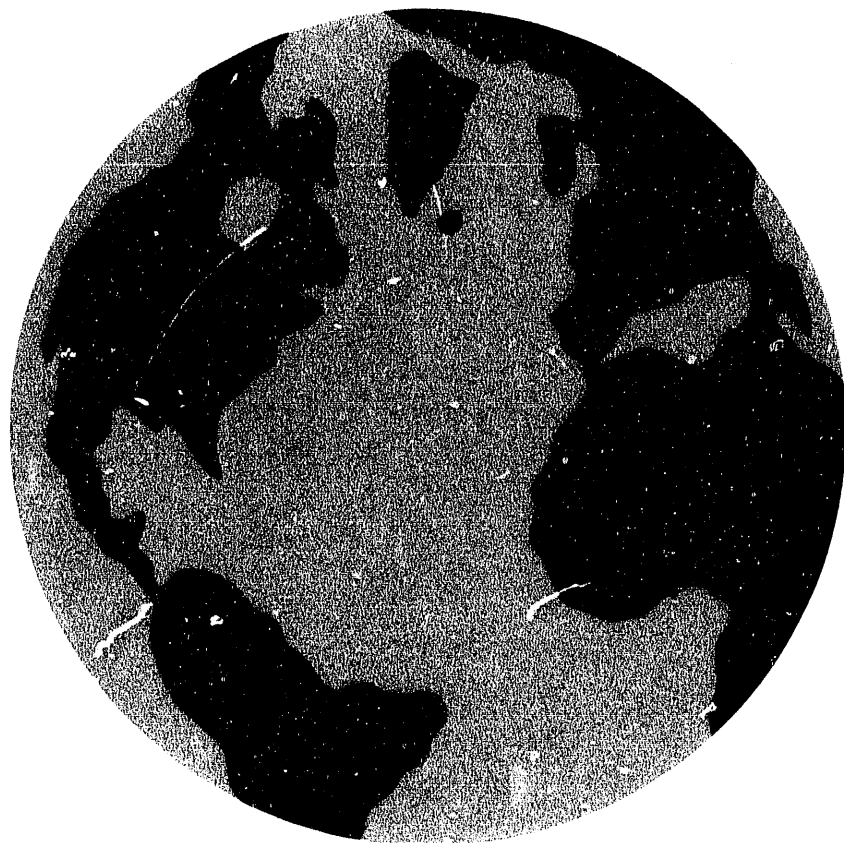


EIA Service Report

Indicators of Energy Efficiency: An International Comparison



Energy Information Administration

July 1990

Preface

This study was undertaken at the request of W. Henson Moore, Deputy Secretary of the Department of Energy. The purpose of this study is to examine energy intensity trends in the major industrialized countries and to explain differences in these trends. This Service Report documents the results of the analysis.

This Service Report was prepared by the Energy Information Administration's, Office of Energy Markets and End Use, under the direction of W. Calvin Kilgore. Information on the study can be had by contacting Mark Rodekohr, Director of the International and Contingency Information Division (202/586-1130), Derriel B. Cato, A. David Sandoval, and Lowell Feld of the Analysis Branch.

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Summary

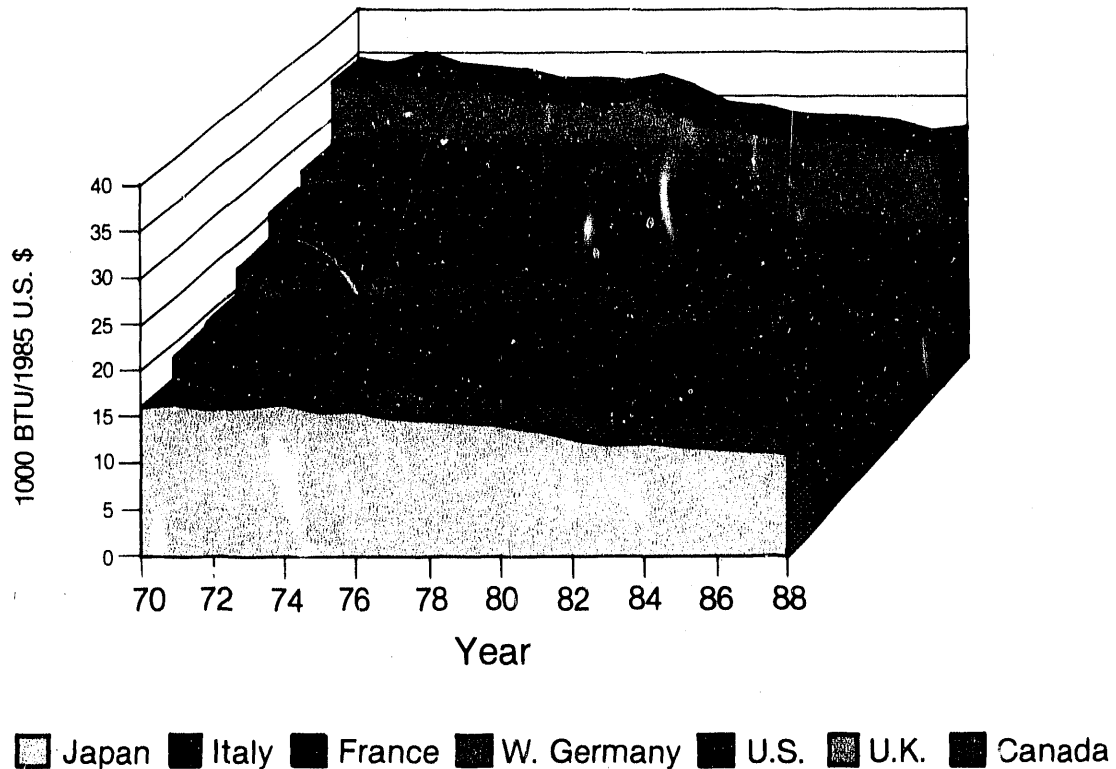
Indicators of Energy Efficiency: An International Comparison

