Climate Change: Current Issues

Edited by
Natalia Trofimenko

April 2011

Kiel Institute for the World Economy

CONTENTS

Should we and can we live without nuclear energy?

Gernot Klepper, Sonja Peterson and Sebastian Petrick

As Japan is struggling to avoid a major nuclear disaster, world leaders, policy makers, academics, and citizens are asking to what extent the world is relying on nuclear energy and how feasible it would be to renounce it.

In Germany, for example, the weight of nuclear power in total energy output has been continually decreasing. Whereas in 2000 almost 30% of the total electricity supply came from nuclear energy, by 2010 the number had decreased to 22.6%. During the same time the share of renewable energy went from 6.6% to 16.5%.

Whether or not Germany can completely phase out nuclear energy in the very short run depends on whether the peak load – the amount of energy demanded during the periods of particularly high demand, such as during summer months with increased use of air conditioning – can be produced without it. In principle, the overall energy-producing capacity in the country can serve such periods of high demand without resorting to nuclear energy. However, the energy market in Germany is regionally segmented, with most of the energy demand and nuclear power plants concentrated in the south. Lacking sufficient transmission grids, renouncing nuclear-generated energy completely and immediately would jeopardize Germany's ability to guarantee that all of its regions will always have electricity available in sufficient quantities.

The medium term outlook is another matter. Whereas there is no consensus in the existing literature about Germany's prospects to renounce nuclear energy, about related deadlines or about investments into alternative technologies, most studies agree that the scheduled phase-out, as it has been agreed upon by the red-green coalition in the year 2000, represents no risks to the country's energy security. In accordance with the agreement, seven of the oldest nuclear power plants in Germany would have been shut down already or, at the latest by 2012, would go off-line. Germany's youngest nuclear plant would be in operation until 2022. The studies that deem nuclear phase-out as possible assume that alternative energy sources will not be the only way of dealing with resultant energy shortages: some tuning will take place on the demand side. Improvements in efficiency, energy savings, development of renewable energy sources, cogeneration (combined production of electricity and heat), as well as access to flexible reserves of conventional power plants, may all play a role in addressing potential energy shortage. Some studies promote additional development of gas and coal plants. A big role is assigned to the development of a Europe-wide electricity grid.

At the international level, most studies assign nuclear power an important role in meeting ambitious targets related to climate change. However, we do find studies that show that even the ambitious targets –the target of keeping the Earth from warming by more than 2 degrees, the so called 2-degree goal – can be achieved without the use of nuclear energy. Prerequisite for such a scenario is large-scale development of alternative technologies, especially carbon capture and storage, and bio energy. Of course, in the long run even carbon capture and storage is only a temporary solution. Still, risks related to this technology are far less than those related to nuclear energy.

In addition to technical feasibility, we must consider welfare losses ensuing from abandoning nuclear energy. In case of Germany, even the official study commissioned by the government implicitly shows that compared to the 2000 phase-out schedule, additional deadline extensions lead to virtually no welfare gain. Other studies suggest that in the long run electricity production via renewable energy sources is more cost-efficient than that based on nuclear power. Nevertheless, it remains to be seen how quickly costs accumulate if the phase-out should take place quicker than scheduled and all of nuclear power plants have to go off line. This will depend on the speed of the scaledown, on the keenness to further develop renewable energy know-how and on the efforts to improve energy savings through smart technologies.

At the global level, the evaluation of the welfare losses associated with the scaledown of nuclear energy is difficult and uncertain. In general, the estimates of welfare losses are acceptable, as long as it is possible to employ alternative technologies. In addition to large scale use of carbon capture and storage technologies, the magnitude of the costs depends on the availability of bio energy and renewable energy sources such as wind- and solar- energy. Even the costs associated with the complete phase-out of nuclear energy in view of the ambitious 2-degree goal are estimated to be reasonable.

What conventional cost-benefit analyses of nuclear energy fail to consider are the waste disposal costs and, more importantly, the costs of a potential accident. As we have already seen from the Chernobyl catastrophe in 1986 and are currently observing in Japan at a – hopefully – smaller scale, such an unlikely but disastrous accident can lead to losses of unparalleled magnitude in economic terms but above all in health threats. The disaster in Japan shows that conventional cost-benefit analyses are not helpful in the context of nuclear power. The unfolding events in Japan would have been estimated as virtually impossible and yet, here we are witnessing it. In conventional analyses, expected costs of a low probability event, even with immense losses associated with it, would be estimated as low. To bring it closer to home, however unlikely Germany is to confront a mishap as the one witnessed at Japan's Fukushima plant on its soil, a similar event can happen – not necessarily induced by an earthquake or another natural disaster but due to event(s) that we cannot fathom at the moment. The question, therefore, is whether societies are ready to expose themselves to such an improbable accident with potentially catastrophic consequences or whether they decide not to expose themselves to such risks in the first place.

Furthermore, conventional cost-benefit analyses focus on the use of cheaper energy and the associated economic prosperity. The accurate costs of nuclear energy should also include possible dangers to life and public health. Thus, in the worst case scenario in Japan, well over 30 million people may get exposed to radiation and vast areas of this already densely populated country may be inhabitable for centuries due to radioactive contamination. To translate such losses in monetary terms and use them in cost-benefit analyses is hardly a morally acceptable matter. One should rather ask whether the losses associated with the phase-out of nuclear energy are not a fair price for preventing such catastrophes – in Japan, Germany, or elsewhere in the world – from happening.

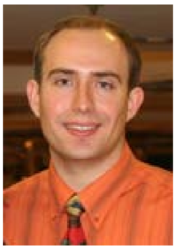
For the countries which already invested in nuclear energy, it is not a matter of whether or not to phase out nuclear energy, but rather of the speed at which such a phase-out should take place. The faster the scaledown, the faster a country like Germany should invest in renewable energy sources, build up potential for carbon capture and storage and develop the necessary infrastructure. The pace will ultimately depend on the political goodwill and the magnitude of investments that the country is ready to shoulder. Obviously, there is a need for a coordinated energy policy across the European Union since, in the long run, the restructuring of the energy sector and the phase-out of nuclear energy, without an increase in energy prices and cross-border trade, will not be possible.

For the countries that currently do not own any nuclear power plants, especially many emerging economies, the question arises whether the investments required for the development of nuclear energy would not be put to better use in the development of renewable energy sources. The climate for such a decision has never been better: last years have seen significant technological progress; decentralized systems make more sense for most regions; natural conditions for renewable sources of energy are cheaper than in Germany.

The choice whether to commit to nuclear energy or renounce it is first of all an ethical and political one. Societies have to decide whether they are willing to expose themselves to unlikely but appalling risks. From the economic point of view, the only remaining question is how quickly and with which cost-efficient measures we can best implement the phase-out of nuclear energy.

Current state of international climate talks

International climate talks are probably the most complex and tense of all environmental negotiations. In order to see the size of the challenge that negotiating parties face, it is important to understand that countering the global climate change is not only an ecological task. The measures to reduce greenhouse gas (GHG) emissions and the measures to increase GHG absorption have direct impact on the development of the energy sector, agriculture, forestry, and other industries. They impact international trade in energy and technologies and international capital flows. In general, the solution to this problem directly affects socio-economic and political interests of all countries in the world. What are the main difficulties on the road to the worldwide agreement to substantially reduce the emissions? What are the results of the last negotiations round in Cancun? Can an agreement that would help to avoid dramatic climate changes be reached in the foreseeable future?



Artem Korzhenevych

The 16th Conference of the Parties to the UN Framework Convention on Climate Change in Cancun, Mexico had a chance to become either the end or a new beginning in a multilateral negotiation process. Despite many pessimistic views in the forefront, the latter scenario could in fact be realized. The Conference has mostly been considered a success, whereby of course, the comparison to last year's discouraging round would not be entirely proper.

One important achievement is the common agreement to recognize the "2 degrees goal": the global objective of not letting the Earth become more than 2°C warmer compared to its pre-industrial level. However, the parties could not agree on binding country-specific goals of CO_2 emission reductions. It should be noted that the existing goals set out in the Kyoto Protocol and in the non-binding Copenhagen Accord are, according to climate experts, not enough to get close to the "2 degrees goal."

The main problem that stalls progress here can shortly be explained as follows. The industrial countries that have ratified the Kyoto Protocol are mostly unwilling to commit themselves to more ambitious emission reduction goals before large developing countries also make corresponding commitments. That would mainly mean that developing countries (primarily, China and India) also have to reduce the use of fossil fuels. From the point of view of developing countries, however, this would pose a barrier to further economic growth and would prevent developing countries from ever reaching the welfare level of the developed world. Moreover, as the developed world has mainly been responsible for the increasing concentration of CO_2 in the atmosphere in the XXth century, developing countries require that the main 'sinners' themselves set more demanding emissions reduction goals.

Several important steps for resolving this problem have, however, been made in Cancun. First of all, financial transfers to developing countries for the purpose of conducting climate-related projects will now constitute 10 billion dollars a year and this amount will increase to 100 billion dollars by 2020. In return, recipients commit to ensure proper measurement, reporting and verification of the conducted projects. In addition, countries have agreed upon a general framework that should help the most vulnerable regions of the world to adapt to the already observable consequences of climate change.

