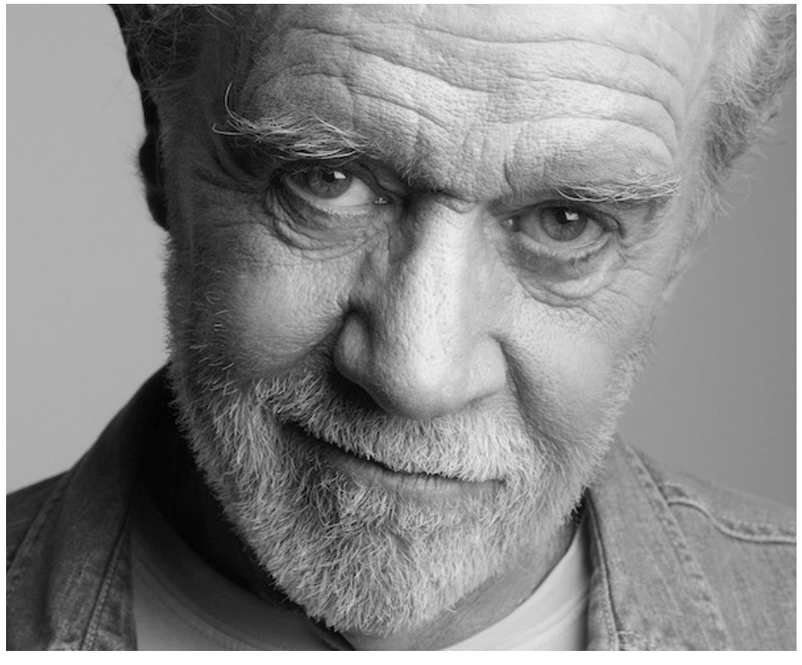
Electricity is really just organized lighting.

George Carlin



Arizona State University
SES 194

Energy in Everyday Life

Order of Magnitude Estimate

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How much electrical energy does the average Arizona household use in a year?

Our guidelines for making an order-of-magnitude estimate:

* *Guess*
* *Talk to your gut*
* *Divide and conquer*
* *Lie skillfully*
* *Punt*
* *Use guerrilla warfare*
* *Lower your standards*
* *Cross-check*

GUESS

I know the annual US energy usage is ~ 10^{20} J, and the US population is ~ 3×10^{8}, so I'll guess ~ 10^{12} J, not too big but not too small, for the average annual Arizona household electrical usage.

GutCheck

My average monthly electrical bill is about $150.

I'll assume my monthly electrical usage is close to the average (*Lie Skillfully*). Some will use less, such as single person apartments, and some will use more, such as multi-person large mansions, but I'll assume mine is comfortably in the middle range.

I know the average price per kW-hr across the USA is ~$0.10. Some states are higher, some lower, but I'll assume this average price point for Arizona.

The average monthly Arizona household uses

$150/month ÷ $0.10/kW-hr = 1500 kW-hr/month

So the annual usage is

1500 kW-hr/month × 12 months/year ~ 15,000 kW-hr/year

One kW-hour is ~4 million joules, so an estimate is (15,000 kW-hr/year) × (4 ×10^6) J/kW-hr ~ 60,000 ×10^6 ~ 10^{11} J/year.

So my guess was “only” off by a factor of 10.
Perfectly fine for an initial guess.

Going back to my original guess, the annual US energy usage is ~ 10^{20} J/yr.

Most of that usage probably comes from industry, perhaps 100 times more than what households use. So, say households use ~ 10^{18} J.

The US population is ~300 million. I'll assume, on average, this means 100 million, 10^{8} ,households.

So, the annual energy usage per household across the USA is~ $10^{18} \div 10^{8} = 10^{10}$ J/yr.

I'll assume Arizona is in line with the USA average.

This is close to the estimate of ~ 10^{11} J based on my monthly electric bill.

I'll split the difference. My final estimate is ~ 5 × 10^{11} J.

How did we do?

From the US Energy Information Administration website
http://www.eia.gov/tools/faqs/faq.cfm?id=97&t=3

In 2012, the average annual electricity consumption for a U.S. residential utility customer was 10,837 kW-hr. Louisiana had the highest annual consumption at 15,046 kW-hr and Maine the lowest at 6,367 kW-hr.

The order of magnitude estimate of ~15,000 kW-hr for an average Arizona household is ok.

Energy: 110 Orders of Magnitude