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August 1998

25th Anniversary of the 1973 Oil Embargo

Energy Trends Since the First Major U. S. Energy Crisis

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Energy Information Administration
Washington, DC 20585
www.eia.doe.gov

Administrator's Message

This year marks the 25th anniversary of the energy crisis of 1973, in some ways the most pivotal year in energy history. Anniversaries are often a time of reflection. In this spirit, the Energy Information Administration presents in this publication 30 major energy trends in the United States over this period. Taken as a whole, these measures provide a picture of how this country has responded to the crisis a quarter century ago.

Through 1972, Americans had become accustomed to expanding energy consumption with minimal concerns about the constancy of supply or sharp price escalations. In 1973, however, expectations about energy supply changed dramatically.

The turmoil started early in 1973, as customers experienced electricity brown outs and rapidly rising prices for fuels and other necessities. Price controls and allocation systems not only failed to resolve these problems, they seemed to aggravate them. Most memorably, October brought an oil embargo by members of the Organization of Petroleum Exporting Countries, cutting further into the supply of oil and elevating prices to levels previously thought impossible. Customers experienced lines and sometimes no fuel at gasoline stations.

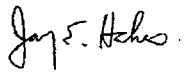
A year of bad news was punctuated in December, when the President announced that because of the energy crisis the lights on the national Christmas tree would not be turned on.

Throughout the year, energy stayed at the forefront of public attention. Interruptions in energy supplies were also closely related to other issues of national importance--a weakening of the economy and a reassessment of America's strategic position in the world.

The purpose of this publication is not to assess the causes of the 1973 energy crisis or the measures that were adopted to resolve it. Our intent is to present some data on which such analyses can be based. Those interested in a fuller set of statistics are urged to consult our recently published *Annual Energy Review* (Web Site address: www.eia.doe.gov/emeu/aer/contents.html).

Many of the trends presented here fall into two distinct periods. From 1973 to the mid-1980's, prices continued at very high levels, in part because of a second oil shock in 1979-80. During this period, rapid progress was made in raising American oil production, reducing dependence on oil imports, and improving end-use efficiency. After the oil price collapse of the mid-1980's, however, prices retreated to more moderate levels, the pace of efficiency gains slowed, American oil production fell, and the share of imports rose.

We hope that the marking of this anniversary will stimulate a lively dialogue on energy issues and that the data presented here will contribute to that discussion.



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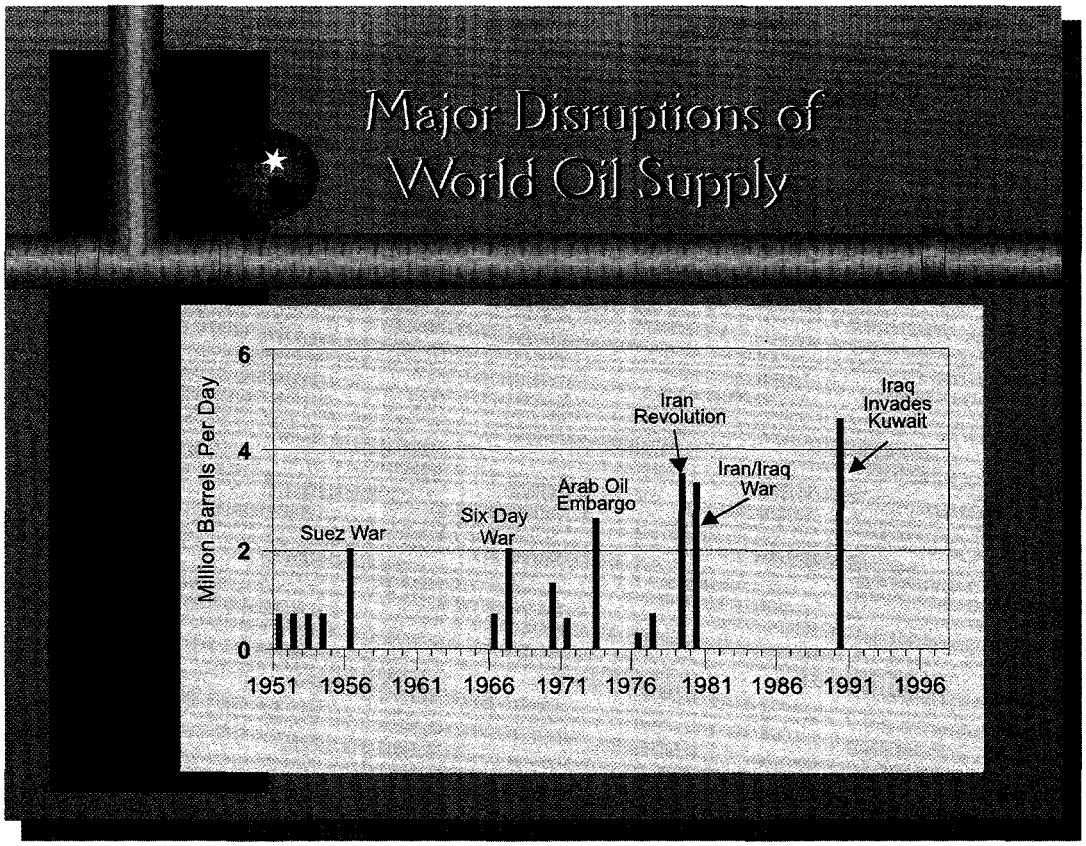


- The 1973 Arab Oil Embargo was the first oil supply disruption to cause major price increases and a worldwide energy crisis.

- In fifteen years during the last half of the 20th century, major disruptions in world oil supplies have occurred. Six of those instances decreased the world oil supply by at least 2 million barrels per day (see illustration above).

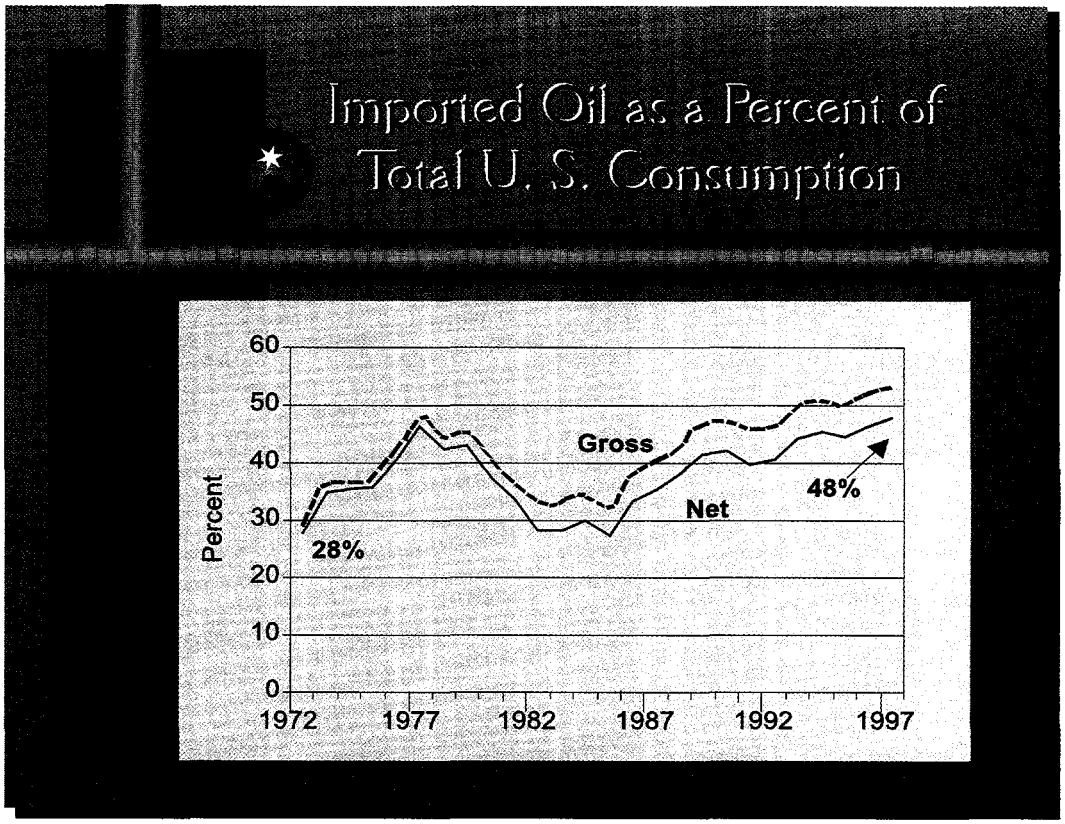
- In 1950, the United States provided 52 percent of the world's crude oil production; by 1997, that figure had dropped to 10 percent.

- Virtually all spare oil production capacity was in the Middle East when the Arab Oil Embargo began in October 1973.

- Supply disruptions increased in severity as world oil production increased and production shifted to less secure areas of the Middle East.

Source: Energy Information Administration, Interagency Database and Projections Working Group.

Figure 2



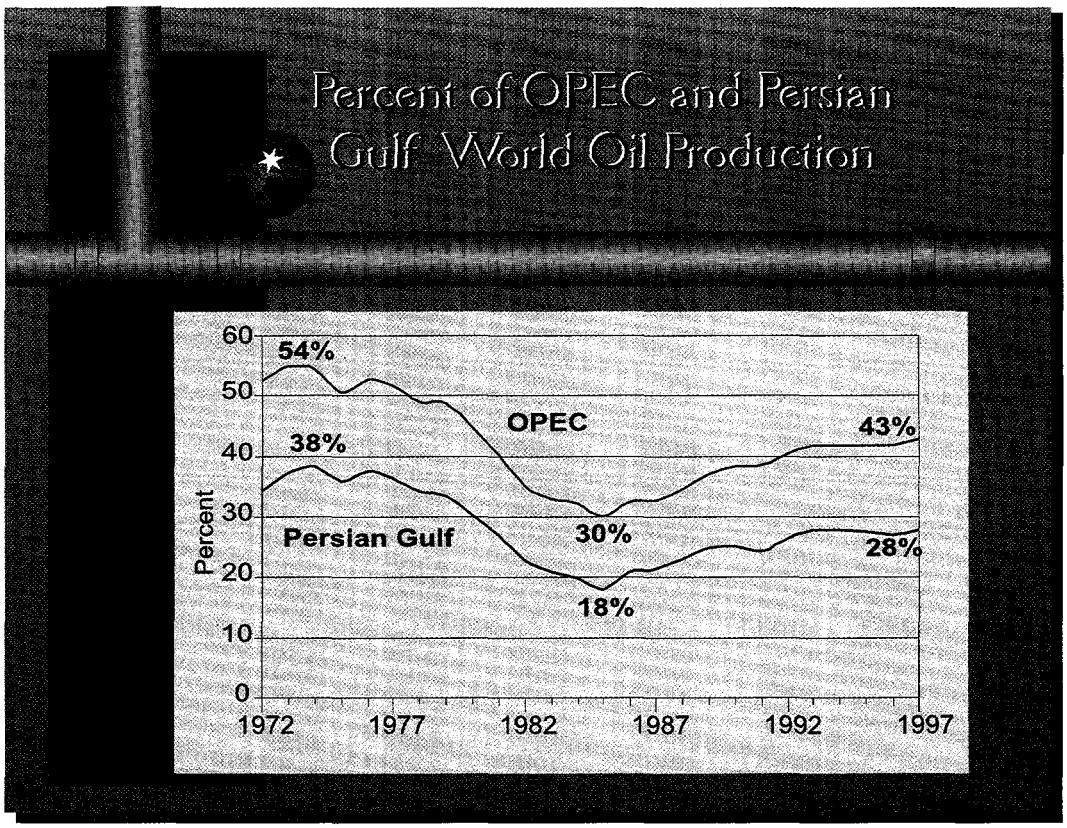
- The share of total U. S. consumption of imported oil declined significantly in the late 1970's and early 1980's. High oil prices prompted consumers to conserve energy and to switch to other fuels.

- U. S. dependence on imported oil has increased to record levels during the last 25 years. Net imports provide 48 percent of U. S. oil consumption (net imports: imports minus exports).

- The share of total U. S. consumption of imported oil has grown since oil prices collapsed in 1986. Gross imports account for 53 percent of U. S oil consumption (gross imports: no offsets for oil exports).

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA- 0384(97)(Washington, DC, July 1998),Table 5.1.

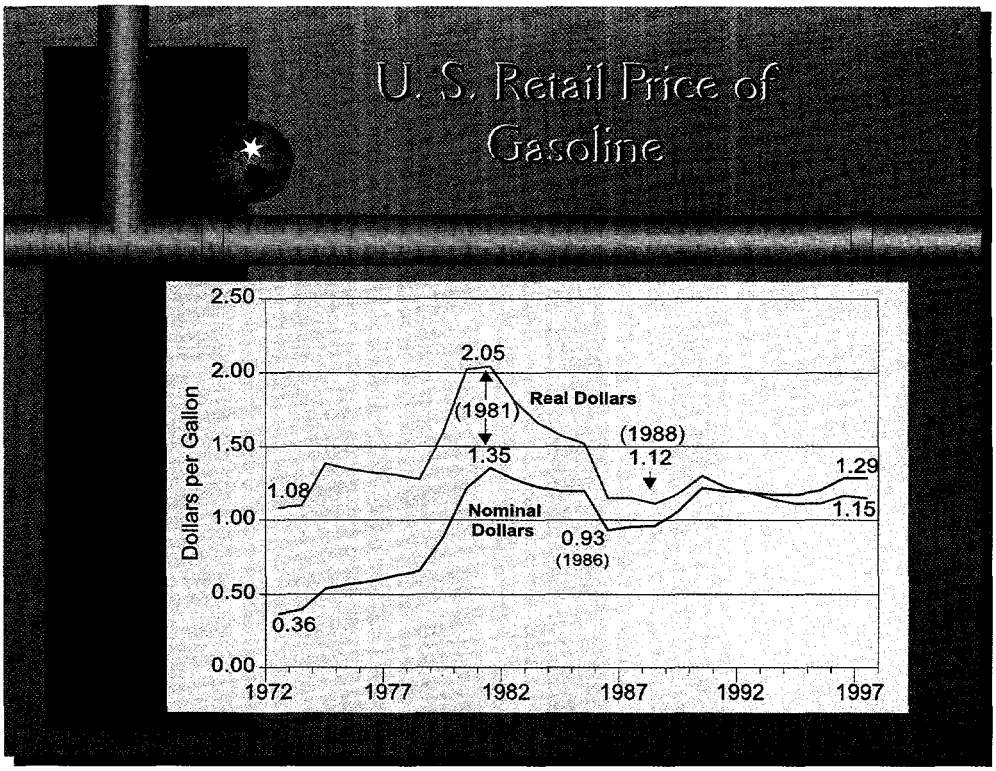
Figure 3



- The share of world oil production provided by members of the Organization of Petroleum Exporting Countries (OPEC) declined by more than two - thirds between 1973 and 1986.
- OPEC's market share was at its lowest prior to the major collapse in oil prices in 1986.
- OPEC's market share has rebounded since the 1986 price collapse and now stands at about 43 percent of world oil production.
- Unlike most other countries, a major portion of OPEC's oil is traded in international markets. OPEC consumes very little of its own oil.
- The largest portion of OPEC's oil production is in those countries that surround the Persian Gulf.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA- 0384(97) (Washington, DC, July 1998),Table 11.4.