The ultimate goal of the worldwide agreement about the specific and binding actions of all states required in order to avoid the dramatic climate change is however not yet reached. The next report by the Intergovernmental Panel on Climate Change, expected in 2013, will most certainly suggest that greenhouse gas emissions be reduced much beyond the bold initiatives discussed in Cancun. In the circle game between developing and developed countries, therefore, one side will have to make the first credible move, and make it very soon. The EU has in this context a chance of returning to its forerunner role in the fight against climate change, for example, by increasing the internal reduction goal from 20% to 30% by 2020. Putting aside all national interests for this decision, however, requires mutual trust and devoted leadership, both currently very topical issues in the united Europe.

Overall, it is evident that the future agreement must be more demanding with respect to the actions of the world community for alleviating the problem of climate change. It must encompass the largest possible number of countries, offering a flexible mechanism to accept obligations according to the level of economic development. Last but not least, it must be valid for a longer time period.

BACKGROUND FACTS

- Negotiations about designing an international treaty to counteract the global climate change started in 1990 and have since then been led by the United Nations.
- The first agreement signed by 192 countries in 1992, the Framework Convention on Climate Change (UN FCCC), includes the general obligations of the signing parties to take the climate change problem seriously and to reduce GHG emissions.
- The quantitative obligations with respect to GHG emissions were first identified in the Kyoto Protocol signed in 1997 according to the principle of "common but differentiated responsibilities". The EU and its Member States ratified the Protocol in May 2002. The treaty was finally brought into force in 2005. The United States is the only major country that has not ratified the Protocol. Defined as belonging to the developing world, such large countries as China (the biggest GHG emittent), India, and Brazil are not yet obligated to any commitment on emissions.
- The Kyoto Protocol expires in 2012. The negotiations for a follow-up agreement go in two major directions. First, stronger emission reduction targets on the developed countries must be set. Second, transition and developing countries must be made a part of the emissions reduction program.
- The Copenhagen round of climate talks in December 2009 has been widely recognized to be a major failure. It finished with a non-binding declaration, which did not correspond to the ambitious aims of the EU and, in particular, Germany. After that, the sole principle of multilateral negotiations under the leadership of the UN has been questioned from many sides.

Do we know enough to control the environmental problems now or should we wait until more is known?

Daiju Narita

Uncertainty prevails… Although the basic causal relationship between global climate change and human emissions of greenhouse gases is pretty much a scientific consensus, climate change still deals with the uncertainty of various sources: scenarios of greenhouse gas emissions, global and regional climate responses to atmospheric greenhouse gases, impacts of climate change on human societies, prospects of agreements and implementation on climate policy, to name a few. These ambiguities and the associated difficulties of decision-making in an uncertain world are a likely cause of political gridlock of climate policy in many countries and in international negotiations of climate change. Yet, since climate change is caused by the gradual accumulation of greenhouse gases in the atmosphere, the control of greenhouse gas emissions needs to be started long before damages become significant. Should we postpone actions against climate change and wait for the uncertainties to be solved? What tools increasing our ability to cope with uncertainty are available to us?

In spite of the coordinated efforts by natural and social scientists to increase the knowledge about the scientific mechanisms and socio-economic dimensions of climate change, many aspects of the phenomenon remain unknown. We know little about the exact effects of atmospheric greenhouse gases on the atmospheric and oceanic temperatures, rainfall, sea level, etc. Even bigger uncertainties remain about the impact of climate change on economic activities such as agriculture, tourism or recreation, about the speed and scope of technological innovations, or about the ability of our political institutions to enforce climate change control policy globally. Some may argue that we should wait for the resolution of these uncertainties before committing to actions against climate change.

At some level, this appeal for waiting makes sense: reduction of greenhouse gas emissions implies significant costs for a wide range of economic sectors; the speed at which we accumulate new knowledge is rapid; and the possibility of resolving more and more ambiguities seems plausible. I argue that, despite the remaining uncertainty of climate change mechanisms and the resultant reservations about actions held by some, it is important that we start reducing greenhouse gas emissions immediately. Just as in the case of entrepreneurs who initiate risky projects in an uncertain business environment, it is sometimes necessary to take actions even without knowing the exact level of future returns. What's more, we do have the means to make informed decisions as to which of these actions are most likely to succeed.

We know that it is possible to perform consistent appraisals of policies whose effects are subject to uncertainty with the help of probabilistic analyses. In the context of climate change, such analyses often rely on climate-economy simulation models, better known in the literature as integrated assessment models. These models combine scientific and socio-economic aspects of climate change to assess different policy options under varying scenarios and to choose the optimal climate control policy. The models can, for example, compute when exactly an aggressive mitigation policy should be put in place, given the costs associated with the reduction in the use of fossil fuel or the costs associated with the use of relatively more expensive low-carbon or carbon-free energy sources.

There are two types of uncertainty which the integrated assessment models consider: uncertainty about the parameters that enter the model (parametric uncertainty) and the inherent randomness (stochasticity) of the climate system. Parametric uncertainty arises from the fact that there are some aspects of climate change that we currently do not completely understand (for example, sensitivity of climate to greenhouse gas emissions, determinants of future mitigation costs, etc.). Stochasticity arises from the fluctuations in the climate system (for example, prolonged and stronger El-Niño events) or from the occurrence of inherently unpredictable catastrophic events (discrete shift in the global climate system through, for example, the disruption of deep ocean circulations).

Explicitly modeling uncertainty, of course, adds significant complexity to the models, and none of the models or methods of dealing with uncertainty is free of criticism. As the researchers continue to broaden our knowledge about the expected costs, damages and effects of climate change and to improve the methods for analyzing the immense and growing information, we should keep in mind that however significant the remaining uncertainties are and however quickly we may be able to resolve them in the future, postponing action against climate change is not an alternative.

BACKGROUND FACTS

- Intergovernmental Panel on Climate Change's 2007 Report (IPCC Fourth Assessment Report) estimates that the increase of global surface temperature by the end of the 21st Century could be anywhere between 1.1°C and 6.4°C, reflecting a variety of assumptions.
- A recent American poll[1] shows that nearly 30% of respondents agree with the statement that "we don't know enough about global climate change, and more research is necessary before we take any actions."

WHAT THE BLEEP DO WE KNOW?

UNCERTAINTIES ABOUT ENVIRONMENTAL PROBLEMS

- The role of the world's oceans in absorbing heat and carbon dioxide from (and releasing them into) the atmosphere;
- The role of different types of aerosols, which in their pure form act as cooling agents but, when contaminated by soot, may also contribute to warming;
- The role of clouds, which have both warming and cooling effects, and which can have very different effects on projections of regional climate depending on how clouds are modeled;
- The role of glaciers;
- The potential for unpredictability in the global weather system;
- The potential for abrupt shifts in the global climate.

- How greenhouse gas emissions will accumulate in the atmosphere and how the resulting change in concentrations will affect the average global temperature;
- How changes in global temperature will be distributed across seasons and regions and how they will affect other variable characteristics of climate, such as rainfall, severity of storms, and sea level;
- How those changes in regional climates will affect natural and human systems, such as agricultural crops, property, species, and human health;
- How short-term impacts will differ from the long-term impacts that will remain after natural and human systems have had time to adapt to the new climate;
- How future trends in emissions will be shaped—they depend on the pace of population and economic growth, the development and diffusion of technologies, and the demand for fossil fuels;
- How to estimate what people are willing to pay for the damages that fall on entities, goods, and services that are not exchanged in markets, such as harm to ecosystems and adverse health effects.

[1] NBC News/WSJ, December, 2009

CLIMATE MIGRATION: A STRATEGY TO ADAPT TO CLIMATE CHANGE OR A FAILURE TO ADAPT?

Global warming has many detrimental effects such as more frequent and severe natural disasters, droughts and floods, a rising sea level, and a reduction in biodiversity that particularly affects species upon which the world's poor rely for their livelihoods. Therefore, global warming will further strain the "carrying capacity" of ecosystems in large parts of the world, i.e. reduce their ability to provide food, water and shelter for the people who currently live there. As a result, many people will be forced to relocate. The most widely cited estimate puts their number at 200 million individuals by 2050 – similar to the current total number of international labor migrants, and more than five times the number of refugees and internally displaced persons accounted for by the United Nations High Commission on Refugees (UNHCR). How reliable are these numbers? What difficulties do we face in trying to predict the impact of climate change on the movement of people? Which policy responses could reduce the need for migration or limit its scope? Do we need an institution that would provide a multilateral framework for dealing with migrants?

Matthias Luecke

The estimate of climate migrants is highly uncertain and probably exaggerated:

1. Environmental migration is a complex phenomenon and difficult to identify. Only a small portion of overall migration can be linked directly to environmental causes, not all of which are related to global warming. Obvious examples of environmental degradation include the rapid desertification of areas in North America mainly caused by exploitative agriculture systems, the drying out of Lake Aral due to water diversion for large-scale irrigation schemes, the Chernobyl ecological disaster, or a farmer's land being submerged by the rising sea levels. Typically, local, regional, and international factors like ineffective governance of natural resource use, population growth, soil degradation, higher temperatures, and extreme weather events combine to threaten livelihoods.

