WORKSHOP NOTICE, AGENDA, PROBLEM STATEMENT, HANDOUT MATERIAL

You are cordially invited
to participate *in a public workshop*
on the Future Use and Characteristics
of the Automobile Transportation System

Tuesday, September 19, 1978

Library, Grant High School
2245 N.E. 36th Avenue
Portland, Oreg.

7:00– 10:30 p.m.

Background: A study of the future use and characteristics of the automobile transportation system is being conducted by the Office of Technology Assessment, a research arm of the United States Congress. Requested by the Senate Commerce, Science, and Transportation Committee, the auto assessment has focused on five issue areas: mobility, energy, environment, safety, and cost and capital. Workshops will be held in eight locations throughout the country as part of a nationwide public participation effort designed to augment staff research and analysis.

Purpose of Workshop: To gather public commentary on the issues, the alternatives for personal transportation, and the policy options relevant to the Federal Government's role in the future of the automobile transportation system.

Registration: Open to the general public (i.e., no affiliation is needed to be eligible to attend), participation will be limited to the first 50 registrants. This will enable those who participate ample opportunity to take part in the dialogue and enable the OTA staff to respond to questions and listen to the discussion. A registration card is enclosed for your convenience. Please pass this information to other individuals who may be interested in attending or to organizations who may want to send representatives.

AGENDA

Workshop on The Future Use and Characteristics of the Automobile Transportation System

7:00 p.m.	Opening Remarks
7:10 p.m.	Auto assessment presentation
7:40 p.m.	Question and answer session
8:10 p.m.	Subgroup formation and discussion
9:15 p.m.	Subgroup presentations
9:45 p.m.	General discussion
10.30 p.m.	Adjournment

AGENDA

Workshop on The Future Use and Characteristics of the Automobile Transportation System

9:00 a.m.	Opening remarks
9:15 a.m.	Auto assessment presentation
10:00 a.m.	Question and answer session
10:20 a.m.	Subgroup formation and discussion
11:30 a.m.	Subgroup presentations
Noon	Lunch
1:15 p.m.	Subgroup discussion
2:30 p.m.	Subgroup presentations
3:00 p.m.	General discussion
4:00 p.m.	Adjournment

WORKSHOP PROBLEM

One goal of our society is to enable citizens to take part in activities that enhance our social and economic wel1-being. Essential to the attainment of this goal is the ability to reach jobs, consumer goods and services, recreation sites, and other desired activities.

There are three ways to facilitate reaching desired activity sites. The first approach —and the traditiona1 one-– is to improve **mobility,** that is, the ease with which people physically move from place to place. The second is to increase **accessibility** by locating people and activities in greater proximity to one another. The third is to reduce the need to make trips by using **technological substitutes** for physical movement, such as telecommunications.

Assuming no wars, economic depressions, or other catastrophic events, and if current trends continue, the Gross National Product of this country in the year 2000 is expected to be about two and one-half times what it is today. Average personal income after taxes will be twice today's in current dollars. Although birth rates are declining, the American population is expected to increase by about 20 percent. In 2000, more of the population will be older (the median age will rise from 29 to 36), a higher percentage of the population will be licensed to drive (notably women), and a higher proportion of the population will live in cities.

Suppose you are an ad hoc advisory committee to the United States Congress and have been asked to devise a mobility plan for the year 2000 that takes these projections into account:

1. How do you envision the personal transportation system for the year 2000 for your area, for the National What would be the characteristics of this system (modes of travel, types of vehicles, energy and safety features, environrnental factors, and so forth)? Would present levels of mobility be maintained or increased? If increased, for whom and how? What would be the rural urban or regional differences?

2. What would be the tradeoffs in terms of energy, natural resources, environnment, safety, and monnetary cost for such a mobility system?

3. What would be the role of a) Goernment, b) industry, and c) the priate citizen in the development, management, and maintenance of such a system? Folr example, what would be the ratio of public and private funding for the systerm and its various components? With regard to public financing, how would funds be raised (general or specific taxes), and how would they be distributed (i. e., subsidies, grants, other)?

4. Do you have other concerns about personal transportation now or in the future that you wish to express?

HANDOUT MATERIALS

AUTOMOBILE TECHNOLOGY ASSESSMENT

To assess changes in the future use and characteristics of the automobile transportation system in the near term (to 1985) and the long term (to 2000 and beyond)

OBJECTIVES:

- To describe the factors that influence the characteristics of the automobile system, its use, and services supporting its use.
- To identify and characterize potential changes in automobile use and characteristics.
- To assess the near-term and far-term effects of various alternative Federal Government policies relating to automobile use and characteristics.
- To present the findings of the assessment in a form useful to the Congress and the public.

STUDY APPROACH

- Identify and analyze issues.
- Describe the automobile transportation system and project its future development.
- Formulate conditions and events that could impact the system or alter its development.
- Identify and analyze policy options that could be adopted by Congress to influence future automobile use and characteristics.
- Assess the consequences and impacts of policy options.
- Present findings to the Congress and the public.

