Futures 43 (2011) 16–26

Contents lists available at ScienceDirect

Futures

journal homepage: www.elsevier.com/locate/futures

The two limits debates: "Limits to Growth" and climate change

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ARTICLE INFO

Article history:
Available online 12 March 2010

ABSTRACT

In this article we compare the current debate about global warming with the earlier discourse of Limits to Growth (LtG) of the 1970s. We are especially interested in the similarities of and differences between the two cases and therefore compare the policy challenges and lessons to be drawn. While the two debates differ on important issues, they share a technocratic orientation to public policy, and susceptibility to similar pitfalls. In both debates alarming scenarios about future catastrophes play an important role. We suggest that climate change policy discourse needs to focus more closely on the social, economic, and political dimensions of climate change, as opposed to its excessive emphasis on emission reduction targets. We also argue that an excessive faith in the market mechanisms to supply global warming mitigation technologies is problematic. In this respect, we provide a reality check regarding the political implications of emission targets and timetables and suggest how policy issues can be moved forward.

1. Introduction

In a recent issue of *Futures*, Nordlund illustrates that futurist research thus far has had only modest impact on IPCC research and assessments [1]. We interpret this as a call to arms, because like Nordlund, we believe that Futurists should actively take part in "...ongoing projects dealing with our common future." [1]. In addressing this call, we draw upon the research of prior futurist scholars, The Club of Rome, and their seminal work on the "Limits to Growth," (henceforth LtG) to identify key challenges and opportunities in addressing the problem of climate change [2].

The current economic crisis has raised concerns that economic issues might dominate environmental policy concerns. While the Obama administration has made important administrative appointments that have been received well in the environmental community, the stimulus plan and other policies do not (yet) adequately reflect the urgency of dealing with pressing environmental challenges. There are concerns that efforts to mitigate global warming, an issue that has gathered substantial momentum in the last decade or so, might get sidelined by the current economic crisis. Global warming might receive massive symbolic policy attention (as was evident before and during the Copenhagen summit of 2009), but not the policy focus required for structural changes necessary to substantially reduce fossil fuel dependence. In this paper, we identify additional challenges involved in mitigating global warming. In so doing, we draw on the policy lessons from the LtG debate of the 1970s. By providing a focused comparison of these debates we note that both tend to share a technocratic

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0016-3287/$ – see front matter
doi:10.1016/j.futures.2010.03.001

approach to policy making. Therefore, given the scale of the climate change problem and its complex politics, it is imperative that the climate change policy focus more closely on the social, economic, and political dimensions, as opposed to its excessive emphasis on emission reduction targets.

Both cases exhibit important similarities, but also important differences. Both the LtG and the climate change discourses share a managerial outlook in that Planet Earth is seen as a system that can be observed, managed and controlled from an astronaut's perspective, as it were [3]. In both cases we see the importance given to numerical modeling, with a strong emphasis on physical variables and a relative neglect of social (as opposed to technological) interventions. And in both cases we detect a somewhat alarmist rhetoric which, against its own self-professed intentions, leads to a public perception that the model results are more or less accurate predictions of the future.

The two debates also demonstrate important differences. In the case of the LtG debate, there was little or no institutionalization of policy recommendations. The discourse was restricted to an activity of a relatively small group of academics and business people which received massive media resonance. Conversely, climate change discourse has produced a truly global institutionalization through the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC). This suggests that the climate change discourse will not wither away any time soon. Another difference is the size of the research enterprise that drives the discourse: while LtG arose from "little science," out of niches in the academic establishment, climate change is driven by "big science," with federal research investments averaging approximately US$ 2 billion per year in the USA alone. In comparison, the Stiftung Volkswagenwerk which financed the Club of Rome's work, made a one off payment of just under one million Deutschmarks in 1970 [4].

Where both cases overlap and where we see the truly enormous challenge is the issue of compatibility of long-term environmental goals with short-term economic logic. The LtG discourse advocated a Zero growth proposal, as economic growth was seen as inimical to environmental protection and resource conservation. Similar notions such as Hardin's lifeboat thesis sought to emphasize the dangers of impending resource scarcity [5]. While Hardin and other neo-Malthusians saw developing countries as the key challenge, the LtG community saw the broader growth paradigm as problematic. From the 1970s until the mid-1980s, these notions constituted the dominant discourse around environmental protection and economic growth.

However, beginning in the late 1980s, the notion of sustainable development (and ecological modernization) began replacing LtG as the main paradigm. Its proponents claim that economy and ecology are not necessarily in conflict with each other and that economic growth is compatible with environmental protection and resource conservation. What gave rise to such an optimistic scenario? Arguably, the scarcities demonstrated in the LtG model runs were mitigated, at least in the short run, by market-led innovation. The world (perhaps falsely) realized that it did not run out of resources in the manner predicted by the LtG report (indeed, the authors of the MIT studies had pointed out that the dire predictions could be averted precisely by acting against them in good time) [2, p. 24]. Yet, notwithstanding the cheer from "growth as usual" proponents [6], the temporary alleviation of resource scarcity has not altered the basic growth algorithm. Once resource prices began to drop, the world returned to its old ways of resource profligacy with a vengeance: the small cars of the 1980s gave way to SUVs of the 1990s.

