Chapter 12
The 2°C Target Reconsidered

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In the face of possible adverse impacts of catastrophic climate change (see Part I; Weitzman 2009, 2010), virtually all ethical approaches suggest that something should be done to reduce the associated risks (Caney 2009; see Part II). This general perspective is also enshrined in Article 2 of the UN Framework Convention on Climate Change (UNFCCC), which states as its objective the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (UNFCCC 1992). Much of the international climate policy debate in recent years can be interpreted as an effort to specify exactly what this means.

After much scientific and political debate (e.g. WMO 1988; WBGU 1996; Stern 2007; Schellnhuber 2006; Tol 2007; Nordhaus 2008, 2010; Hansen, et al. 2007; Smith et al. 2009) and following the decisions by the European Union (1996) and G8 (2009) to adopt the 2°C stabilisation target, all parties to the UNFCCC (except Bolivia) have now agreed to pursue the aim of limiting global warming to 2°C above the pre-industrial level at the UNFCCC conferences of parties (COP) in Copenhagen (COP-15) and Cancun (COP-16) (UNFCCC 2009, 2010).

Leaving aside the question as to whether the sum of climate policies proposed at these conferences will suffice to actually attain the global 2°C target (Rogelj et al. 2010; UNEP 2010 find they will not), in this chapter we want to examine the rationale for global temperature stabilisation goals in general and the 2°C target in particular.

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To understand the controversial and sometimes emotional debate about the 2°C target in the scientific community we follow an unorthodox approach here by inviting outstanding experts, representing opposing viewpoints, to introduce *their* view on the 2°C. We invited Mike Hulme (University of East Anglia, UK) on the one hand, and on the other hand Claus Leggewie (Justus-Liebig University Gießen and Kulturwissenschaftliches Institut (KWI) Esssen, Germany) and Dirk Messner (German Development Institute (DIE)), both members of the German Advisory Council on Climate Change (WBGU), to reflect the controversial scientific and political debate surrounding the 2°C target.

Whilst Mike Hulme (see Sect. 12.1) casts doubt on the usefulness of the very idea of a specific temperature target as guidance for mitigation policy, Claus Leggewie and Dirk Messner (see Sect. 12.2) claim that the 2°C target actually *has* an important instrumental value in the discourse about climate-related risks. In Sect. 12.3 we discuss both contributions and argue that climate stabilisation goals provide a useful framework for discussing climate policy choices on a consistent basis. In our view, given current knowledge and specific ethical arguments the 2°C target appears a balanced choice, but further research and public debate are required to reduce uncertainties and consolidate this hypothesis.

12.1 On the "Two Degrees" Climate Policy Target (by Mike Hulme)

The formal adoption of a global temperature target to drive, or at least guide, climate policy development dates back to the mid-1990s. The origins and history of the "two degrees" target and how it was adopted by the EU Council in 1996 – and re-affirmed in 2007 – has been well documented in articles by Tol (2007) and Randalls (2010). In recent years the "two degrees" target has gained in visibility, both in public discourse and in policy deliberations. For example, it underpins the UK's 2008 Climate Change Act and was commended by the G8 meeting at L'Aquila in July 2009. It was also given prominence in the Copenhagen Declaration which emerged from the UNFCCC meeting in December 2009 in Copenhagen.

"Two degrees" – limiting the rise in globally-averaged temperature to no more than 2°C above the pre-industrial level – has become the benchmark for policy advocacy around climate change and for many environmental and climate justice campaigns. It has also functioned as an anchoring device (Van der Sluijs et al. 1998) in climate science-policy analysis and interaction. And this single index of climate performance – collapsing the complexity and diversity of weather and climate around the world into global temperature – has gained powerful iconic and cultural status. But does the world need a global target in order to drive and guide climate policy? And if it does, is global temperature the most suitable index to use? In this short essay I identify four characteristics of the "two degrees" target: universality; ambiguity; doubtful achievability; and questionable legitimacy. I suggest why each of these characteristics undermines the value and necessity of such a target. I conclude the

essay by contrasting the "two degrees" target with other types of targets developed and used in other areas of public policy-making.