THE BASE CASE OR NO-POLICY-CHANGE BASELINE

A projection of current trends and conditions assuming
- existing policies are continued (and extended)
  no major resource constraints, catastrophes, wars, etc.

Population Growth: 0.9% to 1985; 0.7% to 2000
GNP Growth: 3.5% per year
Disposable Personal Income: Doubles by 2000
Petroleum: Price increase of 3% per year (constant $)
$25.60 per barrel; gasoline $1.24 per gallon (constant $) in 2000.
Demand will be met by:
  oil imports
- synthetic fuels (2.75 MMBD in 2000)
  electric and hybrid vehicles

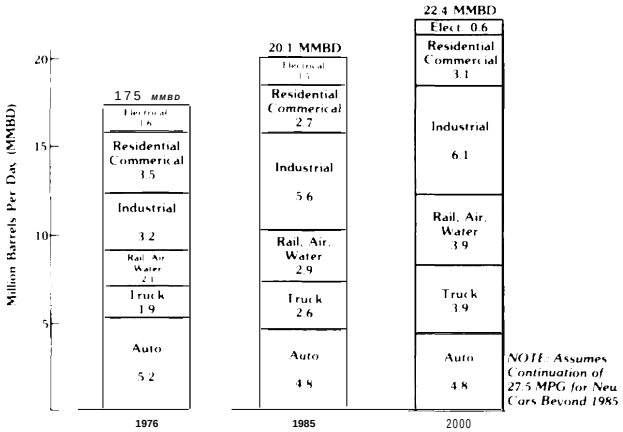
Lifestyles: No major shift

ENERGY

BASE CASE 1985-2000
- Auto fuel consumption 4-5 million barrels per day (MMBD)
- Oil import 10-13 MMBD
- Oil shortfall - world demand exceeds supply

ALTERNATIVES
Increased domestic production
- Conservation – restrict use, allocate fuel, market pricing, taxes
  - more efficient systems
- Substitutes – mass transit
  - telecommunications
  - land use policies
  - life style changes
- Energy sources – shale, tar sands
  - methanol, synthetic fuels
  - electricity

U.S. PETROLEUM DEMAND



Source SyDec EEA Phase I Report and OTA Staff estimates

ESTIMATED PETROLEUM IMPORTS

	Petroleum Demand (All Sectors) MMBD	Required Petroleum Imports MMBD	Estimated Price $ Barrel (1975 $)	cost of Imports Per Year (1975 $)
1977	178	8.5	$1.150	$42 billion
1985	201	10	$17	$62 billion
2000	22.4	126	$26	$120 billion

ENVIRONMENT

Air pollution, noise, solid waste, water contamination, community impacts

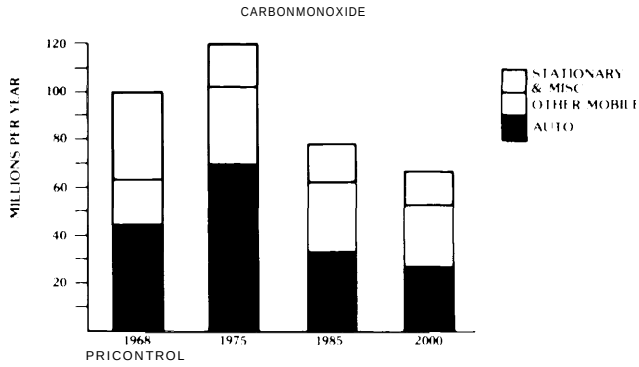
BASE CASE 1985-2000

- **Carbon monoxide –25 to 30 million tons per year from autos**
  - over 20 AQCRs in violation
- **Oxidants - over 60 AQCRs in violation (primarily stationary sources)**
  -130 million people exposed to hazardous concentrations
- **Synthetic fuels - potential major environmental impact**
- **Community disruption -40% of 1970-75 levels**

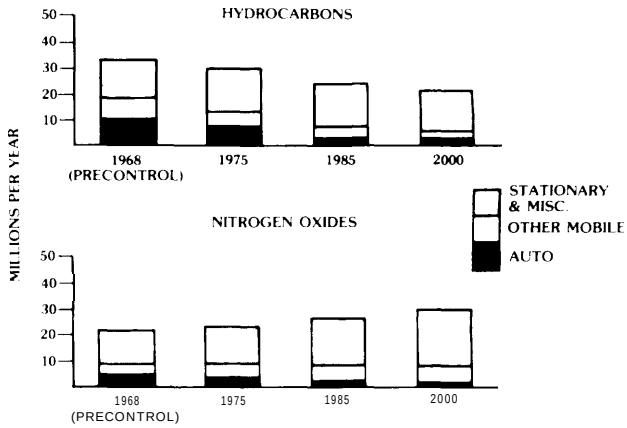
ALTERNATIVES

- **Further tightening of emission standards – 0.4/gm/mi NO_x**
- **Vehicle-in-use inspection and maintenance**
- **Auto use controls; control of other mobile & stationary sources**
- **Research on health effects**
- **Development of electric vehicles**

