

**Global-Change Scenarios: their Development and Use  
US CCSP Synthesis and Assessment Product 2.1b**

**Comments by Dr. Robert Lempert, RAND.**

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*Author team responses in italics:*

**OVERVIEW**

This draft has a wealth of interesting and valuable material. It raises a number of important and interesting issues.

1. However, the draft does not yet seriously grapple with basic questions implied by the title – the development and use of global-change scenarios. Such questions include: Why do organizations turn to global change scenarios and what do they expect from them? What alternatives did they consider? Do current global change scenarios serve the goals for which they were intended? Why or why not?

*We have attempted to engage these questions, both theoretically in the discussions of potential uses for scenarios and empirically in the specific cases discussed. We have also attempted to state and support more clearly our arguments and conclusions regarding the diverse expectations from scenarios, how they have been used, and what purposes they have served, in the revised paper. Providing complete and systematic answers to these large-scale and challenging questions, however, would require an extensive program of primary research well beyond our mandate and capabilities in this study.*

2. The failure to address such questions contributes to the draft's ambiguity about what they authors mean by a scenario and make it unclear how broadly or narrowly the reader ought to read the draft's discussions on the uses of scenarios. Once the authors grapple with these questions, the rest of the report should fall more easily into place.

*We do intend our definition of scenarios to be broad, but not ambiguous. The revised draft has added several paragraphs clarifying the boundaries of what we count as scenarios and distinguishing them from other things they are often confused with. These clarifications have been added both in the introductory sections and in the opening passages of the conclusions, because some reviewers objected to the conclusions on the basis of a different conception of scenarios than we were using. We have also been more explicit about delimiting what types or subsets of scenarios particular conclusions apply to.*

## COMMENTS ON CONCLUSIONS

The first two of the draft's conclusions illustrate this lack of specificity as to what is meant by "scenario." The third conclusion illustrates questions about how broadly or narrowly a reader should interpret the draft's discussions about the use of scenarios.

*Responses are under specific elaborations of the comment below.*

3. The first conclusion reads, "Scenarios are required for responsible decision-making on global climate change." The authors contrast scenario analysis to: 1) not thinking about long-term risks or 2) assuming the future will be like the present. Clearly organizations have a broader range of alternatives in thinking about the future than this listing would imply. Thus, this first conclusion can be interpreted in several ways. The authors might be arguing that the uncertainty facing policy-makers is so deep that they cannot responsibly use traditional decision analytic methods based on subjective probabilities and expected utility analysis. Or they might conceive scenarios and subjective utility analysis as synonymous. Or they might regard scenarios as a subset of subjective utility analysis, particularly useful for examining and communicating interesting points in the distribution of future states of the world. Any of these conclusions might make sense, but it makes an important difference to how one interprets the claim that "scenarios are required" whether the authors regard scenario analysis as an alternative to, synonymous with, or a subset of the subjective expected utility decision framework.

*The clarification of the definition of scenarios presented in the revised draft addresses this. In addition to distinguishing scenarios from other types of descriptions of future conditions intended to inform decisions (e.g., projections, predictions, forecasts), the text now also distinguishes them from assessments, models, and decision analyses: scenarios can provide inputs to any of these when they need future conditions stipulated, but they are not an alternative or substitute for any of them.*

4. The second conclusion, "alternative decision strategies – including the pursuit of robust strategies – do not avoid the need for scenario-based thinking about potential future conditions" further confuses what the authors mean by scenarios. All robustness frameworks of which I am aware are based on a notion of multiple future states of the world and are entirely consistent with at least some concept of scenarios. Kees van der Heijden who works in the Shell Oil/Global Business Network (GBN) scenario tradition argues that one important purpose of scenarios (in the GBN sense of the word) is helping organizations assess robust strategies. Our robust decision making work identifies sets of future states of the world or sets of multiple probability distributions over which strategies are robust and specifies certain important clusters in these sets as scenarios. The economists who examine the robustness of monetary policies use alternative structural models of the

economy, each of which can be regarded as a scenario. This conclusion may rest on some implicit definition of scenarios. If so, the authors should make their definition explicit.