The "two degrees" target is, by definition, *universal*. It offers one numerical index by which to judge the future behaviour of the global climate system. It suggests that climate policy effectiveness should ultimately only be judged against whether it contributes to achieving this one universal goal. It draws attention away from the desirability of a wider set of more diverse climate policy goals which may have greater regional or national legitimacy and traction and which may be easier to implement. Ostrom's (2010) proposal to approach "global commons" problems through polycentric policy initiatives may be impaired by the imposition of a "one-size-fits-all" approach to policy orientation. The "two degrees" target is also highly abstract. Global temperature has no resonance with the everyday experience of weather and climate. It is a constructed quantity. Whether cognitively or existentially, it has difficulty engaging the human imagination. Thinking of environmental and social policy through the lens of "two degrees" also opens the way for the emergent discourse around climate engineering: deliberate manipulation of the planetary atmosphere and oceans to achieve an outcome measured in terms of this one index – global temperature. The metaphor of a global thermostat is a powerful one, but it opens up new frontiers for geopolitical tensions about what the thermostat setting should be and who controls it. Whether viewed rhetorically or pragmatically, adopting such a universal target to guide the conduct of affairs between nations is dangerous and of limited value.

The second characteristic of the "two degrees" target is its *ambiguity*. Global temperature is an "output index" of the climate system rather than corresponding to the range of underlying human "input factors" (such as greenhouse gas and aerosol emissions, land cover, population). And because the relationship between input (human forcing) and output (global temperature) is deeply uncertain, agreeing a target of "two degrees" helps little in specifying what the various input factors should be. Owing to the wide range of possible values of the climate sensitivity and the deep uncertainty about the aggregate global effects of forcing agents such as aerosols and black carbon (notwithstanding the extent of natural climate variability – see below), the "two degrees" target is compatible with a very wide range of input scenarios. If it *were* deemed global target setting was necessary for climate policy, then a carbon dioxide concentration target, for example, would be much less ambiguous. This has indeed been recognised by many campaigners, such as Bill McKibbin's social movement "350.org" which campaigns for an atmospheric carbon dioxide concentration of 350 ppm.

Third, the "two degrees" target is *unattainable*. I don't mean here in the sense that politics, economics, culture and technology may conspire to prevent the necessary emissions reductions (though they may). I mean in a wider sense that manoeuvring the world's development pathway to deliver a re-stabilised global climate at no more than 2°C above pre-industrial levels requires a higher level of understanding than we have of the climate system and the extent of human influence upon it. It implies that the only factors affecting global temperature are human factors and ignores the extent of natural climate variability. Global temperature varies on multiple

time-scales for complex reasons and current understanding suggests that on multi-decadal timescales natural forcing of the climate system could account for up to 0.5°C warming or cooling. This is 25% of the target temperature rise and adds further ambiguity about its achievability (see above). Believing that a "two degree" world can be engineered suggests a level of managerial control of the planetary system that humans are never likely to attain.

Finally, I consider the "two degrees" target in terms of its *legitimacy*. Who has established this goal of international climate policy and who has the right to establish it? What is interesting here is that neither scientists nor politicians are willing to fully accept responsibility for its adoption. The scientific community – as given voice through the IPCC – assiduously makes clear that identifying a target for climate policy is a value-laden judgement and therefore falls beyond the remit of scientific enquiry. Yet the political community – whether advocacy campaigns or national and international politicians – continue to defer to "what the science demands". The Copenhagen Accord, for example, recognised "the scientific [sic] view that the increase in global temperature should be below 2 degrees Celsius" (UNFCCC 2009: 1).

I believe these four characteristics of the "two degrees" target – its universality, its ambiguity, its unachievability and its illegitimacy – challenge its validity and necessity for climate policy-making. Counter-arguments in *favour* of this target include that: (a) it "is demanded by the science" and (b) it usefully focuses the political mind. But as we have seen above, "two degrees" is not *demanded* by science any more than science *demands* a target of zero degrees or of four degrees. There is not a global temperature target waiting to be *discovered* by scientific enquiry. And it is debatable whether the "two degrees" target in fact *inhibits* policy-making at an international level, rather than promotes it. As discussed above, global temperature is an abstract index of planetary behaviour which hides deep ambiguity in the relationship between input control factors and output performance. The "two degree" target – being abstract, distant in time and ambiguous – is as likely to allow politicians to evade its demands as to encourage them to embrace them.

It can also be argued that the "two degrees" target is socially regressive, or at best diversionary. It runs the danger of confusing ends with means. It is not a global climate system delivering some abstract global temperature – whether zero, two or four degrees above the nineteenth century level – that is a public good. The ultimate goals of progressive environmental and social welfare policy revolve around individual and collective human well-being (unless one adopts a strong non-anthropocentric ethic). Thus the end goal of such policy must surely include reducing global poverty, improving literacy and educational opportunity, empowering citizens, etc. Elevating "two degrees" to the ultimate goal of climate policy development may endanger this human welfare agenda.

The "two degrees" target sits easily within a managerialist audit culture which has come to dominate (at least) European societies in recent years, with numerical public sector league tables and performance targets. The danger of such highly quantified audit cultures is that one may hit the narrowly defined numerical target, but miss the desired underlying welfare goals of the policy intervention. With climate change the example of this would be a policy intervention that secured

the "two degrees" target through intrusive large-scale biogeophysical engineering of the atmosphere or oceans, but which did nothing to, say, alleviate poverty, achieve universal energy access or improve female literacy.