Will we witness something similar in the case of climate change? Why or why not, and what are the policy consequences? This paper argues that global warming mitigation requires a fundamental change in our production and consumption processes, and we cannot rely solely on market forces to engender path breaking innovations. Because of the complexity of the problem and high levels of path dependence associated with economies' reliance on fossil fuels, we require large scale, sustained public investment in new generation technologies, instead of relying primarily on the market to provide the necessary innovations. The study of the policy consequences of LtG can be instructive in this regard.

Our objective in this paper is to provoke the readers to think about the concrete policy implications of such "wicked problems" while factoring in the opportunities and limitations afforded by innovation and technology [7,8]. In so doing, we hope this paper will contribute to a better understanding of the prospects and priorities of climate change policies.

2. The "Limits" debate in the 1970s

The Club of Rome, a global non-governmental think tank founded by Italian industrialist Aurelio Peccei and Scottish scientist Alexander King, commissioned Limits to Growth in 1968. It was funded in 1970 by the German Stiftung Volkswagenwerk and released in 1972 [9]. The Club's objective was to gather leading professionals from a variety of fields to think about great challenges facing humanity in an interdependent world, specifically challenges associated with resources and the environment. Its website notes that: "The international effects of this publication in the fields of politics, economics and science are best described as a 'Big Bang:' over night, the Club of Rome had demonstrated the contradiction of unlimited and unrestrained growth in material consumption in a world of clearly finite resources and had brought the issue to the top of the global agenda" [9].

The LtG report was highly technical in its orientation. It employed a system dynamics approach to project the upper limits of human developmental capacity. It examined the interaction of five factors: population growth, agricultural production, nonrenewable resource depletion, industrial output, and pollution generation. Taken together, these formed a complex web of feedback loops, the "vicious and virtuous" circles, whose aggregate interactions constituted the "world system." Within the model, human economic activity served as the exogenous factor, or the ecological monkey wrench, that locked the

system toward environmental collapse. The most salient statement from the original LtG report was that unabated economic and population growth would result in "a sudden and uncontrollable decline in both population and industrial capacity" within the next 100 years. This quote represents the principal conclusion of the LtG report [2, p. 23; see also 41]. While the LtG report should be viewed as an exhortation for policy action, critics incorrectly portrayed it as a false prophecy by focusing the debate on whether the specific, short-term predictions outlined by the LtG report turned out to be true.

As one commentator put it, the Club of Rome report 'doesn't actually "predict" anything. The authors explicitly note that it is not a forecast, and that they do not believe the available data and theories would enable an accurate prediction of what will happen to the world over the next century. The scenarios are simply a range of different examples of how the world might evolve.' [51] The Club of Rome used computer models to project various key input factors and their interactions into the future. The different assumptions guiding these model inputs led to different outcomes, which were called scenarios. Indeed, it is unfair to judge the validity of the LtG report based on the experiences of the 1980s and the 1990s, a point we discuss subsequently.[3]

The policy implications of LtG rested on its assumptions. First, people have the capacity to restrict their resource use to sustainable levels. Second, both governmental interventions and individual self-restraint can drive the necessary changes in consumption. Third, the speed with which these changes occur will largely determine the systemic outcome. The implication was clear: if the requisite personal restraint and political will could be mustered, the trend toward global environmental collapse could be halted.

Upon its release at the Smithsonian Institute in 1972, LtG received substantial publicity, although there was great variation in the responses. There was extensive press coverage and debates in academic circles. The British *Economist* and US *Newsweek* were scathing in their attacks. *The New York Times* reported the reaction from the Nixon administration. Environmental adviser to President Nixon, R.E. Train notes the Club of Rome study predicting that current population, resource use and other trends will end in disaster in next century. But he goes to say that one need not accept dire hypotheses and methods underlying some of more extreme predictions to acknowledge the fundamental validity of questions that various groups are asking (NYT March 30, 1972, p. 19).

Environmentalists commended LtG for bringing awareness to the pressing problems of over-consumption, while critics condemned it for its inadequate data and gloomy predictions. For example, while Kenneth Boulding, a prominent systems thinker, allegedly quipped that, "anyone who believes exponential growth can go on forever in a finite world is either a madman or an economist" [11], a 1972 *Newsweek* editorial penned by Yale economist Henry Wallich labeled LtG "a piece of irresponsible nonsense". [12]. In another famous debate, ecologist Paul Ehrlich wagered with economist Julian Simon that, with 1980 as a baseline, by 1990 market prices for copper, chrome, nickel, tin, and tungsten would dramatically increase, while Simon predicted they would fall. Ehrlich lost the wager and mailed a check for $576.07 to Simon [13]. In some ways Ehrlich was unwise to take only a 10-year horizon (contrary to a century long time line in the LtG report). He was also unlucky because the global economy was sluggish in the 1980s, thus depressing commodity prices – indeed the prices rose in the late 1990s and beyond. Nevertheless, along with the diminished pace of the economy in the 1980s, an important reason why Ehrlich lost was that technological substitution kept prices depressed even as the world population increased by 800 million people during the decade. An example of such substitution effect is the development of glass fiber optic cable to replace many of the functions once reserved for copper. Scholars have noted two other reasons for the drop in the prices of these metals: first, in further support of Simon's position, new mining technologies enabled new discoveries of nickel deposits allowing for an actual resource increase for this metal. Second, supporters of Ehrlich's position claimed that, despite the existence of substitution effects, the prices for this basket of metals were artificially high in the early 1980s due to a spike in the price of oil, and low in 1990 due to an oil price recession. Verweij et al. point out that, over time, the Club of Rome has shifted emphasis away from the natural resources issue [44]:

> Today . . . the Club of Rome (2002) espouses the view that humankind is being threatened in the medium to long run by the build-up of greenhouse gases in the atmosphere that is caused by the continuing use of fossil fuels around the globe. This is almost diametrically opposed to the Club' s views of the early 1970s (. . .), which held that the world's long-term prosperity and stability was under threat from the depletion of fossil resources. The Club of Rome has, therefore, clearly shifted position during the last 35 years – a period in which proven reserves of fossil fuels have steadily increased, something that has often been pointed out by the Club' s critics such as economist Julian Simon.

