Fairness and Physics – observing first principles in global climate policy

Hans Joachim Schellnhuber and Daniel Klingenfeld*

Potsdam Institute for Climate Impact Research, Germany

Introduction

Global climate policy is at the crossroads: the Cancún Agreement documents an ambitious shared vision but essentially fortifies a bottom-up, pledge and review system incapable of delivering the mitigation actions necessary to stabilize the climate system. In this paper, we call for a return to first principles to close the gap between ambition and actions in order to confine global average temperature increase to no more than 2°C. *Fairness* and *Physics* are indispensable aspects to be observed by any successful climate protection strategy. The laws of physics, on the one hand, allow us to translate the 2°C temperature guard rail into a limited global carbon budget for humankind, which, in turn, has to be spent in a way that worldwide emissions peak by the end of this decade. Such a Herculean transformational challenge can only be met, on the other hand, if the fast-growing developing and emerging economies also become part of an integrated climate protection architecture based on equitable burden-sharing worthy of the name. We discuss the fundamental principles for such a global deal and propose an implementation strategy driven by an eminent coalition of pioneers who could overcome the dysfunctional consensus principle of the United Nations Framework Convention on Climate Change (UNFCCC).

Cancún: ambitious goals, lack of strategy

The results from the Cancún climate conference indicate that the patient 'World Climate' has been revived for the time being but that no decision has been taken as to when and how the cure will be administered. Indeed, the Cancún Agreement shows a remarkable divide: on the one hand, the shared vision reaffirms Article 2 of the UNFCCC and the objective to prevent dangerous anthropogenic interference with the climate system. Moreover, restricting the global mean temperature increase to below 2 degrees centigrade above pre-industrial levels constitutes a concrete operationalization of the guiding principle of the Framework Convention. A review process starting in 2013 may even lead to a tightening of the global temperature target towards 1.5°C. On the other hand, when it comes to actual mitigation actions, the Copenhagen Accord – previously an 'illegitimate child' under the Convention given its dubious generation – has been officially adopted under the roof of the UNFCCC. Whether this development can be called a success is highly questionable. The bottom-up, pledge and review system now enshrined in the Cancún Agreement can be likened to the collection plate principle in church: every nation-state offers more or less arbitrarily and in a non-binding way an amount of emissions mitigation deemed appropriate or politically feasible.

On this basis, it is not surprising that there is a widening disconnect between the geophysical requirements to limit global average temperature increase and the actual policies deployed (or the lack thereof) to contain global greenhouse gas emissions. The best that many negotiators seem to hope for is that together with strengthened protocols for measurement, reporting, and verification (MRV), the existing non-binding commitments would be turned into binding ones, increasing their credibility and the likelihood of their actually being implemented. Yet little would be gained in terms of the overall level of ambition. Even if the pledges currently on the table are fulfilled,

global mean temperature is expected to increase by more than 3°C by the end of the century.[1]

In addition, the example of Canada, which ratified the legally-binding Kyoto Protocol but will in all likelihood miss its target by a wide margin, demonstrates that emissions reduction commitments alone, without concurrent agreement on appropriate policy instruments for implementation, are insufficient. Specifying penalties for a future commitment period – to which states have to agree voluntarily similar to the provisions adopted for the Kyoto Protocol at COP 6 in 2001 – is a futile tactic, akin to *ex post facto* self-punishment.[2] As a consequence, without structural changes to the pledge and review approach going forward that encompass the level of ambition *and* the choice of policy instruments for implementation, *dangerous anthropogenic interference with the climate system will become institutionalized under the UNFCCC* – despite the high ideals evoked in the shared vision. Given the magnitude of the challenge and the need to refocus efforts on a more promising architecture for global climate stabilization, the legal status of pledges currently on the table is only of derivative importance.