The United States has long been accused of being energy inefficient based on a comparison of energy intensities among the industrialized countries. Energy intensity is commonly measured by computing the ratio of energy use per unit of Gross Domestic Product (GDP). This is not a true measure of efficiency, however, because it does not account for differences in the standard of living, differences in population densities, or other factors. After corrections are made to account for these factors, the United States often appears to be as efficient or more efficient than many of the other industrialized countries. In this analysis the industrialized economies considered are the Group of Seven (G7): the United States, Canada, Japan, France, Italy, West Germany, and the United Kingdom. Examination of the more detailed data which underlie the aggregate energy/GDP ratio concludes that:

- The United States energy/GDP ratio has declined an average of 2 percent per year since 1970, as much or more than in the other G-7 countries.
- While the United States uses more energy per unit of output in the industrial sector than most other G-7 countries, this is due in part to the development of large, very energy intensive, petrochemical, chemical, and primary metals industries. These industries were developed to exploit large, indigenous energy supplies. Energy intensity does not necessarily equate to energy efficiency.
- Despite a population five to ten times less densely concentrated than in many of the other G-7 countries, and distances that frequently make mass transit systems impractical, transportation energy use as a share of total energy use is only about 5 to 10 percentage points higher than that in the other G-7 countries.
- Even though gasoline prices in the United States are less than half of those in many of the other G-7 countries and United States emission and auto safety standards are much more demanding, new car fuel economy in the United States is now equal to that in all the other G-7 countries.
- After adjusting for differences in climate and household size (houses are larger in the United States than in most other G-7 countries), residential heating efficiency in the United States exceeds that of many of the other G-7 countries.

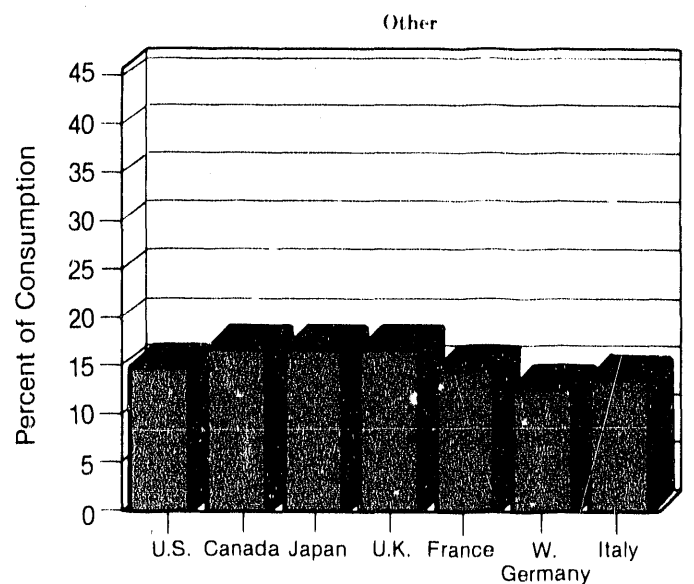
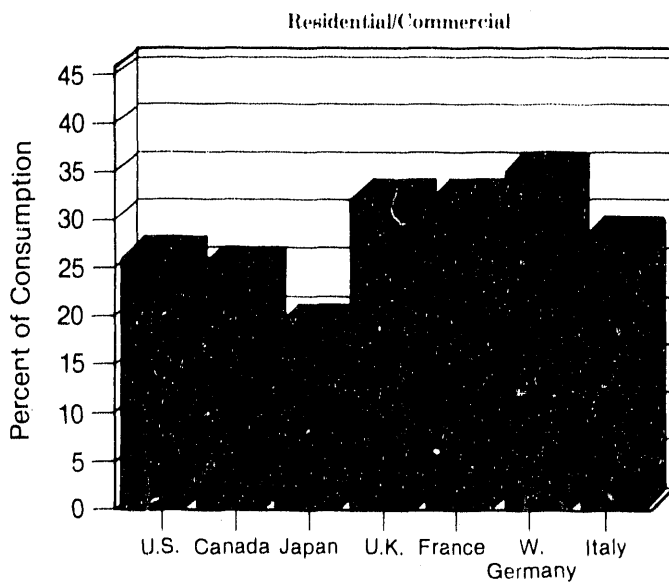
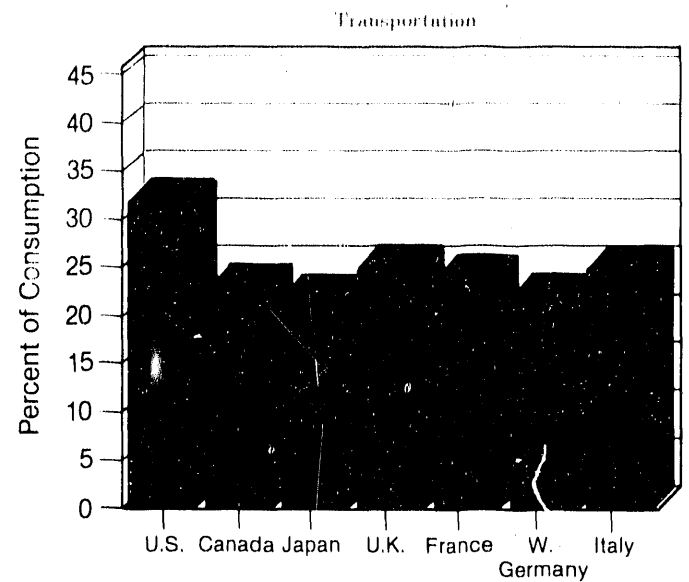
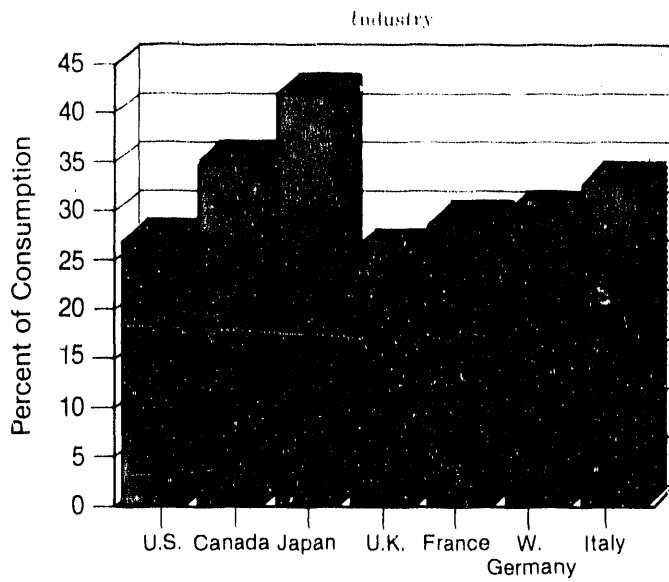
In summary, since 1970 the United States has improved the efficiency of energy use as much or more than have the other G-7 countries. Frequently, the United States is more efficient in its use of energy than are other G-7 countries. Many of the differences in energy use result from the fact that the United States has the comparative advantage of abundant indigenous energy supplies which have been used to develop large energy intensive but not necessarily inefficient petrochemical, chemical, and primary metals industries. The United States continues to hold this advantage, producing 50 percent more energy in 1988 than did all the remaining G-7 countries combined.