Nevertheless, contrary to what critics suggest, the first LtG debate did not focus exclusively on resource scarcity. In fact, the authors included the inability of Earth's ecosystem to absorb pollution as one of the possible trajectories of "overshoot and collapse," even citing the possibility of "thermal pollution" or anthropogenic climate change to bring about "serious climatic effects." [2, p. 73] However, the effects of including this feedback loop in the overall World3 model are indeterminate, as the authors could neither constitute an upper bound for pollution absorption into Earth's atmosphere, nor

[3] A recent reevaluation of LtG predictions based on contemporary data has actually found that the 'standard run' scenario predicted in the original report was prescient in predicting that the world may indeed be on a path to resource collapse by the middle of the 21st century. Conversely, the "comprehensive technology" scenario tends to be "overly optimistic in growth rates of factors such as food, industrial output and services per capita and global persistent pollution." [10]. And Fisk points out that 'The precipitous collapse of economic growth projected by the MIT report does not occur before 2020 in any of the model runs, so it is hard to see how its doomsday projections have been disproved. For a 30-year-old projection using some eight variables, the MIT model did a surprisingly good job of predicting where we were in 2004, as an update shows.' [49].

could they estimate how fast the exponential pollution curves would rise. Consequently, it seems that the inclusion of pollution of any type into the model trajectories could not have drastically altered the model predictions. Nevertheless, it is important to note that the original LtG authors, despite the fact that pollutants only played a minor role in their analysis, shrewdly predicted the possibility of limits imposed by climate change.

Certain resources, such as fisheries, are showing signs of depletion. Further, there have been two subsequent updates to the original LtG report, coming at the 20 and 30 year anniversaries, as well as ecological indices such as the "Ecological Footprint" and "Living Planet Index" contained in the World Wildlife Federation's periodic Living Planet Report that suggest that "Humanity is no longer living off nature's interest, but drawing down its capital." [14]. Indeed, as these indices rightly point out, Earth's biodiversity and "biocapacity" are suffering as a result of human-induced ecological malfeasance. However, despite the salience of these facts, arguably the worst effects of these trends could possibly be mitigated by technological substitution if it becomes financially viable to do so; the opportunities in renewable energy are a case in point.

In the last two decades, policy attention and social discourse have moved to the new "limits" challenge of climate change.[4] In this new conceptualization, the "limit" pertains to the capacity of the atmosphere to absorb and diffuse greenhouse gas emissions. Rather than a limit mandated by the scarcity of resources that are extracted from the earth, the concern is now about the scarcity of another resource: the accumulative or absorptive capacities of atmospheric sinks. Although scientific consensus on climate change is considerable (if not overwhelming), as with the previous debate there are skeptics who question the "new limits" phenomenon and its implications.

There were high hopes that policy action to mitigate climate change would face much less political resistance than the previous limits debate because (among other things) the scientific evidence is provided by a more credible actor: the LtG was authored by a non-governmental think tank (The Club of Rome) while the authoritative actor in the current limits debate is a Nobel prize winning inter-governmental body (the IPCC). However, recent scandals have tainted the credibility of this panel considerably. Further, levels of media attention on this topic have been much higher compared to LtG. Unfortunately, the prospects for inter-state cooperation or market solutions are much bleaker in the case of climate change. This is due to many factors, but primarily because the atmosphere as a common pool resource [15] implies powerful collective action challenges, thereby making effective global policy action difficult, if not impossible. Nevertheless, there are implications that can be drawn and lessons that can be learned from the previous debate.

2.1. Lessons from the LtG debate

The LtG community was primarily non-governmental. While it had little governmental or popular involvement it resonated with the burgeoning environmental movement. In contrast, the climate change discourse involves direct governmental involvement through the IPCC and the UNFCCC structure, and comparatively little in the way of public engagement. Along these lines, it can be argued that governments prefer policy implementation in a traditional top-down fashion. We contend that this dynamic threatens the climate change mitigation potential. For instance, one of the leading countries in climate policy, the UK, shows signs of rhetorical grandstanding but little public involvement in debates about how the country could actually achieve a low carbon society. In spite of vocal opposition and dissent, the 'lack of another perspective,' a public input, to sit across the table from the scientific establishment to argue its case [18], limits the capacity and willingness of democratic governments to take the steps needed to moderate greenhouse gas emissions.[5] Additionally, concerted resistance by fossil fuel industries has thrust public opposition toward an often misguided and sometimes – conspiratorial character. Ironically this might create the conditions for a failure of ambitious climate change policies, either through public resistance, loss of focus or both. The British government has pledged to reduce carbon emissions by 80% by 2050, a very ambitious goal. However, it is likely to alienate the voters if the reduction targets do not get embedded in a policy that can demonstrate how to make the transition to a low carbon society at a sensible cost. No such attempts are visible and thus the second alternative becomes a real possibility, i.e. that the government will not be held accountable to this target because it lies in the distant future.[6]