While the European Union is at least formally upholding its support for ambitious global efforts leading to a timely stabilization of the climate system, the negotiations on how to bridge the gap between ambition and reality appear to be at a dead end. The strategy to keep the process alive by postponing the relevant decisions with respect to mitigation targets, appropriate policy instruments, and burden-sharing among emitters eventually risks collapse. In the footsteps of previous review clauses that were ignored, and action plans that passed away without result (most prominently Article 9 of the Kyoto Protocol and the Bali Roadmap), the sights are now set for 2015 when the review process called for in the Cancún Agreement will be concluded. The hope among

*Email address: daniel.klingenfeld@pik-potsdam.de (corresponding author). [Editor's note: This communication was accepted for publication on 27 July 2011 and will appear in 23 (3) (October 2011) *Global Change, Peace & Security*.]

[1] See: www.climateactiontracker.org (accessed 20 June 2011).

[2] J.E. Aldy, S. Barrett, R.N. Stavins, 'Thirteen Plus One: A Comparison of Global Climate Policy Architectures', *Climate Policy* 3, no. 4 (2003): 373–397.

negotiators, so it seems, is that with the release of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), due by 2014, new momentum will enable the international community to achieve the progress needed to reconnect objectives and actions. Yet so far there is no evidence that the next milestone set should bring the long-awaited breakthrough.

A return to first principles

Against the sobering reality of *international climate politics*, we argue that a refocusing on first principles in *global climate policy* is warranted to achieve the goals laid out in the Convention and further elaborated in the shared vision. *Fairness* and *Physics* are the two pillars on which an adequate solution to the problem has to rest. Fairness, on the one hand, must be at the basis of a new partnership between industrialized countries, emerging economies, and developing countries to jointly undertake a global decarbonization project. Physics, on the other hand, and more precisely climate physics, provides the yardstick for determining the scale of action required: by quantifying a global cumulative emissions limit derived from the shared guard rail for global temperature increase, physical principles define the scale and timeframe for this global effort. It follows that, irrespective of the mitigation strategy chosen, the overall emissions limit must be derived in a top-down fashion. After all, the laws of physics remain the same and are truly non-negotiable – whether viewed from the top down or from the bottom up.

In September 2009, the German Advisory Council on Global Change (WBGU) presented the 'Budget Approach' that takes up these first principles – Fairness and Physics – and proposes a global policy architecture for achieving climate stabilization.[3]

[3] Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen [German Advisory Council on Global Change] (WBGU), *Solving the Climate Dilemma: The Budget Approach.* Special Report (Berlin: WBGU, 2009); D. Messner, H.J. Schellnhuber, S. Rahmstorf, D. Klingenfeld, 'The Budget Approach: A Framework for a Global Transformation toward a Low-Carbon Economy', *Journal of Renewable and Sustainable Energy* 2, no. 3 (2010): 031003-1–031003-14.

The proposal leads away from individual bargaining for more or less far-reaching pledges by nation-states. Instead of such partial approaches, compliance with the 2°C guard rail is introduced as the central target of global climate policy and translated into a global emissions budget for the decades to come. Quantifying this budget requires specification of a probability level with which the temperature guard rail is to be observed. Setting this parameter at 67% (which is by no means a risk-averse specification) yields a remaining global emissions budget of 750 gigatons of CO_2 for the coming four decades. This seemingly impressive figure actually melts down to a mere 25 years of global emissions *at current levels*. In contrast, after only a slight downturn due to the global financial and economic crisis in 2009, worldwide emissions are projected to continue to rise by over 3 percent in 2010,[4] with no end of their growth trajectory in sight despite existing climate policy efforts.

However, and against this 'business as usual' emissions development, the physical reality of a limited global emissions budget compatible with the widely-shared environmental objective of the Convention to prevent dangerous climate change requires that total emissions peak as soon as possible and decline forcefully thereafter. In fact, keeping a realistic chance of remaining within a budget of 750 gigatons of CO_2 necessitates achieving the global emissions peak within this decade, while every year of delay amplifies the challenge of deeper reductions thereafter (see Figure 1).

