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Discursive stability meets climate instability: A critical exploration of the concept of 'climate stabilization' in contemporary climate policy

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ABSTRACT

The goals and objectives of 'climate stabilization' feature heavily in contemporary environmental policy and in this paper we trace the factors that have contributed to the rise of this concept and the scientific ideas behind it. In particular, we explore how the stabilization-based discourse has become dominant through developments in climate science, environmental economics and policymaking. That this discourse is tethered to contemporary policy proposals is unsurprising; but that it has remained relatively free of critical scrutiny can be associated with fears of unsettling often-tenuous political processes taking place at multiple scales. Nonetheless, we posit that the fundamental premises behind stabilization targets are badly matched to the actual problem of the intergenerational management of climate change, scientifically and politically, and destined to fail. By extension, we argue that policy proposals for climate stabilization are problematic, infeasible, and hence impede more productive policy action on climate change. There are gains associated with an expansion and reconsideration of the range of possible policy framings of the problem, which are likely to help us to more capably and dynamically achieve goals of decarbonizing and modernizing the energy system, as well as diminishing anthropogenic contributions to climate change.

1. Introduction

> "Above all, internationally, the best stimulus to the action needed to reduce emissions and create the right incentives for investment in clean technology will be to decide what level *we should aim to stabilize green house gas concentrations and global temperature levels*. This must be the heart of future negotiations on climate change, bringing together science and economics" Former British Prime Minister Tony Blair (Blair, 2006) (emphasis added)

This quote epitomizes one significant way in which contemporary climate policy has been formulated, namely through the bringing together of science and economics to meet some stabilized temperature and concentration target. The concept of climate stabilization emerged concretely during the 1980s, established in important documents such as the first report of the Intergovernmental Panel on Climate Change (IPCC). Drawing upon contemporary policies at the time including ozone and arms control (Prins and Rayner, 2007; Grundmann, 2006), climate stabilization became an important approach to climate policy. We argue that this was a ready-made product of science and economics combined, rather than something later requiring science and economics to be brought together. This paper examines why stabilization was intuitively recognizable within its intellectual context and how the concept became dominant in climate policy discussions and proposals. Furthermore, this paper discusses implications of this solution formulation, and considers ways to expand considerations for de-carbonization and energy modernization along short- to medium-time scales.

This paper situates itself in interdisciplinary approaches that seek to examine complex and dynamic human–environment interactions and interrogate "how social and political framings are woven into both the formulation of scientific explanations of environmental problems, and the solutions proposed to reduce them" (Forsyth, 2003, p. 1). This paper analyses how particular discourses regarding climate challenges and possible solutions have 'fixed' understandings and considerations of complex environmental processes. Through framing, elements of discourse are assembled that privilege certain interpretations over others (Goffman, 1974). Hajer has written that these discursive negotiations involve

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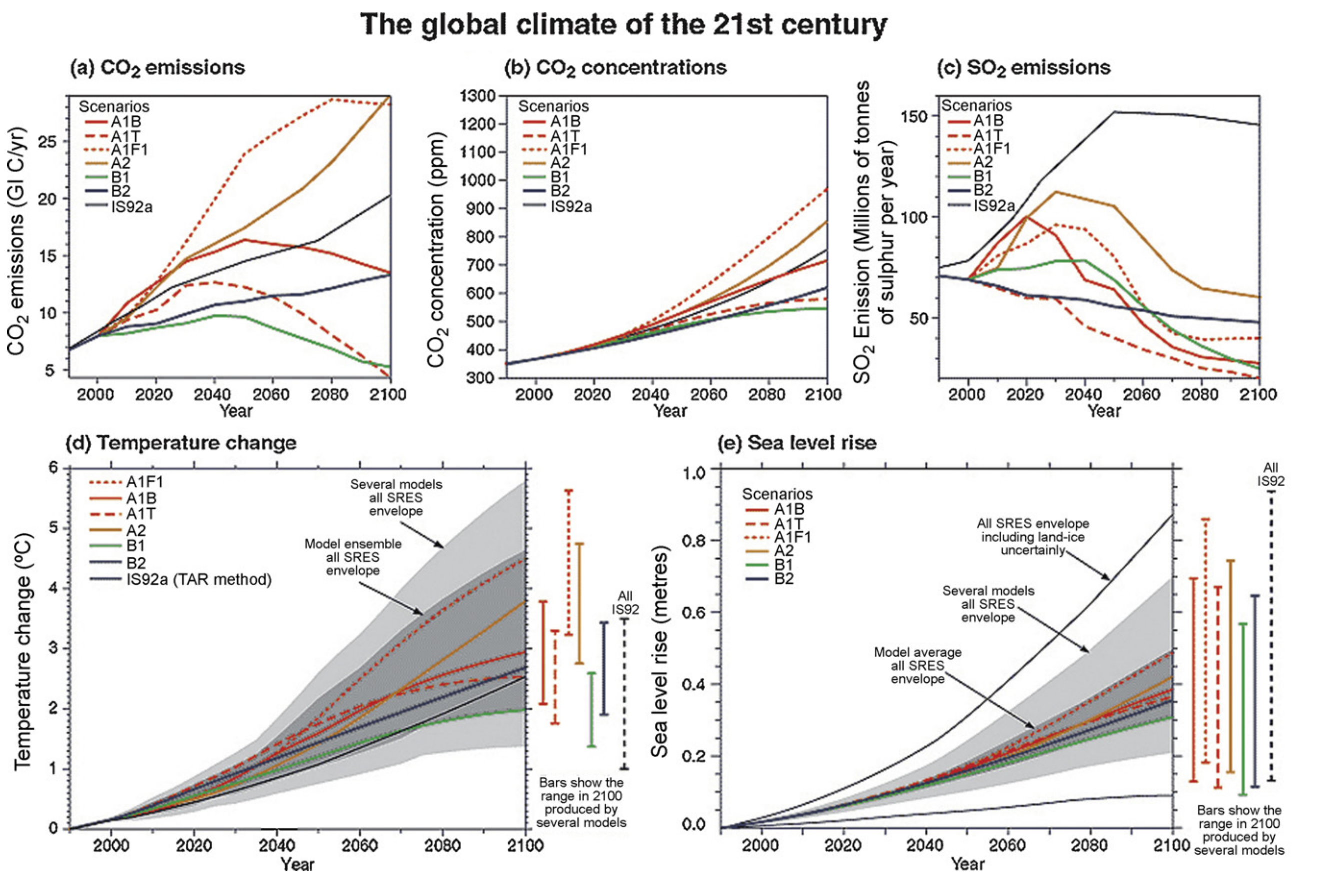

Fig. 1. Global climate and response to CO_2 emissions in the IPCC, WG1, Summary for Policymakers (Houghton et al., 2001, p. 14). The letters (e.g. A1B) that follow various color lines refer to the Special Report on Emissions Scenarios. These plot a variety of emission rates dependent upon various societal, political and economic factors.

"complex and continuous struggle over the definition and the meaning of the environmental problem itself" (Hajer, 1993, p. 5). Furthermore, useful to this study is research that examines how particular discursive constructs have material – such as political economic – implications for ongoing environmental governance. For example, Rayner and Malone (1998), Demeritt (2001), Bäckstrand and Lövbrand (2006), and Liverman (2009) variously draw upon, critique or evaluate contemporary science, policy, or governance associated with discourses around climate change. Concepts like climate stabilization, however, have passed largely unnoticed into the lexicon of climate science–governance with little critical reflection. This paper seeks to fill this gap and illustrate that the clear political attraction to goals and objectives of 'climate stabilization' perilously draws upon a continuing predominantly science-driven and long-term focused climate policy.

