Conserving Electricity

When you look on most of the appliances in your home, you will see several numbers, including the volts (v), hertz (hz), and the watts (w). Sometimes you may have to look in the manual that came with that appliance to find these numbers. The main number we need to figure out the energy that that appliance uses is the watts, which is a unit of power.

What is Power?

The unit for measuring energy in the metric system is the Joule (J) or a newton meter (N m). The equations for various kinds of energy yield joules, for example:

$$KE = \frac{1}{2}mv^2 \quad \text{or as units} \quad (\text{kg})\left(\frac{\text{m}^2}{\text{s}^2}\right) = \text{Nm} = \text{J}$$

In order to determine the energy used by an appliance, you also need to know how long, or the time, that it was turned on. The unit of the watt is a unit of power, or the energy used per time. The equation for power is:

$$P = \frac{\text{Energy}}{t} \quad \text{or as units} \quad w = \frac{J}{s}$$

The unit of a joule of energy is a very small amount of energy and therefore the watt is a very small amount of power. While many appliances are rated in watts, it is common to see power measured in kilowatts (kw) or thousands of watts.

Rating Your Appliance

The electric company actually bills you for the amount of energy that you use. But your appliances are rated by the amount of power that they use. You can easily find the amount of energy used by solving the power equation for energy. You get:

$$\text{Energy} = P\ t$$

Now you can plug in the power in watts that you found on your appliance and the time in hours. When you do that, the units come out to be kilowatt hours (kw hr). While you could convert the units into joules, it has become customary to leave the energy in the units of kilowatt hours.

Now all you need to know is how much your electric utility or company charges you for energy. This will usually be in the units of $ per kw hr. Then you just multiply the kw hrs by the $ per kw hr, and you end up with the cost for that appliance for the amount of time that you have used it.

Conserving Electricity

Print out the table below and fill in the numbers and calculations that follow. For each of the appliances listed below you will need to look on that appliance and find its power rating in watts. You will also need to find out how much your energy utility or company charges you for your electricity. Then estimate how many hours that you use each appliance in a year. Finally, from this information, you can calculate for each appliance the energy use in kwatt hr/year and cost in $/yr. A set of sample calculations and some websites to help you out are given below the table.

Energy Inventory

Cost of Electricity: $ / kwatt hr = ____________					
#	Item	Power (kwatts)	Estimated Time (hr/yr)	Energy Use (kwatt hr/yr)	Cost ($/yr)
1	Toaster				
2	Oven				
3	Incandescent Lamp				
4	Fluorescent Lamp				
5	Television				
6	Computer				
7	Video Games (no TV)				
8	Hair Dryer				
9	Clothes Washer				
10	Clothes Dryer				
11	Table Fan				
12	Hot Water Heater				
13	Food Blender				
14	Clock				
15	Vacuum Cleaner				
16	Space Heater				
17	Clock Radio				
18	Stereo (Amplifier)				
19	CD Player				
20	Power Drill				
21	Torchiere Lamp				
22	Coffee Pot				
23	Refrigerator				

24	Cordless Phone				
25	Electric Blanket				
26	Air Conditioner				
27	Dishwasher				
28	Microwave Oven				
29	Small Freezer				
30					

Sample Calculations

Let's say that you found that your microwave oven has a power rating of 120 watts. To convert that into kilowatts you must divide by 1000 as follows. Place this number in the table.

$$120\text{w}\left(\frac{1\text{kw}}{1000\text{w}}\right)=0.12\text{kw}$$

You estimate that your microwave oven is used 3 hours per day. Multiply by 365 days per year to get the hours used per year as follows:

$$\frac{3\text{hr}}{\text{day}}\left(\frac{365\ \text{hr}}{1\ \text{yr}}\right)=1095\ \text{hr/year}$$

Now you can calculate your energy consumption by multiplying the power in kw times the time used in hr/yr as follows:

$$\text{Energy} = \text{P t}$$

$$\text{E} = (0.12\ \text{kw})(1095\ \text{hr/yr}) = 131.4\ \text{kw hr/yr}$$

\

Finally, we can multiply the energy used in kw hr / yr by the cost in $ / kw hr to get the actual cost in $ / yr as follows:

$$\text{Cost} = (131.4\ \text{kw hr/yr})(0.077\ \$/\text{kw hr}) = \$10.12\ /\ \text{yr}$$

You may need to do a search on the internet or look at your electricity bill to find the cost per kw hr. The calculated numbers are shown in the sample table below.