*We agree that these are all consistent with using scenarios, defined as alternative stipulated future states of the world. The clarifications of the definition of scenarios in the revised paper detail how any of these approaches to decision-making are consistent with – indeed, can require – scenarios.*

5. The third conclusion reads, “scenarios of greenhouse gas emissions and resulting global climate change are needed by so many different users for so many different purposes, that they should be provided in a coordinate manner for the CCSP... these can be provided centrally, provided the underlying reasoning and likelihood judgments are made as explicitly as possible.” This may well be true, but it raises questions about how broadly the reader ought to take such statements about scenario use. For instance, we live increasingly in a networked world where information is available from a plethora of sources and the key players, from Wikiedia, to eBay, to Google to iTunes, position themselves as trusted intermediaries that provide structured access to this vast array of information. Why should CCSP be the central provider of scenarios and likelihood judgments? Is this a very narrow conclusion or a broad one? Have the authors considered and rejected an alternative model where, for instance, CCSP is a clearinghouse for all the emissions and climate scenarios generated worldwide and provides assistance to diverse users in finding and evaluating those most useful to them? Or are the authors just reiterating the important but common observation that analysts ought to make their underlying assumptions as clear as possible when reporting information to decision makers?

*This conclusion has been revised and clarified. It now proposes that CCCSP support the development of a capacity for scenario production and use. Rather than propose a specific institutional mechanism for achieving this, we discuss several criteria necessary for success and identify only a couple of institutional mechanisms to be avoided.*

## **COMMENTS ON SECTIONS 1 AND 2**

6. Section 1 entitled “Scenarios, their Characteristic and Uses” could say much more about the uses of scenarios and provide a more structured discussion of the diverse types of scenarios used in various applications and the important differences in the ways people use the word “scenario.” The list of scenario definitions that starts the section is interesting, but provides no structure for the draft’s subsequent discussions. If the authors want to make the point that there are many different types of scenarios they should offer a categorized list of different types of scenarios, or use one already in the literature, such as the excellent typology proposed by Marjolein van Asselt and her colleagues.

*The revised draft does this. While it retains retain the simple sorting of climate-change scenarios according to where they fit in the simplified causal chain of the climate issue, it also introduces three additional key definitional characteristics of types of scenarios that draw in part on the Van Asselt et al taxonomy.*

7. More importantly, the authors should emphasize and organize early on the very different uses to which organizations put scenarios. At the most basic level these range from the Wack and Schwartz school which uses scenarios as tools to change the mental models of specific decision makers, to the use of scenarios as a set of standardized input cases for comparative runs of different simulation models. These are clearly very different purposes, and imply different meanings of the word scenario. Clarifying the different uses at the start of the document would greatly help the authors organize and situate their subsequent discussion to avoid the problems such as those with the conclusions mentioned above.

*The revised draft now provides more detail on the many potential uses of scenarios, including exploratory and heuristic uses as well as more direct decision support.*

8. Section 2.6 “Scenarios for Climate-Change Decisions” takes a narrow view of decision-making. It focuses on providing information to *individual* decision makers who will presumably use it to decide what is best to do. It neglects organizational and group decision-making. Yet with the possible exception of the abrupt change scenario GBN developed for the Pentagon’s Office of Net Assessment, all the case studies presented in this report involve the use of scenarios by organizations. This focus is not surprising, since the use of scenarios as tools for organizational decisions making is a central theme of the scenario literature. The need to gain consensus among individuals and organizations with vastly different interests, values, and expectations about the future is a central problem for climate-change decision makers. Yet such issues are entirely missing from this discussion.