Climate stabilization can be explained most elegantly by drawing upon three diagrams in Fig. 1, which are taken from the IPCC Third Assessment Report (Houghton et al., 2001). The IPCC processes and products – as well as connected undertakings of the 1992 United Nations Framework Convention on Climate Change (UNFCCC) and 1997 Kyoto Protocol – have greatly influenced policy and public discourse.[1] Fig. 1a shows the rising number of CO_2 emissions and projections of where these are likely to go in the future. Fig. 1b shows the levels of CO_2 concentrations in the atmosphere and assumes different pathways depending on the emission scenario chosen. Fig. 1d then models the effect of these concentrations on global average temperature for those various pathways. This forward moving climate analysis is intuitively appealing, particularly with the history of examining the climatic response to a doubling of CO_2 (as discussed below) (see also Weart, 2003). Climate policy, however, has used a reverse logic of these three diagrammatic links to set out future necessary changes in emissions pathways (Fig. 2). Implicit in policy targets are both the forward and inverse paths: policymakers essentially want to know at what point they can 'acceptably' stabilize concentrations (via the manipulation of emissions) in a way that will avoid both dangerous anthropogenic interference (hereafter DAI) in the climate system, while also avoiding future welfare reductions associated with reductions in economic growth. Effectively, policymakers seek to conduct cost–benefit analyses comparing abatement costs against dollar-denominated climate damages, via some sort of climate model that links the two together. Three examples will suffice here to highlight the contemporary attraction of long-term climate stabilization approaches in climate policy.

First, in January 2007, the European Union (EU) set out proposals and options for limiting global warming to no more than 2 °C above pre-industrial temperatures. This is a temperature target that shows historical continuity from the mid-1990s in their climate framework (Tol, 2007). This 2 °C ceiling was also agreed by the Group of Eight (G8) member nations at the L'Aquila Summit in July 2009 (Wintour and Elliott, 2009). From such a target, two sorts of problematic inferences are frequently drawn: first, that we can easily infer equilibrium concentration targets from equilibrium temperature targets, and vice versa; and second, that 2 °C represents a significant rather than arbitrary threshold. Generally, reports that invite such questionable inferences do not explicitly endorse them, but they relegate caveats to the fine print thus cementing an ideal stabilization target in the political and popular imagination. While this figure can be critiqued on feasibility

[1] Elsewhere, Boykoff (2007) has documented how the IPCC has played a key role in the ebbs and flows of policy and public discourse on climate change.

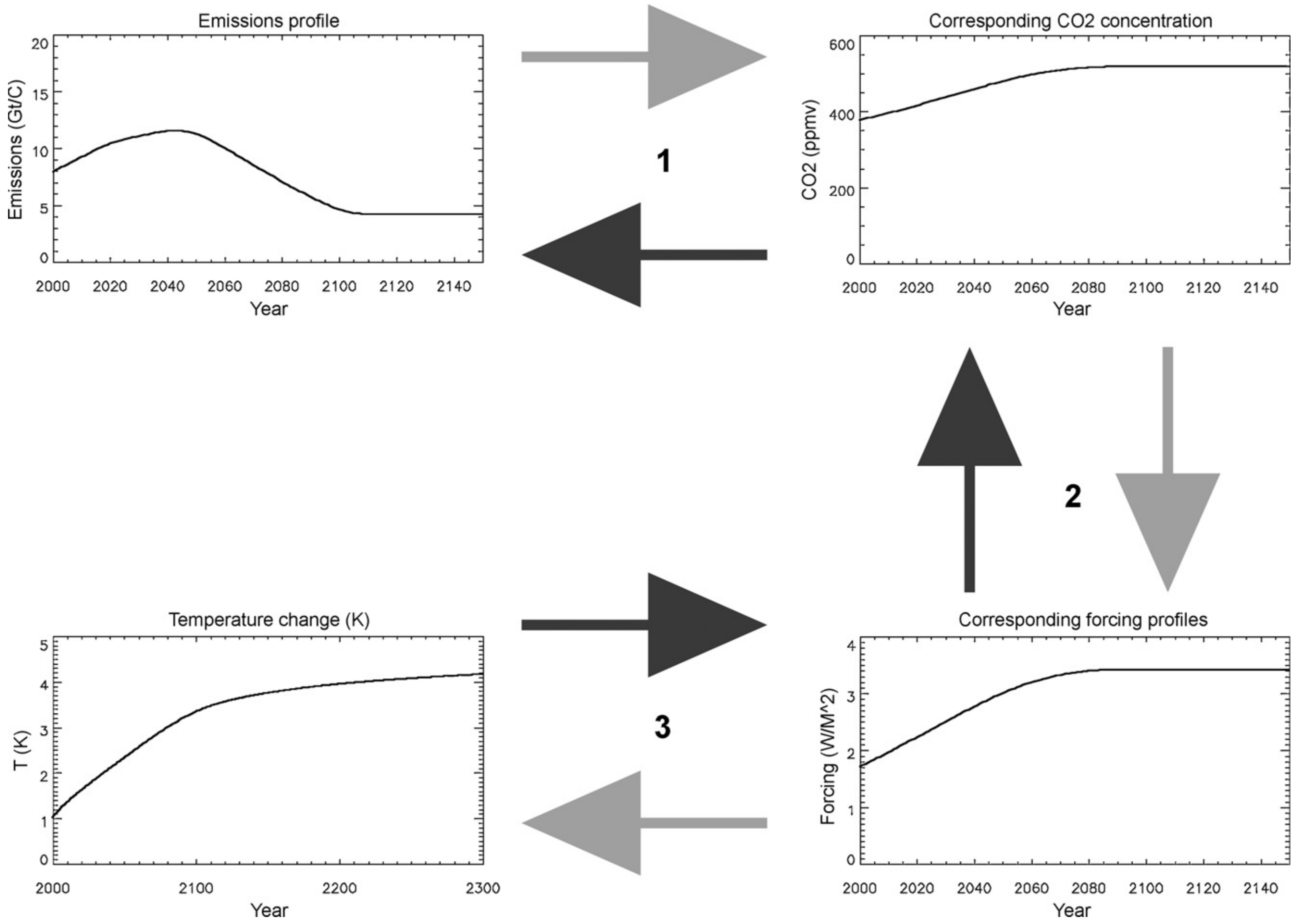

Fig. 2. An illustration of the scientific and policy framing around climate stabilization which moves forward from emissions pathways, to concentrations (1), to forcings (2), to a temperature response (3). The dark grey arrows illustrate the ways in which policy infers back from a temperature response to emissions requirements via forcings and concentrations.

grounds (e.g. Tol, 2007), we argue that the fundamentals behind these kinds of targets are dubious.

Second, the 'Breaking the Climate Deadlock Initiative' (Climate Group, 2008), led by former British Prime Minister Tony Blair and released in advance of the Group of Eight Summit in Japan in July 2008, stated in the Executive Summary that "To have a reasonable chance of limiting warming to 2 °C, we would need to peak concentrations at around 475–500 ppmv CO_2e (including aerosols) and then reduce emissions to stabilize concentrations at 400–450 ppmv by the 23rd century" (Climate Group, 2008, p. 9). This report thereby feeds into and perpetuates a particular approach to long-term climate targets and, additionally, has continued to privilege discussions of long-term mitigation over adaptation. Reaching coordinated solutions to climate change becomes a question of mitigating and managing the long-term future in a very specific, highly abstract way, since it involves future generations emitting just enough CO_2 to maintain the concentrations at their target levels indefinitely regardless of the implications of this strategy for them and their descendents.