In conclusion I wish to contrast the case of climate change and "two degrees" with other areas of public policy where different types and levels of target-setting are introduced. Take the example of public health. National health ministries do not pontificate or plan around a national goal to increase average life expectancy by 'x' years within 'y' decades. If they did set such targets they would be seen as purely aspirational, with little tangible value for health policy-making. The relationships between the range of input (health risk) factors and output performance (average life expectancy across a population) are too complex and unknown. Instead, national health policy targets are much more narrowly prescribed – for example, different treatment rates for different forms of cancer, screening and vaccination programmes, dietary guidelines etc. Such a fragmented approach to public health policy facilitates more pragmatic, targeted, accountable – and hence achievable – management interventions. A *by-product* of their implementation will be to increase life expectancy.

An example closer to the climate change case would be the Millennium Development Goals (MDGs). A key difference here is that specification of the MDGs is explicitly political – it is not claimed that they derive from a scientific analysis which warrants one set of targets over any other ones. The MDGs are focused on very specific welfare goals, unlike the "two degrees" target which is several (ambiguous) steps removed from delivering tangible welfare gains on the ground.

A final example would be to ask why the world has been willing to embrace a universal global temperature target, but has kept well away from the adoption of a global population target. A global population target would be heavily contested for all of the reasons I have suggested above that afflict the "two degree" target: universality, ambiguity, unachievability and illegitimacy. And yet these reasons have not prevented "two degrees" emerging as the goal around which climate policy rhetorically congregates. I suspect one of the reasons for this has to do with the different ways in which scientific knowledge claims – deriving from Earth system modelling in the case of climate change – have interacted with political and ethical argumentation. Science has been used to trump political, ethical and religious argumentation in the case of climate change, but not in the case of population policy – where a global population target is recognised as being undesirable and infeasible.

12.2 Chronicle of a Disaster Foretold. How Climate Change Is Communicated – And Why Global Warming Must Not Exceed Two Degrees (by Claus Leggewie and Dirk Messner)

"Chronicle of a Death Foretold" (*Crónica de una muerte anunciada*) is the title of a novella published by the Colombian writer Gabriel García Márquez in 1981, which recounts, through the eyes of a man returning to a village, what happened there one night and the following morning 27 years earlier: the Vicario brothers are going to

murder the young Santiago Nasar in revenge for his dishonouring of their sister Ángela; on the eve of her wedding she has been rejected by her fiancé, Bayardo San Román, because she is no longer a virgin and Nasar is deemed to be the guilty party. The tale derives its tension from the fact that (almost) everyone is aware of the impending act of violence, but no one wants to prevent it, although even the murderers hope that someone will stop them.

Unlike this clever plot of the predicted murder, disasters are remarkable for the way they occur suddenly, with great force and out of the blue (Clausen 2010). Scientists define disasters by the intensity and scale of an event (i.e. damage, levels of morbidity and mortality rates) and by the duration and time of an event (long/short, past/expected) and its scale (Oppenheimer 2008). If the time of their occurrence and their strength could have been predicted, something might have been done to prevent them. More difficult are the "known unknowns" – danger is sensed, but it is hard to specify it, and preventive measures are taken in the dark. It is possible, *post festum*, to reconstruct path dependencies that caused and triggered the unpleasant event.

Yet it is our duty to anticipate things, such as climate change, that can go terribly wrong. Where disasters have occurred, certain signs have not been recognised and communicated early enough. Or perhaps they have? In view of the complexity of the world in which we live, there is no question of "risk societies" anticipating all the indicators of dangers comprehensively and early enough for them to be averted. A society that seriously tried to do so would be a totalitarian institution or prison. This is not to say disasters such as Hurricane Katrina, 9/11, the current global financial crisis etc. – which could have been predictable and avoidable if the signs had been interpreted correctly – should not give cause for alarm at the thoughtless way in which signs and explicit warnings were ignored. In this respect, there is no need for the "climate disaster," first referred to in the 1980s, to occur; in 2007 the term was on everyone's lips. Climate *disaster* denotes a worst-case scenario, the occurrence of uncontrollable feedbacks and tipping points that may upset the delicate balance of the climate system and have incalculable consequences for the global economy and order (WBGU 2009; Archer and Rahmstorf 2010; World Bank 2010; UNDP 2007).