2. Environmental migration is difficult to measure and even more difficult to predict. First of all, the timing and intensity of catastrophic events such as volcanic activity and other natural disasters, cannot be predicted. Secondly, there is inherent uncertainty about how individuals will respond to increasingly intolerable conditions in their regions: will the whole household leave the affected area or will only individual family members seek work elsewhere and provide for the family members left behind?

3. Migration is a costly process and the poorest of the affected may not be able to afford it because they lack financial resources and social support. Migration is also influenced by migrants' education and skill levels, access to infrastructure, and social networks.

4. Experiences from migration directly linked to climate change, such as the drought of 1983 in Mali or the decrease in rainfall in Burkina Faso, suggest that climate-related movements of people are temporary and over short distances.

Even if the numerical estimate is uncertain, many individuals do live in places highly vulnerable to climate change, their livelihoods will be threatened in new and significant ways, and some of them will have no choice but to relocate. As long as migration away from affected areas is viewed as a problem to be controlled, rather than as a key part of the adaptation to climate change, national governments and the international community will be missing opportunities to develop policies that could reduce the need for migration or limit its scope. Such policies include, but are not limited to, the following:

1. Create early warning systems to alert affected communities and countries of impending serious environmental degradation so that people can

carefully plan their response.

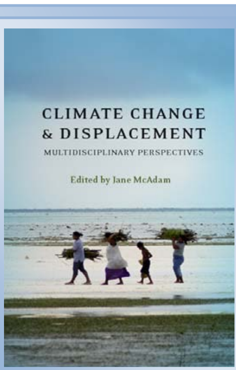
2. Build up infrastructure and basic services in towns near the affected areas that would serve as destination hubs for temporary migrants.
3. Promote access to non-farm jobs.
4. When whole regions become uninhabitable (such as when an island volcano erupts or large areas are flooded), move the affected population to safety. This can be achieved through ad-hoc cooperation among potential host country governments and does not require changes in international law such as a special status for "environmental refugees".
5. Recognize the role of preemptive, voluntary migration as a response to climate change and provide support to accommodate migrants in order to avoid crisis-driven movements of refugees.

Should we try to create an International Migration Organization as a multilateral framework for national migration policies, similar to the World Trade Organization for trade-related policies? Probably not. In the foreseeable future, key governments, including the US, will simply not enter into significant international obligations with respect to their immigration policies. However, most Scandinavian countries have adopted national rules that recognize environmental refugees and provide for their protection. Other countries may want to follow this example.

BACKGROUND FACTS

- Most predictions set the number for future flows of climate migrants at 200 million by 2050. It would mean that by 2050 one in every 45 people will be displaced by disruptions of monsoon systems and other rainfall regimes, by droughts of unprecedented severity and duration, and by sea-level rise and coastal flooding.
- Number of people flooded per year is expected to increase by 10 to 25 million per year by the 2050s and by 40 to 140 million per year by 2100s, depending on the future emissions scenario.
- Poor countries are hit disproportionately: in the decade from 1994 to 2003 natural disasters in advanced countries killed an average of 44 people per event, whereas disasters in poor countries killed an average of 300 people each. A tropical cyclone Gorky in 1991 killed at least 138,000 people in Bangladesh, whereas a much stronger Hurricane Andrew caused only 64 death in the US.

CLIMATE CHANGE & DISPLACEMENT: MULTIDISCIPLINARY PERSPECTIVES
By
Iane McAdam (Ed.)



CHAPTERS:

“Climate Change-Induced Mobility and the Existing Migration Regime in Asia and the Pacific” by Graeme Hugo

“Migration as Adaptation: Opportunities and Limits” by Jon Barnett and Michael Webber

“Climate-Induced Community Relocation in the Pacific: The Meaning and Importance of Land” by John Campbell

“Conceptualizing Climate-Induced Displacement” by Walter Kälin

“‘Disappearing States’, Statelessness and the Boundaries of International Law” by Jane McAdam

“Protecting People Displaced by Climate Change: Some Conceptual Challenges” by Roger Zetter

“International Ethical Responsibilities to ’Climate Change Refugees’” by Peter Penz

“Climate Migration and Climate Migrants: What Threat, Whose Security?” by Lorraine Elliott

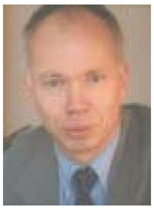
“Climate-Related Displacement: Health Risks and Responses” by Anthony J McMichael, Celia E McMichael, Helen L Berry and Kathryn Bowen

“Climate Change, Human Movement and the Promotion of Mental Health: What have we Learnt from Earlier Global Stressors?” by Maryanne Loughry

“Afterword: What Now? Climate-Induced Displacement after Copenhagen” by Stephen Castles

Climate Finance: What Lessons from Development Aid in the Past?

Much of the effort to mitigate climate change will have to be made in the developing world. However, the ability of less advanced countries to shift to lower-carbon trajectories without compromising economic growth will depend on industrialized countries providing financial and technical assistance. Donors on their part are concerned about huge financial demands being placed on them without any guarantee that the recipients will deliver the required mitigation and adaption results. Which lessons could be drawn from previous development aid? How should climate finance be allocated across recipient countries, and under which conditions is it most likely to be effective?



Peter Nunnenkamp

There are no easy answers to these questions. Decades of experience notwithstanding, the allocation and effectiveness of aid remain highly contested among development economists and experts in the field. This implies that donors will not do the trick by just raising more funds. At the same time, deserving recipients run the risk of receiving too little from donors unwilling to try harder by making their aid more effective.

Naïve as it may be, an important requirement for more effective support would be that donors no longer allocated aid according to their (commercial and political) self-interest. Aid allocation should be guided exclusively by the need and merit of recipients. Likewise, though probably no more realistically, donors should pay heed to frequent calls for less aid proliferation and thereby reduce transaction costs and the administrative burden for recipients.

Fighting global public bads such as climate change provides a clear case for donors to co-finance common pools, rather than showing their flag by individually financing prestigious projects. The common-pool approach would avoid the earmarking of aid by donors. Earmarks tend to be futile to the extent that recipients can redirect local funds according to their own preferences ("fungibility of aid"). They are even harmful if project-specific aid financing is tied to supplies from the donor country, which reduces the welfare of recipients by constraining their choices. The implementation of projects should rather be decided through open tenders in which donor agencies with different specialization profiles can compete.

The effectiveness of aid depends at least as much on the behavior of recipients. The World Bank's message of the late 1990s that aid works when recipients pursue reasonable economic policies and basic institutional requirements are in place has been widely blamed for over-simplification. Yet it cannot seriously be disputed that greater selectivity may help aid effectiveness. This applies especially for large-scale aid programs, including those required for sustaining the environment. In contrast to small projects, it is hardly possible to sideline the – often corrupt – governments of recipient countries and, instead, entrust local communities and non-governmental organizations with aid delivery and project implementation.

Recent experience, e.g., in health-related aid programs, suggests that recipients should be selected and rewarded according to actual performance. Donors would pay for measured delivery of, say, climate-related services by recipients, rather than perpetuating the failed attempt to buy such services by disbursing aid if only recipients *promise* to deliver. An important caveat is in order, however: performance-based aid would still suffer from time-inconsistency problems if not supplemented by sanctions when recipients reverse earlier reforms after having received financial rewards.

BACKGROUND FACTS

- Developed countries are responsible for about two-thirds of the cumulative energy-related CO2 now in the atmosphere.
- Developing countries will account for 90% of the projected increases in global energy consumption,

coal use, and energy-related CO_2 emissions over the next twenty years.

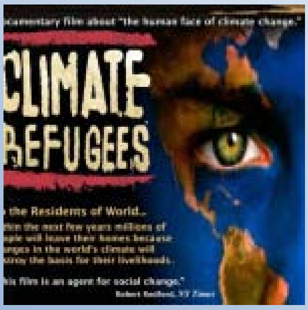
- 75-80% of the costs of damages caused by the changing climate will be borne by the developing countries.
- Even 2 degrees Celsius warming above preindustrial temperatures—the most optimistic scenario—could result in permanent reductions in GDP of 4-5% in Africa and South Asia.
- By 2030 the incremental investment needs for mitigation in developing countries could be $140 to $175 billion (with associated financing requirements of $265 to $565 billion) a year.
- The financing needs for adaptation by that time could be $30 to $100 billion a year. This is additional funding beyond baseline development finance needs.

DOCUMENTARIES ABOUT CAUSES AND CONSEQUENCES OF CLIMATE CHANGE

BLUE GOLD: WORLD WATER WARS by Sam Bozzo

"This isn't about saving the environment, it's about saving ourselves."

Only 3% of global water supply is freshwater, with two thirds of it being frozen in glaciers and polar ice caps and much of the rest being subject to increasing pollution. How do governments and corporations deal with this increasingly scarce product? Are Coca-Cola and Nestle the new face of colonialism? In which parts of the world has access to water ceased being a human right?



CLIMATE REFUGEES by Michael Nash

“Whether you believe man is causing a climate change or we just happen to be in another natural climate cycle, the fact remains: our climate is changing and it’s affecting millions and millions of people in ways that we never thought possible.”