Cost of Electricity: $ / kwatt hr = ___0.077__					
#	**Item**	**Power (kwatts)**	**Estimated Time (hr/yr)**	**Energy Use (kwatt hr/yr)**	**Cost ($/yr)**
28	Microwave Oven	0.120	1095	131.4.	10.12.

Conserving Electricity

You should now be familiar with how to calculate the energy use and cost for the appliances in your home. A reasonable goal would be to start to save or conserve energy by shutting off the appliances that are not needed. You can keep track of the energy and money that you save by printing out and filling in the table below. Don't let the fact that, especially in the beginning, the energy savings will seem to be small. But as you begin to learn where the more significant savings are, these numbers should increase.

Here a just a few examples to get you started of how you can save energy.

Shut off lights in rooms that are not being used. While the energy per light is small, it's amazing how many lights can be on in a house at any given time. And if these lights are left on, overnight for example, the energy loss can add up.

Do you have three electric clocks in the same room? Are all these clocks really necessary?

Leaving for the weekend? Shut down your computer and all of its peripherals.

Not going out right after you shower? Maybe you don't really need to blow dry your hair.

Savings Worksheet: Cost of Electricity: $ / kwatt hr = ___________					
#	Item	Power (kwatts)	Estimated Time Saved (hr/yr)	Energy Saved (kwatt hr/yr)	Money Saved ($)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
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Data For: October 2002
Next Release Date: March 2003

Table 53. Estimated U.S. Electric Utility Average Revenue per Kilowatthour to Ultimate Consumers by Sector, Census Division, and State, October 2002 and 2001 (Cents)

Census Divisionand State	Residential		Commercial		Industrial		Other[1]		All Sectors	
	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001
New England	**11.4**	**12.3**	**9.8**	**10.9**	**7.3**	**7.6**	**12.8**	**13.1**	**9.9**	**10.6**
Connecticut	11.2	11.4	9.4	9.5	7.9	7.6	9.5	9.5	9.8	9.7
Maine [3]	13.6	13.2	NM	13.7	NM	4.6	22.6	22.3	8.7	9.7
Massachusetts [3]	10.8	12.7	10.0	11.4	8.0	8.7	13.3	14.6	9.9	11.3
New Hampshire	12.6	12.7	10.7	10.7	9.3	9.1	11.8	12.3	11.1	11.0
Rhode Island [3]	10.5	11.7	8.6	9.3	7.7	8.8	26.7	21.6	9.2	10.1
Vermont	13.0	13.0	11.3	11.3	7.8	7.9	16.8	15.0	10.9	10.9
Mid Atlantic	**11.4**	**11.5**	**10.3**	**10.7**	**5.7**	**5.7**	**9.1**	**6.4**	**9.4**	**9.5**
New Jersey	9.9	9.9	8.7	9.2	7.0	8.0	16.2	10.4	8.9	9.2
New York	13.8	14.2	12.7	13.3	5.0	4.8	8.6	5.8	11.3	11.3
Pennsylvania	9.8	9.8	8.3	8.2	5.7	5.6	10.4	11.0	7.9	7.7
East North Central	**8.2**	**8.2**	**7.7**	**7.4**	**4.7**	**4.7**	**6.2**	**6.0**	**6.6**	**6.5**
Illinois	8.6	8.8	8.9	7.6	5.4	5.0	5.9	5.5	7.5	6.9
Indiana	7.4	7.5	6.3	6.2	3.9	4.1	9.3	8.8	5.4	5.5
Michigan	8.2	8.2	7.6	7.6	4.8	5.2	10.6	10.6	6.8	6.9
Ohio	8.3	8.3	7.9	8.1	4.8	4.8	5.4	5.6	6.7	6.7
Wisconsin	8.2	8.0	6.5	6.4	4.3	4.2	7.6	7.7	6.1	5.9
West North Central	**7.3**	**7.4**	**5.7**	**5.7**	**4.1**	**4.1**	**6.2**	**6.6**	**5.7**	**5.7**
Iowa	8.4	8.5	6.5	6.5	3.9	4.0	6.4	6.5	5.8	5.8
Kansas	8.0	7.8	6.3	6.3	4.7	4.7	7.8	7.5	6.4	6.3
Minnesota	7.3	7.3	5.4	5.5	4.1	4.1	7.5	7.9	5.5	5.5
Missouri	6.6	6.9	5.2	5.4	3.9	4.1	5.8	7.4	5.4	5.6
Nebraska	6.8	6.6	5.4	5.4	3.7	3.6	NM	6.7	5.3	5.3
North Dakota	6.8	7.0	5.8	5.9	NM	3.9	NM	4.4	5.6	5.6
South Dakota	7.9	7.9	6.4	6.2	4.6	4.5	NM	4.3	6.5	6.4
South Atlantic	**8.0**	**8.2**	**6.5**	**6.6**	**4.2**	**4.4**	**6.4**	**6.7**	**6.5**	**6.7**
Delaware	8.6	8.7	7.1	6.9	4.1	5.3	16.8	15.4	6.4	6.9
District of Columbia	6.7	6.8	6.9	7.2	5.0	4.4	5.5	7.9	6.7	7.1
Florida	8.1	8.7	6.6	7.1	5.3	5.4	7.6	8.1	7.3	7.7
Georgia	7.6	7.9	6.5	6.8	3.9	4.2	8.5	8.8	6.1	6.4
Maryland	7.7	7.4	7.3	6.0	3.7	3.8	9.2	8.8	6.1	6.1
North Carolina	8.6	8.7	6.6	5.9	4.8	4.8	6.7	7.0	6.8	6.5
South Carolina	7.8	8.0	6.5	8.0	3.9	3.9	6.4	6.6	5.8	6.1
Virginia	7.7	7.9	5.7	5.8	4.0	4.1	5.1	5.2	6.0	6.0
West Virginia	6.5	6.6	5.5	5.5	3.8	3.8	10.2	10.0	5.0	5.1
East South Central	**6.9**	**6.7**	**6.4**	**6.3**	**3.9**	**3.6**	**6.4**	**6.2**	**5.5**	**5.2**
Alabama [2]	7.1	7.3	6.6	6.5	4.0	3.7	7.2	6.9	5.7	5.5
Kentucky	5.8	5.7	5.4	5.2	3.2	2.9	4.7	4.5	4.3	4.0
Mississippi	8.2	7.3	6.8	6.6	4.4	4.2	8.8	8.5	6.6	6.0
Tennessee	6.5	6.5	6.5	6.4	4.5	4.2	8.9	8.8	5.8	5.7
West South Central	**7.9**	**8.6**	**6.7**	**7.6**	**4.6**	**4.8**	**6.5**	**7.1**	**6.4**	**7.0**