A final example of the importance of examining climate stabilization can be highlighted with the so-called 'wedges' approach to 'solving the climate problem' as it represents an example of both potential movement beyond such discourses yet one that remains encased in the rhetoric of stabilization. The influential 2004 paper by Pacala and Socolow seeks to inspire feasible movements for mitigation by putting forward 15 choices for emissions reductions – each representing 1 billion tons of carbon/year (1 GtC/yr) – in order to circumvent possible increases in greenhouse gas emissions over the next 50 years.[2] The authors call for industrial-scale implementation of seven of these, which represent potential wedges of sufficient emissions reductions to curb energy use. However, the paper is given the title 'Stabilization Wedges', despite the fact that it really is calling for wedges of emissions reductions (Pacala and Socolow, 2004). At the outset, the paper actually states, "The debate in the current literature about stabilizing atmospheric CO_2 at less than a doubling of the preindustrial concentration has led to needless confusion about current options for mitigation" (Pacala and Socolow, 2004, p. 968). Despite that caveat the paper is itself cloaked in the language of stabilization. While the clarity of their arguments surrounding short- to medium-term emissions reduction deserves commendation, the functional discussion of emissions reductions was subsumed by the discourse of climate stabilization. The tension between their comments regarding 'needless confusion' and their adoption of the language of stabilization emphasizes the attachment we have to ideas of a future 'stable' climate and 'solved' problem. These comments also point to a distinction between three concepts: emissions stabilization, carbon stabilization and climate stabilization, or the stabilization of emissions, concentrations and temperature respectively. While many commentators who use the term climate stabilization implicitly mean concentration stabilization, we adopt the term climate stabilization here

[2] Other authors have stated that the magnitude of necessary reductions is much higher as Pacala and Socolow's analysis may be off by a factor of nearly two (e.g. Hoffert et al., 2002). Thanks to an anonymous referee for pointing this out.

because it is frequently used in public and political discourse. Where we wish to separate these two targets we will identify this in the paper, but most of our critiques apply to both concepts.

Climate stabilization has become an important approach to climate policy, and this paper provides a historical context to this approach and outlines points of critique. None of this is to denigrate the importance of climate mitigation, but rather to examine what the focus on climate stabilization has assumed, obscured or omitted. The paper concludes by recommending that the assumptions underpinning stabilization be subjected to more scrutiny, especially where these have material implications for policy. Though the concept of stabilization played an understandable formative role in early climate policy, continued, unreflective reliance on the concept is likely to impede rather than accelerate sensible, constructive action on climate change. In the next section we outline the scientific dilemmas within climate stabilization and highlight that a focus on equilibrium temperature targets, while climate sensitivity remains relatively unconstrained, is a problematic formulation. We then go on to explore a history of climate stabilization debates through first exploring their general context and then in more depth examining the role of science, economics and other connected debates in the appeal to and of climate stabilization as a climate policy focus. Then we draw out some conclusions about the partiality of climate stabilization in terms of the discussions it enables as well as shuts down.

2. Energy balance and climate stabilization

A simple model of the accumulation of carbon dioxide (CO_2), its conversion to radiative forcing, and the subsequent effect on global mean temperatures, can be given by a three equation model which converts emissions of CO_2 into atmospheric concentrations, which then affect global mean temperature via the resulting radiative forcing. The first component of the model is a simple carbon cycle model, in which CO_2 concentrations are approximated by a sum of exponentially decaying functions, intended to reflect the time-scales of different sinks. The coefficients are based on the pulse response of the additional concentration of CO_2 taken from the Bern model (Siegenthaler and Joos, 1992):

$$CO_2(t) = d\int_{-\infty}^{t} E(t)\left[f_0 + \sum_{i=1}^{5} f_i \cdot e^{(-(t-t')/\tau_i)}\right]dt \quad (1)$$

where $CO_2(t)$ denotes atmospheric concentrations of CO_2 in parts per million by volume (ppmv), k is a conversion factor which turns gigatonnes of carbon into ppmv, $E(t)$ is the emissions timeseries, and the f and τ refer to fractions of atmospheric CO_2 and the associated timescales of those fractional depositions, respectively. This means that there are five sinks in the model, each of which accounts for some fraction of atmospheric CO_2, and each of which has its own timescale.

We can further specify a relationship between CO_2 concentration and forcing:

$$F(t) = F_{2\times CO_2} \ln\frac{CO_2(t)}{CO_{2pre}} \div \ln(2) \quad (2)$$

in which $F_{2\times CO_2}$ is the forcing corresponding to a doubling of CO_2, CO_2 refers to the atmospheric concentration of CO_2 and C_{pre} is the (constant) pre-industrial concentration of CO_2. There is some uncertainty surrounding $F_{2\times CO_2}$, but most General Circulation Models (GCMs) diagnose it to be in the range 3.5–4.0 W/m^2. These two relationships can be used to map changes in CO_2 concentrations to changes in temperature, as in Fig. 1.

Perturbations to the Earth's energy budget can then be approximated by the following equation (Hansen et al., 1985; Schneider and Thompson, 1979):

$$c_{eff}\frac{d\,\Delta T}{dt} = F - \lambda\,\Delta T \quad (3)$$

in which c_{eff} is the effective heat capacity of the system, governed mainly (Levitus et al., 2005) by the ocean, λ is a feedback parameter and ΔT is a global temperature anomaly. The forcing, F, is essentially the perturbation to the Earth's energy budget (in W/m^2) which is driving the temperature response (ΔT). The rate of change is governed by the thermal inertia of the system, while the equilibrium response is governed by the feedback parameter alone (since the term on the left hand side of the equation tends to zero as the system equilibrates). Climate forcing can arise from various sources, such as changes in composition of the atmosphere (volcanic aerosols; GHGs) or changes in insolation (due to fluctuations in solar output, changes in the Earth's orbit, etc.). Since in equilibrium, $c_{eff}(d\Delta T/dt) = 0$, Eq. (3) simplifies to $F = \lambda\Delta T$ and, in the special case of a CO_2 doubling, $F_{2\times} = \lambda S$. These combine to yield:

$$\Delta T = \frac{S}{\ln 2}\ln\left(\frac{CO_2}{CO_{2pre}}\right) \quad (4)$$

Thus, for any specified temperature equilibrium target ΔT, there is a carbon dioxide concentration that will give the maximum permissible warming in a climate system with equilibrium sensitivity S. This is plotted in the accompanying Fig. 3: redder colours represent higher ΔT, and the thick, thin and broken curved white lines represent the combinations of S and CO_2 that satisfy Eq. (4) for ΔT = 2.0, 3.0, and 4.0 °C respectively.

Though this is a very simple and impressionistic model of climate change, it does a reasonable job of capturing the aggregate climate response to fluctuations in the stock of atmospheric CO_2. Extremely simple models such as this suffer from various limitations (over-responding to volcanic forcing, for instance) but generally mimic the global mean temperature response reasonably enough, especially with regard to relatively smooth forcing series. Both the simple model described above and the climate research community's best guess GCMs predict 21st century warming – in response to the kinds of elevated levels of GHG we expect to see this century – of between about 1.5 and 5.8 °C.