NATIONAL EMISSION LEVELS BY SOURCE, 1968-2000



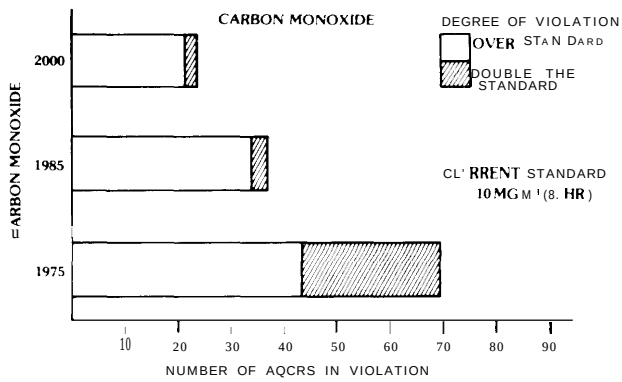
NATIONAL EMISSION LEVELS BY SOURCE, 1968-2000 HYDROCARBONS & NITROGEN OXIDES



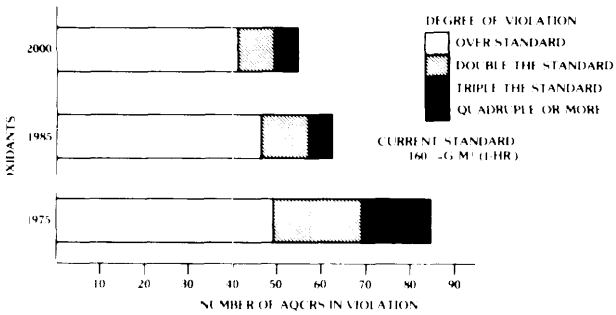
Source: 1968 Data, NAPCA, 1975 Data, EPA, ProJections, Energy and Environmentol Analysis Inc. (EEA) from EPA data

Note Assumes compliance with 1977 Clean Air Act Amendments on new car emissions but no vehicle-in-use controls

PROJECTED NUMBER OF AIR QUALITY CONTROL REGIONS IN VIOLATION OF AMBIENT AIR QUALITY STANDARDS



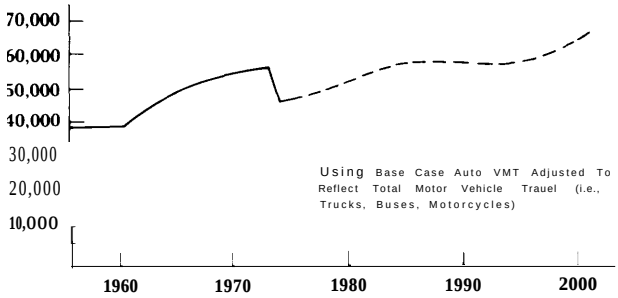
PROJECTED NUMBER OF AIR QUALITY CONTROL REGIONS IN VIOLATION OF AMBIENT AIR QUALITY STANDARDS - OXIDANTS –



* There are 247 Air Quality Control (AQCR) in the U.S. and its territories. Violation of an Air Quality Standard occurs when the permissible concentration of a pollutant is exceeded more than once in the year (i.e., a single reading over standard in a given year is not considered a violation).

Source: Energy and Environmental Analysis Inc. (EEA) From EPA Data

MOTOR VEHICLE DEATHS



SAFETY

BASE CASE 1985-2000

- **Highway fatalities and injuries continue to increase 64,000 deaths, 5 million injuries-year 2000-due to:**
  - **increasing vehicle miles traveled**
  - **increasing number of small cars, large trucks**
- **Because of the lack of definitive goals**
  - **Planning and evaluation of safety improvement is inadequate**
  - **Coordinated program of local, State, and Federal actions is not established**
  - **Level and allocation of resources is inadequate**
  - **Technical improvements are not achieved on a timely basis**

ALTERNATIVES

- **Mandatory seat belt laws**
- **55 mph speed limit enforcement**
- **Reduced alcohol use**
- **Improved vehicle crashworthiness, restraint systems**
- **Elimination of roadside hazards**

1975 MOTOR VEHICLE CRASH STATISTICS*

	Number of Crashes	Deaths	Injuries	Property Damage (Number of Vehicles)
Automobiles	13,500,000	27,500	2,400,000	22,500,000
Total Motor Vehicle	16,500,000	46,000	4,000,000	27,000,000
Total Costs ($ billions)	$37.6	$13.3	$6.1	$18.2