Energy Consumption per Unit of GDP



Total Energy Consumption per unit of GDP

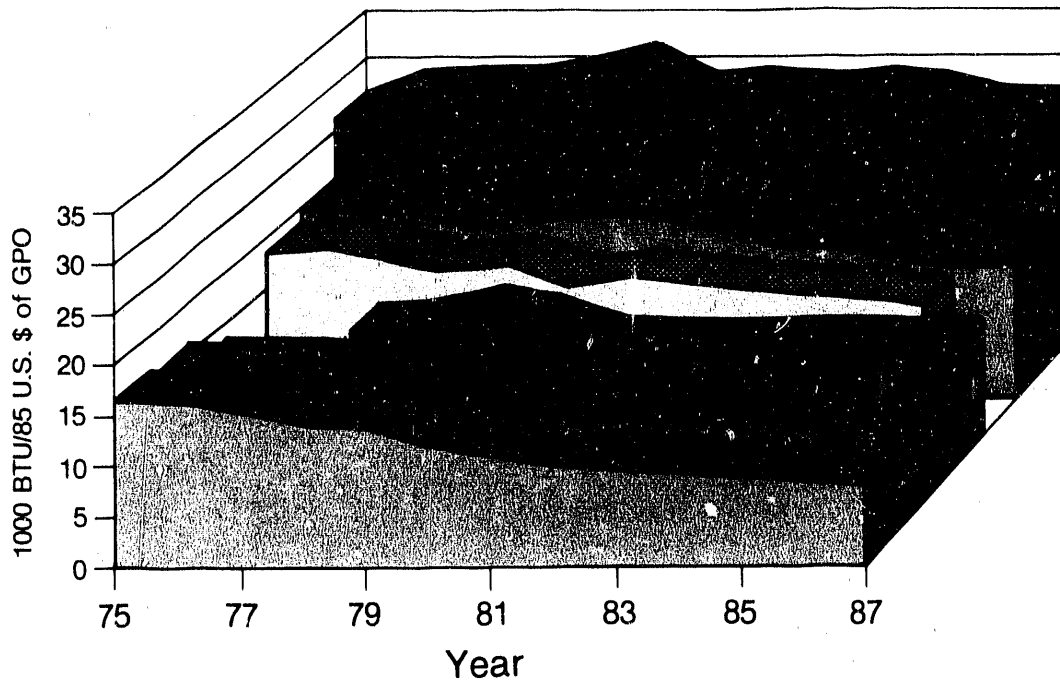
- Total energy consumption per unit of Gross Domestic Product(GDP) is one of the most common measures of "energy efficiency" used to make comparisons across countries. However, this aggregate measure is flawed because it does not account for differences in life styles, population density, industry mix, and other factors.
- An examination of the energy/GDP ratios for the Group of Seven countries (United States, Canada, Japan, France, Italy, West Germany, and the United Kingdom) shows that Canada uses the most energy per GDP dollar while the United Kingdom and United States are the next largest users of energy per GDP dollar. Canada is higher than most other countries because of its large share of energy generated from hydroelectric sources which is valued at a fossil fuel equivalent in international energy statistics.
- The United States has improved its energy/GDP ratio as fast or faster than the other countries since 1970, averaging an annual improvement of 2 percent per year.
- The remainder of this paper will discuss the reasons for the differences in energy efficiency across the G 7 countries.



Sectoral Energy Consumption

- Relative to the other G-7 countries, the United States does not have a high fraction of industrial energy use.
- However, the share of energy used in the transportation sector in the United States is much higher than that in the other G-7 countries because of its low population density and low gasoline price. Regardless of price, the spatial spread between cities and work and home will continue to require high levels of transportation fuel consumption in the United States and Canada.
- The share of energy use in the residential and commercial sector in the United States is among the lowest in the G-7.

