Riding Vs Walking,

Notes by Tim Gutowski, April 7, 2011

All references are to "Energy, A Beginner's Guide", Vaclave Smil (2009)

1. On page 167 Smil gives the energy requirements for driving an efficient compact car (about 6 liters/100km or 40mpg) as 2MJ/km or nearly 30kJ/kg for a 70 kg driver to travel 1 km.
   He then states that an adult (70 kg) briskly walking the same distance (1km) would need 250kJ or 3.5kJ/kg.

   The conclusion is that it saves energy to walk rather than drive. (Not a surprise to most of us)

2. **To estimate the walking energy:**

   a) assume a 2500 kcal diet (p.153)
   b) a physical mark up from say 1.4 to 1.6 (p. 71) for light labor (which we will guess means walking 5 km a day)

   this gives $2500kcal \times \frac{1.6-1.4}{1.4} = 300kcal$

   or 60 kcal/km, or 252kJ/km

   This agrees quite well with Smil.
   (Note also the runner's rule of thumb of 100kcal/mile= 62.5 kcal/km.)

3. **Now estimate the energy to produce gasoline and food.**

a) the energy cost of producing gasoline is only about 15% or 20% of the energy content of gasoline.
b) The energy to produce food can be much higher and more variable.

We do this last calculation in two parts; 1) how much of what food do we need to supply the 60kcal or 250kJ the walker needs per km, and 2) how much energy was needed to produce that amount of food.

According to Smil (p.68) the energy content of fish ranges from 3 to 9 MJ/kg. If we assume 6 kJ/g we need 250/6 = 42 grams of fish (1.5 oz).

Later in the book (p. 180) Smil says it takes roughly 1 toe/t of fish caught or 42kJ/g. Assuming about one half of this weight makes it to the plate (and ignoring transportation, processing, refrigeration, cooking and cleaning up with hot water), we estimate 84kJ/gram of fish on the plate.

Hence $84\frac{kJ}{g} \times 42g = 3.5MJ/km$

Compare this energy requirement for walking (3.5 MJ/km) with 2 to 2.4 MJ/km for driving in a car, and now you see the conclusion has flipped. It now looks energy saving to drive rather than walk!

4. Obviously, there are many variations on this theme which could be calculated (e.g. larger car, more passengers, different diet, health effects of walking etc.) but the bottom line is this is quite surprising. Clearly if you get your calories from your own garden the calculation will favor walking. The main message here is that the energy intensity of food production has become very high. So high in fact that it reverses what one might think of as common sense.