Cars: Part I

Physics and Mathematics of Sustainable Energy

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A few facts:

- Gasoline: 10 kWh per liter or 38 kWh per gallon (thermal).
- Average gas mileage for car in US: 25 mpg, but this ranges considerably.
- mpg = miles per gallon
- Carbon intensity of gasoline: 240g per kWh (thermal).
- Burning one gallon of gasoline[1] releases around 9 kg of CO_2.
- Carbon intensity of electricity in grams of CO_2e per kWh of electricity:
  - US: 350
  - Ecuador: 210
  - India: 710

1. Suppose you drive 20 miles each way to work every workday in an average US gas car.
   (a) How much gas does this use?
   (b) How much energy does this use? Answer in kWh per person per day. Is this a lot or a little?
   (c) How much carbon dioxide is emitted by the car in one year? Answer in tons per year. Is this a lot or a little?

2. Suppose you buy a 10kW (nameplate) solar PV system.
   (a) How much electricity will you generate in one year? Assume a capacity factor of 0.12.
   (b) Assuming that the solar PV saves 300 grams of emissions for every kWh, how much CO_2 will have been prevented due to your purchase of the solar PV panels?

3. Suppose you have two lights on your desk that you leave on for an average of 2 hours a day. You switch from a compact fluorescent bulbs that draw 14 watts to LEDs that draw 7 watts.
   (a) About how much energy will you save in one year?
   (b) How much less CO_2 will be emitted as a result?
   (c) How far would you have to drive to emit an amount of carbon dioxide equivalent to that which you saved by switching bulbs?

[1] This varies, mainly because gasoline is not standard. In different countries it's a different mix of chemicals.