Climate change demonstrates the limits to economic growth based on current economic models that rely on fossil fuels as key energy providers. It is important to recognize that the debates on Limits to Growth are not new. At least since the time of Thomas Malthus, scholars have debated how the natural environment might limit economic growth potential [17]. Neo-Malthusians such as Garret Hardin outlined the "lifeboat ethics" approach in opposition to then popular "spaceship earth" approach. Hardin laid out a concrete policy implication: without a world government that can limit population growth in

[4] There were other "limits" debates as well such as on ozone depletion. However, these debates did not force policymakers to reexamine the basic economic and ecological assumptions across policy domains.

[5] One could argue that the UK government has given in to climate change campaigns such as Friends of the Earth's 'Big Ask' campaign which started in 2005. Ironically, such successful environmentalist lobbying may not be a substitute for broader public involvement.

[6] As one of the early critics pointed out, 'On November 26, 2008 the British government enacted the Climate Change Act of 2008, mandating national emissions reductions . . . In December, 2008 the United Kingdom's Committee on Climate Change (created by the Act) released a report recommending that national greenhouse gas emissions be reduced by at least 80% by 2050 and by 34% by 2022 (or 42% if an international agreement on climate change is reached). The report argues that this amount of emissions reduction is achievable at an affordable cost of between 1% and 2% of GDP in 2050.' Pielke [16] further argues that not only 'is the Climate Change Act all but certain to fail to achieve its ambitious emissions reduction goals in both the short and long term, but that it is fundamentally flawed in its basic conception.' [16].

poor countries, rich countries' survival "demands that we govern our actions by the ethics of a lifeboat, harsh though they may be" [5]. A more sophisticated and widely discussed approach to the "limits" problem was outlined in the LtG report. Prominent scientists provided a highly technical analysis founded on (then) state of the art computer modeling techniques (the World3 model) [2]. Based on media and scholarly attention, LtG can be viewed as an authoritative and scientific inquiry regarding the limits to economic growth imposed by natural resource supplies. This report charted the consequences of population growth and high levels of resource extraction for the global ecological system.

2.2. From government to governance?

Helga Nowotny, commenting on the technocratic orientation of the LtG studies, pointed out that 'In a time when "governance" has replaced "governing," which is now rejected as too statist, we look back with astonishment at the political measures and means of control that were developed at the beginning of the 1970s.' [18, p. 113]. But what seems so alien on renewed reading of the Club of Rome study is not just the technocratic aspect that was clearly present in the first models but the belief in its political practicality and capacity for realization of policy recommendations, which was presented with conviction. As Verweij et al. [44] have said, 'Yet both the Club's underlying assumptions (that unregulated citizens and nations are too selfish or short-sighted to realize that they are slowly but surely undermining their own prosperity) and its ultimate governance ideals (more global, top-down, expert planning to rein in global markets) have remained hierarchical.' Nowotny rightly points to the '*lack of another perspective* – the lack of a view from below, from the local levels, the lack of the inclusion (now at least rhetorically taken for granted) of "imagined lay persons" as consumers, voters, and users—that seems strange and politically impractical in today's world. One asks in astonishment how it is possible to speak of the future without listening to the people it will affect.' [18, p. 113].

This raises the question to what extent the discourse on climate change lives up to such expectations. Has governance replaced government in the minds of major players in the climate debate? Australian scientists Shearman and Smith argue that we need an authoritarian form of government in order to implement the scientific consensus on greenhouse gas emissions [19]. The well-known climate researcher James Hansen laments that "the democratic process does not work" in the case of climate change. In *The Vanishing Face of Gaia* James Lovelock emphasizes that we need to abandon democracy in order to meet the challenges of climate change head on. We are in a state of war. Talk is about a new war effort in order to pull the world out of its state of lethargy (see [20] for a critical assessment).

While climate change, much like the original LtG, clearly reflects the limits to economic growth, there is one crucial difference: unlike the previous limits debates which tended to highlight how resource scarcity and population growth[7] might limit economic growth potential, the climate change literature focuses on the limits imposed by the absorptive capacity of the environment. Instead of resources as limits, sinks are now the limiting factor. Indeed, the policy implications of the two types of limits are different – to the disadvantage of climate change mitigation.

2.3. The role of technology

Arguably, the LtG report insufficiently recognized or factored in the human capacity for technological innovation. Technological innovation and market forces can, at least partially, mitigate resource scarcity by facilitating resource substitution. This argument was made by a host of scholars shortly following the publication of LtG, notably Julian Simon [21] and Herman Kahn [22] (see also [23]). The food crisis in some parts of the world was averted by the "green revolution" that entailed the introduction of new technology (high yielding varieties of seeds coupled with the systematic application of pesticides, fertilizers and irrigation), and policy changes (e.g. altering terms of trade between rural and urban areas). If the current food crisis persists, it would be interesting to see if it leads to investment in the development of "second wave" of green revolution technologies (or the third wave if genetically engineered crops are to be labeled as the second wave).

