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PARALYZED WARMING WORLD

Alexander Ač[*]

Introduction

Climate scientists have been in doubt for many years if increasing concentrations of greenhouse gases (GHG) are the cause of most of the global warming during the last century (i.e. surface air temperature increase by 0.75 °C). Now they know that this warming is not caused by sun activity or any other natural climate factor, and are aware that urgent action to reduce global emissions of greenhouse gases is needed in order to prevent irreversible and dangerous changes of our planet. And they also know that significant changes in climate have already been observed that can be attributed solely to global warming. However, this article will also argue that we are unlikely to see a significant reduction in GHGs in the near future, in spite of the planetary emergency.

I. Climate Paralysis

The last time the concentration of carbon dioxide (CO_2) reached today's level was 15-20 million years ago[1]. At the same time, rate of CO_2 increase is much faster now than it was at any time during the last 800 000 years. During the transition between ice ages and interglacials the average rate of CO_2 change was about 0.0001 p.p.m. (particles per million) per year, whereas today's current rate of change is 2 p.p.m. per year (i.e. 20 thousand times faster). Every day we emit about 100 million tons of CO_2, the equivalent to a large volcano eruption every two days. In the last decade, increase in carbon emissions was more than 3.3 % per year and carbon emissions in 2008 were 40 % higher than in 1990.[2] Thanks to the thermal inertia of climate system, especially of oceans, time lag between the actual CO_2 and its full climate effect is approximately 30 years. In other words, even if we stop all emissions of GHGs immediately, anthropogenic climate change will continue for 30 years or so. Even more troubling, humanity is not only emitting gases that warm the atmosphere, but also particles that cool the atmosphere, known as

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[*] Dr. Alexander Ač is a researcher in Laboratory of Plants Physiology of the Academy of Sciences of the Czech Republic. His research interest lies in plant ecophysiology, global climate change and energy systems

[1] *AK Tripati, CD Roberts, RA Eagle, 'Coupling of CO_2 and Ice Sheet Stability Over Major Climate Transitions of the Last 20 Million Years'*, Science *2009, pp 1394 – 1397.*

[2] I Allison et al., 'The Copenhagen Diagnosis 2009: Updating the world on the Latest Climate Science.' The University of New South Wales Climate Change Research Centre (CCRC), Sydney, Australia, 60 pp. Online at: www.copenhagendiagnosis.org (last accessed on 20 February 2010)

aerosols. A recent study,[3] incorporating the most current knowledge of aerosols and clouds, has shown that inevitable rise in surface temperatures might be 2.4°C compared to pre-industrial period, which is much more than previously thought. This warming will occur if aerosols emissions are to be eliminated. It is now believed that such a temperature increase might trigger many irreversible events, such as disintegration of Greenland ice sheet, or the loss of summer Arctic ice or Himalayan glaciers. This may also lead to a reduction in global food production. In fact, there is good evidence that climate change is already affecting food production in many parts of the world. For instance, south-eastern Australia experienced three record heat waves within the last two years[4]. There is virtually no probability this could happen without a significantly warming climate. As a result, water-intensive rice production in Australia practically vanished and numbers of sheep fell to lowest level since 1920.[5] In addition to the situation in Australia, this year floods and droughts in India led to a 20 % increase in food prices[6].

Up to now about only 45 % of anthropogenic carbon remained in the atmosphere. Thus, the biosphere is helping us to mitigate the rate of climate change. But this free service might not last forever and in fact there are early signs the global carbon sink is weakening. According to a recent study, the ability of warming oceans to soak up carbon might be decreasing[7] and this will be increasingly true also for terrestrial forest ecosystems, as growth of trees will be damaged by higher frequency of droughts.[8] Another threat to forests resulting from warming is larger and/or more frequent pest outbreaks. We have already seen examples from managed forests in Canada where the carbon sink is turning in to a carbon source[9], and the same is true for western USA where forests are increasingly devastated by wildfires.[10] Such observed changes are expected to further continue in the future, but with increasing frequency and severity.

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[3] V Ramanathan and Y Feng, 'On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead', 2008, Proceedings of the National Academy of Science of the United States of America, pp. 14245–14250.

[4] B Brook, 'Two years, three record heat waves in south-eastern Australia', 2009 http://bravenewclimate.com/2009/11/14/three-record-heatwaves-seaust/ (last accessed on 20 February 2010)

[5] D Palmer, 'Drought has lingering impact on Australian food production', 2009 http://www.ausfoodnews.com.au/2009/05/26/drought-has-lingering-impact-on-australian-food-production.html (last accessed on 20 February 2010)

[6] BBC, 'India food prices hit 10 year-high', http://news.bbc.co.uk/2/hi/south_asia/8419799.stm (last accessed on 20 February 2010)

[7] JG Canadell et al. 'Contributions to accelerating atmospheric CO_2 growth from economic activity, carbon intensity, and efficiency of natural sinks', 2007, Proceedings of the National Academy of Science of the United States of America pp. 18866-8870.

