

More Cars

Physics and Mathematics of Sustainable Energy

College of the Atlantic. October 28, 2022

A few facts:

- Gasoline: 10 kWh per litre or 38 kWh per gallon
- Typical gas mileage for car: 25mph, but this ranges considerably.
- Carbon intensity of gasoline: 9 kg per gallon.
- Carbon intensity of electricity generation in the US: 350 g per kWh.
- Carbon intensity of electricity generation in West Virginia: 880 g per kWh.
- Carbon intensity of electricity generation in Sweden: 12 g per kWh.

1. 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 0.20.
- (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 0.75.
- (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 West Virginia?
- (i) How much CO₂ would be emitted as a result of generating this amount of electricity if the electricity was generated in Sweden?

2. Suppose you fly from New York to California twice in a year.

- (a) Flying takes roughly 40 kWh per 100 person-kilometers. Estimate how much energy this takes. What is this in kWh/day? What is this in kW? Is this a lot or a little?
- (b) Very roughly, the direct emissions associated with a flight are 0.1kg of CO₂ per km per person. What are emissions associated with two NY to California flights? Is this a lot or a little?