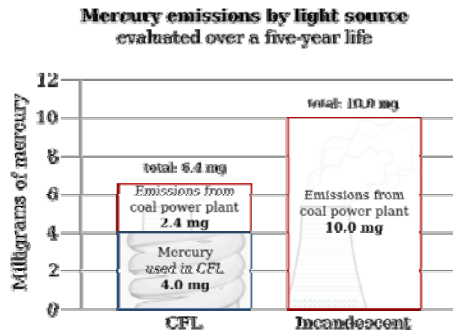


CFL's or not...

The short answer (from Wikipedia):

(http://en.wikipedia.org/wiki/Compact_fluorescent_lamp)



The detailed answer (which would get you full credit):

1. How much Hg is in a bulb?

less than 5 mg in a sub 25W CFL, ultra low Hg bulbs: 1 mg

(http://en.wikipedia.org/wiki/Compact_fluorescent_lamp)

2. How much energy does it use ?

assume: 100 W incandescent bulb
20 W CFL

5 year life span, 8 hrs/day

total burn time: 5 (years) * 365 (days) * 8 (hrs) * 60 (min) * 60 (sec) $\approx 5 \times 10^7$ sec

total energy used:

incandescent : 100 J/s * 5×10^7 s = 5×10^9 J

CFL: 1/5 of that = 1×10^9 J

3. How much coal do we have to burn ?

energy content of coal: 24×10^6 J/kg (CRC handbook)

coal burned for incandescent bulb: 5×10^9 J / 24×10^6 J/kg ≈ 200 kg

coal burned for CFL: 1/5 of that: ≈ 40 kg

note: that assumes a best case scenario of a 100% efficient power plant. Most coal burning power plants have efficiencies around (or below if they are old) 30 - 40%, so we might have to multiply that amount by a factor of 3 (that still ignores any losses during transmission etc.)

4. How much Hg do we emit ?

Hg content of Indiana coals: approximately 0.1 mg / kg

(<http://igs.indiana.edu/Geology/coalOilGas/mercuryInCoal/index.cfm>)

incandescent: 600 kg * 0.1 mg/kg = 60 mg

CFL: 120 kg * 0.1 mg/kg = 12 mg + 5 mg (from bulb)

5. So what ?

assuming that these numbers are correct, using a CFL makes you come out ahead quite a bit, provided that you get all your electricity from coal burning power plants, and Indiana coal is representative.

Note: This balance shifts towards incandescent bulbs if your electricity does not come from coal-burning plants.

6. Final Comment

the purpose of this exercise was NOT to arrive at a set of numbers identical to mine. It was way more important to reason your way through the problem, show the assumptions that you made along the way and how you got your numbers.

To get full credit you have to do the right thing (not screw up the logic of your argument) **and** present it in a way that is understandable. I expect that you tell me what you're doing and why you are doing it and, yes, I expect units as well.

You also might have noticed that I have rounded a couple of times. This seems justified because we did a quick back-of the envelope calculation. The numbers of my estimate are quite different from the ones quoted in Wikipedia. Why might that be? Is my estimate likely too high or too low?