*We disagree that the prior draft only addressed applications of scenarios to individual decision-making, but the revised draft nevertheless provides expanded discussion of the uses of scenarios in settings involving multiple and heterogeneous decision-makers, and the distinct challenges that arise in such settings.*

9. As one tiny example, lines 22-24 on page 30 states, “ national officials ... will need this information principally aggregated to the national level.” But aren’t many national official in democratic countries intensely interested in the distributional consequences of potential policies, since there is a strong correlation between such distributional consequences and the political support or opposition a policy gathers in the national legislature?

*We agree, and have modified the draft to reflect this comment. The draft now notes both national decision-makers' need for finer-scale as well as nationally aggregated information, and the potential involvement of sub-national officials in both adaptation and mitigation-related decisions.*

10. More broadly, scenarios are often offered, as one of their central purposes, as tools to help groups with differing views agree on a common, operational vision of the future. There is no sense from this section of the draft on why this might be an important concern for climate-change decision-making and how different types of global change scenarios might aid or detract from this goal.

*Two changes in the revised draft take note of this point. First, we have noted "clarifying points of potential agreement or disagreement" as one of the exploratory uses of scenarios. Second, the revised draft provides more detailed discussion of the diverse potential uses of scenarios in pluralistic political settings.*

### COMMENTS ON SECTION 3

11. Section 3, "Review and Critique of Global-Change Scenario Exercises" provides a wealth of interesting and useful information about the details of scenario implementation, but, with only a few welcome exceptions, is largely devoid of discussion of why different organizations turned to scenarios and how those scenarios helped or hindered those organizations in achieving their goals.

*This recapitulates comment #1 above, and is addressed in our response to that point.*

12. On p. 31/ln 35, the draft states that the mandate for the 1992 IPCC scenarios explicitly excluded any mitigation policies. This is a key issue. Why was this mandate made?

*This comment, along with a few that follow, poses cogent questions about the reasons particular decisions were taken in the scenario exercises we review. While we are still conducting a few more inquiries to track down some of these uncertainties about the reasons for particular past decisions, producing well-founded answers to all of these will require more primary research than we are able to provide in this report.*

13. On p. 40/ln 39-40 the draft glosses over what would appear to be a central question. The draft notes that the SRES scenarios began their life as GBN-style scenarios illuminating key driving forces, they are generally used as a range of emissions projections. Why is this so? Does it necessarily need to be the case? Is the GBN vision of scenarios as a set of focused narratives that change decision makers'

mental model impossible to implement in the large bureaucratic settings where climate scenarios reside? Is it impossible to implement by climate and emissions modelers who don't personally know the climate change decision makers? If the GBN vision could be implemented would it be valuable to do so? There are a host of questions about the real use of and potential value of scenarios in climate-change contexts raised by the life history of the SRES scenarios that would usefully comprise a chapter in this report. They deserve much more discussion than they are given in this draft.

*The revised draft provides a little more detail on this point, but for the most part our response to comment #12 above applies. This is a research question that we were not able to answer definitively in this report – and it is an important and general one, as the concluding discussions now indicate.*

14. The comment on p.42/ln 9-12 that “the failure to consider less fortunate futures, including ones that might seriously challenge the adequacy of current responses, institutions, and decision-making capabilities, may represent a significant weakness in scenarios to be used in planning long-term management of climate change” is exactly on the point, and an example of the sort of issue this draft ought to highlight. How serious is this problem, how pervasive is it, and is it a fundamental problem of the scenario process or a cosmetic one, what can be done about it? More discussion of these points would be very beneficial.

*In terms of drawing this judgment about SRES and characterizing its seriousness, we believe the present draft is already as directly critical as is appropriate, given our primary purpose of providing guidance for future scenario exercises. In terms of the reasons for this decision, the revised draft provides some discussion in terms of SRES being instructed to respond to criticisms about implications of the IS92 scenarios that some observers found objectionable.*

15. The problems with developing the SRES story-lines, mentioned on p. 42/ln 25-32 are similar to those well-documented in the ethnographic studies of scenario processes conducted by Marjolein van Asselt and colleagues. This draft should put its observations in such broader context.

