



# 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 seven gallons of gasoline. Energy use is sometimes called energy consumption.

## Who Uses Energy?

The U.S. Department of Energy divides energy users into four groups: residential, commercial, industrial, and transportation. These groups 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 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 more than a third 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.

### ■ Heating and Cooling

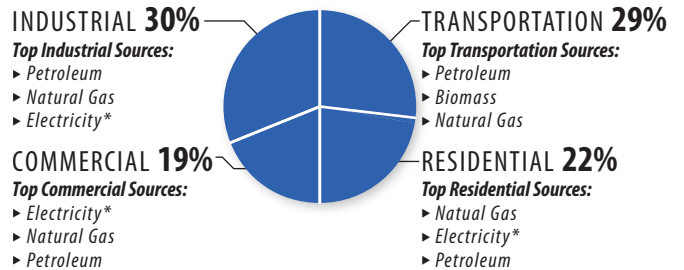
It takes a lot of energy to heat rooms in winter and cool them in summer. Forty-three percent of the energy used in the average home is for heating and cooling rooms. The three fuels used most often for heating are natural gas, electricity, and heating oil. Today, more than half the nation's homes use 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 30 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 660 gallons, a significant decrease. New oil furnaces burn oil more cleanly and operate more efficiently.

## U.S. Energy Consumption by Sector, 2009



\*Electricity is an energy carrier, not a primary energy source  
Note: Figures are rounded.  
Data: Energy Information Administration

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.

### ■ Lighting

Homes and commercial buildings also use energy for lighting. The average home spends 11 percent of its electric bill for lighting. Schools, stores, and businesses use about 38 percent of their electricity 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.

Most 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.

**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 CFL light bulbs, **light emitting diodes (LEDs)** are starting to become available. They are still quite expensive, but costs will decrease as they become more widely adopted.

### ■ Appliances

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.

### Appliance 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 Rating (EER) of the appliance. The EER tells how much it costs to operate the appliance.

### Payback Period

Whether you buy a furnace, hot water heater, 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

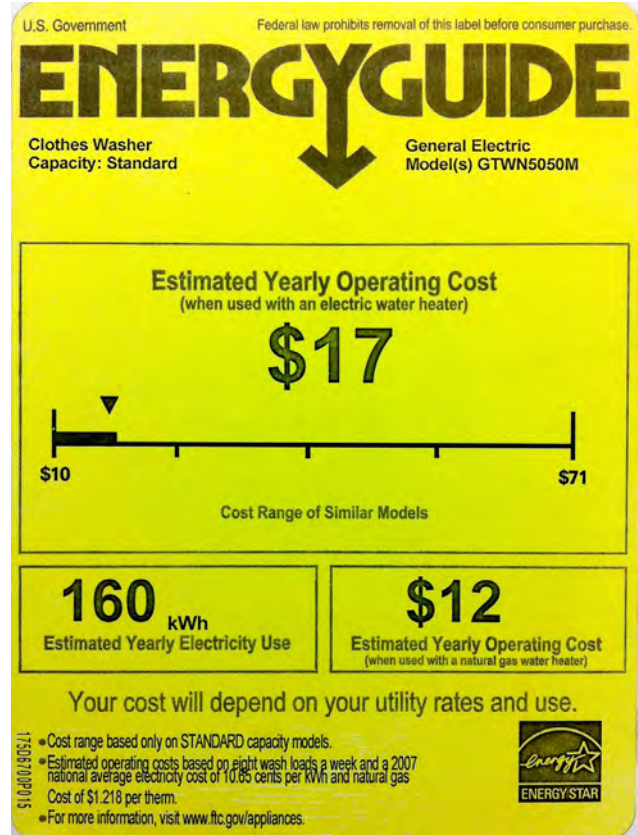
1879 Incandescent **14** LUMENS PER WATT

