How to Deal with Risk and Uncertainty in WGIII /AR5
IPCC Cross-Working Group Meeting on Consistent Treatment of Uncertainties, 6-7 July 2010, Stanford, California, USA

Prof. Dr. Ottmar Edenhofer
Table of Content

• Remarks on the Policy-Science Interface
• How to Deal with Uncertainty
• Consequences for AR5
Table of Content

• Remarks on the Policy-Science Interface
• How to Deal with Uncertainty
• Consequences for AR5
Remarks on the Policy-Science Interface

Three models how to organize the interface:

– Technocratic approach

– Decisionistic approach

– Pragmatic / enlightened approach
The Pragmatic-Enlightened Model

- **Data** → **Targets**
- **Mean 1** → **Qualifier 1** → **Decision 1**
- **Mean n** → **Qualifier m** → **Decision j**
- **Justification** → **Rebuttal** that reduces the plausibility of footings, justifications or means.
- **Back** → **Productive?**

Legend:
- Policy Makers
- Science
- Outcome

Legend:
- Intended
- Unintended

Legend:
- IPCC
- Intergovernmental Panel on Climate Change
- WHO
- UNEP
The Representative Clients of AR5 in WG III

- International level: Negotiators, NGO’s
- National Policies: Parliaments, governments, national agencies
- Regions: e.g. EU
- Sub-National Level: Cities
# How to Deal with Uncertainty

<table>
<thead>
<tr>
<th>Types of Uncertainty</th>
<th>Method</th>
<th>Meaning within the Pragmatic Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parametric uncertainty</td>
<td>Sensitivity analysis, Monte Carlo Simulation</td>
<td>Exploring the importance of mitigation options/ policy instruments</td>
</tr>
<tr>
<td>Model uncertainty/ structural uncertainty</td>
<td>Modelling comparison</td>
<td>How robust are modelling results → getting a sense of robustness</td>
</tr>
<tr>
<td>Qualitative risk assessment</td>
<td>Expert judgment/ expert elicitation</td>
<td>Side costs/ benefits Iteration between targets and means</td>
</tr>
<tr>
<td>Decision making under uncertainty/ risk management</td>
<td>Stochastic IPAs, IAMs</td>
<td>Risk management</td>
</tr>
</tbody>
</table>
# How to Deal with Uncertainty

<table>
<thead>
<tr>
<th>Types of Uncertainty</th>
<th>Method</th>
<th>Meaning within the Pragmatic Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parametric uncertainty</td>
<td>Sensitivity analysis, Monte Carlo Simulation</td>
<td>Exploring the importance of mitigation options/policy instruments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How robust are modelling results → getting a sense of robustness</td>
</tr>
</tbody>
</table>

- **How robust are modelling results**: This involves assessing the robustness of the model predictions to changes in input parameters or assumptions. It helps in understanding how sensitive the model's output is to variations in input data.
- **Exploring the importance of mitigation options/policy instruments**: This involves analyzing the impact of different mitigation options or policy instruments on the model outcomes. It helps in identifying the most effective strategies for reducing uncertainty and risk.

**Side costs/benefits**: This refers to the additional costs or benefits that arise from implementing a particular mitigation strategy. It is crucial for decision-making under uncertainty as it helps in balancing the trade-offs between different options.

**Iteration between targets and means**: This involves alternating between setting specific targets and adjusting the means to meet those targets. It is a practical approach to managing uncertainty in decision-making processes.

**Qualitative Risk Assessment**: This approach involves assessing risks based on subjective judgments rather than quantitative data. It is useful when quantitative data is not available or when the focus is on high-level impact assessments.

**Meaning within the Pragmatic Model**: The table outlines how different methods can be utilized to deal with uncertainty within the context of a pragmatic model. Each method is tailored to address specific types of uncertainty, thereby facilitating informed decision-making.

**Stochastic IPAs, IAMs**: These are models used to analyze the impacts of climate change. They incorporate stochastic elements to account for the variability in climate conditions and human responses.
Sensitivity Analysis

Combinations of different factors determining bio-energy potential

Potential (EJ) vs. Loss of natural area vs. Agricultural efficiency

Van Vuuren et al. (2010)
Sensitivity Analysis

Combinations of different factors determining bio-energy potential

Van Vuuren et al. (2010)
# How to Deal with Uncertainty

<table>
<thead>
<tr>
<th>Types of Uncertainty</th>
<th>Method</th>
<th>Meaning within the Pragmatic Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parametric uncertainty</td>
<td>Sensitivity analysis, Monte Carlo Simulation</td>
<td>Exploring the importance of mitigation options/policy instruments</td>
</tr>
<tr>
<td>Model uncertainty/structural uncertainty</td>
<td>Modelling comparison</td>
<td>How robust are modelling results  → getting a sense of robustness</td>
</tr>
</tbody>
</table>
Exploring the Importance of Mitigation Options

