Futurology and Futurizing:[1]
A Research Agenda on the Practice and Politics of Global Environmental Scenarios

by

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Abstract
Scenarios have become ubiquitous objects in earth systems governance. Defined as plausible descriptions of how the future may develop, scenarios are intended as a tool and process with which the scientific and policy communities attempt to "make sense" of vast amounts of data and complex ecological and social processes. Over the past twenty years, scenarios have grown in number, complexity, and prominence. Despite their prevalence, there has been little systematic analysis of scenarios as scientific and social objects. The paper outlines a research agenda intended to explore two sets of questions related to scenarios. The first, of increasing interest to many engaged in generating scenario analyses, revolves around the products of scenario analyses. Do scenarios meet their purported objective of serving as decision-support tools? The second set of questions views scenarios as social processes and leverages the tools of social science to understanding the roles of scenarios in knowledge production and dissemination.

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Introduction

Scenarios have become a standard tool in the portfolio of techniques that scientists and policymakers use to envision and plan for the future. Defined as "plausible, challenging and relevant stories about how the future might unfold," scenarios integrate quantitative models with qualitative assessments of social and political trends (Raskin, 2005). Arrayed on a spectrum of analytical tools, they fall between deterministic quantitative models of the future and purely narrative descriptions (Nakicenovic et al., 2000).

A brief survey across environmental issue areas reveals the ubiquity of scenario analyses in shaping the knowledge and expectations on which environmental governance is based. For example, scenario building and results representation were employed in the recent Millennium Ecosystem Assessment (MA) (Raskin, 2005), and they have become accepted aspects of the work of the Intergovernmental Panel on Climate Change (IPCC) (Nakicenovic et al., 2000). In particular, the IPCC's "SRES" scenarios—alternative paths for global greenhouse gas emissions—are now widely used at various levels of public sector government and by many private and civil society actors to assess possible future implications and/or risks associated with climate change. Scenarios are also employed within the assessment bodies associated with the Convention on Long-Range Transboundary Air Pollution (CLRTAP),[3] by the teams developing UNEP's on-going Global Environmental Outlook (GEO) assessment (Potting & Bakkes, 2004; UNEP, 2002, 2006), by FAO's Integrated Assessment of Agricultural Science and Technology for Development program,[4] and by the international integrated water management community (Gallopin & Rijsbeman, 1999). In the United States, various emissions scenarios were used within the Regional Greenhouse Gas Initiative (RGGI)[5] involving U.S. states in the Northeast and a host of public and civil society sector advocates for more significant U.S. climate policy action (UCS, 2006).

Despite their prevalence, systematic analysis of scenarios is in its beginning stages. Fundamental questions remain about what scenarios are (i.e Are they projections of alternative futures or are they means of bringing the future into the present?), their methodological validity (i.e. Are scenarios "good science"?) and their policy utility (i.e. Do scenarios produce useful information?). There are, of course, multiple avenues by which to approach these fundamental questions. We focus on two. First, we examine scenarios as decision-support tools and call into question the automatic presumption that scenarios support or influence policy-making. Second, we step back and focus on the process aspects of scenarios, investigating them as social objects that link social worlds and influence political and social spheres.

A brief history of scenario analysis

The origins of scenario analysis trace back, most directly, to the security and futures scenarios of the 1940s and 1950s. Herman Kahn and his work at the RAND Corporation in the 1950s and an NGO called the Hudson Institute in the 1960s is widely cited as a 'father' of scenario construction for futures research and policy analysis (Glenn and Gordon, 2003). This work focused on US public policy, security and defense issues and international development. After Kahn and Weiner's (1967) publication entitled *Toward the Year 2000* scenario analysis became and increasingly popular way to assess emerging security threats during the Cold

[3] See http://www.unece.org/env/lrtap/
[4] See http://www.agassessment.org/
[5] See http://www.rggi.org

War, and in the 1970s as a way to articulate the long-term implications of contemporary trends, including human population growth, oil consumption or deforestation (Berkhout & Hertin, 2002; Raskin, 2005). During this period, scenario analysis was further popularized by its use within the private sector (Garreau, 1994; Schwartz, 1991; Wack, 1985a, 1985b). By this time, governments and private foundations were regularly funding scenario analysis as a mechanism to understand the implications of contemporary trends and/or to attempt to anticipate future opportunities, surprises, discontinuities, and non-linearities.

With the growth environmental concern in the 1960 and 1970s, it became increasingly common to apply scenarios analysis to global environmental trends and concerns. Table 2 contains a catalogue of 30 prominent global environmental change scenarios, starting with one of the most famous – the 1972 *Limits to Growth* (Meadows, Randers, & Meadows, 1972). In fact, there are many more such scenarios. A 2000 report by the European Environment Agency (ICIS, 2000) examines and compares 19 'scenario studies' between 1992 and 2000. These studies, mostly at global or pan-European scale, generally focus on environmental, development and infrastructural issues. All are at least nominally aimed at informing policymaking in some area. The Academic Council of the United Nations University's "Millennium Project" maintains an annotated scenarios bibliography of over 550 entries (Glenn & Gordon, 2003).[6] Starting in the mid-1990s, with the approach of the year 2000, interest in scenarios analysis accelerated again (see Table 2). In particular, these exercises have become more common within international fora, such as the IPCC, UNEP, EU bodies and other multilateral institutions such as development banks. In part, this may be illustrative of growing concern about global climate change and its myriad implications. But, judging from even a cursory glance at the narrative storylines within many of these scenarios (see Table 2's structure column), growing concern about the direction and/or controllability of economic globalization also seems to be driving increased demand for scenario analysis.

