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Energy sources, control, global warming, what must be done and a possible role for 'sundownloaders'

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Abstract

Global warming is a genuine threat to human survival, though causes and therefore also solutions are more subtle, complex and difficult than usually supposed. Burning fossil fuels is a contributor; also 8 billion humans breathe out about 2 billion tons per year of carbon dioxide, just to stay alive; yet total human energy usage is a tiny fraction of solar radiation energy received by our planet. Standard reactions so far are inadequate, costly, dangerous and mis-directed.

An essential internationally-agreed programme to deal with the crisis must include reduction of the human population, better use of solar radiation, and a colossal research effort to find better ways of trapping atmospheric carbon dioxide and converting it into hydrocarbons - so as to achieve at least carbon-neutrality and yet allow use of much the most efficient means we yet know to both store energy and have it ready to hand. The alternative to such a programme is world-wide economic, political and biological disaster, including possible extinction of Homo sapiens.

Sundownloaders may make a useful contribution in one area - making better use of solar radiation. It is already clear that food production using artificial light cannot provide enough at low enough cost to feed the present human population.

The present global warming process, its causes and consequences, are the subject of millions of words per day in paper and internet media communications, but with no sign of deep understanding: this paper is intended to clarify and balance the problems from a serious practical viewpoint, offering serious suggestions about what really should be done by individuals, organisations, businesses, politicians and governments around the world. Global warming is real, its causation not as simple as some make out. Humans need energy from food, merely to survive, and the more humans exist the greater is that requirement. The quantity and cost of energy requirements for social and business functions are often obscured or misrepresented: here we shall challenge what are often unwarranted assumptions and proposals, making new ones. Yes, there is room for disagreement: yes, any statement whatever can be questioned and the truth can only be established if that is done and the argument judged without prejudice; Science, not self-advertisement, not propaganda.

Keywords: Energy; Solar; Sundownloader; Control; Population; International

1 Global warming and related phenomena

Planet Earth is warming up, on average, over-all, although because of the tricks of our atmosphere this may actually give rise to spells of cold weather at particular times and locations, including several episodes during the last two years in Britain. Why the warming? Undoubtedly a contributing factor is increasing concentrations of so-called greenhouse gases

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such as carbon dioxide and methane, which have a proven effect of reducing the amount of radiant energy from the Earth's surface that is able to escape into outer space. Two questions: The Earth really radiates energy? - Yes, every physical body does that and the amount and wavelengths involved vary with the surface temperature of the body in question; this has been known since the work of Max Planck over 100 years ago. Where do the greenhouse gases come from? People have been told and most believe that the sources are human use of fossil fuels and the belching of cows: both no doubt contribute, but other things must be taken into account and are now described.

- Other animals including wild deer and humans belch and/or fart methane.
- To survive every human must use about 2000 kCal per day which requires breathing out about 700 grams of carbon dioxide, over 250kg per year. For 8 billion humans that comes to 2 billion tons of carbon dioxide per year. And how much for all other animal life? (And, yes, much more is released by our use of carbon-based fuels).
- Global warming episodes occurred many times before our species, *Homo sapiens*, existed and from time to time the warming process reverses, and has done so often in the history of our planet. Cooling episodes, Ice Ages, have alternated with warming episodes and similarly have had huge impact on both animal and plant species, their distribution and how they survive change. Causation and mechanisms? Our knowledge over all of this area is extremely limited - in brief we don't know even a half of what we need to know.
- Huge amounts of methane are trapped in Arctic 'permafrost' ground and this is released when the permafrost melts.
- That is, Earth temperature is not in stable equilibrium: any warming is magnified because of this phenomenon. Something similar works for carbon dioxide.
- Sea levels also change, reflecting how much of the world's water (the reason why there is life on Earth, and maybe no-where else at present) is frozen at any particular time.
- The total amount of radiant energy from the sun which falls upon the Earth (measured at the top of the atmosphere, where intensity is not diminished by absorption or back-reflection) is several thousand times the total of all human energy usage, including that obtained by burning fossil fuels. The basic facts here also have been known for well over 100 years: modern measurements of the 'solar constant' differ little from those of Kelvin: and it is well understood that wind energy derives from solar warming of the Earth's surface.

2 What are the real, total, social, and financial costs of energy for human use, from various sources?

Common propaganda has it that electricity sourced from wind, tide, solar, geothermal or hydroelectric sources is cheaper than that obtained by burning oil, natural gas, coal or other fossil fuels, or from nuclear power plants. No financial analysis known to the author justifies that assumption: the capital investment required is, in every case, colossal and for the first three at least the production of electricity is intermittent so that provision must be made for storage of energy until it is required, and/or long-distance transmission to take account of the way that human activities vary over the 24 hours of day and night. No *prima facie* economic or social case has been made: we must conduct the discussion about costs on a rational basis (even if somewhat imprecise): those crude assumptions are not good enough.