* **Sources** *NHTSA* **and** *National Safety Council*

MOBILITY

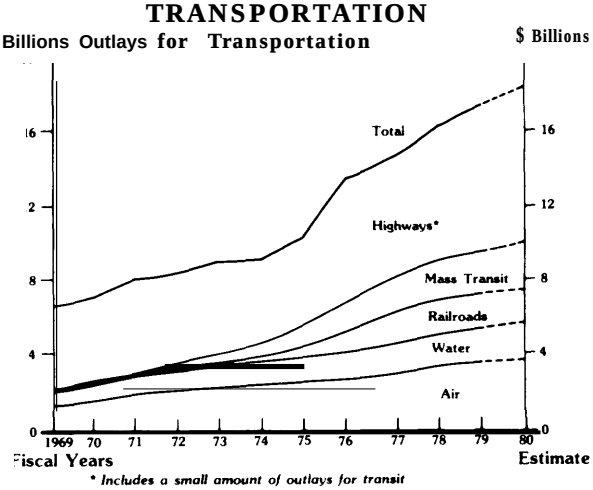
BASE CASE 1985-2000

- **Congestion in urban areas increased significantly**
- **Attempts to achieve large increases in transit ridership result in substantial increases in operating deficits**

ALTERNATIVES

- **Expanded transit services - increased Federal funding**
  - **special programs for the handicapped**
- **Wider use of carpools, vanpools, and incentives for high occupancy vehicles**
- **Improved accessibility through Federal/ local land use policies**
- **Improved telecommunications**

FEDERAL OUTLAYS FOR TRANSPORTATION



* *Includes a small amount of outlays for transit*

Source: The U.S. Budget in Brief, Fiscal Year 1979

BASE CASE – TRANSIT FINANCING AND RIDERSHIP (BILLIONS PER YEAR – COSTS IN 1975 DOLLARS)

	1975	1985	*2000*
Federal Capital Grants	$1.2	$1.7	$1.7
Federal Operating Assistance	*$0.3*	*$0.9*	*$0.9*
Total State & Local Funds	$1.7	$2.7	$4.9
Transit Ridership (Billions of Revenue Passengers Per Year)	5.6	6.5	6.5

COST **AND** CAPITAL

BASE CASE 1985-2000

- **Decrease in highway construction –increased maintenance**
- **Increased competition among auto manufacturers due to narrower product size differentiation**
- **Possible failure of one or more of the major auto manufacturers**
- **Increase in auto ownership and operating costs**

ALTERNATIVES

- **Greatly increased Federal funding to meet highway maintenance and transit operating needs**
- **Control of auto maintenance and repair costs**

TECHNOLOGICAL DEVELOPMENTS 1985-2000

- **Development and large-scale utilization and commercialization of:**
  –Liquids from oil shale and tar sands
  - Synthetic fuel from coal
  – Methanol
- **More efficient propulsion systems**
  –Spark ignition, diesel
  - Gas turbine, stirling
- **Development and large-scale commercialization of electric and hybrid vehicles**
- **Greater utilization of lightweight materials**
- **Improved emission controls-Particularly** *NOx*
- **Improved safety technology**

ASSESSMENT OF THE FUTURE CHARACTERISTICS AND USE OF THE AUTOMOBILE TRANSPORTATION SYSTEM

SEPTEMBER 11,1978

CONGRESS OF THE UNITED STATES
Office of Technology Assessment
WASHINGTON, D. C. 20510

BASE CASE

The "Base Case" is a projection of some features of the automobile transportation system to the year 2000. It assumes that present Government policies and programs will be continued, that the population will grow at a moderate rate, that life styles will not change significantly, and that the economy wiII stay healthy and vigorous. The Base Case indicates the direction that present policy is leading and serves as a frame of reference for the study. Some principal Base Case projections are:

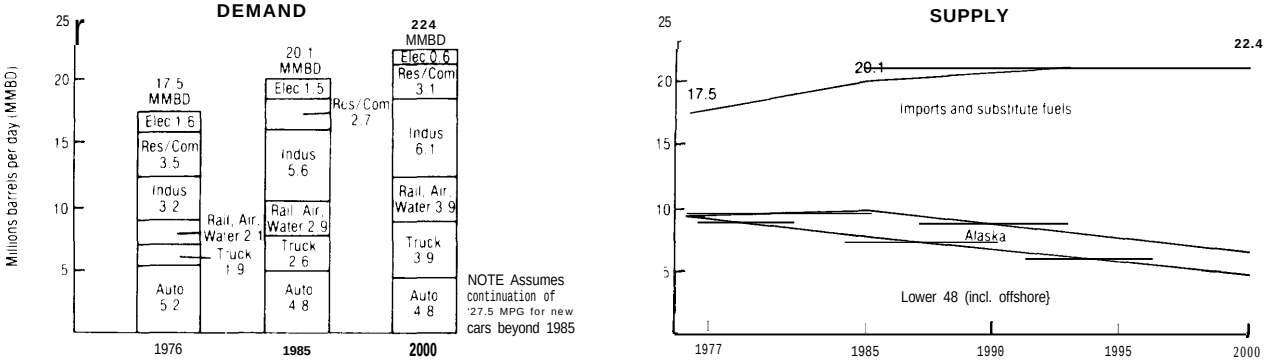
Projections	1975	1985	2000
Population			
U.S. population (millions)	214	233	260
Urban area population (millions)	130 (61%)	149 (64%)	177 (68°/0)
Licensed drivers (millions)	130	151	177
Male/female drivers (millions)	71/59	78173	89188
Economics			
Gross national product ($ trillions)*	1.52	2.22	3.72
Disposable personal income per capita ($ thousands)*	5.0	6.7	10.1
Automobile transportation system			
Autos in use (million)	96	118	148
Auto VMT† (trillions)	1.0	1.4	1.8
Annual transit rides (billions)	5.6	6.5	6.5
Gasoline price per gallon •	$0.57	$0.77	$1.21
Fleet fuel economy (MPG)	13.5	19.4	24.6
Petroleum used by autos (MMBD)#	5.0	4.8	4.8
Petroleum imports (MMBD)#	7.4	10.0	12.5
Auto 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
Highway deaths (thousands)	46	58	64