The oil crises of 1973 and 1979 illustrated that exogenous shocks on primary resource availability can spur the development of new resources and technologies. Although these "solutions" deferred issues of resource depletion into the (then) future (and our present), the broader lesson is that under certain conditions, human ingenuity and adaptability, often mediated through governmental intervention, can alter patterns of consumption and production, at least at the margins. In this capacity, the social, political, and economic dimensions of human response need to be anticipated, and if possible, accounted for in making predictions about resource scarcity. However, despite the importance of anticipating public responses to resource price changes, as Kempton et al. point out, it is puzzling that the public does not take greater advantage of cost savings through energy conservation, even in the face of governmental efforts to promote cost savings through energy conservation [59].

The 1970s and 1980s taught us that technological innovation is not exogenous to the socio-political process. Appropriate institutional context can help to develop and diffuse new technologies. Although humans must confront resource limits, in

[7] Arguably, this report tended to assume somewhat higher levels of population growth rates. Over the last five decades, both endogenous factors (birth contraceptives, educational opportunities for women, and urbanization) and exogenous factors (specifically diseases such as malaria, diarrhea and HIV/AIDS) had led to deceleration in population growth rates According to the U.S. Census Bureau, the growth rate of the global population was 2.19%, 1.94%, 1.75%, 1.48% and 1.19% in 1962, 1972, 1982, 1992 and 2002, respectively [23].

the short run, resource scarcities can be mitigated. Unfortunately, this often leads politicians, with their short time horizons, or under pressure to focus on the economy or national security, to get distracted by such trends. It is true that environmental problems on the scale of climate change require changes in *both* short-term and long-term production and consumption patterns. However, one should not get distracted by short-term successes. Eventually, we need technologies to help us reduce the carbon intensity of our wealth production. It is no longer sufficient to meet energy needs by developing new methods of deep sea drilling, or by blasting the tops off mountains to extract coal more efficiently; rather we need new technologies to wean us away from fossil fuels altogether.[8] We fear that alarmist predictions are creating conditions for symbolic changes, Copenhagen being a case in point. The challenge is to embark upon political action to combine long-term promises with short-term policies. This would involve moving the climate change debate from its current alarmist orientation to a more pragmatic and institutional basis. In other words, instead of debating over long-term emission targets, policymakers should confront basic questions about the short- to medium-term social, economic, and political implications of climate change, and how we might alter our trajectory toward a low carbon society. For example, reducing transportation energy use to reduce GHG emissions can also improve energy independence, which is a very important goal for many nations. Other complementary goals include energy security, jobs creation (in the Clean Energy sector), improving human health (e.g. through reductions of black soot [63]), and transitioning away from oil before Peak Oil. Such policies would provide benefits that can be appropriated at the national level (as opposed to creating a global public good), this does not distract from at the importance of the major collective action dilemma faced by international policy negotiators in the problem of preserving a global common pool resource.

3. The case of climate change

There has been a sharp rise in media reports on climate change over the past three years [25,26]. According to many reports climate change is the leading global policy challenge. The challenge has many aspects; two are mentioned here. First, it is a challenge to science because of the size and complexity of the problem (like LtG before). This aspect refers to the physical changes in our natural environment. Second, it poses problems for collective action, and thus for public policy. Some actors in the debate seem to assume, incorrectly in our view, that highlighting the potentially dramatic physical changes will be enough to elicit the requisite responses from society. This ignores fundamentals of politics, especially the power of both the affluent consumers, be they in Europe, North America or the rising powers (Brazil, Russia, India, China = BRICs), and the fossil fuel lobby to resist or postpone change.

Climatic trends over the past two centuries demonstrate that the Earth is warming beyond its natural cycle of temperature fluctuation. Scientists attribute this warming to substantial increases in the anthropogenic emissions of greenhouse gases. If the atmosphere can be viewed as a ''sink'' with a limited accumulative capacity, the accretion of greenhouse gasses creates a greenhouse effect whereby the Earth's atmosphere reflects back toward the surface much of the solar heat that would ordinarily diffuse outward, in turn melting polar and glacial ice packs and raising global temperatures to levels unsustainable for habitation in many of Earth's most populated places. Because the climatic divergence correlates with industrialization, the global population explosion, vastly increased resource extraction, and economic growth – all considerable sources of greenhouse gas emissions, human activity is again thought to be the ecological monkey wrench undermining the systemic balance.

In 2007 the IPCC released its Fourth Assessment report. This was done in two stages, beginning with the publication of the Summary for Policymakers. To this the US government reacted in the following way, according to the *New York Times*: 'The Bush administration, which until recently avoided directly accepting that humans were warming the planet in potentially harmful ways, embraced the findings, which had been approved by representatives from the United States and 112 other countries . . .. 'The word 'embraced' is interesting, as this did not lead the US to take action on climate change. Rather, it is likely the endorsement of the research carried out which is done in large part in the US. This is how the article reads on:

> Administration officials asserted . . . that the United States had played a leading role in studying and combating climate change, in part by an investment of an average of almost $5 billion a year for the past six years in research and tax incentives for new technologies. At the same time, Secretary of Energy Samuel Bodman rejected the idea of unilateral limits on emissions. ''We are a small contributor to the overall, when you look at the rest of the world, so it's really got to be a global solution,'' he said. (NYT February 3, 2007)

After the full report was released, the *New York Times* reported that 'President Bush had agreed with leaders of the other major industrialized nations that ''the issue warrants urgent action, and we need to bring forward in a more accelerated way the technologies that will make a lasting solution possible.'' He declined to say how much warming the administration considered acceptable, saying, ''We don't have a view on that.'' [It was] noted that the United States had invested $12 billion in climate research since 2001.' (NYT November 18, 2007 Late Edition – Final). What is striking is the embracing of the science, showcasing US investment in research, while at the same time being evasive on climate change policies and US goals.

