Energy Consumption

Energy Use

Think about how you use energy every day. You wake up to an alarm clock. You take a shower with water warmed by a hot water heater. You listen to music on the radio as you dress. You catch the bus to school. That's just the energy you use before you get to school! Every day, the average American uses about as much energy as is stored in about seven gallons of gasoline. Energy use is sometimes called energy consumption.

Who Uses Energy?

The U.S. Department of Energy divides energy users into different categories: **residential**, **commercial**, **industrial**, and **transportation**. These are called the sectors of the economy.

Residential and Commercial Sectors

Any place where people live is considered a residential building. Commercial buildings include offices, stores, hospitals, restaurants, and schools. Residential and commercial buildings are often grouped together because they use energy in the same ways—for heating and cooling, lighting, heating water, and operating appliances.

Together, homes and buildings consume almost 40 percent of the energy used in the United States today. In the last 30 years, Americans have reduced the amount of energy used in their homes and commercial buildings. We still heat and cool rooms, and heat hot water. We have more home and office machines than ever. Most of the energy savings have come from improvements in technology and in the ways the equipment is manufactured.

③Heating and Cooling

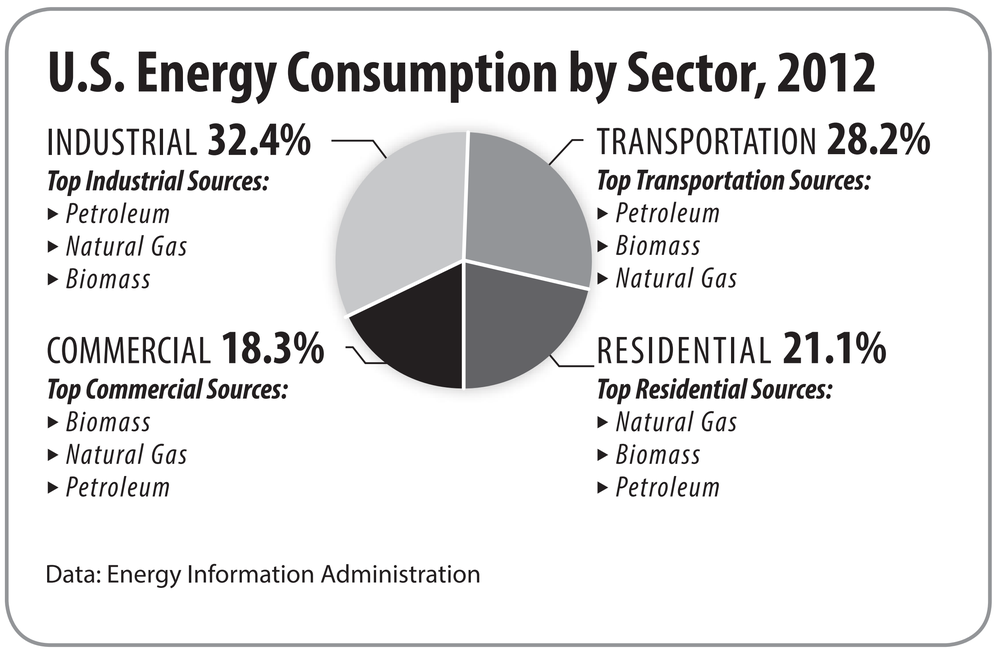
It takes a lot of energy to heat rooms in winter and cool them in summer. Fifty-six percent of the energy used in the average home is for heating and cooling rooms. The three fuels used most often for heating are natural gas, electricity, and heating oil. Today, more than half the nation's homes use natural gas for heating.

Most natural gas furnaces in the 1970s and 1980s were about 60 percent efficient. That means they converted 60 percent of the energy in the natural gas into usable heat. New gas furnaces are designed to be up to 98 percent efficient.

The second leading fuel for home heating is electricity. Electricity also provides almost all of the energy used for air conditioning. The efficiency of heat pumps and air conditioners has increased more than 50 percent in the last 35 years.

Heating oil is the third leading fuel used for home heating. In 1973, the average home used 1,300 gallons of oil a year. Today, that figure is about 550 gallons, a significant decrease. New oil furnaces burn oil more cleanly and operate more efficiently.