Although climate change is a global problem *par excellence*, anyone wanting to act successfully (whether at local or global level) must take into account patterns of perception that differ significantly from one culture to another: one climate in many climate worlds. The sea level will rise to a greater or lesser degree along all coastlines, but the mechanisms of perceiving and adjusting to this finding will differ culturally according to how water, flooding and inundations are interpreted locally and how they have been managed in the past. Climate change is thus a "disaster" or "crisis" *sui generis* which resembles or is made commensurable with "known" crises and disasters and which we therefore assess and interpret from our memories of past crises and disasters.

Natural events and social disasters, by challenging established social patterns of interpretation, disrupt cultural order and intensify moral discourses. Dealing with the potential mega-crisis (or meta-crisis) of climate change corresponds to the familiar reactions of complex societies to similarly rapid and radical social change.

The patterns of interpretation vary between alarmist hyperbole and mollifying denial, between collectivisation and segmentation, between the assignment of guilt and the delegation of action to third parties and the assumption of individual responsibility, and between preventive activism and wait-and-see confidence in humankind's great capacity to adjust.

However, the possibility of disastrous climate change, backed by planetary boundaries such as the "tipping points" at various places in the global system, is firstly likely to unsettle the constructivist view of the world, which attributes logical values of scientific knowledge not least to the social conventions and communications of the scientific community (and not to the external or objective in nature). Secondly, the reality of global warming dynamics challenges also prevalent theories of international politics (game theory), which call on the actors involved to look for a middle ground to strike a balance between interests and power structures. This would possibly result in a 3–4°C compromise – which might culminate in irreversible Earth system changes and "tipping points".

Bruno Latour in particular has demanded a sort of "respect" for "natural things" and objects in the construction of scientific facts and emphasises the autonomy of "nature" and "dynamics in ecosystems". His perspective remains constructivist, in that he takes account of social conventions and communications as constitutive conditions of scientific practice (in the laboratory, for example) – *les faits sont faits*. He does not, however, reduce "actions" exclusively to human beings, but ascribes also to non-intentional "actors" (nature, dynamics of ecosystems) their own *modus operandi* in world-making. The "knowing one" is removed from the stage as sole entertainer: "Let us return to the world which is still unknown and despised" (Latour 1988: 173). Accordingly, this sociologist then calls for a "parliament of things," which grants non-human entities legitimate membership of the collective (Latour 2001). "We are now entering into an *interplay* with nature" (loc. cit.: 85).

A residue of uncertainty undoubtedly remains as to whether climate change "really" exists and is "really" becoming dangerous; climate researchers even cherish the desperate hope that they may be wrong. Science cannot prove anything conclusively, let alone predict a trend with any accuracy. Just as there is a broad scientific and medical consensus that smoking (including passive smoking) is harmful, so anthropogenic climate change is highly plausible today. In addition, just as smoking bans in restaurants and persuasive campaigns calling for nicotine consumption to be reduced or stopped are urgently needed, so regulatory measures, economic incentives and voluntary restrictions of carbon dioxide (CO_2) emissions at global level are imperative. On this there is today a general political consensus.

For politics and the public it is also important not only to insist on "best solutions" but also to be realistic and present second and third best ways to avoid greenhouse gases. This is precisely how the IPCC can stimulate the political debate on alternatives for energy and technology policy.

Scientific policy advice can preclude the possibility of overpoliticisation by addressing the political and societal debate, rather than science. Advice on policy must also always address and try to convince civil society, since the desired political change to a climate-compatible society will otherwise fail to occur.

That there is no easy way to move from knowing to doing is ultimately unimportant. It is not only the pressure exerted by the lobbies and deniers that is to blame for this: behind it is the phenomenon of "protective ignorance," to which too little attention is paid and which only ever accepts scientific data and conclusions that are consistent with its own image of the world. Against the background of such cultural prejudices, the Yale jurist Dan Kahan (2010) has advised the IPCC to improve the presentation of information, and to do so in such a way that it is more likely to find the consent of normatively divergent positions and to avoid cultural wars over the climate. Climate protection and climate change adjustment programmes, in which civil societies are not involved and local knowledge is not respected, are doomed to failure.

Such openness may, of course, easily overextend the customers, the notoriously uninformed public. Participatory elements should therefore be included to make it easier to disseminate and acquire knowledge on what is happening in nature and the environment: we value and protect only what we are familiar with, and knowledge is nothing without the informed. Hans Jonas's ecological imperative ("Act in such a way that the effects of your actions are compatible with the permanence of real human life on Earth") must be seen in a knowledge-sharing civil society as the sum and combination of small, personal acts, which can then be supported and strengthened by wise legislation, targeted market incentives, company initiatives and far-sighted investment.