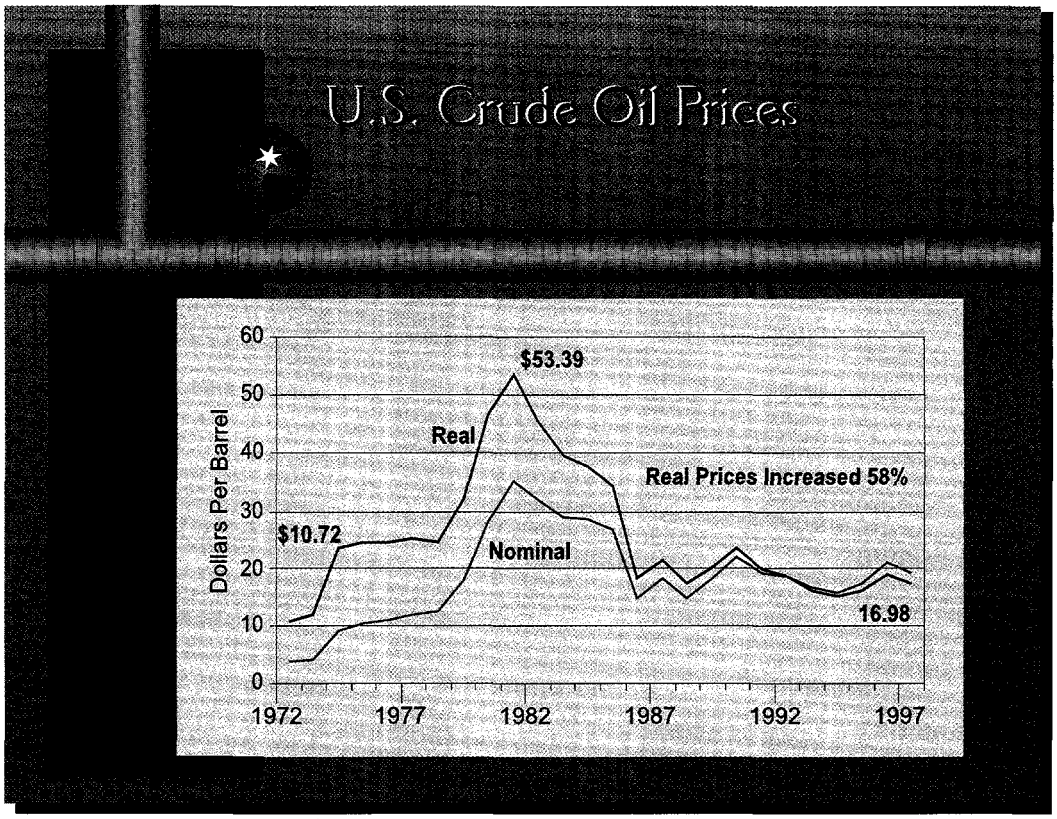
Figure 4



- During the past 25 years, the nominal price of gasoline (price not adjusted for inflation) has risen at an average annual rate of 5.2 percent; the real price of gasoline (price adjusted for inflation) rose only one-fourth of a percent per year.
- Gasoline prices (real and nominal) reached a peak in 1981.
- Gasoline prices declined after 1981 despite a steady rise in real taxes, a reflection of world crude oil market movement.
- The nominal price of gasoline dropped about 31 percent between 1981 and 1986, a post-embargo low.
- The real price of gasoline dropped 43 percent between 1981 and 1986 and continued a slow decline for 2 years more. By 1988, the price of gasoline had declined 45 percent, for a post-embargo low.
- Gasoline price increases are strongly influenced by the price of crude oil.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA- 0384(97)(Washington, DC, July 1998),Table 5.22.
Note(s): 1972-1977: price of leaded regular gasoline was used; **1978-1996**: price for all types of gasoline was used.

Figure 5



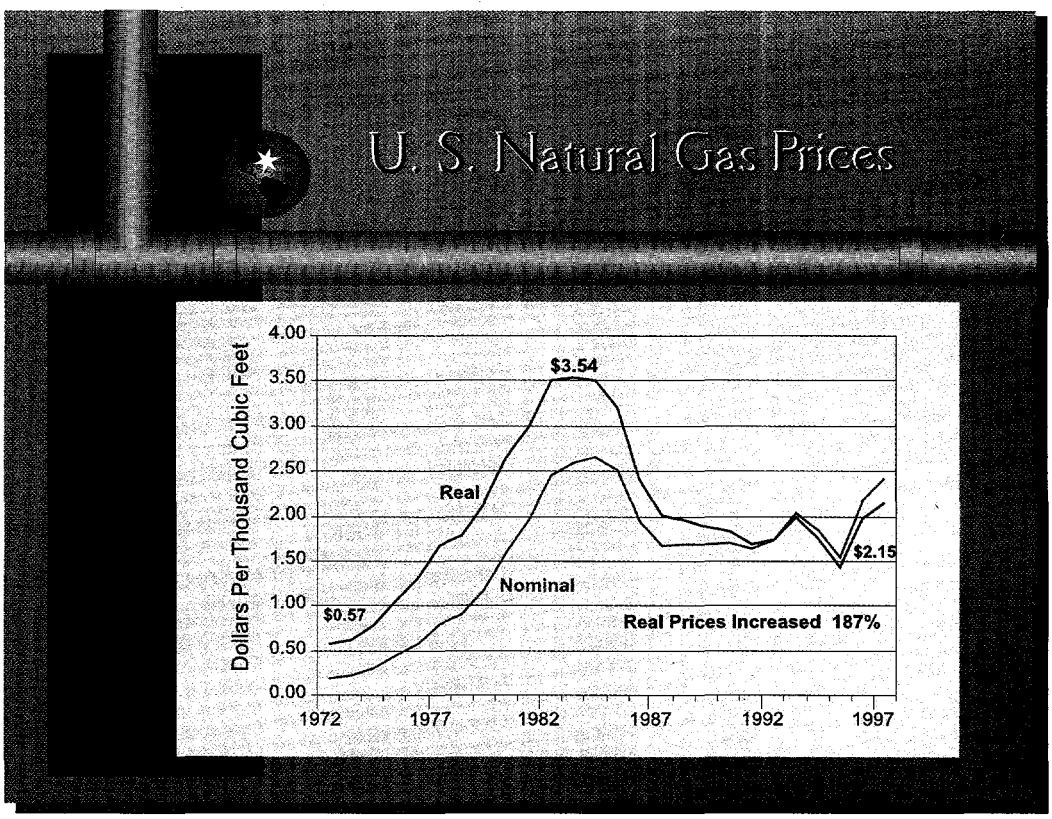
- The real price (inflation-adjusted) of crude oil paid by refiners (refiners acquisition costs) rose from $10.72 in 1972 to $16.98 in 1997, an increase of 58 percent.

- Prices peaked in 1981 during the Iranian revolution. The Iran-Iraq war increased fears of another disruption.

- Since 1981, there has been a steady decline in oil prices due in part to the following:
  --supplies from non-OPEC sources increased and absorbed some of the demand for OPEC oil
  --revenue requirements by members of OPEC led to a consistent overproduction above their established quotas.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA-0384(97) (Washington, DC, July 1998), Table 5.19.

Figure 6



- In an era of regulation and scarcity, the inflation-adjusted natural gas wellhead prices increased about 187 percent by 1997, from $0.57 to $2.15.

- In 1954, the Federal Power Commission (now the Federal Energy Regulatory Commission) first set controls on wellhead prices for gas intended for interstate transmission to consumers.

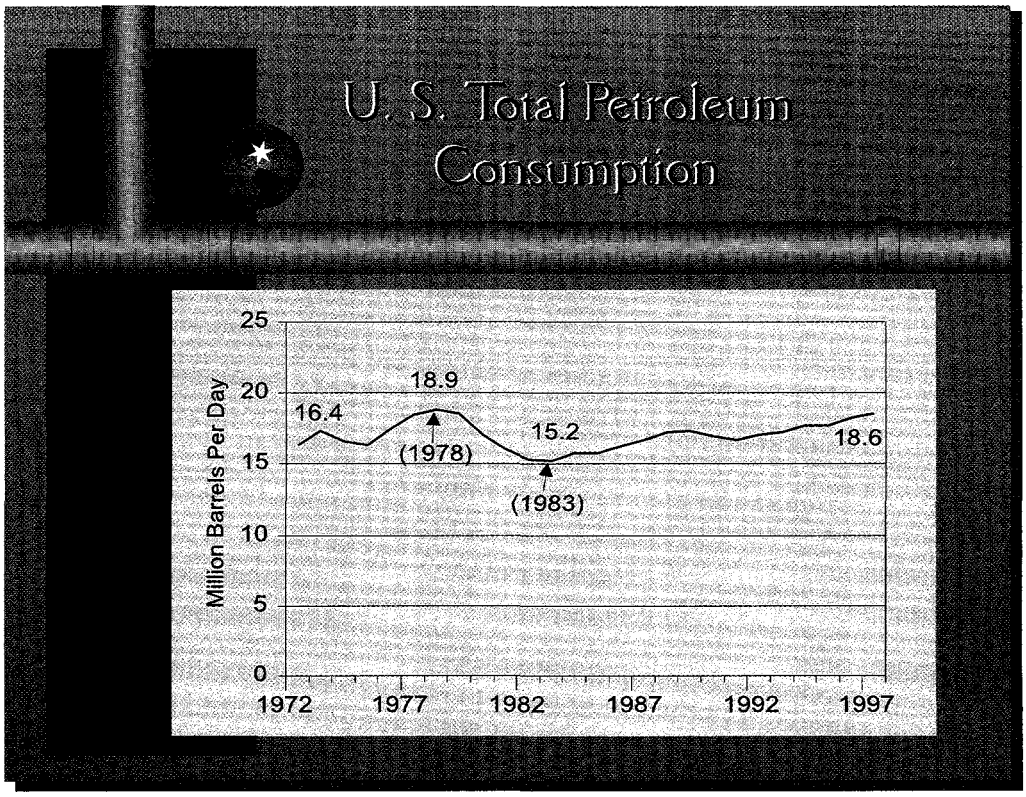
- Beginning in 1980, interstate transmission of *new gas* (not under existing long-term contract) was decontrolled while interstate transmission of *old gas* (under existing long-term contracts) remained controlled. All gas was decontrolled in 1993.

- Once the marginal supply of interstate transmission of gas was decontrolled, the average wellhead price of *new gas* rose, prompting a boom in gas exploration and development.

- Average wellhead prices peaked in the early 1980's as more gas entered the market. Gas prices are now strongly seasonal, increasing in winter and falling in summer.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA- 0384(97) (Washington, DC, July 1998),Table 6.8.

Figure 7



- The total petroleum consumption in the United States has grown at an average annual rate of 0.5 percent during the past 25 years.

- Following the 1973 OPEC price increases, U.S. consumption of petroleum declined for 2 years to a level of 16 million barrels per day by 1975. After which it rose until 1979 when the Iranian revolution caused the oil price to rise and consumption to decline.

