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Modifying the 2°C Target

Climate Policy Objectives in the Contested Terrain of Scientific Policy Advice, Political Preferences, and Rising Emissions

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Modifying the 2°C Target: Climate Policy Objectives in the Contested Terrain of Scientific Policy Advice, Political Preferences, and Rising Emissions

In the twenty years since the United Nations (UN) Framework Convention on Climate Change was adopted, progress in the area of international climate policy has been modest at best. Annual greenhouse gas emissions have increased by over one-third since 1992. Acute conflicts of interest among industrialized, emerging, and developing countries remain a persistent obstacle. A comprehensive global climate treaty will not be concluded until 2015 at the earliest, and it will not enter into force before 2020. One of the few points of general consensus in the international community is on the overarching objective of limiting the global temperature increase to two degrees Celsius in order to avoid crossing the threshold into "dangerous climate change."

Although the European Union (EU) had already started to campaign for the 2°C target in the mid-1990s, this target was not formally adopted until 2010 at the UN Climate Change Conference in Cancún. If one is to accept key findings from climate research and the recommendations from scientific policy advisors, emissions will have to be reduced significantly between 2010 and 2020 to stay below the 2°C limit. Yet given that global emissions trends are moving in the opposite direction and will be impossible to reverse in a matter of a few years, this goal is patently unrealistic. And since a target that is obviously unattainable cannot fulfill either a positive symbolic function or a productive governance function, the primary target of international climate policy will have to be modified.

The present study has been written to address this void. Its express aim is to stand apart from the innumerable studies detailing theoretically possible measures to avoid crossing the 2°C threshold. Instead, this paper provides the first systematic analysis of possible options for modifying the 2°C target. A particular focus is placed here on the relationship between climate science and climate policy.

Contrary to widespread hopes, the global agreement on the 2°C target has contributed little to the implementation of ambitious policy measures worldwide. The target currently serves a primarily symbolic

and declarative function. For this reason, a pragmatically motivated reduction in the level of political ambition carries risks. This is particularly critical for the EU, which has gained worldwide recognition as a leader in climate policy, not least because of its role in bringing the 2°C target into the international climate policy arena and successfully pushing through its adoption as a global limit. But the EU not only risks damage to its public image. Since Europeans derive their internal emissions reduction objective of 80–95 percent (compared to 1990 levels) by 2050 directly from the 2°C target, a weakening of the global climate policy target would inevitably lead in turn to a debate over the easing of EU reduction targets. This could become a highly controversial issue in the coming years, when the EU has to decide on its legally binding emissions target for 2030.

Despite the dwindling probability that the established goal can still be met, there has been no broad discussion to date about the future of the 2°C target. There is no "Plan B." As global emissions continue to rise, the EU will not be able to avoid this question much longer. The heads of state and government of EU Member States who hold the decision-making power in this area will have to develop clear ideas about how a change in the target formula can be achieved in conformity with Member States' interests in climate, foreign, and economic policy.

Since scientists have a very influential position in global climate discourse, and since the current target formula is explicitly "science-based," policy makers will not be able to modify the target on their own. But to be able to identify the potentials and legitimate grounds for modifying the 2°C target, climate policy makers must engage critically with the target formula and the emissions reduction paths that have been derived from it. From the perspective of climate policy, the 2°C target may still be considered sacrosanct in the EU, but from the perspective of climate science, it is entirely questionable.

The various options for modifying the 2°C target can be differentiated first and foremost by the level of intervention involved. A *reinterpretation* of the current target would entail adjusting certain assumptions of climate economics in order to temporarily avoid the crucial "make-or-break" point of the 2°C target—the last possible year in which global emissions would have to peak. Possible starting points for such an approach could be found in the uncertainties that exist within climate and energy system models, but also in the more fundamental question of whether the 2°C target should still be understood as an absolute upper limit or whether it might be a threshold that could be crossed temporarily. While the *reinterpretation* approach strives for an indirect and politically less risky path to reducing ambition levels, the *revision* approach takes a direct route. This could mean accepting a less ambitious global target that would be significantly higher than 2°C or even giving up a specific global stabilization target altogether.

The EU will probably favor a reinterpretation over a revision of the 2°C target. However, that does not mean its preferences will necessarily prevail. What ultimately happens will be determined by the actions of major emitters like China and the USA, and even more by how global emissions levels evolve over the next several years. If the trend is not reversed soon, a reinterpretation of the 2°C target might not be enough. If the EU wants to maintain its role as a global leader in climate policy, it will have to investigate all options for target modification as soon as possible—even those that seem politically unappealing.

No matter which option the EU chooses to pursue in the medium term, and which one is ultimately adopted in international climate policy, the relationship between climate policy and climate science will undoubtedly become much more pragmatic. The need to reinterpret or revise the 2°C target arises primarily from international climate policy's lack of success. Yet its failure is also the failure of the dominant approach to policy advice up to now: the attempt to delimit the range of options available to climate policy by establishing "science-based" climate objectives. What seemed to be a non-negotiable planetary boundary will be subject to (more or less publicly visible) renegotiation.

In the future, climate policy and climate research will be much less mutually dependent. To remain relevant, scientific policy advisors will have to cease to issue absolute demands as if these were the only alternatives available to policy makers. Science-based climate policy advice should confine itself to presenting the preconditions and consequences of specific policy options rather than seeking a role as a de facto political actor. This would enable climate policy makers to reach more informed decisions about the various options available at an earlier stage.

Status and Functions of the 2°C Target

In international climate policy, there is broad consensus, at least formally, on the necessity of limiting the increase in the global average temperature to a maximum of 2°C above pre-industrial levels. The definition of 2°C as the threshold beyond which the consequences of climate change could spin out of control has been the most successful attempt to date to translate the relatively abstract demands in Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC) into concrete guidelines.[1] The Convention states: "The ultimate objective of this Convention [...] is to achieve [...] stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[2]

The Establishment of the 2°C Target in Climate Policy

Members of the climate policy community often emphasize that the 2°C target is a figure derived from scientific research. Scientists themselves, however, are generally well aware that this target is more political in nature—another target could have been set just as easily. Scientific research on climate change has reported numerous indications that 2°C could be an advisable guideline, but has not produced clear evidence that this precise figure is imperative.[3] As a result, only a part of the scientific community actively promotes the 2°C target. Contrary to a widespread misconception, none of the Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC) have ever made an explicit case for the 2°C target. The first analysis of whether and how this goal can still be reached will be published in the IPCC's Fifth Assessment Report. Numerous prominent climate researchers and policy advisory bodies such as the German Advisory Council on Global Change (WBGU) have been arguing since the mid-1990s for the establishment of a 2°C limit. However, the active engagement of the European Union was the crucial factor in achieving international agreement on the 2°C target.[4]

European climate policy was early to recognize the 2°C limit as an effective means of operationalizing the stabilization objective formulated in Article 2 of the UNFCCC. European environmental ministers adopted their first resolution on the matter in 1996. At the spring summit of the European Council in 2005, the heads of state and government finally approved the target. In 2007, the question of how to actually achieve this target was addressed in the first European Energy Strategy. There, the 2°C threshold served as a "strategic target" which, if pursued, would lead to a sustainable, secure, and competitive energy supply in Europe. The targets currently under consideration in the EU—an 80 to 95 percent reduction in emissions (compared to the base year 1990) by 2050—are derived directly from the global 2°C target.[5] Since 2007, the EU has succeeded in gradually gaining support for this target from all its most important negotiation partners—even China, India, and the USA. In the

1 Michael Oppenheimer and Annie Petsonk, "Article 2 of the UNFCCC: Historical Origins, Recent Interpretations," *Climatic Change* 73, no. 3 (2005): 195–226.

2 United Nations (UN), *United Nations Framework Convention on Climate Change* (New York: UN, 1992).

3 Béatrice Cointe, Paul-Alain Ravon, and Emmanuel Guérin, *2°C: The History of a Policy-Science Nexus*, IDDRI Working Paper 19/2011 (Paris: Institut du développement durable et des relations internationales, 2011); Joel B. Smith et al., "Assessing Dangerous Climate Change through an Update of the Intergovernmental Panel on Climate Change (IPCC) 'Reasons for Concern'," in *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* 106, no. 11 (2009): 4133–37.

4 On the evolution of the 2°C target, see Carlo C. Jaeger and Julia Jaeger, *Three Views of Two Degrees*, ECF Working Paper 2/2010 (Potsdam: European Climate Forum [ECF], 2010; Samuel Randalls, "History of the 2°C Climate Target" *WIREs Climate Change* 1, no. 4 (2010): 598–605; Richard S. J. Tol, "Europe's Long-term Climate Target: A Critical Evaluation" *Energy Policy* 35, no.1 (2007): 424–32; Cointe, Ravon, and Guérin, *Policy-Science Nexus* (see note 3).

5 Council of the European Communities, *1939. Meeting of the Council (Environment)*, doc. 8518/96 (Brussels, June 25, 1996); Council of the European Union, *Meeting of the European Council – Presidency Conclusions*, doc. 7619/1/05 REV 1 (Brussels, March 22 and 23, 2005); Council of the European Union, *Brussels European Council – Presidency Conclusions*, doc. 7224/1/07 (Brussels, March 8 and 9, 2007); European Commission, *A Roadmap for Moving to a Competitive Low-carbon Economy in 2050*, COM(2011) 112 (Brussels, March 8, 2011).

Cancún Agreements, which were approved at the 2010 United Nations Climate Change Conference, the 2°C target was adopted for the first time by a Conference of the Parties to the UNFCCC: "[The Conference of the Parties, COP] further recognizes that deep cuts in global greenhouse gas emissions are required according to science, [...] so as to hold the increase in global average temperature below 2°C above pre-industrial levels."[6] To date, however, there has been no agreement at the UN level on a package of measures that would allow this target to be reached.[7]

A climate policy that proclaims the 2°C limit as its credo creates high expectations and puts itself under enormous pressure to show results. The difference between the current average global temperature and the historic climate data from the pre-industrial age is estimated to be around 0.8°C. Due to the relative inertia of the climate system and the long lifespan of many greenhouse gases in the earth's atmosphere, even global emissions up to the present date will result in an additional temperature increase of at least 0.5°C.[8] Every step toward reducing carbon dioxide emissions today will only affect the earth's temperature several decades in the future. Even if the world's biggest emitters make good on their promised reductions the 2°C limit will be surpassed significantly.[9] In light of this fact, it was decided at the UN Climate Conference in Cancún that a review would be conducted from 2013 to 2015 to assess whether the emission reduction measures undertaken up to that point have been consistent with the 2°C target. The Parties to the UNFCCC also decided that a debate should take place following the publication of the IPCC's Fifth Assessment Report, which is scheduled to be published in 2013 and 2014, on whether the temperature target should be changed from 2°C to 1.5°C.

The Problem-Centered Approach—Formulating a Science-Based Target

International climate policy has been defined for two decades by the paradigm of a "problem-centered," top-down governance approach. This approach focuses first on establishing a limit grounded in scientific research that defines what is still a tolerable level of climate change. In the second step, the resulting threshold value is used to determine a global emissions reduction target. Finally, regulations are formulated that establish how the reductions determined to be necessary by this method (or conversely: the remaining emissions rights) should be distributed among individual states, preferably through a UN treaty that is binding under international law.[10]

With the agreement on the 2°C target, international climate policy made a "scientized" global target the centerpiece of its activities and its communications with the public. Although the ultimate decision on the exact maximum temperature limit is in the hands of politicians, they cannot make this decision independent of the climate research community—particularly since global climate policy leaders such as the EU have always declared their policies to be "science-based." Whereas policy makers relinquish all authority to determine which global emissions reduction paths should be derived from the 2°C target, they act virtually autonomously in the final step in this process—the UN negotiations over the allocation of emissions reduction commitments among nation states. Yet in this top-down discourse, negotiations do not seem to constitute an independent level of activity but merely the transposition of scientifically "imperative" targets and reduction paths into policies.[11] In contrast to an

6 UNFCCC, Decision 1/CP.16 – *The Cancun Agreements: Outcome of the Work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention*, FCCC/CP/2010/7/Add.1 (March 15, 2011).