In the future, we may see more use of renewable energy sources, such as geothermal and solar energy, to heat and cool our homes and workspaces.



③Lighting

Homes and commercial buildings also use energy for lighting. The average home spends six percent of its energy bills on lighting. Schools, stores, and businesses use about 20 percent of their energy for lighting. Most commercial buildings use fluorescent lighting. It costs more to install, but it uses a lot less energy to produce the same amount of light.

Many homes still use the type of light bulb invented by Thomas Edison over 100 years ago. These **incandescent bulbs** are not very efficient. Only about 10 percent of the electricity they consume is converted into light. The other 90 percent is converted to heat.

Due to the Energy Independence and Security Act of 2007, traditional, inefficient incandescent light bulbs are being phased out of use in the U.S. over the next few years. Consumers can choose several types of more efficient light bulbs as replacements. Energy-saving incandescent, or **halogen**, bulbs are more expensive than traditional incandescent, but use 25 percent less energy and last three times as long.

Compact fluorescent light bulbs (CFLs) can be used in light fixtures throughout homes. Many people think they cost too much to buy (about $3 to $10 each), but they actually cost less overall because they last longer and use less energy than incandescent bulbs.

Even more efficient than CFLs, **light emitting diodes (LEDs)** are available. They are still expensive in comparison, but costs will decrease as they become more widely used.

③Appliances

Over the last 100 years, **appliances** have changed the way we spend our time at home. Chores that used to take hours can now be done in minutes by using electricity instead of human energy. In 1990, Congress passed the National Appliance Energy Conservation Act, which requires appliances to meet strict energy efficiency standards. As a result of this Act, home appliances have become more energy efficient. Water heaters, refrigerators, clothes washers, and dryers all use much less energy today than they did 25 years ago.

③Appliance Efficiency Ratings

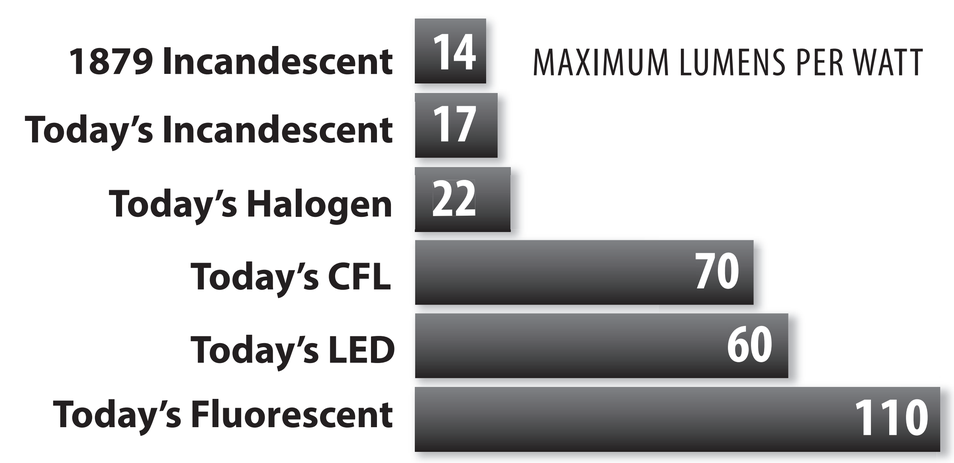
When you buy an appliance, you should pay attention to the yellow **EnergyGuide label** on every appliance. This label tells you the **Energy Efficiency Ratio (EER)** of the appliance. The EER tells how much it costs to operate the appliance.