Industrial Energy Intensity

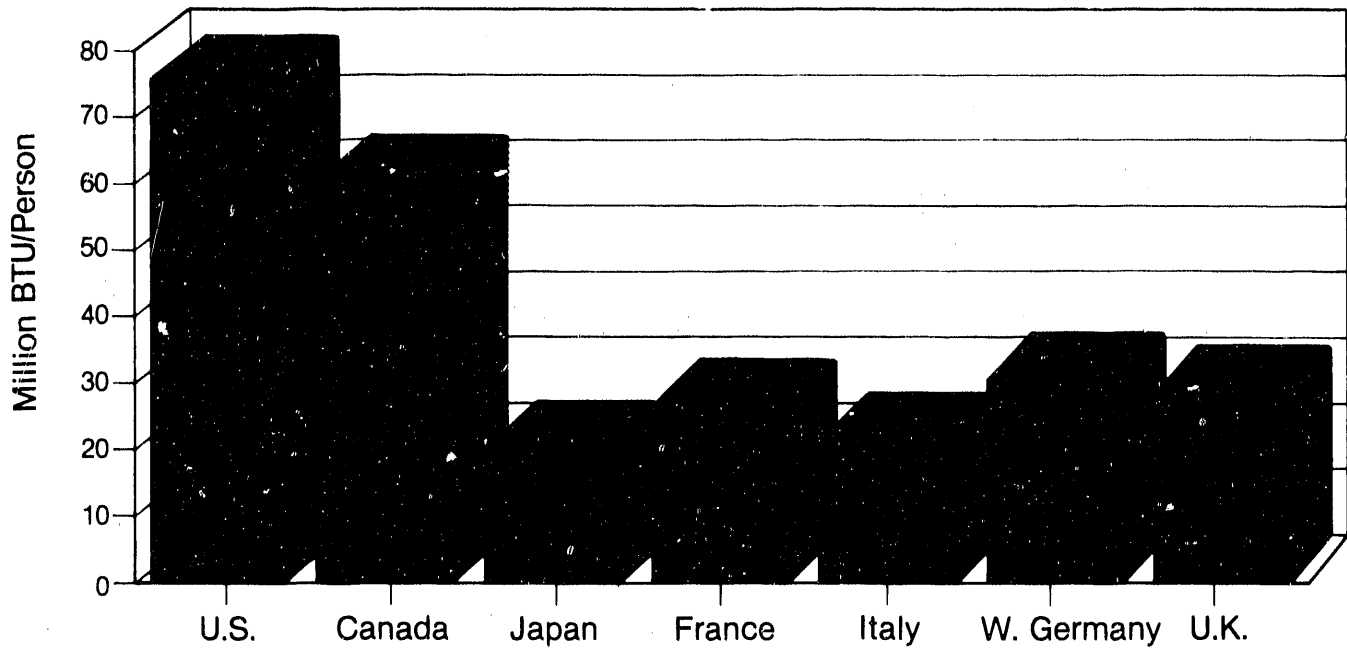


Japan
 Italy
 W. Germany
 France
 U.K.
 U.S.A.
 Canada

Industry Energy Intensity

- While the United States uses more energy per unit of output in the industrial sector than most of the G-7 countries, this reflects the large indigenous energy supplies in the United States and the development and use of an industrial sector that relies on these resources. For example, the United States developed a large petrochemical industry capable of using indigenous resources as inputs. This sector is very energy intensive.
- It is interesting to note that Canada, which is the other G-7 country with large energy, mineral, and other natural resources, also uses more energy per unit of output than most other G-7 countries. In contrast, the energy intensity per unit of output (gross product originating, GPO) in the manufacture and fabrication of items that use processed natural resources (non-raw materials manufacturing) varies little among the G-7.
- The rate of improvement in the industrial energy/GPO ratio in the United States has been greater than in most other G-7 countries, averaging close to 3 percent per year since 1975.

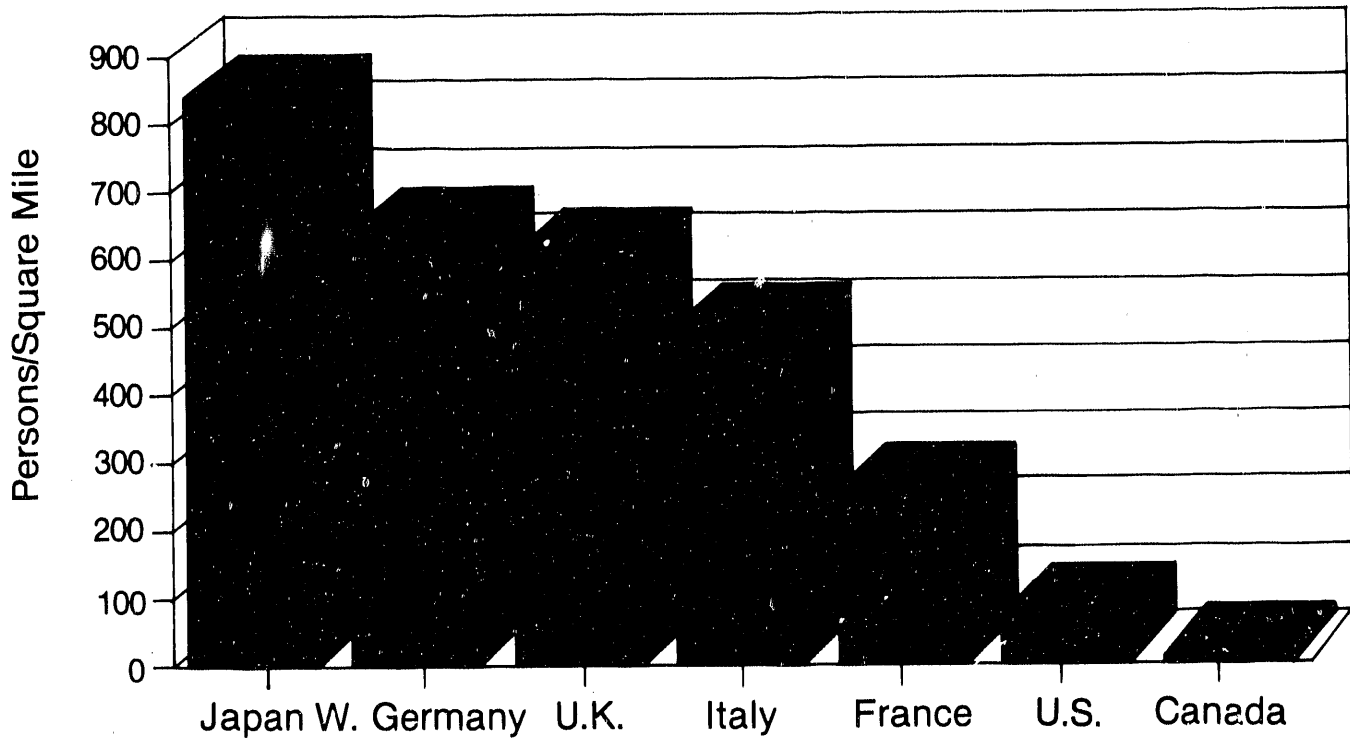
Transportation Energy Consumption Per Capita, 1987



Energy Consumption per Capita in Transportation

- Transportation energy use per capita in the United States and Canada is more than twice as much as the other G-7 countries due in large part to a much greater population density in the other G-7 countries.
- Great distances between population centers often make mass transit systems impractical in the United States and Canada.