7 The timetable adopted at the Conference of the Parties in Durban in 2011 (COP 17) envisions that a global treaty on emissions reductions will be agreed upon by 2015 (COP 21) and will enter into force in 2020. The attempts made to reach such a comprehensive agreement have failed regularly to date, most recently in the "Bali Action Plan," passed in 2007, which should have been adopted at the 2009 Climate Summit in Copenhagen (COP 15).

8 Veerabhadran Ramanathan and Yangyang Xu, "The Copenhagen Accord for Limiting Global Warming: Criteria, Constraints, and Available Avenues," *PNAS* 107, no. 18 (2010): 8055–62; WBGU, *Climate Change: Why 2°C?*, Factsheet 2/2009 (Berlin, 2009).

9 International Energy Agency (IEA), *World Energy Outlook 2012* (Paris, 2012), 241ff.; Joeri Rogelj et al., "Analysis of the Copenhagen Accord Pledges and Its Global Climatic Impacts—a Snapshot of Dissonant Ambitions," *Environmental Research Letters* 5, no. 3 (2010): 1–9.

10 In contrast to widespread assumptions, the focus of the top-down approach to climate policy is not on the preferred level of political action (UN system) but the overarching policy goal (limiting global warming to 2°C), with all further steps being derived from this goal; see William Hare et al., "The Architecture of the Global Climate Regime: A Top-down Perspective," *Climate Policy* 10, no. 6 (2010): 600–14.

11 On the interactions between climate science and climate policy, see Roger A. Pielke Jr., *The Honest Broker. Making Sense*

"actor-centered" perspective, which takes the existing limitations on action in the international political system as its starting point and exercises caution in assessing the global climate regime's ability to solve the problem in the short to medium term, the "problem-centered" approach assumes that effective global governance structures must and can be established within a matter of years. This explains why international climate policy's failure to reach agreement on reduction commitments in line with the 2°C target has not led to critical re-examination of the target, but only to criticism of the industrialized and emerging economies' leaders for their "lack of political will to take action."

In European and international climate policy, consensus on the 2°C target is so solid that the means by which this limit was arrived at are hardly given a second thought, despite numerous scientific uncertainties.[12] Climate policy debates neglect to mention, for example, that the category of "global average temperature" is not a simple measurement but a complex statistical construct, a product of values taken from thousands of measuring stations across the globe that must be related to each other in a meaningful way. In other words, scientists do not just create an average of all the temperatures measured, but carry out theory-based adjustments to correct for distortions that result from, for example, the unequal distribution of measuring stations across the globe or effects from urban settlements located nearby.[13] The task outlined in Article 2 of the UNFCCC establishing a boundary between dangerous and non-dangerous climate change is also fraught with scientific uncertainties. The Fourth Assessment Report of the IPCC expresses strong doubts about whether it is expedient to use just one index in the assessment of climate risks[14]: such an approach does not provide a basis for predicting what global average temperature will still be "safe" in a few decades, no matter how "safety" is defined. The use of a single global threshold as a benchmark is already questionable because temperatures and sea levels will change differently from region to region. Negative climate change impacts are likely to begin appearing in many countries long before the global 2°C limit has been reached, but in some countries they will appear only later. Most importantly, the establishment of an absolute threshold for dangerous climate change obscures the fact that in a changing world climate, "security" will depend critically on the societal capacities available in individual countries to cope with fundamentally new climatic situations.[15]

Despite the many uncertainties inherent in it, 2°C has been able to prevail as the global temperature threshold. It functions as the central point of reference in the climate debate, and as the one concrete objective on which key actors from policy, media, and research have been able to reach at least interim agreement. A central factor in the success of the 2°C target is the relative ease of communicating and interpreting a temperature category in the form of a whole number compared to other scientific categories such as the atmospheric concentration of greenhouse gases (measured in parts per million, ppm) or radiative forcing (measured in watts per square meter, W/m^2). The decision to establish a fixed limit using a temperature category with no fractional numbers represents the desire to reduce complexity and the desire to claim objectivity joined together in a mutually beneficial synergy. This gives the 2°C target a high level of discursive versatility for application within the climate debate, but it also leads to many false conclusions.[16] In an endeavor to downplay ambiguities in the description of causal chains, climate policy and the media have tended to edit out not only the

of Science in Policy and Politics (Cambridge, 2007); particularly for the case of the IPCC see Silke Beck, "Moving beyond the Linear Model of Expertise? IPCC and the Test of Adaptation," *Regional Environmental Change* 11, no. 2 (2010): 297–306.

12 The numerous uncertainties in climate science are often unknown in the sphere of climate policy because they tend to be obscured by median values and best estimates. For a discussion of the obstacles to a critical examination of quantitative knowledge, see Bettina Heintz, "Zahlen, Wissen, Objektivität: Wissenschaftssoziologische Perspektiven," in *Zahlenwerk. Kalkulation, Organisation und Gesellschaft*, ed. Andrea Mennicken and Hendrik Vollmer (Wiesbaden, 2007), 65–85.

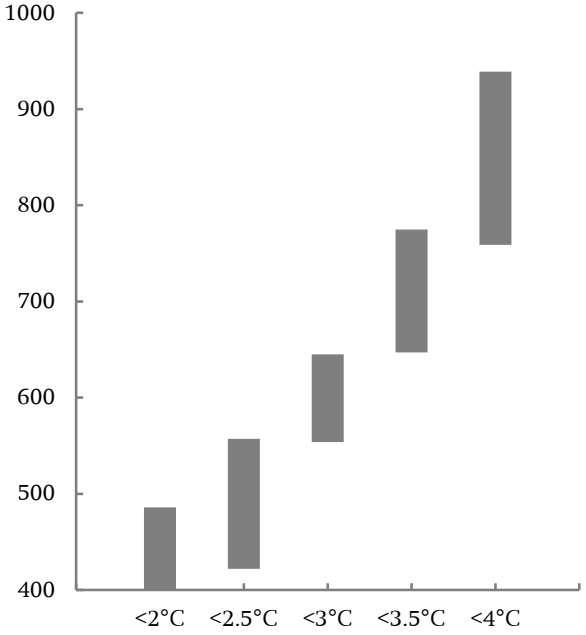
13 Kevin E. Trenberth et al., "Observations: Surface and Atmospheric Climate Change—Appendix 3.B: Techniques, Error Estimation and Measurement Systems," in *Climate Change 2007: The Physical Science Basis – Contribution of Working Group I to the Fourth Assessment Report of the IPCC*, ed. Susan Solomon et al. (Cambridge and New York, 2007), SM.3-1–SM.3-11.

14 Stephen Schneider et al., "Assessing Key Vulnerabilities and the Risk from Climate Change," *Climate Change 2007: Impacts, Adaptation and Vulnerability – Contribution of Working Group II to the Fourth Assessment Report of the IPCC*, ed. Martin L. Parry et al. (Cambridge and New York, 2007), 779–810.

15 Bruce T. Anderson, "Intensification of Seasonal Extremes Given a 2°C Global Warming Target," *Climatic Change* 112, no. 2 (2012): 325–37; Mike Hulme, *Why We Disagree about Climate Change. Understanding Controversy, Inaction and Opportunity* (Cambridge, 2009), 191ff.

16 Theodore M. Porter, *Trust in Numbers. The Pursuit of Objectivity in Science and Public Life* (Princeton, 1995).

Figure 1
Greenhouse Gas Concentrations and Likely (> 66%) Maximum Temperature Rise before 2100 (in ppm CO_2e)



Source: Rogelj et al., "Supplementary Information," in "Emissions Pathways" (see note 19), 6.

numerous uncertainties inherent in predicting concrete effects of a global temperature increase to 2°C, but also the wide range of projections that have been made regarding what specific atmospheric concentration of greenhouse gases[17] will lead to what specific temperature effect. The ongoing improvement of climate models will by no means narrow the range of these uncertainties but instead will widen it. As improved computing capabilities allow scientists to integrate an increasing number of climate-relevant factors into their models, the variety of possible climate scenarios will also increase.[18]

For this reason, it is also impossible to use climate models to definitively say what total global level of emissions or greenhouse gas concentrations (expressed in CO_2-equivalents, CO_2e) would be acceptable under a given temperature target for 2100.[19] To translate this exceptionally important relation for climate policy into comprehensible terms, one must first define a desired probability of reaching a given temperature target. On this basis, the range of maximum values can be determined (see Figure 1). Thus, if one wants to limit the temperature increase in the twenty-first century to 2°C at a (standard) probability of at least 67 percent, the range of admissible greenhouse gas concentrations would be 400–486 ppm CO_2e. For a target of 2.5°C, the corridor would be 422–557 ppm CO_2e. This has two implications: (1) If one wants to limit the increase to 2°C, it may be enough to stabilize greenhouse gas concentrations at 486 ppm; however, in the worst case, even 400 ppm would bring about a temperature effect of 2°C. (2) Although international climate policy proceeds on the unquestioned assumption that it would be possible to adhere to the 2°C target with a (quite ambitious) stabilization at 450 ppm CO_2e, it is quite possible based on current climate research that this concentration would cause a temperature increase of 2.5°C.[20]

The Carbon Budget Approach

Over the past several years, a strategy known as the "budget approach" has gained prominence in science-based climate policy advice. It allows for relatively straightforward conclusions to be drawn from the 2°C target about the total amount of greenhouse gases that may still be emitted worldwide. Yet the persisting uncertainties in climate science are only mentioned in passing and hardly taken into consideration in the climate policies produced through this strategy. The conclusions drawn using the budget approach are indeed

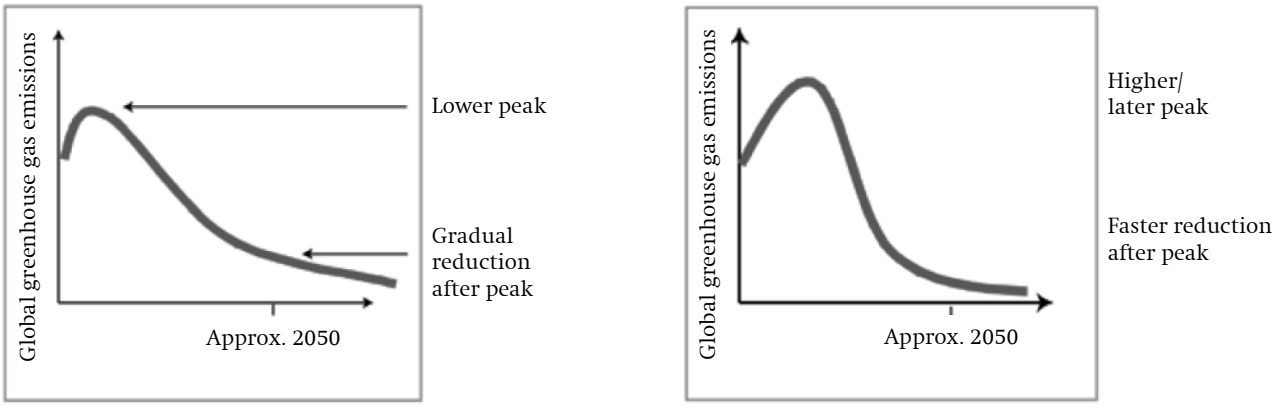
17 In addition to carbon dioxide (CO_2) this includes methane, ozone, nitrous oxide, and hydrofluorocarbons. Their concentration in the earth's atmosphere is relatively low, but their warming potential is much higher than that of CO_2.

18 Kevin Trenberth, "More Knowledge, Less Certainty," *Nature Reports Climate Change* 4 (February 2010): 20f. For a description of the policy-relevant uncertainty factors in climate modeling, see United Nations Environment Programme (UNEP), *The Emissions Gap Report. Are the Copenhagen Accord Pledges Sufficient to Limit Global Warming to 2°C or 1.5°C? A Preliminary Assessment* (Nairobi, 2010); Céline Guivarch and Stéphane Hallegatte, "2C or not 2C?," *Global Environmental Change* 23 (2013): 179–92.