[8] Unfortunately, as it now stands, these technological substitutions for fossil fuels are probably still a long way off. See for example [56].

3.1. Alarmism

In a report in *Nature*, scientists from the WHO and the University of Wisconsin Madison estimated that climate change leads to approximately 150,000 deaths annually due to the "direct-acting temperature effects of ... extreme heat, cold, drought or storms; changes in air and water quality and changes in the ecology of infectious diseases" [27]. They go on to note many of the other calamitous effects of climate change including altered storm patterns, increased severity of weather events, sea level rise and freshwater loss, desertification in currently arable regions, species extinctions and so on. The policy challenges from these, and the forced human migration, food and water crises, and public health issues that follow, are alarming.

However, it would be wrong to fall into the trap of climatic determinism. Arguably, the above scenario is not inevitable. We should have learned this lesson from the first LtG debate: social and political intervention will make a difference. Clearly, in the case of climate change market forces are not reliable if we want to prevent the direst of consequences. What is required is an acknowledgement that no matter how successful we will be with mitigation policies, we are already committed to climate change. This does not mean that we will see hundreds of thousands of people die as a consequence of climate change. Such consequences are preventable if we adapt our infrastructures in time. This is costly and looks politically less 'correct' as it seems to divert attention and resources away from the 'big goal' of climate change prevention. As a matter of fact, the IPCC, at least from its 2001 reports, has acknowledged the importance of adaptation alongside mitigation [28–31]. As the consequences of global warming will be primarily affecting the regions that are least capable of altering its trajectory, adaptation is bound to be part of an appropriate policy response [32]. In a more general way, it could be said that a sensible policy response should try to reduce the vulnerability of societies [51]. And as we realize how much time we have lost in the past 20 years, some call for adding a third policy, that of remedial action (i.e. geo engineering projects in order to take CO_2 out of the atmosphere). In 2009, the Royal Society in the UK published their report *Geoengineering the Climate: Science, Governance and Uncertainty* in which various options are discussed. Taking adaptation seriously and preparing for the worst by also considering remedial action, should dampen the alarmist rhetoric.

Until now, climate change politics has been presented as an unfolding drama with just enough time to prevent 'dangerous warming'. It was said that we have 10 years before we reach the point of no return. Implicit in this message was that adaptation and remediation were secondary, if at all necessary. This story line is no longer applicable, as the alarm is raised every few months to new levels. In 2007, the mantra had become that it was 'now or never to save the planet' [60].[9] The following events have helped the climate change issue climb the level to top political attention and to be cast in such an alarmist tone. In 2004 the Hollywood blockbuster *The Day After Tomorrow* brought the message of abrupt climate change to a home audience. After 2005 there was huge rise in media attention to climate change, most of it dramatic in tone [25,26]. In 2006 and 2007 many professional science organizations issued statements that climate change is a serious problem which requires urgent action [45]. In 2007 the IPCC released its fourth report and won the Nobel Peace Prize together with Al Gore. However, the alarmist strategies that led to the politicization of climate change did not have the anticipated impact on the international level. This became clear in December 2009 when 193 UN states failed to agree on a treaty in Copenhagen. At the same time, opinion polls have shown a decrease in the sense urgency felt by the public as economic issues take precedence [47]. If it ever was a political strategy in order to galvanize nations, companies and consumers into action, the alarm rhetoric has clearly failed in achieving its objective.

3.2. The role of models and scenarios

Like the Club of Rome, the IPCC uses scenarios to communicate model results to the public. According to the IPCC's terminology, a model is 'a numerical representation of the climate system based on the physical, chemical and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties.' These models are 'applied as a research tool to study and simulate the climate, and for operational purposes, including monthly, seasonal and interannual climate predictions.' There have been various predictions based on these models, ranging from climate sensitivity estimates (i.e. the rise in average global surface temperature as a result of doubling CO_2 concentrations) to predictions about sea level rise, species loss, glacial retreat, and increased weather hazard frequency. So what are predictions then? The IPCC says 'a climate prediction or climate forecast is the result of an attempt to produce an estimate of the actual evolution of the climate in the future, for example, at seasonal, inter-annual or long-term time scales.' Climate predictions are to be distinguished from climate projections which depend upon the emission/concentration/radiative forcing scenario used.' And scenarios, in turn, 'are based on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realised and are therefore subject to substantial uncertainty.' [53]

While common language might use these various terms interchangeably, they are not. We need not ponder too long on the different definitions, especially as they are not held universally, and even climate scientists at times use them in varying ways [54]. But an understanding of the role of scenarios seems helpful. In a paper for the *Philosophical Transactions of the*

[9] *UK Prime Minster Gordon Brown put it this way:* 'If we do not reach a deal this time, let us be in no doubt; once the damage from unchecked emissions growth is done, no retrospective global agreement, in some future period, can undo that choice. By then it will be irretrievably too late.' [64].