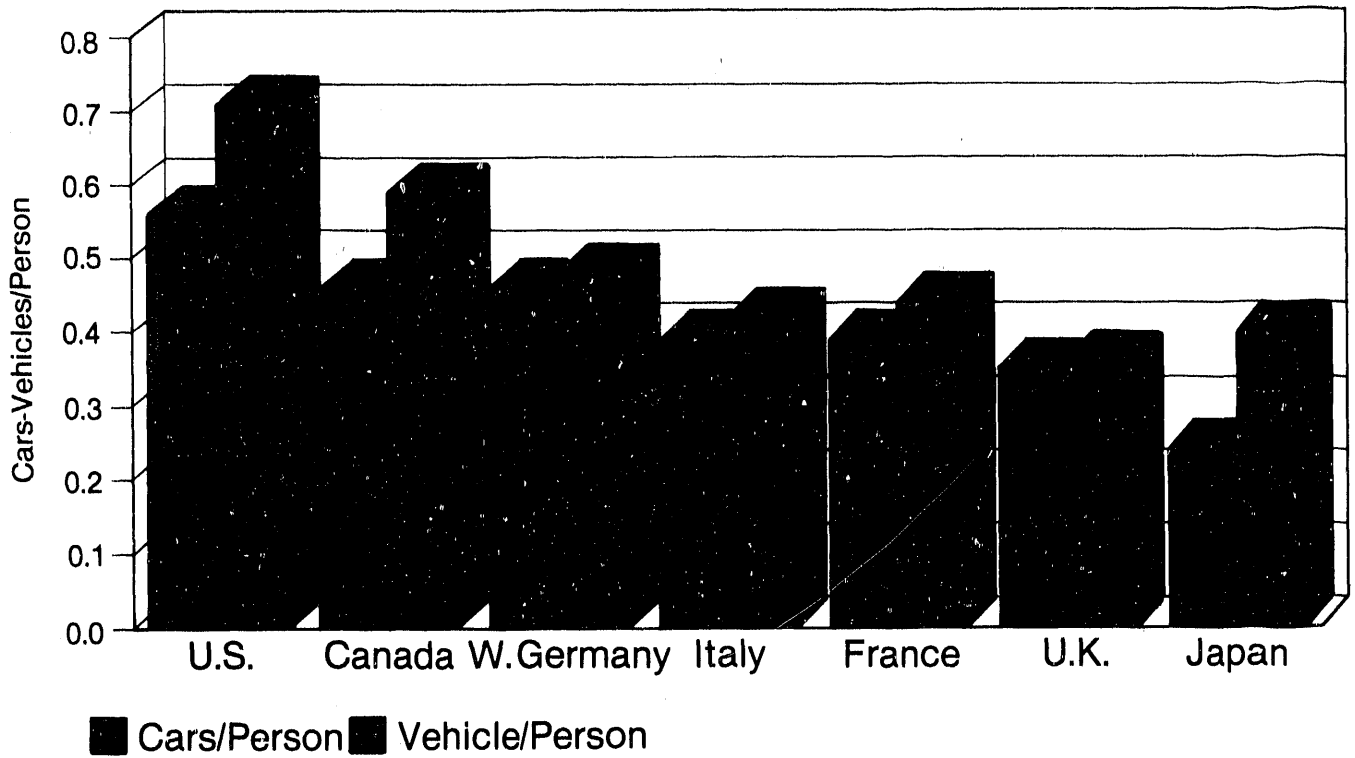
Population Density per Square Mile, 1988



Population Density per Square Mile

- The population density in the United States and Canada is 5 to 10 times less than in many of the G-7 countries.