19 Joeri Rogelj et al., "Emissions Pathways Consistent with a 2°C Global Temperature Limit," *Nature Climate Change* 1 (2011): 413–18.

20 It should be kept in mind that concentration targets such as 450 ppm CO_2e—in contrast to temperature targets like 2°C—are not understood as an absolute upper limit that cannot under any circumstances be temporarily exceeded, but as a stabilization objective to be reached in the medium to long term. The greenhouse gas concentration may indeed overshoot the value of 450 ppm for several decades if it can then be reduced and stabilized below a threshold value. See OECD, *OECD Environmental Outlook to 2050. The Consequences of Inaction* (Paris, 2012), 111ff.

Figure 2
Illustration of Different Emission Pathway Types for Identical Carbon Budgets



Source: UNEP, *The Emissions Gap Report 2010* (see note 18), 11.

"defining the reality" of the current climate discourse to a significant extent.

The carbon budget approach has been used successfully to overcome the narrow focus on the long-term percentage reduction targets that predominated for so long. Climate scientists no longer concentrate on the (provisional) end points of emission curves, but on their paths over time. Discussions no longer revolve around reduction targets for the year 2050—such as 50 percent lower emissions worldwide or 80–95 percent lower emissions in the industrialized countries. Rather, the objective now is to calculate a maximum total amount of greenhouse gases that can be emitted up to 2050 or 2100. This approach is not only much more suited to the problem than is the focus on selective long-term reduction targets; it also has implications for the medium-term course of emission paths. Carbon budget studies based on the 2°C target assume that global emissions, which have increased by almost 40 percent worldwide since 1990, will continue to increase over the next few years but will soon reach their peak and then begin to decline drastically.[21] A number of different emissions reduction paths are conceivable, even within a set budget for total emissions defined by climate science. However, as a rule, the higher the peak turns out to be and the later it is reached, the greater the subsequent annual reduction rates will have to be in order to remain within the total emissions budget (see Figure 2).

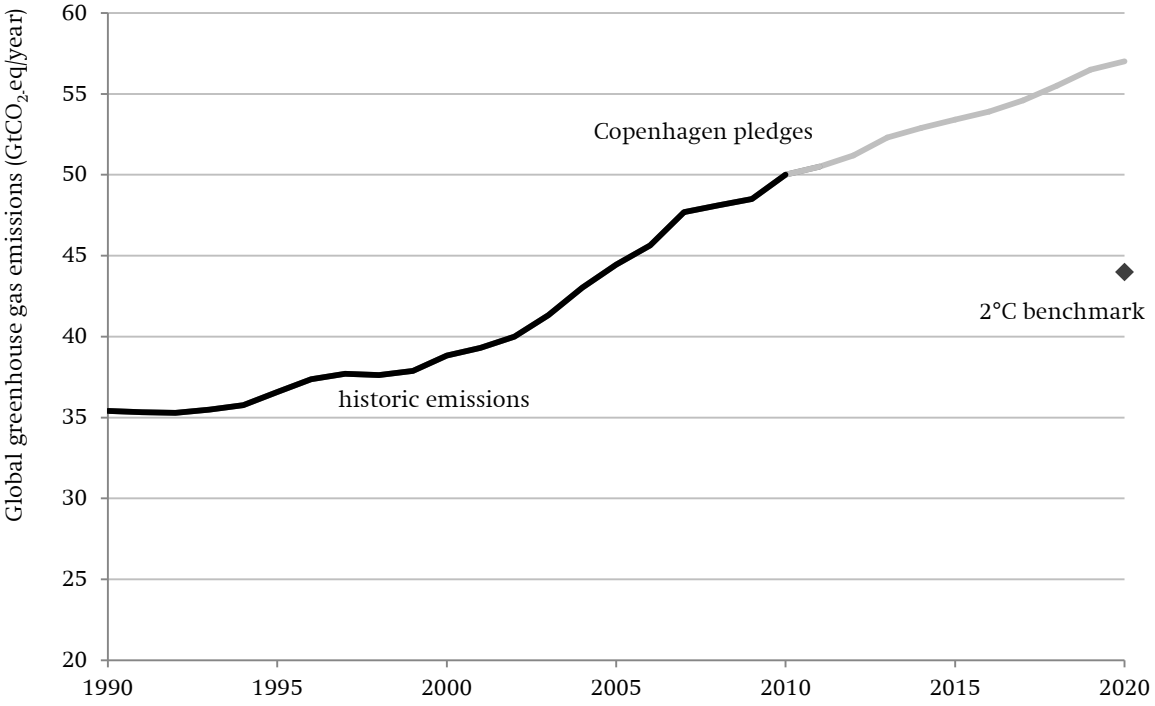
However, there are some limiting factors to consider. The annual reduction rates that will be necessary after the emissions peak is reached in order not to exceed the total global carbon budget cannot be set arbitrarily at any level, no matter how high. Currently 3 percent per year is considered the upper limit for what is economically and technologically feasible.[22] For this reason, carbon budget studies usually cite the last possible year that the peak must be reached to stay within the 2°C limit with a sufficient degree of probability.

Up until 2009, policy recommendations from climate scientists emphasized that the global emissions peak would have to be reached in the second decade of the twenty-first century, that is, by 2020 at the latest. Following the Copenhagen Climate Summit, however, another figure quickly emerged that further limited the options open to climate policy. To accurately eval-

21 An annually updated summary of current research is provided by the United Nations Environmental Programme; see UNEP, *The Emissions Gap Report 2012. A UNEP Synthesis Report* (Nairobi, 2012).

22 Ibid., 3. Global estimates of feasibility in climate-economic models usually relate only to the economic and technological dimensions, but rarely to the—virtually unquantifiable—political and social dimensions; see Brigitte Knopf et al., "Managing the Low Carbon Transition—From Model Results to Policies," *The Energy Journal* 31, Special Issue 1 (2010): 223–45; Guivarch and Hallegatte, "2C or not 2C?" (see note 18); Glen Peters et al., "The challenge to keep global warming below 2°C," *Nature Climate Change* 3 (2013): 4–6. Just how ambitious a global annual reduction rate of 3 percent is can be shown by a comparison with the EU, whose emissions reduction between 1990 and 2010 was on average below 1 percent per year.

Figure 3
Historic Emissions and Predicted Course of Emissions Based on the Current Reduction Pledges



Source: UNEP, *The Emissions Gap Report 2012* (see note 21); De Vit and Höhne, *Why the Durban Outcome Is Not Sufficient* (see note 23).

uate progress meeting the reduction commitments for 2020 that had been pledged by industrialized and emerging countries in Copenhagen, a global emissions benchmark was introduced for the end of the decade: 44 gigatons (Gt) CO_2e. This made it clear, as Figure 3 shows, not only that there is a significant gap between reduction pledges made in Copenhagen, which are not binding under international law, and the levels required by the 2°C target *(emissions gap)*, but also that the current level of emissions (50 Gt) is more than 10 percent higher than the proposed maximum level for 2020.[23] Therefore—in contrast to what was long thought to be true—in order to achieve the 2°C target, it will not suffice to reach the emissions peak at the end of the current decade. The trend reversal has to take place several years before that point, and it must be followed by significant emissions reductions through to 2020.

The constraints established in the carbon budget approach are of enormous significance for climate policy. Due to political and economic path-dependencies, it will be possible to predict both the earliest date of the global emissions peak and the minimum expected emissions level for 2020 several years in advance. However, an emissions peak compatible with the 2°C target is now almost impossible to reach. Evidence of its improbability can be seen in the paths of industrialization and energy supply taken by the major emerging economies, the continuing non-binding nature of reduction pledges in the UNFCCC process, and the time schedule agreed upon in Durban for an international climate treaty. It is therefore likely that increasing numbers of climate scientists will rule out the possibility of achieving the 2°C target in the coming years[24]—decades before the 2°C limit will actually be reached.

23 UNEP, *The Emissions Gap Report 2012* (see note 21), 24f.; Caroline De Vit and Niklas Höhne, *Why the Durban Outcome Is Not Sufficient for Staying below 2°C*, Policy Update 3 (Cologne: Ecofys, February 2012).

24 A few such voices are already being heard; see, e.g., Geoffrey J. Blanford, Richard G. Richels, and Thomas F. Rutherford, "Feasible Climate Targets: The Roles of Economic Growth, Coalition Development and Expectations," *Energy Economics* 31 (2009): S82–S93; Kevin Anderson and Alice Bows,

Political vs. Scientific Logic

In the framework of the top-down paradigm, the 2°C target has been serving for almost two decades as a common reference point for climate policy and climate science, as a "boundary object" that allows these two very different spheres to communicate and interact productively. But although policy and science have "co-produced" the 2°C target, they each use this target in markedly different ways.[25] In climate policy, the 2°C target has served primarily as a prominent symbol of the orientation toward an ambitious, yet still (if only barely) attainable global emissions mitigation agenda. In climate science, on the other hand, the target is used as the basis for complex calculations, especially to determine target-compatible carbon budgets and emissions reduction paths. These two functional logics have long enjoyed a mutually supportive relationship. Efforts to raise the status of climate policy have gained scientific legitimacy, while climate research has found a growing political consensus and increased societal relevance, reflected not least of all in significantly improved funding. But the longer it takes to reverse global emissions trends, the more difficult it will become to maintain the harmonious relationship between the political and symbolic dimension of the 2°C goal and the scientific and calculative dimension.

Should the mainstream of climate science begin to accept that the international community will probably fail to meet this central objective, the 2°C target will lose its extraordinary status. For national governments that have assumed a leading role in the global climate regime, such as those in Europe, it is not realistic to continue to pursue goals that are patently unachievable or to work on obviously unsolvable problems. Furthermore, the increasingly palpable consequences of climate change will soon close off an avenue that was still open in the 1990s—that of temporarily removing climate change from the political agenda. This will make it necessary to modify the currently almost undisputed 2°C target in the years to come. Pressure is mounting for change, not only in the target formula but also in the level of ambition that has been declared in international and European climate policy. This has the potential to bring about a fundamental transformation in the working relationship that has existed between EU climate policy and climate science since the early 1990s.

"Beyond 'Dangerous' Climate Change: Emission Scenarios for a New World," *Philosophical Transactions of The Royal Society* 369 (2011): 20–44; PricewaterhouseCoopers, *Too Late for Two Degrees? Low Carbon Economy Index 2012* (London, November 2012).

25 Cointe, Ravon and Guérin, *Policy-Science Nexus* (see note 3), 18ff.; Geoffrey C. Bowker and Susan Leigh Star, *Sorting Things Out. Classification and its Consequences* (Cambridge, 2000), 296ff.; Sheila Jasanoff, "Ordering Knowledge, Ordering Society," *States of Knowledge: The Co-Production of Science and Social Order*, ed. Sheila Jasanoff (London, 2004), 13–45. For an insightful empirical analysis of the usages of the 2°C target in the UK see Christopher Shaw, "Choosing a dangerous limit for climate change: Public representations of the decision making process," *Global Environmental Change* 23 (2013): 563–71.

Focus:
The Political Characteristics of the 2°C Target from the Perspective of the EU

In the European Union, decisions about the fundamental direction of climate policy are not made by sectoral policy makers but by the European Council, through a consensus of the currently 27 heads of state and government of the EU Member States. These decisions are prepared by the European Commission as well as the Council of the European Union, but without any significant input from the European Parliament. The decisions of the heads of state and government influence not only international climate policy negotiations but also the global competitiveness of European businesses, competition among European economies, and national climate and energy policies. Given the enormous challenges that will arise as climate change continues, the media, the scientific community, and even scientific policy advisors usually fail to acknowledge that for Member State governments, climate policy is just one of many policy areas of pressing concern.