Scenarios typologies

Any cursory engagement with the scenarios domain quickly uncovers the range of definitions regarding the object itself. A simple internet search yields several definitions of scenarios: "A detailed story about the future, told in the past tense"; "Narrative descriptions of assumptions, risks and environmental factors and how they may affect operations. Scenarios attempt to explore the effect of changing several variables at once with objective analysis and subjective interpretations"; "Portrayals of alternative futures, usually in the form of written descriptions, but they could include graphs and illustrations. They may be broad, or focus on a particular aspect of life. They may often include a story of how that future came to develop, outlining anticipated key events, choices and consequences. A scenario would ideally also state its assumptions. Scenarios are sometimes well developed in Science Fiction" (Google, 2007); a strategic planning method that some organizations use to make flexible long-term plans" (Wikipedia, 2007).

More formal definitions of scenarios also abound. The European Environment Agency's assessment of European and global scenario studies traces a history of scenario definitions. In 1967, Kahn and Wiener offered a foundational definition of scenarios as "hypothetical sequences of events constructed for the purpose of focusing attention on causal processes and decision points" (quoted in ICIS, 2000). Within the environmental arena, four recent large scale initiatives have incorporated and analyzed scenario methodologies. The

[6] See http://www.acunu.org

recent US Climate Science Program's assessment of scenarios defines a scenario as a description of potential future conditions produced to inform decision-making under uncertainty" (Parson et al., 2007:1). The Millennium Ecosystem Assessment offers a definition of scenarios as "plausible, challenging and relevant stories about how the future might unfold," which integrate quantitative models with qualitative assessments of social and political trends (Raskin, 2005). The European Environmental Agency study uses a working definition of scenarios as "archetypal descriptions of alternative images of the future, created from mental maps or models that reflect different perspectives on the past present and future (ICIS, 2000). Likewise, Working Group II of the Intergovernmental Panel on Climate Change (IPCC) defines a scenario as "a plausible description of how the future may develop, based on a coherent and internally consistent set of assumptions about key relationships and driving forces (eg, rate of technology changes, prices)" (Watson, Zinyowera, & Moss, 1996).

The range of definitions suggests various categories by which to organize the rich and diverse field of scenarios. Scenarios can be categorized as quantitative or narrative, global or regional, and single or multi-scalar (Raskin, 2005). Scenarios can also be categorized by issue area or by the number of alternative futures—ranging from three to over forty—they embody. Others make distinctions between trend and peripheral scenarios, where the former focus on likely outcomes and the latter on unlikely, unpredictable and/or extreme events (ICIS, 2000).

While these typologies can be useful, we propose a meta-level distinction between scenarios as products and scenarios as processes. This distinction captures the division within the scenarios community between those engaged in the practice of futurology, who place greater emphasis on the quality and policy utility of the end products generated in a scenario analysis and those who engage in futurizing, which is more concerned with the dialogue and learning among participants in a scenario exercise. As with all typologies, this distinction should be used with caution, as products encapsulate processes, and processes are products in and of themselves. Yet, we contend that the product/process distinction is clarifying to a scenarios research agenda. In particular, this distinction is relevant to assessing the policy utility of scenarios and the practices and institutions by which scenarios create knowledge and meaning. Moreover, the distinction is important to keep in mind when attempting to apply lessons from past experience to current activities. Lessons from one type of scenario activity may not translate well to the other type.

Futurology: Scenarios as products to inform decision-making

One common understanding of scenarios is as tools to support decision-making. However, even here, there are different kinds of scenarios. Our analysis begins with a typology of three different logics by which scenario analysis brings information about the future—however contingent—to bear on decision-making in the present. We recognize that these categories are not entirely mutually exclusive, yet they are useful to rigorous thinking regarding the utility of scenarios.

1. Forecasting scenarios – Likely futures

The most common purpose ascribed to a scenario analysis is the goal of projecting into the future. These types of scenarios are often called forecasting scenarios. Outputs from forecasting scenarios are intended to be used both as inputs to other modeling exercises and as sources of information to improve policy-making.

Forecasting scenarios developed to address the limitations of future projections based solely on quantitative models. Standard integrated assessment models generate outputs by linking demographic, economic, and ecological dynamics via explicit assumptions about cause-effect connections, typically based on established trends and theoretically grounded relationships between variables. Such models are limited in their ability to incorporate complexity and indeterminacy (Berkhout & Hertin, 2002). Moreover, they are limited to using knowledge that is sufficient to support meaningful quantification (Wehrmeyer, Clayton, & Lum, 2002). When used to project future trends, such models tend to draw on quantified relationships based on past trends as road maps for the future.

Such approaches have clear limitations. Scenario analyses attempt to overcome these limitations by generating a range of alternative futures based on various "story lines" (Raskin, 2005). Story lines are narrative descriptions of the futures used to parameterize key relationships between variables. The advantages of the story line approach are two-fold. First, they are explicitly intended to accommodate surprises and discontinuities in the dynamics being modeled. Second, the narrative elements allow scenario developers to incorporate qualitative knowledge about potential futures into their analyses (De Jouvenel, 2000).

The innovations embodied in forecasting scenario analysis have not gone unchallenged (Parson et al., 2006). The coupled quantitative-narrative outputs generated through scenario analysis raise questions about methodological validity and interpretation of results. In many ways, the narrative aspects of scenarios are incongruous with the methodology of quantification underlying the modeled components of scenarios. Moreover, generating multiple projections of the future begs questions about which future is most likely.

Some of these concerns are beginning to be addressed. The next generation of global environmental scenarios will likely break from the past practice of generating alternative visions of the future based on a handful of story lines, with no assessment of which is the most likely. One group of scholars advocates assigning probabilities to alternative futures (Richels, Manne, & Wigley, 2004; Webster et al., 2003). A competing approach proposes increasing the number of scenarios to several hundred, creating a scenario probability space (Lempert, Popper, & Bankes, 2003).

