Entropy for Dummies - Global warming and Entropy

Bob Thomson, Ottawa, 3 March 2009

Entropy is a measure of the amount of energy no longer able to be converted to work.

The First and Second Laws of Thermodynamics state that the total amount of energy in the universe is fixed, and that new energy cannot be produced.

Energy can only be transformed from one form to another, and in one direction only, i.e. from useful energy to energy that is no longer available for "work".

For example, burning coal or falling water can be transformed into motion or electricity, but ashes and lower level water cannot be reused again without using other sources of energy.

Evolving energy/entropy paradigms

It took hundreds of thousands of years for Homo Sapiens as hunter-gathers to largely exhaust the supply of wild animal and vegetable food sources using progressively more efficient tools, a period during which world human population grew and grew.

Population pressures generated a new energy paradigm in the transition to sedentary agriculture, which permitted storage of food energy and over millennia led to specialization and increased complexity within the human population.

It took thousands of years before the human population outgrew the agricultural energy paradigm. The reduction of forests and wood sources in Europe in the Middle-Ages, the limits of domesticated animal energy on land utilization, population pressures and other factors pushed the development of new but still finite energy sources such as fossil fuels to satisfy changing and growing human "needs".

The industrial "revolution", after only a few short centuries now, has expanded the consumption and transformation of finite energy to the point where the byproducts and waste of energy production and use are now serious limits on global productivity and further growth, not to say toxic and disruptive of the climate and environment of the entire planet.

- The area of the earth available to produce our resources & capture our emissions is 2.1 ha. per person average - "global" hectares
- The average per person footprint is 2.7 global ha. while only 2.1 global ha. are available
- US citizens each require an average of 9.4 global ha or nearly 4.5 Planet Earths if everyone had US consumption patterns
- Chinese citizens use on average 2.1 global ha per person (one Planet Earth)
    - see https://tinyurl.com/eco-foot-prints for these figures

It takes 9 calories of vegetable food "energy" to produce 1 calorie of animal food "energy". An average person needs 2000 calories per day to survive. In our industrial society, this takes 16,000 calories of fossil fuel energy to produce, transport and/or manufacture. Hunter gatherers took only 15 hours a week to meet their needs, i.e. 180 calories to produce 2000 calories! (source?)

In a practical sense, the Second Law of Thermodynamics and the concept of ENTROPY mean that we do not have unlimited sources of energy to fuel further economic growth. The energy we currently derive from hydrocarbons (coal, oil and gas) are the result of millions of years of accumulation of incoming solar energy via plant photosynthesis and compaction, on an essentially finite planet.

We have now reached, or will soon reach, the point of "peak oil", i.e. the point at which we extract and use hydrocarbon resources faster than we find new sources or develop more efficient technologies to use them. Synthetic or agro-fuels and new materials made from carbohydrates vs hydrocarbons (e.g. grown vs extracted) are subject to the same limits of entropy.

Is new technology the solution? Yes/Maybe/But...

In 1865, English economist William Stanley Jevons discovered an efficiency paradox: the more efficient you make machines, the more energy they use. Why? Because the more efficient they are, the better they are, the cheaper they are and more people buy them, and the more they'll use them. Alec Dubro, The Myth of the Efficient Car

"Decroissance" - Degrowth – No-Growth

There is a growing civil society movement advocating degrowth, eco-economics and many variants of a zero or even negative economic growth or a steady-state approach. Voluntary simplicity is a key tenet for most of this movement, advocating less work, more satisfaction from social "consumption" than material consumption. This doesn't necessarily mean a return to the cave. We need somewhere between the 180 calories of hunter-gathers and the 200,000 calories of industrial society to produce the 2000 calories we need each day to physically survive. A major paradigm shift should be possible once we learn to distinguish between human "wants" and "needs" and to cooperatively redistribute the existing over-accumulation of production, infrastructure and income.

We need a new "3 Rs".
Renounce – Redesign – Rebuild
Because Reduce, Recycle and Reuse won't be enough

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