Attempts to solve environmental problems through climate policy are inseparable from the rules of the political process—whether at the Member State, EU, or UN level. *Policies* are inconceivable without *politics*, and policy objectives are not pursued independently of political power objectives—a rule that applies even to the area of sustainability policy.[a] Decisions made at the EU level in response to the impending failure to meet the 2°C target will therefore not be based purely on rational or even scientific considerations. The European heads of state and government will always examine such considerations for their broader political rationality. This does not necessarily mean that ambitious climate goals are impossible. The dynamic that brought about the European Council's sweeping decisions on climate and energy policy in March 2007—following the failed EU Constitutional Referenda in France and the Netherlands—was indeed driven by a desire to publicly demonstrate the value of deeper European integration by taking on crucial issues for the future.[b]

The historic evolution of international climate policy clearly shows that political problems do not exist in any inherent, a priori sense. They only arise when it appears possible to reverse the undesired effects by human intervention—a question that forms the crux of the dispute over human-induced vs. natural climate change—and when political actors begin working to bring about change.[c] The political sphere is usually not capable of creating the necessary provisions on its own, however. The definition of the problem contained in Article 2 UNFCCC ("dangerous anthropogenic interference with the climate system") could only be formulated through discursive interactions with the spheres of climate science, media, business, and civil society. Yet eighteen years passed from the Climate Framework Convention of 1992 until formal consensus was reached on how to translate the problem into a concrete interim target (the 2°C limit) at the Conference of the Parties (COP 16) to the UNFCCC in Cancún. This reveals a significant divergence in the two basic functions of international climate policy objectives.[d] On the one hand, the 2°C limit fulfills a *symbolic and declarative* function, particularly by establishing a common understanding of an upper temperature limit to climate change. It has indeed lent a certain degree of scientific legitimacy to EU climate policy makers' ambitions since the decisions of the Environment Council of 1996. Leading up to the decision at the UN climate summit of 2010 in Cancún, the campaign for the 2°C target also allowed the EU to clearly establish its position as a global climate policy leader, which has been greeted with a positive response in many EU Member States. On the other hand, however, the 2°C target may not be able to fulfill the function of providing *political guidance for the problem-solving process*, especially due to the long-postponed agreement in the UNFCCC framework and the increase of more than one-third in global emissions. Since the Conference of the Parties in Cancún, no agreement has been reached on any appropriate package of measures. This is also not likely to come about in the near future, since it would require levels of emissions reductions that—at least from the viewpoints of the respective governments—no longer appear politically feasible in many industrialized and emerging economies.

Since the 2°C target is based at its core on scientific parameters, it is difficult for policy makers to apply a predominantly political logic when evaluating the success of climate policy. After all, the more precisely a policy goal is defined, the greater its risk of failure. Since an objective widely considered unattainable cannot fulfill a positive symbolic or a productive governance function, the 2°C target will inevitably have to be modified.

a Susanne Dröge (ed.), *International Climate Policy. Priorities of Key Negotiating Parties*, SWP Research Paper 2/2010 (Berlin: Stiftung Wissenschaft und Politik, March 2010).

b Oliver Geden and Severin Fischer, *Die Energie- und Klimapolitik der Europäischen Union. Bestandsaufnahme und Perspektiven* (Baden-Baden, 2008), 113ff.

c Deborah A. Stone, "Causal Stories and the Formation of Policy Agendas," *Political Science Quarterly* 104, no. 2 (1989): 281–300.

d Nicholas Stern, *The Economics of Climate Change. The Stern Review* (Cambridge, 2007), 318ff; David Victor, "Global Warming: Why the 2°C Goal Is a Political Delusion," *Nature* 459 (2009): 909.

Climate Policy Objectives in the Political Process

Since the decisions of the European Council in March 2007, not only European climate policy but also EU energy policy has been following the "strategic objective" of helping to keep the global average temperature below the 2°C limit.[26] Since then, the European Council, with express reference to the IPCC, has repeatedly stated that the EU should orient itself towards reducing emissions by 80–95 percent (compared to 1990 levels) by 2050.[27] The roadmaps for climate, energy, and transport submitted by the EU Commission in 2011 are also based on this reduction target.[28] There will be serious consequences for the EU if, in the middle of the current decade, the 2°C target becomes clearly impossible to achieve and international climate policy experiences a major crisis of credibility as a result. First, the EU will be threatened with another foreign policy failure in one of the few fields of international policy in which it has taken a leading role over the last two decades.[29] Second, the EU's internal ambitions will also likely be subject to critical evaluation in the areas of climate, energy, and ultimately also industrial policy—especially since enthusiasm for the EU strategy of green growth has been limited de facto to the northern and western European Member States. If the 2°C target should fail, not only would pressure mount to change the EU emissions reduction targets for 2050 that were derived directly from it. Even more importantly, the EU would be extremely cautious in establishing binding climate and energy policy targets for 2030, which are critically important at the moment for the investment behavior of European companies.[30] The transformation to a European low-carbon economy, a process begun in 2007 under the German EU Council presidency, would be interrupted if not brought entirely to a halt.

Since the EU is only responsible for just over 10 percent of global greenhouse gas emissions, it will not be able to singlehandedly move the world onto a emissions reduction path in line with the 2°C limit. Even the negotiations roadmap unexpectedly approved at COP 17 in Durban is unlikely to contribute much to achieving the emissions reductions that are already necessary by 2020.[31] The Europeans will therefore not be able to avoid confronting the looming crisis of the 2°C target. In light of the conflicts of interest at the global level and the constantly rising emissions, every modification in the core objective of international climate policy will amount to a weakening of this target. As the global leader in climate policy and the political architect of the 2°C target, the EU can, however, exercise significant influence on the direction such modifications may take. There are two fundamentally different approaches for modifying the target: to gradually increase the flexibility of the 2°C target (reinterpretation) or to completely change the central climate policy target (revision). Which of these two basic ap-

26 Council of the European Union, *Brussels European Council* (see note 5), 10. The EU first stipulated this commitment in the form of medium-term headline targets for 2020, the "20-20-20" goals. From a legally binding emissions reduction target of 20 percent, the heads of state and government derived first a binding increase in the share of renewable energy sources to 20 percent, and second the legally nonbinding ("indicative") goal of reducing energy use by 20 percent.

27 It has been widely overlooked that if the IPCC changes these numbers in one of its future Assessment Reports, the EU will either have to follow suit or distance itself from the IPCC's findings.

28 Severin Fischer and Oliver Geden, *The EU's Energy Roadmap 2050: Targets without Governance*, SWP Comments 8/2012 (Berlin: Stiftung Wissenschaft und Politik, March 2012). The 2050 emissions reduction corridor of 80–95 percent only applies to industrialized countries, to represent their fair share in the context of a 50 percent global reduction, a pathway consistent with achieving the 2°C target. In the EU, the 80–95 percent corridor has gained huge prominence only since it was mentioned in a table within the IPCC's Fourth Assessment Report, see Sujata Gupta et al., "Policies, Instruments, and Co-operative Arrangements," in *Climate Change 2007: Mitigation – Contribution of Working Group III to the Fourth Assessment Report of the IPCC*, ed. Bert Metz et al. (Cambridge and New York 2007), 776.

29 Sebastian Oberthür and Marc Pallemaerts (eds.), *The New Climate Policies of the European Union* (Brussels, 2010).

30 Oliver Geden, "Impending Paradigm Shift. International Climate Negotiations and Their Impact on EU Energy Policy," *KAS International Reports* 28, no. 9 (2012): 22–34; European Commission, *A 2030 Framework for Climate and Energy Policies,* COM(2013) 169 (Brussels, March 27, 2013).

31 European Commission, *The 2015 International Climate Change Agreement: Shaping International Climate Policy beyond 2020*, COM(2013) 167 (Brussels, March 26, 2013).

proaches and which specific details within each of them the EU will favor depends on a multitude of factors—not just the ability of a modified climate objective to address the problem in its full scope, but also the foreign and economic policy preferences of the EU and the domestic political preferences of the governments of its Member States.

Playing an active role in the modification process is a politically delicate undertaking for the EU. Europe will have a difficult time distancing itself from the previous target since it wants to maintain its image as a leader in climate policy, to appear on the international stage as a recognized pioneer and agenda-setter, and at the same time to create political conditions that are conducive to building a European strategy for green growth. In its position in the international community up to now, the EU has been able to meet the essential criteria that justify its global leadership role in this policy field. The 2°C target that was pushed through by the Europeans was a global call to action, with the UNFCCC process taking center stage in the architecture of the global climate regime. In the process of target formulation and the definition of adequate measures, the EU assigned a major role to climate research. Even if internal EU climate policy only partially fulfills the criterion of a "science-based" approach in the period up to 2020,[32] the EU has been playing a leadership role among the industrialized countries in the emissions reductions achieved since 1990.[33] This is enhanced by the Union's positive role in the global climate regime, which includes financial solidarity with the countries most severely affected by the impacts of climate change.[34]

The engagement of the EU in international climate policy and the question of how to provide appropriate financial support for developing countries would not be directly affected by a modification of the 2°C target. Yet even advocating a weakening of the previously consensual target may come at a high political cost to the EU. The Union would not only risk devaluing a huge political victory of the past; it would risk sacrificing its status as a climate policy leader and possibly also face a serious challenge to the ongoing transformation to a European low-carbon economy—a project that entails significant short- to medium-term costs.[35] If the EU adopts the more pragmatic stance that the 2°C target must be modified, it will endeavor to avoid unintended negative effects of this modification. In the critical transitional phase, two possible points of departure seem particularly promising, although they are not necessarily feasible: the strategy of avoiding an open break with the mainstream of climate science (in the form of the IPCC and its representatives), and the strategy of maintaining ambitious emissions reduction goals, if possible within the 80-95 percent range already envisioned up to 2050. In this way, the EU could attempt to achieve three objectives: to lend scientific legitimacy to a new target, to demonstrate that the previous target did not fail due to lack of political will on the part of the Europeans, and to show that the Union is not attempting to "profit" from a weakening of global ambition levels by using this process as an excuse to significantly reduce its own efforts.[36]

32 The Europeans have not yet internally adopted the emissions reductions range of 25–40 percent proposed by the IPCC for the industrialized countries for 2020. The EU decisions made in 2007 only envisioned a reduction goal of 20 percent for 2020, which is to be tightened only when other industrialized and emerging economies are also willing to make significant emissions reductions.

33 At least according to stipulations of the UNFCCC accounting regime, which only considers the emissions produced on the territory of a particular country, but leaves aside the emissions embedded in the global trade of goods and raw materials See Steven J. Davis and Ken Caldeira, "Consumption-based Accounting of CO_2 Emissions," *PNAS* 107, no. 12 (2010): 5687–92; Michael Jakob and Robert Marschinski, "Interpreting Trade-related CO_2 Emission Transfers," *Nature Climate Change* 3 (2013), 19–23.

34 Although it is likely that large portions of the promised funding will not be provided in addition but simply reallocated within the existing budget for development cooperation; see Martin Stadelmann, J. Timmons Roberts, and Axel Michaelowa, *Keeping a Big Promise: Options for Baselines to Assess 'New and Additional' Climate Finance*, CIS Working Paper 66/2010 (Zurich: Center for Comparative and International Studies [CIS], November 18, 2010).

35 European Commission, *Roadmap for a Low-carbon Economy* (see note 5).

36 In order to maintain a positive image in the media and in the wider population, it is not absolutely necessary for EU climate policy to actually solve the problem of "dangerous climate change." In the case of complex, global, and long-term problems, individual governments or the EU are rather expected to demonstrate "competence in problem-solving"; see Gunnar Sjöblom, "Problems and Problem Solutions in Politics. Some Conceptualisations and Conjectures," in *The Future of Party Government*, Vol. 1: *Visions and Realities of Party Government*, ed. Francis G. Castles and Rudolf Wildenmann, (Berlin and New York, 1986), 72–119; Nikolaos Zahariadis, *Ambiguity and Choice in Public Policy. Political Decision Making in Modern Democracies* (Washington D.C., 2003); Nils Brunsson, *The Organization of Hypocrisy. Talk, Decisions and Actions in Organizations* (Copenhagen, 2006).