Arkansas	7.3	7.6	5.5	6.0	3.7	4.3	6.8	6.7	5.4	5.7
Louisiana [3]	7.7	7.9	6.8	7.4	4.6	4.8	6.6	7.4	6.3	6.5
Oklahoma	7.5	6.7	6.3	7.7	3.6	3.4	5.4	5.4	5.8	5.7
Texas [4]	8.1	9.2	6.8	7.8	5.0	5.2	6.8	7.4	6.7	7.5
Mountain	**8.3**	**8.2**	**7.0**	**6.9**	**4.9**	**4.9**	**NM**	**5.0**	**6.8**	**6.6**
Arizona	9.0	8.9	7.8	7.8	5.6	5.4	NM	3.8	7.7	7.6
Colorado	7.8	7.7	6.0	6.1	4.5	4.7	NM	7.0	6.2	6.2
Idaho [4]	6.9	6.4	6.0	5.7	3.6	3.7	5.7	5.3	5.5	5.2
Montana	7.7	7.3	6.4	5.6	4.0	4.4	NM	7.9	6.1	5.8
Nevada	9.6	9.1	9.8	8.7	7.3	7.1	NM	6.0	8.6	8.1
New Mexico	9.0	9.2	7.4	7.7	4.8	5.1	NM	5.3	6.9	7.1
Utah	6.7	6.4	5.7	5.7	3.9	3.7	NM	4.3	5.3	5.3
Wyoming	7.8	7.0	5.9	6.7	3.6	3.4	NM	4.9	4.8	4.6
Pacific Contiguous	**10.0**	**10.5**	**NM**	**12.5**	**7.7**	**8.9**	**NM**	**7.6**	**10.5**	**10.7**
California [2]	11.6	12.5	NM	14.9	9.2	10.6	NM	8.7	12.3	12.8
Oregon	7.3	6.9	6.8	6.1	4.9	4.4	9.3	7.9	6.5	5.9
Washington	6.5	6.1	6.4	5.8	NM	4.8	4.6	4.2	5.9	5.6
Pacific Noncontiguous	**14.4**	**14.8**	**12.6**	**12.9**	**10.4**	**10.4**	**12.5**	**13.8**	**12.4**	**12.7**
Alaska	12.1	13.0	10.1	11.0	7.7	8.1	12.2	13.8	10.4	11.2
Hawaii	15.8	15.9	14.2	14.2	11.1	11.1	13.8	13.8	13.5	13.5
U.S. Average	**8.55**	**8.86**	**8.18**	**8.28**	**4.85**	**5.05**	**6.67**	**6.70**	**7.26**	**7.40**

