

World Energy Usage

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Introduction

This report examines the Earth's ability to support the current human population. Specifically, can the Earth sustain human life if everyone in the world consumed enough energy to make themselves happy? I use a recent academic survey to classify individual happiness, utilize this measure to assess the current status of the United States population, and subsequently extrapolate these numbers to identify the potential consumption of the entire world.



Fig. 1: Images of minimum sea ice concentration for 1979 (left) and 2003 (right). (Courtesy of [NASA](#). [10])

Motivation

There is clearly a lot of literature surrounding the issue of US vs. global consumption; popular websites will even calculate your total global footprint, but I am interested in sufficiency. [1] If it was globally distributed, do we currently generate enough energy to satisfy the world's demand? How much do we actually need to generate to live satisfying lives?

Kahneman and Deaton have recently proposed that happiness - one's everyday satisfaction with life - saturates at an income level of \$75,000 (\$US). [2] They used several quantitative measures to show that, while Americans will rate their overall satisfaction with life continuously higher depending on their income level, their actual day-to-day happiness stops increasing after \$75k. This level of income is thus a present-day metric of how much a household must consume to be happy in the US.

The Energy of Happiness

Let us now make the simple assumption that income is proportional to energy consumption and ask how much energy the US would have to consume to make all Americans happy. The present mean household income in the US is \$67.8 k. [3] It would thus have to increase by the factor

$$\frac{\$75.0 \text{ k}}{\$67.8 \text{ k}} = 1.106$$

to satisfy the Kahneman-Deaton criterion. According to the CIA World Factbook, the US consumed $1.17 \times$

10^{20} joules in 2007. [4] The energy required to make all Americans happy in 2007 would have been

$$1.106 \times 1.17 \times 10^{20} \text{ joules} = 1.29 \times 10^{20} \text{ joules}$$

or just 11% more than the U.S. actually consumed.

World Happiness

Using the same reasoning, we may now calculate how much energy would be required to make everyone in the world happy. According to the CIA World Factbook the U.S. and world populations were 3.07×10^8 and 6.78×10^9 , respectively. [4] The amount of energy required to make all 6.8 billion people happy would then be

$$\frac{6.78 \times 10^9}{3.07 \times 10^8} \times 1.29 \times 10^{20} \text{ joules/year} = 2.85 \times 10^{21} \text{ joules/year}$$

or 5.7 times the actual world energy consumption in 2007 (5.0×10^{20} joules). [4,5] A 6-fold increase in energy consumption would, of course, mean a 6-fold increase the annual CO_2 emissions for the world coming at a time when the safe global concentration for CO_2 in the atmosphere (350 ppm) had already been exceeded. [6-10] According to The Worldwatch Institute, the consequences are potentially dire:

"Even if emissions slow, their tendency to raise temperatures lasts long into the future. CO_2 concentrations are expected to rise for decades after emissions peak, and temperatures could continue going up for centuries, depending on when emissions stabilize. A 2008 study calculated that even if greenhouse gas concentrations in the atmosphere stabilize at 2005 levels, it would be impossible to avoid a total warming of 1.4 - 4.3 degrees Celsius above preindustrial levels by the end of this century." [6]

Conclusion

One could use the US calculations to contend that moderate consumption brings happiness and that the US has done well to enable its inhabitants to reach this level. The report numbers used are averaged and hide an interesting detail. The 2009 median household income was only \$50, 007. [3] Half of the households in the US make roughly \$25,000 less or 2/3 the needed income to be happy.

In any event, the Earth cannot support everyone consuming at the \$75,000 level. People of other cultures, with their unique norms and memes, may not need to consume at this level to be happy. This might be a trait specific to the US. Perhaps other nations can find happiness in culturally specific manners without having to develop to the US level. What are we working for, if it is not happiness?

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