•In 1975 dollars.
†Vehicle miles traveled.
#Million barrels per day.

ENERGY

Domestic petroleum production slackened in the 1960's and peaked in the early 1970's. World production, while still increasing, is expected to peak between 1985 and 2000. If consumption continues to climb, it is anticipated that a petroleum shortage—accompanied by a significant increase in petroleum prices—will develop before the end of the century.

U.S. PETROLEUM



SOURCE SyDec/ EEA Phase I report and OTA staff estimates

Continuing high demand in the face of limited supply will force prices upward and stimulate development of alternative energy sources. For the automobile these might be shale oil, tar sands, coal liquids, alcohol, and electricity. All are more costly than petroleum at present, and a substantial shift to any would take many years to accomplish. In the meantime, petroleum conservation would make the supply last longer, thus buying time and smoothing out the transit ion.

SOME LAWS AND POLICIES IN EFFECT

- **Emergency Petroleum Allocation** Act of 1973 which permits rationing of petroleum-based fuels and price controls during an emergency.
- Nationwide 55 mph speed limit which went into effect in 1974.
- Energy Policy and Conservation Act of 1975 which set a 27.5 mpg standard for average new car fuel economy by 1985.
- Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976 which will put 7,500 to 10,000 electric vehicles into use by 1984.
- Several programs in the Department of Energy to develop gas turbine and Stirling engines and-to promote research on synthetic fuels.

Some Conservation Methods

Smaller, lighter cars
Increased engine efficiency
Increased use of mass transit
Car and van pools
Travel restrictions (time & place)
Increased gasoline taxes
Gas guzzler tax
Decontrol of fuel prices
Gasoline rationing

Some Alternative Energy Sources

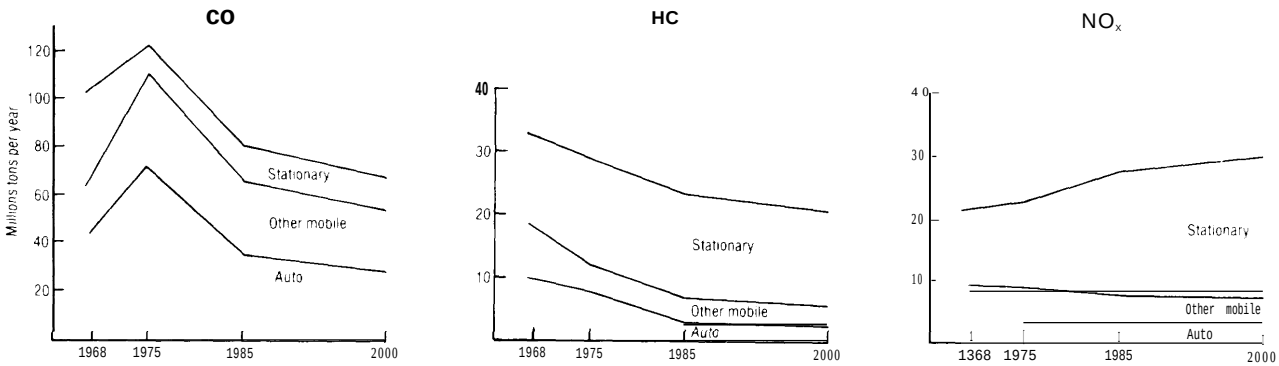
Methanol and ethanol
Shale oil and oil from tar sands
Coal liquids
Electric and hybrid vehicles
Hydrogen

ENVIRONMENT

Widespread and intensive use of the automobile, the predominant mode of personal transportation in this country, has caused serious concern about effects on the environment. Chief among these is air pollution. Others are noise, water pollution (from road salt, lead, used oil, and spilled fuels), solid waste (scrapped batteries, tires, and auto bodies), and community disruption. There is also concern that the advent of new automotive technology may bring new or increased environmental hazards.

The major air pollutants emitted by automobiles are carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxide (NO_x). CO—resulting from incomplete combustion of fuel — is harmful to human, animal, and plant life. HC and NO_x interact in sunlight to produce photochemical oxidants (smog), which are lung irritants that are especially harmful to the old, the infirm, and the very young.

