Towards Complete Decarbonization
The World in Transition

Nebojša Nakicenovic
International Institute for Applied Systems Analysis
Technische Universität Wien
naki@iiasa.ac.at

Congress on Climate Change, Plenary Session (Theme 3) on Reducing the Risks of Climate Change: Opportunities for Mitigation, Copenhagen — 11 March 2009

World Primary Energy

Nakicenovic 2009
Global Mean Temperatures are Rising

<table>
<thead>
<tr>
<th>Period</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>0.128±0.026</td>
</tr>
<tr>
<td>100</td>
<td>0.074±0.018</td>
</tr>
</tbody>
</table>

Years °/decade


Global Change Challenges

- Sustainable access to energy and food (a prerequisite for reaching MDGs)
- Security and reliability of systems
- Deep CO₂ and GHG reductions
- Investment in R&D and deployment
- Climate, Economy, Investment Crises
The Example of Lighting

United Kingdom

Nakicenovic Source: Fouquet and Pearson, 2003 #8 2009
Surface Temperature Change
AOGCM projections for illustrative SRES scenarios

Long-Term Stabilization Profiles
Global Mitigation Challenges

- Significant mitigation potential by 2030 at carbon price up to about $100/tCO₂ (~$370/tC ≡ $50/bbl)
- Technological change essential for reducing mitigation costs and increasing potentials
- “Upfront” investments reduce longer-term mitigation costs and increase potentials
- Investment in RD&D and diffusion reduce mitigation costs

Nakicenovic #14 2009
2050 Emissions and Probability of 2°C

Based on Forest et al. CS PDF
Source: Riahi, et al., 2008

2050 Emissions and Probability of 3°C

Based on Forest et al. CS PDF
Source: Riahi, et al., 2008
**Share of Carbon-Free Energy**

- **4.5°C**
- **4.0°C**
- **3.0°C**
- **2.0°C**

*maximum temperature change over the 21st century assuming 3°C climate sensitivity*

**Energy Supply Investments**

*maximum temperature change over the 21st century assuming 3°C climate sensitivity*
**Energy Systems Investments**
Supply Side and End Use

- 4.5°C
- 4.0°C
- 3.0°C
- 2.0°C*

<table>
<thead>
<tr>
<th>Temperature</th>
<th>2000</th>
<th>2030</th>
<th>2050</th>
<th>2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>ppmv - CO₂ Equivalent</td>
<td>billion US$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1430</td>
<td>1390</td>
<td>1090</td>
<td>970</td>
<td>820</td>
</tr>
</tbody>
</table>

*1 maximum temperature change over the 21st century assuming 3°C climate sensitivity

Source: Nakicenovic

---

**Government R&D in IEA countries**
in billion US$ (2006)

Source: Doornbosch, et al., 2008
History of US Federal Government R&D

Energy is one-third of total international bank financing

Bank lending to energy-sector and total bank lending to emerging markets

Source: World Bank, 2009
The magnitude of the change required in the global energy system will be huge.

The challenge is to find a way forward that addresses simultaneously climate change, security, equity and economics issues.

Paradigm change is needed: radical improvements in energy end-use efficiency, new renewables, advanced nuclear and carbon capture and storage.

Needs to be globally integrated but with maximum support of countries and local levels.

In the best spirit of science: fact-based and peer-reviewed.