Royal Society of London the former IPCC chairman Robert Watson says that scenarios are the crucial tool to influence policymakers:

> Besides direct observations of change, one of the most important tools for helping to foster policy changes are plausible future scenarios. In most of the scientific assessments mentioned above (e.g. stratospheric ozone depletion, acid deposition and climate change), the use of scenarios has played an absolutely critical role in describing plausible future changes and identifying the implications of different policy choices and convincing policy-makers to take action. [55]

And Hjerpe and Linnér point out, 'The IPCC 'describes scenarios as 'alternative images of how the future might unfold . . . to analyze how driving forces may influence future emission outcomes' (. . .), i.e., they are not designed to provide blueprints for the future. The IPCC . . . emphasizes that neither probability nor desirability is attached to the various scenario families . . . The future evolution of society is recognized as an uncertain process of interaction between, for example, demographic development, socio-economic development, and technological change.' [50]

There is no probability assigned to the various scenarios which opens the way for decision makers to pick the one that aligns with their preconceptions. In this sense, both LtG and IPCC have used scenarios in order to communicate the possibility of a dystopian future, not as a prediction, but as a reminder that something needs to be done urgently if we are to prevent the worst.

3.3. Differences to LtG

Though similar on some analytical dimensions including its technocratic focus, climate change differs from LtG in some key respects – unfortunately making its politics and economics more challenging. First, the "economic collapse" predicted by LtG was largely instigated by diminished supplies of tradable resources – food, oil, copper, etc. – which are rival and excludable, possessing the characteristics of "private" goods. As the supplies of these resources declined, their prices rose and market incentives facilitated technological innovation. This was illustrated perhaps most visible during the oil shocks of the 1970s when – despite sudden and historically high oil prices – market signals and technological innovation made fuel-efficient automobiles available to meet the demand while relaxing supply constraints through the discovery of new oil fields. With climate change, however, the solutions are not likely to similarly arise. First, the supply constraints cannot be relaxed, at least not in the short run. Arguably, the supply might be increased by carbon sequestration via biomass creation and forest (re)generation. Further, efforts at carbon emission reduction via transfer to clean energy sources (wind, solar, etc.) would provide a method of averting the limits. However, the relatively minor role alternative energy sources play when compared to oil and coal, and the massive investment required to bring them to a level that would really make a difference in the short run, does not lend hope to the notion that the limits can be averted in such a fashion. Additionally, some of these schemes could lead to perverse outcomes (e.g. we would be able to soak up more carbon if we first cleared existing forests and planted new trees).

Second, the atmosphere is a rival but non-excludable common pool resource. Thus, resource scarcity is not likely to translate into higher prices, and innovation is not likely to be prompted by market incentives, unless a method can be found to assign property rights to atmospheric sinks (the right to emit greenhouse gases). This latter approach has been taken up in proposals for a carbon trading scheme to which we now turn.

3.4. Cap and trade?

Recognizing the inherent collective action problems in climate change, mechanisms such as the Kyoto protocol, the primary inter-governmental treaty on climate change, the European Union Emissions Trading System (EU ETS) and various national exchanges in the US, Sweden, Australia, New Zealand among others, have been established to prevent the so-called "tragedy of the atmospheric commons" by creating atmospheric property rights, and then encouraging their efficient allocation through carbon emissions trading. The hope is that once property rights are established, greenhouse emissions will become sufficiently costly and will encourage the development and adoption of emission reduction technologies. While some claim that there have been notable successes with cap and trade mechanisms, offering some hope in market mechanisms, there are strong reasons to be skeptical. Although the World Bank reports that the value of global carbon trading markets more than doubled from 2006 to 2007, from 31 to 64 billion dollars [33], this does not quite indicate a doubling in traded carbon volume, as prices have risen, and the overall volume in traded carbon emissions represents but a drop in the bucket of total carbon emitted (see also [32,34,42,43]).

Allocation of emission rights is likely to have distributional consequences. Not surprisingly, politics is placing roadblocks in the evolution of these mechanisms. There are other salient social, political, and economic policy challenges as well. First, given the limited ability of developing countries to enforce even the most basic property rights, how would they enforce the more exotic carbon rights? For example, as Coleman points out, carbon accounting, or the method through which carbon emissions are calculated, does not lend itself easily to policing. Instead, emitters rely on indirect measures such as a calculation involving the amount of fuel burned in production to estimate CO_2 emissions [35].

Second, the exemption of developing countries from international global emission reduction targets will create moral hazard problems in which major developing country polluters will have incentives to favor growth over emission reduction.

In addition, oil-exporting countries including rich countries such as Saudi Arabia are seeking compensation for reduced export earnings [36]. A moral hazard problem arises when actors, who do not bear full consequences of their actions, have incentives to behave in socially harmful ways. In 2007, China emerged as the leading global emitter of carbon dioxide, although its per capita emissions are far less than that of the United States [36]. As per the Kyoto protocol, China is a developing country, and thus not yet required to reduce emissions. The same holds for India. The implication is that even large, politically painful emission reductions in the developed countries will have little overall impact unless China (and other BRICs) curb their growing emission levels [37]. Unless all key polluters cooperate, quite a challenge given huge developmental gap between established and emerging polluters, a serious regulatory push in the developed world could force an outward migration of industry, or "industrial flight," to less regulated economies, thus having little effect on total global emissions. Clearly, the exemption granted to developing countries becomes a convenient tool for skeptics to make a case for the status quo because a "China Effect" is likely to dominate emission reductions in developed countries.