SOURCES OF AIR POLLUTION



Although automobile emissions will drop significantly by 2000 they will still be far from eliminated, particularly in urban areas. It is projected that about 130 million people in U.S. cities will still be exposed to hazardous levels of smog or CO by the year 2000.

SOME LAWS AND POLICIES IN EFFECT

- Department of Transportation Act of 1966 which protects natural beauty in parks, recreational areas, and historical sites.
- National Environmental Policy Act of 1969 which calls for study of environmental impacts when planning federally assisted highways.
- Highway Act of 1970 which sets air quality and noise level standards for highway projects.
- Clean Air Act of 1970 and later amendments which set emission standards for new autos through 1981. (CO: 3.4/gm/mi, HC: 0.41 gm/mi, NO_x: 1.0 gm/mi).
- Noise Control Act of 1972 which authorizes EPA to set noise control standards for all types of motor vehicles.

SOME METHODS TO REDUCE AUTO AIR POLLUTION

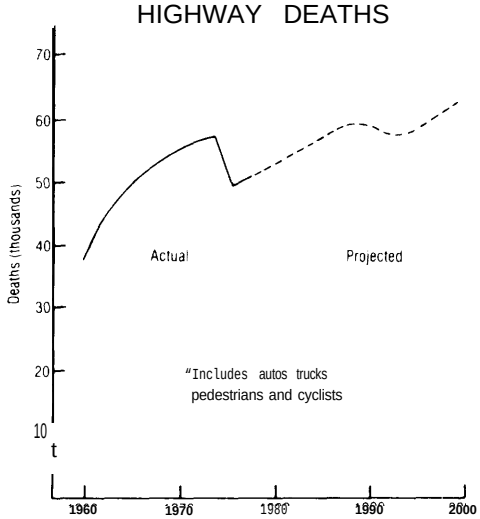
- Improved emission control devices on new cars
- Cleaner engines
- Use of electric vehicles in urban areas
- Staggered work patterns
- Periodic inspection and maintenance of automobiles in use
- Restrictions on auto use in certain areas or at certain times

SAFETY

In 1977, 47,715 people died in traffic crashes on U.S. streets and highways, and over 4.3 million were injured. The cost of property damage alone exceeded $18 billion.

Between now and 2000, it is expected that the death and injury rates (the numbers per mile of travel) will decrease. The **totals of highway deaths and injury,** however, will keep growing as there will be more drivers, more cars on the road, and more miles traveled. Over the remainder of this century, it is projected that about 1 million people will die and 130 million will be injured in traffic crashes.

HIGHWAY DEATHS



1975 Autos in use — 96 million
Auto VMT* — 1 trillion
Drivers — 130 million

1985 Autos in use — 118 million
Auto VMT — 1,4 trillion
Drivers — 151 million

2000 Autos in use — 148 million
Auto VMT — 1.8 trillion
Drivers — 177 million

Safety is a complex problem that involves driver behavior, vehicle characteristics, roadway features, and driving conditions. Safety is a matter of both design and use. Safety is not just an individual concern. Industry has a part to play. All levels of Government— local, State, and Federal— are involved. There is no single, simple solution to the problem of highway death and injury.

SOME LAWS AND POLICIES IN EFFECT

- Federal Motor Vehicle Safety Standards—50 standards governing such features as brakes, safety glass, and seat belts are now in force; 20 revisions or new standards are under consideration.
- Federal Highway Safety Program Standards—there are 18 standards dealing with highway design, driver licensing, police, medical services, and the like.
- 55 mph Speed Limit—established in 1974 as an energy conservation measure, it is now considered an important safety measure as well.

SOME **WAYS TO IMPROVE TRAFFIC SAFETY**

Short Term

Reducing drunk driving
Observance of the 55 mph speed limit
Increased seat belt use (voluntary or mandatory)
Passive restraints

Long Term

Improved occupant restraints
40 to 50 mph crash protection
Better driver training and licensing
Reducing hazards to pedestrians and cyclists
Removal of roadside obstacles and traffic hazards

MOBILITY

Almost every aspect of our daily life is shaped by the automobile. Over 90 percent of personal travel today is by automobile. About 85 percent of all households own an automobile, and nearly half own two or more (not counting light trucks, vans, and campers). We now spend about $30 billion of Federal, State and local funds each year to build and maintain the street and highway network.

In large cities, public transit is available as an alternative for those who do not choose to drive and for those who cannot because of poverty, age, or physical handicap. Despite $4.5 billion in Federal aid to transit in 1977, the service in many communities is less than adequate In rural areas there is virtually no alternative to the automobile for trips beyond walking distance.

The present and expected future demand for personal travel is illustrated by the Base Case projections shown below.