Note that the sequence of equations (1) → (2) → (3) maps emissions to concentrations, to forcings, to global mean temperatures. Mitigation policies regularly invert this sequence. In an early paper on the development of scenarios, Enting et al. describe "inverse calculations determining the emission rates that would be

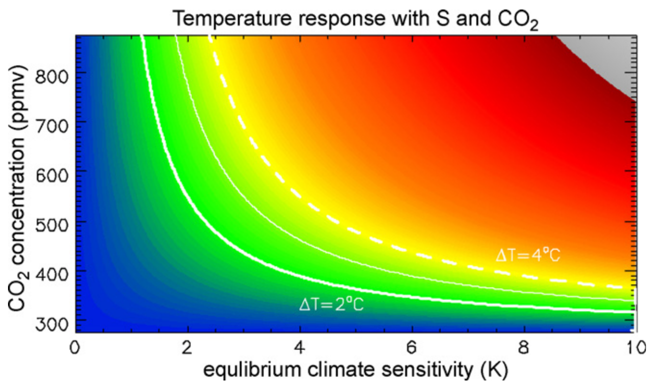

Fig. 3. Equilibrium global mean temperature response mapped against climate sensitivity and CO_2 concentrations. Lines of constant color represent lines of constant temperature response. The 2, 3 and 4 °C equilibrium isolines are shown in white (after Frame et al., 2007).

required to achieve stabilization of CO_2 concentrations via specific pathways" (1994, p. 1). As the authors note, performing this calculation in the presence of carbon cycle uncertainty is difficult, since many different emissions paths are possible within the "error bars" associated with the carbon cycle. Characteristically, inversion processes such as this are hard problems because they involve inferring the state of some system, in which the data are consistent with many such states (Bennett, 2002). Examples include attempting to infer multiple properties regarding the state of the atmosphere from satellite radiance data (Rodgers, 2000), or working out characteristics of a person from their footprint on a beach. In the carbon cycle case, a wide range of emissions pathways and carbon cycle parameter settings are consistent with a given CO_2 concentration path, so inferring an emissions path from that concentration profile is underdetermined. A similar process happens when one attempts to map (3) → (2). Again, a wide range of forcings are compatible with a given temperature response, because of uncertainty in system parameters (the system's effective heat capacity and equilibrium climate sensitivity).

These processes are shown in Fig. 2. The forward calculation is shown by the lightly shaded arrows; the inverse calculation by darker ones. In a sense, equilibrium-based mitigation policy relies on having some idea about how GHG emissions build up in the atmosphere, and how equilibrium levels of CO_2 might map to equilibrium temperature change. A choice is then made regarding either the maximum acceptable CO_2 concentration (a concentration target) or a maximum allowable equilibrium temperature increase (a temperature target). Inverse calculations are then conducted to see what these might imply for permissible emissions pathways (e.g. Meinshausen, 2006). Concentration and temperature targets are different ways of addressing equilibrium climate policy. Either explicitly (by making temperature the target) or implicitly (by defining a maximum 'allowable' concentration that will 'prevent DAI') these policies use the full set of forward and reverse calculations described above.

The issue then turns on decisions regarding the definition or evaluation of just what comprises DAI. This evaluation is a combination of the positive (credible climate models relating forcing to response; credible damages models, etc.) and the normative (decisions regarding risk aversion; decisions regarding acceptable levels of 'interference' or damage; decisions regarding how to cost damages). Various papers have analyzed the debates over the putative maximum tolerable DAI level (Oppenheimer, 2005; Parry et al., 1996; Mastrandrea and Schneider, 2004). The precise level of DAI and its interpretation is clearly contestable and political. Here we focus on the EU's stated target of avoiding an equilibrium warming above 2 °C (from pre-industrial temperatures), however, the argument applies to any such arbitrary threshold.

If we assume our policy seeks to avoid DAI by keeping anthropogenic warming (above pre-industrial levels) below 2 °C, what levels of CO_2 concentration would be needed to get to that point? Here is where the inversion (3) → (2) matters, since we need to know the relationship between CO_2 concentration and temperature response. In the last decade or so, many studies have attempted to determine this relationship but the net result of these has been to keep the IPCC's 'traditional' 1.5–4.5 °C range for a doubling of CO_2 largely intact since the early 1990s. Some studies (Knutti et al., 2002; Andronova and Schlesinger, 2000; Frame et al., 2005) have shown that recent warming alone does not provide a strong constraint on the upper bound of this quantity. Additional evidence from previous eras (Schneider von Deimling et al., 2006; Hegerl et al., 2006) are required to narrow the range back even as far as the traditional values, though combining evidence from previous eras with modern climate data is not without its problems. Three main sources of uncertainty hamper our estimation of S. There are uncertainties in current forcings, F, particularly in the level of aerosol forcing (Fig. 2 in the IPCC Summary for Policymakers), uncertainty in historical and paleo-forcings, as well as uncertainties in earth system (especially ocean) heat uptake, c_{eff} (Levitus et al., 2005), as well as uncertainties in global feedbacks, λ (Meehl et al., 2007). This confluence of uncertainty, and the range of opinions of how easy it is to combine different lines of evidence, makes it problematic to infer S from recent climate change, or past climate change events (e.g. Knutti and Hegerl, 2008). This is why there is such a range of distributions in the literature on climate sensitivity.

However, even the traditional IPCC range is inconveniently large when trying to formulate a policy that does not overshoot a 2 °C temperature target. Once the equilibrium concentration target for CO_2 has been obtained (by inversion in the case of a temperature target; by decision in the case of a concentration target), then one needs to work out a range of scenarios to meet it, this time requiring an inversion of the carbon cycle. Thus climate policy, aiming at long-term climate stabilization, draws (explicitly in the case of a temperature target; implicitly in the case of a concentration target) upon two problematic sets of scientific inferences. The reliance on equilibrium targets simplifies certain parts of the problem by removing the (inconvenient) transience, allowing us to draw a simple map between concentration and sensitivity that does not depend on the thermal inertia of the system (Fig. 3). However, the equilibrium system properties (such as climate sensitivity) are subject to considerable uncertainty, and thus the translation from damages (temperature increase) to concentration targets is also subject to uncertainty. Even if we assume that climate sensitivity is in the vicinity of the IPCC's estimate(s), we would need to stabilize concentrations anywhere in the vicinity of 700–330 ppmv CO_2 (and this range neglects the additional uncertainty that might be produced from equilibrium temperature–carbon cycle feedbacks).

Thus stabilization policy becomes difficult given (1) the scientific community's lack of progress on narrowing the possible range on climate sensitivity and (2) the timescale mismatch between equilibrium concentration and temperature targets and short- to medium-term policy formulation. The February 2007 release of the United Nations-sponsored IPCC Fourth Assessment Report (AR4) from Working Group I (WGI) provides an example. As noted above, the IPCC and related UN Conference of Party (COP) processes have contributed significantly to shape ongoing considerations of climate governance. The 2007 report contained the same sensitivity range as the first IPCC report in 1990, with the proviso that it is difficult to rule out higher values (Meehl et al., 2007). This uncertainty is expected to narrow in coming decades as we learn more about the parameters c_{eff} and λ (in the simple model above) and about the physical processes that underpin these aggregated parameters, but for the present it remains problematic to establish convincing equilibrium concentration and/or temperature targets in the presence of such a wide band of uncertainty. While these approaches have proven valuable in terms of linking climate science inquiries with policy action (by social or scientific consensus as Van der Sluijs et al., 1998, point out), the focus on equilibrium conditions has diverted policy-relevant scientific endeavors away from short- and medium-term goals. Under any mitigation policy that seeks to avoid long-term commitments to a warmer climate, global greenhouse emissions will need to fall significantly by 2050, regardless of the precise details of GHG concentrations and temperature rise in several centuries' time. This policy dynamic attempts to balance equilibrium climate concerns against short term mitigation action, and the mismatch between these timescales has helped reinforce other vortices of intense but chronically contentious policy issues, such as that surrounding economic discounting (e.g. Hepburn, 2007).