From the *exploration* of climate change the path led via public *deliberation* to the debate on what action is needed to avoid dangerous global warming. Joint work of natural and social scientists translated into options for *crisis and risk management* in a global warming context (Messner and Rahmstorf 2010). An important guideline here is the "two-degree safety barrier," known in political jargon as the "two-degree target". It is an indication, as simple as it is compelling, of the physical limits to the volume of greenhouse gases that can be dumped in the atmosphere and sets out the breathtaking message that the world's population must immediately begin to make significantly less use of fossil energy sources or leave them in the ground. In this framework worldwide carbon emissions must be limited to no more than about 750 gigatons of CO_2 by 2050. At the current rate, this global budget will be exhausted in 20 years. Delaying the reversal of the trend until 2020 would necessitate annual global reductions far beyond what was agreed by the industrial nations in the Kyoto Protocol for the whole of the first 5-year commitment period. Any further loss of time would mean exploding costs and make the two-degree barrier ultimately obsolete (WBGU 2009), since consequential damage to the climate would increase disproportionately as the temperature rose, and behind the safety barrier lurk incalculable dangers.

The term "safety barrier" in this context can be used both metaphorically and literally: safety barriers on roads are protective devices made from metal or concrete which protect passers-by and buildings against vehicles that leave the road and the drivers and passengers against injury as they do so. "Two degrees" thus forms something like a meta limit value for greenhouse gases, indicating that any increase in the average global temperature should be limited to two degrees above the pre-industrial level in 1880. Two degrees (rather than 1.5 or 2.3) is a guide value

(and more than an informed guess) based on the simple physics of climate (according to the concept of climate sensitivity) and setting an upper limit on humankind's CO_2 budget. At the end of the day our societies, governments and the international community need to decide which kind of global risks (such as impacts of global warming on agriculture, water supply, extreme weather events; tipping points in the Earths' system) and which kind of risks which impact next generations are acceptable for human mankind. This can be seen from a normative perspective (justice, fairness in and between societies and between generations), from a political perspective (which kind of impacts and risks are societies able to manage?), from an economic perspective (will our economies be able to adapt to global warming?), and from a security policy point of view (will global warming result in international security crisis?). Against this background, many social scientists have been coming step by step to the conclusion (analysing the "facts and figures" produced by climate scientists and investigating the impacts of different stages of global warming on societies) that the 2°C threshold is reasonable. Most social scientist working on climate change agree that a global warming in a range between 3°C and 4°C would overburden many societies, economies and the international system and might translate into unmanageable risks (World Bank 2010; UNDP 2007; WBGU 2009).

In 1979 the economist W. D. Nordhaus was the first to describe two degrees of warming as a dangerous limit, based on the assumption that two degrees centigrade is the limit of the warming which has occurred naturally over the last 10,000 years (cited in Oppenheimer and Petsonk 2005, p. 197). Meanwhile, a wide range of scientific, political and social actors have converged around the idea that global warming should be limited to two degrees above the pre-industrial temperature. The United Nations Framework Convention on Climate Change (UNFCCC) required signatories to take steps to avoid dangerous climate change (UNFCCC 1992, Article 2). The UNFCCC did not quantify the extent of climate change that should be considered dangerous, leaving it to the signatories to reach agreement on that definition. Of great importance were the WBGU reports of 1995, 1997 and 2003 commissioned by the German government; they were fed into the drafting of the Kyoto Protocol (WBGU 1995, 1997) and the current EU policy (WBGU 2003). In the 1995 WBGU report the global average temperature today is calculated to be around 15.3°C, leaving only 0.8 degrees of warming before the climate reaches a dangerous temperature. However, the report adds 0.5 degrees of warming to the assumed tolerance range to reflect humankind's "improved adaptive capacity" (WBGU 1995:13). In its latest assessment in 2007 the IPCC forecast that a rise of more than two degrees would lead to potentially significant losses of food production in certain sub-regions (in Africa, for example), an increasingly high risk of extinction for 20–30% of species, more severe droughts and floods and an unstoppable "widespread to near-total" loss of the Greenland ice sheet over a very long period. However, it predicted that at four degrees global food production was "very likely" to decrease and that there would be "major extinctions around the globe" and the near-total loss of Greenland's ice, precipitating a 2–7-m rise in the sea level in the long term. As temperatures rose, the severity of floods, erosion, water pollution, heat waves, droughts and such health problems as malnutrition and diarrhoea would also increase, according to the

IPCC. "Two degrees" was endorsed by the G8 in July 2009 as an aspiration which should guide international climate negotiations, and the Copenhagen and Cancún summits also endorsed the principle.