[8] CD Allen et al., 'A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests', Forest Ecology and Management, 2009, article in press.

[9] *WA Kurz et al., 'Mountain pine beetle and forest carbon feedback to climate change',* Nature *2008, pp. 987-990.*

[10] *AL Westerling et al., 'Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity',* Science *2006, pp. 940-943.*

II. Copenhagen Paralysis

World renowned climatologist James Hansen director of NASA Goddard Institute for Space Studies state in an recent interview for The Guardian[11] that Copenhagen negotiations "should collapse," because anything being discussed there guarantees climate disaster. In 1988 Hansen was one of the first scientists who alarmed the world to then potential, and now quickly materialising dangers of global warming, which is manifested as global climate change. At the same time, many leading environmentalists, activists, policymakers, and to a certain extent also economists, see any kind of Copenhagen deal as the only possible starter for long-term decline in GHGs emissions. For instance, Nobel prize winning economist Paul Krugman defends "cap-and-trade" approach, which was discussed in Copenhagen, as the only politically feasible approach that could ensure us avoiding the worst impacts of climate change[12]. The large portion of "Copenhagen paralysis" arises from dispute over what GHGs concentration we should aim for. Even if we consider Hansen to be an outlier within the climate community, there is increasing number of scientists suggesting that reaching or even over-shooting 450 p.p.m. of CO_2 equivalent is unacceptable. One might indeed question the political, social or ethical credibility of aiming at the 450 p.p.m stabilization, given that corresponding warming might yield between 7-9 meters of sea level rise at the equilibrium state[13]. At the same time, most economists and policymakers think that 450 p.p.m is the lowest achievable long-term limit. In fact, even reaching 'disastrous' 450 p.p.m. requires peaking of GHGs emissions within 5-10 years followed by an annual decrease, such as we observed during the ongoing global recession, over 40 years to virtually zero.

Ultimately Hansen was right and the Copenhagen negotiations virtually "collapsed" when only 27 of the attending countries signed the treaty with non-binding emission targets and with no mechanisms proposed about how to reduce carbon emissions. The previously suggested target of 80% emission reduction relative to 1990 by 2050 was also not mentioned in the final statement. Some people might argue that this is indication of better climate treaty in the future, but it is more likely indicative of the fact that world leaders are not capable on agreeing on even most modest emission limitations.

III. Energy Paralysis

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[11] S Goldenberg,'Copenhagen climate change talks must fail, says top scientist', Guardian, 2 December 2009 http://www.guardian.co.uk/environment/2009/dec/02/copenhagen-climate-change-james-hansen

[12] P Krugman, 'Unhelpful Hansen', The New York Times, 7 December 2009 http://krugman.blogs.nytimes.com/2009/12/07/unhelpful-hansen/ (last accessed on 20 February 2010)

[13] PU Clark and P Huybers, 'Global change: Interglacial and future sea level', *Nature* 2009, pp. 856-857.

The climate problem is very closely related to another significant (yet much less publicised) problem, so-called "peak oil"[14]. Until recently, this was merely a theoretical concept predicting that the rate of oil extraction has to reach peak or plateau globally, after which only decrease in production would follow, irrespective of new drilling, new technology, or oil price. While large oil companies and some energy analysts claim that peak in oil production is at least two to three decades away, increasing number of prominent geologists and oil analysts insist that there is high probability of imminent oil peak, or even that we have already past the point of maximum oil production[15]. More prominently, International Energy Agency (IEA) chief economist Fatih Birol warned that peak oil will be reached by 2020, if no new oil fields are discovered[16]. The indisputable truth is that since the beginning of 2005 global oil production has reached an undulating plateau[17], as we saw oil prices jump to record levels of $147 per barrel and the collapse of the global financial system in July 2008. Global oil production has since decreased and it is more than questionable if we can increase the rate of oil extraction for more than a few years, given the ongoing global economic contraction and reduced investments in future oil extraction projects. The Authoritative Hirsch report[18] ordered by US government in 2005 has shown that the world needs at least 15-20 years in order to avoid most of the negative economic impacts of peak oil. This is not surprising, as almost all of our road, ship, and air transport is dependent on oil.

In order to sustain current rates of energy consumption globally, the world will increasingly search for oil alternatives. While it is true that low-carbon wind and solar energy sources are experiencing wild growth (at least they experienced it until the onset of recession) with the help of governments, they still contribute to our primary energy consumption only marginally. More worryingly, with stagnating or declining oil production we will see the implementation of not only low-carbon technologies (i.e. already mentioned wind and solar energy, and increasingly also nuclear energy), but also high-carbon energy sources, such as gas-to-liquids, coal-to-liquids, tar sand, and oil shales. All of these non-conventional oil sources have higher carbon footprint per generated energy unit. In fact, based on recently published research regarding the possible disappearance of Tibetan glaciers, Hansen states that: "Coal emissions must be phased out over the next 20 years and

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[14] http://en.wikipedia.org/wiki/Peak_Oil (last accessed on 20 February 2010)

[15] K Aleklett et al., 'The Peak of Oil Age – analyzing the world oil production Reference Scenario in World Energy Outlook 2008', *Energy policy* 2009, article in press.

