



Energy Conservation

CALCULATING KILOWATT HOURS, COST AND CO₂

BOX 1.

Electricity is measure in kilowatt hours (kWh)

1 kilowatt = 1000 watts

kWh = kilowatts x hours the lights or devices are on

Let's work through a scenario.

The Eco-Action team audited 20 classrooms at John Lewis Middle School. The average length of time classroom lights were left on was 7 hours per day. Watt Watchers also found that each audited room had 16 light fixtures, and each fixture had three tube bulbs. According to Mrs. Ranger, our custodian, each tube bulb is 17 watts.

1. What is the total wattage of the light fixtures in the room?

$$17 \text{ watts} \times 3 \text{ tube bulbs} \times 16 \text{ lights fixtures} = 816 \text{ watts}$$

2. 816 watts is equivalent to how many kilowatts? Using the conversion factor in Box 1, divide 816 by 1000.

$$816 \text{ watts} = .816 \text{ kilowatts (kWh)}$$

3. What are the kilowatt hours (kWh) used per room in a day?

$$.816 \text{ kilowatts} \times 7 \text{ hours a day} = 5.712 \text{ kWh/day}$$

4. How many kilowatt hours (kWh) are used by the 20 audited classrooms in a day?

$$5.712 \text{ kWh/day} \times 20 \text{ classrooms} = 114.24 \text{ kWh/day}$$

5. How many kilowatt hours (kWh) are used by the 20 audited classrooms in a five day school week and a 21 day school month?

$$114.24 \text{ kWh/day} \times 5 \text{ days} = 571.2 \text{ kWh used in a 5 day school week}$$

$$114.24 \text{ kWh/day} \times 21 \text{ days} = 2,399.04 \text{ kWh used in a 21 day school month}$$



Let's find out the cost for kilowatt hours (kWh) used by the 20 audited classrooms at John Lewis Middle School.

1. Go to EIA.gov. <https://www.eia.gov/electricity/state/>
2. Use the chart or hover over your state. Identify the *average retail price (cents/kWh)* for your state.

Name	Average retail price (cents/kWh)	Net summer capacity (MW)	Net generation (MWh)	Total retail sales (MWh)
Alabama	9.63	30,110	145,057,994	90,280,456
Alaska	19.38	2,745	8,247,359	5,972,487
Arizona	10.85	28,872	111,925,144	78,348,302
Arkansas	7.78	14,763	67,999,352	49,602,708
California	16.58	75,926	195,265,408	255,224,272
Colorado	10.02	16,590	55,386,279	56,450,480
Connecticut	18.41	9,033	39,453,552	20,833,925
Delaware	10.55	3,378	8,240,644	11,773,100
District of Columbia	12.03	32	79,331	11,357,910
Florida	10.32	57,369	244,252,035	238,565,391
Georgia	9.62	36,989	129,239,371	139,868,074
Hawaii	29.18	2,811	9,796,773	9,337,161
Idaho	8.17	5,210	18,172,120	23,753,508
Illinois	9.6	45,631	188,003,357	142,654,808
Indiana	9.75	26,696	113,459,711	104,194,376



3. To calculate the cost per room in a day, use the following equation. Illinois will be used for this example. 9.6 cents is the same as \$0.096. In the equation use \$0.096. If needed, refer back to page one, number two for kWh/day.

$$\$0.096 \text{ cents/kWh} \times 5.712 \text{ kWh/day} = .54 \text{ cents/day (round to the nearest cent)}$$

4. What is the total cost for all 20 rooms?

$$.54 \text{ cents/day} \times 20 \text{ rooms} = \$10.80 \text{ per day}$$

5. What is the total cost for the 20 rooms pers a five days school week and a 21 day school month?

$$\$10.80 \text{ per day} \times 5 \text{ days} = \$54 \text{ in a 5 day school week}$$

$$\$10.80 \text{ per day} \times 21 \text{ days} = \$226.80 \text{ in a 21 day school month}$$



OPTIONAL

Let's calculate how many pounds of CO₂ are emitted via classroom lighting at John Lewis Middle School.

BOX 2.

Pounds (lbs) of CO₂ emissions = conversion factor x kWh
(The conversion factor is calculated in number three.)

$$1 \text{ MWh} = 1000 \text{ kWh}$$

1. Go to EIA.gov, <https://www.eia.gov/electricity/state/>. Find your state in the list and click to see your state's electricity profile. For this example, I'm using Florida.
2. Find *Carbon Dioxide* under the Emissions section in Table 1.

Emissions		
Sulfur dioxide (short tons)	58,965	11
Nitrogen oxide (short tons)	64,598	6
Carbon dioxide (thousand metric tons)	107,792	2
Sulfur dioxide (lbs/MWh)	0.5	28
Nitrogen oxide (lbs/MWh)	0.5	36
Carbon dioxide (lbs/MWh)	971	25

3. Convert pounds per megawatt hour (lbs/MWh) to pounds per kilowatt hour (kWh). The solution is your state's conversion factor.

$$971 \text{ lbs/MWh} \div 1000 \text{ kWh} = .971 \text{ lbs/kWh}$$



4. Use the equation below to calculate the average pounds of CO₂ emitted by all audited classrooms in one day, a five day school week, and a 21 day school month. Reminder kWh/day was calculated on page one. Refer to numbers three and four for one day, five days, and 21 days usage.

conversion factor x kWh/day for the 20 audited classrooms = lbs of CO₂ emitted/day

$$.971 \text{ lbs/kWh} \times 114.24 \text{ kWh/day} = 110.92 \text{ lbs of CO}_2 \text{ emitted/day}$$

$$.971 \text{ lbs/kWh} \times 571.2 \text{ kWh used for a 5 day school week} = 554.64 \text{ lbs of CO}_2 \text{ emitted/5 day school week}$$

$$.971 \text{ lbs/kWh} \times 2,399.04 \text{ kWh used for a 21 day school month} = 2,329.47 \text{ lbs of CO}_2 \text{ emitted/21 day school month}$$

WHAT DOES A POUND OF CO₂ LOOK LIKE?

At standard pressure and 15°C (59°F), the density of carbon dioxide gas is 1.87 kg/m³ (0.1167 lbs/ft³). One pound of carbon dioxide gas (454 g) occupies 0.2425 m³ (8.566 ft³, 64 gallons, 243 liters). It would fill a cube 62.4 cm high (24.6 ft) or a sphere 77.4 cm across (30.5 ft).