Scenario users may be the ultimate arbiters in informing debates about techniques to refine the outputs of forecasting scenario analyses. For example, user needs are driving the trend to generate scenarios that are regionally specific (Grübler et al., in press). Likewise, the ideas of utility to policy-makers are mobilized in debates over assigning probabilities to alternative futures. Finally, there has been a clear progression in the extent to which scenario analyses have attempted to incorporate user input into the scenario development process. For example, the recent Millennium Ecosystem Assessment conducted focus group interviews in order to identify issues of concern to users. In addition, the MA has tracked the uptake of the MA scenarios by key stakeholders (Reid, 2006). Prior scenario exercises did not engage in the same level of public outreach.

2. Hedging scenarios – A full range of futures

In addition to projecting into the future, a second, closely-related purpose of scenarios is to allow policy-makers to evaluate the robustness of decisions across a range of potential futures. Unlike forecasting scenarios, the goal of hedging scenarios is to capture the full range of alternative possible futures rather than to identify the most likely possible futures. Decision-makers seek to insure that present-day decisions will produce desired outcomes

across a range of possible futures. The Global Business Network, the key private sector organization promoting scenario analysis, offers a definition of scenarios that captures this distinct perspective. They define scenarios as "tools for ordering one's perceptions about alternative future environments in which today's decisions might be played out" (GBN, 2004).

This type of scenario analysis is common practice in the private sector and in the national security domain, but less widely used in global environmental governance arenas. Royal Dutch/Shell, a key pioneer in scenario analysis, established its internal scenarios group to support robust decision-making. Shell's scenarios efforts date back to the 1970s oil shocks, during which Shell managers were caught off guard by political developments that the company could have but did not anticipate and thus for which they did not prepare (Wack, 1985a, 1985b). Likewise, in the US, national security agencies, such as the Central Intelligence Agency, Department of Defense, and the National Intelligence Council regularly develop scenarios focused on threats to U.S. security or U.S. interests around the world (NIC, 2004).

3. Back-casting scenarios – An ideal future

A third type of scenario defines a desirable future and examines various pathways to reaching that future (Berkhout & Hertin, 2002; Raskin, 2005). These types of back-casting scenarios are built around creating consensus around a particular future to strive for or a particular future to avoid. The scenario then lays out the range of trajectories by which to reach or avoid particular future outcomes. It is important to maintain the distinction between backcasting and forecasting scenarios. While forecasting scenarios may include one or two projections into future that developers/participants most want to see, these are not back-casting scenarios in that they do not pre-identify the future outcome and they do not explore the range of possible trajectories to reach that outcome.

We consider this typology a useful launch pad for an analysis of scenarios as decision-support tools for two reasons. First, it is helpful in clarifying the different types of knowledge about potential futures that constitute the field of scenario analysis. Second, it provides one useful framework for developing research questions. For example, the typology suggests questions regarding current best practices in each of these forms of scenario analysis. Are best practices in hedging scenarios relevant to fore-casting scenarios? Another set of questions relates to how the different types of scenarios relate to each other and to an external policy context? Is there a natural progression from fore-casting to back-casting scenarios as issue areas become more established? One might also ask about differences in scenario development techniques and user evaluations of policy utility across scenario type. Are the applications of scenario analyses consistent with their underlying design principles? Do scenario goals match up with scenario audiences across different scenario types? Are there limits to the kinds of information provided by different types of scenarios?

Futurizing: Scenarios as social processes

Taking a step back from the functional products of scenario analyses reveals a second layer to the roles of scenarios in global environmental governance. Scenario exercises are social processes. For example, they can serve to build networks of individuals linked by common concerns, generate shared understanding, or stabilize interaction between different social worlds.

Social science approaches from the disciplines of science and technology studies, sociology, and political science all provide insight in the "social work" done by scenarios.

Scholarship in the field of Science and Technology Studies (STS) offers a number of ways to understand scenario building and reporting processes as knowledge production processes and the implications of viewing scenarios as "artifacts." First, one might seek to explore the "boundary work" involved with scenario development and use or to see scenarios as "boundary spanning" artifacts (Gieryn, 1999; Guston, 1999; Jasanoff, 1990). These concepts help us to explore how tensions and debates endemic within and between scientific research agendas and policymaking agendas are contested and, perhaps, settled (or temporarily stabilized) through the use of scenarios. Scenarios can be understood as "boundary objects" that link different social worlds, such as science and non-science (Star & Griesemer, 1989). Individuals and organizations within each social sphere use them for specific purposes, while maintaining the objects' identity and creating a sphere in which they can collaborate and co-exist. Thus, perhaps scenarios provide a sheltered context for the usual confusion, contestation, or conflict that accompanies boundary work. This function, like Shackley and Wynne's (1996) "boundary ordering devices," produces consistency, despite the fact that boundaries between science and policy are inconsistent and dynamic. One might ask how scenarios interact with and organize the various levels of scientific understanding and modeling underlying them.

Following Latour (1987) and Jasanoff (2004), scenarios might also be understood as spheres of "co-production," where knowledge and social order are produced simultaneously. Scenarios, in this framework, co-produce knowledge and social order by facilitating collaboration between scientific and technical experts of various types and policymakers and other non-scientists. An advantage of the co-productionist approach is that it calls attention to audiences for information and knowledge. One can explore how both knowledge creators (those participating in a scenario process, for example) and their audiences are (or can be) trained to understand information (images, texts, etc.) in particular ways that link their social reality or world views with particular knowledge sets (VanDeveer, 2004). How do scenarios frame debate and collective understanding, through discourse, participation patterns, and the use of images? For example, images of air pollution transport and deposition patterns across the European continent help to convey the notion that European nations share an airshed and that no national government could protect national air quality on its own (VanDeveer, 2004). In the climate change arena, the now ubiquitous graph of carbon dioxide concentration measurements at the Mona Loa Observatory—the so called "hockey stick"—has become an iconic image associated with global warming (Szasz, 1994).

