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

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Author team responses in italics:

General Comments:

Overall, this is a remarkable document that makes a strong contribution to global scenario practice. My comments should not be taken to detract from this overall assessment, but are intended to strengthen the effort.

1. Throughout the report underplays the critical issue of the framing of central questions. No doubt this is partly because the authors have presumed up front that the issue in question is narrowly focused on climate change, or some related area such as the global environment. But often in scenario work by far the hardest task is knowing how to frame the central questions that needs answering, in a way that is deeply relevant to users.

   We agree. This is stressed in the discussion of decisions made in producing scenarios, Section 1.2.

Page-by-page comments.

2. Pg 1, line 27: The document says scenarios are used for issues with long time horizons, high stakes, and substantial uncertainty. "Long time horizons" is not quite right, as scenarios are also developed for short horizons, although in situations where there are still high stakes and substantial uncertainty. For example, companies and governments regularly do work on the potential outcomes of 'crisis' situations with time horizons measured in weeks or months. The appropriate time horizon for scenarios is determined by the time in which relevant processes unfold and the full consequences can be seen for the issues under review, and this may be relatively short or long.

   This is corrected. The draft now stresses depth of uncertainty and size of stakes as the primary challenges that call for scenario-based thinking, with time horizon a secondary factor that may matter only because uncertainties deepen as time horizons lengthen.

3. Pg 6, lines 23-32. It is essential to evaluate and criticize scenarios in terms of the set of scenarios, not any individual scenario. The test of a scenario exercise is the relevance and usefulness of the set to policy, strategy and decision makers. Of course, individual scenarios need to be tested for internal consistency, alignment of narrative and quantification, etc.

We agree. The draft makes this point, in the introductory discussion of scenarios and the discussion of uncertainty in scenarios.

4. Pg. 7, line 17: A set of scenarios cannot cover and represent all uncertainties. There are always important elements of selectivity and design in scenario building. A set of scenarios is frequently developed to shift users' attention to new aspects of a problem, thus re-framing the problem and examining new, unexpected and challenging outcomes.

   This raises a more general issue in scenarios. There ought to be something like a Hippocratic Oath for scenario builders, to be honest to the user group regarding the decisions made regarding framing and selection of the central uncertainties in a particular problem area. The worst sin of a scenario builder is to manipulate the framing to account for one's own personal prejudices.

   We agree. The revised draft makes this point.

5. Pg. 8, especially the table: The emphasis given here to representing uncertainties in scenarios, while correct, tends to neglect the use of scenarios to elucidate those factors that are pre-determined. Identifying the factors that are pre-determined and important and elucidating their implications, is an important element of scenario creation and deserves a great deal of thought and analysis. The work of Peter Drucker provides a masterful illustration of the importance and value of serious reflection into factors that are determined but overlooked and under-analyzed – e.g., his work on the long-term effects of an aging population.

   We agree. This point has been added to the revised draft in the discussion of dimensions of variation among scenarios in Section 1.2.

6. Pg. 30, lines 9-18 (but this issue appears in several places): To connect scenarios usefully to decision-making, one must think in terms of a nested sets of scenarios, each operating on a different time horizon. In much of his prior and current work there are normally three relevant time horizons, but climate change applications add a fourth. Most scenario exercises relevant to climate change thus far have tended to work on just one time-horizon, and attempt on that basis to draw conclusions for other time horizons. This is very difficult if not impossible given that different factors and forces are at work at shorter vs. longer time horizons.

   In climate change, the four relevant time horizons are:

   1) The 100-200-year time horizon of the relevant geophysical changes – looking into deep history and the deep future. This is the time-scale that defines the largest-scale planetary risks.
   2) A roughly 50-year time horizon, which is the period for new technology sets entering and penetrating. In other energy and resource applications (i.e., not climate change), this is the longest time horizon considered.

(e.g., an OECD meeting last week was laying out plans for new R&D work related to nuclear fusion. They laid out a scenario in which the first commercial fusion plant would be deployed in 2050.) This time-horizon is important for explorers and technologists, but is quite different from the 100-200 year horizon. The work over this horizon is to understand potential new technological options and resource issues, and to make decisions (in the energy business) about exploration programs and basic physics and technology research programs.