The scale of the global decarbonization effort and the corresponding time pressure call for an implementation concept that is fair and inclusive in order to integrate the largest emitters. The budget approach proposes to allocate the remaining carbon budget among the global population on an equal per capita basis and thus proportionally among

[4] P. Friedlingstein, R.A. Houghton, G. Marland, J. Hackler, T.A. Boden, T.J. Conway, J.G. Canadell, M.R. Raupach, P. Ciais and C. Le Quere, 'Update on CO_2 Emissions' [Letter to the Editor], *Nature Geoscience* 3:811-812 (2010), 21 November 2010 [Online publication: http://www.nature.com/ngeo/journal/v3/n12/full/ngeo1022.html; accessed on 25 July 2011].

individual countries.[5] Although this distributional principle can only be an approximation for equity,[6] a flat distribution of emissions rights among all people based on the democratic principle of 'one human – one emissions entitlement' offers the best chance to overcome the moral deficiencies of the current system and to include, most notably, developing countries. In fact, countries with below-average per capita emissions will become important partners in climate protection.[7] These countries can sell surplus emissions rights to countries with higher per capita emissions and receive significant sums for low-carbon development within the framework of a global cap-and-trade system.

Developing an implementation strategy

The first principles laid out in the budget approach – Fairness and Physics – serve as the starting point for an implementation concept termed *2°max Climate Strategy* that was presented in April 2010.[8] The focal point of the strategy, and its near-term objective, is to bring about the global emissions peak during this decade and to enable farther-reaching global emissions reductions in the decades to come. From a geophysical perspective, achieving the global emissions peak before the year 2020 constitutes, as we have argued, a prerequisite for retaining an acceptable chance of observing the 2°C temperature guard rail.

---

[5] Alternative distributional principles have been advanced, for example, by P. Baer, G. Fieldman, T. Athanasiou and S. Kartha, 'Greenhouse Development Rights: Towards and Equitable Framework for Climate Policy', *Cambridge Review of International Affairs* 21, no. 4 (December 2008): 649–666; J. Frankel, 'An Elaborated Proposal for Global Climate Policy Architecture for All Countries in All Decades'. Discussion Paper 08-08, Harvard Project on International Climate Agreements, Belfer Center for Science and International Affairs, Harvard Kennedy School, October 2008; S. Chakravarty, A. Chikkatur, S. Pacala, R. Socolow and M. Tavoni, 'Sharing Global CO_2 Emissions Reductions among One Billion High Emitters', *Proceedings of the National Academy of Sciences* 106 (2009): 11884–11888.

[6] For a discussion of this issue, see, for example, WBGU, *Solving the Climate Dilemma*; L. Wicke, *Beyond Kyoto – A New Global Climate Certificate System: Continuing Kyoto Commitments or a Global 'Cap and Trade' Scheme for a Sustainable Climate Policy?* (Berlin, Heidelberg: Springer 2005).

[7] WBGU, *Solving the Climate Dilemma*; D. Messner, H.J. Schellnhuber, S. Rahmstorf, D. Klingenfeld, 'The Budget Approach'.

[8] See L. Wicke, H.J. Schellnhuber, D. Klingenfeld, *Nach Kopenhagen: Neue Stategie zur Realisierung des 2°max-Klimazieles* [After Copenhagen: A New Strategy to Realize the 2°max Climate Objective] PIK Report No. 116 (Potsdam: PIK, 2010) – a short English version is available at: http://www.pik-potsdam.de/research/publications/pikreports/.files/english_short_pr116 – and L. Wicke, H.J. Schellnhuber and D. Klingenfeld, *Die 2°max-Klimastrategie – Ein Memorandum* [The 2°max Climate Strategy – a Memorandum] (Münster: LIT, 2010) for a comprehensive presentation of design elements.