A collection of expert opinions and personal accounts from the survivors of natural disasters and rising sea levels all over the world that has won its producer over twenty awards, including being selected as the feature production at the 2009 UN Climate Change Conference in Copenhagen.

Climate change and agriculture

Agriculture is very vulnerable to climate change. Climate change decreases crop yields directly through higher temperatures and indirectly through its effects on water availability by making precipitation more and more unpredictable. These effects combined with the already existing pressure on food security due to increasing population and rising incomes, make food shortages in the future more likely. The wheat price hikes following the failure of wheat harvest in Russia due to drought in the summer of 2010 (only after 2 years of the last global food price crisis) are only indicators of what is to come at a larger scale when extreme weather events become more likely. What specific impacts of climate change should we expect in the future? What can we learn from the history of agricultural research and existing practices to encounter the impacts of climate change on agriculture? What kind of investments need to be done in order to mitigate and adapt to these impacts more effectively?

Aslihan Arslan

That climate and agriculture are intricately connected is not a new phenomenon. Farmers and agricultural scientists have been trying to counteract the negative impacts of climate on food production for millennia. The prospect that climate change will increase global temperatures significantly and cause precipitation to be more unpredictable has recently put this millennia-old struggle to maintain and increase global food security on the spotlight. Luckily we have many previous policies and practices that have proven to work in the past and we can draw from them for future climate change action and policy.

The Green Revolution was one of the most important milestones in agricultural history that lifted millions of people out of poverty in Asia and Latin America thanks to the spread of improved seeds, fertilizer and irrigation technologies. Yields of basic food crops have increased twofold in developing countries since 1960, with half of this increase attributable to improved seeds and the other half to input intensification. Prices of most food crops have decreased, and caloric intake and life expectancy increased as a result of increased production. The distribution of the benefits from these technologies, however, was unequal within and across countries: wealthier farmers (with access to irrigation) benefited more than the poor, and Sub-Saharan Africa benefited the least. Based on a rich body of literature, we now know the reasons why adoption was patchy: dysfunctional land and credit markets, lack of proper technical assistance and the unsuitability of these technologies for marginal agro-ecological conditions. The existing success stories combined with our knowledge of these imperfections provide low-hanging fruits on our way to help agriculture deal with the implications of climate change:

- There are still many farmers in the developing world, who did not benefit from the first green revolution but may do so if some basic constraints are lifted. There is a need for targeted extension services to disseminate existing technologies such as improved seeds, no-till agriculture or drip-irrigation that can make a big difference in agricultural productivity. The overarching constraints for development, such as imperfect land, credit and insurance markets, have to be relaxed with government and international involvement.
- Public spending on agricultural R&D has been decreasing in many countries since 1990s. There is a need for continued investments in R&D to increase productivity in the face of new challenges, especially in Africa.
- There is a need for more research on how agriculture can play a role in climate change mitigation: e.g. improving crops' input-use efficiencies can increase yield potential and decrease GHG emissions. Crop and soil management techniques need to be modified to decrease the emissions from these processes.
- The first Green Revolution – where it was successful – had some negative impacts as well, including the loss of crop genetic diversity as farmers adopted the new seeds on a large scale.

We cannot afford to lose agro-biodiversity further knowing all too well that their rich genetic base may contain the solutions to the evolving threats posed by climate change (e.g. drought, new pests and diseases). International and national efforts for the conservation and use of crop genetic diversity should be encouraged and publicized better to improve their status on the climate change and agricultural development agenda.

- There is a significant amount of waste in agricultural food chain in developing countries, mainly due to poor infrastructure, lack of storage and processing facilities and poor transportation. Investments to deal with these constraints and to decrease waste may not sound as sexy as "new drought resistant seed to end hunger!" Nonetheless, they should be among the policy priorities to deal with the increasing food demand.

"Land grab" is a recent phenomenon that developed under the pressure of climate change and food price crises. As some countries realize that they cannot rely on their own production and international markets, they started leasing/buying large-scale land in developing countries for agriculture. These deals may pose a threat to the food security of the receiving countries if not managed well. They also have the potential to strengthen food security if they are transparent, socially and environmentally sustainable. One needs, of course, to ensure positive spillovers for the receiving country agriculture. The framework for international regulation that would ensure that international land deals benefit both the investing and receiving country populations is still not available.

BACKGROUND FACTS

- The impact of climate change on agriculture will most hardly hit developing countries where 75% of the population lives in rural areas and more than 50% of the workforce depends on agriculture.
- Most staple crop production will decrease in most parts of the world (though some areas will see yield increases), with South Asia facing the largest decline.
- Calorie availability will decrease significantly, increasing child malnutrition and food insecurity in general.
- To cope with a 40% increase in world population, production would need to rise by 70%.
- A dozen species of animals provide 90 percent of the animal protein consumed globally and just four crop species provide half of plant-based calories in the human diet.
- Crop wild species that are crucial sources of traits used by scientists to improve crops' resistance to droughts, pests, diseases and extreme weather events are under threat: 16-22% of wild species will be threatened by extinction by 2050.
- Food price volatility and increased demand for land for bio-fuels (both of which will probably be exacerbated by climate change) are among the drivers of "Land Grabs." In 2009, around 45 million hectares of land were acquired by industrialized and emerging economies, mostly in Africa.
- Agriculture also contributes to climate change; therefore it plays a role in mitigation as well as adaptation. Around 10% of total GHG emissions stem from agriculture, most of which is related to fertilizer production and use, and crop and soil management.

Ocean iron fertilization: Can we afford to postpone exploring this option?

„Give me half a tankerful of iron and I'll give you an Ice Age," boasted John Martin in 1988. Whether or not ocean iron fertilization effectively removes CO2, retains carbon in the ocean for an adequate amount of time, and has predictable and acceptable environmental disturbances still remains to be seen, decades after Martin's statement. Given the distinct possibility that we may exhaust the CO_2 emissions budget by 2024, can we afford to wait any further before clarifying the uncertainties that surround the process of ocean iron fertilization? Which scientific, economic, and legal issues need to be examined in order to make an informed decision as to whether to include ocean iron fertilization into the Kyoto Protocol as a viable option to offset anthropogenic greenhouse gas emissions?

Katrin Rehdanz

Wilfred Rickels

By some estimates, roughly half of the carbon dioxide that humans put into the atmosphere each year is absorbed by carbon sinks – reservoirs that accumulate and store some carbon-containing chemical component – on land and in the oceans. A combination of increasing temperatures (for example, warmer autumns and resulting soil decomposition) and economic activities (such as agriculture) reduced the rate of terrestrial and oceanic carbon uptake, which necessitates human intervention aimed at enhancing or substituting these natural carbon sinks.

The greatest terrestrial carbon sinks occur in young, growing forests and can be enhanced by means of forestation. The oceanic sinks may, in some regions, be enhanced by means of fertilization, for example by artificially enhanced upwelling of macronutrients or by purposeful addition of the micronutrient iron. Whether or not climate change can be mitigated through these measures remains debatable, primarily because of continued uncertainty about three factors: uncertainty about the magnitude of the gains – in terms of reduced emissions – resulting from engaging in such measures; uncertainty about the potential for shifting emissions to other locations, and regarding the degree to which the emissions are reduced permanently as opposed to being simply shifted to a different period. In any case, the terrestrial vegetation sinks have entered the Kyoto Protocol as offsets for anthropogenic greenhouse gas emissions. By contrast, the oceanic sinks have not.

The uncertainty about undesired adverse effects of purposeful iron fertilization on marine ecosystems and biogeochemistry has led to attempts to ban commercial and, to some extent, scientific experiments. Such a ban is what significantly slows down the exploration of this option and may preclude it from consideration altogether. In fact, demands have already been made that research, and in particular large-scale experiments on ocean iron fertilization, should not be further pursued. We challenge this view and argue that further research about the climate-engineering potential of ocean iron fertilization is not only desirable but necessary.

First of all, even if emissions were to be cut significantly, it is possible that the current levels of atmospheric carbon concentration are already sufficiently high to result in irreversible climate change. Ocean iron fertilization directly decreases atmospheric carbon concentration and thus, in principle, could facilitate the removal of past emissions. As the risks of a truly catastrophic climate change cannot be dismissed as negligible in a compelling fashion, large-scale carbon removal projects may become an option of last resort and we simply cannot afford to postpone research that would help us understand the workings of ocean iron fertilization. In particular, we need to know more about the intended and unintended consequences of ocean iron fertilization. It has been documented, for example, that there are some significant perturbations of marine biogeochemistry and ecology. In fact, some alteration of the functioning of oceanic ecosystems is the very objective of carbon sequestration. As of today, we know little about the dangers of such disturbances. We know even less about how these negative effects compare to the damages resulting from leaving CO_2 in the atmosphere.

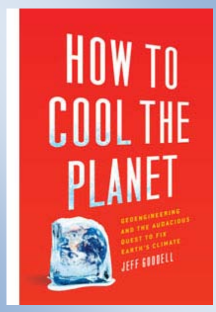
Secondly, the potential of ocean iron fertilization is far from negligible in relation to other abatement options from an economic perspective. Estimates of the costs associated with ocean iron fertilization are in the same order of magnitude as the estimates of the costs associated with forestation projects. Ocean iron fertilization can also generate more carbon credits, even if we take into account the possibility that emissions shift to other regions or that the reductions are not permanent.