The "two degrees" target is deployed routinely by campaigners, artists and scientists as a threshold around which narratives of urgency, concern or collapse are constructed. By functioning in this way "two degrees" acquires many of the properties of a "boundary object" (Star and Griesemer 1989). That is, it has become a socially constructed entity which is powerful and has endurance both because it is has credibility in many different worlds and because it works to stabilise discourse across the boundaries of these worlds.

It was clear that the principle would come up against major challenges and opposition. The most significant challenge to the consensus came from US President George W. Bush, who said "…no one can say with any certainty what constitutes a dangerous level of warming, and therefore what level must be avoided" (US President George W. Bush, 11 June 2001, cited in Singer and Avery 2007: 223). Some opponents have established a No Targets project (www.notargets.org.uk). Even if they share the concern that the change observed in the climate is largely anthropogenic, unprecedented and in need of a radical response, they find it problematical for a number of reasons to imagine the existence of a single global dangerous limit: the "notion of a single global dangerous limit is a myth which gives primacy to instrumentalist responses whilst denying the need for a change in the value systems which characterise modernity" (Shaw 2010). And they ask important questions:

"We are collecting stories from individuals and organisations engaged in behaviour change programmes to find out what role the dangerous limit idea plays in their work. Does the idea of the need to avoid two degrees of warming help in these projects or is it an irrelevance? If it is not helping at either the micro or macro level, then there is a strong argument that the dangerous limits discourse should be abandoned. We argue that challenging the legitimacy of the "two degree" dangerous limit concept will give space for a democratic discussion about what sort of world we want to live in" (Shaw 2010).

Target-based approaches are common in many fields of policy-making, such as education, health care, social care, economic performance, development cooperation and many other areas of public life. There are reasons for questioning the language of targets, but not the logic of imposing limits. We must certainly acknowledge the relative status of targets: the Association of Small Island States along with other developing nations have argued for 1.5 degrees of warming to be the upper limit. And we must discuss and deliberate further on what will happen *if* it is not possible to stay below two degrees of warming. The instrumental value of limits and targets however, is beyond doubt. In such large areas as safety at work and health, consumer and environmental protection, limits are common and are essential policy instruments for setting maximum admissible quantities, concentrations or levels of harmful substances, noise, radioactivity, etc.

Limit values are political and legal quantities based on scientific findings on the harmfulness and dangers of disturbance variables, but always exposed to influences, preferences and relative strengths of a political nature and always admitting of

exceptions. The two-degree safety barrier is far more than a limit value that can be explained in technical terms: it is a communicative guide quantity, which is far more difficult to define.

12.3 Reconsidering the Arguments of Hulme and Leggewie/Messner

In the following we respond to Hulme and Leggewie/Messner, and lay down our own perspective of the 2°C target. We consider the 2°C target as a "focal point" in the debate (Jaeger and Jaeger 2010), but come to our conclusion from a different perspective from that of Leggewie/Messner. In our view, the 2°C objective has two major merits: first, as a global climate stabilisation goal it provides a useful framework to structure the global climate policy debate – contrary to Hulme. Second, we consider it an appropriate climate policy goal enabling currently available scientific knowledge to be combined with some explicit value judgements. Our argument is structured along three questions: (A) Why set a global mitigation target? (B) How should we determine a global mitigation target? (C) Why 2°C?

12.3.1 Why Set a Global Mitigation Target?

Climate change as a global problem involves large-scale risks for humankind. At the same time, climate stabilisation also involves costs and risks, such as geo-engineering options, extensive use of biomass with adverse effects on food markets, or risks related to massive use of carbon capture and storage (CCS) (see Chap. 13). Thus, climate policy needs to balance the risks from climate impacts with risks from transforming the world energy system. Global stabilisation targets, such as limits for global mean temperature change, atmospheric greenhouse gas (GHG) concentrations, or cumulative human GHG emissions, provide a narrative framework for explicitly discussing the choices and tradeoffs faced by humankind. They allow questions to be asked, such as what are the climate impacts and risks in a world that is 1.5°C, 2°C or 4°C warmer than that of pre-industrial level? What are the costs, policies, and potential side-effects of attaining these alternative stabilisation targets? Even though the present uncertainties in knowledge of climate impacts and policy responses are substantial, a consistent framing of climate policy choices along the lines of global stabilisation goals has the merit of eliciting rigor in stating these uncertainties explicitly and clearly. In the political debate, different stabilisation targets can focus and coordinate a complex, global discourse by enabling consistent debate about the consequences of different courses of climate policy action on the global as well as regional and local scales.