- Mitigation potential of nuclear is limited (but high use in the baseline)
- 400 ppm neither achievable without CCS nor without extension of renewables
- Biomass potential dominates the mitigation costs of low stabilisation

Knopf, Edenhofer et al. (2009)
# How to Deal with Uncertainty

<table>
<thead>
<tr>
<th>Types of Uncertainty</th>
<th>Method</th>
<th>Meaning within the Pragmatic Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parametric uncertainty</td>
<td>Sensitivity analysis, Monte Carlo Simulation</td>
<td>Exploring the importance of mitigation options/ policy instruments</td>
</tr>
<tr>
<td>Model uncertainty/ structural uncertainty</td>
<td>Modelling comparison</td>
<td>How robust are modelling results → getting a sense of robustness</td>
</tr>
<tr>
<td>Qualitative risk assessment</td>
<td>Expert judgment/ expert elicitation</td>
<td>Side costs/ benefits Iteration between targets and means</td>
</tr>
</tbody>
</table>
Iteration Between Targets and Means

Science: Scope of options

Science

Goal-setting by policy makers

1.5°C target
2°C target

Consideration of unintended side-effects

Data
How to Deal with Uncertainty

<table>
<thead>
<tr>
<th>Types of Uncertainty</th>
<th>Method</th>
<th>Meaning within the Pragmatic Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parametric uncertainty</td>
<td>Sensitivity analysis, Monte Carlo Simulation</td>
<td>Exploring the importance of mitigation options/ policy instruments</td>
</tr>
<tr>
<td>Model uncertainty/ structural uncertainty</td>
<td>Modelling comparison</td>
<td>How robust are modelling results → getting a sense of robustness</td>
</tr>
<tr>
<td>Qualitative risk assessment</td>
<td>Expert judgment/ expert elicitation</td>
<td>Side costs/ benefits Iteration between largest and means</td>
</tr>
<tr>
<td>Decision making under uncertainty/ risk management</td>
<td>Stochastic IPAs, IAMs</td>
<td>Risk management</td>
</tr>
</tbody>
</table>
The Meaning of Risk

**Severity of Risk** = \( F[\text{Probability, Scope, Intensity}] \)

**Impact** = Scope \( \times \) Intensity

**Risk Aversion:**
How much would decision-makers invest to eliminate/reduce this risk?

**Response/Management:**
What kind of institutions are required for eliminating/reducing these risks?
Three Categories of Risk

• **Normal Risks**
  – Scope: Individual, local
  – Intensity: Endurable, reversible
  – Probability: Normal distribution

• **Large Scale but Bounded Risks**
  – Scope: Transnational
  – Intensity: Endurable, reversible/irreversible
  – Probability: Normal distribution

• **Systemic Risks:**
  – Scope: Transnational and transgenerational
  – Intensity: Terminal, irreversible
  – Probability: Fattened tail
## The Risk Matrix

<table>
<thead>
<tr>
<th>Category</th>
<th>Response</th>
<th>Market (Household Failure)</th>
<th>State/Third Sector (Market Failure)</th>
<th>Global Collective Action (State Failure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Risks</td>
<td>Gradual adaptation within sectors</td>
<td>Regulation of insurance markets</td>
<td>Regulation of reinsurance markets</td>
<td></td>
</tr>
<tr>
<td>Large Scale but Bounded Risks</td>
<td>Weather derivatives</td>
<td>Fiscal support to European heatwave/hurricane Katrina</td>
<td>Regulation of financial markets in 2009</td>
<td></td>
</tr>
<tr>
<td>Systemic Risks/Catastrophies</td>
<td>No adequate response known</td>
<td>No adequate response known</td>
<td>Provision of global public good with different technologies (e.g. Weakest Link, Best-Shot)</td>
<td></td>
</tr>
</tbody>
</table>
Table of Content

• Remarks on the Policy-Science Interface
• How to Deal with Uncertainty
• Consequences for AR5
Consequences for the AR5/ WGIII

- Exploration of the whole solution space
- Development of 2nd best scenarios + evaluation of modeling comparison exercises
- Identifying types of risk management
- A few pragmatic guiding questions
  - What are consistent ways to achieve stabilization goals?
  - What is the relative importance of mitigation options and policy instruments?
  - What are „threshold probabilities“ undermining your policy options?
  - Getting a sense of unmanageable risks
  - What can go wrong along specific transformation pathways?
Thank you for your attention!