# Stuff

Physics and Mathematics of Sustainable Energy

College of the Atlantic.

1. Estimates vary, but the energy associated with making a car is roughly 100 GJ.

   (a) If you own the car for ten years, what is this energy cost in kWh/day? What is the carbon cost in tons of $CO_2$ per year?

   (b) If you burn a gallon of gasoline, how much $CO_2$ is emitted?

   (c) Burning how much gasoline would release as much $CO_2$ as was released in the making of the car?

   (d) How far could you drive with this amount of gasoline?

2. Vaclav Smil[1] estimates that the embodied energy in a smartphone is 0.25 GJ.

   (a) If you own the phone for two years, what is this energy use in kWh/day?

   (b) Smil estimates that a smartphone annually consumes 4 kWh of electricity. How much would this electricity cost in Maine? How does the yearly energy use of the phone compare to the yearly energy consumption of the phone?

3. A 2MW turbine requires around 80 tons of steel.

   (a) How much energy would such a turbine produce every month?

   (b) How much $CO_2$ is saved by the turbine, assuming that its electricity displaces electricity generated in the U.S?

   (c) What is the embodied emissions in the steel in the turbine?

   (d) What is its carbon payback time?

4. Mike Berners-Lee[2] cites an estimate that the carbon cost of building a new, two-bedroom house is 80 tons. Let's round this up to 100 tons.

   (a) Assume the house lasts for 100 years. How much carbon dioxide is this per year?

   (b) How much fuel oil, per year, would generate the same amount of carbon dioxide?

   (c) Discuss the relative merits of insulating a very leaky house or tearing it down and building a new one.

[1] Smil, Vaclav. "Embodied energy: Mobile devices and cars [Numbers Don't Lie]." *IEEE Spectrum* 53.5 (2016): 26-26.

[2] Berners-Lee, Mike. How bad are bananas?: the carbon footprint of everything. Greystone Books, 2011.