Analyses of scenarios based in sociology and political science would emphasize different aspects of the "social work" done by scenarios. A sociological analysis of scenarios might focus on the organizations within which scenarios are produced (McNamara, 2001). Under what conditions do modern bureaucratic organizations, both public and private, enable the deliberative processes that drive effective scenario analyses? How do various institutional contexts within which scenario analysis is employed matter for the production, dissemination, and use of the scenarios themselves or their results? A second set of questions of interest to sociologists focuses on the various networks created through scenario development processes. Network characteristics such as network density and network structure may explain the extent to which certain scenario analyses are evaluated as more or less useful by decision-makers (Canan & Reichman, 2002). For example, scenario users can be categorized according to their proximity to the scenario production process. Scenario users include those that both

generate scenario outputs and use those outputs in subsequent analyses, i.e. producer-users. Other users can be characterized as recipient-users, operating in national and sub-national policy arenas (UCS, 2006). Different users with differing interests and perspectives are likely to attribute varying levels of technical credibility, relevance (to them) and legitimacy to particular scenario development processes and outputs (Mitchell, Clark, Cash, & Dickson, 2006). Finally, an examination of the ways in which scenarios can be used to highlight questions of equitable development or to frame and mobilize social action are potential contributions of sociological approaches. How do they circulate and mobilize change in the world? That is, what is the relationship of scenario development processes and outputs to human decisions and human action? How do scenarios engage, reproduce, and challenge global patterns of inequality, representation, and resource consumption?

Likewise, political science approaches would emphasize the extent and nature of the influence of scenario development processes and products on political discourse and/or the actions or knowledge of political actors. For example, work on the influence of scientific and technical assessment on politics focused inquiry on the changes (if any) induced in particular "issue domains" (Farrell and Jaeger 2005; Mitchell, et. al. 2006). Such work suggests that scenarios' influences might be traced to changes scenarios induced in actors' knowledge or understandings of particular issues, because of processes of social learning and/or because particular "problems" or "solutions" were framed or reframed by scenario development.

The Brown University Scenarios Workshop

The consideration of scenarios both as products and as social processes highlights the myriad of questions to be asked about the practice and politics of scenarios. Given the wide-ranging list of questions, we co-organized a workshop on scenarios to refine the list of promising research directions. The "Global Environmental Futures: Interrogating the practice and politics of scenarios" workshop was held on March 23 and 24, 2007 at the Watson Institute for International Studies at Brown University. The workshop featured fourteen presentations by scenarios form various institutional settings and across various issue domains. Copies of the power point presentations and background readings are available through the workshop website at http://www.watsoninstitute.org/ge/scenarios/.

In organizing the workshop, we pursued three avenues to generate a scenarios research agenda. First, the presentations focused on the MA, IPCC SRES and other current scenario analyses to provide an overview of current practices/best practices in scenario production and scenario use across a range of scenario types. Panelists addressed impacts scenarios, emissions stabilization scenarios, ecosystem scenarios, and private sector and civil society environmental scenario analyses.

A second group of presenters contributed the greater experience generated from over four decades of scenario development in other issue domains to the current state of knowledge regarding global environmental scenarios. Scenario exercises have long been employed around issues such as national and international security, human population trends, public health, and energy supply and demand (UN, 2005; van Vuuren, Weyant, & Chesnaye, 2006; Wei, Liang, Fan, Okado, & Tsai, 2005). For example, a substantial literature has assessed the accuracy of past projections of both population (Bongaarts & Bulatao, 2000) and energy prices and demand (Craig, Gadgil, & Koomey, 2002; O'Neill & Desai, 2005). Beyond assessing numerical accuracy, analyses have investigated why population and energy scenarios have gone wrong, and what influence they have had (or not) on policy processes

(Greenberger, 1983). Experience in the security domain can offer insight into effective linkages with policy communities. More than any other issue domain, scenario analysis around security issues has been most directly and effectively linked to a policy agenda. Furthermore, population, energy, and security issues no longer constitute separate domains. Environment-related scenario analysis increasingly intersects with other substantive areas of scenario analysis. For example, the analysts at the U.S. National Intelligence Council plan to incorporate climate change and related aspects of land use change into their next global trends scenario, due out in December of 2008 (NIC, 2004). These reports highlight geopolitical, demographic, economic and environmental trends of interest to US security policy and foreign policy makers. By including these other domains, we accessed a larger body of empirical research on scenario analysis.

Finally, the third element of the workshop structure was to bring into dialogue scenario practitioners, both producers and users, with social scientists. This productive exchange contributed social science insights to the analysis of scenarios while also establishing scenarios as scientific and social processes worthy of study within the social science community. Moreover, the workshop expanded the community of scholars, analysts and scenario practitioners engaged in concerted efforts to improve the practice of scenario development for environmental policy and to improve collective knowledge about the relationships of scenario processes and outputs to policy making.