	Base case projections		
	1975	**1985**	2000
Automobiles (million)*	95	118	148
Licensed drivers (million)	120	151	177
Autos per licensed driver	.73	.78	.84
Vehicle miles traveled (trillion)*	1.03	1.43	1.80
VMT per licensed driver (thousand)	7.9	9.5	10.2
Urban driving under congested conditions	10%	14%	24%
Transit ridership (billions)	5.6	6.5	6.5

● Excludes vans, light trucks, and campers.

Whether these expected levels of travel will materialize depends upon a continuing supply of petroleum or substitute fuels at reasonable cost. But we will also face other mobility problems. Streets and highways will require more maintenance as they age and traffic grows heavier. Congestion in urban areas is expected to worsen. Supporting even a modest increase in transit service will entail major increases in State and local operating subsidies by 2000. The problem confronting the Federal Government is how to allocate resources so as to assure adequate mobility for all.

SOME LAWS AND POLICIES IN EFFECT

- Federal-Aid Road Act of 1916 which established the basic system of Federal aid to States for highways
- Highway Revenue Act of 1956 which set up the Highway Trust Fund to help finance highway construction
- Urban Mass Transit Act of 1964 which provides Federal aid to transit
- Federal-Aid Highway Act of 1973 which allows Federal highway funds to be used for transit

SOME ALTERNATIVES

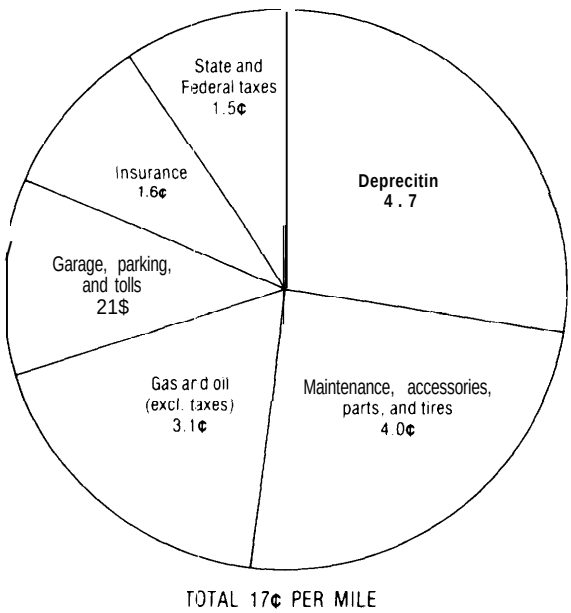
- building more highways
- making more efficient use of existing highways
- improving urban transit systems
- improving rural and intercity public transportation
- promoting paratransit
- special aid to those who do not own an automobile or cannot drive
- improving accessibility through land use planning
- fostering telecommunications as a substitute for travel

COST AND CAPITAL

The cost of the automobile transportation system is felt in many ways. For the typical household, automobile ownership and use represents the second or third largest item in the budget—exceeded only by housing and sometimes food. The building and maintenance of roads costs taxpayers over $30 billion annually. For industry, compliance with Government regulations and development of new technology for the future automobile transportation system entails large capital investments. Ultimately these new engines, alternative energy sources, better automobiles, and improved highways will be translated into higher costs to the consumer. Accompanying these costs will be the need for increasing expenditures to support public transit as a means of relieving congestion, saving energy, and providing mobility to those who cannot, or choose not, to own or use the automobile.

The figures and table below illustrate three aspects of the cost of personal transportation.

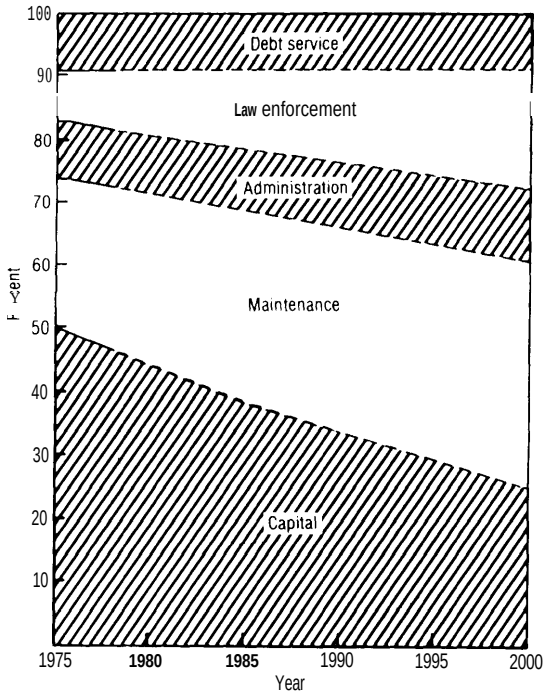
COST OF OWNING AND OPERATING
A STANDARD-SIZE AUTOMOBILE*



TOTAL 17¢ PER MILE

● Based on 1976 data, assuming 10,000 miles per year

DISTRIBUTION OF TOTAL
HIGH WAY DISBURSEMENT*



'Federal State nd local governments combined

PROJECTED TRANSIT COSTS
1975 dollars (billions)

