

Useful Global-Change Scenarios: current issues and key challenges

Watson Institute, Brown University

March 23, 2007

Edward A. Parson

University of Michigan

Based on:
Global Change Scenarios: their development and use
Synthesis and Assessment Product 2.1b, US CCSP

Edward A. Parson, University of Michigan

Virginia Burkett, US Geological Survey

Karen Fisher-Vanden, Dartmouth College

David Keith, University of Calgary

Linda Mearns, National Center for Atmospheric Research

Hugh Pitcher, Pacific Northwest National Laboratory

Cynthia Rosenzweig, NASA Goddard Institute for Space Studies

Mort Webster, University of North Carolina

Sponsorship and Federal liaison: DOE Office of Science

Scenario: a description of potential future conditions, developed to inform decision-making under uncertainty.

Global change scenarios: major types

- Emissions scenarios
 - Climate-model inputs (Analysis goes forward)
 - Exploring energy/econ/tech futures (Analysis goes backward)
- Climate scenarios
 - Inputs to impact assessment
 - Inputs to mitigation and adaptation decisions
- Scenarios of first-order impacts (e.g., sea-level rise)
 - Inputs to assessment of subsequent impacts
- Multivariate scenarios for impact assessment
 - Specify key determinants of vulnerabilities, basis for evaluating adaptation responses
 - May include climate, other environmental, and socio-economic characteristics

Global change scenarios: four basic claims

1. We need them – in assessments and decision analyses, to specify inputs that are ...
 - Essential
 - Exogenous
 - Uncertain (deeply)
2. They are growing more prominent and contentious, and will likely continue to do so
3. They inevitably blend expert knowledge, judgment, and (disciplined, transparent) speculation: attacks as “unscientific” or “speculative” are true but irrelevant
4. Global change has fundamental differences from established areas of scenario use and expertise, which are the source of the hardest challenges to useful scenarios.

Overview of current practice:

most global change scenario exercises have ...

- Been used in assessments or models: connection to concrete decisions is indirect
- Focused on emissions and resultant climate change
- Been conducted by national or international bodies ...
- Stated ~ 4 discrete scenarios, with spatial scale from big nations to globe
- Been produced using quantitative models (energy-economic models for emissions, GCMs for climate)
- With ~ no probability info provided (for emissions ... some parametric uncertainty in climate given emissions)
- Detailed contents more shaped by capabilities and preferences of producers than needs of users.

Major use of scenarios in assessments rather than decisions – Implications?

- Scenarios serve as organizing devices for assessments, contribute to issue framing (e.g., how serious?)
- Prominence of major assessments
 - Additional, unforeseen uses of scenarios
 - Political controversy and attack: scenarios always vulnerable
- Response? Maximal transparency re process, reasoning, assumptions – including weaknesses, difficulties, disagreements

Scenarios to support decisions:

Big gap between potential and practice

Consider information needs of real decisions, not a mythical global climate-change decision-maker

- Impacts and Adaptation decisions:

- Climate change for relevant domain, spatial scale, time horizon
- Based on likely distribution of emissions trends, including mitigation
- Plus many local conditions, including socio-economic, that shape vulnerabilities
- Best progress: Downscaled, impacts-relevant GCM scenarios; improved representation of climate-model uncertainty given emissions;
- Worst progress: socio-economic conditions shaping vulnerabilities, responses

- Mitigation Policy decisions (national and other) ...

- Global emissions and climate without further mitigation (avoid circularity)
- Provides overall meter of severity, concern, but ...
- Also need structure of national emissions, key influences and uncertainties
- And policy and economic context for practical mitigation policies ... other major policies, economic trends, what others are doing
- Little activity or success (unless in secret)

- Energy and Technology decisions (mostly private actors)

- Over-riding uncertainty is mitigation policy
- Even global emissions and climate change are secondary
- Little activity or success (unless in secret)

Scenarios of global emissions and climate change: how well do they meet these needs?

- Include some uncertainties needed by most decisions, but exclude key needs of most.
- Required additional information ...
 - Unlikely to be obtained as model outputs
 - Likely to include qualitative as well as quantitative characteristics
 - Include structural as well as parametric uncertainties
 - Require closer collaboration with scenario users (sometimes they are the relevant experts)
 - Requires inputs from multiple domains, at various spatial scales: global processes can't do it all, need linked cross-scale structure
 - Requires experimentation and development of new methods and processes

What role for “core” scenarios of global emissions and climate change?

Necessary for most decisions, sufficient for none ... most used, scrutinized, criticized

- Emissions scenarios: include alt. baselines, alt. levels and forms of explicit mitigation effort, specified future targets for back-casting and feasibility analysis
- Based on wide range of socio-economic futures
- Using various degrees/forms of coordination
- Some with richer linkages to qualitative/narrative scenarios: when alternative narratives imply significant changes in behavior and values, strive to represent this in model structure, not just parameter values

Scenario development process: involvement of users

- Strongly favored in conventional scenario exercises
- Easiest and most fruitful when users are identified, few (or can be faithfully represented), homogeneous ..
- This applies to all the specific decision types identified above.
- Contrast “core” global emissions and climate scenarios: potential users vast, diverse, unidentified. Hardest to usefully involve them without introducing biases that may render scenarios less useful for others.
- Exception – involve climate modelers, to discuss and negotiation provision of their input needs
- With vast, diverse users, Extreme transparency can substitute for participation: Enough detail (including the warts) that users can understand what you did and decide which/whether/how to use.

Improving treatment of Uncertainty in Scenarios

- Problem: (for core emissions and climate scenarios): What do the scenarios mean? “plausible” or “equally sound” are not adequate answers.
- Explicit representation of interval probability judgments for key variables
- Our conclusion: Do more, especially in emissions scenarios
- Why?
 - An essential piece of making underlying reasoning transparent
 - When users are numerous, diverse, distant, can’t convey likelihood judgments through informal consultation
 - Diverse users: some need quantitative probability information for their subsequent analysis; others need to consider it in deciding which scenarios to use ... and those who don’t want it can ignore it.
 - If scenario developers don’t make their likelihood judgments explicit, others (less informed) will do it
 - Even in intense consultations with expert users, explicit probability talk can be valuable focus for deliberations
 - Allows inclusion of extremes, plausible worst-cases: a major need for many decisions, nearly always excluded from current scenario exercises

Alternatives to Scenarios?

- Seek robust decision strategies?
- Normatively created scenarios for back-casting, feasibility analysis
- Neither avoids need for scenario-based assumptions.

Scenarios: refining the definition

Scenarios must be distinguished ...

From assessments, models, decision-support activities that may *use* scenarios;

From other types of statements about future conditions – predictions, forecasts, projections.

- Multi-dimensional but schematic
- Come in groups
- Claim less predictive confidence (but still enough to merit attention)
- Further in the future.