Black Carbon e-Bulletin

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Fast-action strategies complement CO_2 emissions reduction[1]

Prof. Mario Molina, Mario Molina Center, Mexico.

Current emissions of anthropogenic greenhouse gases (GHGs) have already committed the planet to an increase in average surface temperature by the end of the century that may exceed the critical threshold for tipping elements of large scale components of the Earth's climate system, including abrupt change, with potentially irreversible and unmanageable consequences.

Current international climate policy is primarily focused on long-term reductions of CO_2 emissions, mainly through increased energy efficiency, renewable energy sources, and other low-carbon strategies. Efforts to limit CO_2 emissions alone may not be sufficient to avoid or reduce the risk of "dangerous anthropogenic interference'' (DAI) on a decadal time scale, including the risk of abrupt climate change.

With the climate system approaching the DAI zone, if not already within it, a critical need for fast-action response to help avoid DAI and abrupt climate changes has emerged. Fast-action regulatory measures refer to those that can begin within 2–3 years, be substantially implemented in 5–10 years, and produce a climate response within decades. Four of the available fast-action regulatory strategies that can complement the CO_2 emissions reduction strategies are summarized below.

The first includes phasing down the production and consumption of hydrofluorocarbons (HFC), together with accelerating the phase-out of hydrochlorofluorocarbons (HCFCs), as well as recovery and destruction of stratospheric ozone-depleting Greenhouse Gases (GHGs) in discarded products and equipment. It was nearly 35 years ago, in 1975 Ramanathan (1975)[2] discovered the greenhouse effect of chlorofluorocarbons (CFCs) and the Montreal protocol succeeded in mitigating the global warming effect of CFCs. The Montreal Protocol, with over 20 years of success, is increasingly seen as a regulatory framework that can ensure significant additional climate mitigation on a decadal time scale to help reduce the threat of DAI and abrupt climate change. It can be amended in order to phase down the production and consumption of hydrofluorocarbons (HFCs) with high global warming potential, even though these gases do not deplete stratospheric ozone.

The second is by reducing emissions of black carbon particles. Black carbon has well-established public health effects. In addition, it is estimated to be the second or third largest warming agent (Ramanathan and Carmichael, 2008)[3], although there is uncertainty in determining its precise radiative forcing. Black carbon is also considered to be accelerating the melting of snow and ice, including the Arctic, Greenland, and the Himalayan-Tibetan glaciers. Wallack and Ramanathan[4] estimate that it may be possible to offset the warming effect from

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Editorial: Rising to the challenge

Achim Steiner, Executive Director, UNEP

There is no doubt that climate change is one of the defining environmental challenges of our time, made more so important by the multiple effects that it is expected to have on all other aspects of the environment and development. As we look towards Copenhagen, with a range of different scenarios being predicted, it is important to keep the urgency of action required at the forefront of any debates on appropriate policies and strategies to address climate change.

It is well accepted that air pollutants have an effect on global and regional climate. Though the science on black carbon is not as well understood as some of the other climate forcers, scientific knowledge about black carbon's negative consequences is growing. It is also becoming evident that targeting black carbon and other short-lived non-carbon dioxide gases that contribute to global warming, offers unique opportunities for preventative mitigation actions that can have fast impacts on the climate.

The possibility of significant health co-benefits of and avoiding the prospect of accelerated melting in the Arctic, Alpine and Himalayan glacier regions, provides a compelling enough case for action on black carbon. Implementation of the two-degree target for climate control could offer considerable co-benefits for improving air quality, provided that technologies that would create the additional pollution (e.g. woodstoves) are avoided. Integrating

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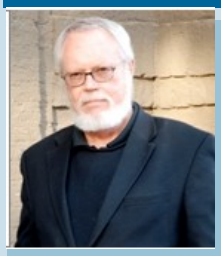
Rapid Black Carbon Reductions Can Reduce Tipping Point Risks



Durwood J. Zaelke, Institute for Governance & Sustainable Development. USA

Recent climate science suggests that we are close to passing the tipping points for abrupt climate changes. These changes include the disappearance of the Arctic summer sea ice and the melting of major ice sheets, such as Greenland and the West Antarctic as well as the Hindu Kush-Himalayan-Tibetan Plateau. One recent study[1] by Prof. Tim Lenton of the University of East Anglia/ Tyndall Center – one of the leading experts in the field – is presented in a report commissioned by the major reinsurer Allianz along with the WWF.