*The issues identified in the van t’Kooten and van Asselt paper are distinct from those we identified here, but we have noted them in the discussion of the two-by-two scenario structure, where we find them more apt. (Note: We have confirmed with the reviewer that this was the paper he was referring to.)*

16. The authors might compare the SRES process to that of the Global Scenario Group (GSG), which similarly developed a set of storylines articulated by model runs. But the GSG seemed to have less trouble combining the storylines with the quantitative

results. There are a number of differences in the processes, including that the SRES scenarios were produced under the direction of governments while the GSG is a collaboration of non-profit organizations, and the SRES scenarios aim to provide a non-biased scientific view while the GSG took a more advocacy position.

*We have briefly noted the GSG exercises, in the context of the revised report's expanded discussion of normatively based scenarios. We do not find much in common between the challenges faced by these two activities, however. The normative orientation of the GSG exercise is a crucial distinction. More fundamentally, the modeling underlying the GSG project is a simple spreadsheet-based accounting framework, so the challenges SRES faced of integrating distinct causal logics of narrative scenarios and quantitative models did not apply to GSG.*

17. On p. 57/lns 22-27 and p. 58/lns 10-12 the draft mentions that the UKCIP scenarios are being used by several organizations to inform decision making. It would be very useful to have much more information on why these organizations are using the scenarios, what they are using them for, and how well they meet their needs. At very least, would it be possible to talk to the users and report what they had to say?

*The revision provides a little more detail on these points. As with several of the points requesting further research, however, this would require primary research that has not been done yet. We have drawn on the few evaluations that have been done of the application of these scenarios.*

18. The discussion in Section 3.5 on the Pentagon/Global Business Network Abrupt Change Exercise suggests that the authors interviewed scenario-developer Peter Schwartz. Schwartz writes extensively, as a principal exponent of the Shell Oil/GBN scenario school, on the topic of the questions missing from this study – why organizations turn to scenarios and how those scenarios can help organizations achieve their goals. It is thus disappointing that this section offers no critical assessment of how Schwartz's vision of how organizations ought to use scenarios -- described in such detail in his, Pierre Wack's, and Kees van der Heijden's writings - - played out in this particular cases

*The revisions provide more elaboration of their heuristic and exploratory conception of scenarios. The GBN exercise is not a particularly good illustration of this philosophy, however, as it was largely a staff exercise done with limited input from the client office only at the beginning and end of the process.*

19. On p. 70/ln 7, why haven't these scenarios been incorporated into any operational decision?

*Because the relevant decision-makers have more immediate priorities and are only slowly coming to recognize the need to incorporate climate change in their long-range planning decisions. The revisions provide more detailed discussion of this issue, more generally than just in this case.*

20. Section 3.8 on Scenarios of Ozone Depletion in International Policy-making presents a success story for scenarios. The draft reports that this scenario exercise was “highly influential in breaking the deadlock in international negotiations.” It would be interesting to learn more about why this was the case, what characteristics of the scenarios were aligned correctly with what characteristics of the political environment in which they appeared made the scenarios so influential? More broadly, perhaps Section 3 of this report might begin with this case study and others where you can say something concrete about how organizations used the scenarios and why. In this list I might include the Pentagon Abrupt Change Scenario, the work of the Global Scenario Group, your case study on NAPAP vs. EMAP, and the use scenarios in the most recent California Department of Water Resources (DWR) Water Plan, whose 2005 Public Advisory Committee update describes some of the success and frustrations DWR experienced with their scenarios. Then you can move to discussions of the other scenario case studies in the draft where it may be harder to assess why and how organizations have used them for decision-making.

*The revised draft has extensively reorganized the treatment of the short cases, to couple them with the thematic discussions where they are most relevant.*

21. On p. 71/ln 10, why were changes of sea level rise not considered in this scenario analysis?

*(This comment refers to the case on climate-change in the Columbia River system.)  
The demands that were assessed and projected all occur substantially up-river from the region subject to any tidal and sea level rise effects.*

22. On p. 75, this discussion of how and why the EMEP scenarios were used is excellent and should be a model for the rest of the draft.