Third, some argue that the corruptive influences of market exchange will limit any real structural changes that cap and trade systems might bring forward. Kevin Smith of Carbon Trade Watch, a non-governmental monitor of carbon emissions trading schemes succinctly notes that "The problem with market-based schemes is they are vulnerable to being gamed for self-interest," going on to note that lobbying pressure often increases the level of the carbon cap to much higher than it should be in order to be effective [38].

It is important to note that there are alternative solutions to Cap and Trade, such as Cap and Convergence, Fee and Dividends [61], and carbon taxes. Additionally, there have also been local and national efforts to reduce fossil fuel dependence such as California's "Flex Your Power Program," and the US government's "Energy Star" program. However, Cap and Trade is to date the leading policy solution in many countries worldwide [62], and constitutes the largest internationally recognized policy effort to date. Unfortunately, local or national efforts such as those mentioned do not constitute anywhere near the level of action required to alter the climate change trajectory, nor do they constitute significant public involvement in the overarching climate change negotiations. It remains to be seen whether an international policy alternative to Cap and Trade will present itself. Presently, prospects are not encouraging.

Fourth, whereas the short-term predictions of LtG might have been largely mitigated through market incentives, requiring little in the way of inter-governmental regulatory cooperation, the reverse is true for climate change. To successfully reduce domestic emissions, politicians must make the unsavory political choice of heavily regulating and enforcing carbon emission reduction through carbon taxes or emission fees. Although the extent to which this may or may not reduce economic growth is questionable, introducing broad-based regulatory and taxation outlays for businesses in any time, especially during a historic recession, is likely to be politically unpopular. Further, resource prices are again depressed due to macro economic factors, making investment in carbon-neutral or low emission technologies less viable.

Finally, whereas the overshoot and collapse scenarios of the original LtG debate were mainly seen as global, the worst effects of climate change are likely to be felt by those nations that are least accountable to its causes.[10] Unfortunately this could have at least two possible effects on the prospects for pre-emptive amelioration. First, it places the onus of responsibility on nations that are least capable of resolving the crisis. Second, it places the climate change crisis in the same category as foreign aid, rather than billing it as a global necessity. In this respect, industrialized citizens will be less likely to stand behind the implementation of broad-based internationally cooperative schemes, and more likely to view it as another "Africa problem," thus diminishing its overall salience. As a consequence, politicians of all stripes in the industrialized world will be reluctant to jeopardize their political position for the amelioration of problems of the poor, or problems of a "distant" future.

4. Conclusion

Given the grim scenario outlined above, how might the environmental community draw on the experience of the 1970s and 1980s to inform its political strategies in relation to climate change? The climate change discourse, as propagated by its main players from within the IPCC, tends to have a technocratic orientation combined with large doses of alarmism. We urge a change in this discourse from debating long-term emission targets to confronting the socio-political dimensions of this mammoth policy challenge. Governments alone are not going to solve the problem; neither is the Kyoto treaty even if the United States were to join it. Europe is in the forefront of this debate but its compliance with the Kyoto targets is not encouraging. New technologies are unlikely to emerge and diffuse quickly, no matter how gloomy the climate change predictions are. So far, the political energies have been invested primarily to create demand for intervention from governments and firms. The assumption is that, faced with such overwhelming evidence, the supply of new technologies will be initiated. This has not taken place, at least not on the scale required to stabilize (let alone reverse) greenhouse gas emissions. We now need direct interventions to increase the supply of new technologies, and the environmental community needs to champion significant governmental interventions in this context [see 40]. We need innovation initiatives on the national level and broad public involvement in order to address the problem in a sustained manner. Unlike the previous LtG episode, we doubt markets will be able to supply these technologies spontaneously.

[10] A key trajectory of the LtG, diminished food production capacity would also likely be felt by the poorest nations first. See [39] for a criticism which points out those crises will be felt at the local level and primarily in poor communities.

In addition to technological substitutions, it is also important to mention that a real solution to the "wicked problem" of climate change must also include a reorientation of public values away from consumption at all costs, and toward an emphasis on sustainable production and resource usage. One example of this type of reorientation is the emerging "Transition Towns" movement [57] that emphasizes community level action and awareness; communication across multiple sectors, community and governmental levels; and local adaptation to environmental changes. Indeed these two notions: values reorientation and governmentally provided technological solutions are mutually constitutive. Unfortunately, there is not enough space in this article to give adequate treatment to the importance of values shifts. It is certainly a productive avenue for future research (see also [58]).

Additionally, there are other important points that we could not do justice to within the limits of this article. This refers especially to the point about lack of public engagement – we would want to explore who the 'other' voices are and how they get excluded or privileged. We also would need to examine in greater detail the underlying reasons for public skepticism, a narrative which is now growing rather than weakening. We also need to analyze the different epistemic foundations of IPCC science compared to LtG science: not just their different institutional settings. This would answer questions about their actual 'credibility' and epistemological foundations. Finally, we need to discuss the ramifications stemming from the fact that apart from mitigation strategies, we now also have to include adaptation and remediation. However, these tasks will have to await further research and separate publications.

Acknowledgements

We would like to thank Helga Nowotny, Mike Hulme and two anonymous referees for valuable comments on earlier drafts of this paper.

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