3 Storage of energy, other than fossil fuels

What sources of energy (especially energy to be delivered in the form of electric power) may be formed under human control and then kept at hand until needed?

- Hydrogen and other combustible gases.
- Liquid hydrocarbons made by chemical synthetic processes or derived from living organisms grown for the purpose (especially algae).
- Plant-based, solid carbonaceous materials including wood.
- Water pumped to a height then used for generation of electricity.
- Similarly other heavy materials moved to a height and producing electricity by a mechanical contrivance as they move down under gravity.
- Gas under pressure.
- Nuclear materials including those artificially made if that becomes practical.

4 How stored energy is used, simplicity, convenience, cost, dangers, fields of application

A huge essay could be written about this, though the subject matter is mostly obvious. Let us simply point out here that batteries are heavy and bulky (as are gas cylinders): compressed gas is dangerous: stored gas (low pressure) distributed through pipes has been widely used for nearly 200 years: liquid hydrocarbons are readily stored and transported and the energy yield on burning is high: although battery-powered flight has been achieved it will not, cannot, replace the jet-powered airplane for long-distance flights. Battery power works quite well for motor-cars over short ranges; otherwise much the most convenient, cheap, widely-usable, reasonably-safe energy source for personally-independent mobility is liquid hydrocarbon fuels - unlikely to be supplanted within the next 100 years - and they serve also for stationary electrical-power plants though in that case there are many alternative, including piped gas (and the same can be said of energy for domestic use).

About hydrogen: this gas is easily made from surplus electricity by electrolysing water and the notion is wide-spread that it can serve for the production of electricity where required by use of 'hydrogen electrodes'. That isn't going to work any time soon because of the very low solubility of hydrogen in water and its slow reactivity with electrode surfaces. Use of hydrogen cannot be (not yet) a simple reversal of its production from electricity.

5 Carbon-zero, carbon-neutrality.

To use absolutely no carbon-based fuel may be an attractive idea but would make it impossible to support human populations and societies anything like what exists now, which would immediately collapse. Something like that may happen anyway because of the underlying, non-human, global-warming process, and we must be prepared. Carbon-zero would probably mean a very few remaining humans, millions perhaps but not billions, supporting themselves though subsistence farming and collecting edibles from the wild.

Carbon-neutrality is another matter. If we use only such carbon fuels as we ourselves make from atmospheric carbon dioxide then our contribution to global warming through carbon dioxide release is only the inescapable biological consequence of humans being alive. But nothing near this is even within sight: to achieve it will mean colossal research effort and one objective of this article is to emphasise that point and the need for colossal funding.

6 Production of food, photosynthesis, vertical farming.

All human food is derived from photosynthesis directly or otherwise and it is strange how very inefficient that natural process is - typically less than 1% of the solar radiation falling upon a plant emerges as the chemical energy of plant products[1]. Vertical farming (VF) is widely-popular because of the idea that it can replace ordinary agricultural production of foodstuffs - and there will be a contribution, no doubt - but if we are talking about VF based on artificial light there is already ample evidence that the cost of electricity alone will make it impossible to feed the world that way, and what's more the strongest such evidence is from the admirable originator of the phrase "vertical farming", Dr Dickson Despommier, whose group calculate that the cost of electricity (priced at US$0.02 per kWh) to grow wheat by VF might be as low as US$7.99 per kilo[2]. Several points follow:

- That is already about 40 times the bulk price of wheat (delivered free on board ships at ports in the southern USA) in 2017.
- Commercially, electricity costs 5 to 20 times more than that, so the cost of electricity alone (from ordinary sources) would be some 200-800 times the historical bulk price of the world's major staple food.
- Other costs, in total, are predicted to be equal to or greater than the electricity.
- To understand Dr Despommier's approach:- he favours local, dedicated production of electricity, e.g. geo-thermal, for the purposes of VF so the low price-per-unit quoted is more reasonable than it seems; though the capital cost of providing electricity by those dedicated means is not discussed.

In apparent conflict to that analysis; there are already profitable VF producers and artificial light is widely used both in VF and more conventional greenhouse horticulture! A simple explanation - the products concerned are of high value, high water content but low calorie content. They are appreciated, used and consumed by humans but contribute little or nothing to the requirement of 2,000 kCal/day (lettuce, herbs and tomatoes are about 95% water). It is the author's personal belief that VF will contribute substantially in future to that essential food supply, but not using artificial (electric) light: there are alternatives.