3) Third, the 20-30 year investment horizon for new projects. These new investments are chosen from currently available technology sets, for which the longer-term technological development issues that are flexible in the 50-year time horizon are now constraints. Scenarios over this time horizon are built around issues of geopolitical risk, regulatory risk, consumer behavior, and other determinants of investment decisions.
4) Finally, a 5-year time horizon, that is concerned with immediately available actions, short-term flexibility of the system, and immediately available policy options, e.g., the bringing of renewables, or new nuclear plants, onto the agenda.

Each time horizon operates under different constraints. More factors are changeable over the longer terms, but these may also be constrained by decisions made in the near term. In such a nested set of scenarios, each time horizon bears on a different set of policy choices. Thinking of this structure helps resolve the question of why decision-makers have thus far derived so little use from scenario exercises. Most climate-change scenarios are a mix of the two longest time horizons, and they try to use potential developments over these horizons to influence shorter-term policy decisions. For example, in the SRES process, many decisions were made regarding what technology sets would be used, as though the resultant scenarios could advise on investment choices. They cannot without coupling them with consideration of shorter-term factors.

In subsequent work I led at Shell after the SRES, we tried to connect the scenarios more closely to decisions by focusing on the two middle time horizons. The work on a 2050 horizon mostly concerned resources and technology options; the shorter (20-year) work aimed at developing investment guidelines for fossils and renewables. (See “Energy Needs, Choices and Possibilities, Scenarios to 2050”, both the booklet and an abridged version for NAE journal “The Bridge”).

We agree. The revised draft includes discussion of the multi-horizon nature of some climate decisions and implications for scenario design.

7. Pg. 32 (this also arises on pg. 44): One of the great weaknesses of the IPCC scenarios, both in 1992 and equally in the SRES, was the need to make them conditional on an assumption of no mitigation policies. I argued against this

forcefully, but was informed we simply had to proceed this way because it was our mandate. This was a major impediment, because it is extremely difficult to do conditional scenarios that extend into the longer term.

In particular, this causes great difficulties for the highest-carbon scenarios. These not only require a reversal of historical trends of decarbonization as we shift back toward coal, but they also stretch the limits of credibility of the no-mitigation assumption. The difficulties are somewhat lesser for the lowest-carbon scenarios. While a similar negative-feedback process might be expected to operate on low-carbon futures, there is a long history of improving efficiency and decarbonization in the world economy, so one can construct plausible arguments whereby the continuance and strengthening of these processes generates low-carbon futures arise without intentional mitigation, although imposing this assumption still makes it somewhat more difficult to envision such futures.

The revised draft discusses this issue extensively, more in general and prospective terms than in terms of further criticism of IPCC.

8. Pg. 36, lines 10-18: Throughout the SRES process, there was a fundamental difference of view between the scenario practitioners and the modelers. This included terminology. Modelers use the word scenario for any quantified projection. Scenario practitioners are more concerned with classes of scenarios, which SRES was persuaded to call "scenario families." By my accounts, SRES did not have 40 scenarios; it had four, each with one "marker" quantification plus several alternative quantifications. The proliferation of scenarios to 40 also complicates the assignment of probability, since the 40 comprise quantifications across families and non-representatively within families.

We agree. The revised draft makes these points.

9. Pg. 39-40: I disagree with the climate-change modelers regarding the absolute necessity of quantifying probability in scenarios. Scenarios done well are designed for a particular purpose and an identified user group. In constructing scenarios it is often most useful to take as a design target, the aim to make each scenario equally likely for the user population – i.e., they are to appear equally likely in the perception of the targeted users. You should not try to make one in a set more likely than the others. You must work to carry the case of plausibility for each scenario and demonstrate that it is worthy of consideration.

This advice is not meant to exclude consideration of lower-probability, high-consequence events. I call these "wild cards." Where a set of scenarios might be constructed to capture perhaps 95 or 99 percent of the range of outcomes, wild cards are the important extremes that lie beyond that. As with scenarios, the focus of wild cards is on clarifying and informing decisions. The particular purpose of wild cards is to allow questions of the form 1) What should I do in the unlikely case a wild card happens?; 2) What should I do to monitor this possibility in order

to be able to respond more quickly?. For example, I would view the GBN work for the Pentagon as principally about identifying the consequences of 'abrupt climate change' and highlighting the need for appropriate monitoring measures of the possible emergence of this high impact phenomenon.