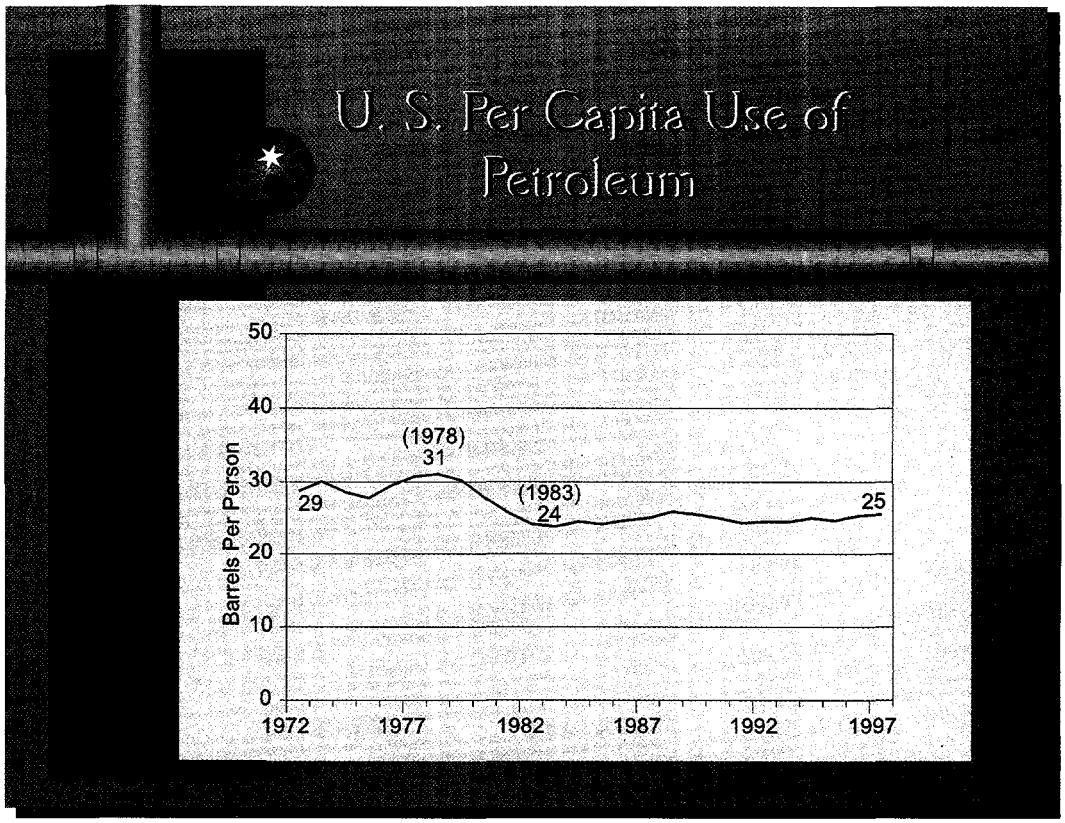
- A marked decline in petroleum consumption in the United States continued into the early 1980's. By 1983, the United States was consuming a low of 15.2 million barrels per day -- a decline of almost 20 percent from the record consumption level of 18.9 million barrels per day in 1978.

- Since 1983, the United States has experienced a rather steady increase in petroleum consumption. The present-day consumption level is nearly equal to the 1978 all-time high petroleum consumption level.

- In 1990, another oil price increase during the Persian Gulf war caused a slight and temporary decline in U. S. oil consumption.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA- 0384(97) (Washington, DC, July 1998), Table 5.1.

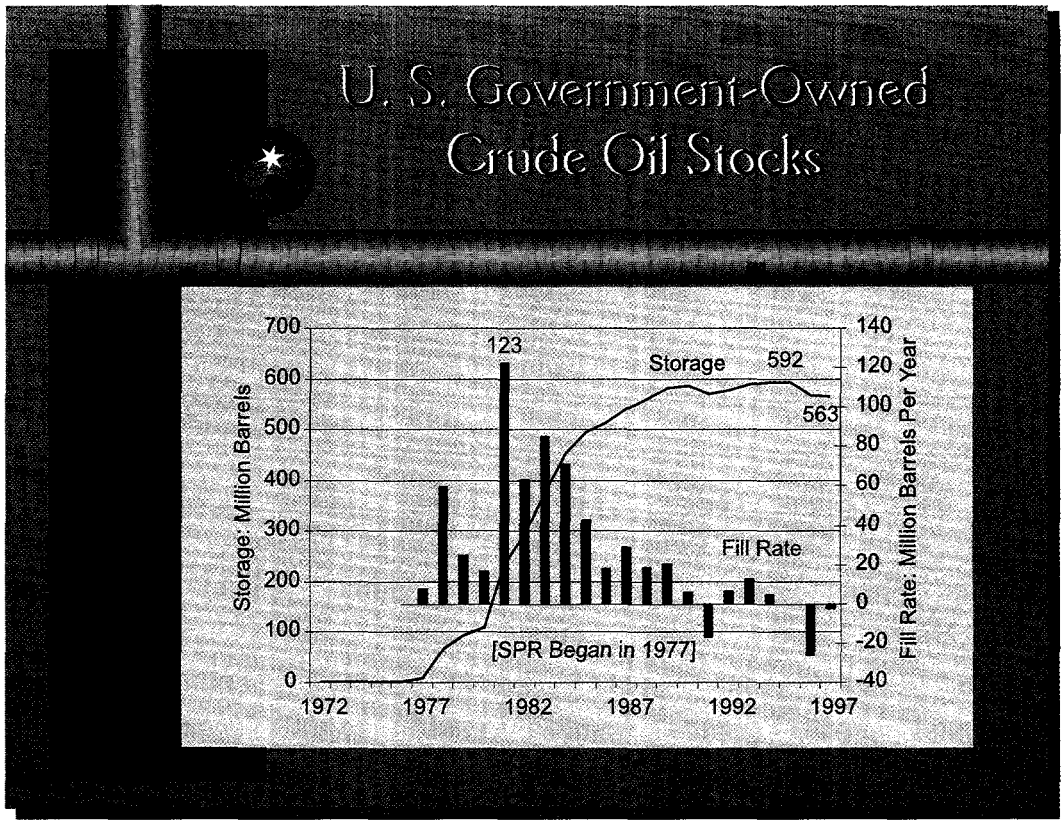
Figure 8



- The *per capita* (per person) use of petroleum decreased at an average annual rate of 0.5 percent during the past 25 years.
- The U.S. per capita use of petroleum decreased for 2 years and then increased to a peak of 31 barrels in 1978.
- From 1978 to 1983, petroleum use per capita in the United States dropped 23 percent, from a peak of 31.0 barrels. (During this period, the population rose 5.5 percent.)
- From 1978 to 1983, the consumption of total petroleum in the United States declined 19 percent.
- From 1983 to 1988, crude prices declined in both real and nominal terms, and petroleum use per capita rose slightly. After 1988, petroleum use per capita declined, leveling off at about 25 barrels per capita.
- Expansion of gas availability and environmental considerations in recent years helped stabilize per capita oil use, especially oil used for industrial and electricity production.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA- 0384(97)(Washington, DC, July 1998), Tables 5.1 and 1.5.

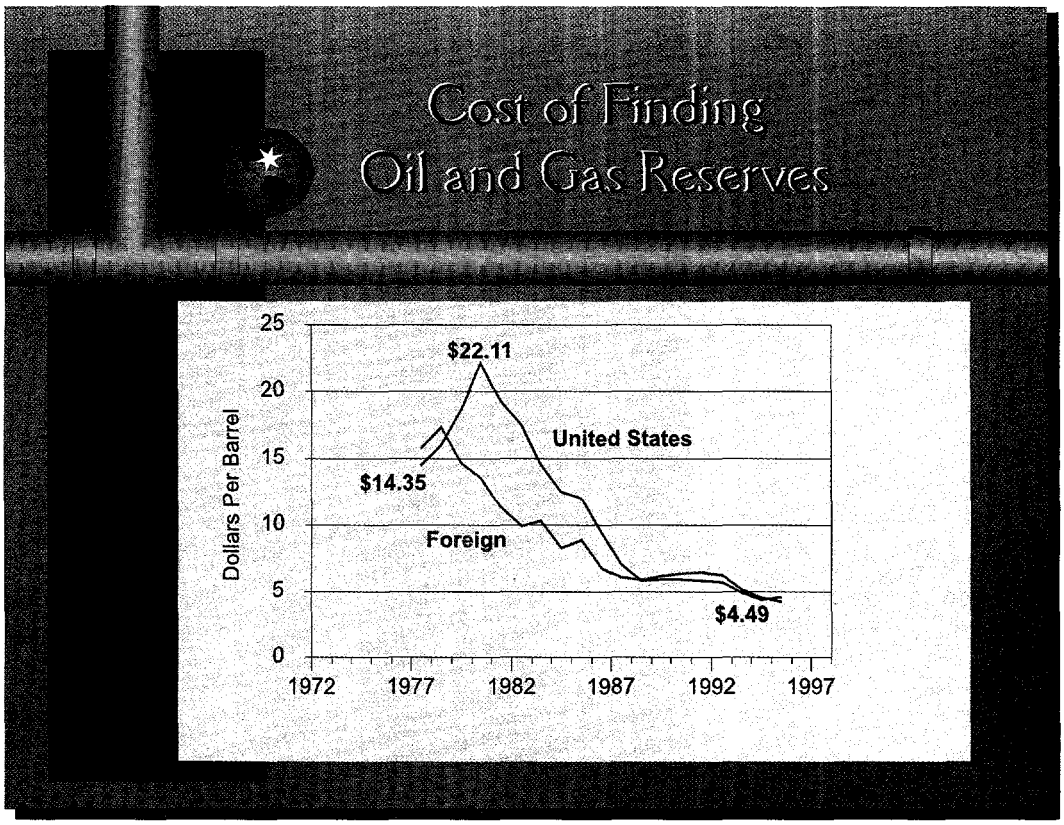
Figure 9



- The U. S. Government initiated the Strategic Petroleum Reserve (SPR) in 1976.
- In 1977, the SPR fill rate began with imported crude oil. By 1994, the Reserve had reached its maximum storage of 592 million barrels.
- The SPR fill rate ended in 1994. As of 1997, the Reserve storage is at 563 million barrels of crude -- about 57 days of net U. S. petroleum imports.
- The United States has held two public sales of crude oil from the Reserve in 1990/91 and 1996/97.
- The first public sale -- 21 million barrels at the time of the Gulf war -- was intended to stabilize the price of crude oil, which had risen to more than $33 per barrel. A second public sale of 28 million barrels occurred in 1996/97.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA-0384(97)(Washington, DC, July 1998),Table 5.15.

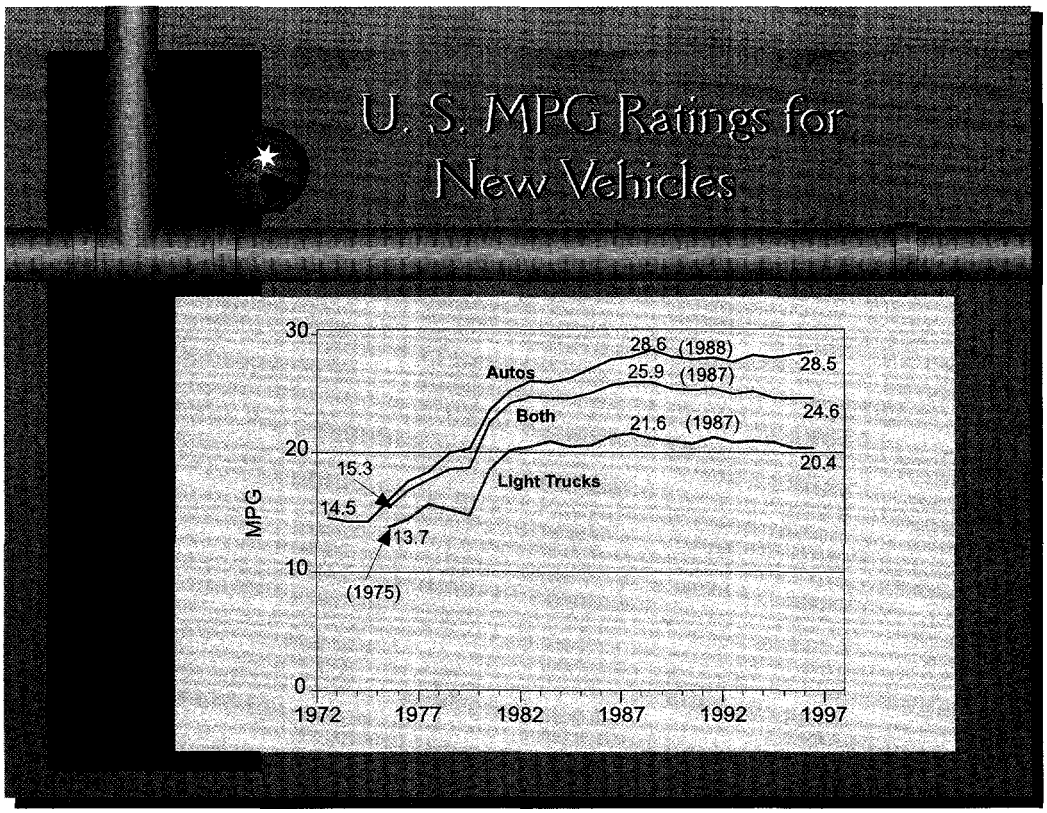
Figure 10



- The cost of finding new oil and gas wells has declined significantly since 1977 when EIA began collecting these data.
- A new barrel of oil or gas reserves that cost about $15 to find in 1977 (inflation- adjusted price) costs less than $5 to find today.
- Reserve cost reductions occurred primarily because of significant improvements in exploration and development technology.

Source: Form EIA-28, "Financial Reporting System."
Note(s): Costs are calculated as the ratio of total exploration and development expenditures to total oil and gas reserve additions (barrels of oil equivalent) for the major energy producers reporting to the Energy Information Administration. All costs are expressed in 1996 dollars, excluding the purchases and sales of reserves, and are 3-year weighted averages centering on the year shown.