The world political system of course, is decentralised and climate policy needs to take this fact into account. In his contribution, Mike Hulme argues that universal

stabilisation goals are dangerous, as they, as abstract metaphors, (i) raise contentious issues within the international community about which global stabilisation goal to pursue, and (ii) divert attention from other important societal goals and more specific and regionally crafted climate policies. We fully agree on the importance of developing and adopting multi-level policies that are more specific than the general framework provided by global stabilisation goals, as, for example, outlined in Ostrom (2010) or Lenton (2011). We also agree on the critical need of climate policy to take other societal goals into account (and vice versa), especially those related to the realisation of the demands of justice (see Part II). In fact, it is the very intention of this book to integrate the analysis of climate change and poverty simultaneously to avoid one-sided analysis and policy. However, we do not share the view that climate policy necessarily crowds out other policy objectives. In addition, focusing on regional policy efforts does not eliminate the potential for conflict in a *global* public good problem such as climate change: conflicts over the level of ambition of regional climate policies will arise irrespective of the conceptual framework that is used to frame these. The advantage of global stabilisation goals is, in fact, to make such conflicts and different political viewpoints transparent, so they can be consciously dealt with.

Without global stabilisation goals, the political debate would need to rest on ad hoc arguments and decisions, absent any perspective on the longer-term impacts of the choices made. This would be a dissatisfying approach to rational policy-making. That is why we agree with the notion that the "the instrumental value of limits and targets is beyond doubt", as put by Leggewie and Messner, even if substantial uncertainties of these global targets remain (see below, Sect. 12.3.3).

12.3.2 How Should We Determine a Global Mitigation Target?

There are three identified approaches employed to derive global stabilisation targets: (i) reducing physical impacts of climate change, (ii) cost-benefit analysis of GHG mitigation policy, and (iii) mitigation policy as insurance against catastrophic climate change and the human consequences it would entail, such as activating tipping points in the earth system (Lenton et al. 2008). We briefly discuss each of these approaches below.

While it is, in our view, convincing to evoke physical climate changes, and in particular the risk of planetary catastrophes to justify climate policy, an approach exclusively focussing on physical impacts of climate change faces severe problems: first, it fails to take into account adverse impacts of aggressive mitigation policies. For example, food prices may rise resulting in hunger crises and conflicts, due to extensive biomass use in energy systems (see Chap. 14). In our view exploring the full scope of the consequences of alternative future climate policy pathways is crucial when considering global policy alternatives, as from an ethical perspective, the risk of severe side-effects of climate policy measures (e.g. large-scale use of biomass in energy systems) can prompt a revision of policy ends (i.e. stabilisation goals). Second, merely referring to climate impacts does not fully and explicitly embrace the inherent ethical judgements involved in trading off different types

of risks against each another. Yet, these ethical issues often seem to be crucial in the disagreement about global mitigation targets. Nature alone cannot determine a global mitigation target or any other sustainability target (e.g. which risks are acceptable, etc.). Rather, society decides in which kind of world it wants to live – though not independently from natural scientific findings. Both Hulme and Leggewie/Messner clearly state this above. The role of scientists can only be to inform society of the full consequences and risks of pursuing specific paths for action. They should also make related normative judgements and core uncertainties transparent and provide different policy alternatives as an "honest broker" (Pielke 2007; Edenhofer and Kowarsch 2012). In the end, decisions need to be reached using fair procedures, taking into account the expected consequences of policy options and related ethical judgements, which should be assessed in public debate (see Part II). We see clear agreement between Hulme, Leggewie/Messner, and our argument on the need for a public debate into the different alternative paths and related ethical value judgements. This might also provide a solution for Hulme's legitimacy problem. The debate over the Stern Review's assumptions on intergenerational equity is one example of how ethical judgements in policy proposals can be discussed explicitly, but it also demonstrates the challenges associated with this (Nordhaus 2007; Dasgupta 2007; Heal 2009; Howes et al. 2011).

Importantly, cost-benefit analyses have helped to clarify the basic structure of the climate policy problem and have gone some way towards incorporating these demands of an "honest broker" (e.g. Nordhaus and Boyer 1999; Stern 2007, 2008; Nordhaus 2008). One major problem facing numeric cost-benefit analyses of climate policy is that they require quantification of all costs and benefits, including impacts on ecosystems, health, migration, and human lives which necessarily involve substantial ethical choices (see Baer and Spash 2008 for a critique).

In a recent series of papers, Martin Weitzman (2009, 2010) has demonstrated that if there is a small chance of large-scale climate change (high temperature increase and/or high damages), cost-benefit analysis indicates that the value of mitigation becomes infinite. Thus, Weitzman proposes, GHG mitigation should more usefully be regarded as an insurance policy against catastrophic climate change. In our view, and presumably also in the eyes of Leggewie/Messner, framing climate policy as insurance and risk management is a good starting point for the discussion of global stabilisation goals. Complementing it by both quantitative and qualitative disaggregated cost-benefit analyses that focus on more specific risks and consequences of policy alternatives as explained above, will provide a useful set of conceptual tools for discussing the basic decision problems and related ethical issues imposed by climate change.