The revised paper discusses treatment of probability in scenarios, although we reach a conclusion somewhat more favorable for explicit characterization of probabilities. The treatment of low-probability wild cards is quite consistent with the reviewer's comments.

10. Pg. 42: I agree strongly with the point regarding under-development of narrative scenarios in the SRES process. This work was approached principally by starting with the modeling groups and building the scenario frameworks around them. At Shell and my subsequent work, we do it the other way around. Begin with a rich narrative, then ask what must I model to make these real and credible, to enrich the resultant dialog with policymakers, so the dialog can take place with them being confident that the necessary analysis been done.

At the Paris workshop, several people were carrying models on laptops that allowed back-of-the- envelope quantification of the initial scenarios being sketched. These were necessary to give spine and structure and form to the stories.

Modelers were given freedom to model the fundamental assumptions about population growth, economic drivers, etc. These fundamental assumptions tended to persist through the rest of the exercise.

To develop global change scenarios properly, you would need not just one workshop, but much deeper work to develop narratives and the range of assumptions on drivers. Perhaps in the future climate-change scenarios should be developed using a small team of 3 – 5 people working full time. These people would play the role of honest brokers re assumptions, and would do much of the coordination and more detailed analysis. There was some of this in SRES, but not enough to offset the dominance of the modelers.

In addition, such an exercise needs a challenging advisory group – an energetic, expert group probing and questioning assumptions and suggesting alternatives early in the process, to anticipate potentially difficult issues that might emerge later. This group should be challenging the basic qualitative logic before proceeding to quantification, and continuing thereafter. For example, the controversy over purchasing power parity, which I agree was an overblown issue in the criticism of SRES, might have been raised earlier. Similarly, the strong assumptions about convergence of incomes between industrialized and developing countries – really adopted as a normative equity goal – would have been challenged earlier by realists, rather than being left hanging – and not very well justified or explained – as a point for attack of the results.

There was a problem in SRES of transparency of the models. The models were not complete black boxes, as each team provided information about their model structure, but their relationships in mapping drivers to consequences were not fully transparent. It was usually not possible to diagnose the origin of different results between modeling groups. The resultant loss of transparency impaired the process's capacity to explain and understand.

Transparency is enhanced if models are developed at least in part to serve specific purposes in the scenarios exercises. Models that come to the exercise complete have a particular responsibility to provide transparency. The value of transparency in analysis is so great that I would even prefer a simple, transparent spreadsheet over an opaque model (although controlling for transparency, I prefer richer models to spreadsheets.)

Scenarios are also devices for bringing to the attention of policymakers fundamentally new concerns for their consideration. Thus Shell's 2001 scenarios contrasted the familiar world of the 1990's which highlighted rapid globalisation and reliance on markets with an emerging, poorly understood world characterised by stronger states, nationalism, tensions and pervasive security issues. This work done prior to 9/11 encouraged strategic dialogue and attention to emerging challenges. (See attached document, "People and Connections, Scenarios to 2020", on Shell's scenarios, produced in 2001.)

Most of these points are made in the revised draft, although we have refrained from making any specific institutional suggestions regarding how to organize the scenario capacity we recommend. Instead, we identify criteria for successful performance. Clearly a strong advisory board would be one way to help advance several of the criteria we state.

11. Pg. 42: In my view, the SRES scenarios should have had descriptive names. The names were dropped because of a real fear that those who would find any argument to critique the scenarios would find the names an irritant or a particularly vulnerable target. Names, metaphors and images are important for embedding scenarios in the user's mind. They are helpful in memorising and can clarify and highlight the meaning of scenarios for the targeted policymakers.

    We agree. The revised draft makes this point.

12. Pg. 80: A successful scenario exercise has an absolute need for narrative clarity and logic. Many climate change scenarios have not spent enough time getting that right. This makes all the rest problematic.