The various options for modifying the 2°C target can be differentiated above all by the level of interventions involved.[37] While variants of the reinterpretation approach aim at an indirect reduction of climate policy ambitions, the revision approach calls the 2°C target fundamentally into question. The EU will probably prefer a reinterpretation of the 2°C target, and will be able to rely on the support of large parts of the climate research community, numerous non-governmental organizations (NGOs), and many developing countries. What remains uncertain, however, is whether the EU will be able to achieve this in the context of the international climate regime. Here, less ambitious major emitters will have a significant voice in determining the direction, especially China, India, Russia, and the USA.[38] But even more decisive will be the future trajectory of global greenhouse gas emissions. The longer it takes to reverse emissions trends and the weaker this reversal turns out to be, the more unlikely it is that a conservative reinterpretation of the 2°C target will suffice. If the European Union does not want to surrender its leadership role in international climate policy, it will soon have to grapple seriously with all the various options for a modification of the 2°C target—including those that seem less politically desirable at present.

37 Even if the two-degree limit has broad support in the climate research community, arguments favoring several other options can still be found in the scientific debate on advantages and disadvantages of specific target categories, even in the Fourth Assessment Report of the IPCC; see Brian Fisher et al., "Issues Related to Mitigation in the Long Term Context," in *Climate Change 2007: Mitigation—Contribution of Working Group III to the Fourth Assessment Report of the IPCC*, ed. Bert Metz et al. (Cambridge and New York, 2007), 194ff.

38 Even in the negotiations on the Kyoto Protocol, the USA succeeded in pressuring the EU to accept a compromise that was unpopular at the time: emissions trading, a market-based instrument. Today, the Europeans are its strongest advocates; see Chad Damro and Pilar Luaces Méndez, "Emissions Trading at Kyoto: From EU Resistance to Union Innovation," *Environmental Politics* 12, no. 2 (2003): 71–94.

Options for Target Modification

A modification of the 2°C target is inevitable, but the precise form it will take is still uncertain. The following section presents an outline of options available for target modification illustrating the spectrum of possible interventions. The four options described here are in no way mutually exclusive. It would certainly be possible to combine individual elements of them or to implement several of the options in succession. Considerations and decisions about a modified global target will be shaped by three main contextual factors: climate policy, climate research, and global greenhouse gas emissions. It is impossible to predict how these factors will evolve and what momentum they may develop. However, the specific path dependencies involved make it possible to identify some of the most influential variables that will affect developments in the period up to 2020.[39]

Contextual Factors

The international policy process will be dominated until at least the end of 2015 by efforts toward a "grand solution" by way of a global agreement, similar to the period preceding COP 15 in Copenhagen in 2009. Yet there is little chance that the desired breakthrough can be achieved within the UNFCCC process in the time leading up to COP 21. The plan agreed on in Durban is ambitious: to finalize negotiations on a treaty that would commit all industrialized countries and emerging economies to stringent and binding reduction targets by 2015. It is highly likely that at least the USA will refrain from signing any such agreement in the foreseeable future. For this reason among others, the participation of China, India, and Russia is also anything but certain.[40]

Under the existing UNFCCC regime, a formal review process is agreed to be conducted between 2013 and 2015 to assess fulfillment of the voluntary emissions reduction pledges made after the Copenhagen Summit and to evaluate their compatibility with the 2°C target. It is unlikely, however, that this review process will lead to an increased level of ambition within the current decade, despite frequently expressed hopes to the contrary, and although scientific advisory bodies have recommended such a policy, if not declared it absolutely essential. Moreover, the overall level of commitments established in a new global treaty may not necessarily be consistent with the 2°C target. Even the usually upbeat European Commission is already lowering expectations in this regard: "The current negotiations are to be guided by the long term goal of putting the world onto a pathway [...] below 2°C [...]. However, it seems unlikely that governments will agree precisely how the entirety of this challenge can be shared in an equitable manner in 2015. [...] the new agreement must therefore also provide the tools and processes to enable the further strengthening of individual and collective ambition."[41]

Developments in the second half of the decade will depend largely on the course and the outcomes of the

39 This chapter will not consider unforeseen or highly unlikely events or developments ("wildcards") that could have a strong impact on the course of international climate policy, particularly because it is impossible to predict how they might influence the debate on a global climate target. Such events could include the rapid global implementation of zero-emission energy technologies, dramatic advances in knowledge in the area of climate research (particularly in regard to climate sensitivity), the swift implementation of large-scale interventions in the climate system (geoengineering), a sudden acceleration of climate change, or an extended period without a global mean temperature increase.

40 Sven Harmeling et al., *An Insufficient Breakthrough. Summary of the Climate Summit in Durban*, Germanwatch (Bonn, December 2011); Oliver Geden, "Hope Is Not Enough in Battle against Climate Change," *Spiegel Online International*, November 26, 2012; David Robinson, *US Energy and Climate Change Policies—Obama's Second Term*, Oxford Institute for Energy Studies (Oxford, 2013).

41 European Commission, *The 2015 International Climate Change Agreement* (see note 31), 4. Interestingly enough, this paragraph resembles remarks made in a speech by Todd Stern, the US State Department's Special Envoy for Climate Change eight months earlier, which drew strong criticism from EU officials at that time: "This kind of flexible, evolving legal agreement cannot guarantee that we meet a 2 degree goal, but insisting on a structure that would guarantee such a goal will only lead to deadlock. It is more important to start now with a regime that can get us going in the right direction and that is built in a way maximally conducive to raising ambition, spurring innovation, and building political will." See Todd Stern, "Remarks at Dartmouth College," August 2, 2012.

UN climate summit at the end of 2015. If that summit fails spectacularly on the level of Copenhagen in 2009, this could lead to a loss of faith in the international community's problem-solving capacity and a decline in the general desire to work towards global cooperation, and in turn to a severe loss of momentum in the UNFCCC process. However, even if a comprehensive, ambitious, and internationally binding global climate agreement can be sealed, it would take far longer for it to enter into force than previously anticipated. It took seven years to ratify the Kyoto Protocol, which was much more modest in its scope and aspiration level. During the ratification process, aside from working out regulatory details, the predominant focus of international climate policy would be on trying to influence those major emitters whose behavior threatens to delay or even prevent the entry into force of a UN climate agreement. The focus here would likely once again be the USA, which requires a two-thirds majority in the Senate for final approval of a treaty that is binding under international law. Depending on how the ratification rules of a global climate agreement are stipulated, it might not be absolutely necessary for every major emitter to join the treaty for its entry into force. However, with an "opt-out" by the USA or China, the "grand solution" approach to international climate policy would go on indefinitely with no end in sight.[42] But even if all major emitters could be brought into an ambitious treaty, there would still be a risk that the ratification process would not be concluded until well beyond 2020, and that global emissions would continue to increase alongside the ratification process. This would mean that the targets agreed upon in 2015 would have long since become obsolete and unrealistic by the time the treaty entered into force. The symbolic function of a global climate target and its governance function would once again be fundamentally disconnected.

As long as efforts to seal a comprehensive global climate agreement have not definitively failed, the EU will continue to be one of the strongest supporters of this approach. Pending the outcome of UNFCCC negotiations, the EU will take the utmost care in its domestic climate policy to avoid making decisions that could be interpreted as a step away from its previous declarations. Arguing that it is important to foster this fragile international process, the EU would rather postpone establishing any binding climate and energy targets for the period after 2020 than to make clear concessions on current positions in response to pressure from Eastern and Southern European Member States.[43] But to send reliable investment signals to European companies, it will be necessary to make a decision on internal EU targets for 2030 no later than 2017. Failing a positive outcome of COP 21, the global framework conditions for setting ambitious unilateral targets will not be very favorable.

There is no way to predict how climate science will evolve in the future and what knowledge it will produce. However, we are able to see the ways that climate science informs and influences climate policy in a very general sense. Past experience shows that the publication of an IPCC Assessment Report is a significant stimulus to global climate discourse and, in Europe at least, even takes center stage in climate policy debates. This was seen in 2007 and is expected to be the case again with the Fifth Assessment Report, which will appear between September 2013 and October 2014 in a total of four volumes. With thousands of finely-printed pages that summarize and evaluate current research in climate science, the individual detailed accounts are less important in the reception of the IPCC Report than are the public statements by prominent climate scientists and the summary reports provided for policy makers. The content of these summaries—as opposed to the actual Assessment Report—is not written independently by the participating scientists, but must be formulated and adopted in a complex process with the involvement of government officials. The Fifth Assessment Report is not expected to soften previous statements of the IPCC—quite the opposite. Yet it will also not go so far as to reject the possibility of achieving the 2°C target. With the newly introduced RCP2.6 scenario, the Fifth Assessment Report will actually be the first IPCC document to include a detailed assessment of the conditions that would make it possible to reach a specific temperature stabilization target.[44]

42 This would resemble a scenario developed by Evans and Steven already prior to Copenhagen, when they predicted that a failure of COP 15 might transform the UNFCCC process into a *multilateral zombie*, "staggering on, but never quite dying—just like the Doha trade round." See Alex Evans and David Steven, *An Institutional Architecture for Climate Change. A Concept Paper* (New York: Center on International Cooperation, 2009), 8.

43 Geden, "Impending Paradigm Shift" (see note 30); European Commission, *A 2030 Framework* (see note 30).

44 The RCP scenarios (Representative Concentration Pathways) outline emissions paths linked to different stabilization levels of the climate system. The nomenclature of the most challenging scenario, RCP2.6, refers to radiative forcing, a

There are strong indications that pessimism about the feasibility of the 2°C target will increase in the climate science community with each passing year. Yet it would be impossible for individual scientists or research groups to seriously endanger the climate policy consensus around the 2°C target with their findings or public statements. Far more influential on the climate policy discourse are analyses by globally recognized policy institutions or assessment studies evaluating the current research in all its breadth. Since the Sixth Assessment Report will only be issued at the end of the decade, it is hard to estimate what role the IPCC would be accorded in a discussion about the (in-)feasibility of the 2°C target and possible alternatives to it. Judging from the current situation, two annual publications will probably shape this discourse: the *World Energy Outlook* from the International Energy Agency (IEA) and the *Emissions Gap Report* from UNEP (United Nations Environment Programme). The IEA already takes a skeptical view regarding the chances of achieving the 2°C objective. In the *World Energy Outlook 2012*, it concluded that without rapid and drastic emissions reductions, the world would soon find itself in a situation where the existing fossil-fuel driven infrastructure would emit so much CO_2 over the course of its remaining lifespan that this would in itself exhaust an emissions budget compatible with the 2°C target, a situation described as an energy infrastructure lock-in.[45] Many climate policy actors allege, however, that the IEA (which is an autonomous body within the Organisation for Economic Co-operation and Development, OECD) favors conventional energy sources, underestimates the potential for the development of renewables, and is overly pessimistic about the chances of pursuing an ambitious climate change agenda. For this reason, the IEA's analyses alone would not suffice to break the consensus around the 2°C target. This would only happen if similar views were heard from the UNEP in its *Emissions Gap Report*, for instance, which is written largely by distinguished scientists and in past issues has contained both dismal climate change scenarios and optimistic policy forecasts, a combination that is typical of the climate discourse in general.[46]

When and how the question of modifying the 2°C target is placed on the agenda will depend very much on the course and public perception of internal developments in the domains of climate policy and scientific policy advice. But even if international negotiations in the coming years should raise hopes that a comprehensive and ambitious global climate agreement can be achieved, or if the scientific community resists declaring the core objective of international climate policy to be unattainable, anticipated emissions trends still leave no room for any other conclusion than that the 2°C target is doomed to fail—at least in the way it is currently defined. Neither the UNEP nor the IEA expect that current climate policy will be able to prevent a marked increase in global emissions, which over the long term will have the effect of raising temperatures on the order of 3.5°C. With every year that global emissions of greenhouse gases increase, so will the pressure on the target formula in current use.

Deliberate Modification of Assumptions in Climate Economics

Global emissions budgets were originally calculated to make climate policy goals more accurate than would be possible using simple end point emissions reduction targets such as "50 percent globally by 2050." This approach was also intended to create a sense of urgency for short- to medium-term action, above all through the formulation of a last possible year for emissions to peak in the current decade and a maximum emissions level for 2020. But sufficient momentum for urgent action never picked up; global emissions are still rising and the widely accepted maximum levels set for 2020 have already been exceeded

category widely used in climate science. Long-term stabilization at 2.6 W/m^2 corresponds roughly to a temperature increase of 2°C; see Detlef P. van Vuuren et al., "RCP2.6: Exploring the Possibility to Keep Global Mean Temperature Increase below 2°C," *Climatic Change* 109, no. 1–2 (2011): 95–116.