As for the legitimacy of ocean iron fertilization, as viewed by the public international law, the pertinent agreements dealing with the protection of the marine environment indicate that ocean iron fertilization is to be considered lawful to the extent to which it represents authentic scientific research. As scientific experiments are carried out within a limited marine area and the associated detrimental effects are acceptable relative to the potential gains, further scientific research must be permitted to explore the carbon sequestration potential of the ocean in order to make an informed decision on whether to reject ocean iron fertilization or to integrate it into the flexible mechanisms contained in the Kyoto Protocol.

BACKGROUND FACTS

- Today, most countries have accepted a 2°C temperature increase above pre-industrial levels as the maximum tolerable limit for global warming.
- Given the current global CO_2 emissions, the corresponding emission budget will only last until 2024.
- Oceans absorb more than a quarter of the CO_2 emissions.
- Iron fertilization is relatively inexpensive and can theoretically sequester for less than €5/ton CO_2.

HOW TO COOL THE
PLANET: GEOENGINEERING AND
THE AUDACIOUS QUEST TO
FIX EARTH' CLIMATE
By
Jeff Goodell



How are scientists trying to lower the temperature of the entire planet?

Do the ideas, once "fringe", seem sane and even inspired in the face of the economic crisis and global political realities?

Who is to blame if something goes terribly wrong?

Unable to predict even next week's weather, can we tinker with the planet's thermostat?

What are the unintended consequences?

Is the alternative worse than the risks?

May climate engineering be our last best hope, our Plan B?

Who should control the process?

What R&D needs to be done in order to support climate engineering?

What are the ethical, moral and religious reasons for favoring or opposing various techniques?

Can one or more methods be used for military, political or even terrorist purpose?

Is trade at the source of environmental problems or a way to mitigate them?

Natalia Trofimenko

Environment and trade do not conjure up the image of a good alliance. The most obvious effect of trade is increased transport of goods and transport is responsible for 1/3 of global carbon emissions. In a less palpable way, trade increases a country's ability to produce more goods and services and this increased production results in higher energy demand and, consequently, in higher emissions. Trade results in a redistribution of production across the globe, according to the countries' comparative advantage, and it is possible that some economies become more emission-intensive. Some of the redistribution of production will occur due to differences in environmental regulations, whereby dirty industries from countries with more stringent or better enforced regulations migrate to countries with less stringent climate policies. Finally, trade also increases global income levels, which may be bad if more people can afford automobiles (or good if more people choose relatively more expensive green cars). To complicate the matters further, global exchange of goods makes it difficult to estimate the exact carbon emissions by individual countries – how environmentally conscious are we if we import goods produced by highly polluting industries abroad? So, is trade at the source of environmental problems or can it serve to solve them?

It is difficult to overlook the fact that the transport of goods is responsible for a third of global carbon emissions or that the car sales in the rapidly growing China increased by 50 percent in 2010 as compared to 2008. It is also true that global import and export flows make the true emissions by separate countries virtually untraceable. Yet, it is imprudent to demonize trade as it may be an efficient way of tackling the problem of climate change.

Although trade liberalization is often linked to some challenging structural changes in the economies that undergo it, many developing countries which followed trade liberalization policies have experienced unprecedented economic growth, China and India being the most renowned success stories. Whereas climate change does not recognize borders, it is generally accepted that better off countries are better equipped to face the challenges resulting from climate change than poor countries.

Trade liberalization trims countries' production sector whereby the increasing competitive pressures squeeze out less efficient producers. Whereas the production output itself may and will rise – with the associated increase in carbon emissions – the share of wasteful activities by inefficient producers will decrease.

Developing countries lack human and financial resources to invest in research and development of technologies that mitigate climate change. Trade is the way for developing countries to benefit from the innovations in climate change technologies taking place in industrialized countries. Imports of intermediate goods and capital provide developing countries with more energy-efficient equipment. Exports, and the ensuing knowledge exchange with the suppliers in developed countries, give access to more efficient production methods. Even trade among the developed countries has positive spillovers for developing countries: an exchange of knowledge will lower the price of state-of-the-art technologies, reduce the costs of future innovation and imitation and will make climate-friendly technologies more affordable in the long run. Thus, trade is of great relevance when it comes to protecting environment at low costs.

In fact, it is distortions in trade that can hinder actions against climate change. Imports of solar lamps to Africa, for example, are subject to a so called luxury goods tariff. The resulting higher price prevents wide-spread use of these environmentally-friendly products. Another example of the detrimental effect of trade restrictions on climate is the restrictions on exports of agricultural goods. Producing 1 kg of beef can take as much as 15 thousand liters of water if it is produced in the United States and only 146-300 liters per kilogram if it is produced in Africa. Another forgotten fact is that almost 100 percent of input factors in African agriculture are locally made and almost no machinery is used in production, while European and American farmers import fertilizers, pesticides, seeds, seasonal workers and equipment from all over the world. Ironically, the "buy local" campaigns are almost always headed by "green" politicians and activists. Even more ironic is that at the same time as imports from some country are demonized for the resulting CO_2 emissions, exports to the same country are promoted.

Climate change threatens food production and trade can bridge differences in supply and demand, by providing the regions with food scarcity with imports from the areas that have remained unaffected or even have benefited from global warming. Short of humanitarian aid, only trade can ensure adequate food and water for *all* countries.

Finally, long history in dealing with worldwide trade negotiations, multilateral and bilateral agreements, and resolutions of "fairness" issues as they relate to trade can provide valuable insights and lessons for streamlining international climate talks.

TRADE AND THE ENVIRONMENT
By
Brian R. Copeland &
M. Scott Taylor

What are the theories linking international trade to environmental outcomes?

What empirical implications derive from these theories and how are they supported by the data?

Is free trade good for the environment?

Will developing countries specialize in pollution-intensive goods with further trade?

What happens to pollution when economic growth is driven by technological progress as opposed to capital accumulation?

BACKGROUND FACTS

- Maritime transport accounts for the bulk of international trade by volume and for a significant share by value. Around 90% of world trade is carried by the international shipping industry.
- Aviation represents an 11.2% share of CO_2 emissions, rail transport constitutes another 2% share and road transport has the biggest share, at 72.6% of the total CO_2 emissions from transport. Among the different modes of transport, shipping is the most carbon emission efficient.
- According to a study by the International Energy Agency, employing technologies that already exist or that are currently being developed could bring global energy-related carbon dioxide (CO2) emissions back to their 2005 levels by 2050.
- Scientists at the Carnegie Institution of Washington at Stanford University estimate that 23% of global CO_2 emissions — about 6.2 billion metric tons — are traded internationally, usually going from carbon-intensive developing nations like China to the comparatively less carbon intensive West. In a few rich nations, such as France, Sweden and Britain, more than 30% of consumption-based emissions could be traced to origins abroad; if those emissions were tallied on the other side of the balance sheet, it would add more than four tons of CO_2 per person in several European nations.
- Imports accounted for 10.8% of U.S. carbon emissions, enough to add an additional 2.4 metric tons of CO_2 per person. China, of course, fell into the opposite camp: 22.5% of the carbon emitted in China is actually exported to other countries, reducing its per capita carbon footprint from 3.9 tons to 3 tons.

The future of shipping emissions

Setareh Khalilian

International climate negotiations have so far not encompassed greenhouse gas (GHG) emissions of the shipping sector: its regulation is left untouched by climate agreements. One obstacle to finding an agreement is the familiar argument about sharing burdens. Thus, Chinese delegates have stated that they will not support plans that impose uniform standards on rich and poor alike. To complicate matters further, the highly globalised shipping sector cannot be easily separated into developed and developing nations because most vessels operate internationally and their country of registration can be changed easily. A ship may have an owner and an operator who belong to different nations, have registered their firms in a third country and run the ship under the flag of that nation. Hence the question of how to allocate the emissions of this international and highly inter-connected sector to individual countries is a complicated topic for negotiations. Finding agreements on how to curb emissions and settle the questions of financing are even more so. Nevertheless, without such agreement, the rapid growth of the shipping sector and consequentially its GHG emissions could avert the progress made in other sectors and jeopardize the goal of avoiding dangerous climate change. How should the regulation of GHG emissions be implemented in this setting? What are the options for reducing emissions in the shipping sector? Which potential alternatives are available?

The climate talks in Cancún have not provided any development in regulating shipping emissions – no decisions were taken either in respect to mechanisms for reducing emissions or in respect to shipping (and aviation) as possible financing sources for global climate change mitigation programs, leaving the topic up to the IMO.

There are various technological solutions available to curb shipping emissions and in some cases it is surprising that not more of these solutions are already being employed by the industry as they could benefit ship's owners long-term fuel spending. Arguably, that is due to the fact that operators usually pass the fuel costs on to owners whilst the former have most control over these emission curbing options. Hence some regulation is a necessary incentive for improvements in this respect.

As the graph shows, there are very cheap mechanisms such as optimizing the transport routes (voyage execution) and operations, up to the costly installation of solar panels. The size and the age of the vessel are highly relevant for its GHG emissions – which then again is a disadvantage for developing countries that have on average older fleets than developed countries.