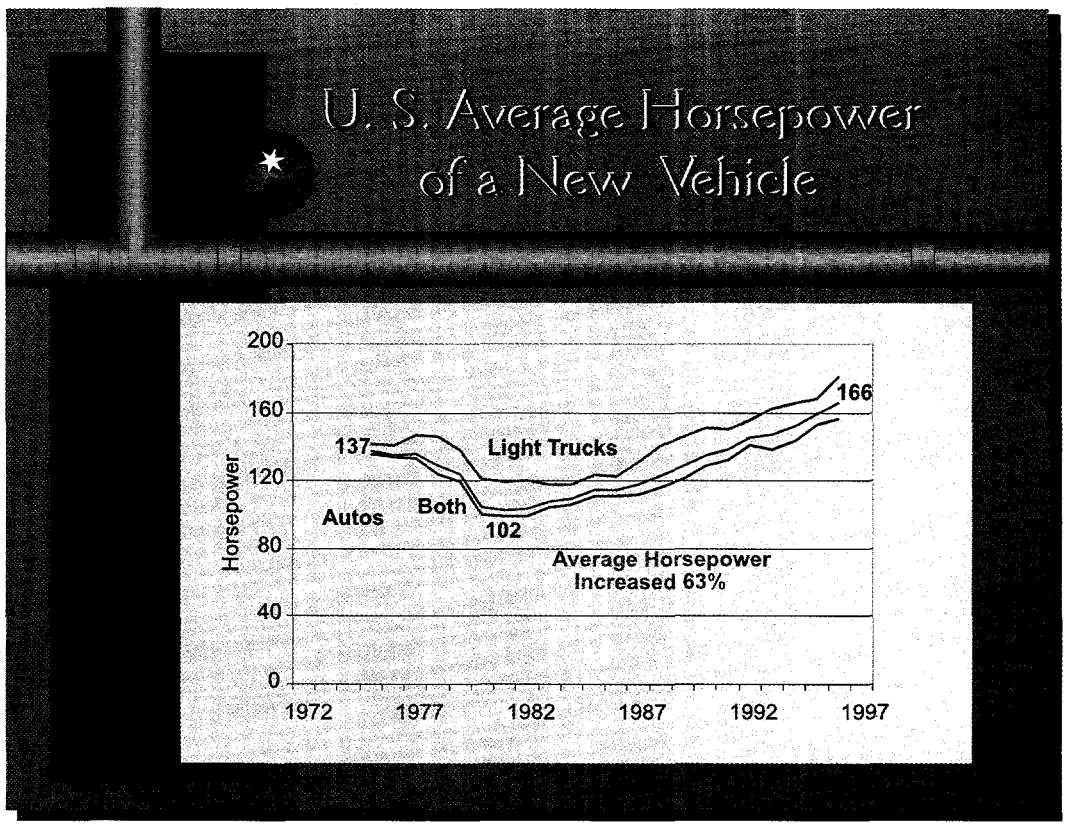
Figure 11



- The average annual rate of increase in the miles per gallon (mpg) rating for automobiles is 2.7 percent.
- From 1975 to 1996, the average annual increase in the mpg rating for automobiles and *light trucks* is 2.3 percent. (Light trucks include minivans, sport utility vehicles, and small pickup trucks.)
- In 1975, Congress authorized the Department of Transportation to set and enforce automobile efficiency standards (*CAFE*: Corporate Average Fuel Economy). The miles-per-gallon rating for new automobiles increased steadily from 1975 through 1988.
- After 1988, new automobile operating efficiency leveled off at about 28.5 mpg.
- Today, CAFE standards are 27.5 mpg for passenger cars and 20.7 mpg for light trucks.
- From the late 1980's to present, light trucks gained market share and began to slowly pull the mpg-combined-average rating below the 1987 peak.

Source: Environmental Protection Agency, *Light-Duty Automotive Technology and Fuel Economy Trends Through 1996*, EPA/AA/TDSG/96-01 (Ann Arbor, MI, August 1996), Table 1.

Figure 12



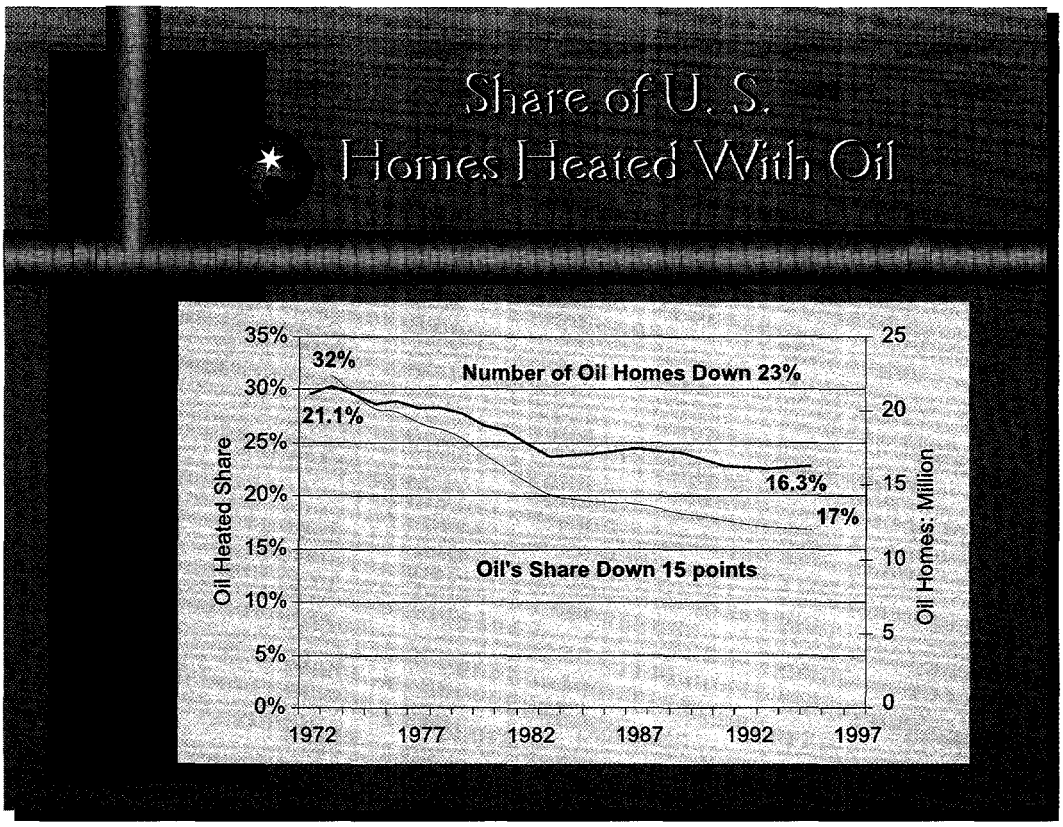
- Average horsepower of cars and *light trucks* decreased from 137 horsepower in 1975 to a low of 102 in the 1981/82 period, then rose 62 percent by 1996. (Light trucks include minivans, sport utility vehicles, and small pickup trucks.)

- New car efficiency standards became effective in 1978, stimulating development of smaller cars, more efficient engines, and improvements in major vehicle components -- all of which contributed to improved fuel efficiency. With such changes, efficiency standards were achieved with progressively higher-powered cars.

- Since 1982, the average horsepower of new vehicles has increased steadily, even as sales for high-powered cars and light trucks dominate the sales for lower horsepower. Meanwhile, corporate average fleet efficiencies continue to meet the standard of 27.5 mpg for passenger cars.

Source: Environmental Protection Agency, *Light-Duty Automotive Technology and Fuel Economy Trends Through 1996*, EPA/AA/TDSG/96-01 (Ann Arbor, MI, August 1996),Table 1.

Figure 13



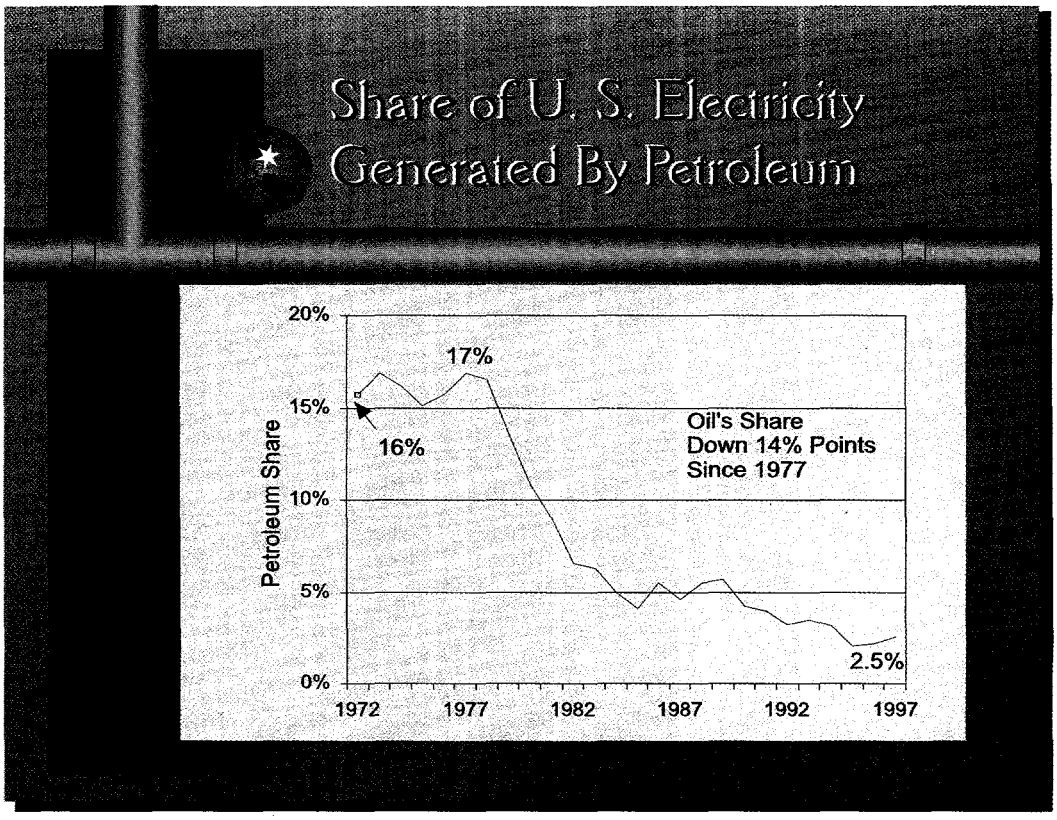
- The *share* of homes using oil heat has gradually fallen from 31.0 percent in 1972 to 15.3 percent in 1996. The *number* of homes using oil heat has fallen by 23 percent.

- From 1973 to late 1980 -- after the Arab oil embargo and the subsequent increase in the price of oil heat -- there was a moratorium on building new homes with natural gas heat in many northern regions. As a result, the decline in oil heat was somewhat slower than it would have been.

- Oil heat was also displaced by electric heat, which is more readily available in outlying suburban areas, where most new homes are built. In addition, there has been a slightly higher population growth in the Southern and Western regions of the United States, where electric home heating (and cooling) is a frequent choice.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA-0384(97) (Washington, DC, July 1998),Table 2.6.
Note: Oil heated homes can use either heating oil or liquefied petroleum gas (LPG) for forced air furnaces, hot water central heating, or small portable kerosene heaters.

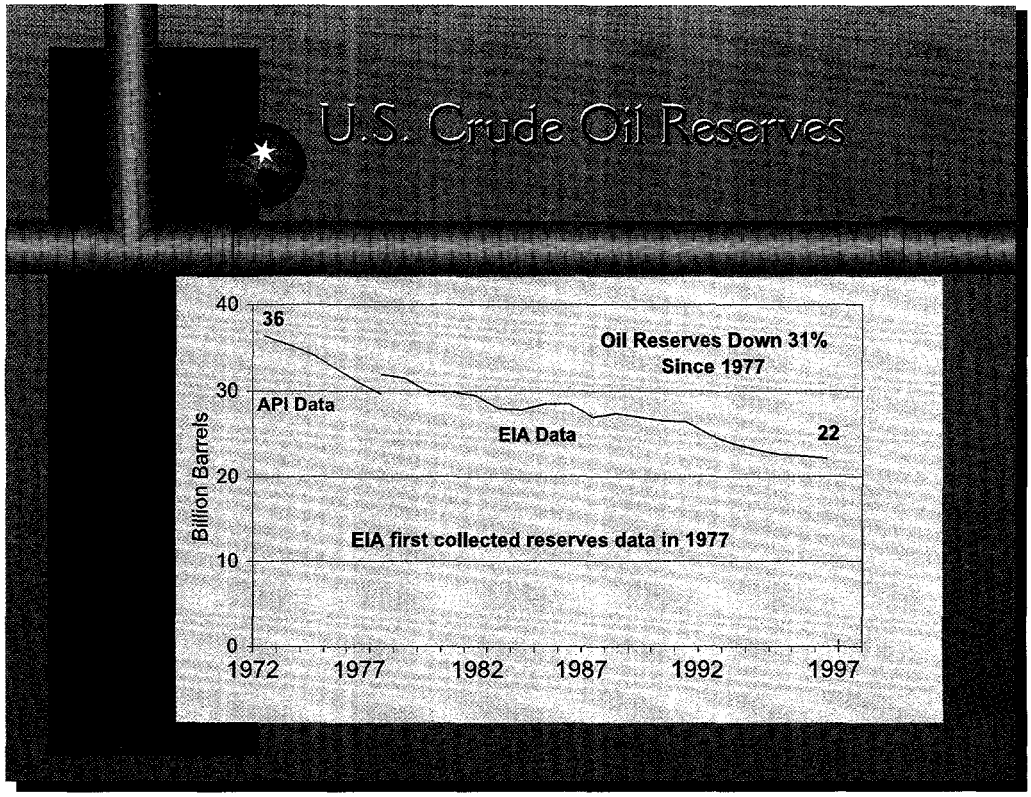
Figure 14



- The share of electric utility net generation from oil has decreased 14 percentage points since 1972, to about 2.5 percent of all electricity generation.
- Changes in the generating capacity are relatively slow and fuel choice is based on projections of future fuel prices.
- In the mid-1970's, oil-fired generation represented 16 to 17 percent of the nation's capability based on forecasts made in the 1960's and early 1970's of continued growth of electricity demand and stable supplies of cheap fuel oil.
- Oil has been displaced as the prime mover principally by the growth in coal generation spurred by higher oil prices in the 1970's and much more recently by flexible natural gas-fired generation.
- After 1978, oil-fired generation fell steadily to about 2.5 percent in 1997.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA-0384(97) (Washington, DC, July 1998),Table 8.3.

Figure 15



- Since 1972, economic conditions and technological capability have varied dramatically. Crude oil reserve estimates have varied because improved technology has increased finding rates. Oil now can be economically produced in the United States from more marginal fields than was the case in 1972.