③Payback Period

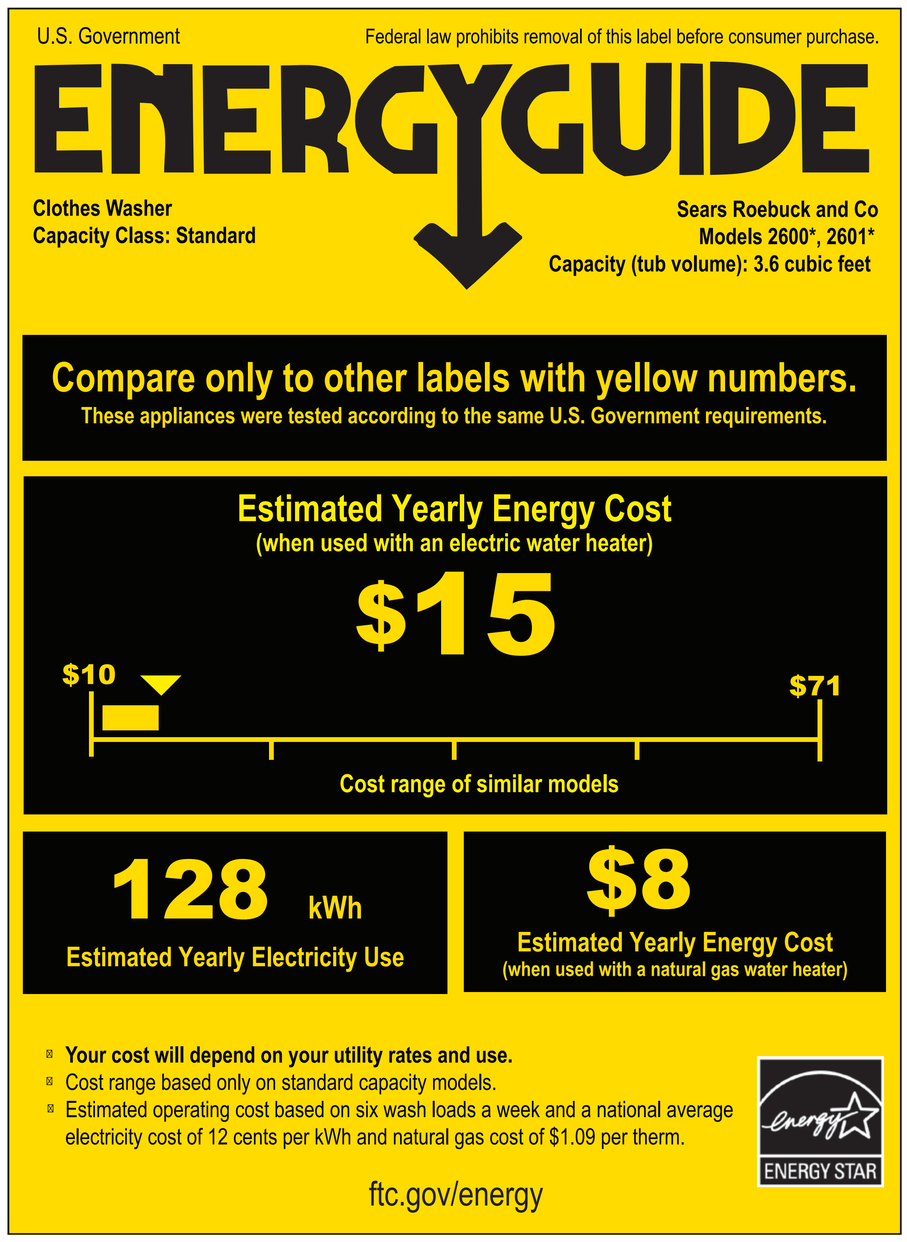
Whether you buy a furnace, hot water heater, refrigerator, or other home appliance, you must choose the best bargain. Since most high-efficiency systems and appliances cost more than less efficient ones, you have to know how much it will cost to operate the appliance each year and how many years you can expect to use it. The **payback period** is the amount of time you must use a system or appliance before you begin to benefit from energy savings.

For example, if you buy an efficient refrigerator that costs $100 more, but uses $20 less electricity each year, you would begin saving money after five years. Your payback period would be five years. Since refrigerators usually last ten years, you would save $100 over the life of the appliance and save natural resources.