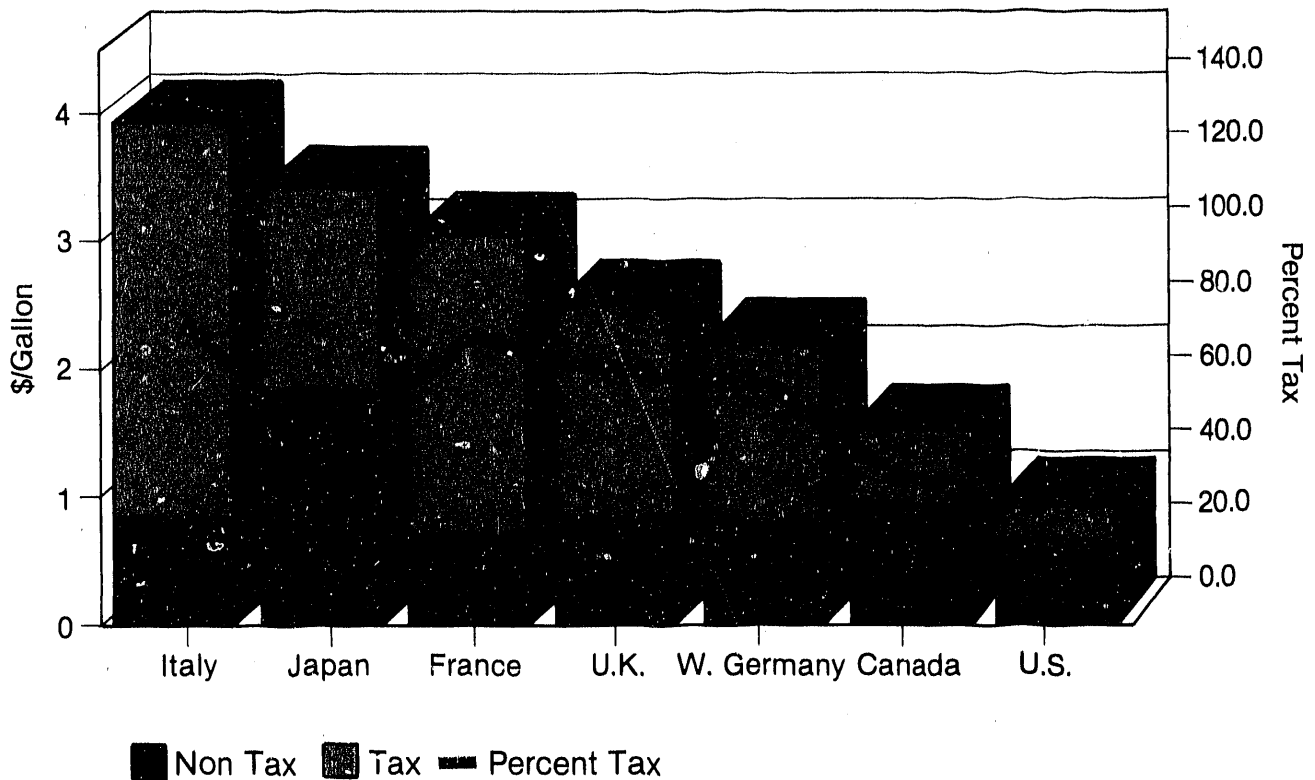
Vehicles and Cars per Person, 1988



Vehicles per Person

- Lower population densities (greater distances) generally result in both the United States and Canada having more automobiles per person than do the other G-7 countries.

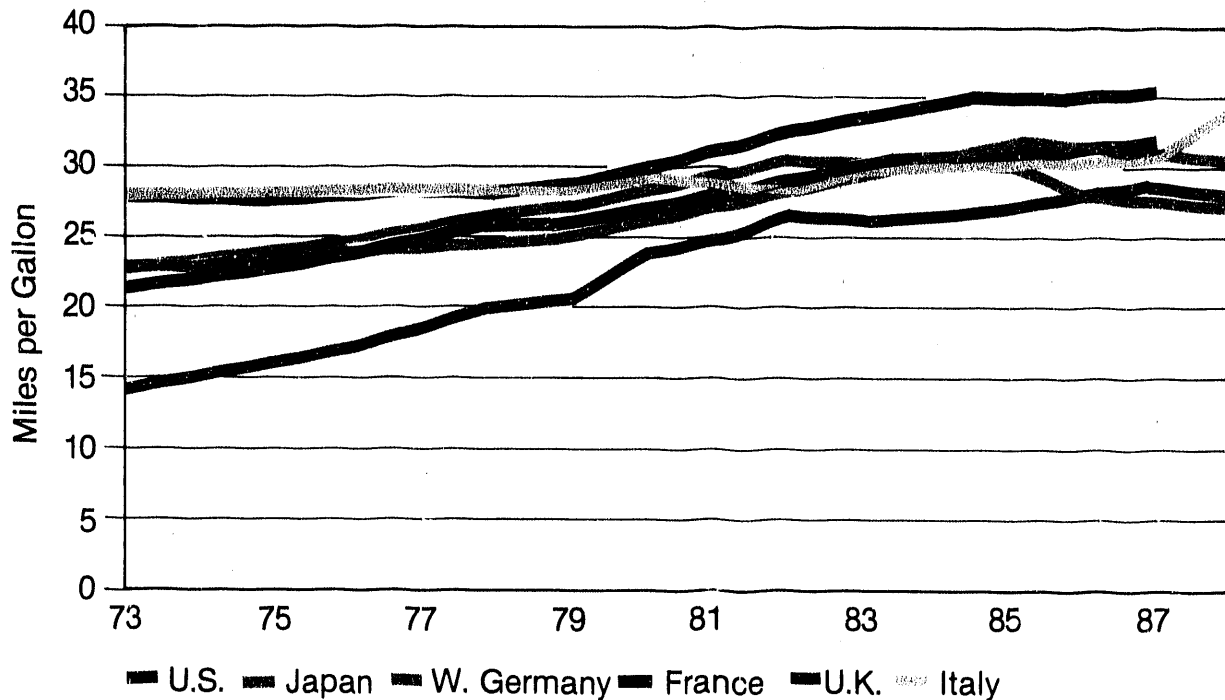
Gasoline Prices and Taxes, 1988



Gasoline Prices and Taxes

- Another reason for the greater transportation use in the United States is the relative low price of and taxes on gasoline. Prices in the United States are much less than those in most of the other G-7 countries. Large indigenous supplies of petroleum are usually associated with lower prices, as countries with large supplies exploit their comparative advantage.
- It is important to note that the tax portion of United States gasoline prices has increased from 11.3 percent in 1980 to 31.2 percent in 1988, while West Germany has increased its tax component 15.6 percentage points and Japan only 9.9 percentage points between 1980 and 1988.
- Gasoline taxes in the United States are end-user fees, earmarked for improvement of the transportation system, as opposed to supporting general revenues as in most of the other countries.