What the shipping sector needs are both incentives and regulation. Hence market-based measures are the preferred option as a report by the European Commission Joint Research Centre concludes. They include carbon pricing options such as a bunker fuel tax and an emissions trading scheme which stimulates technological innovation and the implementation of available technological solutions. The benefit of the market based measures is the potential for large revenues that both the shipping and the aviation industry could thereby provide for the costly global climate mitigation programs.

The IMO's environment committee is working in a similar direction – there are plans for introducing mandatory technical and operational measures that would reduce GHG emissions of the shipping industry. The core measure is an Energy Efficiency Design Index but it is not yet clear whether the IMO will agree on this. However, the EU is more and more impatient and has signaled that if there is no progress till the end of 2011, the EU could proceed with its own regulation of GHG emissions of the shipping activities in its waters.

There are also other private measures that have taken on the task of reducing shipping emissions. Richard Branson has set up a free internet database called Shippingefficiency.org that will list the energy efficiency of most internationally operating vessels. It uses data on the engine size and the CO2 emissions of nearly 60,000 ships, including the majority of the world's container ships, tankers, bulk carriers, cargo ships, cruise liners and ferries. The database, which relies on information supplied by the UN and international ship registers, would provide something similar to an eco-label scheme that makes it possible for importers, exporters, and vacationers going on cruises to choose between clean and dirty ships.

It will allow supermarkets, oil and mining companies, food importers, retailers and manufacturers to specify that their goods are transported by the least polluting ships, thereby empowering the consumers. This scheme is particularly interesting because there are large differences between ships due to age and size: nearly 15% of the world's ships account for about half of all the industry emissions.

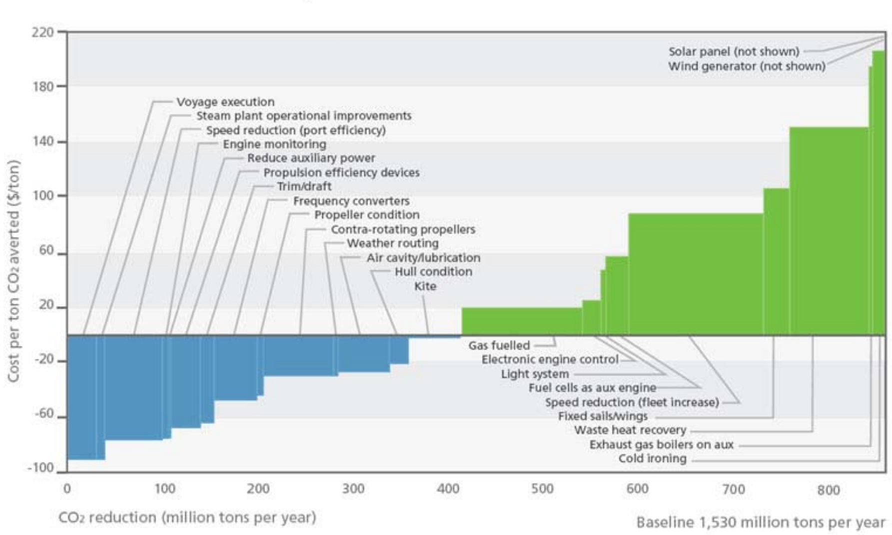
One can only hope that private initiatives like that of Richard Branson as well as regional pressure such as that from the EU will have an effect on the international negotiations on shipping emissions. Due to the rapid growth of this sector, curbing shipping emissions is an urgent matter. And, as demonstrated above, a lot of the emission reductions can be implemented by fairly simple operational and technological measures.

BACKGROUND FACTS

- The latest data suggests that the international shipping sector is responsible for around 1bn tones of GHG emissions a year, which is about 3-4% of the world's total.
- The sector's emissions have doubled since 1990 and are forecast to continue rising at a rate of 2.5 per cent per year – leading to an estimated 150-200% increase by 2050.
- Shipping is not covered by the U.N.'s Kyoto Protocol or any other international agreement, hence the industry does not have any mandatory emissions regulations.
- Shipping is the most environmentally-friendly mode of transport, moving 90% of global goods while being responsible for max. 4% of global manmade GHG emissions.
- The International Maritime Organization (IMO) remains in charge of GHG emissions regulation in shipping following the UN climate talks in Cancún, but the decision-making process is slow.

Next possible stage for the IMO to take decisions is at the July 2011 session of the Marine Environment Protection Committee of the IMO. Tangible results of this session could be presented in the Durban [UNFCC] Conference in December 2011.

FIGURE 1: AVERAGE MARGINAL CO_2 REDUCTION COST PER OPTION – WORLD SHIPPING FLEET IN 2030



Source: DNV (Det Norske Veritas) 2010

INTERNATIONAL TECHNOLOGY TRANSFER – NOT QUITE THE SILVER BULLET IN INTERNATIONAL CLIMATE POLICY

Technology is often described as crucial for rapid and sustained global climate mitigation. Particularly important for reducing CO_2 emissions and for mitigating climate change are technologies that increase the efficiency of energy supply and consumptions, technologies that facilitate a switch to low-carbon fuels like natural gas, and technologies related to the development of renewable energy sources and nuclear power. The ability to research and develop such technologies, however, is not uniformly distributed and the calls for greater access to and transfer of clean technologies from those who have them (industrialized countries, bar a few exceptions) to those who don't (developing countries) have been made repeatedly both in political and academic circles. Are international technology transfers the panacea for reducing global greenhouse emissions?

Sonja Peterson

There are two reasons why the transfer of energy-efficient and advanced technologies from the industrialized to the developing countries has to play an important role in the global mitigation of greenhouse gases. The first reason has to do with the desire to reach ambitious emission targets at reasonable cost. In developing countries energy is often used very inefficiently. The same global output could be produced with only half the GHG emissions if all economies would have the same low energy intensity (the amount of energy to produce a good or service worth 1 USD) as, for example, Germany. At the same time investments into research and development of emission saving technologies are taking place mainly in industrialized countries. The second reason has to do with the burden sharing between industrialized and developing countries. While the former are responsible for the major share of past emissions and have more means for emission abatement, the developing countries will suffer most from the adverse effects of climate change. Before the 2009 climate conference in Copenhagen representatives from developed as well as developing countries signaled that technology transfer financed by the industrialized countries could be a feasible solution in the negotiations. Even though Copenhagen failed, technology transfer is seen as the preferable way to move forward and was one of the major issues in the Cancun meeting in December 2010.

While I agree that technology transfer is indeed important, I strongly doubt that it can play an important role to reduce global GHG emissions as a stand-alone measure. First of all, the question remains how to induce such technology transfer and how to channel it to the most useful places. Then there is the question about the scope of the resultant emission savings: the transfer that we have seen so far through channels such as foreign direct investment, trade or development aid has not let to major emission savings. Emissions savings per unit of output were at least partly invalidated by an increased scale in production or a shift in the output mix towards more emission-intensive products. Targeted transfers, such as CDM projects or technology funds, have been more effective and have a higher potential to reduce emissions but they are still not sufficient without additional measures. Rather than trying to initiate emission reductions by fostering technology transfer, the international community should initiate emission reductions, i.e. set absolute emission targets and install carbon prices, and this will then automatically foster technology transfer. An international carbon price will provide incentives for technology transfers and channel them to the most cost- or otherwise effective areas. Furthermore, a reduction in the existing barriers to technology transfers such as missing patent rights or missing absorptive capacity (education, trained staff, etc.) in developing countries cuts the overall costs of reaching a given target. In that sense, what holds true on a national level where the public good nature of information calls for support of technology policies and support for research and development is also true on an international level: we need both carbon pricing and technology policies hand in hand. Where I do see a role that technology funds can play in fostering technology transfer is their ability to pave the way towards an international agreement on binding emission targets. By lowering emissions in developing countries such funds can provide incentives for these countries to agree to emission targets. Also, if part of the monetary transfers from industrialized to developing countries perceived as a necessary part of a fair burden sharing is happening via such a fund, a transfer can be more acceptable to industrialized countries than buying large amounts of emission permits from developing countries.

In a nutshell: fostering international technology transfer alone will never be able to fix the problem of climate change. It is more important to set absolute global emission targets and to install an international price for carbon. Yet, to get there, support of technology transfer may be of help.

Whereas international technology transfer is not the silver bullet to climate change, it can play an important role. The devil though is as always in the detail and there are lots of wrinkles to be ironed out. How do we actually design a technology fund? How do we acquire the funds? How do we divide them among recipient countries? How do we make sure that adequate technology leading to emission savings and reducing the global costs of emission savings is being transferred? How do we tackle the problem of missing absorptive capacity in the developing countries? How do we induce the owners of technologies to employ them in developing countries? How do we link such a fund to a global agreement? How successful the role of such a fund will be depends on how these questions are answered.