An emerging scenarios research agenda

The goal of the Brown University scenarios workshop was to lay the groundwork for a multi-year research effort designed to advance debate and methods for improving scenario analysis. The workshop discussion yielded both a list of key questions at the core of a scenarios research agenda and a list of scenario production activities that can serve as scenario research laboratories. Potential research sites range from the new generation of emissions scenarios by those affiliated with the IPCC scenarios, to the global scenarios produced by the US National Intelligence Council, to four generations of UK climate scenarios, to IIASA greenhouse gas initiative stabilization scenarios (see Tables 1 and 2). In terms of key research questions, a consensus among the workshop participants identified the following two areas as a necessary core to a scenarios research agenda

1. Are scenarios used and policy useful?

One characteristic of environmental scenarios is their widespread proliferation over the past decade. The fact of proliferation may be interpreted as an endorsement of the utility of scenario analyses to decision-makers. However, there is currently no academic research that tests this proposition. Very little is known about how, by whom, and to what effect scenarios are used. Among recent, large-scale scenario exercises, only the Millennium Ecosystem Assessment tracked MA scenario use by key stakeholder groups (Reid, 2006). Given the general gap in academic research, we look to practitioner insights for guidance.

The general consensus among scenario practitioners is that those involved in the process of generating scenarios benefit most from the exercise and find the resultant scenario products most useful. In contrast, there is widespread skepticism and lack of information about the utility of global scenario exercises characterized by significant separation between scenario producers and scenario users. There are lessons to be drawn from these practitioner insights both for

mechanisms to improve the policy utility of scenarios and for research geared at understanding the policy utility of scenarios. These lessons suggest three testable hypotheses.

The first testable claim is that scenarios are most useful when there is clear and close connection between the production of scenarios and their intended users. This type of connection is not limited to a particular type of scenario or user group. Rather, it tends to exist when there is an institutional connection between producers and users. For example, the National Intelligence Council's global trends scenarios have as their direct and clearly identified clients Washington policy-makers. The scenarios are developed and released in December between the presidential election and inauguration, meaning that as it develops the scenarios, the NIC does not know its specific "customer." However, the general category of scenario user is clearly identified, and his/her needs are incorporated into the scenario design process and the NIC's scenario output communication strategy (Burrows, 2007). Large-scale global environmental scenarios tend to targeted at multiple user groups. For example, the IPCC's global emissions scenarios are geared at an international audience, including all the participants in the UN climate changes negotiations. However, the most direct application of the IPCC emissions scenarios is as inputs to other impact and mitigation modeling efforts carried out of the institutional umbrella of the IPCC. Anecdotally, the uptake of IPCC emission scenario outputs appears to have been much greater within scientific and technical communities than it has been in policy communities.

A second hypothesis regarding the utility of scenarios is that scenarios are most useful when the scale of the scenario matches the scale of concern to decision-makers. This is a challenge for many large-scale environmental scenarios, which tend to focus at the global or macro-regional level. For example, the World Business Council's scenarios for sustainable development portray an undifferentiated, global picture. The IPCC SRES scenarios divided the world into four regions. UNEP's GEO 3 and GEO 4 scenarios incorporate six differentiated geographic regions. Issues of scale are of significant concern to scenario producer communities. Among recent scenario exercises, the MA scenarios have made most progress in developing sub-global scenario exercises. Examples of MA sub-global scenarios include a Southern Africa exercise, the India exercises, and an exercise focused on Madison, WI among others (Zurek, 2007). Yet, even with this disaggregation, it is unclear the extent to which the MA scenarios informed policy decisions. The MA scenarios had neither an institutionally linked client nor were they targeted at the single user group. Projected users included international and national policy makers, civil society groups, the academic community and private sector actors. The preliminary analysis of MA reveals some but limited uptake across all user groups.

Third, this entire discussion has been purposefully vague about defining utility. Defining and determining the utility of scenarios stands at the intersection between two trends. On the one hand, theory (Farrell & Jaeger, 2005) and preliminary analysis suggests that utility cannot be defined in the abstract, independent of users and their evaluations of the purpose of scenarios. The US EPA, which is beginning to use scenarios to support decision-making, emphasizes that it is the decision-makers' prerogative to evaluate if scenario information is useful (Scheraga, 2007). On the other hand, lack of clarity about the intended purpose and potential applications of scenarios is the origin of some of the disaffection with scenario products and processes. Anecdotally, there is a tendency to expect scenarios to do all things for all people. For example, the Union of Concerned Scientists has developed temperature change scenarios for the US Northeast. In communicating the scenario results at a town meeting, a dairy farmer asked if the scenarios could tell him when he should invest in air conditioners for his dairy barns (Wake,

2007). A scenario analysis can never answer this question. Therefore, a research agenda focusing on the utility of scenarios to policy-relevant decision-making must be carefully attuned to the limits of scenarios, without pre-empting the range of user-based assessments of utility.

2. How do scenarios produce meaning?

As argued above, if we take seriously the proposition that scenarios are best understood as social processes, than we must treat the reports and other artifacts they produce as products of social interaction. Attention to the NIC's global trends analyses help to illustrate these points and the incumbent need to use analytical tools from social science to interrogate them.

The NIC is tasked with being the center for midterm and long-term strategic thinking with the array of US national intelligence organizations and the broader intelligence community. Hierarchically, NIC administrators report to the Director of National Intelligence (DNI). NIC analysts work extensively with NGO, university and private sector individuals and organizations as part of their analytical work. They do so, at times, by commissioning reports, presentation and/or meeting participation from such individuals and groups. NIC staff also participate in conferences and meetings organized by others – in the NGO, academic and private sectors. NIC staff publish reports on timely topics, with most such reports being classified. A minority of these are also issued in unclassified form. Likely the NIC's most high profile responsibilities are those associated with leading processes to produce "National Intelligence Estimates" (NIE). NEI's "are DNI's most authoritative written judgments concerning national security issues" ("NIC Mission" on NIC website). NEI's are intended to provide policymakers with the best information and judgments of intelligence community members, irrespective of whether these judgments conform to existing US policy. As such, NIC staff attempt to coordinate the expertise, information and personnel across a host of intelligence agencies to assess the likely course of future events around particular security issues. Beyond NEI's, the NIC has also become known among some policymakers, academics and media outlets for the trends and scenarios analysis they publish. The most recent such assessment, "Mapping the Global Future," was published in December of 2004 (NIC, 2004). Another is planned for publication in December of 2008. Previous global trends reports – "Global Trends 2010" and "Global Trends 2015" -- were published in 1996 and 2000 (NIC, 1997, 2000).