Today's Incandescent **14**

Today's CFL and LED **66**

Today's T8 Fluorescent **92**

### ENERGYGUIDE LABEL



### Washing Machine Payback Period

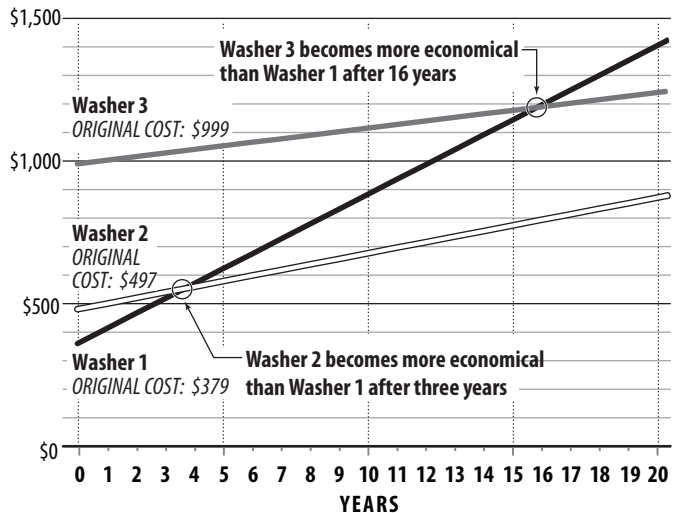
Spending a little bit more money on an energy efficient appliance could save you several hundred dollars over the lifetime of the product. The payback period could be shorter than you think!



|                                  | 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

### COST OVER THE LIFETIME OF THE MACHINE





# Energy Consumption

## Industrial Sector

The United States is a highly industrialized country. We use a lot of energy. Today, the industrial sector uses 30 percent of the nation's energy. Since 1973, the **industrial sector** has grown by two-thirds, but has used only 15 percent more energy to fuel that growth. Every industry uses energy, but six energy-intensive industries use most of the energy consumed by the industrial sector.

### ▪ Petroleum Refining

The United States uses more petroleum than any other energy source. Petroleum provides the U.S. with about 37 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, heating oil, chemicals, and other products. Almost half of a refinery's operating costs (43 percent) is for energy. Refineries today use about 30 percent less energy than they did in 1973.

### ▪ Steel 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 to 20 percent of the total cost of making the steel. Most of this energy comes from coal, or electricity generated from coal.

Since 1975, the steel industry has reduced its energy consumption by 45 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.

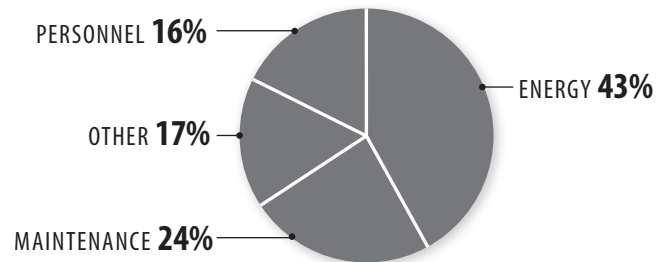
The use of recycled steel also saves energy. It requires 33 percent less energy to recycle steel than to make it from iron ore. Today, two-thirds of new steel is made from recycled scrap, making steel the nation's leading recycled product.

### ▪ Aluminum 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. The U.S. is the world's largest consumer of aluminum.

It takes huge amounts of electricity to make aluminum from bauxite, or aluminum ore. Today, it takes 58 percent less energy to produce a pound of aluminum than it did 40 years ago. Using recycled aluminum requires about 95 percent less energy than converting bauxite into metal. In 2008, about one-third of the supply for aluminum production came from recycled materials.

## U.S. Oil Refinery Operating Expenses



Data: Energy Information Administration

## PETROLEUM REFINERY



Image courtesy of BP

## STEEL PRODUCTION



### ▪ Paper Manufacturing

The United States uses enormous amounts of paper every day—newspapers, books, bags, and boxes are all made of paper. In fact, the U.S. is the world's leading producer and consumer of paper and paper products.