BACKGROUND FACTS

- Future GHG emissions will increase primarily in the developing world. In the next 30 years, only one-third of the global growth in carbon dioxide ($CO2$) emissions is projected to take place in the industrialized countries. Hence, developing countries will need to leapfrog a technological generation or two in order to avoid the fossil-fuel trap and move directly to environmentally friendly technologies.
- Industrial countries on are responsible for almost 80 per cent of cumulated industrial GHG emissions up to date and have per capita emissions that are 5 to 200 times larger than those in many developing countries. For example, per capita emissions of approximately 20 t CO^2 in the USA and ca. 10 t CO^2 in Germany stand in contrast to ca. 4 t CO^2 per capita emissions in China, around 1.2 tCO^2 in India and less than 0.1 tCO^2 in many African countries.
- Currently, there are 22 supranational and national funding programs that include several funds by the World Bank, but also program and funds by the United Nations Development Program (UNEP), the Brazilian Development Bank, the African Development Bank, the European Commission, as well as the Governments of Germany, Japan and Australia. The pledges of these funds and programs currently add up to around 26.8 billion USD. Most of the funds have a limited time horizon, with no commitments being made beyond 2012. The World Bank Technology Fund (CTF) and the funds from the Global Environmental Facility (GEF) for the elimination of barriers to energy-efficient and renewable technologies focus explicitly on technology transfer.
- Estimates for the necessary fund for fighting climate change in developing countries range between USD 200 and 250 billion a year by 2030.

AFRICA AND CLIMATE CHANGE: CAN AFRICA MANAGE ON ITS OWN?

Africa, ironically the smallest offender in terms of CO_2 emissions, is predicted to be the region that will be the worst affected by global warming and climate change. And, unlike some other regions with their concerns about the more or less distant future, Africa has already experienced the detrimental effects of climate change. The Sahel droughts in 1970s and 1980s killed over a million of people in West Africa and resulted in the loss of valuable grassland, savanna, and other resources crucial for the livelihoods of the people. Cyclones that hit Mozambique in 2000 displaced 500,000 people and left 950,000 people dependent on humanitarian assistance. The 2002-2003 drought left an estimated 14 million people in need of food aid. A flood in Uganda in 2007 left 400 thousand people homeless, diminished food supplies, and displaced the wildlife in the area. Such occurrences can only be expected to increase, both in frequency and in intensity, as the world becomes warmer. Will Africa be able to handle climate-related disasters on its own?

Manfred Wiebelt

Africa is expected to be hit by climate change on multiple fronts. The most visible consequences of climate change – more frequent and more violent natural disasters, such as droughts, floods, landslides, and earthquakes – combine with Africa's dependence of rain-fed agriculture, fast growing population, poverty and poor governance to affect more than the economic livelihoods of its people. By redrawing the maps of water availability, food security, prevalence of diseases like malaria, cholera and typhoid, and flows of forced migration, climate change has the potential of raising tensions and triggering conflicts. Reduced water supply will lead to increasing competition between different social groups, local communities, and countries. Reductions in crop yields will lead to higher food prices and increase the stakes for control over the increasingly scarce agricultural land. Changes in sea levels and natural disasters will cause large-scale destabilizing movements of population. The cumulative effect of these challenges will increase poverty in the states where the governments already struggle to provide adequate services to their citizens and could tip fragile states towards armed conflict and we already have examples of such tendency. For example, depleted water and land resources are believed by many to be at the source of the Darfur conflict in Sudan. As such, the effects of global warming on Africa will be more catastrophic than on any other region in the world, as they are exacerbated by wide-spread poverty and poor governance.

Although climate change presents daunting challenges to governments around the world, African governments are faced with a set of additional challenges: how to meet the water and food needs of a growing population; how to increase communities' resilience to drought and floods; how to expand economies heavily dependent of rain-fed agriculture and few cash crops when faced with more adverse and unpredictable weather; and how to share increasingly scarce resources between different social groups, communities and countries. Can Africa handle these challenges on its own? Very unlikely.

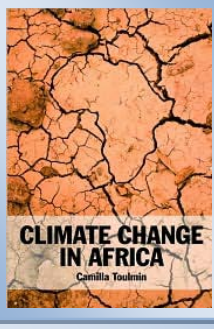
First of all, given their relatively low level of carbon emissions, there is little African countries can do to reduce the scale of the problems they are likely to face — emission reductions must be primarily the responsibility of the developed world. Secondly, Africa is in a unique position in that, in spite of the rhetoric, the need for food, fuel and cash are more immediate than the threat of climate change. Therefore, any action aimed at reducing poverty in the region will have beneficial effects on Africa's ability to cope with climate change and to avoid economic and social calamities. Although there is a lot of debate as to which actions are uniformly effective in reducing poverty, some of them are less controversial than others. Thus, the provision of financial, technological, information, marketing and other support services in agriculture has been shown to be effective in reducing poverty. Conditional cash transfers to poor households, in exchange for enrollment of children into schooling, is a way to mitigate poverty while simultaneously investing in future human capital.

Access to new varieties of plants that produces higher-yielding disease-resistant crops and allows farmers to produce more food than their families need so they can sell surplus crops at local markets is another measure that can help the poor in the regions where subsistence agriculture is prevalent. As of today, it is unrealistic to expect African countries to be able to finance these initiatives on their own. Even more involvement from the international community will be needed in order to deal with the direct consequences of climate change lest low-emission and climate-resilient development fall low on Africa's priorities list. International agencies can and should provide support in collecting meteorological and other data and in training African researchers to analyze the data and interpret its significance to policy-makers. Finally, Western countries can take upon themselves the task of providing incentives for pharmaceutical companies to invest in the health of African countries.

BACKGROUND FACTS

- Africa is home to 15% of the world population, but emits less than 3% of global pollutant emissions.
- There is already evidence that Africa is warming faster than the global average, with more warm spells and fewer extremely cold days. Northern and southern Africa are likely to become as much as 4 degrees C hotter over the next 100 years and will be much drier.
- Projected reductions in crop yields could be as much as 50% by 2020 and 90% by 2100.
- Academics have modelled the effects of global warming on civil war - finding that, by 2030, climate change will lead to a 54% increase in the incidence of civil conflict - leading to an additional 393,000 battle deaths.
- The crop model indicates that in 2050 in Sub-Saharan Africa, average rice, wheat and maize yields will decline by up to 14%, 22% and 5%, as a result of climate change.
- With climate change, food availability in the region will average 500 calories less per person in 2050, a 21% decline.
- As temperatures rise above 2°C, scientists predict that an estimated two billion people worldwide will be affected by water shortages.

CLIMATE CHANGE
IN AFRICA
By
Camilla Toulmin



What is the price that African countries will pay for the events for which they are the least responsible?

How will climate change affect access to water, production and availability of food, forests, and the occurrence of conflict?

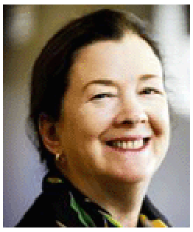
What does climate change have to do with female emancipation or access to education?

What is the potential that the carbon markets might hold for Africa?

INVITED CONTRIBUTIONS

Green Technology and Intellectual Property

Bronwyn Hall (University of California, Berkeley and University of Maastricht)
Christian Helmers (Universidad Carlos III de Madrid)



In December 2009, the United States Patent and Trademark Office (USPTO) launched a "Green Technology Pilot Program" under which patents related to green technology benefit from a substantially expedited processing of patent applications. While initially put in place for a 12-month period, the scheme has recently been extended through December 2011 and the eligibility of patent applications expanded (U. S. Federal Register Vol. 75, No. 217). Similar schemes exist in a number of major patenting countries including Korea and the UK. The underlying motivation of these schemes is that the speedier granting of patents will encourage the development of green technology and its diffusion, although, in fact, there is little empirical evidence on the issue.

The definition of eligible patents under these fast-track schemes is relatively flexible. While the USPTO initially relied on a selection of US patent classifications to single out "applications pertaining to environmental quality, energy conservation, development of renewable energy resources, or greenhouse gas emission reduction" (Federal Register Vol. 74, No. 234: 64666), it waved the requirement in May 2010. Instead the USPTO applies similar criteria as the UK Intellectual Property Office (UKIPO) in its `green channel', where applicants are only required to submit a written explanation of why the technology for which patent protection is sought is green (see http://www.ipo.gov.uk/p-pn-green.htm).

These schemes illustrate a major issue in the debate on the role of intellectual property and in particular patents in climate change mitigation: it is difficult to assess the role of patents given the difficulties in objectively specifying general criteria that define patentable green technology. While policy makers hurry to proactively employ the patent system to encourage innovation and diffusion of green technology, it remains unclear which technologies are green and for which of these green technologies patents play an important role.

There has been a longstanding and lively debate on the role of patents in promoting the development and diffusion of knowledge generally. In regard to climate change mitigation, the role and importance of patents in encouraging invention and diffusion is particularly unclear, for a number of reasons.

First, patents are a policy instrument devised to address the knowledge externality inherent in innovation, i.e., knowledge is partly available to third parties without compensation. Climate change, however, involves powerful environmental externalities at a global scale. The presence of two externalities (one positive and one negative) and their interaction makes it difficult to evaluate a single policy instrument in the form of patents.