[1] Includes public street and highway lighting, other sales to public authorities, sales to railroads and railways, sales for irrigation, and interdepartmental sales.

[2] Reclassification of California Industrial customers in 2001 resulted in a shift of customers from the Industrial to the Commercial sector. Comparison of data of the Commercial and Industrial sectors with prior year same month data might exhibit a wide variance.

[3] Availability of lower Standard Offer rates to consumers of Massachusetts, Maine, and Rhode Island, resulted in significant revenue declines and subsequent reduction in cost of retail electricity (cent/KWH).

[4] Increase in rates for Industrial consumers in Idaho resulted in higher revenues and prices (cents/KWH) over October 2001.

Notes: · Values for 2001 have been revised and are preliminary. · Values for 2002 are estimates based on a cutoff model sample. See Technical Notes for a discussion of the sample design for the Form EIA-826. Utilities may classify commercial and industrial consumers based on either NAICS codes or demand/or usage falling within specified limits (based on different rate schedules.) · Retail sales and net generation may not correspond exactly for a particular month for a variety of reasons (i.e., sales data may include purchases of electricity from nonutilities or imported electricity). Net generation is for the calendar month while retail sales and associated revenue accumulate from bills collected for periods of time (28 to 35 days) that vary dependent upon customer class and consumption occurring in and outside the calendar month. · Totals may not equal sum of components because of independent rounding.

Source: · Energy Information Administration, Form EIA-826, "Monthly Electric Utility Sales and Revenue Report with State Distributions."

Energy Use of Some Typical Home Appliances

If you want a general estimate of how much electricity your home appliances consume, you can refer to the list below, which provides the energy consumption (Wattage) of some typical home appliances. If you have appliances that are not listed in the table, or desire a more exact figure based on a specific appliance in your home, use the following formula to estimate the amount of energy a specific appliance consumes:

$$\frac{\text{Wattage} \times \text{Hours Used Per Day}}{1000}$$

= Daily Kilowatt-hour (kWh) consumption
(1 kilowatt (kW) = 1,000 Watts)

Multiply this by the number of days you use the appliance during the year for the annual consumption. You can then calculate the annual cost to run an appliance by multiplying the kWh per year by your local utility's rate per kWh consumed.

For examples:

Window fan:

$$\frac{200 \text{ Watts} \times 4 \text{ hours/day} \times 120 \text{ days/year}}{1000}$$

= 96 kWh × 8.5 Cents/kWh
= $8.16 /year

Personal Computer and Monitor:

$$\frac{(120+150) \text{ Watts} \times 4 \text{ hours/day} \times 365 \text{ days/year}}{1000}$$

= 394 kWh × 8.5 Cents/kWh
= $33.51/year

You can usually find the wattage of most appliances stamped on the bottom or back of the appliance, or on its "nameplate." The wattage listed is the maximum power drawn by the appliance. Since many appliances have a range of settings (for example, the volume on a radio), the actual amount of power consumed depends on the setting used at any one time.

Here are some examples of the range of nameplate wattages for various household appliances:

Aquarium = 50-1210 Watts
Clock radio = 10
Coffee maker = 900-1200
Clothes washer = 350-500
Clothes dryer = 1800-5000
Dishwasher = 1200-2400 (using the drying feature greatly increases energy consumption)
Dehumidifier = 785
Electric blanket- *Single/Double* = 60 / 100
Fans
  Ceiling = 65-175
  Window = 55-250
  Furnace = 750
  Whole house = 240-750
Hair dryer = 1200-1875
Heater *(portable)* = 750-1500
Clothes Iron = 1000-1800
Microwave oven = 750-1100
Personal Computer
  CPU - awake / asleep = 120 / 30 or less
  Monitor - awake / asleep = 150 / 30 or less
  Laptop = 50
Radio *(stereo)* = 400
Refrigerator *(frost-free, 16 cubic feet)* = 725
Televisions (color)
  19" = 110
  27" = 113
  36" = 133
  53"-61" Projection = 170
  Flat Screen = 120
Toaster = 800-1400
Toaster Oven = 1225
VCR/DVD = 17-21 /20-25
Vacuum cleaner = 1000-1440
Water heater *(40 gallon)* = 4500-5500
Water pump *(deep well)* = 250-1100
Water bed *(w/ heater, no cover)* = 120-380

