Start here

Now the challenge is to minimize the energy consumed, the cost, and carbon footprint by using more energy-efficient types of lights, by choosing the number of bulbs of each type, and by choosing from the total number of bulbs. Counting the number of bulbs they are and their type, you have found in your research, e.g., for the National Optical Astronomy Observatory (NOAO) and the "Types of lights" document. Also determining the number on this page, you see that numerical sets that add up to the total cost of bulbs, the ones that are the same, and carbon footprint, by using the steps from pages 2 through 5. Thus, for the final output of page, take the difference of the numbers from your final set of calculations and the next set of calculations. That will give you how much energy, cost, and carbon footprint you have saved.

### Bulb Type 1

#### Step 1

For all bulbs:

- Energy usage per kilowatt-hour does not change.

- Cost of electricity per kilowatt-hour does not change.

- Lumen efficiency does not change.

- Lumen efficiency does not change.

#### Step 2

#### Step 3

### Bulb Type 1

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

Because how quickly watt-hours add up, the term kilowatt-hours 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 (or energy) by 1000. This is the amount of energy used in one night.

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.

### Bulb Type 1

#### Step 8

Energy cost in one night for one bulb of Type 1

#### Step 9

Energy cost in one night for one bulb of Type 1

#### Step 10

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.

#### Step 11

#### Step 12

#### Step 13

Now let’s determine how much light is being wasted by shining up into the sky. Roughly 30% of the light used is wasted. We’ll multiply the results from the above steps by 0.3 to determine the wasted light.