As importantly, this approach has created a policy framework obsessed with targets and timetables that are inherently uncertain, while distracting from alternative approaches based on creating pathways to progress. There is no special reason, however, to think that an answer, even if forthcoming, will be sufficient to justify a policy response unless one accepts a simplistic linear science-policy model. Shackley et al (1998, p. 194) have commented, "the impression that climate change can be so predicted and managed is not only misleading, but it could also have negative repercussions should policymakers act on this assumption." As Holling (1973) has pointed out in relation to ecology, stability approaches require a precise ability to be able to predict the future, or at least to understand fully the governing system dynamics, otherwise the ability of a system to respond (resilience) could be diminished in taking managerial actions. By relying on a policy that chooses to get the world to CO_2 concentration and temperature levels just below DAI, might such binary logic be increasing the likelihood that any external perturbation or unexpected events that were not modeled could put the world into the 'dangerous' territory?

3. Roots and cultures of climate stabilization as a research topic

If these are the complexities in climate science relating to stabilization, why, when and how did the concept of climate stabilization emerge and become so attractive? Prior to the 1980s the term climate stabilization was principally used to discuss geo-engineering strategies, frequently militarized, that would be used to control the future climate (Fleming, 2007; see, for example, Kellogg and Schneider, 1974). This imagination of controlling a managed environment remained relatively unaltered though stabilization acquired a very different meaning deriving from policy imperatives in the 1980s to protect the climate from other human interference. In this section we first trace the climate story around climate stabilization, then move on to argue that the economists with energy modelers were important actors in shaping the policy debate, before briefly outlining the uptake of stabilization discourses by policymakers and environmental groups.

3.1. Climate stories

Commonly, researchers date climate stabilization to the mid-1980s, although there is some confusion about its actual development. Agrawala (1998), for example, suggests that stabilization emerged predominantly with the first IPCC report through links to Article 2 of the UNFCCC, which aimed to avoid DAI with the global climate. Others date it back to 1985 (Oppenheimer and Petsonk, 2005). The latter argument appears the most convincing tracing stabilization to discussions in the Villach meetings in 1985 that, combined with the experience from ozone policy, and despite still being cautious about climate science (Boehmer-Christiansen, 1994a) was one of the first forums for discussing policy options (Franz, 1997). Even up to the Villach conferences in 1985 climate scientists would rarely pose direct policy questions, at least partly because scientists frequently worked on two different problems, the question of climate sensitivity and the question of the carbon cycle.[3] Thus it would be fair to argue that until the mid-1980s the full framing of the question by scientists had not been established and there was also less political will for mitigation strategies when the impact of increasing CO_2 was rather uncertain.

Even so, there remained frequent confusion about what exactly was to be stabilized. In the U.S. context, Senator Chafee's letters in 1986, for example, talk about both the stabilization of emissions and concentrations. The two are different concepts, however, though they became increasingly linked within the emerging mode of climate policy. The first, emissions stabilization, was a topic discussed in energy circles and was neither novel in the 1980s nor tightly coupled to climate change debates, unlike the second, concentration stabilization. Oppenheimer and Petsonk (2005) suggest that the confusion persisted into the adoption of the UNFCCC and this set in place these two separate types of targets (emissions and concentrations). The UNFCCC and the IPCC managed the relationship between what would be considered 'bearable emissions' and the stabilizations required to avoid DAI. "The goal of the convention should be to hold concentrations of GHGs in the atmosphere at a safe level, and to set achievable targets for energy efficiency and for afforestation" (Anon., 1991, no pp.). This set in motion a possible logic for climate policy: define a level of DAI in the climate response then, assuming knowledge of climate sensitivity, trace out what level of concentrations of CO_2 will get the world to that point, and then, assuming one understood details of the carbon cycle, work back into what emissions scenarios will get the world to that concentration. The 1990 IPCC First Assessment Report (FAR) Working Group 1 Summary for Policymakers itself stated, "we calculate with confidence that ... immediate reductions in emissions from human activities of over 60% [are needed] to *stabilize* their concentrations at today's levels ..." (Houghton et al., 1990, p. 1, emphasis added). Such influential proclamations contributed then to a path dependence as well as confusion around how to 'stabilize' emissions and/or GHG concentrations in the atmosphere.

This notion of stabilization as a policy goal is founded on the normative idea of DAI, that beyond some temperature level, climate change-related risks pass from being safe or tolerable to 'dangerous'. As we noted earlier, there is still much discussion about what this level should be (Gupta and van Asselt, 2006; Oppenheimer, 2005; Parry et al., 1996), though there is frequent admission, as Boehmer-Christiansen (1994a) notes, that this limit should be decided scientifically, subject to value-laden decisions about just what constitutes "danger". The most responsible interpretations of DAI tend to focus on both increasing risks and increasing uncertainties as global temperatures warm and are explicit about their treatment of uncertainty as well as risk (Mastrandrea and Schneider, 2004; Keller et al., 2005, for instance). Popular or more naïve interpretations tend to permit caricatures based on the poor inferences mentioned earlier; that equilibrium concentration targets can be inferred from equilibrium temperature targets and that an equilibrium warming of 2 °C represents a magical threshold between tolerability and unfettered disaster. Generally, reports that invite such unjustifiable inferences do not explicitly endorse these themselves: they simply relegate the caveats to the fine print, usually on the dubious justification that policymakers and the general public are not sufficiently sophisticated with risk or uncertainty to appropriately contextualize the caveats. Subsequent popular interpretations of DAI in the climate change problem are often misleading.[4] Politically the question of

[3] This can be documented through the research being funded by the US Department of Energy which separated the two agendas in terms of policies, though the forward logic (Fig. 1a–d) was present in, for example, a 1980 report (Anon., 1980).

[4] For example, Monbiot (2006) begins his book by claiming "there [is] little chance of preventing runaway global warming unless greenhouse gases are cut by 80%." Very few scientists would regard this as a credible summary of the state of current science: the GCM projections of 21st century climate the IPCC's AR4 are linear in the dynamical sense even in fossil fuel intensive scenarios. Uncertainties in the coupled response between the carbon cycle and global temperatures are neglected by the structure of the AR4 projections, though they are quantified in the model comparison study conducted by Friedlingstein et al. (2006) where, under the fossil fuel intensive A2 scenario, the "gain" due to carbon cycle temperature feedbacks "leads to an additional warming ranging between 0.1 and 1.5 °C". The upper end of this range is may be quite high, but it is decidedly finite. An exception to this is Walker and King (2008) who talk about both the uncertainties surrounding 2° and the difficulties of setting emissions policies due to climate sensitivity uncertainties.

