Bulb Type 1

Use the numbers in the colors above to complete the next section of this worksheet. Repeat these steps for each type of bulb.

For this first set of calculations we will use Bulb Type 1. First we will find the efficiency of each bulb. The efficiency is the ratio of lumens to watts. The efficacy is related to the efficiency, but they are not the same thing. A larger efficacy means the bulb is more efficient. Which of the bulbs has the highest efficacy?

We want to determine what percent of all lights are of Type 1. To do this, we'll take the number of squares of Type 1 and divide it by the total number of light squares.

Next we want to determine how many bulbs of Type 1 are in the city. To do this, we'll take the percent of Type 1 and multiply it by the total number of lights in the city (2,000,000).

In this next step, we will find the energy used in one hour. Electric utility companies measure energy in a unit called watts. For example, if you have a 100W bulb and the light is on for 11 hours it uses 1100W*11 hours = 11,000W-hours. To calculate the amount of energy used, the wattage (in watts) of the bulb is multiplied by the number of hours the light is on per night. Watts is a measure of power which is the rate of energy over time. By multiplying by time (e.g., 11 hours), you end up with energy.

Now let’s take a closer look at energy, cost, and carbon footprint.

Because of how quickly watt-hours add up, the term kilowatt-hour is used to represent 1000 watt-hours. You can convert the number of watt-hours to kilowatt-hours by dividing the number of watt-hours (in energy) by 1000. This is the amount of energy used in one hour.

An important part of light pollution is the enormous cost that is required to keep the lights turned on. Electric utility companies charge for electricity by the kilowatt-hour (KWh). Next we will calculate how much it costs to light up one bulb of Type 1 for one night.

Electricity is most commonly produced from coal, natural gas, or nuclear power. When chemicals are burned, greenhouse gases are emitted that contribute to air pollution and climate change. The final important aspect of light pollution is the amount of greenhouse gases that are emitted during the production of electricity. Greenhouse gases are measured by the mass of the carbon dioxide gas. The amount of greenhouse gases produced depends on the type of fuel used to produce electricity. Because that’s hard to know exactly, we’re going to use an average of 0.84 kg per kilowatt-hour. To calculate how much greenhouse gas is produced, you need to multiply the kilowatt-hours used in one night by 0.84 kg/KWh.

Now let’s determine how much energy, cost, and carbon footprint is used for the entire city in one night. To do this, we’ll multiply the results from the previous page for one bulb by the total number of bulbs we calculated in Step 3.