

# Activity – Efficiency of a Water Heating System

**Goal:** Participants gain a sense for how much energy is consumed in a daily activity and how the efficiency varies based on method used

**Learning objectives.** By the end of the activity the participants:

1. can theoretically calculate the energy required to heat water to a boil
2. are competent in using the Watt-meter and basic measuring tools (thermometer, graduated cylinder)
3. can calculate energy consumed to heat water based on experimental measurements
4. can convert energy units between kWh, kJ, Btu
5. can calculate the efficiency of water heating devices.

**Key concepts:**

Power vs. energy  
Energy units / conversions  
Energy efficiency (ratios, percent calculations)  
Measuring/calculating energy consumption

**Supplies:**

Graduated cylinders (one per group)  
Thermometers (one per group)  
Hotpot (could have a couple of different models)  
Microwave  
Watt meter (one per group)  
Calculators

**Background:**

The theoretical amount of energy needed to heat a substance such as water can be calculated based on the mass, temperature rise and specific heat of the substance:

$$Q = m C_p \Delta T$$

Where:

Q is the energy required (joules, J);  
m is the mass of the substance (g);  
 $C_p$  is the specific heat (J/g/°C); The specific heat of water is 4.186 J/g/°C.  
 $\Delta T$  is the change in temperature (°C).

When we actually heat a substance, however, there are inefficiencies in the process and some heat energy is lost to the surroundings. We can measure the actual energy consumed by electrical appliances to heat water with a watt meter. The electrical