First, how and why are NIC's global trends reports produced? NIC's trends reports are written by NIC staff on the basis of a series of conferences and meetings organized by NIC or by NIC contractors. Some of these gatherings focus on specific topics or themes, with discussions organized around commissioned background papers. Others have more wide-ranging structured or semi-structured agendas. Participants include NIC staff, government employees from within and from outside intelligence community organizations, and analysts from academia, NGOs, think tanks and private sector firms. NIC staff set the some of the topics for these meetings and, in response to feedback, they can schedule others and/o restructure planned gatherings. NIC staff produce a short, written conference report for each meeting. The 2020 process produced the "Mapping the Global Future" publication (NIC 2004) and established a website that contains information on all of the preparatory conferences and the conference reports and background papers.[7] This website also links to a downloadable "International Futures" model, the development of which was partially supported by the NIC, hosted on the website of the

[7] The "Mapping the Global Future" webpage can be found on the Director of National Intelligence's website at http://www.dni.gov/nic/NIC_2020_project.html

University of Denver.[8] The model is intended to help simulate global systems and it is intended for classroom and other educational uses.

Beyond the physical, published products of the NIC processes, the content of the final report includes four storylines. These storylines are explicitly framed as "fictional scenarios" that "describe possible worlds upon whose threshold we may be entering, depending on how tends interweave and play out" (NIC, 2004: 16). The storylines, and the trends upon which they rest, rely heavily on the duel axes of factors relating to states and markets that are common themes in scenario storylines. A review of the the brief description of scenario structure in Table 2 illustrates this theme. As such, some of the major trends identified in the NIC process include the rise of new state powers, continuing and accelerating challenges to the global state system, and the pace, impacts, inequality and governability of globalization. These tends are assumed to yield "pervasive insecurity" among many elites and publics around the globe and, as the report makes clear, the US role in global affairs and its reactions to significant trends are assumed to play important roles in determining future outcomes. The four storylines are as follows:

> *1. Davos World* robust economic growth, led by China and India, over the next 15 years reshapes the globalization process, giving it a more non-Western face and transforming the political playing field as well.
> 2. *Pax Americana* US predominance survives radical changes to the global political landscape and serves to fashion a new and inclusive global order.
> *3. A New Caliphate* a global movement fueled by radical religious identity politics could constitute a challenge to Western norms and values as the foundation of the global system
> 4. *Cycle of Fear* concerns about proliferation might increase to the point that large-scale intrusive security measures are taken to prevent outbreaks of deadly attacks, possibly introducing an Orwellian world.

In general, the scenarios and the language in the report are discourses of risk, threats and opportunities – to and for the United States. At one level, one might say that there is little here that is surprising. In the early part of the 21st century, US officials were concerned about the rise of new state powers, the preservation of (benign) US global power, the rise of Islamic fundamentalism and the proliferation of weapons of mass destruction. Yet, some aspects of the scenarios might surprise, including the notion that the rise of Chinese economic and political power may both re-enforce and alter aspects of US hegemony in ways for which US policymakers and publics may be ill-prepared. In the "cycle of fear" scenario, strongly coercive government reactions to WMD threats serve to enhance illicit arms flows and harm global economic growth and stability. Many readers will not find the parameters of the scenarios surprising – globalization, US hegemony, Islamic fundamentalism, the rise of Chinese power and weapons of mass destruction. Yet, the scenarios can serve to articulate a small number of the many permutations of these factors in combination. They also serve, particularly in reference to their articulation of important trends and storylines, to define the priorities of a particular community of actors and what these actors believe their audience should think about.

Conclusion

What to make of these details, and of such exercises? This paper does not purport to offer definitive explanations or interpretation scenario processes or products. Rather, it seeks to

[8] See http://www.ifs.du.edu/

demonstrate that scenario production processes and the artifacts such processes produce are interesting and fruitful places for social research. The IPCC scenarios, the MA scenarios, and the NIC 2020 work was well covered in national and international media and a number of participants in the process believe they learned from it and believe the reports have "held up pretty well."[9] The scenario outputs offer a window into the collective expectations, hopes and anxieties of members of the global climate change, ecosystem governance, and intelligence communities. As such, they offer sights for research into the construction and reconstruction of collective ideas and meaning within this community.

[9] VanDeveer and Pulver interviews and discussions with NIC staff members, IPPC SRES participants and MA participants.

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Table 1: Ongoing Environmental Scenarios Exercises

UNEP Fourth Global Environmental Outlook (GEO 4)

- The Global Environmental Outlook is UNEP's periodic report on the state and trends of the global environment. The fourth installment is due to be published in late 2007 or early 2008, containing both model driven analysis of environmental and social trends into the 21st Century, as well as narrative storylines and illustrative case examples of contemporary actions, institutions and challenges.

National Intelligence Council Global Trends 2025

- NIC staff members have begun the planning and background meetings for the series of meetings and themes that will help them build the 2025 scenarios. Most of the process will take place in 2008 and the final report is scheduled for release in December of 2008, after the US Presidential election and before the new President takes office.