The Allianz report notes that climate emissions must peak quickly and decline steeply in order to avoid passing dangerous tipping points. Failure to do this, the report explains, will impose staggering financial costs on the world:

- A hurricane in the New York region: "Potentially the cost could be 1 trillion dollars at present, rising to over 5 trillion dollars by mid-century."
- Die-back of the Amazon forest: "Beyond ~2 °C the costs of committed die-back rise very rapidly and more than double to around $US 7,800 billion and $US 9,400 billion NPV [net present value] for 3 °C and 4 °C respectively (with forest area losses of circa 3.9 and 4.3 million km^2)."
- Changes in Asian monsoon patterns: "Future costs (in today's prices) might be expected to double from around $US 21 billion to $US 42 billion per decade in the first half of the century. However, a range of other factors are likely to act to increase these costs and consequences in the same period."

These are only a few examples from the study. To prevent these impacts and their extraordinary costs, reducing CO_2 emissions is essential, but it is not enough. CO_2 accounts for about 50 percent of climate forcing and its long-term damage to the climate system makes it critical to take aggressive reductions now. But the other 50 percent of climate forcing must be targeted as well. A recent article by Dr. Mario Molina[2] describes the importance of key non-CO_2 strategies for rapidly reducing the risk of passing the tipping points described by Prof. Lenton. Here we elaborate on one of those strategies: reducing black carbon (soot) emissions.

Black carbon is a key target for several important reasons. First, it is estimated to be the second or third-largest human contributor to global warming, meaning reductions will yield significant benefits. Second, it is relatively straightforward and cost-effective to reduce. Third, in addition to the climate benefits, reducing black carbon emissions would also have a positive effect on public health, air quality, and agriculture. Finally, because of its short atmospheric lifetime – just days to weeks – action on black carbon will bring almost immediate results.

UNEP is in a unique position to catalyze black carbon reductions by leveraging funds for black carbon mitigation, bringing together public and private stakeholders from both developed and developing countries, and facilitating collaboration among relevant agencies and intergovernmental organizations on effective strategies.

COP 15 in Copenhagen is an important opportunity: black carbon mitigation strategies can be advanced quickly by a decision during the upcoming climate talks under the mandate of the Bali Action Plan to take cooperative action "now, up to and beyond 2012." The decision would establish a work program for willing Parties to promote measures to reduce black carbon and other non-CO_2 warming agents and to expand biosequestration to complement aggressive CO_2 emission reduction targets and timetables. A decision on a broader "fast-action" mechanism to take action "now, up to and beyond 2012" and to reduce the risk of abrupt climate change (ACC) could add to the success in Copenhagen.

Regardless of what takes place in Copenhagen, there are other avenues for immediate action on black carbon. Because the citizens in developing countries are most affected by black carbon and stand to benefit the most from mitigation, it is important to concentrate on strengthening current initiatives in these regions. It is also essential that these initiatives be fully supported and designed to complement and enhance these nations' development objectives, including reducing mortality and illness.

UNEP also has a pivotal role to play in expanding research, monitoring and assessment of black carbon and other aerosols' impact on climate change, air pollution, public health, agriculture, water, and weather patterns. In addition, UNEP should establish and convene task forces on science and policy related to black carbon and other non-CO_2 climate forcers.

While CO_2 will be in the limelight during Copenhagen and remains the primary target, there is no time to waste in moving forward on black carbon and other short-lived climate forcers. CO_2 may be half of the climate problem, but taking aggressive action now on the non-CO_2 forcers that make up the other 50 percent will help forestall abrupt climate change in the near term.

1. Lenton T, et al., Major Tipping Points in the Earth's Climate System and Consequences for the Insurance Sector (2009). Available at http://assets.panda.org/downloads/plugin_tp_final_report.pdf.