To this end, we propose the implementation of a 'peak-and-trade' policy scheme with a comprehensive emissions cap that involves as many countries as possible.[9] The objective is to induce a wide-ranging, significant carbon price signal to substantially affect the global emissions trajectory to the scale required. In order to phase in the scheme, we suggest setting the initial cap at a relatively generous level of 35 gigatons of CO_2 from fossil sources in the year 2015 which should be kept level until the year 2020. An overlay with emissions curves corresponding to a global emissions budget of 750 gigatons of CO_2 from 2010–2050 shows that the cap needs to be lowered significantly in future commitment periods to comply with the global carbon budget (see Figure 1).

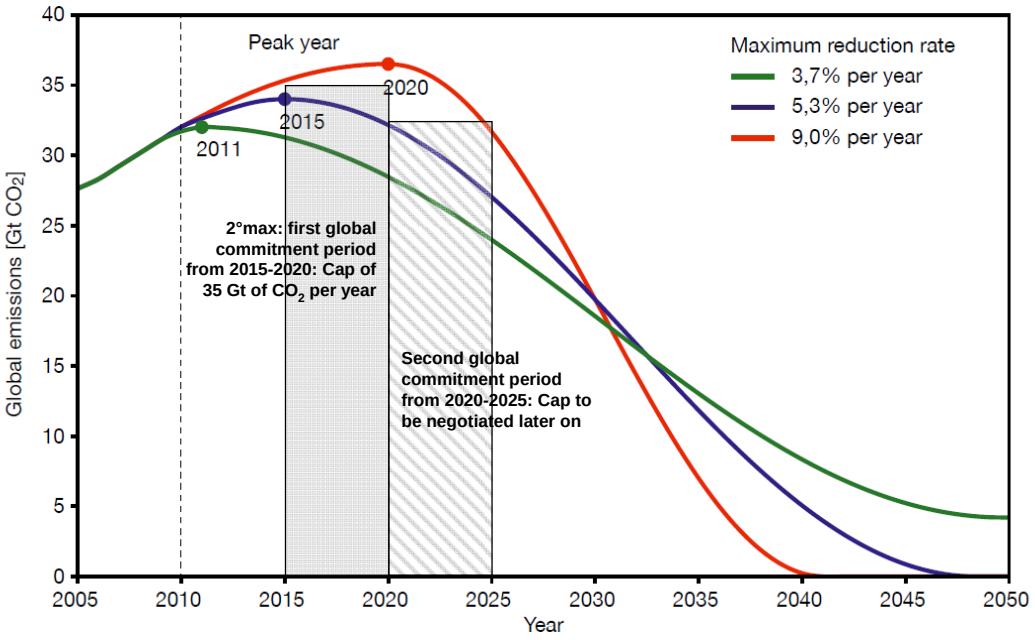

Figure 1. Source: modified from WBGU, *Solving the Climate Dilemma*, 16

Explanation: The three depicted exemplary emissions trajectories until 2050 correspond to a residual global budget of 750 gigatons of CO_2 from fossil sources that holds a 67% probability of achieving compliance with the 2°C guard rail. The differences in slope relate to different peaking years. Note that the level of the cap indicated corresponds to a setting where full global participation is assured. Lower initial emissions coverage implies a lower absolute cap for coalition members.

[9] The term 'peak-and-trade' refers to a cap-and-trade scheme with the objective to bring about the global emissions peak.

In addition, the strategy incorporates provisions for fast-growing countries like China, which are already near or above current world average per capita emissions levels, in order to increase the prospects of their participation. In this context, it is *essential* for the price signal to extend to large developing countries, since it is in these countries that the largest emissions increases would otherwise occur in the years ahead and where the potential for carbon-intensive lock-in is greatest. To illustrate this point, at the height of the global financial and economic crisis in 2009, that saw global carbon dioxide emissions decline by 1.3 % over the previous year, China and India boosted their emissions by 8 % and 6.2 % respectively,[10] thereby adding close to 600 million tons of CO_2 to the world total. This is more than the national yearly emissions of Canada or the UK and in fact only surpassed by the yearly national emissions of six countries worldwide (including China and India).[11] In the absence of forceful policy intervention, this emissions growth trend is set to continue its steep path.