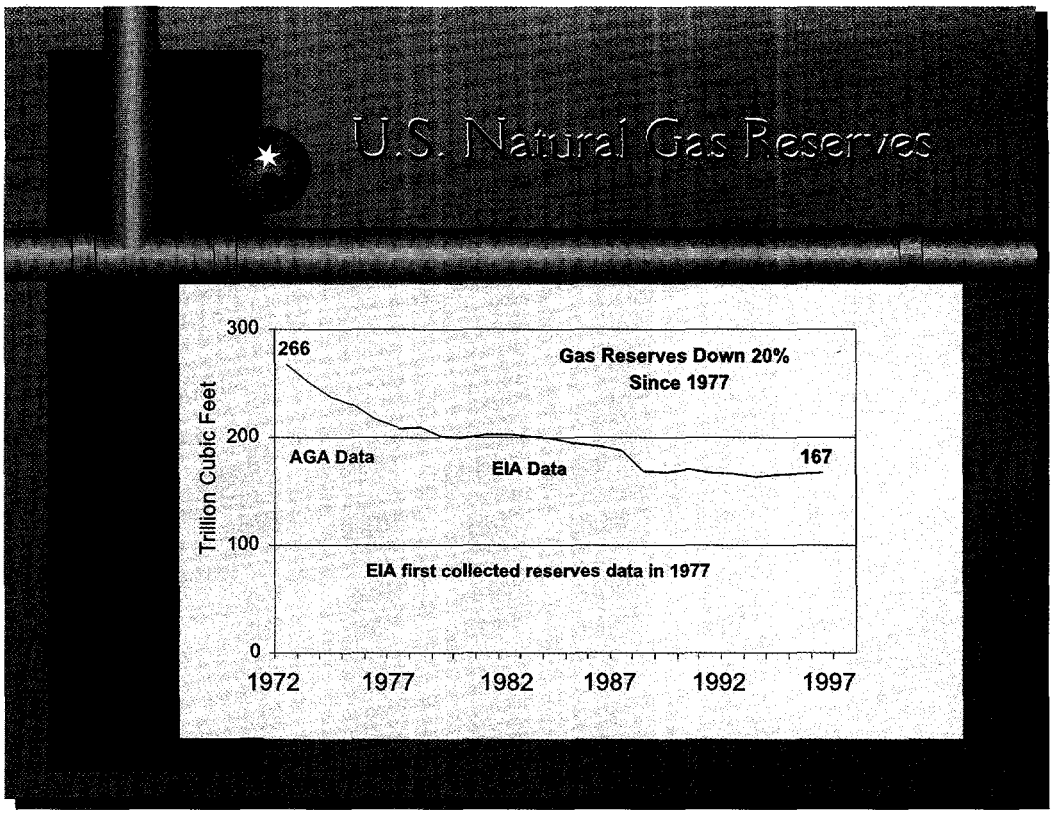
- In 1972, the American Petroleum Institute (API) estimates of crude oil reserves were 36.3 million barrels.

- EIA and API estimates differed by 2.3 million in 1977 -- when they first overlapped. The differences were attributed principally to the different approaches to reserves estimation.

- In 1996, EIA's estimates of crude oil reserves were 22.0 million barrels.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA-0384(97)(Washington, DC, July 1998), Table 4.10.
Note(s): **Prior to 1977:** A technical committee sponsored by API assembled these data. **Beginning in 1977:** EIA was solely responsible for assembling the crude reserves data. ***Oil reserves***: The estimated quantities that can be recoverable with reasonable certainty in future years from known reservoirs under existing economic and operating conditions.

Figure 16



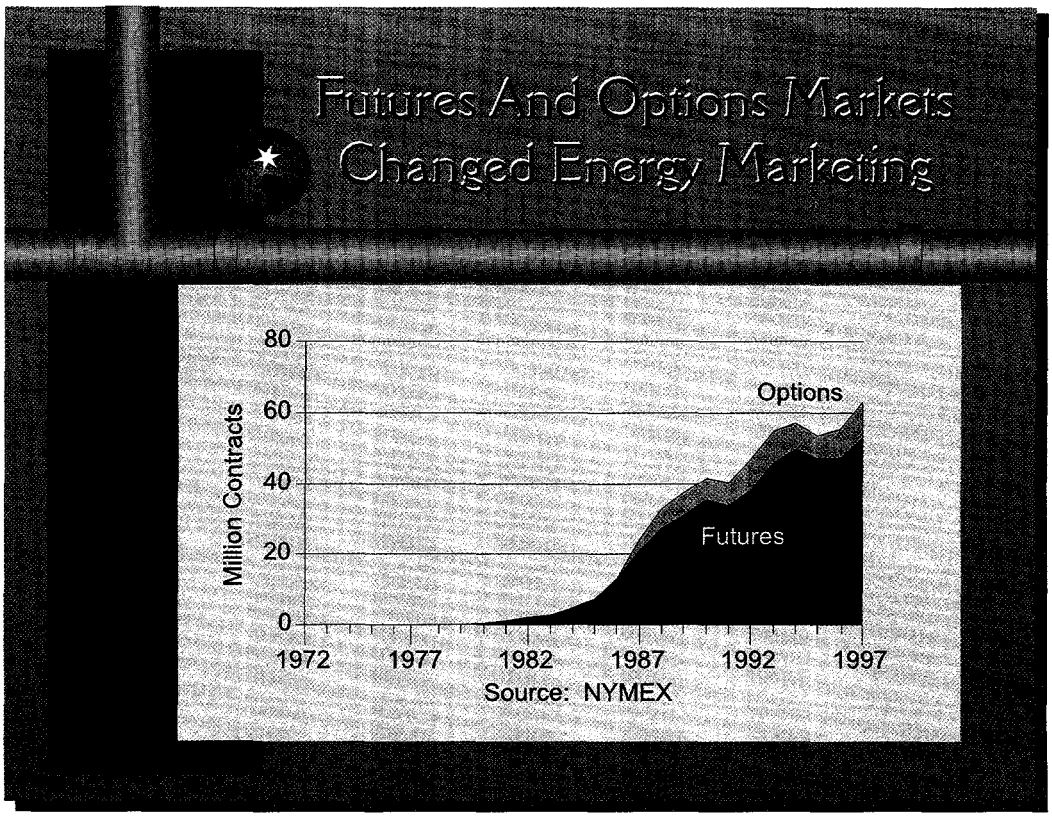
- Since 1972, economic conditions and technological capability have varied dramatically. Natural gas reserve estimates have varied because improved technology has increased finding rates. As for crude oil, natural gas now can be economically produced in the United States from more marginal fields than was the case in 1972.

- In 1972, the American Gas Association (AGA) estimates of natural gas reserves were 266 trillion cubic feet.

- In 1996, EIA's estimates of natural gas reserves were 166.5 trillion cubic feet.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA-0384(97)(Washington, DC, July 1998), Table 4.10.
Note(s): **Prior to 1977:** A technical committee sponsored by AGA assembled these data. **Beginning in 1977:** EIA was solely responsible for assembling the natural gas reserves data. ***Natural gas reserves***: The estimated quantities that can be recoverable with reasonable certainty in future years from known reservoirs under existing economic and operating conditions.

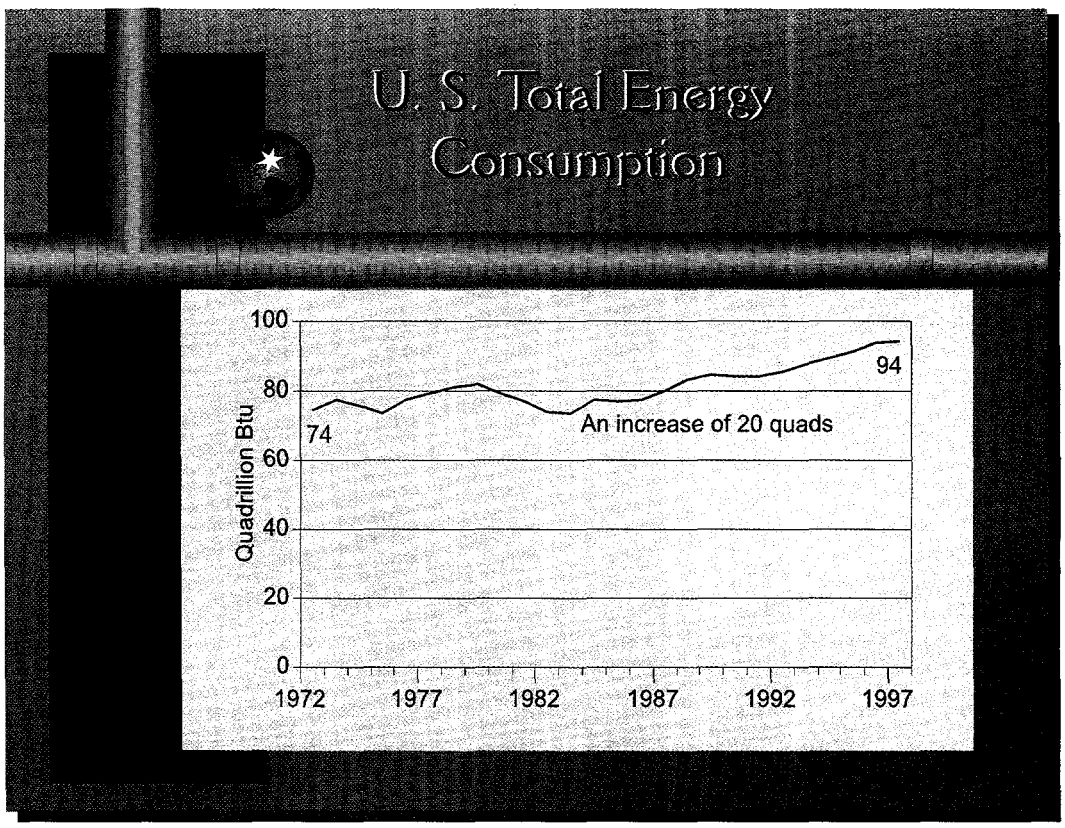
Figure 17



- Since starting with heating oil futures in 1978, energy futures and options markets on the New York Mercantile Exchange have grown and profoundly changed energy marketing.
- Crude oil is usually not sold at a fixed price when purchased. It is often sold at a reference price using a futures price at delivery.
- Gasoline futures prices are watched closely by distributors.
- Heating oil distributors make widespread use of future contracts.
- Natural gas futures started in April 1990 and grew rapidly.
- Electricity futures and options started in 1996 -- their possible effects on markets during deregulation are not yet known.

Source: New York Mercantile Exchange.

Figure 18

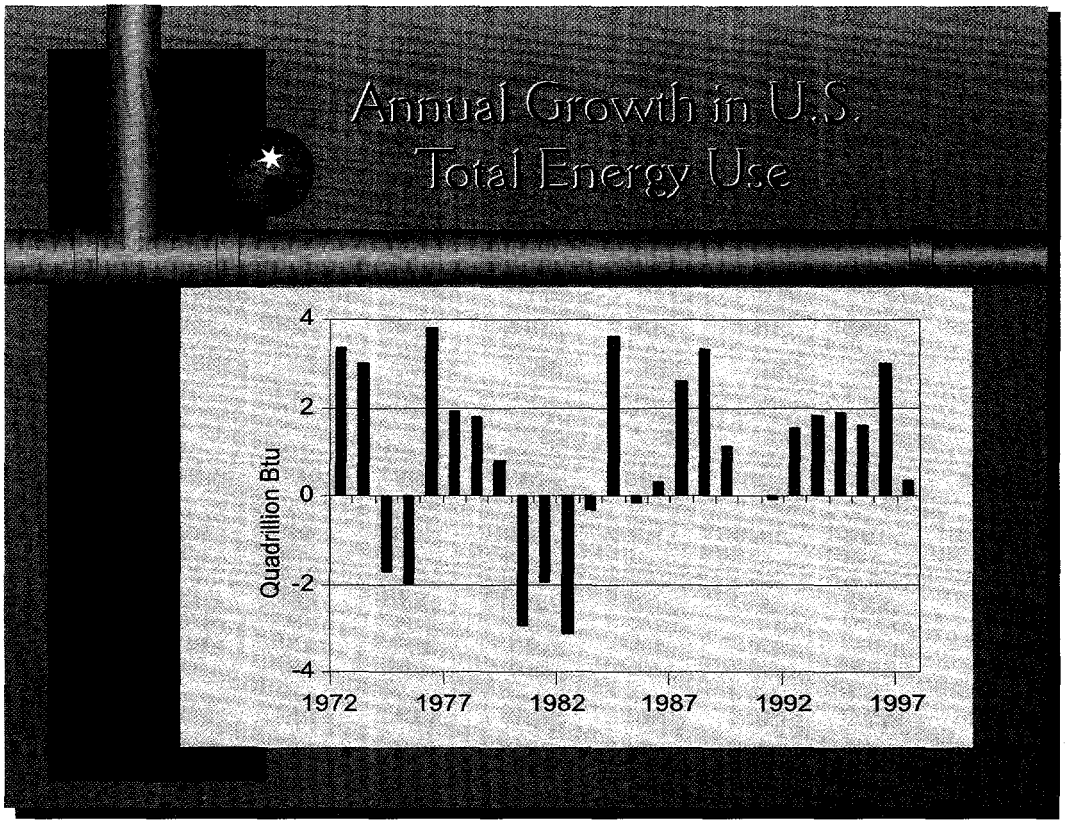


- From 1972 to 1996, energy consumption increased by 20 quadrillion Btu -- to 94.2 quadrillion Btu -- a compound growth rate of about 1.0 percent.

- The reductions in growth rate correspond to the 1974/75 and 1981/82 changes in economic growth.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA-0384(97)(Washington, DC, July 1998),Table 1.3.
Note: Data include an estimate of 3 quadrillion Btu for nonutility renewables prior to 1990.