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. In 1973, the amount of energy needed to make one ream (500 sheets) of copy paper was equal to 3.7 gallons of gasoline.

Today, with advanced technologies, the energy used to make the same amount of paper would equal just two gallons of gasoline.

The paper and pulp industry uses 42 percent less energy today, 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.

### ▪ Chemical 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 30 percent 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 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.

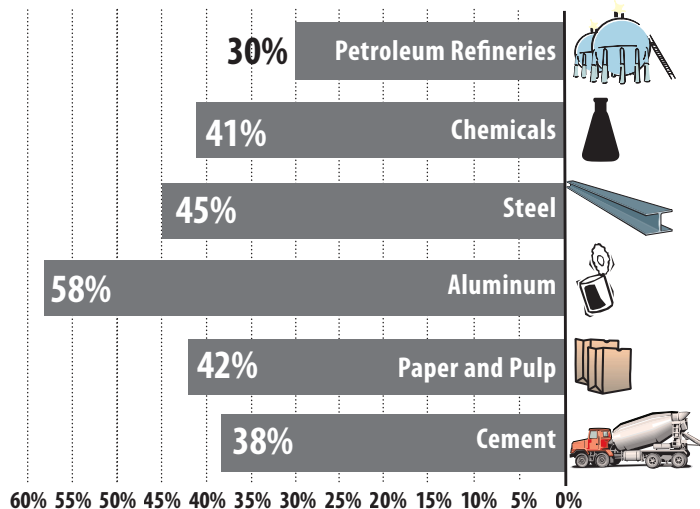
### ▪ Cement Manufacturing

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 3,500 degrees Fahrenheit.

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 Energy Use, 1975 to Today



Data: U.S. Department of Energy, American Chemistry Council, Portland Cement Association

### PAPER RECYCLING



Image courtesy of National Renewable Energy Laboratory



# Energy Consumption

## Transportation Sector

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

### ▪ The 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 33 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 102 million cars on the road. Today, there are more than 137 million cars. There are more cars being driven more miles than ever before. Forty-eight percent of the passenger vehicles sold in 2009 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.

### ▪ Commercial 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.

▪ **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 have diesel engines and can travel farther on a gallon of diesel fuel than they could on a gallon of gasoline.

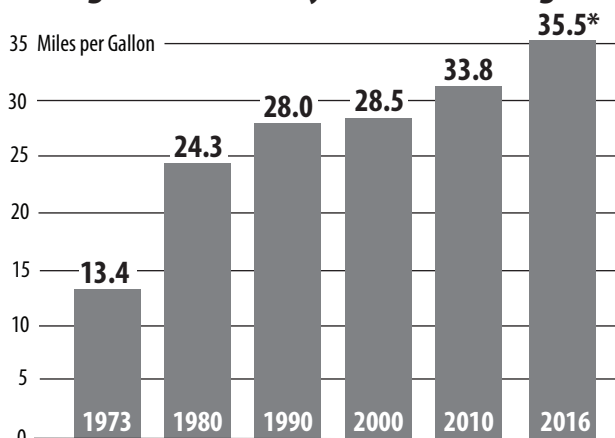
▪ **Trains** carry most of the freight between cities. In the last 30 years, trains have improved their fuel efficiency by 52 percent. Trains are lighter and stronger and new locomotives are more efficient.

▪ **Airplanes** move people and products all over the country. In 2009, more than 800 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.

▪ **Mass Transit** is public transportation for moving people on buses, trains, light rail, and subways. Today, there are about eight billion trips made on public transit systems. That sounds like a lot, but it is less than the number of trips made in 1970. 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.

### Average Fuel Economy of New Passenger Cars



\*By 2016 new model cars and light trucks will have to meet a 35 mpg fuel economy standard.

Data: U.S. Department of Energy

### TRAFFIC CONGESTION