Lighting Efficiency



ENERGYGUIDE LABEL

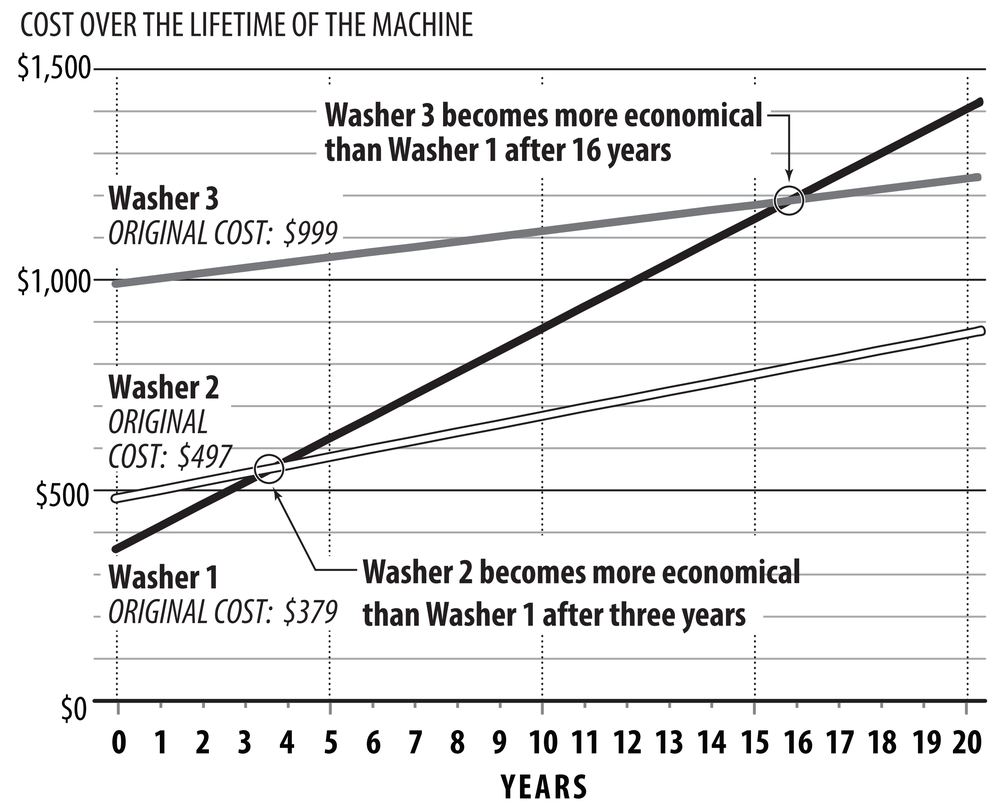


Washing Machine Payback Period

Spending a little bit more money on an energy efficient appliance could save you several hundred dollars over the lifetime of the product. The payback period could be shorter than you think!

	WASHER 1	WASHER 2	WASHER 3
Original Cost	$379	$497	$999
Estimated Annual Electricity Use	427 kWh	160 kWh	102 kWh
Price of Electricity (per kWh)	$0.12	$0.12	$0.12
Operating Cost per Year	$51.24	$19.20	$12.24

Data: NEED analysis of washing machine EnergyGuide labels



Energy Consumption

Industrial Sector

The United States is a highly industrialized country. We use a lot of energy. Today, the industrial sector uses 32.4 percent of the nation's energy. Every industry uses energy, but six energy-intensive industries use most of the energy consumed by the industrial sector. However, advanced technologies allow industries to do more with less energy.

③Petroleum Refining

The United States uses more petroleum than any other energy source. Petroleum provides the U.S. with about 36 percent of the energy we use each year. Petroleum can't be used as it comes out of the ground. It must be refined before it can be used.

Oil refineries use a lot of energy to convert crude oil into gasoline, diesel fuel, aviation fuel, heating oil, chemicals, and other products. About a quarter of the energy used by the industrial sector was for refining petroleum. Refineries today use about 30 percent less energy than they did in the 1970s, but rising fuel costs provide a challenge in maintaining reductions.

③Steel Manufacturing

The steel industry uses energy to turn iron ore and scrap metal into steel. Hundreds of the products we use every day are made of steel. It is a very hard, durable metal and it must be heated to very high temperatures to manufacture it. Producing those high temperatures takes a lot of energy. The cost of energy in the steel industry is 15 percent of the total cost of making the steel. Most of this energy comes from coal and natural gas, or electricity generated from those sources.