Refrigerators, although turned "on" all the time, actually cycle on and off at a rate that depends on a number of factors. These factors include how well it is insulated, room temperature, freezer temperature, how often the door is opened, if the coils are clean, if it is defrosted regularly, and the condition of the door seals. To get an approximate figure for the number of hours that a refrigerator actually operates at its maximum wattage, divide the total time the refrigerator is plugged in by three.

If the wattage is not listed on the appliance, you can still estimate it by finding the current draw (in amperes) and multiplying that by the voltage used by the appliance. Most appliances in the United States use 120 volts. Larger appliances, such as clothes dryers and electric cooktops, use 240 volts. The amperes might be stamped on the unit in place of the wattage. If not, find a clamp-on ammeter—an electrician's tool that clamps around one of the two wires on the appliance—to measure the current flowing through it. You can obtain this type of ammeter in stores that sell electrical and electronic equipment. Take a reading while the device is running; this is the actual amount of current being used at that instant.

Note: When measuring the current drawn by a *motor*, in the first second that the motor starts, the meter will show about three times the current than when it is running smoothly.

Also note that *many appliances continue to draw a small amount of power when they are switched "off."* These "phantom loads" occur in most appliances that use electricity, such as VCRs, televisions, stereos, computers, and kitchen appliances. Most phantom loads will increase the appliance's energy consumption a few watts per hour. These loads can be avoided by unplugging the appliance or using a power strip and using the switch on the power strip to cut all power to the appliance.

Calculate Your Power Needs
http://www.solarsense.com/Spec_Your_System/Calculators.html

Energy Units and Conversions

Energy Units and Conversions

A BTU (British Thermal Unit) is the amount of heat necessary to raise one pound of water by 1 degree Farenheit (F).
1 Joule (J) is the MKS unit of energy, equal to the force of one Newton acting through one meter.
1 British Thermal Unit (BTU) = 1055 J (The Mechanical Equivalent of Heat Relation)

Power = Current x Voltage (P = I V)
1 Watt is the power from a current of 1 Ampere flowing through 1 Volt.
1 kilowatt is a thousand Watts.
1 kilowatt-hour is the energy of one kilowatt power flowing for one hour. (E = P t).
1 kilowatt-hour (kwh) = 3.6×10^6 J = 3.6 million Joules

1 calorie of heat is the amount needed to raise 1 gram of water 1 degree Centigrade.
1 calorie (cal) = 4.184 J
(The Calories in food ratings are actually kilocalories.)

1 BTU = 252 cal
1 Quad = 10^{15} BTU (World energy usage is about 300 Quads/year, US is about 100 Quads/year in 1996.)
1 therm = 100,000 BTU

Power Conversion

1 horsepower (hp) = 745.7 watts

Gas Volume to Energy Conversion

One thousand cubic feet of gas (Mcf) -> 1.027 million BTU = 1.083 billion J = 301 kwh
One therm = 100,000 BTU
1 Mcf -> 10.27 therms

Energy Content of Fuels

Coal	25 million BTU/ton
Crude Oil	5.6 million BTU/barrel
Oil	5.78 million BTU/barrel = 1700 kWh
Gasoline	5.6 million BTU/barrel (a barrel is 42 gallons)
Natural gas liquids	4.2 million BTU/barrel
Natural gas	1030 BTU/cubic foot
Wood	20 million BTU/cord

Conserving Electricity

The following table presents one possible result for the Energy Inventory. Your results might be different depending on which appliances are in your house, how many people are using them, and how often they are used.