The required integration of developing and emerging economies into a comprehensive architecture to enable a timely global emissions peak can only succeed if emission rights are allocated in a fair and transparent manner. Similar to the budget approach, the 2°max Climate Strategy builds on an immediate equal per capita allowance allocation in order to extend a common emissions cap as broadly as possible and to bring developing countries on board from the outset. However, in order to counter initial imbalances due to the unequal allocation of allowance supply and demand, and to avoid possible economic distortions, the strategy allows specification of the total amount of financial transfers among countries, which can be modified over time.[12] The magnitude of these transfers is to be negotiated in what would probably be the grandest political compromise of all time.

[10] P. Friedlingstein, et al., *Update on CO_2 Emissions*.
[11] World Resources Institute – Climate Analysis Indicators Tool (WRIA-CAIT), http://cait.wri.org/, 2010, emissions data for 2007 (accessed on 25 July 2011).
[12] Maintaining an equal per capita allocation while limiting transfer payments can be done by negotiating transfer prices for emission allowances among governments before company-level trading takes place.

Fuel and resource companies are the regulated entities which would need to purchase emissions allowances from a common market, leading to a comprehensive and uniform price signal in industrialized *and* developing countries. Consumers and businesses worldwide would have strong incentives to change their behavior toward low-carbon lifestyles and business practices, setting off major innovation impulses. The operation of such a comprehensive carbon market can only succeed if the number of companies covered by the system is manageable and if emissions are easily verifiable. An *upstream* point of regulation focusing on the carbon content of fuels – and targeting national producers of coal, oil, and gas as well as importers and exporters of such products – appears to be the only practicable option, particularly in view of the varying administrative capacities around the world.

Despite its relative simplicity compared to alternative options, such architecture calls for a *cooperation revolution* among nation states and requires the establishment of appropriate global institutions: a long-run carbon budget can only be managed in a credible way as to its long-term integrity if the decisions about the supply of allowances are removed from day-to-day politics. Along with other scientists, we propose the stepwise creation of a *World Climate Bank* to eventually adopt the role of independent trustee of a global carbon budget, in line with the physical requirements to confine climate change to tolerable levels.[13] The case of independent central banks for currencies to ensure achievement of long-term goals should serve as a powerful reminder that governments are indeed capable of yielding sovereignty in key areas to create institutions to achieve public purpose. The example of the European Central Bank shows that such an evolution has even been possible on the supranational level. The challenge – and task – ahead is to gradually overcome too narrow conceptions of

---

Refer to L. Wicke, H.J. Schellnhuber, D. Klingenfeld, *Nach Kopenhagen: Neue Stategie zur Realisiering des* 2°*max-Klimazieles* [After Copenhagen: A New Strategy to Realize the 2°max Climate Objective].

[13] L. Wicke, *Beyond Kyoto*; WBGU, *Solving the Climate Dilemma*; O. Edenhofer, B. Knopf and G. Luderer, 'From Utopia to Common Sense: Global Climate Policy that Could Work', *Nova Acta Leopoldina* N.F. 112, no. 384 (2010): 59–70; D. Klingenfeld, *Evaluating Global Climate Policy – Taking Stock and Charting a New Way Forward*. PIK Report No. 117 (Potsdam: PIK, 2010).

the national interest and the value of sovereignty in clearly delineated areas so that a cooperative outcome can be achieved that lives up to reasonable expectations.

Despite the ultimate objective of establishing a truly global emissions cap and a global carbon market, the 2°max Climate Strategy is not a thought experiment anchored in a theoretical first-best setting without linkages to actual negotiation dynamics. On the contrary, the strategy lays out practical ways to reconcile climate policy interests in developing and developed countries. Yet it is likely that the failure of the U.S. Senate to pass national climate legislation has dealt a final blow to the near-term prospects for a comprehensive international climate agreement. In addition, the structural opposition of fossil fuel-exporting countries to ambitious global emissions limits may be an even bigger roadblock.

