INVESTIGATION

25

Personal Energy Use Audit

Quantitative

PURPOSE

- Record and calculate approximate personal energy use in the home today
- Compare the amounts, by-products, and dollar costs of competing fuels that are necessary to support personal energy consumption

INTRODUCTION

Electrical consumption has gone up in the United States over the last 50 years for a number of reasons, including increased per capita demand and commercial and industrial demand from economic expansion. While the number of Americans grew by 87 percent from 1950 through 2000 (from under 150 million to almost 280 million), their energy consumption expanded by a much greater 194 percent.

At the same time, some traditional sources of fuel for electrical generation have stagnated or even fallen. In the energy mix today, coal is the dominant fossil fuel for the production of electricity—and growing. In 2001, 51.7% of our electricity was from coal. Petroleum now supplies very little electricity in the U.S., less than previously. Natural gas supplies about 16% of our electricity. Natural gas supply and demand were in relative balance in the United States until the mid-1980s, when a production-consumption gap developed. As a result, in 2001 domestic production of natural gas was 19.7 trillion cubic feet, consumption was 22.2 trillion cubic feet, and imports were 3.98 trillion cubic feet.

Fig. 25-1

One of many thousands of electrical transmission towers in the U.S. energy grid.

Nuclear electric power did not exist in this country until 1957. The new industry expanded rapidly until the 1979 accident at Three Mile Island in Pennsylvania and the Chernobyl catastrophe in Ukraine in 1986. As fewer new units came on line and old units began to shut down, the number of operable units fell to 104 in 2001. Today about 21% of our electricity is from nuclear power, a portion currently in a downtrend.

Our personal use of electricity is very small when compared to the total used in the United States

today, and personal consumption of fuels is equally small. But as you have seen in other investigations, when the small amounts used by individuals are added up, they become a very significant value for a large population. Personal decisions about how much energy to use or save and which sources to depend on are very significant.

On the Home Electrical Use chart, **Fig. 25-2**, record the amount of time you use each appliance each day. If an appliance is used a few times a week or less, prorate it to a daily use. If you use any appliances not on the list, determine their power (in watts) by multiplying the volts by the amps on the appliance label. Add these to the list. Convert the watts of power to kilowatts and multiply by the time used to get kilowatt-hours/day.

Fig. 25-2
Home Electrical Use Survey

Appliance	Power (W)	Power (kW)	Number hours/day	Energy/day (kWh/day)
Room AC	1,360			
Clothes washer	512			
Clothes dryer	5,000			
Dishwasher	1,200			
Refrigerator	795			
Blender	300			
Coffeemaker (Drip)	1,100			
Coffeemaker (Perc)	600			
Food Processsor	370			
Hot plate	1,200			
Microwave oven	750			
Mixer	150			
Toaster	1,100			
Computer	60			
Radio	70			
Television	90			
Stereo	125			
VCR	50			
Hair dryer	1,200			
Iron	1,100			
Window fan	200			
Sewing machine	75			
Vacuum cleaner	650			
Light bulb (@75W)	75			
Other				
Other				
TOTALS				

Use the following equivalences in calculating answers to Exercises 1–5. Be sure to show the steps of your work, including set-ups and proper units, as well as final answers.

Conversion Factors

1 kwh = 3.41×10^3 BTU (British Thermal Units)
1 BTU = 2.93×10^{-4} kWh
1 BTU = 1,055 J (joules)
12,000 BTU = 3.52 kWh = 1.27×10^7 J

1 pound bituminous coal = 12,000 BTU
1 barrel oil = 5.6×10^6 BTU = 5.91×10^9 J
1 ft^3 natural gas = 1,030 BTU = 1.09×10^6 J
1 g ^{235}U = 4.0×10^7 BTU = 4.22×10^{10} J

1. How much electrical energy do you consume each day, on average? How much would that be each year?

2. Suppose the electricity in your region was supplied by the burning of natural gas.

a. How many cubic feet of natural gas is needed to support your energy lifestyle?

b. 1,000 ft^3 of natural gas contains about 20.2 kg of methane and when burned completely produces 122 lb of carbon dioxide. How much methane would you consume in one year, and how many pounds of carbon dioxide would you produce?

3. Suppose coal were used in the generators instead of natural gas.

a. How much coal would be burned to provide your energy?

b. When coal is burned, about 2.3 lb of CO_2 is produced for every kilowatt of electrical energy consumed. How much carbon dioxide would be produced by your yearly electricity use?

4. Suppose the electrical power was produced by nuclear power. How much uranium would be needed for your yearly consumption?

Exercises

Exercises

5. Calculate comparative costs.

   a. The cost for U_3O_8, the primary nuclear reactor fuel, is \$10.15 per pound, or about \$0.022 per gram. What would be the cost of the uranium to generate your electricity?

   b. Coal costs about \$24.38 per ton, and the cost of natural gas for electric utilities, on the average, is about \$4.67 per 1,000 cubic feet. Calculate the cost of these two fuels to produce your yearly electricity.

6. Compare the pros and cons of using these fuels to produce electricity on a large scale.

   a. Is the cheapest fuel necessarily the best choice? Explain your reasoning in economic, social, and environmental terms.

   b. Discuss in some detail extraction, processing, transportation, burning, waste products, and health and safety aspects of the problem.

7. Outline five ways to reduce the use of electrical power in your everyday life.