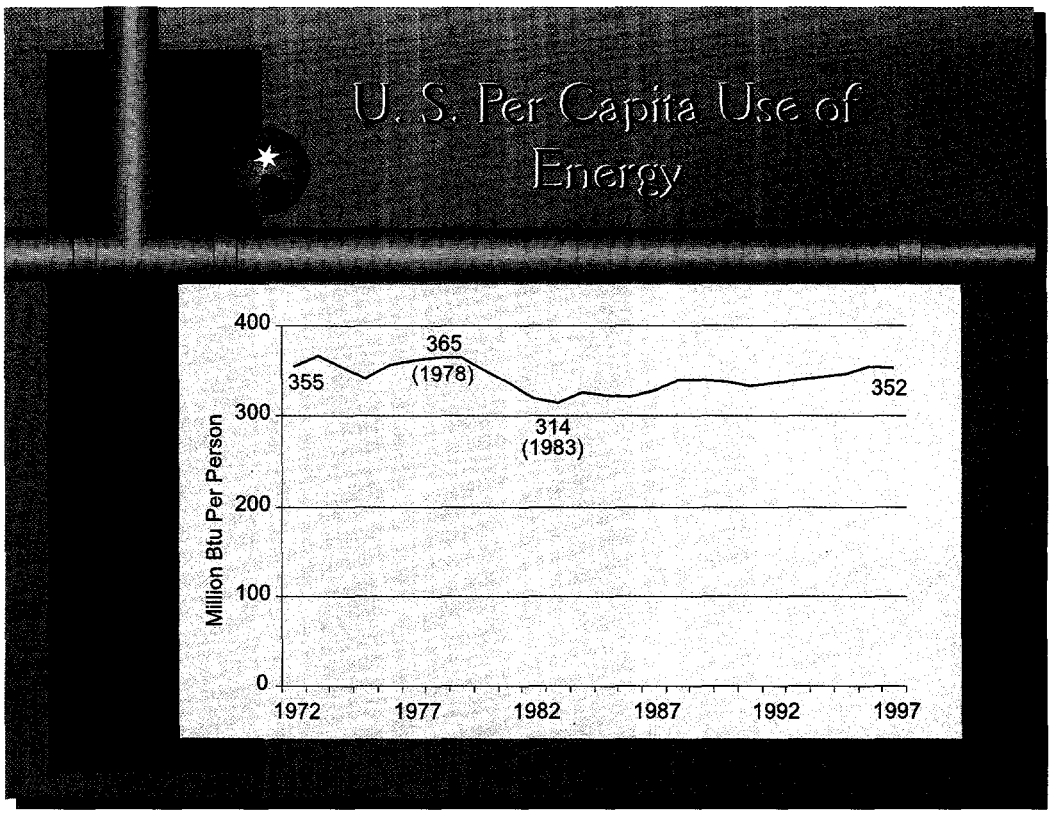
Figure 19



- U. S. energy consumption has increased by more than 28 percent -- about 21 quadrillion Btu -- during the last 25 years.
- Energy growth has occurred during periods of relatively low or stable prices, and also during periods of healthy economic growth.
- Significant declines in energy consumption occurred following major increases in energy prices, as well as during periods of sluggish economic activity.
- Total energy use declined four consecutive years -- from 1980 to 1983.
- More than half of the overall energy growth of the last 25 years -- about 11 quadrillion Btu -- has occurred during the last 6 years.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA-0384(97)(Washington, DC, July 1998),Table 1.3.

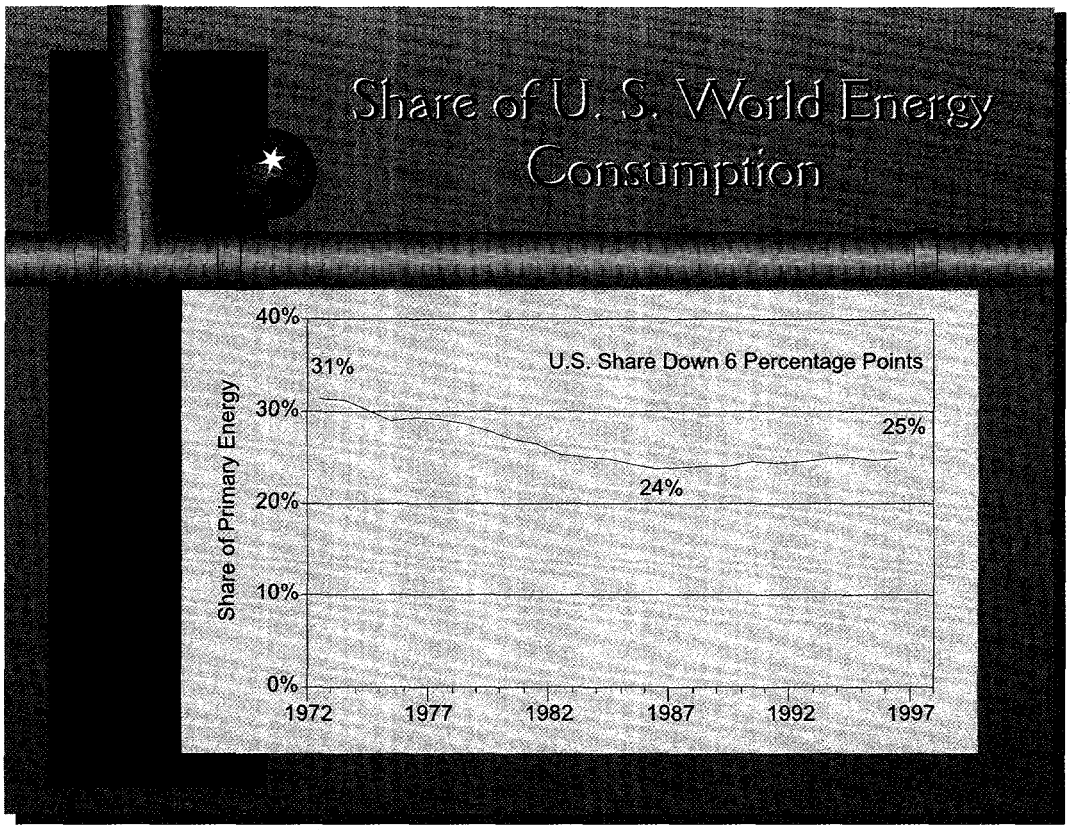
Figure 20



- The per capita use of energy has declined 0.8 percent over the last 25 years.
- The per capita use of energy decreased for 2 years immediately following the OPEC embargo.
- In 1978, the per capita use of energy peaked at 365 million Btu -- a level not since repeated.
- Although the population rose 5.5 percent from 1978 to 1983, the energy use per person dropped 14 percent.
- The start of the decline in consumption of energy coincided with the onset and after effects of a second oil price increase.
- From 1983 to present, the energy use per person increased at a steady low rate of 0.8 percent per year.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA-0384(97) (Washington, DC, July 1998),Tables 1.3 and 1.5.
Note: The total energy consumed shown in Table 1.3 was increased by 3 quadrillion Btu for renewable energy not previously included for the years 1972-1989.

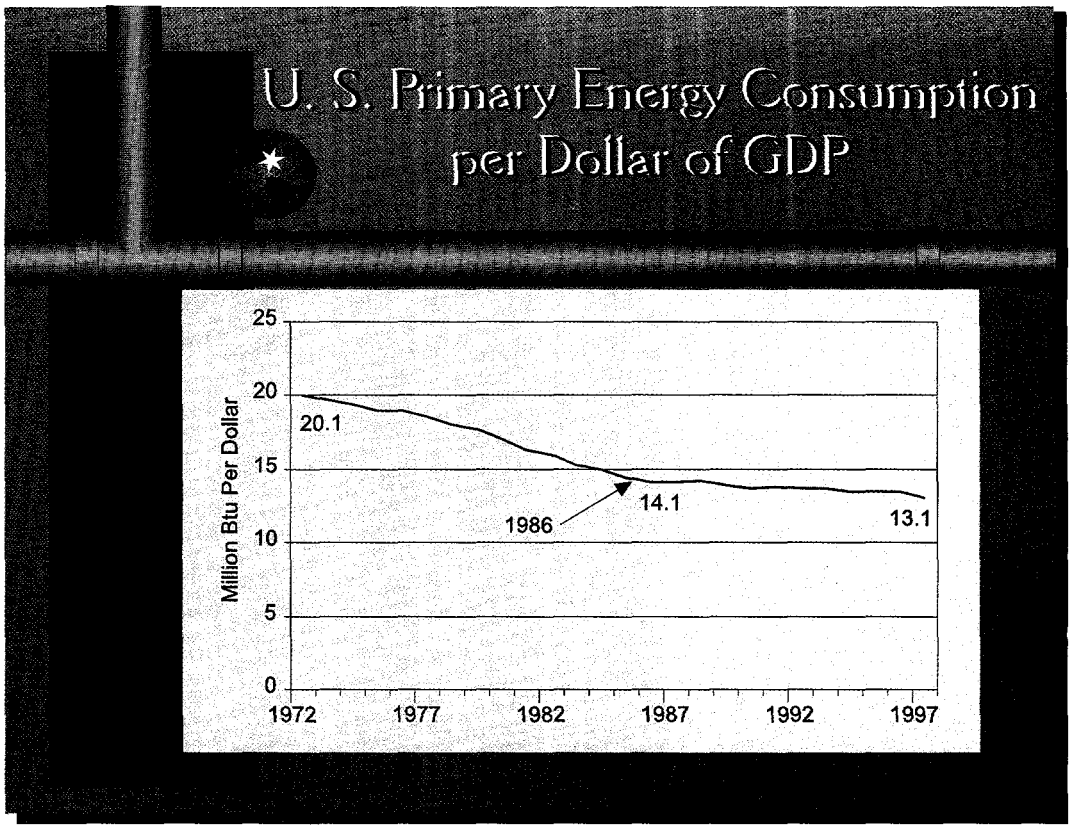
Figure 21



- Comparing world energy consumption with the United States consumption is difficult, because the statistics are more complete for the United States than for the rest of the world.
- U. S. consumption fell from approximately 31 percent of world energy consumption in 1972 to 25 percent in 1996.
- The share of U. S. consumption stabilized because the growth in the developing world energy consumption de-emphasized growth in U. S. energy consumption.

Source: Energy Information Administration, *International Energy Annual 1996*, DOE/EIA-0219(96)(Washington, DC, February 1998), Table E1.
Note(s): There is a discontinuity in the time series between 1989 and 1990. In the United States, expanded coverage of nonutility use of renewable energy began in 1990. Independent power producers' use of coal was included in U.S. consumption beginning in 1992 -- the changes are too small to show.

Figure 22



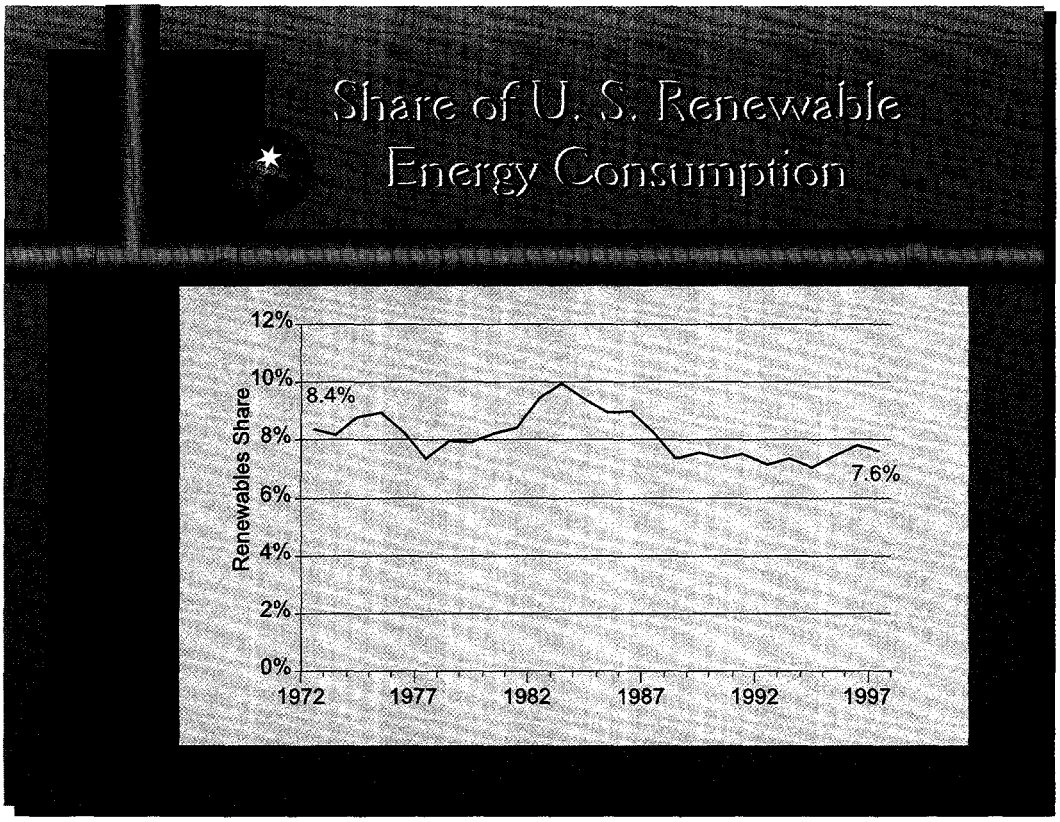
- Energy consumption per dollar of GDP has declined at an average annual rate of 1.7 percent during the past 25 years.

- In 1972, the energy consumed per dollar of GDP was 20.1 million Btu. From that high point a steady decline began and lasted through 1986. After 1986, decline in the energy consumption per dollar of GDP slowed significantly.

