Reality Math
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Measuring Electricity II

1. Kilowatt-hours are different from Kilowatts

Electricity is bought and sold in kilowatt-hours. If you use a flow of 1 kw for 1 hour, you have used a kilowatt-hour of electricity.

kilowatts x hours used = kilowatt-hours
watts x hours used = watt-hours
1000 watt-hours = 1 kilowatt-hour (kWh)

If your clothes dryer is using 4 kW for ½ hour, you will have bought
4 kW x ½ hr = 2 kWh of electricity.

1. How many kWh of electricity would your 10-**watt** clock radio use in
   (a) one day?

   (b) one month?

   (c) one year? Assume that it is always plugged in.

Electricity in North Carolina costs about 10 cents per kWh. If your flat-screen TV draws 120 watts when it is on, and it is on 8 hours a day (US national average according to *The Economist)* every day, let's figure out what the electricity for the TV will cost each year.

Well the TV will be on (8 hours/day) (365 days a year) = 2,920 hours every year
(120 watts) (2920 hours) = 350,400 watt-hours = 350 kilowatt-hours
(350 kWh) ($0.10 each) = $35 for the electricity for the TV for a year

2. (a) What would electricity for your clock radio cost annually?

   (b) If your hot water heater uses 3000 watts when it is heating water and it is actually heating water 4 hours a day, how much would the electricity for hot water cost in a year?

   (c) Why is it a good idea to insulate your hot water heater, turn it off when you are out-of-town, and put a timer on it so you are not heating water all day long when you don't need it?

2. Total Household Electrical Consumption in the US

U.S. residential sector electricity consumption by major end uses in 2018, as projected in the *Annual Energy Outlook 2019*:

End use	Billion kWh	Share of total
Space cooling	214	15%
Space heating	207	14%
Water heating	174	12%
Lighting	91	6%
Refrigeration	87	6%
Televisions and related equipment[1]	62	4%
Clothes dryers	60	4%
Computers and related equipment[2]	26	2%
Furnace fans and boiler circulation pumps	25	2%
Freezers	20	1%
Cooking	16	1%
Clothes washers[3]	10	1%
Dishwashers[3]	7	1%
Other uses[4]	460	31%
Total consumption	1,462	

3. (a) What are the three biggest uses of electricity in US households?

   (b) What is a more common name for the biggest use?

   (c) Using the sun to heat water in pipes on your roof (solar hot water) would help with which of these three biggest uses?

The population of the US in 2019 is 327 million. There are 2.6 people per household on average.

4. (a) About how many households are there in the US in 2019?

(b) If each household uses an average flow of 1 kW of electricity 24 hours a day, about how many kWh does each household use in one year?

(c) The total kWh for all these households would be how many million kWh?

(d) The total kWh for all these households would be how many billion kWh?

(e) The real total for US households is 1,462 kWh according to the US Department of Energy in the table above. Your answer to (d) should have been 1,102 billion kWh using 1 kW for each household all the time. So do US households actually use a bit more or less than 1 kW all the time?

3. CO_2 Emissions from Generating Electricity

According to the US Environmental Protection Agency, making electricity in the US produces on average 1.4 pounds of CO_2 per kWh.

5. If your household uses 1 kW on the average all day and night,
   (a) how many kWh does each house use in a year? (4. (b))

   (b) How many pounds of CO_2 emissions per year would your household be responsible for if your electricity was average US electricity?

   (c) Estimate each US household's electrical CO_2 footprint in tons per year.
   2000 pounds = 1 ton

   (d) Estimate the total US CO_2 emissions from all the US households in tons. Use the total consumption figure from the table on the previous page.

4. Light Emitting Diodes (LEDs)

6. A normal traffic light is always on. It uses **one** of its 150-watt incandescent bulbs all the time (red, yellow, or green).

   (a) How many kWh does one light use in one year?

   (b) If electricity costs $0.10 per kWh, how much does the electricity for one traffic light with incandescent bulbs cost per year?

7. Denver, Colorado replaced its 150-watt incandescent traffic light bulbs with light emitting diodes (LEDs) that used 14 watts each in 13,000 traffic lights.

(a) How many kWh does one of these LED traffic lights use in one year?

(b) How much does the electricity for one LED traffic light cost per year?

(c) How many dollars per year in electricity costs does Denver save per traffic light using LED instead of incandescent?

(d) How many dollars per year in electricity costs does Denver save in total?

5. Total United States Electricity and CO_2

According to the CIA World Factbook, the US produced 4.1 trillion kWh of electricity in 2016. Let's estimate how many tons of CO_2 were put into the atmosphere producing all this electricity.

8. (a) At 1.4 lbs CO2 per kWh, about how many pounds of CO_2 were emitted making all this electricity?

(b) How many tons is this? Round off your answer to to one significant digit and use the word millions, billions, or trillions.

(c) Communicate. What have you found out about CO2 emissions from US electricity? Explain your result in a clear and accurate sentence.

(d) Reflect. Give one adverse effect coming from all this CO_2.

9. Determine how much CO_2 emissions Denver saves with their new LED lights every year.

(a) How many kWh/year saved per light?

(b) How many kWh saved in total?

(c) About how many **tons** of CO_2 were kept out of the atmosphere every year?

10. Reflect. Give two big benefits from using less electricity.