Since 1990, the steel industry has reduced its energy consumption by 30 percent per ton of steel. New technology has made steel stronger so that less steel is needed for many uses. For example, the Willis Tower, formerly the Sears Tower, in Chicago could be built today using 35 percent less steel.

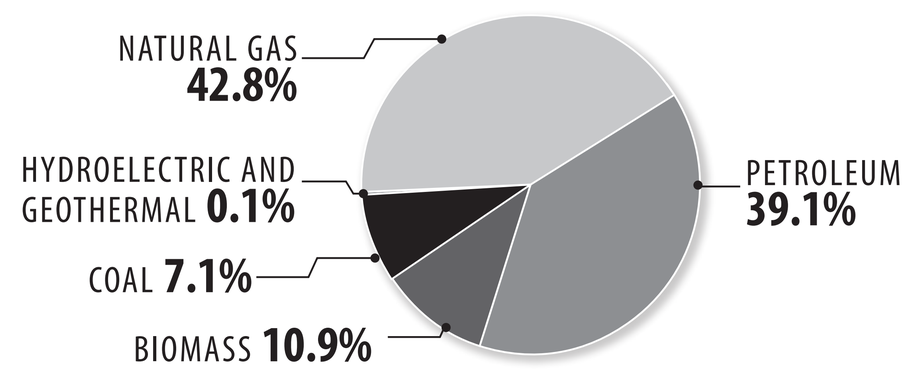
The use of recycled steel also saves energy. It requires 75 percent less energy to recycle steel than to make it from iron ore. Today, two-thirds of new steel is made from recycled scrap, making steel the nation's leading recycled product.

③Aluminum Manufacturing

Aluminum is a very light-weight, versatile metal. We use aluminum to make soft drink cans, building materials, car parts, and many other products.

It takes huge amounts of electricity to make aluminum from **bauxite,** or aluminum ore. The cost for this energy is about one-third the total cost of manufacturing aluminum. Today, it takes 20 percent less energy to produce a pound of aluminum than it did 20 years ago. Using recycled aluminum requires about 95 percent less energy than converting bauxite into metal.

U.S. Industrial Energy Consumption by Source, 2012



Data: Energy Information Administration

PETROLEUM REFINERY

Image courtesy of BP

STEEL PRODUCTION

③Paper Manufacturing

The United States uses enormous amounts of paper every day—newspapers, books, bags, and boxes are all made of paper. Energy is used in every step of paper making. Energy is used to chop, grind, and cook the wood into pulp. More energy is used to roll and dry the pulp into paper.

The paper and pulp industry uses 30 percent less fossil fuels today than in the past, mainly because of better technology and increased use of wood waste to generate electricity on-site. Many industries have lowered energy use by using recycled materials. In the paper and pulp industry, it is not cheaper to use recycled paper because it costs money to collect, sort, and process the waste paper.

Recycling has other benefits, though. It reduces the amount of paper in landfills and means fewer trees must be cut.

③Chemical Manufacturing

Chemicals are an important part of our lives. We use chemicals in our medicines, cleaning products, fertilizers and plastics, as well as in many of our foods. The U.S. has the world's largest chemical industry. Chemical manufacturing uses almost one-quarter of the energy consumed by the industrial sector.

The chemical industry uses energy in two ways. It uses coal, oil, and natural gas to power the machinery to make the chemicals. It also uses petroleum, propane, and natural gas as major sources of **hydrocarbons** from which the chemicals are made.

New technology has increased energy efficiency in the chemical industry by more than 50 percent in the last 35 years.