DAI invokes issues of risk aversion and ethical questions of who stands to gain or lose from climate change as well as sidelining all kinds of uncertainties about impacts, adaptation and societal pathways.[5]

The focus on climate stabilization at a point just before DAI also relates to another heuristic that has framed many climate research programs. Climate research has often been framed in terms of a doubling of concentrations of CO_2, scenarios that have become institutionalized at the core of climate change research (see, for example, Charney, 1979; Hansen et al., 1981; Manabe and Wetherald, 1967; Newell and Dopplick, 1979; Ramanathan, 1988; Schneider et al., 1980; Stouffer and Manabe, 1989; Thompson and Schneider, 1982).[6] Indeed, energy scenarios were examined for their carbon content, in comparison to the doubling of CO_2 scenarios (Kellogg and Schware, 1982). One historical forebear of the doubling CO_2 tradition is Arrhenius, whose theoretical research focused upon climatic responses in relation to a doubling or halving of CO_2 concentrations (Fleming, 1998). More directly, equilibrium responses to a doubling of CO_2 became a common way of conceiving of the problem for model testing (Charney, 1979). In order to explore transient responses to increases in CO_2, one needs to have a model which adequately represents transient ocean properties; since the first really credible coupled atmosphere–ocean GCMs were not developed until the 1990s, the atmospheric GCMs were generally coupled to simplified ('slab' or 'swamp') ocean models, which are inadequate for the transient problem, but produced prima facie credible equilibrium responses. Doubling scenarios were therefore very useful ways of testing climate models. This 'doubling' research was then articulated in the first IPCC report and had become a typical way of conceptualizing and formulating questions about CO_2 and climate responses. Moreover, in climate science, the models that focused on CO_2 doubling enabled the establishment of ranges of expected climate sensitivity figures. Since the late 1970s, estimates derived from these models have produced results in the 1.5–4.5 °C range (Charney, 1979; Morgan and Keith, 1995; Van der Sluijs et al., 1998). In spite of considerable attention from a sizable portion of the climate science community, this range has remained essentially static over the period between the first IPCC Assessment Report (Houghton et al., 1990) and the Fourth Assessment Report (IPCC, 2007).[7] Climate sensitivity "manag(es) the interface between different social worlds (climate modeling, climate impacts research, climate policy making) and acts as an 'anchor' that fixes the scientific basis for the climate policy debate" (Van der Sluijs et al., 1998, p. 317; see also Andronova et al., 2005). Thus by understanding the climate sensitivity to a doubling of CO_2 concentrations it would then be possible to compute this for a variety of future scenarios relating to CO_2 emissions. One important outcome of this research was that the future CO_2 concentration level at which climate would stabilize could be used as a policy response, a question that economists might readily and optimally solve using this heuristic as the model for a cost–benefit analysis. Thus we suggest there is an institutionalization of climate stabilization discourses. Hajer characterizes 'discourse institutionalization' as one that tethers institutional activities and actors to storylines, such as links between CO_2 doubling, climate sensitivity and thus climate stabilization (Hajer, 1995). Through this institutionalized storyline, climate stabilization discourse has solidified and reproduced itself through ongoing scientific inquiries, policy-relevant research statements and decisions over time.

3.2. Social science stories

A parallel logic can be found in the work of economists. In this paper we are not specifically concerned with economic models per se, or with the differences in adaptation, impacts and mitigation analyses. We suggest that these economic analyses have broadly drawn from and supported climate stabilization discourses, usually as a heuristic that might guide decision-making. Within the framework outlined above, economists have attempted to identify an optimal and efficient approach that could give rise to a climate policy that was focused as much on a cost-effective stabilization target as reducing emissions to cause least harm.

The economist William Nordhaus in 1977, for example, started to develop this now very familiar mode of reasoning in 1977. Using a highly simplified, heuristic model of the climate, and assuming a doubling of CO_2 concentration as a reasonable upper limit to impose for the climatic response, Nordhaus (1977) examined the costs of controlling emissions that would meet this target. Indeed it is interesting that inasmuch as scientific work has frequently been guided by doubling concentration scenarios, so has economic work (Azar, 1998). Nordhaus explicitly made clear that the calculations were fraught with all kinds of uncertainties, but concluded that one could use a 'best guess' scenario since damages would be a roughly linear function of CO_2 concentrations (Nordhaus, 1982).[8] Bach, likewise, called for "[a] broad systems approach ... to help define some 'threshold' value of CO_2-induced climate change beyond which there would likely be a major disruption of the economic, social and political fabric of certain societies ... An assessment of such a critical CO_2-level ahead of time could help to define those climatic changes, which would be acceptable and those that should be averted if possible" (Bach, 1980, p. 4). Thus for an emerging set of economic formulations of the problem of climate change, the heuristic that would guide policy action would be one that took a fixed concentration target as a proxy for a climate target, that could then be used to analyze the costs and benefits of mitigating action to meet that target.

A cost–benefit analysis of climate change would thus be possible. It is notable that this re-frames the debates from one of the costs and benefits of cutting emissions, to one that includes the costs and benefits of the resultant climate or as Oreskes et al. (2008) put it, the "*carbon* problem" becomes the "*climate* question." Climates are to be efficiently managed. This is reflected, as they illustrate, in the *Changing Climate* report (National Academy, 1983) and also in the growing quantity of economic work in the early 1980s, especially as it related to energy and climate change. Boehmer-Christiansen (1994b) argues that climate policy has to be understood within changing energy politics. The late 1970s had seen rising energy prices fuelled by concerns about fossil fuel longevity of supply amidst a host of political interventions. A key question for energy politics in the 1980s was the declining price of fossil fuels, which questioned the role of the state in controlling energy supply/demand. Climate change offered a new means to tackle the fossil fuel industries and carbon constraints could highlight the need for nuclear solutions (Boehmer-Christiansen, 1994b).

[5] We cannot do justice to these points in this paper, but we must thank an anonymous referee for pushing us to expand the range of our comments here and throughout the following sections.

[6] An exception to this was Manabe and Stouffer (1979) who modeled quadrupling of CO_2 scenarios.

[7] Chapter 10 of the AR4 notes that "results confirm that climate sensitivity is very unlikely below 1.5 °C. The upper bound is more difficult to constrain because of a nonlinear relationship between climate sensitivity and the observed transient response ... studies that take all the important known uncertainties in observed historical trends into account cannot rule out the possibility that the climate sensitivity exceeds 4.5 °C, although such high values are consistently found to be less likely than values of around 2.0 °C to 3.5 °C" (IPCC, 2007, p. 798).

[8] Any non-linear costs were actually associated with linear concentration increases, i.e. a climatic danger would emerge after a certain concentration threshold was passed.

From the late 1970s and early 1980s energy researchers were increasingly considering the technologies and economics of managing CO_2 emissions that might significantly influence the climate. There were debates over whether climate change would become the main limiting factor for energy growth rather than peak oil scenarios (D'Arge and Kogiku, 1974; Nordhaus, 1974; Perry, 1982; Oreskes et al., 2008). Much depended upon assumptions of future resource availability and energy efficiency. The International Institute for Applied Systems Analysis (IIASA) concluded in work in 1983 that "transition to fast breeder nuclear reactors, centralized solar and coal synfuels must be made . . ." (as discussed by Wynne, 1984, p. 285) to establish a secure energy supply in the future. Climate change could offer an agenda for change (a lever) in the energy industry thus translating climate stabilization targets through political negotiations about energy growth and fossil fuel use (Boehmer-Christiansen, 1994a,b). A different example comes from a study by the German Federal Environmental Agency that examined energy efficiency, but concluded that growth could be disentangled from carbon emissions (Lovins and Lovins, 1982). Their confidence in technological developments led them to suggest that energy efficiency gains resulting in CO_2 reductions would reduce the time pressure on climate scientists to find the climatic answer. Assumptions about energy demand and efficiency thus filtered into the cost analyses that would suggest which climate targets might be feasible in terms of energy costs and which stabilization targets were realistic in terms of energy growth. Climate stabilization discourse provided an interface (particularly for policy advice) between climate debates and energy debates, but the interface was increasingly vulnerable to the multiplicity of assumptions (climatic, economic and energy demand) being worked into them (see also Pielke et al., 2000).