45 This means that after 2017, only those power plants, Industrial plants, buildings, and vehicles could go into operation that emit no CO_2 unless it was compensated for by closure of existing plants before the end of their technical and economic lifespan; IEA, *World Energy Outlook 2012* (see note 9), 265.

46 For instance, in the second edition of this report (2011), the emissions gap calculated for 2020—the difference between the 2°C benchmark and current emissions trends—is wider than in the previous year's report. The tone of the report itself, however, is significantly more positive, as UNEP now considers manifold options for emissions reductions. Such options do undoubtedly exist, yet the authors investigate only their technological and economic potentials and not their political chances for realization. See UNEP, *Bridging the Emissions Gap. A UNEP Synthesis Report* (Nairobi, 2011).

(see Figure 3). Therefore, if central assumptions of climate economics remain unchanged, climate science will soon be forced to conclusively reject the feasibility of the 2°C target.

Changing specific assumptions and boundary conditions is not in itself illegitimate; it is a constitutive element of advances in scientific knowledge. Likewise, the model parameters used in prominent studies of climate change economics such as the *Stern Review* have been the subject of rigorous scientific debate, although this is little-noticed in the policy-making and public spheres.[47] But if assumptions were deliberately changed in order to maintain the 2°C target, this would certainly be motivated by climate-policy considerations. This process would take place, however, entirely within the domain of climate science or scientific policy advice. These modifications would not be seen as politically driven, and in fact such interventions would not even be noticed by most climate policy actors. The knowledge base of climate science offers multiple starting points for such an approach, some of which have already been used in the recent past, because "often the policy demand for evaluations of the 2°C target has pushed modelers toward implementing more optimistic assumptions for their mitigation portfolios."[48]

Elements of a Modification

An *increase in the maximum reduction rates after 2020* would have no impact on the overall size of an emissions budget up to 2050. By going significantly beyond the usually assumed—but already quite optimistic—feasibility limit of a global 3 percent emissions reduction per year, the models would be able to capture anticipated delays in reaching the emissions peak. This would also make it possible either to increase the maximum emissions level for 2020 (44 Gt CO_2e), which was first established after the 2009 Copenhagen Climate Summit, in a gradual manner, or to do without such a figure altogether. Delaying the last possible peak year—the central "make-or-break" point for climate policy in the carbon budget approach—could also be enabled by reducing the "acceptable" *probability of staying below the 2°C limit* from the approximately 67 percent currently favored by scientific policy advisors to 50 percent, which would extend the remaining emissions budget considerably.[49] The same effect could be achieved by *increasing negative emissions* in the second half of the twenty-first century. Most studies on the feasibility of the 2°C target now assume that we have to be able to significantly reduce the net amount of greenhouse gases in the atmosphere within a few decades (see Figure 4), not only through reforestation programs but even more through the combustion of fast-growing biomass in power plants and the subsequent capture and underground storage of the resulting CO_2 (Bio-Energy with Carbon Capture and Storage, BECCS).[50] The assumed amount of negative emissions could be raised gradually to compensate for emissions in excess of budgets during the first half of the century.

Consequences for EU Climate Policy and Climate Research

The main result of such interventions, which may also be combined in various ways, would be to enable climate policy to maintain the 2°C target for several years longer than originally calculated. From the perspective of the EU, a more "flexible approach" to pivotal assumptions of climate economics is by far the most comfortable option for modification. The conditions that underpin the EU's leadership role would remain intact, and the 2°C target would continue to function as a central reference point for climate policy. The idea that there is a clear boundary separating "dangerous climate change" from "non-dangerous climate change" could be maintained because the political and economic restrictions that such a boundary would impose would be somewhat relaxed. And yet of course the world would remain in a situation where "time is running out," to quote a popular metaphor.

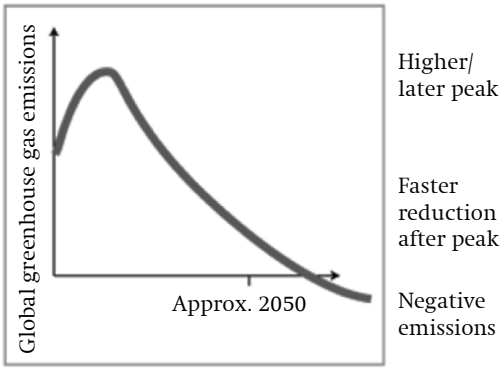
47 For a summary of the scientific debates around the *Stern Review on the Economics of Climate Change*, which was commissioned by the British Labour government under Tony Blair and very widely reported in the global media, see Hulme, *Why We Disagree about Climate Change* (see note 15), 124ff.

48 Guivarch and Hallegatte, "2C or not 2C?" (see note 18). By regularly commissioning energy system transformation scenarios, climate policy makers today are not so interested in a detailed analysis of *how* the 2°C target could be achieved, but primarily in positive signals from the scientific community that the 2°C target *is* still achievable.

49 Malte Meinshausen et al. "Greenhouse-gas Emission Targets for Limiting Global Warming to 2°C," *Nature* 458 (2009): 1158–62.

50 Van Vuuren et al., "RCP2.6" (see note 44), 111ff.; UNEP, *Emissions Gap Report 2010* (see note 18), 12f.

Figure 4
Greenhouse Gas Mitigation Path with Negative Emissions



Source: UNEP, *The Emissions Gap Report 2010* (see note 18), 11.

Nevertheless, it is doubtful that the relatively small amount of time that could be gained in this way would actually be used to turn the tide in global emissions. The role that climate research and scientific policy advice would play in this process is highly questionable, although it is unlikely that their selective interventions would become the focus of widespread public debate.

Overshoot: Benchmark instead of a Strict Upper Limit

A second, but much more comprehensive option for reinterpreting the 2°C target would consist in maintaining the target but fundamentally changing its character. Instead of continuing to define 2°C as a strict upper limit, it would be reinterpreted as a benchmark or reference point that will only be achievable in the long term. This would, of course, require an admission that it is impossible to avoid crossing the 2°C mark, which has been understood up to now as the threshold to dangerous climate change. This problem would be somewhat alleviated, however, by the promise of reversing the trend in the foreseeable future, and of stabilizing the increase of global mean temperature in the long term to below 2°C.

Elements of a Modification

This option could draw from the principle of temporary overshoot already established in climate science. In the central target categories used in climate modeling—atmospheric concentrations and radiative forcing—the general assumption is that the thresholds consistent with limiting the temperature increase to a maximum of 2°C (450 ppm CO_2e and 2.6 W/m^2) will initially be exceeded before concentrations and forcing can be reduced significantly, and will eventually stabilize at their equilibrium level. The IPCC's RCP2.6 scenario is therefore also called RCP3-PD ("peak and decline"). Due to the relative inertia of the climate system, however, it may be possible (though it is by no means guaranteed) that the temperature increase will remain below the 2°C mark during this process.[51] To explicitly accept a temperature overshoot would be the next logical step. In view of faltering climate negotiations and persistent increases in emissions, such an option has occasionally been considered within climate research, but it has also been pointed out that the reversal of a "temperature overshoot" may take a long time.[52]

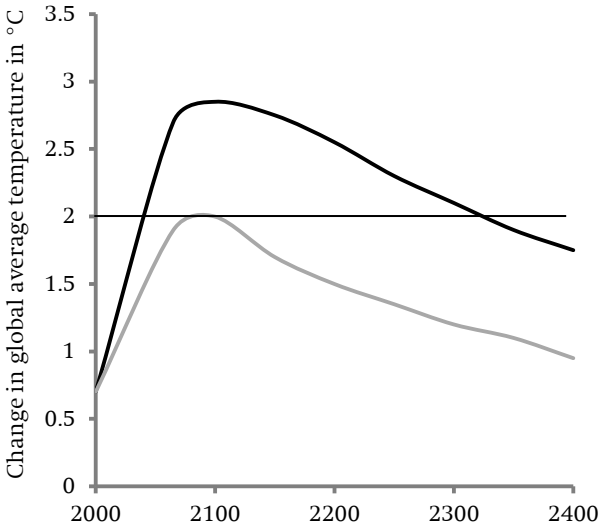
Should the European Union agree to such an option and still hope to avoid the charge of arbitrariness, certain limits would have to be established, particularly on the maximum value beyond the 2°C mark and on the maximum period of time for the entire overshoot phase. In terms of climate policy, it would also make sense to delay the beginning of the overshoot period as long as possible to gain time for advanced adaptation measures.[53] An overshoot of 250 years, as shown in Figure 5 (p. 24), with a maximum value of 2.8°C would likely be difficult to sell at first. Initially both of these parameters would be set much lower, for example, at 50 years with a maximum value of 2.3°C. Based on such specifications, climate economists could then recalculate exact emissions budgets.

51 Leon Clarke et al., "International Climate Policy Architectures: Overview of the EMF 22 International Scenarios," *Energy Economics* 31 (2009): 64–81.
52 Martin Parry, Jason Lowe, and Clair Hanson, "Overshoot, Adapt and Recover," *Nature* 458 (2009): 1102f; Jason Lowe et al., "How Difficult Is It to Recover from Dangerous Levels of Global Warming?", *Environmental Research Letters* 4, no. 1 (2009).
53 Manoj Joshi et al., "Projections of when Temperature Change Will Exceed 2°C above Pre-industrial Levels," *Nature Climate Change* 1, no. 8 (2011): 407–12.

Consequences for EU Climate Policy and Climate Research

The principal appeal of this approach for climate policy would be that the 2°C target could be maintained conceptually. The transition from an upper limit to a benchmark could be seen as an expression

Figure 5
Possible Temperature Paths, Interpreting the 2°C Target as an Upper Limit (Gray) or as a Benchmark (Black)



Source: author's illustration based on Parry, Lowe, and Hanson, *Overshoot* (see note 52), 1102.

of a pragmatic approach to climate policy, a way for the EU to seize the last option available to hold on to the 2°C target, at least formally. However, this process would also need to be accompanied by a reinterpretation of the 2°C threshold itself. After all, if the threshold is still relevant, why is it suddenly no longer "dangerous" to cross it? And under what conditions can it be shifted? Furthermore, since the upper limit is evidently not at 2°C, where is the "real" one? If the public gains the justifiable impression that the threshold between non-dangerous and dangerous climate change is not one that is absolute and scientifically definable but rather very much open to political and social negotiation,[54] and furthermore that climate researchers participate actively in this process, then the reputation of climate science—not least because of many prominent scientists' earlier practice of setting a precise boundary—will also be at stake.

Under certain conditions, the EU could maintain its leadership role in international climate policy even if it advocates an overshoot target, especially since it will continue to stand out in a positive way against major emitters like China, India, and Russia. If Europeans do not initially call their unilateral emission reduction targets into question, they cannot be accused of seeking to reap the benefits of a target modification. The EU is likely to come under internal pressures in the medium term, however, especially if it allows other industrialized countries and emerging economies more time for emissions reductions, thus disadvantaging European companies. Within the UNFCCC process, the strong EU position will not suffer if the Europeans link the overshoot option with the argument that developing countries need additional funding to adapt to climate change if the 2°C threshold is likely to be crossed. If climate research succeeds in coming to terms with the temporary overshooting of the 2°C target—not only intellectually, but also with its reputation intact—and thus maintains its prominent role in the climate debate, it will be able to support the EU proposal in light of the lack of political alternatives. Even NGOs will not categorically reject the idea of an overshoot scenario given that their preferred target of 1.5°C, which the UNFCCC had pursued at least as an option, is no longer considered tenable when understood as a strict upper limit.[55] But the scientific community and NGOs will only consider an overshoot as long as they can expect governments to take the limitations set on its level and duration seriously.