③Cement Manufacturing

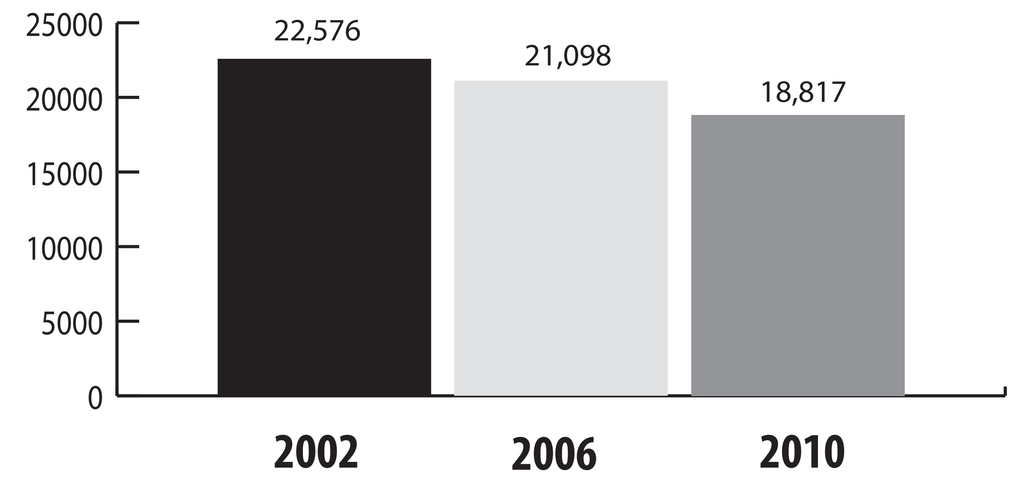
Some people think the United States is becoming a nation of concrete. New roads and buildings are being built everywhere, every day. We use lots of concrete.

Concrete is made from cement, water, and crushed stone. A lot of energy is used in making cement. The process requires extremely high temperatures—up to 1,800 degrees Celsius (3,400°F).

Cement plants have reduced their energy consumption by more than one-third using innovative waste-to-energy programs. Many of the cement plants in the U.S. use waste fuels to meet between 20 and 70 percent of their energy needs. These wastes, such as printing inks, dry cleaning fluids, and used tires, have high energy content. For example, the energy content of one pound of tires is greater than one pound of coal. This industry is using energy that would otherwise be wasted in a landfill.

Reduction in Manufacturing Energy Use, 2002 - 2010

With advancements in technology and increased efficiency and conservation measures, the total U.S. manufacturing energy consumption decreased by 17% from 2002-2010.



Data: Energy Information Administration

PAPER RECYCLING

Image courtesy of National Renewable Energy Laboratory

Energy Consumption

Transportation Sector

The United States is a big country. The transportation sector uses about twenty-eight percent of the energy supply to move people and goods from one place to another.