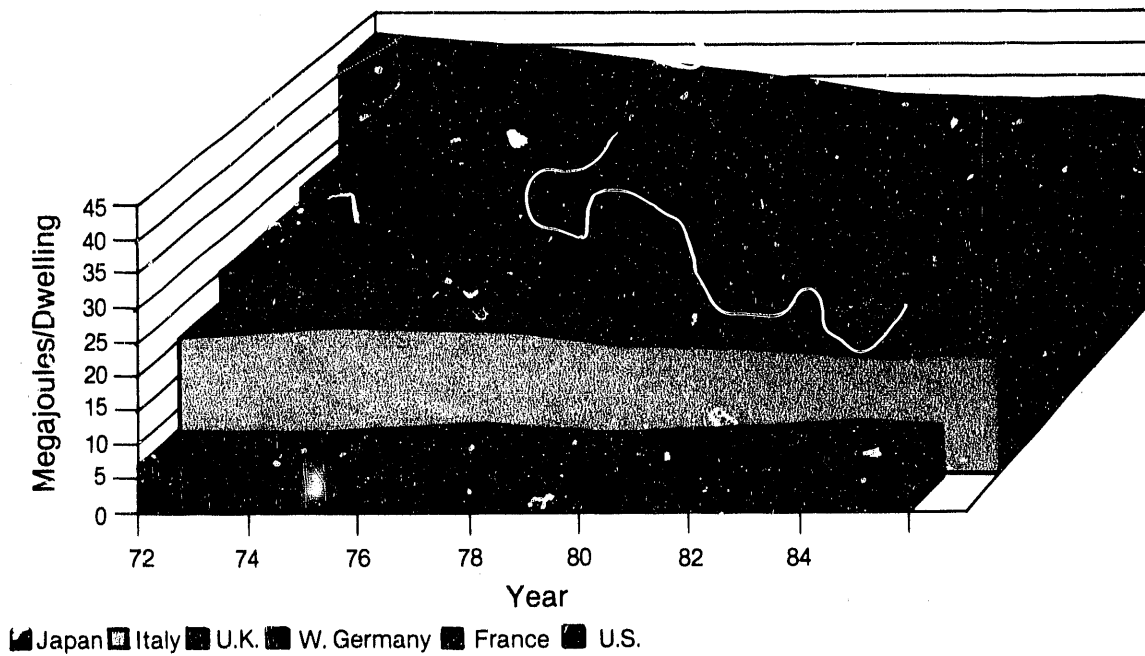
New Car Fuel Efficiency



New Car Fuel Efficiency

- New car fuel efficiencies in the United States are now roughly equivalent to those in the other G-7 countries, even though our gasoline prices are clearly far lower than prices in the other countries.
- Improvements in new car efficiencies in the United States and Canada have been far greater than those in the other G-7 countries. However, data for Canada are not available after 1985.
- In addition to comparatively low prices for gasoline, two other factors have caused adverse effects on U.S. automobile fuel efficiency, auto emission standards (particularly during the 1973-1985 period) and crash-avoidance standards that add weight.

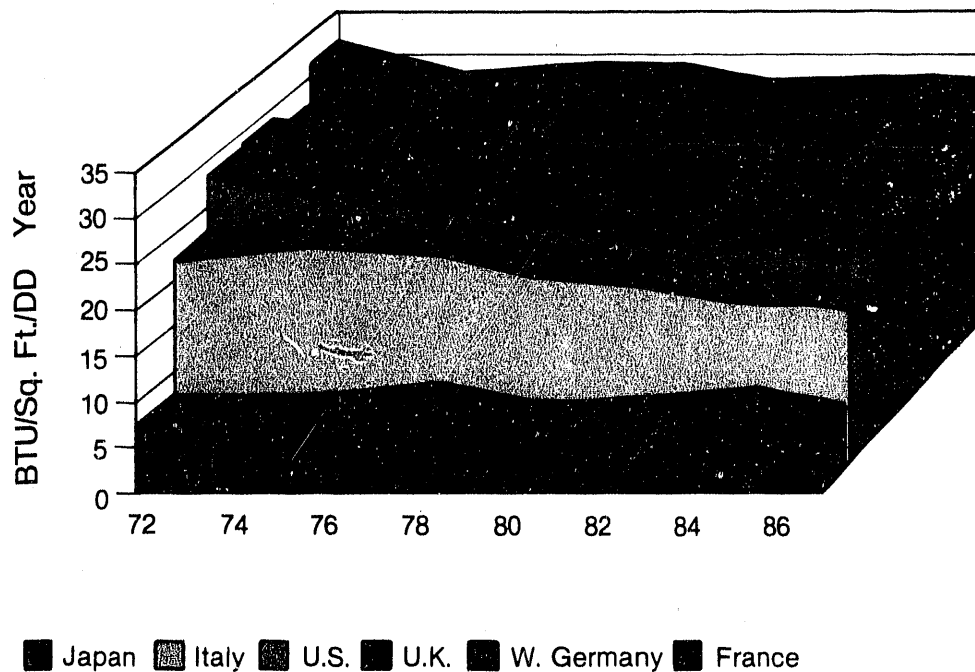
Heating Intensities: Dwellings (Climate Corrected)



Heating Intensities: Dwellings

- While energy use per dwelling, when corrected for differences in climate, is higher in the United States than for most other G-7 countries, it is now in the range of most other countries after having improved greatly since the early 1970's.
- Factors influencing standards of living, such as amount of living space and use of air conditioners, increase the intensity of energy use per dwelling in the United States.
- Comparable data for Canada are not available.