Based on the lessons of past UNFCCC negotiations, there is no guarantee that the international community will actually make use of the additional time that can be gained for climate policy through use of the temperature overshoot option. Failing a trend reversal in global emissions, negotiating governments will be tempted to regularly take advantage of the new target architecture in order to expand their scope of (in-)action without having to formally abandon the 2°C target. If the option of a limited temperature overshoot is opened up even in theory, it will become

54 On the debate over the possibility to define a threshold to "dangerous climate change," see Suraje Dessai et al., "Defining and Experiencing Dangerous Climate Change," *Climatic Change* 64, no. 1 (2004): 11–25; Hulme, *Why We Disagree about Climate Change* (see note 15), 191ff.

55 UNEP, *The Emissions Gap Report 2010* (see note 18), 26. Viewed from an overshoot perspective, the 1.5°C target no longer appears wholly unrealistic, but only less quickly attainable than the 2°C target.

a legitimate bargaining position to increase the extent of the overshoot and to extend its duration. This would gradually undermine the 2°C target. Its governance function would remain limited, and every attempt to readjust the overshoot would further reduce its symbolic power. Since the 2°C target cannot actually fail if it is no longer understood as a strict upper limit, it could be retained indefinitely—similarly to the case with the target of 0.7 percent of donor countries' gross national product/income for development aid, which was established by the UN in 1970 but is still unmet. Likewise, the aim of eventually reaching the 2°C target would never be formally abandoned, but beyond its use in launching periodic action plans, a temperature overshoot target would have little binding force.

Transition to a Less Stringent Global Target

An overshoot reinterpretation of the existing temperature target may fail to generate any momentum in climate policy whatsoever, and in the worst case may ultimately even serve to mask a perpetual standstill. From this perspective, the formulation of an entirely new climate policy target seems more reasonable. At the same time, this is a step that entails some risks for the EU.

Elements of a Modification

The option of weakening the existing target would not consist of specific interventions into the structure of emissions budgets, but would essentially mean increasing the size of the budgets themselves. From the EU perspective, this would constitute a serious public relations problem. If the EU should advocate a shift to a 2.5°C or even 3°C target—understood as a new upper limit—this would be clearly identifiable to the public as a reduction of previous climate policy ambitions. The effect of this could at least be softened by simultaneously changing the target category. For example, a temperature target on the order of 2.5°C could also be expressed as a concentration target of 550 ppm CO_2e or—corresponding to the logic of the new IPCC scenarios—as a radiative forcing target of 3.65 W/m^2.[56]

56 See Rogelj et al., "Emissions Pathways" (see note 19), 10. 550 ppm would equal 2.5°C only under the assumption of a 50 percent probability of staying below the given temperature target, which would be significantly less ambitious than the currently favored 67 percent. Generally, a change of target categories would have the advantage of overcoming a significant source of scientific uncertainty: the relation between a given greenhouse gas concentration and the resultant temperature effects.

Consequences for EU Climate Policy and Climate Research

Regardless of what category the EU chose to express a weaker target, its image as a climate policy leader would most likely suffer. A final departure from the 2°C target would signal not only that international climate policy has lowered its ambitions but also that quantified climate stabilization targets are always open for renegotiation. With a less stringent global target, international climate policy would be gaining time—not only to conclude and implement a comprehensive global climate agreement but also to reverse current trends in global emissions. Here, the question of whether the new target formula would ultimately be able to exercise a substantial governance function would have to initially remain open. While climate economics could relatively easily base emissions budget calculations on a revised starting point, the natural sciences would have to abandon the idea of a clear threshold to dangerous climate change.[57] After more than two decades of statements that have emphatically stressed the imperative of a 2°C limit, it would hardly seem credible for scientific policy advisors to suddenly shift this threshold, especially since it—in contrast to the option of an overshoot—entails a more-than-temporary weakening of climate stabilization objectives. This dilemma may have an advantage, however, in that it would shift the focus of scientific climate policy advice away from the natural sciences, with their normative tendency to pursue non-negotiable limits (*planetary boundaries*), and toward the social sciences, with their higher level of conceptual and political flexibility.[58]

57 Scientific approaches to a new definition of the threshold have previously attempted either to offset the lack of emission reductions with additional adaptation measures or to reject the idea of a uniform boundary outright. See Martin Parry, "Closing the Loop between Mitigation, Impacts and Adaptation," *Climatic Change* 96, no. 1-2 (2009): 23–27; Timothy M. Lenton, "Beyond 2°C: Redefining Dangerous Climate Change for Physical Systems," *WIREs Climate Change* 2, no. 3 (2011): 451–61.

58 See Frank Biermann, "Planetary Boundaries and Earth System Governance: Exploring the Links," *Ecological Economics* 81 (2012) 4–9; Hans von Storch, Armin Bunde, and Nico Stehr, "The Physical Sciences and Climate Politics," in *The Oxford*

Just how much damage would be done to the image of the EU would depend significantly on the behavior of the other major emitters as well as on the range of policy alternatives on hand at the particular moment when decisions have to be made. NGOs, developing countries, and climate scientists are likely to favor a weakened target of 2.5°C or 550 ppm over a total abandonment of quantified global stabilization objectives. In addition, the EU's climate policy would be viewed in a much more favorable light internationally if the need of additional financial resources for adaptation measures in developing countries were acknowledged, and also if the current unilateral level of ambition (80–95 percent by 2050) were initially maintained. It is questionable, however, whether agreement on this could be reached in the context of the EU's fiscal and economic policy. Under certain circumstances, the EU would be compelled to implement trade policy measures alongside its ambitious decarbonization strategy to help maintain the competitiveness of European companies on the global market and to prevent a relocation of European industry to countries without CO_2 pricing, which would be counterproductive.[59]

Doing without an Exact Stabilization Target

The most far-reaching option for a revision of the 2°C target would be to reject the problem-solving capacity of the top-down approach in international climate policy. This would entail giving up the formulation of a precise stabilization target as the starting point for calculating emissions budgets. This step would not only involve acknowledging that the 2°C target has failed, but would also signal a fundamental change of course in international climate policy. It would be based on the realization that for the foreseeable future, the governance structures needed to convert a global target (no matter what the category or level) into appropriate emissions reductions will be lacking, and perhaps also on an acceptance of the uncertainties that exist in climate science.[60]

Elements of a Modification

This option for target modification would refrain from making any promises about reaching a precise long-term stabilization objective. The key question of how to provide "climate security" could then no longer be answered with a definition of a single global threshold. Instead, the focus would be on the regionally specific impacts that are likely to arise from climate change and on improving societal capacities to cope with them. Emissions reductions would not decline in importance, they would remain essential as a means to reduce the pressure resulting from a changing climate. The rejection of global stabilization targets would bring about a dramatic shift of focus in climate policy. The primary emphasis would no longer be on seeking a "grand solution" at the global level in a breakthrough treaty agreement. Instead it would shift to pragmatically realizing the potentials for emissions reductions in individual countries and economic sectors and to significantly expanding measures to adapt to climate change.

Such a policy approach could not dispense entirely with an overarching target—quite to the contrary. A new target formula must be able to cultivate symbolic appeal on the one hand while also fulfilling a substantial governance function on the other. This would only be possible with a flexible target formula. One conceivable means for accomplishing this would be to establish "climate neutrality"—the goal of reducing the net greenhouse gas emissions at least to the level of the natural rate of absorption, or even to zero—as a long-term global objective at the UN level.[61] Even if it meant that this climate policy vision could only be realized in the very long term, it would nonetheless chart out a clear direction in which all states and eco-

Handbook of Climate Change and Society, ed. John S. Dryzek, Richard B. Norgaard, and David Schlosberg (Oxford, 2012), 113–28; Steve Rayner and Clare Heyward, "The Inevitability of Nature as a Rhetorical Resource," in *Anthropology and Nature,* ed. Kerstin Hastrup (London, 2013), forthcoming.

59 Susanne Dröge, "Using Border Measures to Address Carbon Flows," *Climate Policy* 11, no. 5 (2011): 1191–1201; Daniel Gros and Christian Egenhofer, "The Case for Taxing Carbon at the Border," *Climate Policy* 11, no. 5 (2011): 1191–1201.

60 Maxwell T. Boykoff, David Frame and Samuel Randalls, "Discursive Stability Meets Climate Instability: A Critical Exploration of the Concept of 'Climate Stabilization' in Contemporary Climate Policy," in *Global Environmental Change* 20, no. 1 (2010): 53–64.

61 Within the resulting policy framework, the selective deployment of negative emissions technologies like BECCS might prove to be necessary. But as long as global emissions are still on the rise, it would seem politically dubious to rely on scenarios that are based on a global net negative emissions balance in the second half of the century.

nomic sectors need to be heading. The "all-or-nothing" approach that has dominated up to now would be replaced by the principle of (measurable) "steps in the right direction."

Consequences for EU Climate Policy and Climate Research

The task for ambitious climate policy actors such as the EU would be to commit themselves early on to a challenging decarbonization path and to begin to prove that an emissions reduction policy is technologically feasible, is beneficial in terms of energy security, and is at least not economically detrimental. Moreover, this would raise the standing of flexible and incentive-based cooperative agreements between individual industrialized, emerging, and developing countries.[62] Indeed, global agreements would continue to be necessary in areas such as forest protection, financial aid to developing countries, transparency in emissions data, and CO_2 pricing.

From today's perspective, it is hard to imagine how the EU could successfully communicate this option for modifying the 2°C target. A key strand of the international climate discourse has consistently sought to create ambitious timetables for precisely specified stabilization targets. In this way, the desired outcome and ultimate success of international climate policy has always been represented in the mainstream discourse. While this "targets and timetables" approach may be highly attractive for communications purposes, it has not brought about actual reductions in global emission levels. An alternative approach that focuses on "policies and measures" without a clear target for average global temperature increase or the atmospheric concentration of greenhouse gases is extremely unappealing to the EU.[63] Furthermore, from our current perspective, it is impossible to draw any reliable conclusions about the potential effectiveness of this approach to climate policy.

A change of course in climate policy would be seen as inconsistent with the EU's ascribed leadership role, unless significant doubts arose with regard to the top-down approach and its capacity to address the problem, or major emitters like the USA, India, and China refused all other options for target modification. To prevent international climate policy from losing all its momentum, the EU would have to demonstrate effective leadership by taking action to address what has become an obvious failure of the prior approach; it would have to seize and present this failure as an opportunity to mark a new beginning in climate policy.

In a flexible global climate policy regime, however, the EU's unilateral emissions reduction aspiration would likely be below current levels (80-95 percent by 2050), unless its economic transformation strategy has progressed significantly by this point or unless multilateral cooperation agreements produce rapid results. What is completely unclear at this point is how the EU's relationship with climate science would evolve. The rejection of a problem-centered approach with a precise stabilization target would certainly shift the balance of power in the field of scientific policy advice more than any other option for target modification. In an actor-centered approach to climate policy—one that relies on flexible cooperation, economic co-benefits, and effective adaptation measures—the need for social science and engineering knowledge would increase significantly. This would mean that in the political sphere there would no longer be an equivalent to the overly optimistic belief of the natural sciences that it might be possible to effectively manage natural and societal processes on a global scale.[64] Freed of any obligation to respect political interests, climate researchers who today are among the strongest proponents of the EU's aspirations in climate policy could become its most eloquent and powerful critics.

62 David G. Victor, *Global Warming Gridlock. Creating More Effective Strategies for Protecting the Planet* (Cambridge, 2011), 59ff.

63 The situation is different in the USA, where a pragmatic approach is preferred even by supporters of an ambitious climate policy; see Nigel Purvis and Andrew Stevenson, *Rethinking Climate Diplomacy. New Ideas for Transatlantic Cooperation Post-Copenhagen* (Washington: The German Marshall Fund of the United States, 2010); Daniel H. Cole, *From Global to Polycentric Climate Governance*, EUI Working Papers 30/2011 (Florence, 2011); Victor, *Global Warming Gridlock* (see note 62).