12.3.3 Why 2°C?

The first question arising in a discussion of a specific climate stabilisation goal is the choice of the metric. This is also one focus of Hulme's second and third point of criticism concerning ambiguity and doubtful achievability of a temperature

stabilisation goal. Four metrics are commonly considered: (i) atmospheric CO_2 or GHG concentration measured in parts per million (ppm), (ii) radiative forcing measured in watts per square metre (W/m^2) which includes aerosols in addition to GHGs, (iii) global mean temperature change above the pre-industrial levels measured in °C, and (iv) cumulated anthropogenic CO_2 emission budgets measured in $GtCO_2$. In brief, we generally consider all of them to be useful metrics with regard to their principal function identified above, i.e. structuring the debate of alternative climate policy choices. As noted by Hulme, temperature targets suffer from significant uncertainties in prediction due to natural variability, which may be a reason to opt for concentration targets or emission budgets. These are more closely related to human activity which is ultimately what is regulated by policies. Lenton (2011) suggests the metric of radiative forcing "to limit the rate and gradients of climate change" which requires aerosol emissions to be taken into account. In our view, though, the uncertain relationship between every step in the chain linking anthropogenic emissions (the prediction of which itself being subject to major uncertainties), atmospheric GHG stocks, radiative forcing, global mean temperature change, regional temperature change, and specific climate impacts, impose an irreducible challenge for any of these metrics. For example, when proposing a carbon budget as a policy target, the probabilistic consequences for global mean temperature change and regional impacts will be of interest to assess the climate consequences of such a budget; vice versa, when considering temperature stabilisation levels the probabilistic range of commensurate carbon budgets will need to be considered to guide policy.

Due to the uncertainties involved in climate change, we are aware how a sense of preciseness from using figures should be avoided when discussing global stabilisation goals as they may be misleading. Talking about a 2°C target to be achieved with very high probability does not mean that it should be distinguished from a 2.1° or 1.9° target. It is however, for example, certainly different to a 1°C or 3°C global temperature change. Each of the corresponding trajectories characterises qualitatively different risk portfolios related to climate impacts, adaptation and mitigation efforts, given current best available knowledge.

From a risk management or insurance perspective, based on the ethical grounds in Part II, in our view current knowledge suggests that the 2°C target – associated with budgets and atmospheric concentration levels that deliver a significant probability of actually achieving such a target (Meinshausen et al. 2009) – is a sensible climate policy goal. As Leggewie/Messner argue, according to our present (necessarily incomplete) knowledge it significantly reduces the risk of high and potentially catastrophic global mean temperature changes (e.g. more than 6°C; see Stern 2008, Table 1; and Weitzman 2010, Table 2) and of triggering critical earth system tipping points (Lenton et al. 2008). On the other hand it suggests only "moderate" costs if cost effective policy responses can be brought to bear (see Chap. 13; Edenhofer et al. 2010; Knopf et al. 2011). Cost-benefit analyses of mitigation efforts of a more ambitious 1.5°C target, suggest steeply rising mitigation costs, while the gains in terms of reduced catastrophic risk are hard to specify. Moving to a 3°C target instead appears to increase probabilities of catastrophic climate change

(Stern 2008; Weitzman 2010). These take the form of moving towards critical areas for several tipping point as assessed by experts (Lenton et al. 2008) and shifting the planetary mean temperature level beyond the maximum level experienced in the last 400,000 years (Hansen et al. 2007). Meanwhile, a 3°C target would not relax mitigation costs much in a world with cost-effective policies, although this might change in a world with highly ineffective mitigation policies.

A full-fledged cost-benefit analysis is far beyond the scope of this chapter and perhaps beyond the state of the art of science in the foreseeable future. We therefore strongly emphasise the need for a more robust knowledge base (particularly concerning very low stabilisation targets) and are far from claiming to have provided a definite answer. The Fifth Assessment Report (AR5) of the IPCC, due in 2014, will hopefully provide a more robust and accessible knowledge basis for this type of exercise that is essential for a rational policy process. New knowledge can of course also lead to a substantial revision of the arguments for the 2°C target.

To conclude, we consider global climate stabilisation targets – following Leggewie/Messner – as a necessary and helpful instrumental guide for structuring the debate about climate change policy, if the wise amendments and restrictions by Hulme are taken into account. Based on the ethical arguments in Part II and on current knowledge, the 2°C target seems to us to be a reasonable temporary target, until new evidence or ethical arguments in the public debate suggest another conclusion.

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