Second, climate change mitigation involves a wide range of different technologies. While some green technologies are ground-breaking and produced specifically in the objective to mitigate climate change, for a significant share of green technologies, the underlying technology is mature and in the public domain. Moreover, a large number of such existing technologies was not devised with the intention to combat climate change but eventually turned out to be useful for this purpose. This implies that it is difficult to determine whether and to what degree a (patented) technology is (eventually) useful in mitigating climate change. ***The Economist*** (December 5th 2009), for example, reports on energy savings on the order of 13 million tonnes of CO_2 annually thanks to the simple replacement of copper wire with integrated circuits in power adapters. Another example of the usefulness of existing technologies in climate change mitigation are improved biomass cooking stoves, which rely on relatively basic technology, aimed at increasing energy efficiency and thus reducing emissions from the burning of biomass in developing countries.

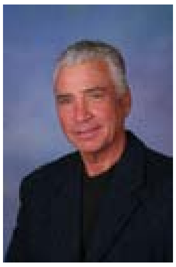
This means that coming up with a sharp classification of technologies into categories such as `clean' and `dirty' that might be useful for both policy and research is a difficult task. Nevertheless some progress has recently been made in this area for clean energy as well as carbon capture and storage technologies with the creation of the European Patent Office's "Y02 patent tags", which are derived from a broad mapping of relevant technologies to patent documents (http://www.epo.org/about-us/publications/general-information/clean-energy.html).

It also means that most of the relevant technological progress may be expected to come from incremental improvements of a wide range of existing off-patent technologies, often invented in fields not directly related to climate change mitigation. While such incremental innovation may be patentable, such patenting will leave ample scope for competing technologies which limits the role specific patents may play for technological progress in this area.

Why it might be justified to pay a lot to avoid dangerous climate change

Martin Weitzman (Harvard University)

Based on the 2010 E.ON prize winning paper "Additive Damages, Fat-Tailed Climate Dynamics, and Uncertain Discounting" (http://www.economics-ejournal.org/eon-prize-2010)



How much should we do for climate change today in order to prevent damages in what seems to be a very distant future? Are there feasible scenarios that can result in such catastrophic climate degradation that we would be willing to pay a lot to avoid such damage?

The issue of climate change is notoriously complicated and involves so many different disciplines, subfields and viewpoints that no analytically tractable model can aspire to illuminate more than one or two facets of the problem. And even within this narrow scope, the prognoses and the resulting policy recommendations depend crucially on the assumptions being made about the parameters that go into the cost-benefit analyses when attempting to find optimal balance between mitigation, adaptation and unavoidable damage. My research shows that combining as little as three forms of structural uncertainty about climate change are aplenty to produce severe economic implications: uncertainties about the substitutability of climate damage and consumption, uncertainties about how to discount climate damages, and uncertainties about how to express future temperature dynamics.

1. Substitutability of climate damage and consumption

Some of the effects of climate damage - such as to drive up food prices, increase demand for air conditioning or heating, increase the costs for building dikes, or to raise energy prices - simply imply a loss of material wealth. It is well possible though that the main impact of climate change will happen on things that are not readily substitutable with material wealth. These include the loss of endangered species or more general biodiversity, negative health impacts due to more frequent heat waves or spreading of diseases like Malaria, and conflicts arising from climate migration and a fight for water.

2. Discounting climate change

How much do we care about the world our future generations will live in? How should we value the damages that will occur only in a very distant future? Numerous factors go into determining how to discount climate change and there are uncertainties surrounding each of these factors. For example, there is uncertainty about future technological progress, economic growth rates and the distribution of growth among different economies, and all of these may affect how we weigh the preferences of the current generation versus the preferences of the future generations. Furthermore, there is uncertainty as to the scope of the government's responsibility, i.e. whether its responsibility is to the current voters or to both the current and the future generations. And can we be sure that future governments will not have incentives to deviate from its optimal policies?

A small change in the weights we assign to the future versus the present or considering an unquestionably altruistic but not impossible idea that the future is just as important as the present will have dramatic effects on the outcomes of the economic analyses.

3. Future temperature dynamics

The unprecedented scale and speed of greenhouse gas (GHG) emissions accumulated over a long period, ambiguity about the future emissions and the Earth's response to changing conditions bring us into uncharted territory and make predictions of future climate change highly uncertain. The situation is further complicated by natural influences, such as changes in the sun and volcanic activity, which undoubtedly have an impact on future temperatures, but the extent of the damage is unknown because the timing and intensity of such occurrences cannot be predicted.

When the uncertainty about how to express future temperature dynamics is merged with the assumption of low substitutability between climate damages and consumption and with an unknown but potentially miniscule discount rate, the combination can in principle lead to infinite aggregate damages resulting from climate change. Which means that, based on a cost-benefit analysis, any amount of mitigation costs would be justified in order to avoid such disastrous scenario.

This message is intended neither to cause despair nor to negate the need for further numerical simulations to guide policy. It is meant as a cautionary note that the application of cost-benefit analysis to the issue of climate change seems to be more prone to volatility resulting from high dependency on subjective judgments about structural uncertainties than most other applications.

OUR READERS' PICK

"The Upside of Down: Catastrophe, Creativity, and the Renewal of Civilization" By Thomas Homer-Dixon

Setareh Khalilian

Thomas Homer-Dixon, a Professor in the Faculty of Environment at the University of Waterloo, has provided us with an inspiring and fascinating contribution to the literature on globalisation and the upcoming challenges for humankind. The main argument of his book, *The Upside of Down*, is that a number of converging stresses could eventually lead to a catastrophic breakdown on a global scale. Hi identifies five such "tectonic stresses" that are gradually building up: energy scarcity, mostly oil dependency; economic instability and widening gaps between rich and poor; demographic stress from large differences in population growth rates between rich and poor societies and from expansion of megacities in poor societies; environmental stress from damages to land, oceans and forests; and climate stress from changes in the composition of Earth's atmosphere.

The effect of the five tectonic stresses are multiplied by rising connectivity, global inter-dependency, increasing speed of our societies as well as the unprecedented power of very small groups of people to cause catastrophic destruction. Overall, the potential for synchronous failure with negative synergies is immense. We have paid too little attention to resilience of our complex societies, having focused on efficiency instead – thereby adding to the vulnerability of the global system.

Homer-Dixon presents well-illustrated and highly engaging comparison between the current situation of large industrialised countries and the downfall of the Roman Empire. By defining a "return on investment from energy production" and showing the gradual decline of this return, he argues that energy scarcity will be at the heart of the global crises ahead of us, and that it was also the main culprit for the downfall of Rome together with unsustainable complexity of the system. This fresh and interesting perspective on the failures of Rome is just one of the many strengths of this book, and its historical analogies help to convince the reader that we are indeed underestimating the challenges to humankind.

On the upside, the author argues that we can abate the effect of crises by strengthening resilience of our system, reducing immediate global inter-dependencies and by preparing for the next crisis. There are also inherent positive effects of breakdown – as long as it is small and controlled, breakdown provides for opportunities for reform and renewal, just as a healthy forest needs occasional small fires to renew itself. He also hints at various potentials that are not yet sufficiently used, such as large-scale problem solving via the Internet.

This is a highly recommendable book. The author lucidly lays out the various future scenarios, makes compelling historical analogies and explains the interplay between the stresses and their multipliers. Reading it is a mind-broadening exercise in assessing the risks inherent in our global economic and social system.

Institute for the World Economy
Hindenburgufer 66
24105 Kiel, Deutschland

Managing Editor:
Natalia Trofimenko
Natalia.trofimenko@ifw-kiel.de

The Kiel Institute is an international center for research in global economic affairs, economic policy consulting, economic education and documentation. The Institute engages especially in creating solutions to urgent problems in global economic affairs. On basis of its research, the Institute advises decision-makers in policy, business, and society and informs the broader public about important developments in international economic policy. As a portal to research in global economic affairs, the Kiel Institute has established a network of International Research Fellows that supports the worldwide awareness of the Institute's activities and gives additional research impulses in form of scientific advice, joint research, and teaching stays in Kiel. The Institute lays a special focus on economic education and closely cooperates with the world's largest library in economic and social sciences. Visit us online at www.ifw-kiel.de

List of contributors from the Institute for the World Economy and their contact information

Arslan Aslihan	aslihan.arslan@ifw-kiel.de	+49 431 8814 499
Khalilian Setareh	setareh.khalilian@ifw-kiel.de	+49 431 8814 233
Klepper Gernot	gernot.klepper@ifw-kiel.de	+49 431 8814 485
Korzhenevych Artem	artem.korzhenevych@ifw-kiel.de	+49 431 8814 578
Luecke Matthias	matthias.luecke@ifw-kiel.de	+49 431 8814 497
Narita Daiju	daiju.narita@ifw-kiel.de	+49 431 8814 212
Nunnenkamp Peter	peter.nunnenkamp@ifw-kiel.de	+49 431 8814 209
Peterson Sonja	sonja.peterson@ifw-kiel.de	+49 431 8814 406
Petrick Sebastian	sebastian.petrick@ifw-kiel.de	+49 431 8814 263
Rehdanz Katrin	katrin.rehdanz@ifw-kiel.de	+49 431 8814 407
Rickels Wilfred	wilfried.rickels@ifw-kiel.de	+49 431 8814 408
Trofimenko Natalia	natalia.trofimenko@ifw-kiel.de	+49 431 8814 245
Wiebelt Manfred	manfred.wiebelt@ifw-kiel.de	+49 431 8814 211