[16] S Connor 'Warning: Oil supplies are running out fast', 3 August, The Independent, interview with Dr. Fatih Birol. http://www.independent.co.uk/news/science/warning-oil-supplies-are-running-out-fast-1766585.html (last accessed on 20 February 2010)

[17] M Höök, RL Hirch, K Aleklett, 'Giant oil fields decline rates and their influence on world oil production', *Energy Policy* 2009, pp. 2262-2272.

[18] RL Hirsch et al., 'Peaking of world oil production: impacts, mitigation, and risk management', http://www.netl.doe.gov/publications/others/pdf/oil_peaking_NETL.pdf (91) 2005 (last accessed on 20 February 2010)

unconventional fossil fuels, such as tar sands and oil shale must remain undeveloped."[19] At the same time, energy experts such as Robert Hirsch, while acknowledging the science and consequences of climate change, also insist that in the face of peak oil we will definitely need coal in the coming decades. Prominent economist Jeffrey Sachs recommends using coal-to-liquid technology as an alternative to oil[20], apparently ignoring devastating climate impact of this approach, but revealing the increasing complexity of modern society.

IV. Predicament Paralysis

There is a good reason to ask if we can quickly (in 10-15 years) change the ongoing global trends such as rising GHGs emissions, rising energy consumption, deforestation, soil erosion, overfishing, desertification, or population increase. It is clear that the collective factor behind all global negative trends is population increase, together with increasing material needs of individuals. But what is the reason of population increase? Garrett[21] argues that both population increase and standards of living act only as *feedbacks* to energy efficiency, i.e. higher energy use efficiency enables more people to enjoy higher standards of living. In a positive feedback loop, increasing population encourages faster energy and resource consumption and so on. Once this mechanism is started, it is almost impossible to reverse it quickly. For instance, if we would apply effective policies for population stabilization these would stabilise population only after 70 years. Even more worryingly the core strategy of many environmental policies it the increase of energy efficiency with the hope that this would somehow decrease total use of energy, and consequently also decrease GHGs emission.

Some indication of our future may also be found by looking back to the history books. After James Watt greatly improved efficiency of steam engine, exponential consumption of coal reserves was enabled. This effect was firstly noticed by economist Stanley Jevons, and is now known as "Jevons paradox"[22]. It is probable that people advocating for increasing energy efficiency only are either not aware of Jevons paradox, or do not believe in

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[19] J Hansen, 'Survival of Tibetan glaciers', December 2009, NASA Science Briefs, http://www.giss.nasa.gov/research/briefs/hansen_14/ , see also B Xu et al., 'Black soot and the survival of Tibetan glaciers', Proceedings of the National Academy of Science of the United States of America, 2009, article in press. (last accessed on 20 February 2010)

[20] J Sachs, 'Jeffrey Sachs: you ask the questions', The Independent, 5 May 2008 http://www.independent.co.uk/news/people/profiles/jeffrey-sachs-you-ask-the-questions-821137.html (last accessed on 20 February 2010)

[21] TJ Garrett, 'Are there basic physical constraints on future anthropogenic emissions of carbon dioxide?', 2009, Climatic Change online at: http://www.springerlink.com/content/9476j57g1t07vhn2/fulltext.pdf (last accessed on 20 February 2010)

[22] H Hering (2006) 'Jevons Paradox', 2006, In Cutler J. Cleveland (eds.), *Encyclopedia of Earth*. Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment: http://www.eoearth.org/article/Jevons_paradox (last accessed on 20 February 2010)

effects of it. Thus while increasing energy efficiency is important, we should not believe that it will lead to decrease of total energy use.

Conclusion

The world has already experienced significant effects of global climate change, both positive and negative. More warming will mean less positive and more negative impact in the future. We cannot avoid this, and we must adapt as much as possible to prepare for future changes. The issue of adaptation is complicated by the fact that the countries least responsible for climate change are those who suffer from climate change the most, as they lack necessary resources. Given the climate inertia, we are committed to at least 30 years of even if we were to take immediate action regarding emission cutbacks. Given the energy systems and infrastructure inertia (e.g. average lifespan of coal power plant is about 75 years) and population increase inertia (70 years) we are likely committed to much more warming deemed acceptable by most climatologists. The core solution to global warming, increasing energy efficiency, may only worsen the whole problem.

Efforts to reduce emissions will be greatly complicated be peak oil. As we will try to apply alternative technologies to mitigate negative economic impacts of decreasing oil availability, we will not apply only low carbon technologies, but also high carbon technologies. Can legislation for banning the non-conventional fossil fuels be suggested? This seems to be rational decision from the point of view of future generations, but almost totally irrational decision from the point of view of today. As a civilisation, we will do everything we can in order to hold status quo, and thus we are paralysed.