

## **Addressing abrupt climate change: Can bio-energy help plug a Kyoto gap?**

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**The availability of a potentially large-scale negative emissions energy system means that carbon dioxide levels can be brought down over a few decades to much lower levels than has previously been thought possible, given only zero emissions energy technology and increased energy efficiency. This negative emissions system includes Bio-Energy, the production of high value liquid fuels and electricity from biomass, and Carbon Capture and Safe Storage. Putting these two technology types together, we have BECS – Bio-Energy with Carbon Storage.**

The 2001 National Academy of Science Report 'Abrupt Climate Change: Inevitable Surprises', and the novel concept of Bio-Energy with carbon Capture and permanent Storage (BECS) that yields a negative emissions energy system, together create a new situation. From the first comes bad news that the threat of abrupt climate change (ACC) due to cumulative anthropogenic emissions is real. From the second comes good news that responding to this threat can be taken out of the 'too hard' basket, to which it was consigned during the negotiation of Kyoto. Not only can it be brought out of the 'too hard' basket, but so it should be, since the 1992 Rio Climate Convention calls for cost-effective precautionary measures in response to such threats, without delay on account of scientific uncertainty.

### ***The Bad News: very low CO<sub>2</sub> levels may be needed***

Unfortunately, the unstable dynamic processes that have caused ACC in previous epochs are poorly understood. Climate science has so far succeeded in modelling only one mechanism of abrupt climate change – the possible slowing or stoppage of the Thermo-Haline Circulation. Other mechanisms have been described that, prima facie, could provoke warming above some threshold including:

- release of methane from thawing Arctic tundra;
- enhanced solar absorption following the loss of Arctic summer sea ice;
- reversal of natural biotic sinks to become net emitters at higher temperatures.

Any of these, alone or in a complex cascade interaction with the others, might initiate an irreversible process towards radical regime change in the climate system. The eventual triggering of climate catastrophe (disappearance of snow and ice cover on Greenland and Antarctica, or the onset of a new deep ice age, respectively leading to a raising or lowering of the ocean surface by around 30 meters) cannot be ruled out, with transitions possibly rapid on the evidence of paleo-climatological studies.

At best, reducing emissions to zero can cause atmospheric carbon dioxide (CO<sub>2</sub>) only gradually to approach equilibrium with the level in earth's natural surface sinks. But that level has been raised over the last two centuries by absorption from the atmosphere of human induced emissions. The threshold for precipitating one or other of the several processes that might trigger a catastrophic abrupt climate change event may be below the level reached already, with the very substantial inertia of the climate system all that lies between us and such an event, and hopefully giving time to put effective measures in place. Note that non-CO<sub>2</sub> greenhouse gases, for which we currently have no control technologies, will likely add about 100 ppm CO<sub>2</sub>-equivalent by the end of the century. So if climate scientists eventually discover that only a small increase above the pre-industrial level of 285ppm is safe, CO<sub>2</sub> would need to be reduced to below 300ppm, which can't be done with zero emissions technologies.

***The Good News: negative emissions energy systems***

The availability of a potentially large scale negative emissions energy system means that carbon dioxide levels can be brought down over a few decades to much lower levels than has previously been thought possible, given only zero emissions energy technology and increased energy efficiency. Three years ago, talk of approaching pre-industrial CO<sub>2</sub> levels in a few decades would have been regarded as fantasy. However, the IPCC's Third Assessment Report did not link two types of carbon technology that it reviewed separately. These are Bio-Energy, the production of high value liquid fuels and electricity from biomass, and Carbon Capture and Safe Storage, already being rapidly driven ahead by USDOE research programmes.

Putting the two technology types together, we have BECS – Bio-Energy with Carbon Storage – in which biomass is processed into electricity, or hydrogen-rich transportation fuel, and carbon dioxide wastes are compressed at the processing plant for safe storage underground. BECS is therefore a negative emissions energy system. With reasonably foreseeable advances in the constituent technologies, and success in motivating a very large number of land-owners and land-occupiers to engage in bio-mass-for-energy cropping, BECS offers the prospect of rapidly reducing greenhouse gas levels towards the pre-industrial, should investigation of ACC show this to be needed.

Most of the land available and suitable for growing the biomass raw material needed for bio-energy exists in the many developing countries that are not blessed (or cursed) with oil reserves. Thus dealing with the threat of ACC needs to be outward looking, rather than focused on 'domestic action' like Kyoto. Establishing a new world order in energy markets, with a broad-based bio-energy supply side, confers both enhanced energy security globally and prospects of sustainable economic growth with rural development for many land-rich but otherwise impoverished developing countries. By providing additional impetus to bio-energy it would also enhance the effectiveness of Kyoto in response to gradual climate change.

[ see notice of Conference on Greenhouse Gas Emissions and Abrupt Climate Change on p XX of this issue ]

FIRST ANNOUNCEMENT

WHAT CAN BE DONE ABOUT THREATENED ABRUPT CLIMATE CHANGE?

Abstracts are invited for papers to a Conference to be held June 2004 in Europe  
(final decision on date and place imminent, likely Paris 24-26 June)

on the theme:

**Greenhouse Gas Emissions and Abrupt Climate Change:  
Positive Options and Robust Policy**

Thanks to support from the United Nations Foundation and its affiliate the Better World Fund, finance is now assured to enable presenters of selected papers to attend this Conference, which is being organised by contributors to the letter to Science of 26<sup>th</sup> October 2001, pp786-787. The aim will be to explore the prospect that negative emissions energy systems, involving both Bio-Energy and CO<sub>2</sub> Capture and Storage (BECS) can reduce CO<sub>2</sub> levels towards pre-industrial over a few decades. Such an outcome is not possible without taking steps to 'be prepared' for the event – say two decades hence – that precursors of abrupt climate change are detected and political agreement is reached

*Noah built the Ark before it began to rain.*

*Selected Conference papers will be published in 2004 in a special issue of the  
Journal of Mitigation and Adaptation Strategies for Global Change*

Assessments of the Conference outcomes by leading international experts, along with plain English summaries of the selected Conference papers, and science-driven Policy Recommendations, will be published in a book, mid-2005. For further information, including an outline Conference program and the letter to Science mentioned above, see web-site <http://www.iiasa.ac.at/~oberstei/ff/index.html?sb=1>. Contributions are sought in all relevant fields e.g. abrupt climate change risk assessment, carbon cycle dynamics, technological assessment, land use change and the enviro-socio-economic aspects of energy plantations and agro forestry, capacity building, and the global political economy of a precautionary strategy. Expressions of interest and comment are welcome immediately, and should be e-mailed to the managing editor for these publications, Peter Read [pread2@attglobal.net](mailto:pread2@attglobal.net) with copy to [oberstei@iiasa.ac.at](mailto:oberstei@iiasa.ac.at). Abstracts for papers on any aspect of the problem should be submitted via the website by 14<sup>th</sup> Jan '04