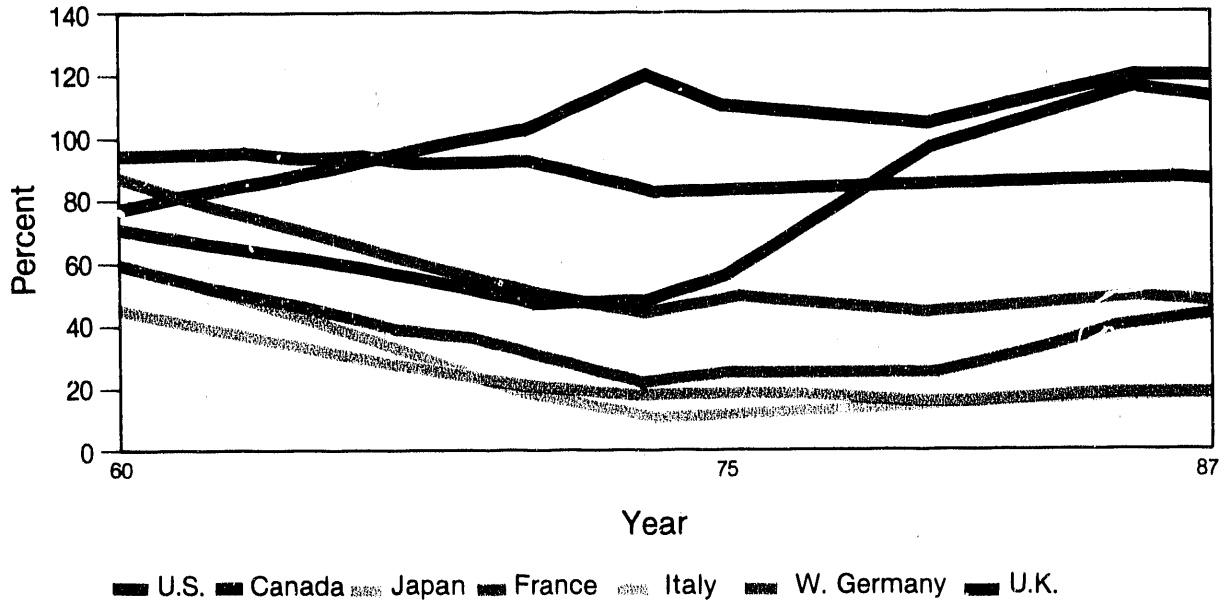
Heating Intensities: Floor Space (Climate Corrected)



Heating Intensities: Floor Space

- When corrected for differences in living space, the United States is among the most efficient of the G-7 countries. In other words, our energy use per square foot per degree day is much lower than for most other G-7 countries.
- The low figures for Japan are likely due to the relative lack of central heating and to their greater use of apartments and other multifamily dwellings when compared to other countries.
- Comparable data for Canada are not available.

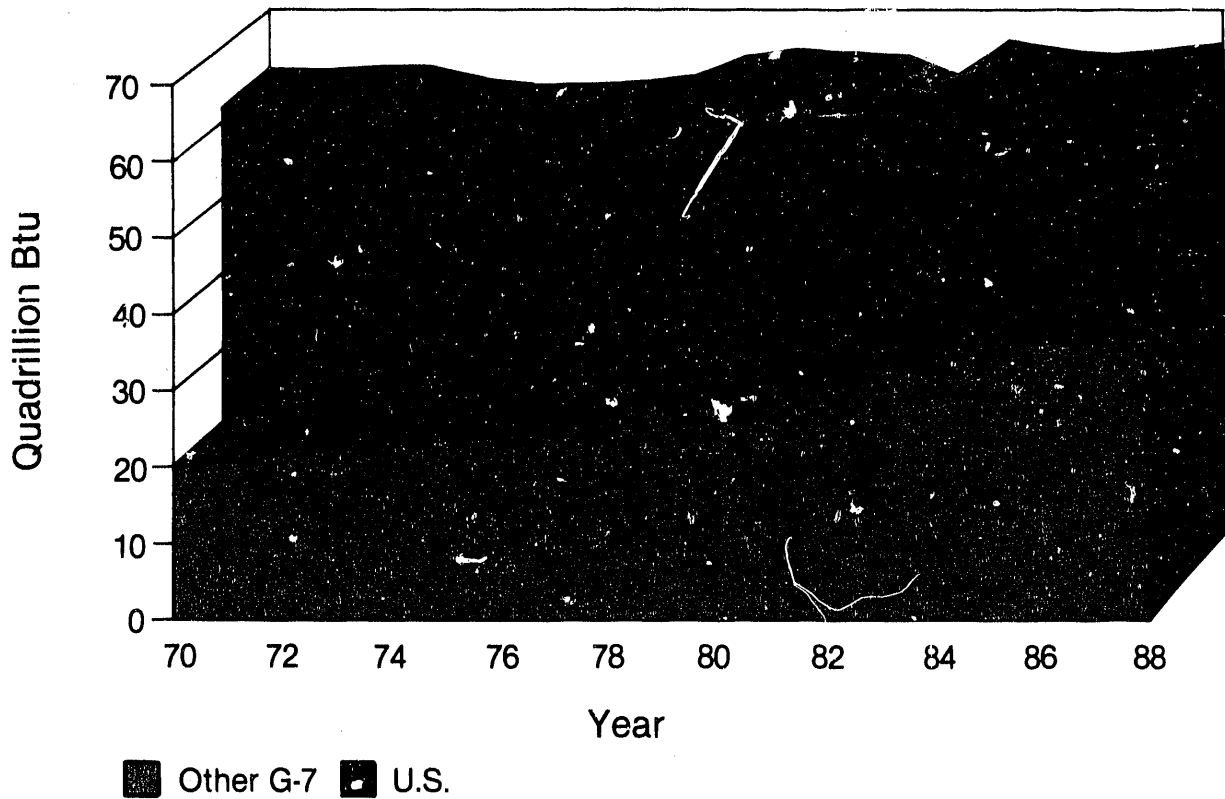
Energy Self Sufficiency (Production/Consumption)



Energy Self-Sufficiency

- One area often overlooked in the "energy efficiency" debate is the role of indigenous energy production. Countries with large indigenous resources use this comparative advantage and encourage energy intensive industries. This factor tends to make their energy/GDP ratio higher than countries with few energy resources.
- The United States, Canada, and more recently the United Kingdom have large indigenous energy resources relative to consumption. These resources have been growing in Canada and the United Kingdom, stable in the United States, and declining in most other G-7 countries.
- Domestic production, as a share of consumption in the United States, is almost double that for France and West Germany and more than 4 times that for Japan and Italy.

Total Energy Production



Total Energy Production

- In 1970, the United States produced 3 times as much energy as did all the other G-7 countries combined. By 1988, the United States still produced about 50 percent more energy than did the other G-7 countries combined.
- Interestingly, energy consumption per person has grown steadily in all G-7 countries between 1970 and 1988, except in the United States and the United Kingdom, where energy consumption per capita in 1988 was virtually the same as it was in 1970.

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