

Cars

Physics and Mathematics of Sustainable Energy

College of the Atlantic

A few facts:

- Gasoline: 10 kWh per litre or 38 kWh per gallon
- Typical gas mileage for car: 30mph, but this ranges considerably.
- Carbon intensity of gasoline: 240g per kWh.
- Burning one gallon of gasoline releases around 9 kg of CO₂.
- Burning one liter of gasoline releases around 2.4 kg of CO₂.
- Carbon intensity of electricity generation in the US: let's use 400 g per kWh. (This varies around the country and from day to day depending on the particular mix of electricity on the grid at any one time.)

1. Suppose you drive 20 miles each way to work every workday in a typical 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 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 CO₂ 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?
3. Let's compare driving 1000 miles in conventional and electric vehicles.
 - (a) In the conventional car, how much gas does this use?
 - (b) How much does this gas cost?
 - (c) How much CO₂ is emitted by the car?
 - (d) How much of the thermal energy released when burning the gasoline goes into the kinetic energy of the car? Assume that the car's engine has an efficiency of 0.25.
 - (e) How many kWh of electricity would be needed by an electric car to go 1000 miles. Assume that the efficiency of the electric car is 0.85.
 - (f) How much would this electricity cost?
 - (g) How much CO₂ would be emitted as a result of generating this amount of electricity, assuming the US average carbon intensity.
 - (h) How much CO₂ would be emitted as a result of generating this amount of electricity if the electricity was generated in a coal-burning power plant with an intensity of 1 kg/kWh?