Physics of Energy
Spring 2010

Lab 1: Energy and Power

Introduction:
It is very important to understand the difference between energy and power. These terms are often confused and incorrectly used interchangeably. Energy is defined as the ability to do work. It is measured in BTUs, Joules and kWh. It takes energy to do anything. Energy is needed to heat your home, light lights, run computers and move your car, to name a few.
Power is energy divided by time, so the unit of power is joule/s, which is called a watt. Power can be viewed as a capacity. A 100 watt light bulb is the capacity of that light bulb. It has 100 watts whether it is on or off. Turn it on, then energy is consumed. Power is the rate at which energy is used.

Background/Definitions:
Electricity in the United States has a frequency of 60Hz and usually a voltage of 120V AC (certain appliances like electric dryers run off of 240V AC)

Electric Power is measured in Watts.
P = VI
Power = VI = Joules/ second = Watts

1000 Watts = 1 kW

Electric Energy = (Power)(time) = KWh

A word about Safety:
Safety always comes first. When working with electricity there is the possibility of getting an electric shock if you are not careful. You can avoid this hazard by following these basic rules:

1. No Food or Drink in Lab.
2. Always check power cords. They should not be frayed, loose or damaged in any way.
3. Always have dry hands when plugging into a wall outlet.

Purpose:
The purpose of this lab is for you to gain a familiarity with energy and power. Specifically it will assist in giving you a sense of the relative power consumption of various devices and appliances. When discussing power consumption, devices and appliances that consume electricity are often referred to as loads.

Procedure:

In this lab you will be using a Kill-a-Watt meter to record power related measurements on a variety of devices and appliances. Available measurements include Voltage (Volts), Current (Amps), Power (Watts), Energy (kWh) and cost ($). You will notice other measurements available on the meter but we will not be using them in this lab. There is a variety of electricity consuming devices, powered through a standard AC plug, in this room. A few of them are listed on your spreadsheet to help you get started.

1. Take a few minutes to familiarize yourself with the meter by reading the instructions and just playing with the buttons.
2. Set the cost of electricity to 17 cents per kWh.
3. Use the Kill-a-Watt meter to record the Power (Watts) of 10-15 devices. Be sure to take measurements both with the item on and when it is off or not being used. For example take a measurement for the phone charger when a phone is plugged into it charging and when nothing is connected to it.
4. When finished taking measurements, press and hold the reset button on the meter until RST flashes. Now plug your computer in through the meter before going on to number 5.
5. Save a copy of the Google Docs spreadsheet (lab1a) to your local drive. Enter the power data you collected into column C of the spreadsheet set up in Google docs.
6. In column D convert each entry to KWatts
7. Estimate the amount of time per day that each item in your spreadsheet may be drawing power and enter it into the spreadsheet.
8. Calculate the kWh used in day, month and year for each entry (use the measured power values to do this).
9. Now check your meter and record the energy consumed by your computer in kWh as well as the cost projections for an hour, day, week, month and year. Enter this information on the"computer" tab of the spreadsheet (found at the bottom of the page).
10. *Optional*
    A. Plug a light into your meter and record the Voltage and Current. Calculate the Power and compare it to the measured power value. Does this match up to the rated wattage of the lightbulb?
    B. Create a graph - bar graph or pie chart - depicting the relative power consumption of each over the course of a month.

Follow-up Questions:

1. Did any of your items draw power when off? If yes, why do you think this is the case?
2. Based on the Watt reading for your computer when it is on, calculate the projected cost of leaving it on for a month straight (using $0.17/kWh). How does your calculated value compare with your reading?
3. Take the Watt meter home with you and measure a variety of loads that you use in your daily life or that are just interesting. Monitor some loads for long durations, like overnight, to get more useful kwh readings. Enter this data into your

spreadsheet and use the information to help create your own set of benchmarks that are useful to you. Write a few sentences about this exercise and what, if anything, useful came out of it.