*The revised text has retained this case and attempted to sharpen its lessons.*

#### **COMMENTS ON SECTION 4**

23. Section 4 on “Issues, Challenges, and Controversies in the construction and use of scenarios” contains much useful discussion, but could usefully be reorganized to provide more structure for the overall report, and for the controversies discussed in this section. The following discussion will address the subsections in the order in

which I believe they should be presented. This ordering, which emphasizes how scenarios are used rather than challenges facing their developers, would help address the draft's relative lack of attention to the former and provide useful context for the discussion of the latter.

*The revised draft has re-organized Section 4 along the lines suggested.*

24. Sections 4.5 “Scenarios and Assessments in Climate Policy Debates” and Section 4.6 “Scenarios and Decisions” describe two of the key uses to which organizations put global change scenarios. Both provide some good discussion of the key questions underemphasized in this draft -- Why do organizations turn to global change scenarios and what do they expect from them? What alternatives did they consider? Do current global change scenarios serve the goals for which they were intended? Why or why not? To emphasize their importance, the authors should consider beginning Section 4 with these the current Sections 4.5 and 4.6, and do much more to highlight their main themes and lessons in the introductory comments (currently just three lines) to this section.

*The revised draft has re-organized Section 4 along the lines suggested.*

25. Once the draft had laid out the ways in which scenarios are used and the goals for their use, it could then describe the process of developing scenarios. Section 4.3 contains much useful information. In particular, many useful points are raised in the discussion of the differences between the relationships between scenario-developers and clients in the classic GBN model and that often found in the climate change area.

Having described the uses of scenarios and the process of developing them, the authors could then usefully turn to the consistency and integration of scenarios, currently in Section 4.1, and then to the treatment of uncertainty, currently addressed in Section 4.2. The draft's current discussion could greatly benefit from such placement in an overall context.

*The revised draft has re-organized Section 4 along the lines suggested.*

26. The current discussion in Section 4.2.1 and 4.2.2 offers a lengthy five-page detour describing probabilistic estimates of future projections differentiated by values of one quantitative parameter. This is obviously a limiting case that allows for simple discussion of the subjective probability framework, and also describes the most commonly used output of the SRES process – the range of quantitative emissions scenarios. But the basic point of the draft's discussions – that one can usefully place probability distributions over the range of values for a single parameter – is sufficiently obvious to require little more than a few sentences. The relevant and

interesting question – why did the SRES exercise devolve in its audiences’ minds to a single range of emissions paths – is not addressed by this discussion. There are numerous other topics which the authors could usefully mention in these five pages, ranging from a description of different formalisms for characterizing the types of uncertainty addressed by scenarios (e.g. single subjective probabilities estimates, probability intervals, imprecise probabilities, belief functions, the quantification of scenarios as vulnerabilities of robust strategies which derives from robust decision making, etc.); a discussion of the vast literature on how organizations use, misuse, and process uncertain information; to a description of the Peter Schwartz/Pierre Wack concept of scenarios which in a significant lack is never presented in any coherent fashion anywhere in the draft.

*The section has been substantially cut, as suggested.*

27. Section 4.2.5 on the debate of quantifying probabilities provides a useful discussion of an important topic, but could easily stand on its own without Sections 4.2.1 and 4.2.2. The authors identify the core issue when they write (p. 95/ln 35-38) “a final argument against quantifying probabilities is that the attempt to do so may represent an unhelpful distraction that consumes times and resources, generates conflicts, and is of little value to scenario users. Whether this is the case, of course, is in part a judgment to be made by scenario users, not developers.” The authors should certainly cite any literature of which they are aware that shows that organizations that use scenarios with quantified probabilities obtain better outcomes than organizations that use scenarios without such probabilities. Otherwise, the authors should acknowledge that their preference for placing probabilities on scenarios is based on their personal judgments as to what is most useful. The authors’ argument that the usefulness of quantified probabilities may be enhanced in situations where there are large numbers of diverse decision makers is a useful contribution to the debate.