	1975	1985	2000
Federal capital funds. ., ...	1.21	1.71	1.71
Local matching (20 percent)	.30	.43	.43
Federal operating assistance.	.30	.93	.93
Local share.	1.41	2.27	4.47
Total Federal aid	1.51	2.64	2.64
Total local burden	1.71	2.70	4.90

SOME WAYS THE FEDERAL GOVERNMENT CAN INFLUENCE COSTS

. regulation of repair practices and costs
. incentives or standards for auto durability
. no-fault insurance
• decontrol of fuel prices
• tax incentives for industry to develop new technology and alternate energy sources
• underwriting R&D for new technology
• capital assistance to industry for high-risk ventures
• changes in highway and transit funding
• levying tolls and fees on autos i n congested areas

AUTOMOTIVE PROPULSION SYSTEMS

The Otto Cycle Engine is the spark-ignition, internal combustion engine currently used in most passenger cars. Gasoline and air are mixed in the carburetor, fed into the combustion chamber, and ignited 'by an electric spark. The expanding gases in the cylinder push a piston to provide motive power.

The Stratified Charge Engine is a slightly modified Otto cycle engine. Fuel is fed into the combustion chamber in a way that produces a rich fuel-air mixture near the spark plug and a lean mixture elsewhere. The spark plug ignites the rich mixture, which in turn ignites the lean mixture, producing a more complete burn and—in some designs—a more efficient use of fuel.

The Diesel Engine is an internal combustion engine that uses the heat of compression rather than a spark to ignite the fuel-air mixture. The diesel engine is used extensively in trucks and buses and in some models of Volkswagen, Oldsmobile, Cadillac, Mercedes, and Peugeot automobiles.

The Gas Turbine (Bray ton Cycle) Engine uses the expanding gases from a continuous burning of fuel to drive a turbine. Most of the turbine output is used as motive power, but some is used to drive a compressor to provide air for the combustion process.

The Stirling Cycle Engine is an external combustion engine. The heat from fuel burned outside the engine is used to expand a confined working fluid (usually helium or hydrogen) which in turn pushes a piston. The expanded (and therefore cooled) working fluid is compressed and reheated for another piston stroke.

Electric Motors for automobiles operate from energy stored in batteries. Mechanical devices, such as flywheels or regenerative braking systems, may be added to augment or to conserve the supply of electricity.

Hybrid Vehicles use two different sources of energy. The most common combines a battery powered electric motor with an internal combustion engine that supplies auxiliary power for periods of increased load, such as during acceleration or high-speed cruise.

ALTERNATIVE FUELS

Several alternatives to gasoline are being considered as future automotive fuels. Among these are shale oil, oil from tar sands, coal liquids, alcohol, and hydrogen. In comparison with gasoline, all now cost more to produce and require more energy for extraction and refining. A table summarizing the advantages, problems, and state of development of these fuels is on the reverse side.

Shale oil is **a** petroleum-like substance that is contained in certain rock or shale. The recovery process involves heating the shale to evaporate the oil, which is then drawn off and condensed. The resulting crude shale oil can then be refined to produce a synthetic gasoline with properties close to those of petroleum based fuel.

Several pilot plants are now in operation. Large-scale commercial production is not likely for 10 to 15 years.

Tar sands are sand and clay saturated with a heavy oil. The extraction and refining processes are similar to those for shale oil. The final product has properties similar to gasoline.

A commercial plant, producing 50,000 barrels per day, is in operation in Canada. Commercialization in the United States is not expected for 10 to 15 years.

Coal liquids can be produced by several different methods. The basic process uses steam to add hydrogen to the coal. Ash, sulfur, and other contaminants are removed. The product is then upgraded and refined to gasoline or diesel fuel.

A commercial facility is now operating in South Africa. Several pilot plants exist in the United States, but extensive commercial production is believed to be 10 to 20 years away.

Alcohol fuels—ethanol (ethyl alcohol or grain alcohol) and methanol (methyl alcohol or wood alcohol) —offer promise as automotive fuels. Each can be used in pure form or in blends of up to 20 percent with gasoline, a mixture known as gasohol.

Ethanol comes from the fermentation of grains, plants, and agricultural or municipal waste. Methanol can be produced from coal, natural gas, naphtha, and (not as easily) the same sources as ethanol.

Automobiles in Brazil have been using ethanol blends for several years. Gasohol is now being sold in Illinois, Iowa, and Nebraska. California has initiated a gasohol program, and Colorado has approved one. it is estimated that it would take 10 to 15 years to build the industrial capacity sufficient to meet 10 percent of our daily automotive fuel demand.

Hydrogen, the most plentiful element in the universe, offers great potential as a transportation fuel. It can be stored as a gas, liquid, or metal hydride.

Hydrogen is being successfully used as a fuel in the U.S. space program. Large-scale production and use as an automotive fuel is believed to be at least 25 years away and is contingent upon solution of the problems of conversion, storage, handling, and safety in use.