    We agree. The revised draft makes this point, in Section 1.2 and the conclusions.

13. Pg. 84: While this is not the only example of good practice, the Shell scenarios work following SRES made a serious attempt to link narratives and models. (See "Energy Needs, Choices and Possibilities, Scenarios to 2050", both the booklet and an abridged version for NAE journal "The Bridge").

The revised draft refers to both these exercises, in the context of how scenarios have been connected to decision-making. Unfortunately, the published accounts of these exercises do not include methodological detail regarding how the integration of narratives and models was achieved.

14. Pg. 88: The problem of drawing on collective expert opinion is not just one of aggregating. Often the issue is trying to understand who is the most insightful person in an area. In effect, the storylines and logics of such a person or these people get more weighting. You also often find that their views are most strongly based on available evidence – a fact that makes it easier to present a judgment based on unequal weighting of relevant experts, as the reference can be to the evidence instead of to the individual experts.

We agree. The revised draft makes this point.

15. Pg. 90: There is a strong distinction to be drawn between scenarios and wild cards. Scenarios are for policy formation within the main bounds of the distribution, perhaps 95 or 99% of probability. They are used to draw out current assumptions about how the world is working and test them, to make sure we feel we have got robust premises for decisions. But it is also necessary to look at extreme cases. As one example, in designing the major new Troll rig in the North Sea, Shell did look at the 2050 situation with climate change and the potential worst-case of sea level rise, and decided as a result to build the rig one meter higher than they otherwise would have.

We agree. The revised draft discusses the importance (and specific applications) of wild-card scenarios.

16. Pg. 91. Of course scenarios cannot cover the total range of all relevant uncertainties, and this becomes more strongly true as the scenarios grow more complex. There is judgment and selection everywhere in the design of a scenario set.

We agree. The revised draft makes this point, in Section 1.2 and the discussion of treatment of uncertainty in scenarios.

17. Pg. 94: The argument that scenario builders should explicitly quantify probabilities presumes that scenario builders are better informed than users. But if the main thrust of a scenario exercise is to aid the users in their decisions, there is tremendous value in having strong discussion among users regarding probability assignment. If experts or scenario builders do this, a highly valuable

conversation among users is reduced. The one factor that would push the other way would be cases in which relevant probabilities are strongly defined by scientific expert knowledge, perhaps say in climate modeling. In climate change, this may map onto the hierarchy of nested sets of scenarios discussed above. The case for expert involvement in assigning probabilities to scenarios is strongest at the longest time-scale, 100-200 years, a period over which no one has experience and scientific knowledge of slow geophysical processes is likely to predominate. As the time horizons grow shorter, the case for user involvement in arguing and assigning probabilities grows stronger.

This is a very interesting proposal, which adds a new dimension to our discussion of assignment of probabilities. We have added a discussion of this to the section on quantifying probabilities.

18. Pg. 100: We have now developed procedures by which we can use up to 50-80 people in building scenarios. This is quite advantageous, since bigger sets of participants brings more diversity of view. (See attached document, "Scenarios: An Explorer's Guide")

We agree. The revised draft makes this point.

19. Pg. 104: While there is an important distinction between "positive-outcome" scenarios and those that are purely normative – i.e. aiming at achieving a desired state of the world, and identifying how we get there – many positive scenarios also have embedded normative elements. This is not easily avoidable and is not necessarily a problem, but does require that the intentions and assumptions of scenario makers be declared as explicitly as possible.

We agree. The revised draft makes this point.

20. Pg. 111: In developing scenarios to support decisions, the second time-horizon (20 years in energy) is a good starting point, because this is the period over which investment decisions are made. Scenarios can be extremely helpful in project evaluation. With the addition of some intermediate logical steps from scenarios to workable investment policy guidelines, one can use scenarios to test projects.

The revised draft has added this possibility to the discussion of uses that scenarios can serve for energy and technology managers.

21. Pg. 111-112: Scenarios and decisions. It is important to emphasize that scenarios are perishable goods. They have a useful life for policy-makers that is much shorter than the time horizons of the scenarios themselves.

We agree. The revised draft makes this point.