Cost–benefit analysis does not provide a simple answer to climate change, because it inherently requires value judgments about discounting, costs and uncertainties. This is particularly the case when estimating damages and adaptation costs (Demeritt and Rothman, 1999), which is why some early climate economics separated out the cost–benefits of prevention and adaptation policies (Thompson and Rayner, 1998, p. 292). Cost–benefit analysis inherits the uncertainties from the climate components, but has additional uncertainties resulting from the assumptions in the costs of mitigation pathways and impacts. But as Cohen et al. (1998) point out, the aggregation of global mean climate changes serves a technocratic agenda focused on emissions controls, an agenda whose social science the economists have most readily filled. Further, Cohen et al. (1998), using the example of the US, suggest that it is difficult to pose questions about ethics, development, aid, trade and responsibility to future generations, when the analysis is framed by balancing the economic benefits of releasing carbon versus the potential GDP costs and risks of environmental change. Or, Azar (1998, p. 312) suggests that alternative interpretations of the need to avoid dangerous climate change must be made rather than trying to solve the puzzle of the "optimal level of climate change." The economic justification for climate action has therefore further embedded the approach to climate stabilization within climate policy. While this was acknowledged as a heuristic this had few repercussions, but useful heuristics can rapidly be translated into direct policy guidance.

3.3. Policy and public stories

Climate stabilization was taken up in policy statements and analyses from the late 1980s as a prescriptive goal for climate policy and an aim for the campaigning of environmental non-governmental organizations (ENGOs). Partly this was borrowed from similar policy logics that had been applied to controlling ozone and nitrous oxides (Franz, 1997; Grundmann, 2006; Oppenheimer and Petsonk, 2005). There is also similarity with arms issues whereby one controls both the total stock of arms as well as the location of those arms (Prins and Rayner, 2007). Here we select just a few examples to illustrate the rise of climate stabilization as a policy goal (more recent examples were given in the introduction). A Dutch Ministry of Environment funded project concluded in 1988 with the need for climate stabilization, preferably at just 1 °C above pre-industrial temperatures, but certainly a maximum target of 400 ppm CO_2 concentration (Krause, 1988). Drawing from Irving Mintzer's work a Commonwealth Group of Experts the following year also agreed that while there were uncertainties it was important to make substantial emission cuts to a level that would achieve 'approximate stability'. They suggested that doubling CO_2 concentrations should be postponed beyond 2075 thus restricting temperature increases in the order of 0.6–1.7 °C by 2060 on top of warming already committed to (Holdgate et al., 1989). An OECD report in 1992 also concluded with the need to identify appropriate targets for policy concluding that there were three possible science-based targets: stabilization of atmospheric concentrations of CO_2 at current levels; not allowing global mean temperature to rise more than 2 °C; or not allowing a rate of change faster than 0.1 °C per decade (Barrett, 1992). Indeed the report pointed out the problems of inferring emissions targets in the latter two cases given the uncertainties in extrapolating from temperature targets to emissions. Yet the latter two became the focus of discussions for the European Union (EU) and since 1996, the EU has put forward a maximum temperature target of 2 °C, which was originally approximated to a 550 ppm CO_2e concentration target (cited in European Environment Agency, 1996). Tol (2007) amongst others has disputed this figure as being weakly supported by cost–benefit analysis, but regardless of the figures it is clear that climate stabilization is politically appealing in part because of the promise of reward for (potentially costly) actions taken now.

The growing numbers of ENGOs since the 1970s, spurred on by 'Earth Day' in the US (Gottlieb, 1993), have assimilated these ideas into their discussions of climate change too. Partly this can be associated with a 'quasi-religious' ideal of stability (Kwiatkowska, 2001) that holds discursive power for engaging public and government attention to 'save the planet'. A guiding ethos of climate stabilization is the imagined future, safe, secure, stable climate, which can be engineered by our actions now; but the flipside of this myth is that if action is not taken the future will be insecure, unsafe, and unstable.[9] These equilibrium and stability myths thus share static responses and polarizing dynamics that are counterposed to an approach based upon resilience and the incorporation of surprise (Timmerman, 1986; see also Jasanoff and Wynne, 1998). They reflect a project of bringing order to our existence and resonate with other environmental debates in the 1970s including that of population, not least in their demands for global management (Buttel et al., 1990; see also Sayre, 2008).[10] Several examples of this polarized strategy can be highlighted. The 'Stop Climate Chaos Coalition' explicitly draws on an either/or

[9] The word myth is being used in the sense of stories that make sense of the world, not untrue or fantastical statements.

[10] First, there is an upper limit beyond which it would be dangerous to go without fearful consequences (DAI, carrying capacity); second, the way to tackle this is to limit (and stabilize) the amount of people or carbon in the atmosphere; and third, to do this there are a number of scenarios through which population and emissions can travel (and will stabilize at eventually). In both cases there are sources of uncertainty at each inference, between system response and concentration (climate sensitivity, human-resource models) and between concentrations and scenarios (carbon cycle feedbacks, unexpected birth/death events) (e.g. as expressed by Global Committee of Parliamentarians on Population and Development, 1985).

approach to future climatic states in its declaration of a 2 °C threshold (climate chaos or calm—Stop Climate Chaos Coalition, 2009), while organizations such as Greenpeace have repeatedly made claims about the necessity of stabilizing global mean temperature, a figure frequently taken to be 2 °C (e.g. Kelly, 1990; see also Doyle, 2007). This is manifested directly in contemporary ENGOs such as 350.org, which is an international campaign to mitigate climate change through reducing and keeping atmospheric CO_2 concentrations below 350 ppm. Climate stabilization has thus become an enduring myth, providing an easily graspable understanding of climate change, even though there are many questions about the framing of the problem, the accuracy of the figures and the implications for management. It has provided a ready interface between scientists, economists, policymakers and environmentalists, and it is this collective weaving that makes it so hard as a concept to disentangle from.

4. Implications and discussion

Forsyth states that "assessments of frames should not just be limited to those that are labeled as important at present, but also seek to consider alternative framings that may not currently be considered important in political debates" (2003, p. 78). Considered in this way, climate stabilization – as a framing concept – has focused attention for political and policy engagement in particular ways; among them are a broad focus on mitigation rather than adaptation, and on static quantification of an equilibrium response rather than more dynamic goals of decarbonizing energy systems. Our work here traces how this discourse has developed, and how it has been fixed (or stabilized) for policy aims; yet we argue that such a discourse is problematic in that it has been consistently resisted and contested by 'unstable' bio-physical processes. As climate stabilization has become a guiding concept for political action on climate change, it has encased policy in areas of intractable scientific uncertainty that create all kinds of problematic assumptions and prescriptions, which influence both climate science and environmental economics.

Climate stabilization presents a good example of how Levy et al. (2001) describe issue development and policy in accumulating stages from early simple, but rigid unscientific goals that are effective in anticipating policy, but which inevitably outlive their usefulness and are difficult to replace with more sophisticated goals because of the enduring socialization in the former. Scientists desiring action on climate change might have been concerned about any possible destabilization of the dominant framing, particularly as the reactionary discourses of vested interests opposed to decarbonization became stronger. With scientists and policymakers focused on the more immediate task of establishing the reality and (rough) magnitude of the problem, the stabilization-focused science-policy debate became an attractive approach and has guided many scientists, economists and policymakers into these modes of thinking. Tony Blair, in the quote at the start of the paper, suggests that stabilization provides a concept that has appealed to the instincts of scientists and economists. In terms of its historical genesis, however, stabilization is perhaps better conceived as a concept that emerged through an uneasy connecting of physical science, economics and policy thereby offering a framing of the question in a specific way that was amenable to these analyses.

