profits

The profitability of motor vehicle manufacturing varies considerably from year to year and from company to company. On the whole, the industry's return on equity and profit margins compares favorably with manufacturing generally.[53] For Base Case conditions, the key factors affecting profits are:

- The anticipated growth in sales,
- The increased capital and manufacturing costs resulting from meeting Government standards, and
- The change in the new car sales mix. 54

The rate of growth in sales projected for the Base Case represents a significant increase over the rate of growth experienced in recent years and tends to improve the outlook for industry profits. The costs of meeting Government standards are expected to increase the price of new cars, but not to the point where sales or profits are affected significantly.

The impact of sales mix on profitability is

[53]*Sydec EEA*, pp. 111-174 to 111-177.

[54]"NO attempt is made to assess the impact on profits of trends in other lines of business engaged in by manufacturers—including foreign operations, trucks and truck parts, and nonautomotive enterprises. The impact of each on the overall profits of the auto companies is considerable. For instance, GM sold more than 3 million trucks in 1976, manufactured 1.6 million cars and trucks overseas, and genera ted $7.5 billion in overseas sales and $438 m i 1 lion in defense and space work. General Motors Corporation, *Anuual Report*, 1976.

Table 41 .—Added Capital Requirements for Technology to Meet Fuel Economy Standards: Cumulative 1977-85

Technology	Units (millions)	Total capital requirement (millions)	Capital per unit
Downsizing	10	$6,250	$625
Material substitution	10	375	37.5
Improved spark-ignition engines.	10	250	25
Three-speed automatic transmission with torque converter lockup	10	200	20
Diesel engines.	1.5	562	375
		$7,637	

SOURCE: *Sydec/EEA* from U.S. DOT, National Highway Traffic Safety Administration, *Data and Analysis 1981-84 Passenger Automobile Fuel Economy Standards*.

assumed to be adverse. Projections indicate an increase of $486 in the average price per car, but an increase in revenue per car of only $230, due to the shift to smaller cars. A 1976 study of two domestic manufacturers indicates that the variable profit margin is less for small cars than for large ones. ”

Several factors could offset the possible decline in profitability caused by the growing share of the market captured by small cars:

- Savings in material costs due to downsizing (possibly **$200** per car),
- Improvements in productivity, due to producing smaller cars in greater volume,
- General improvements in technology and efficiency, and
- Sales volume growth above expectations, which would result in lower fixed costs per car.

No quantification of future industry profits was attempted,

Employment and Productivity

In recent years, productivity (output per employee) in automobile manufacturing has grown at the rate of **2.7** percent per year. If productivity continues to increase at this rate, a slight decline in automobile manufacturing employment could come about by 1985. However, because of expected increases in other types of motor vehicle manufacturing (trucks and buses), overall employment in the industry is expected to remain relatively constant, as it has since **1967.**[56] **(See** table **42.)**

[55]Pioneer Engineering and Manufacturing Company, *Development of a Motor Vehicle Materials Historical, High-Volume Industrial Processing Rates Cost Data Bank*, Volumes I and II (Warren, Mich.: Pioneer Engineering and Manufacturing Co., May 1976 and November 1976).

[56]This projection is at variance with the Bureau of Labor Statistics (BLS) forecast for 1985. The BLS forecast sees motor vehicle output growing at 2.2 percent per year and productivity at 3.7 percent, with motor vehicle industry employment declining from 860,000 in 1976 to 800,000 in 1985. See *Sydec/EEA*, p. III-180.

Table 42.—Employment in Passenger Car and Parts Manufacturing

	Domestic new car sales[a]	Employment in domestic automobile manufacturing[b]	Domestic new car sales per employee
1974	7,454,000	796,000	9.36
1975	7,053,000	772,000	9.13
1976 ...., ...	8,611,000	809,000	10.65
1985 Base Case.	10,707,000	791,000	13.54

[a]Assumes 18 percent of all U.S. sales are imports.
[b]The employment figures are for the major domestic manufacturers (GMC, Ford, Chrysler, AMC) and relate solely to passenger and automobile parts manufacturers. Total employment in motor vehicle and parts manufacturing (including trucks and buses) was 850,000 in 1976.
SOURCES: U.S. International Trade Commission, *The Fuel Efficiency Tax Proposal*, July 1977; *Sydec/EEA*, based on data from U.S. Department of Commerce, Bureau of Economic Analysis.