Sample Inventory

Electricity Cost = 0.077 $ / kwatt hr					
#	**Item**	**Power (kwatts)**	**Estimated Time (hr/yr)**	**Energy Use (kwatt hr/yr)**	**Cost ($/yr)**
1	Toaster	1.3	360	468	36
2	Oven	12.0	360	4320	332
3	Incandescent Lamp	0.1	4380	438	34
4	Fluorescent Lamp	0.02	4380	88	7
5	Television	0.15	3650	548	42
6	Computer	0.3	3650	1095	84
7	Video Games (no TV)	0.025	730	18	2
8	Hair Dryer	1.3	360	468	36
9	Clothes Washer	0.5	400	200	15
10	Clothes Dryer	4.9	800	3920	301
11	Table Fan	0.025	288	7	1
12	Hot Water Heater	5.0	876	4380	337
13	Food Blender	0.3	365	110	8
14	Clock	0.005	8760	4	1
15	Vacuum Cleaner	0.6	365	219	17
16	Space Heater	1.0	720	720	55
17	Clock Radio	0.002	8760	18	1
18	Stereo (Amplifier)	2.3	720	1660	128
19	Air Cleaner	.05	8760	438.	34
20	Power Drill	1.0	100	100	8
21	Torchiere Lamp	0.15	4380	657	51
22	Coffee Pot	0.2	180	36	3
23	Refrigerator	0.8	4380	3504	270
24	Floodlight	1.0	360	360	28

25	Electric Blanket	0.2	720	144	11
26	Air Conditioner	3.5	720	2520	194
27	Dishwasher	1.5	360	540	41
28	Microwave	1.0	360	360	28
29	.Small Freezer	0.5	4380	2190	168
30					

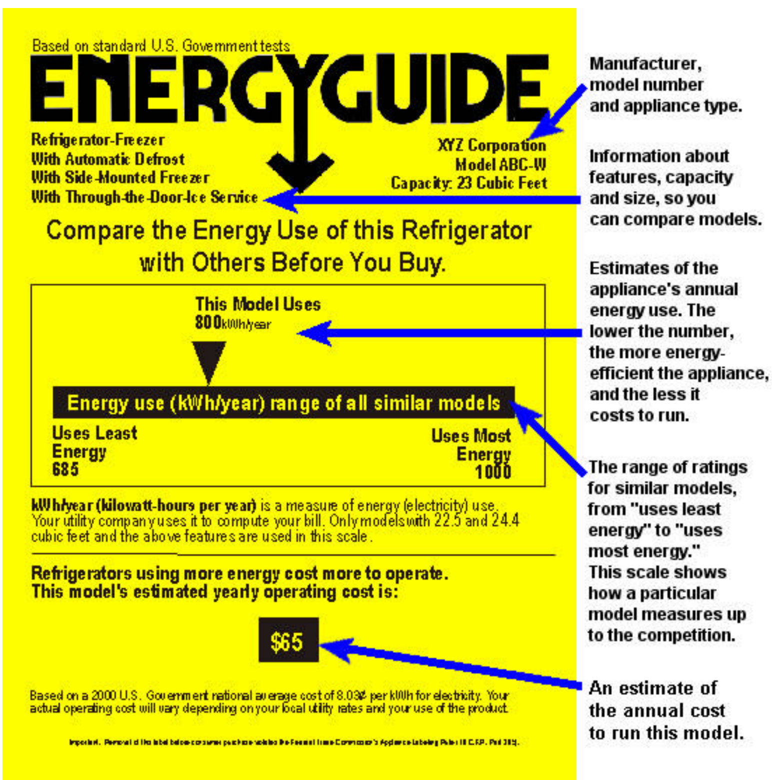
Appliance Efficiency

In general, from year to year, new home appliances have become more energy efficient. The amount of energy it takes an air conditioner or dishwasher to do its job today is a lot less than one that was bought 10 years ago. This increase in efficiency is sometimes so great that we can actually save money by replacing an older appliance with a new one, even if the old one is still working fine. The cost of the new appliance is more than made up by the cost savings in the use of less energy.

Part of the reason for this increasing energy efficiency is the National Appliance Energy Conservation Act of 1987 (NAECA), which was adopted by the United States congress in 1987. As part of this agreement, energy standards are continually set to improve the energy efficiency of major appliances, especially large energy use appliances such as air conditioners, refrigerators, and clothes dryers.

When you go shopping for a new appliance, there may be a tremendous difference in the energy efficiency between competing brands and models. It is usually true that the more energy efficient models do cost more, but again, you get the savings back by using less energy.

The Trade Commission has an appliance labeling rule that requires appliance manufacturers to put labels on many home appliances. A sample of one of these labels is shown below:



From the website http://www.ftc.gov/bcp/conline/pubs/homes/applnces.htm produced in cooperatation with the US Department of Energy