64 See Mike Hulme's contribution ("On the 'Two Degrees' Climate Policy Target") in Brigitte Knopf et al., "The 2°C Target Reconsidered," in *Climate Change, Justice and Sustainability—Linking Climate and Development Policy*, eds. Ottmar Edenhofer et al. (Dordrecht, 2012), 121–37.

Conclusion

The 2°C target has been of exceptional importance for international climate policy and scientific policy advice. In its present form, there will be strong pressure for this target to change, however, as a rapid and profound trend reversal in global greenhouse gas emissions over the current decade is no longer likely. Although there are various options for a modification of the 2°C target, an in-depth discussion has been lacking until now. From the perspective of key policy makers and scientific policy advisors, a reinterpretation or a fundamental revision of the target entails high risks—not only to the image of the EU as a climate policy leader but also to the reputation of climate science.

It therefore stands to reason that the EU will initially take a back seat in discussions about modifying the 2°C target. This is because, first, Europeans take pride in their role in the adoption of the 2°C target at the UN level, which they perceive as a major climate policy success and one they do not want to negate. Second, the EU derives its own emissions reduction targets directly from this 2°C target, so a change would also undermine the architecture of European climate and energy policy. The EU will therefore endeavor to stick to the well-established target formula as long as possible. For this reason alone, the first step towards target modification—which will go largely unnoticed by the wider public—should come from climate research itself in the questionable form of a *deliberate modification of assumptions in climate economics.* By gradually extending the remaining global emissions budgets for the period up to 2050, this approach could postpone the impending failure of the 2°C target, at least for a few years. Judging by currently predicted emissions increases,[65] however, it seems likely that a further modification option will have to be used in the medium term.[66]

From the present standpoint, it seems very unlikely that the EU will make the case for a *transition to a less stringent global target*, whether in the form of a temperature target (e.g., 2.5°C), a concentration target (e.g., 550 ppm CO_2e), or a radiative forcing target (e.g., 3.65 W/m^2). Reacting to the failure of the 2°C target only by setting a new upper limit would be difficult to communicate in a credible way. This would also place climate scientists in an awkward position: either they would have to endorse the process by moving the threshold of dangerous climate change[67] or they would suffer a severe loss of influence within the international climate regime, which in turn would affect their resource endowments. It is also unlikely that the EU will opt for *doing without an exact stabilization target* as soon as it becomes clear that modifying the 2°C target by changing the assumptions of climate economics will no longer be sufficient. Such a fundamental revision of the target system would have to be embedded in a far-reaching paradigm shift in climate policy.[68] The priority would then be more on achieving realistic short- to medium-term emissions reductions as well as comprehensive adaptation mea-

65 UNEP, *The Emissions Gap Report 2012* (see note 21), 10ff.; IEA, *World Energy Outlook*, 246 (see note 9); OECD, *OECD Environmental Outlook to 2050* (see note 20), 80f.

66 This is unless scientific policy advisors manage to abandon crucial "make-or-break" points that are a major part of the current 2°C discourse, e.g., the last possible peak year or the maximum emissions level in 2020. If such an approach were adopted, every additional year of increasing emissions could be balanced out by a further increase in negative emissions during the second half of the century, essentially preventing the abandonment of the 2°C limit up to the year that global mean temperature actually exceeds this threshold.

67 That this is not entirely ruled out is shown, for example, in statements made in an interview with the WBGU chairman Hans-Joachim Schellnhuber. To the question of whether the consequences of exceeding the 2°C threshold—which the WBGU was substantially involved in developing—would be dramatic, he responded, "[N]aturally 2.01 degrees does not mark the end of the world, at least not abruptly. From today's scientific perspective one could maybe also live with a warming of between 2 and 3 degrees. But we should at least come to rest within this corridor, because beyond it, uncontrollable forces would come into play." Hans-Joachim Schellnhuber in conversation with Olaf Stampf and Gerald Traufetter, "Tritt in den Hintern," *Der Spiegel*, August 16, 2010: 113.

68 Oliver Geden, "The End of Climate Policy as We Knew it" in *Expect the Unexpected. Ten Situations to Keep an Eye on*, SWP Research Paper 1/2012, ed. Volker Perthes and Barbara Lippert (Berlin: Stiftung Wissenschaft und Politik, January 2012), 19–22; Marcus Carson, Tom R. Burns, and Dolores Calvo (eds.), *Paradigms in Public Policy: Theory and Practice of Paradigm Shifts in the EU* (Frankfurt a. M., 2009).

sures than on working toward quantified long-term objectives and a comprehensive global climate treaty. Not only would the EU be forced to redefine its role within the new international climate policy regime, scientific policy advisors would also be under great pressure to change their approach. From a European perspective, such a significant step will probably only become conceivable when all other options for target modification have failed. It therefore seems likely that for the EU, the preferable medium-term option would be the *overshoot* approach, that is, the transformation of the 2°C target from a strict upper limit to a mere benchmark for international climate policy. The most important political advantage of this would be that the EU could maintain the problem-solving approach that has prevailed since the adoption of the UN climate framework convention in 1992, regardless of its modest track record so far.[69] The 2°C target could be formally retained, natural scientists would not be forced to move the threshold of dangerous climate change, and climate economists would still be in a position to calculate precise emissions budgets. The main long-term danger of such a reinterpretation is that the 2°C target would lose its governance function entirely and serve only a symbolic and declarative function.

Regardless of which modification option the EU prefers in the medium term and which of the conceivable options prevail within international climate policy, the relationship between climate policy and climate science will inevitably have to change. The impending necessity to reinterpret or even revise the 2°C target primarily marks a fundamental failure of international climate policy. But it also highlights the failure of scientific policy advice. Compared to its influence on other public policies and national-level policymaking, the influence of science on international climate policy has always been relatively strong, both in terms of defining basic causal chains as well as in setting the short- to medium-term agenda.[70] The 2°C target and the emissions budgets derived from it are only the most visible expressions of this. By the time policy-savvy climate scientists realize that fundamental assumptions of climate economics must deliberately be adjusted to postpone the global emissions peak further, it will become clear that setting "scientific" climate targets to constrain the options available to policy makers has failed. What seemed to be a non-negotiable planetary boundary will be subject to (more or less publicly visible) renegotiation.[71]

The problem-centered modes of extensive environmental governance associated with the global emissions budget approach are ultimately unfeasible politically—and therefore fail to fulfill the main criterion for success of scientific policy advice. The dismal prospects of this approach cannot be chalked up to the lack of effective governance structures in the domain of global public goods or to the divergent interests of industrialized, emerging, and developing countries. Its key weakness is the lack of consideration of crucial political factors, in particular the ways multilateral organizations, national governments, and political parties actually work. Not even the EU, which describes its climate policy explicitly as "science-based," would actually be prepared to submit to the logic of a (regional) emissions budget. In the upcoming process of setting and implementing internal climate targets that are legally binding for the post-2020 period, the EU will not only want to remain flexible enough to accommodate international political conditions, the domestic political climate in its Member States, and the interests of key economic actors;[72] it will also have to refrain from using stringent budgeting mechanisms to put emissions reductions at the top of the political agenda for the next four decades. Basing climate policy on carbon budgets is inconceivable for the very reason that major new findings in climate science, such as changes in estimates of the long-term

69 That this option is attractive for EU climate policy can thus far only be deduced from statements of individual representatives. For example, Artur Runge-Metzger, chief climate negotiator of the European Commission, when asked whether compliance with the 2°C limit was still realistic given the increasing emissions, answered: "That is certainly still possible for the long term, but it may well be that we will at some time temporarily exceed 2°C." Artur Runge-Metzger in conversation with Marcus Pindur, "Es muss gehandelt werden auf internationaler Ebene," *Deutschlandradio Kultur*, accessed June 16, 2011, http://www.dradio.de/dkultur/sendungen/interview/1477900/.

70 Reiner Grundmann and Nico Stehr, *The Power of Scientific Knowledge. From Research to Public Policy* (Cambridge, 2012).

71 Ted Nordhaus, Michael Shellenberger, and Linus Blomqvist, *The Planetary Boundaries Hypothesis: Review of the Evidence* (Oakland: Breakthrough Institute, 2012).

72 Severin Fischer and Oliver Geden, *Updating the EU's Energy and Climate Policy. New Targets for the Post-2020 Period* (Berlin: Friedrich-Ebert-Stiftung, 2013). In the case of mid- to long-term policymaking, political organizations usually manage conflicting demands by taking different (and therefore inconsistent) positions in the areas of statements, decisions, and actions. See Brunsson, *Organization of Hypocrisy* (see note 36).

temperature increase resulting from a doubling of CO_2 concentration in the atmosphere *(equilibrium climate sensitivity)*, would automatically result in emissions budget adjustments over which policy makers would have no influence.[73]

In the process of modifying the 2°C target, the working relationship between the EU and climate science will also change. The EU will no longer be able to count on climate scientists to unconditionally support its international climate policy preferences. At the same time, climate scientists will have to accept that their relatively privileged status will be limited to the areas of media access and research funding, whereas their political influence will be no greater than the influence of scientists in other policy areas.[74] In this process, climate policy will tend to "politicize" while climate science will tend to "scientize." Scientific policy advisors will also have to carefully examine their role. When appearing in the media or before parliamentary committees, they should not attempt to distill the enormous volume and range of climate research into explicit demands for political action. Rather, they should restrict themselves to presenting the conditions and consequences of specific policy alternatives.[75]

The history of the 2°C target clearly demonstrates that the establishment of an absolute climate target contributes little to effective risk management if major emitters refuse to actually implement corresponding measures because the reduction paths appear too ambitious to them. The 2°C target might have worked well as a focal point for climate policy formulation,[76] but it has clearly failed as a focal point for appropriate action. Furthermore, unrealistic pledges send the signal that they can be disregarded with few political or reputational consequences.[77] A more pluralistic approach in scientific advice to climate policy makers could result in a more pluralistic understanding of "legitimate" policy options. Climate policy makers would be better informed and thus better able to assess the trade-offs linked with different policy options and to decide what is realistically attainable. A global climate target can only promote successful problem solving if it fulfills both a positive symbolic and a productive governance function.

73 Myles R. Allen and David J. Frame, "Call off the Quest," *Science* 318 (2007): 581–82; Alexander Otto et al., "Energy Budget Constraints on Climate Response," *Nature Geoscience* (2013): Advance Online Publication.

74 Frank Nullmeier, "Neue Konkurrenzen: Wissenschaft, Politikberatung und Medienöffentlichkeit," in *Von der Politik- zur Gesellschaftsberatung. Neue Wege öffentlicher Konsultation*, ed. Claus Leggewie (Frankfurt a. M. and New York, 2007), 171–80.

75 Pielke, *Honest Broker* (see note 11); Ottmar Edenhofer and Martin Kowarsch, *A Pragmatist Concept of Scientific Policy Advice* (Berlin: Mercator Research Institute on Global Commons and Climate Change, 2012). According to Edenhofer and Kowarsch (22), the presentation of alternatives would lead to a situation in which "politicians can no longer legitimate policy options by referring either to an alleged 'inherent necessity' of a certain policy option based on a (pseudo) scientific consensus on it, or to uncertainties and disagreement in sciences." Such an approach would require not only first-best but also second-best policy scenarios. See Brigitte Knopf, Gunnar Luderer, and Ottmar Edenhofer, "Exploring the feasibility of low stabilization targets," *WIREs Climate Change* 2 no. 4 (2011): 617–26.

76 Jaeger and Jaeger, *Three Views of Two Degrees* (see note 4).

77 Guivarch and Hallegatte, "2C or not 2C?" (see note 18), 189f.

List of Abbreviations

BECCS	Bio-Energy with Carbon Capture and Storage
°C	Degrees Celsius
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COP	Conference of the Parties
EU	European Union
EUI	European University Institute
Gt	Gigatons
IDDRI	Institute for Sustainable Development and International Relations
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
NGO	Non-governmental organization
OECD	Organisation for Economic Co-operation and Development
PNAS	Proceedings of the National Academy of Sciences of the United States of America
ppm	parts per million
RCP	Representative Concentration Pathway
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
W/m^2	Watts per square meter
WBGU	German Advisory Council on Global Change