7 What must be done?

From the above it should be clear already that carbon net-zero (carbon-neutrality) is nothing like enough to solve all the problems in sight. More than that, even to abolish the burning of all carbon-based fuels is not guaranteed to stop global warming. The outline proposals here therefore begin with ideas about what should be done anyway, to preserve our species whatever happens, followed by relatively minor suggestions for actions (at costs of no matter how many billions of dollars) which may contribute to that ultimate objective. The first two will be needed anyway even if the others work really well.

- Prepare for economic disaster, starvation and mass-migrations. This requires politicians and political thinking far beyond anything yet seen anywhere, enormous advances in the structure and functions of the United Nations with international cooperation of world-wide scope including for research and economics. The alternative is world-wide war. We cannot afford national leaders like Trump, Putin, Johnson and the rest. We cannot afford selfishness and fascistic arrogance (even of ordinary people, cyclists, extinction rebellion activists and the like; not even of the multi-billionaires), nor religious interference in the essential steps.
- Reduce the human population of the world. Perhaps aim at 2 billion, or less; about where it was 100 years ago.
- Improve the energy-efficiency of food production both by genetic engineering and making better use of sunlight.
- Research at whatever cost to achieve at least carbon-neutrality, or beyond that if it proves possible. Here too we are looking for better use of sunlight.
- Control waste-disposal and pollution: use land-fill waste to build sea-walls where they will be needed, like in Britain.

8 Better use of solar radiation?

Is there any question? Life on Earth (and all our fossil fuels) have been and still are based upon radiant energy from the sun. We are probably facing a crisis as explained above and must find ways to improve the efficiency of how we use of day-to-day solar energy, reducing our dependence on what was received millions of years ago. What are the problems?

First and obvious is that radiation intensity as received at the Earth's surface varies with latitude, season and time of day; variation greater than first seems likely because low-level sunlight must pass through a thicker layer of atmosphere and we must add the effects of weather and atmospheric pollution. Second, full-intensity, overhead sunlight is too much for many things, including plants as they have evolved (few species flourish or even survive at 50% of maximum intensity: most crop species do best at 10-20%). Third the temptation clearly exists to maximise electricity production or other forms of energy output, summed over the whole 24 hours period, and thus concentrate on mid-day; orienting solar panels accordingly; whereas our need for energy is greatest late and early in the day, and at night.

And what are the solutions?

- Battery and other forms of energy storage, as described: costly, and not good enough.
- Use moving reflectors to follow the sun: high expense, both initial and for operation.
- Redirect low-level sun to improve its effects just when most needed and most beneficial economically, The recently-invented Sundownloader does this with reflectors of unique, novel shapes such that, although stationary, they redirect light to a chosen target area all through a defined period of use that may be all year long: inexpensive to make, instal and operate. It is not claimed that they will serve all purposes nor be the only system in use, but especially in respect of small domestic installations and to improve crop yields they surely will contribute. Horticulture experts cheerfully concede that to add solar energy to a greenhouse amounting to just 10% of full sun intensity (200 PAR units) will double output. That seems definitely attainable. And if a solar panel installation could produce even 10-20% extra electricity, nearly all in the early morning and late evening?

In short, sundownloaders are worth trying out and if they contribute even 10% of the extra and better-timed electricity that the world needs, and 10% extra crop yields, that will be a colossal success. What is more, they are neither ugly nor intrusive, which solar farms, wind turbines and solar thermal power stations certainly are. Do we really want the North Sea to be full of windmills? How could we then sail across, as I first did 70 years ago, in a boat without a motor?

9 Other research and development

As hinted above, even greater needs are to find economic and acceptable means to convert atmospheric carbon dioxide into liquid hydrocarbon fuels and/or to exploit stored hydrogen directly for electricity generation, efficiently. Surely, both can be done. Proof is lacking that either can be done at low enough cost to be useful - so nothing unreasonable in a closing proposal that 10-20 billion US dollars should be set aside to support such research, anywhere in the world, in such manner that no one person or corporation profits from success. The whole world needs this, by all means let the whole world pay.

10 Conclusion

There is no doubt that a huge and internationally-agreed effort is required to mitigate the impact of global warming upon the human species. This is established, even though it is not clear that human use of hydrocarbon fuels and other wasteful activities have caused the warming or even contributed to a significant degree. One element of the response must be to make better use of the solar radiation that falls on our planet; another is to reduce the human population of the planet.

Compliance with ethical standards

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References

[1] https://trcboyde.net/assets/files/Downloading%20the%20Sun.pdf.

[2] https://trcboyde.net/assets/files/Concept,%20Definition,%20Economics%20of%20Vertical%20Farming%20-%20T%20R%20C%20Boyde.pdf