③The Automobile

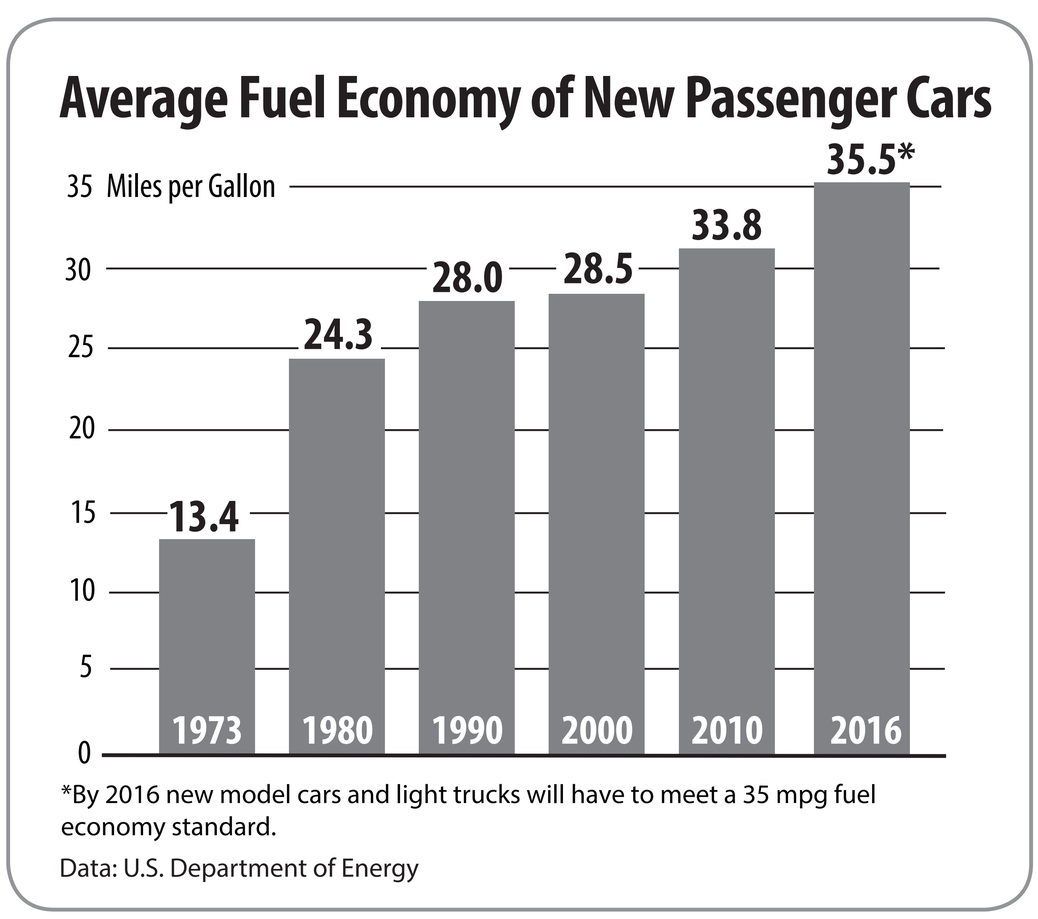
Americans love automobiles. We love to drive them. We don't want anyone telling us what kind of car to buy or how much to drive it. Forty years ago, most Americans drove big cars that used a lot of gas. The gas shortages of the 1970s didn't change Americans' driving habits much. What did change was the way automobiles were built. Automakers began making cars smaller and lighter. They built smaller and more efficient engines.

One reason for the changes was that the government passed laws requiring automobiles to get better gas mileage. With new technologies, cars now travel more miles on each gallon of gas. Today, new passenger cars get an average of 35 miles per gallon. If automakers hadn't made these changes, we would be using 30 percent more fuel than we do today.

In 1973, there were 125 million vehicles on the road. Today, there are more than 244 million vehicles. There are more cars being driven more miles than ever before. Forty-nine percent of the passenger vehicles sold in 2012 were sport utility vehicles and light trucks. With the recent fluctuations in fuel prices, however, demand for these big vehicles has dropped, while demand for hybrids and other fuel efficient vehicles has increased.

③Commercial Transportation

Passenger cars and light trucks consume about two-thirds of the fuel we use for transportation. Commercial vehicles consume the rest. These vehicles—trains, trucks, buses, and planes—carry people and products all across this vast country. Commercial vehicles have also become more fuel efficient in the last 40 years.



③**Trucks** use more fuel than any other commercial vehicle. Almost all products are, at some point, transported by truck. Trucks are big and don't get good gas mileage. They usually have diesel engines and can travel farther on a gallon of diesel fuel than they could on a gallon of gasoline.

③**Trains** carry most of the freight between cities. In the last 30 years, trains have improved their fuel efficiency by 55 percent. Trains are lighter and stronger and new locomotives are more efficient.

③**Airplanes** move people and products all over the country. In 2011, more than 700 million passengers flew on planes. Airlines are twice as efficient today as they were 30 years ago. Fuel is one of the biggest operating costs for airlines. Making planes more energy efficient is very important to airlines.

③**Mass Transit** is public transportation for moving people on buses, trains, light rail, and subways. In 1970, nine percent of workers who commuted to work used public transit systems. Today, only five percent travel by mass transit. Why is this? One reason is that Americans love their cars. Another is that people have moved from cities to suburbs and many businesses have followed. Most mass transit systems were designed to move people around cities or from suburbs to cities. Very few systems move people from suburb to suburb.

Most people worry about air pollution from auto exhaust. They also worry about traffic congestion. Congress has passed legislation supporting public transit. If public transit is convenient and the cost is reasonable, people may leave their cars at home.

TRAFFIC CONGESTION