Climate stabilization became an intuitively reasonable heuristic during the 1980s because of a wide variety of intersecting intellectual heritages, a lack of alternatives, and model inadequacies. It has been valuable in that it has focused attention on diminishing negative human contributions to the changing climate; however, in so doing, it has encouraged policy to focus on considerations of long-term equilibrium targets, that may have posed comfortable predicaments for political and policy cycles, but have stymied short term action as policymakers wait for the answers that will solve all the questions about scientific, political, and economic uncertainty. Collectively, the recent 2008 UN COP14 provided numerous illustrations where climate negotiations have thus been lulled into contradictory unnerving comfort. For instance, former US Vice President Al Gore garnered rapturous applause when he 'upped the ante' of long-term promises by declaring "the truth is that the goals we are reaching toward are incredibly difficult, and even a goal of 450 parts per million, which seems so difficult today, is inadequate. We will soon need to toughen that goal to 350 parts per million" (Gore, 2008). Yet, at this meeting in Poznan, Poland, short-term agreements and actions remained a scarcity.

A number of conclusions can therefore be drawn from this paper. First, we suggest that stabilization discourse has proved valuable for supporting particular scientific approaches to 'solving' climate change. Second, we argue that the focus on finding a scientific answer to the question of climate policy might be misplaced and that we also need a broader engagement with the ethics and politics of the science–economics hybrid of climate stabilization. Third, we posit that climate stabilization discourses may have led to unrealistic public expectations that leave open the possibility of future public and political critique.

First, some research communities may actually benefit from the focus on stabilization since it gives their research agendas an apparent policy relevance that would otherwise be hard to defend. For instance, paleoclimate modeling – while valuable as a part of fundamental research programs and process understanding in geophysics, biodiversity and ecosystems research – perhaps benefits from a prominence accorded it by its claims to help constrain climate sensitivity (Hegerl et al., 2006; Schneider von Deimling et al., 2006; Crucifix, 2006) that would be hard to sustain if the global policy community were to reframe the question in terms of the relationship between 20th century attributable warming (Stott and Kettleborough, 2002) and expected 21st warming (Frame et al., 2006). Thus, from this perspective one might not expect some researchers to embrace the sort of reframing conversation we have in mind here.

Scientific centres institutionalize these conceptualizations by organizing research groups to study the specific problem of the equilibrium response, such as, for example, the Climate Sensitivity group within the Hadley Centre. The establishments of groups primarily focused on climate sensitivity is a sensible response to explicit policy direction, but focus on climate sensitivity is, in turn, a response to the fact that stabilization and its attendant notions have become 'obligatory passage points' (Latour, 1987) in previous scientific enquiries and policy documents. The recurring and somewhat unreflectively accepted theme of climate stabilization in proposed policy frameworks is the thing that should be questioned. The levers open to today's policymakers are primarily related to current and future sources of emissions, and very little of the infrastructure that provides those anthropogenic sources (or sinks) will be around on equilibrium response timescales. Natural sources and sinks in a new equilibrium are subject to considerable uncertainty. Thus, the policy focus needs to move from focusing on a more static quantification of the details of the equilibrium response – stabilization – to more dynamic formulations that seek to decarbonize energy systems on multi-decadal timescales. While establishing and subsequently meeting long-term climate targets may be one of a set of sufficient conditions for mitigating the worst outcomes of anthropogenic climate change, over the next several decades a much more important task is to achieve substantial decarbonization goals. Moreover, the present lack of enforcement mechanisms to curb carbon-based energy habits makes the achievement of long-term emissions reduction proposals even less likely.

Second, the focus on long-term stabilization targets places scientific certainty and uncertainty at the centre of considerations of decarbonization and distinct from political perspectives. By framing action in such a way, further scientific inputs regarding links between GHG concentrations, emissions and temperature change can unearth more questions to be answered, rather than settling already existing ones (Jasanoff and Wynne, 1998). Therefore, *greater* scientific inputs actually can contribute to *more* complicated policy decision-making by offering up a greater supply of knowledge from which to develop and argue varying interpretations of that science (Sarewitz, 2004). The allure of the scientifically focused ‘climate stabilization’ discourses distracts attention from open political debate about the timescale, respective burdens and objectives of climate policy. Instead of posing these challenges and/or objections to particular actions as scientific ones, they can more effectively be treated as political ones (too), as well as ethical ones. Rayner notes, however, that “for good or ill, we live in an era when science is culturally privileged as the ultimate source of authority in relation to decision-making” (2006, p. 6); often, the focus on securing scientific certainty can effectively obstruct effective policy action (see also Oreskes, 2004). Also, as mentioned before, it contributes to dominant considerations of mitigation policies, often to the detriment of considerations for policy action on adaptation. Thus, assessments of anthropogenic climate stabilization have prematurely foreclosed around fixed international policies on mitigation (e.g. Kyoto Protocol) and associated proposals/practices (e.g. targets and timetables, temperature rise ceiling of 2 °C and 450–550 ppm CO_2 atmospheric concentration caps).

Third, while the stabilization-based discourse may have been valuable in building broad policy actor and public engagement in climate mitigation, it has also fostered sub-optimal aims and unrealistic expectations. For instance, the ‘Stop Climate Chaos Coalition’ based in the UK has now involved over 11 million citizens, spanning a wide range of environmental and labour organizations as well as development charities and faith-based groups. However, their mission statement includes a call to support activities that “keep global warming below the two degrees (Celsius) danger threshold to protect people and the planet” (Stop Climate Chaos Coalition, 2009). While those claims-makers – barring medical science breakthroughs – will not be alive to defend their claims, there is irony in claiming intergenerational equity as the ethical requirement to stabilize the climate, when the attention remains focused on stability instead of preparing our grandchildren for new relations with their future climates (through already existing commitments to a certain amount of climate change). By critiquing stabilization we are not critiquing long-term thinking *per se*; we posit that this should be an open engagement rather than one tied predominantly to scientific targets and notions of stability. Moreover the name Stop Climate Chaos has a strange Canute-ishness about it, as though we either could or should stand together on a beach and command, in the name of good climate governance, that change and variability cease.

If climate can be stabilized in this sense, then clearly the level of DAI or stabilization target becomes an intensely political and ethical question, as the future global climates will effectively be determined by actors living in the early years of this century who design and implement such a policy (in this regard an international agreement is vital). It thus privileges and instantiates their conceptions of safe, dangerous and tolerable, silencing both current and future discontents.[11] It also suggests some rational basis by which certain impacts are allowable, raising the opportunity for populations to demand either protection or compensation for a stable climate that has destabilized their livelihoods. Therefore any mitigation options pursued that aim to suck carbon out of the atmosphere cannot merely be seen as technologies to benignly stabilize the climate, but rather must be seen as active and heavily politicized interventions. Critical ethical and political dilemmas are therefore obscured within the technocratic calculability of climate stabilization policies.

In this paper we have argued that the elegant attraction of ‘climate stabilization’ discourses has culminated in a focus on long-term mitigation targets and a cost-effective climate policy that does not address broader political and ethical questions about the timescale, actors and costs involved. It seems appropriate, scientifically, historically and socially, to question this discursive hegemony and open up debates on more productive and effective framings of climate policy. This paper therefore argues that while the climate stabilization discourse (and associated ways of thinking/proposing/acting) has been valuable in drawing greater attention to human influences on the global climate, it is time to *explicitly* move to more productive ways of considering minimizing detrimental impacts from human contributions to climate change.

[11] Future discontents do have the ability to have the last say by revisiting policy; but this means that the intended stabilization has not taken place. As long as the stabilization policy holds, it locks in the norms of its architects.

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