New Intergovernmental Panel on Climate Change (IPCC) Scenarios

- IPCC Task Group on New Emissions Scenarios (TGNES) made final recommendations to IPCC plenary in April 2006, recommending development of new scenarios to be used in the Fifth Assessment Report, to replace the SRES scenarios. Scenarios to be developed by modeling community in an integrated way (i.e., not just emissions scenarios but scenarios that include emissions, climate change, and impacts), with results assessed in an IPCC Special Report on Integrated Scenarios to be completed by 2010. Note that the plenary has not yet agreed to the Special Report.

IIASA Greenhouse Gas Initiative stabilization scenarios

- A set of stabilization scenarios using three different development paths (based on the SRES storylines) and several alternative stabilization levels, developed at IIASA over the period 2004-2006. Nine papers describing the scenarios and models used are in press for a special issue of Technological Forecasting and Social Change.

U.S. Climate change scenario exercise

- Development of alternative baseline and stabilization scenarios as part of the U.S. Climate Change Science Program (CCSP) as one of the >20 "synthesis and assessment plans" called for by the CCSP Strategic Plan. Three modeling groups involved (MIT, DOE/U.Md., EPRI/Stanford).
- Public review draft available at: http://www.climatescience.gov/Library/sap/sap2-1/public-review-draft/default.htm

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Table 2: Catalogue of International Environmental Scenario Analyses

STUDY	Date	Horizons	Regions	Focus	Structure
Impacts of Climate Change: A System Vulnerability Approach to Consider the Potential Impacts to 2050 of a Mid-Upper Greenhouse Gas Emissions Scenario (Global Business Network)	2007	2050		Climate change	Starts by focusing on vulnerable systems, then considers what climate change might do to them
World Bank: The Road to 2050: Sustainable Development in the 21st Century	2006	2050	Global	Environment	Uses UN predictions of population and wealth as a basis for discussion of environmental impacts
Air Quality and Ancillary Benefits of Climate Change Policies (European Environment Agency)	2006	2030	Europe	Air quality	Analyzes projected changes in air quality and shows costs and benefits of climate and pollution policies
Millennium Ecosystem Assessment	2005	2050 & 2100		Ecosystems: changes in services and effects on humans	2 main dimensions: continuation of globalization versus fragmentation, reactive versus proactive responses to ecosystem deterioration 1. *Global Orchestration* (global, reactive): low population growth and high economic growth; investment in public goods, energy-intensive lifestyle 2. *Order from Strength* (regional, reactive): very high population growth and low economic growth; fragmented world preoccupied by security, not public goods 3. *Adapting Mosaic* (regional, proactive): high population growth, initially low economic growth that increases after 2020; diverse regional efforts to protect ecosystems 4. *TechnoGarden* (global, proactive): moderate population growth, relatively high and increasing economic growth; globally connected world with strong environmental policy and technology
US National Intelligence Council's 2020 Project: "Mapping the Global Future"	2004	2020	Global	Focuses on economics and security, includes environmental issues under the heading of "ethical issues"	*1. Davos World* robust economic growth, led by China and India, over the next 15 years reshapes the globalization process, giving it a more non-Western face and transforming the political playing field as well. 2. *Pax Americana* US predominance survives radical changes to the global political landscape and serves to fashion a new and inclusive global order.

					3. A New Caliphate a global movement fueled by radical religious identity politics could constitute a challenge to Western norms and values as the foundation of the global system *4. Cycle of Fear* concerns about proliferation might increase to the point that large-scale intrusive security measures are taken to prevent outbreaks of deadly attacks, possibly introducing an Orwellian world
The Future for Fisheries (Pauly et al., *Science*)	2003			Fisheries	Applies the 4 UNEP scenarios (*Markets First; Policy First; Security First; Sustainability First*) to an analysis of marine fisheries
UNEP's 3rd Global Environmental Outlook (GEO-3)	2002	2032	6	Environment	*Markets First; Policy First; Security First; Sustainability First* (correspond respectively to 1a, 1b, 2b, and 3b above)
African Environment Outlook (UNEP)	2002	2032	6	Environment	(uses the 4 categories from GEO-3, originally from GSG) 1. *Market Forces* 2. *Policy Reform* 3. *Fortress World* 4. *Great Transitions* Applies scenarios to African context via demographics (total population and the urban population figures for Africa, and for each of its sub-regions); economy and society (GDP as Purchasing Power Parity); agriculture and forestry (severely degraded cropland); and environment (water use and urban household water pollution) *Driving forces*: demographics, economics, social issues, culture, technology, environment, governance
Global Water Outlook to 2025: Averting an Impending Crisis (International Food Policy Research Institute)	2002	2025	36	Water access, consumption	Predicts water access and consumption in each country/group of countries in 2025
OECD's *Environmental Outlook*	2001	2020	10	Environment in OECD countries	*Reference* with policy variants (e.g. subsidy removal, eco-taxes)
Asian Environment Outlook (Asian Development Bank)	2001		Asia	Environment	Policy recommendations based on projected future trends due to "driving forces of change": population explosion; urbanization and industrialization; income growth and inequality; technological change; governance; institutions, policy, and the market