2. Mario Molina, et al., Reducing abrupt climate change risk using the Montreal Protocol and other regulatory actions to complement cuts in CO_2 emissions, in Tipping Elements in the Earth System (Special Feature), Proc Natl Acad Sci (Hans Joachim Schellnhuber ed., forthcoming Dec. 2009).

PROJECT SURYA

Mitigation of Global and Regional Climate Change

Buying the planet time by reducing black carbon, methane and ozone

(Part II)

Nithya Ramanathan[1], I. H. Rehman[2], A. Kar[2], N. Bhatt[3], and V. Ramanathan[3]

A primary aim of Surya is to introduce cleaner technologies in ways that are locally relevant, appropriate and ultimately sustainable through increasing participation of local populations. These efforts will include *a priori* and ongoing community surveys in order to select feasible cleaner-burning methods that take into account local customs, dietary needs and locally available fuel sources. We are working directly with three different manufacturers (Phillips, British Petroleum, and EnviroFit; stoves are shown in the images above) to select energy-efficient and BC-free (or nearly BC-free) stoves for general use. In addition, Surya will provide ongoing training in the use, maintenance and repair of the new stoves and mobile phones. Project Surya will develop a strong, locally accessible, network of entrepreneurs for cooking technology service, repair, fuel supply, and stove marketing. It will also employ an adaptive technology dissemination plan in which there will be routine exchange of information between the users (i.e. the women who cook with the stoves) and the companies and cook-stove researchers. The stoves will be modified in response to user feedback.

Phillips Stove in Surya village. Photo: Douglas Varchol

Project Surya additionally builds research and development capacity in the target region by locating a majority of the implementation, research, analysis, and technology development in India. Indian institutions, such as The Energy and Research Institute in New Delhi, Sri Ramachandra University in Chennai, Jawaharlal Nehru University, and the Indian Institute of Technology in Delhi, will lead the implementation effort. Collaboration and knowledge transfer will involve leading institutions in the United States, including Scripps Institution of Oceanography at UC San Diego, UC Los Angeles, and UC Berkeley and in the European Union nations.

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Editorial ...

black carbon into global policies to address climate change should be a key component of efforts to meet the two-degree target.

To achieve black carbon emissions reductions on the scale that is required to address climate change, the issue must be elevated beyond the air pollution circles and integrated into global policies to address climate change. It is only in this context, where black carbon is considered alongside the Kyoto six, that some of the major benefits of addressing black carbon will be realised.

UNEP includes climate change as one of the six priority areas under the Medium Term Strategy and will continue to stimulate policy discussions on how to incorporate black carbon into climate change efforts. Beyond this, UNEP will also to look to work with partners to develop programmes and projects to address these issues while the international community works towards developing concrete targets for reduction of carbon dioxide emissions. The urgency of action that is required cannot be overstated. Concerted action that embraces new ways of thinking and addresses climate change in an integrated and operational manner is needed.<

ABC SYMPOSIUM AND ABC-ASIA SCIENCE TEAM MEETING

A symposium on Atmospheric Brown Clouds (ABCs) was held in Incheon, Republic of Korea on 23-24 November 2009. The symposium, organized by the Seoul National University in collaboration with the ABC science team, Ministry of Environment, Republic of Korea, and UNEP, was attended by nearly 100 participants representing the scientific community. During the symposium, distinguished atmospheric scientists and leading impact assessment experts shared their research findings related to ABCs.

The ABC-Asia science team meeting held its annual meeting in conjunction with the ABC symposium. The meeting, which reviewed the progress and future activities related to ABC science, adopted a data protocol, including a standard data reporting and exchange format for compilation of ABC- related data. It is expected that the data protocol will help in harmonizing the compilation of ABC data, including black carbon data. <

Project Surya ...

Pilot Phase Has Started

In order to field-test our approach to stove deployment and data collection, we have embarked on a pilot phase to replace traditional mud stoves with cleaner cooking technologies in 500 households. The research focus will be on testing the implementation methodology, and on identifying suitable technologies which will conveniently and economically fulfill the lighting and cooking needs of the project population from the existing battery of commercially available technologies. The pilot project is being executed in Khairatpur village in IGP, located at the coordinates 26.47N; 81.65E, in the Sultanpur District of Uttar Pradesh state of India. The experience and data gathered during this pilot phase will be used to conduct the first field phase with five to ten thousand households in the three regions.