- The steady decline through 1986 is a reflection of the emphasis placed on conserving energy, and of increasing energy efficiency in virtually all areas of energy consumption. Although oil prices began dropping in the early 1980's, the efficiency gains were by and large here to stay.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA-0384(97) (Washington, DC, July 1998),Tables 1.3 and 1.5.
Note 1: The total energy consumed shown in Table 1.3 was increased by 3 quadrillion Btu for renewable energy not previously included for the years 1972-1989.
Note 2: Energy consumption per dollar of GDP is a measure of energy intensity. Energy intensity is the ratio of the amount of energy consumed to an indicator of the amount of goods produced or services provided.

Figure 23



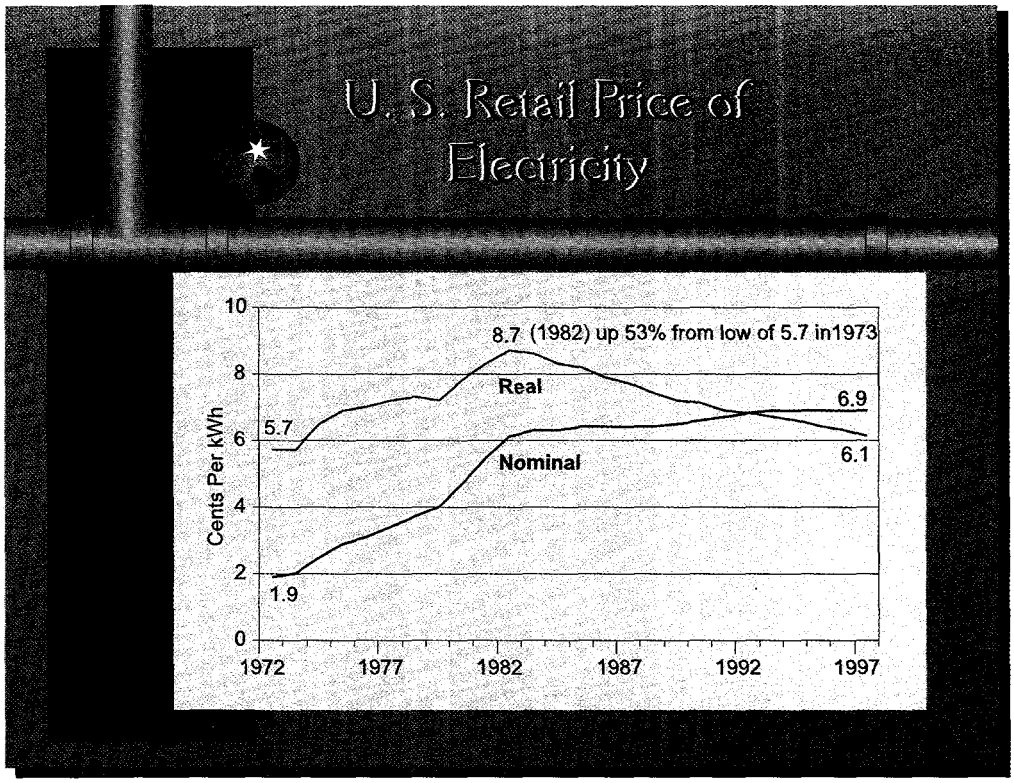
- Renewable energy was approximately 8.4 percent of U.S. total consumption in 1972. It declined slightly to 7.6 percent in 1997.

- Renewable energy comes from hydroelectric power, geothermal, biofuels, solar and wind-generated energy.

- Prior to 1990, about 3 quadrillion Btu of electricity generated from solar and wind energy were not counted in the statistics. In addition, consumption statistics for renewable energy did not include residential use of renewable fuels such as solar heating and hot water.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA-0384(97)(Washington, DC, July 1998),Tables 1.3 and 10.2.

Figure 24



- The *nominal price* (not inflation-adjusted) of electricity has risen at an average annual rate of 5.3 percent during the past 25 years. In contrast, the *real price* (inflation-adjusted) has risen at a rate of 0.3 percent.

- Electricity prices (real cents per kilowatthour) have followed two broad trends: (1) growth throughout the 1970's and into the early 1980's; and (2) a decline (real dollars) since about 1982. Increased competition in the electric power industry has created downward pressures on prices.

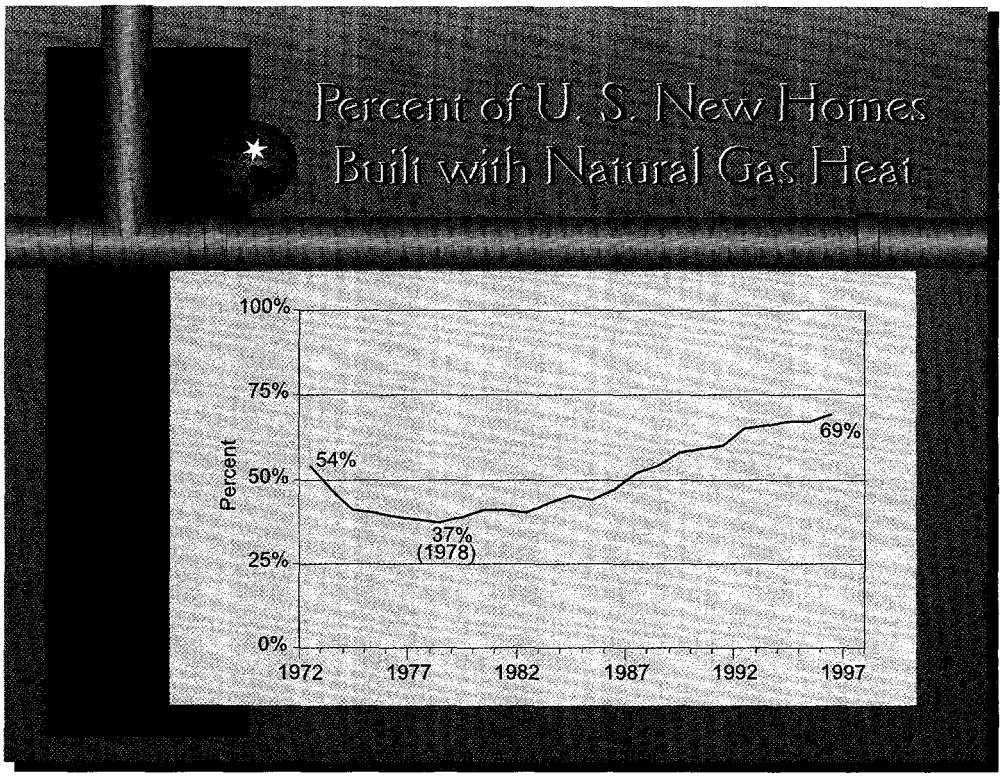
- The retail price of electricity, in real terms, rose 53 percent from a low 5.7 cents per kilowatthour (kWh) in 1972 to 8.7 cents per kWh in 1982. Also, during that period the nominal price rose even more dramatically, 1.9 to 6.1 cents per kWh, a staggering 220 percent, almost tripling the price.

- A rise in fossil fuel prices between 1972 and 1982 strongly influenced the price of electricity.

- The nominal price continued to rise after 1982, but at a much more gradual rate. Meanwhile, the real price showed a steady decline of about 30 percent by 1996.

Source: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA-0384(97) (Washington, DC, July 1998), Table 8.13.

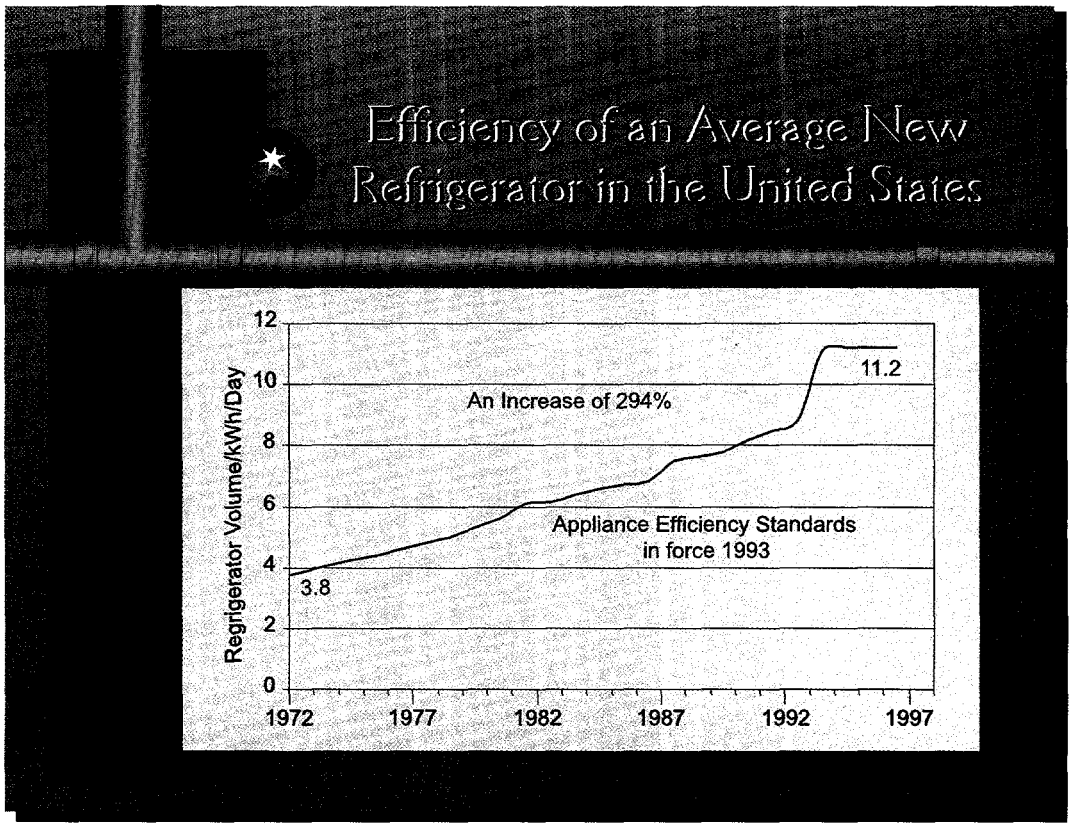
Figure 25



- The percent of new homes built with gas heat increased at an average annual rate of 0.9 percent during the past 25 years.
- A sharp drop in newly built gas-heated homes occurred following the oil embargo from a pre-embargo level of 54 percent to a 1978 level of 37 percent.
- Concerns about the dependable availability of natural gas in the 1970's led to restrictions on the use of natural gas in new homes. Restrictions were in place in the northern region of the country until the late 1980's.
- Increases in nominal natural gas prices accelerated after the embargo, reaching a plateau in 1983. Although natural gas prices (in nominal terms) remained fairly constant after 1983, in real terms they declined.
- New gas hookups increased with the 1985 decontrol of wellhead prices and the expansion of natural gas imports.
- Currently, two-thirds of new homes are built with natural gas heat.

Source: U. S. Department of Commerce, Bureau of the Census, *Characteristics of New Housing: 1995*, (Washington, DC, October 1996).

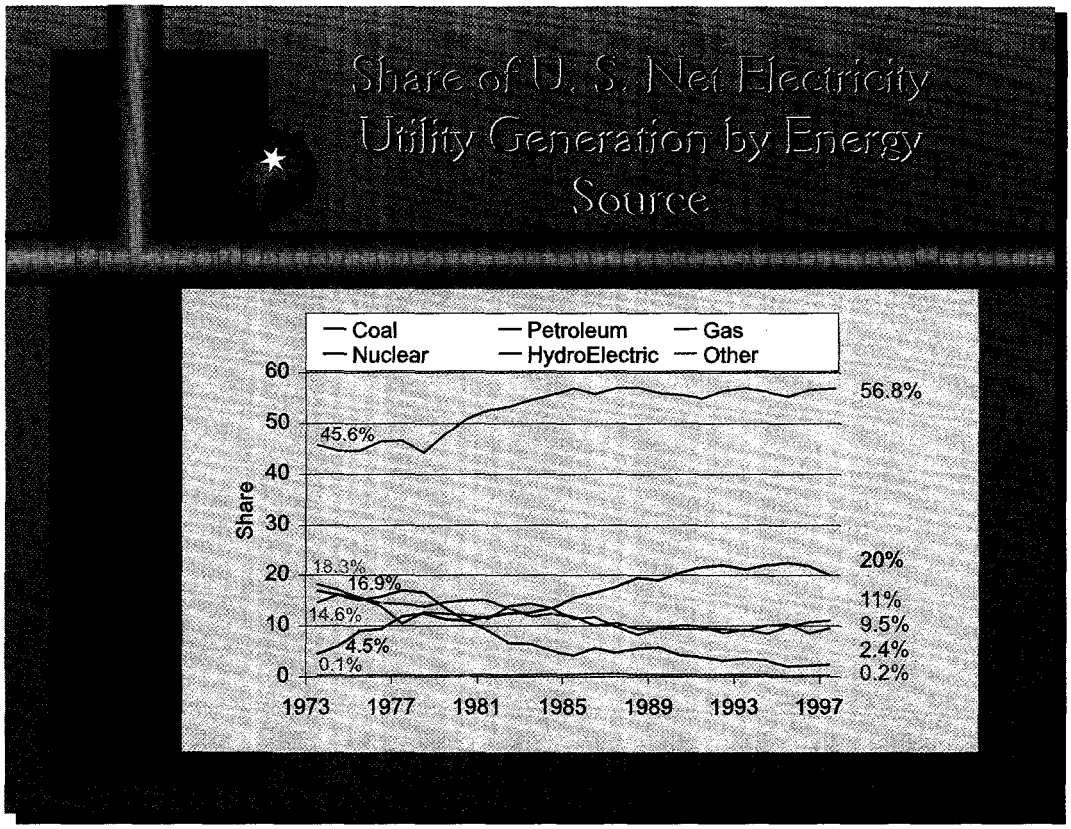
Figure 26



- The efficiency of an average new refrigerator increased dramatically, from 3.84 cubic feet per kilowatthour per day in 1972 to 11.22 cubic feet per kilowatthour by 1996.
- New technology, increasing price of electricity, and anticipated energy efficiency standards contributed to increased efficiency in new refrigerators.
- The National Appliance Energy Conservation Act of 1987 set minimum efficiency standards for 13 product types, including refrigerators. After 1993, no refrigerator could be sold that did not meet the standards. Standards will be updated again in 2002.