IPCC's Special Report on Emissions Scenarios	2000	2100	4	Climate Change	AI: rapid market-driven growth with convergence in incomes and culture A2: self-reliance and preservation of local identities, fragmented development B1: similar to AI, but emphasizes global solutions to sustainability B2: local solutions to economic, social, and environmental sustainability
World Water Vision	2000	2025	18	Freshwater Crisis	*Business-as-usual*: current water policies continue, high inequity *Technology, Economics, and the Private Sector*: market-based mechanisms, better technology *Values and Lifestyles*: less water-intensive activities, ecological preservation
EPA's Environmental Scenarios Project	2000			Aquifer depletion/ water quantity; sprawl; biotechnology and nanotechnology; chemicals in the environment; climate change	2 main dimensions: economic growth and social cohesion (defined by shared environmental values versus environmental indifference, economic inequities, social justice) 1. *Eco-efficiency revolution* (high growth and cohesion) 2. *Full Speed Ahead* (high growth, low cohesion) 3. *Soft Landing* (low growth, high cohesion) 4. *A Darker Age* (low growth and cohesion)
UNEP's 2nd Global Environmental Outlook (GEO-2000)	2000		6	Environment	Region-specific studies undertaken to analyze policy alternatives (example: Asia and Pacific alternative policy study on emission reductions for sulphur and nitrogen oxides under different scenarios: business as usual, single policy packages such as the introduction of clean technologies, efficient transportation and fuel switching, and a combination of all three called the multiple policy package)
Global Biodiversity Scenarios for the Year 2100 (Sala et al., *Science*)	2000	2100	Divided by biome	Biodiversity	Developed global scenarios in 10 terrestrial biomes and in freshwater ecosystems based on analysis of 5 drivers: changes in land use, atmospheric CO2 concentration, nitrogen deposition and acid rain, climate, and biotic exchange For each biome, 3 alternative scenarios
World Business Council for Sustainable Development	1997	2050	n.a.	Business and sustainability	*FROG1:* market-driven growth, economic globalization *GEOpolity*: top-down approach to sustainability *Jazz*: bottom-up approach to sustainability, ad hoc alliances, innovation

UNEP's 1st Global Environmental Outlook (GEO-1)	1997		6	Environment	Compares projected future under business as usual with a brief discussion of "alternative development scenarios" illustrating that technology transfer can lead to significant changes in energy consumption, land use, and carbon dioxide emissions
Global Scenario Group (GSG)	Started in 1995	2050	11	Environment; poverty reduction; human values	1. *Conventional Worlds*: gradual convergence in incomes and culture toward dominant market model a) Market Force: market-driven globalization, trade liberalization, institutional modernization b) Policy Reform: strong policy focus on meeting social and environmental sustainability goals 2. *Barbarization*: social and environmental problems overwhelm market and policy response a) Breakdown: unbridled conflict, institutional disintegration, and economic collapse b) Fortress World: authoritarian rule with elites in "fortresses," poverty and repression outside 3. *Great Transitions*: fundamental changes in values, lifestyles, and institutions a) Eco-Communalism: local focus and a bio-regional perspective b) New Sustainability Paradigm: new form of globalization that changes the character of industrial society

(Source: Drawn primarily from Nakicenovic et al. 2000, Parson et al. 2007, Raskin 2005; for other sources please see text)

Table 2 (cont): Pre-1995 Global Environmental Scenarios

STUDY	Date	Horizons	Regions	Focus	Structure
The Coming Anarchy, Kaplan	1994				Narrative-based; dark vision of increases in demographic, environmental and social stresses; surging populations, disease, and depletion of natural resources will lead to mass migration and group conflict
Scanning the Future, The Dutch Central Planning Bureau	1992	2015			Modeling-based; macroeconomic model 1. *global crisis*, overall economic decline 2. *balanced growth* 3. *European renaissance* 4. *global shift* 3 and 4 predict economic stagnation in some regions and expansion in others, but all scenarios optimistically predict convergence between rich and poor regions
Into the 21st Century, Burrows et al.	1991				Narrative-based; 1. *pessimistic*, if present trends continue 2. *piecemeal*, fragmented attempt to find environmental and social solutions 3. *optimistic*, dramatic changes in attitudes and values toward altruism, cooperation,a dn ecology
Surprising Futures, Svedin and Aniansson	1987	2075			Narrative-based; results of workshop of social and natural scientists 1. *the big load*, continues dominant trends 2. *the big shift*, toward new centers of power in India & China 3. *history lost*, future of crises 4. *hope regained*, environmentally, socially balanced global development
The Sane Alternative, Robertson	1983				Narrative-based 1. *business as usual* 2. *disaster* 3. *authoritarian control* 4. *hyper-expansionist* 5. *sane, humane, and ecological* Emphasizes need for significant psychological and social changes
The Global 2000, Barney	1980	2100		11 sectors: pop, tech, economy, climate, food, fisheries, water, forestry, energy	Modeling-based; uses set of linked models to predict continuation of trends in population, natural resources, and environment; predicts huge population growth leading to global poverty

The Next 200 Years, Kahn et al.	1976				Narrative-based
The Future of the World Economy, Leontief	1976	2000	15	Prospective UN economic policies	Modeling-based; tracked economic flows An optimistic scenario: income gap between industrial and developing countries decreases by one half by 2000 Sustained economic growth will require large capital investments in developing regions and significant political, social and institutional changes
Catastrophe or New Society? A Latin American Model, Herrera et al.	1976	2060	4	Agriculture, nutrition, housing, capital goods, other	Modeling-based; *Bariloche Model* used to address sociopolitical issues; backwards-oriented
Mankind at the Turning Point, Mesarovic and Pestel	1974		10 (follow-up project to *Limits to Growth* aimed at regional disaggregation)	Economy, population, food, energy, environment	Modeling-based; used 5 different sub-models for each of the categories listed impending crisis, need for significant changes
The Limits to Growth, Meadows et al.	1972	2100	Global model	Population, capital, agriculture, nonrenewable resources, pollution	Modeling-based; "systems dynamics model" *14 scenarios* with different assumptions on technical progress, social policy, and value changes

(Source: Raskin 2005)