*While we are unaware of any systematic research indicating differential effectiveness in scenario use depending on whether probabilities are expressed or not, the revisions have provided more explicit supporting argument for under what conditions we expect explicit probability assignment to be most useful, and why.*

28. The authors seem to assume without justification that there is only one way to provide quantitative information comparing the likelihood of alternative scenarios. Given the degree of uncertainty, perhaps some type of imprecise probability of belief function would be more useful than a single probability density function. Perhaps a range of probabilities would be more appropriate, so that scenario developers might specify that none four SRES scenario families have less than 10% or more than 90% likelihood. Perhaps, consistent with the draft’s discussion on p. 106, probabilities ought to be contingent on socio-economic-political events for which the scenario-users’ subjective probabilities might be better than those of the

scenario developers. For instance, the scenario-developers might make clear that a high probability of low SRES emission scenarios is contingent on certain future political events about which the users might have better knowledge than the climate experts. Whichever way the authors choose to argue, they should make clear whether they are arguing from literature on how organizations use such information or their own judgment about how organizations should use such information.

*The revisions provide more detail on various means and degrees of specificity with which probability judgments can be expressed.*

29. Section 4 could then close with the current section 4.4 on “Communication of Scenarios.” It would be useful to add some discussion of communicating the narrative components of scenarios, in addition to the quantitative information.

*We have taken this suggestion in re-organizing Section 4.*

## **SUMMARY COMMENTS**

30. The authors of this draft face a challenging task. Scenarios are widely employed. But there are many competing scenario concepts, and the literature on how they can be most effectively used is sparse. In contrast to many of the other CCSP reports, the authors of this draft had to structure a body of information characterized by a very high ratio of anecdote to formal findings. The authors have assembled a great deal of useful information and raise some important points. Nonetheless, the document fails to grapple with the central issues implied by its purview – how and why organizations use scenarios, how these scenarios do and do not help these organizations meet their goals, and how future global-change scenarios could improve their contributions. Once the authors have decided what they can say about these questions and organize their draft accordingly, much of the useful information they present here should fall into place.

*This reprises earlier comments. Some of these suggest reorganizations, which we have largely adopted. Others request additional empirical research. We have provided a little more in the revised draft, but several of these requests go beyond our capabilities or mandate in this project.*

31. The authors should also keep in mind for both themselves and for the reader the caution that begins the draft, that is, that the judgments expressed here are often based on the personal experiences of the authors and not scientific studies of how scenarios have and could contribute to organizations’ goals. Given the nascent state of the literature in this area, this draft more usefully than most might suggest areas where future research might contribute most significantly to our understanding of the development and use of global change scenarios.

*In the revisions, we have attempted to make this point more clearly and forcefully.*

## **MINOR COMMENTS**

32. p. 2/ln 13: Conventional methods often generate errors often generate serious errors projecting out less than 10 or 20 years. Remember the peaceful end of the Soviet Union, 9/11, the Internet bubble?

*This section is revised so it can no longer be taken to imply that there can be reliable socio-political projections a few years in advance.*

33. p. 11/ln 21-26: The quote from Pierre Wack comes from a concise statement of the purpose of scenarios which is counter to much of what is described in this draft. It seems odd to use it here without taking on the broader argument.

*It is hard to get around the fact that much of what is presented as scenario-based analysis in the climate-change field would not be recognized as scenarios by Wack. The broad purview and broad definition of scenarios we have adopted make such disjunctions inevitable.*

34. p. 29. Nothing on state level officials? More climate policy is going on at the state level right now than on the federal level.

*The earlier draft had considered state officials for adaptation and impacts decision. The revisions have now noted that they may also be involved in mitigation-related decisions.*