Source: Association of Home Appliance Manufacturers, *Refrigerators Energy Efficiency and Consumption Trends*, July 14, 1997.
Note(s): The efficiency of a refrigerator is expressed in "volume cooled per unit electric energy per day." **Volume** is measured in cubic feet and **electrical energy** is measured in kilowatthours. Increased efficiency compensates for the increasing size of refrigerators. **Average efficiency** is the sales-weighted average over all models sold in the United States.

Figure 27



- Electric utilities used petroleum for 17 percent of electric generation in 1973. During the 1973 oil embargo petroleum prices soared while its availability was labeled as questionable, thus began a long-term decline in the use of petroleum as a fuel for electric generation.

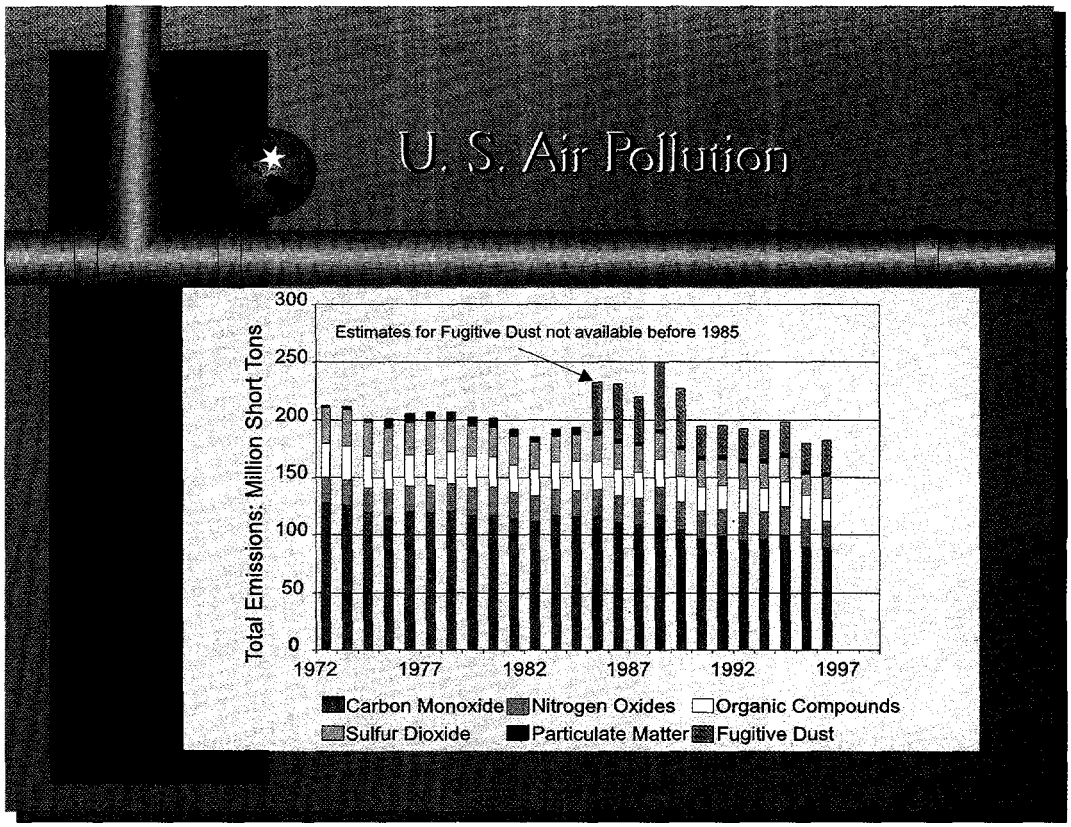
- Petroleum-fired electric plants produced only 2 percent of electric generation in 1997 -- due to increased use of nuclear, gas-fired and coal-fired electric generation.

- A rapid growth of nuclear electricity generation was slowed by the 1979 accident at the Three Mile Island nuclear power plant. No new orders for nuclear reactors were made after 1978.

- Electric utility generation by nuclear reactors has improved significantly. The national capacity factor below 65 percent in the 1970's and 1980's has surpassed 70 percent since 1991, achieving 76 percent in 1996.

Source: **Nuclear portion of domestic electricity**: Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA-0384(97) (Washington, DC, July 1998), Table 8.3; **Reactor performance:** *Annual Energy Outlook* 1998, DOE/EIA-0383(98)(Washington, DC, December 1997), p 54; Form EIA-759, "Monthly Power Plant Report."

Figure 28



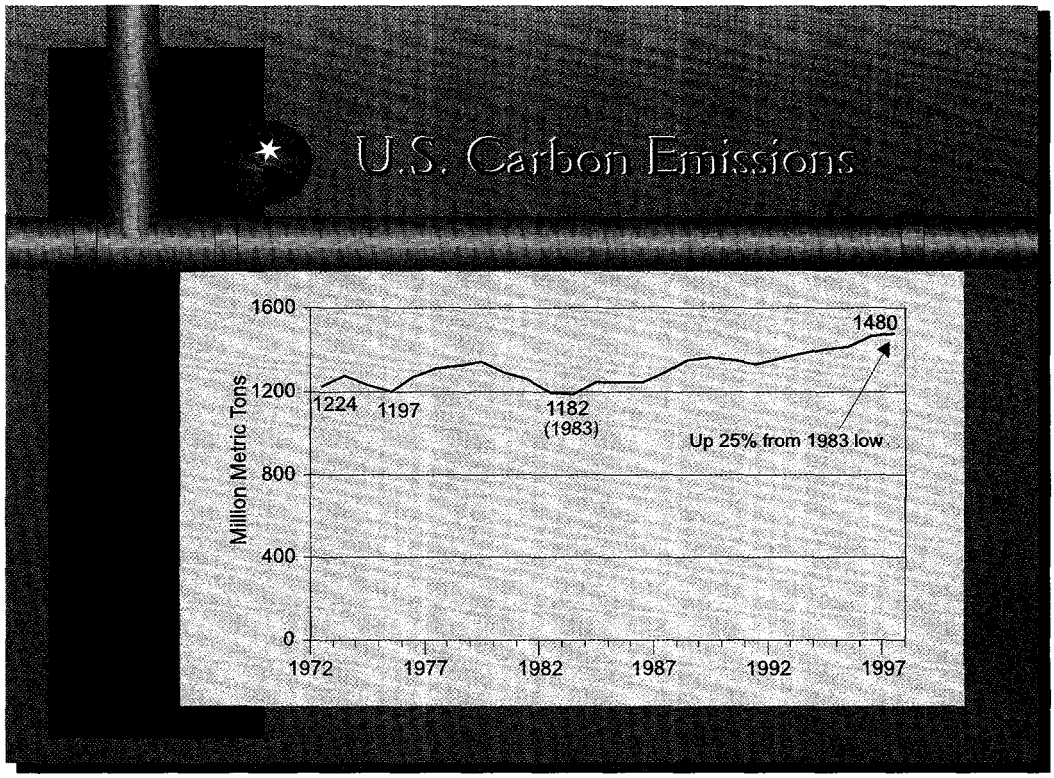
- Total emissions for all criteria pollutants shown, except nitrogen oxides, have declined even though vehicle miles traveled and gross domestic product have increased. (Pollutants shown include carbon monoxide, organic compounds, sulfur dioxide and particulate matter.)

- Total emissions declined substantially on a per-capita basis, from about 1.2 pounds per person in 1972 to 0.68 pounds per person in 1996. The decreases are attributable to the Clean Air Act regulations which began in 1970 and continued into the 1990's. Changes in the business cycle and improved manufacturing practices also have played a role in the decline.

- Lead emissions (too small to report in the graph) declined from an estimated 221 thousand short tons in 1970 to 3.9 thousand tons in 1996, largely due to the removal of lead from gasoline.

Source: Environmental Protection Agency, Office of Air and Radiation, *National Air Pollutant Emission Trends Report: 1900 - 1996*, EPA-454/R-97-011 (Washington, DC, December 1997), Appendix A.
Note: Particulate emissions including fugitive dust consist of particles less than 10 microns in diameter (PM-10).

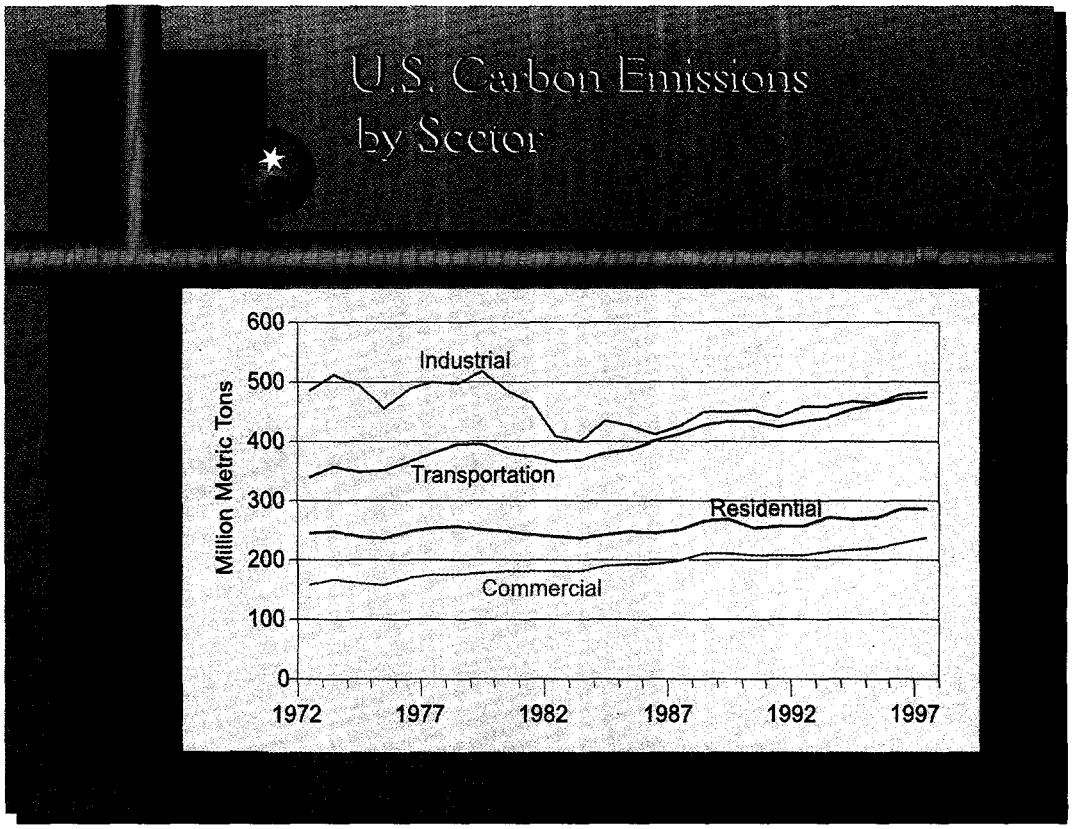
Figure 29



- Carbon emissions in the United States have risen at an average annual rate of 0.8 percent during the past 25 years.
- U. S. carbon emissions are the product of : (1) demand for energy services; (2) end-use energy efficiency; (3) energy transformation efficiency; and (4) the choice of fuels used.
- The use of energy services has tended to track the growth of the U. S. economy. But, emissions have grown much more slowly than the U. S. economy or even energy consumption because of the increases in energy efficiency and large-scale fuel switching.
- Periods of declining emissions have tended to coincide with periods of prolonged higher energy prices.
- In the 1990's, with real energy prices at lower levels than during previous decades and further fuel switching of marginal importance, energy consumption and emissions track economic growth much more closely than in the preceding two decades.
- The carbon emissions range between 5 and 6 metric tons per person per year.

Source: For **1990-1997**, Energy Information Administration, *Emissions of Greenhouse Gases in the United States 1997*, DOE/EIA-0573(97) (Washington, DC, report in preparation). For **other years**, EIA estimates based on unpublished analysis.

Figure 30



- The average annual rates of carbon dioxide emissions varied by sector during the past 25 years -- Residential, 0.7 percent; Commercial, 1.6 percent; Industrial, -0.04 percent; Transportation, 1.4 percent.

- Carbon dioxide emissions grew in all sectors during the past decade.

- Carbon dioxide emissions in the Industrial sector are still lower than they were in the 1970's. This is partly due to a shift in the structure of the U. S. industry from energy-intensive basic industries (steel and chemicals), towards more complex and less raw material-intensive products -- a shift that can be partly due to fuel switching and increasing energy efficiency.

- Carbon dioxide emissions in the Transportation sector were stabilized in the early 1980's by the increasing fuel efficiency of post-1980 model cars. However, as vehicle fuel efficiency gains have diminished, transportation emissions have resumed their growth.

Source: For **1990-1997**, Energy Information Administration, *Emissions of Greenhouse Gases in the United States 1997*, DOE/EIA-0573(97) (Washington, DC, report in preparation). For **other years**, EIA estimates based on unpublished analysis.

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Contacts

This report was prepared by the Energy Information Administration (EIA). General direction was provided by W. Calvin Kilgore, Director, Office of Energy Markets and End Use, cal.kilgore@eia.doe.gov. For specific information, please contact John Pearson, john.pearson@eia.doe.gov, or Henry Weigel, henry.weigel@eia.doe.gov.