However, the architecture proposed can be built up gradually if a coalition of pioneering states moves ahead: the European Union, Japan and the BASIC countries, particularly the three energy heavyweights China, India, and Brazil, could become a powerful nucleus for an effective global climate protection strategy that can deliver. Recent developments in Australia with regard to pricing carbon are equally encouraging. This limited but eminent coalition would already make up close to fifty percent of global carbon dioxide emissions[14] and could set off a transformative impulse leading to a virtuous circle of expanding membership. The detailed principles of the agreement should first be negotiated among the initial coalition of pioneers. In a second step, the structure should be codified as a new protocol under the UNFCCC, thereby consciously opening the architecture for further members and anchoring it firmly in the international negotiation process, without at the same time succumbing to the self-constructed unanimity trap that has plagued the negotiations to date.

While carbon leakage, as well as inadequate global emissions mitigation due to incomplete coverage, would remain as major challenges for an initial sub-global

[14] WRI-CAIT, 2010, extrapolated data for 2007.

alliance, the incentives for free riders can be lowered by means of strategic trade measures by coalition members in the form of border tax adjustments, whose implementation may be necessary in a transitional period.[15] In addition, research cooperation would raise the benefits of working together and over time create incentives for other countries to join an emerging global regime.[16] A coalition of cooperating states that lays the foundation for establishing the necessary institutions and that tackles the question of burden sharing among countries with unequal development profiles may, in fact, be the most promising way forward.

Notes on contributors

Prof. Dr. Hans Joachim Schellnhuber CBE has been director of the Potsdam Institute for Climate Impact Research (PIK) since he founded it in 1991. He is Professor for Theoretical Physics at Potsdam University and External Professor at the Santa Fe Institute. Schellnhuber is Chairman of the German Advisory Council on Global Change (WBGU). He is a member of numerous national and international panels for scientific strategies and policy advice on environment and development matters, e.g. the US National Academy of Sciences, the German National Academy of Sciences (Leopoldina) and the Max Planck Society. Furthermore, he is a member of the Editorial Boards of several scientific journals like *Proceedings of the National Academy of Sciences* and *Climatic Change* and has authored or co-authored about two hundred and fifty articles and more than fifty books in the fields of condensed matter physics, complex systems dynamics, climate change research, Earth System analysis, and sustainability science.

Daniel Klingenfeld, MPP, M.Sc. is working at the Potsdam Institute for Climate Impact Research. He is research analyst for Professor Schellnhuber at the German Advisory Council on Global Change to the Federal Government (WBGU). In addition, he is completing his doctoral thesis in climate policy. He holds degrees from Harvard Kennedy School (Master in Public Policy) and ESCP Europe (M.Sc. in Management). Following his graduation from Harvard in 2008, Daniel Klingenfeld worked in the Climate Change and Clean Energy Group at IHS Cambridge Energy Research Associates. Building on further experience in the energy domain, such as for example with the National Commission on Energy Policy in Washington D.C., he focuses on the challenges of global energy and climate policy design.

[15] See, for example, A. Mattoo, A. Subramanian, D. van der Mensbrugghe and J. He, *Reconciling Climate Change and Trade Policy*, The World Bank Development Research Group Trade and Integration Team. Policy Research Working Paper 5123 (Washington, DC: The World Bank, November 2009); K. Lessmann, R. Marschinski and O. Edenhofer, 'The Effects of Tariffs on Coalition Formation in a Dynamic Global Warming Game', *Economic Modelling* 26 (2009): 641–649.

[16] K. Lessmann and O. Edenhofer, 'Research Cooperation and International Standards in a Model of Coalition Stability', *Resource and Energy Economics* 33, no. 1 (2011): 36–54.