Scaling Up

A sustainable financial model is currently being developed to improve the adoption rate of the new technologies. This model will include the creation of a cap and trade program where villagers who adopt the energy-efficient stoves can sell carbon credits. Surya's accurate, reproducible climate data will quantify the equivalent CO_2 emissions saved by reductions in emissions of BC, methane and ozone. This data will then be used to secure carbon credits for the villagers. It is our expectation that the monetary returns to the villages and the villagers through these credits will be an important motivating factor.

Surya aims to make its approach to climate mitigation a governmental policy, through UNEP's process. Building on success in the first phase, the goal will be to scale up Project Surya to all of India, China and other regions of the world where biomass-fueled cooking is prevalent. The Surya concept has been enthusiastically received by UNEP, Sida, EU-India joint initiative, and the World Bank. Surya has also received widespread media coverage, including a front page article in the New York Times and an article in Scientific American which lists Surya among the top 10 climate experiments. <

For more details on Surya:
http://www-ramanathan.ucsd.edu/ProjectSurya.html

[1]University of California at Los Angeles; [2]The Energy and Resources Institute, New Delhi; [3]The American Heart Association; [4]Scripps Institution of Oceanography, University of California at San Diego

Fast-action strategies ...

one to two decades of CO_2 emissions by reducing black carbon by 50% using existing technologies.

International financial institutions could use climate and health funds to obtain the cobenefits of black carbon reductions. Regional and bilateral partnerships could accelerate black carbon reductions as well.

The third is by reducing precursor gases that lead to formation of tropospheric (lower atmosphere) ozone. Tropospheric ozone is a major pollutant toxic to humans and plants including, crops, and is a significant GHG. Human activities do not emit ozone directly, but add pollutant gases such as carbon monoxide (CO), nitrogen oxides (NOx), methane, and other non-methane volatile organic compounds (VOCs) that generate ozone in the troposphere. The Royal Society[5] estimates that rigorous global implementation of air pollution regulations and available technologies, including those for shipping and aviation, can reduce NOx and CO emissions by >50%, which would reduce the anthropogenic tropospheric ozone forcing from 20 to 10%[6]. That reduction in ozone forcing would delay by 10 years' time when the threshold for DAI would otherwise have been passed[4].

The fourth is by increasing biosequestration through improved forest protection and biochar production. Canadell et al.[7] estimated current emissions from deforestation to be 1.5 Gt C, or 5.5 Gt CO_2 per year, the vast majority from deforestation in tropical regions. The *Stern Review*[8] notes mitigation from reduced deforestation is ''highly cost-effective.''

Like other biosequestration strategies, biochar technology captures CO_2 through plant photosynthesis. The captured carbon is then converted through pyrolysis into a stable charcoal-like substance called ''biochar,'' with estimates of characteristic storage time varying from hundreds to thousands to tens of thousands of years[9](Pyrolysis is high-temperature decomposition in an oxygen-deprived environment.)[9] In addition to its potential to replenish long-term carbon sinks, biochar can be a beneficial soil amendment, as noted by a recent review of published literature by Sohi et al.[9]

These and other fast-action strategies may reduce the risk of abrupt climate change in the next few decades by complementing cuts in CO_2 emissions.

Establishing a DAI threshold, however, cannot be based on science alone as it also involves social and political judgments about acceptable outcomes and risks, including considerations of the precautionary principle, interpersonal equity, and a sense of ''carbon justice'' to protect the most vulnerable. Considerations of economic costs and impacts and economic well-being also inform DAI threshold analyses.

The fast-action strategies discussed here can complement strategies for adapting to the effects of climate change by delaying warming for several decades, reducing adaptation costs, and mitigating risks to ecosystems and economic prosperity.<

1. Prepared based on the article titled "Reducing abrupt climate change risk using the Montreal Protocol and other regulatory actions to complement cuts in CO_2 emissions" by Mario Molina, Durwood Zaelke, K. Madhava Sarma, Stephen O. Andersen, Veerabhadran Ramanathan, and Donald Kaniaru, which appeared in www.pnas.org/cgi/doi/10.1073/pnas.0902568106
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