Near-Term Mitigation in the Context of Long-Term Climate Goals: Lessons from the Integrated Assessment Community

Leon Clarke

GTSP Technical Workshop
College Park, Maryland

October 1, 2013
<table>
<thead>
<tr>
<th>Study</th>
<th>Regions</th>
<th>Deepest Goals</th>
<th>Non-Idealized International Action</th>
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<tbody>
<tr>
<td>AME (Asian Modeling Exercise)</td>
<td>Global and Asian Countries</td>
<td>450 ppmv CO2-e, High Price Path</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Pioneered working groups to explore different elements of data; focused on Asian results.</td>
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<td>EMF 22: Global</td>
<td>Global</td>
<td>450 ppmv CO2-e</td>
<td>Fragmented</td>
<td>No</td>
<td>No</td>
<td>First large, coordinated fragmented policy study.</td>
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<td>AgMIP (Agricultural Model Intercomparison Project)</td>
<td>Global</td>
<td>450 ppmv CO2-e **</td>
<td>N/A</td>
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<td>EMF 27 (International)</td>
<td>Global</td>
<td>450 ppmv CO2-e</td>
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<td>RECIPE</td>
<td>Global</td>
<td>410 ppmv CO2 only</td>
<td>Delays and fragmented action through 2020 and 2030</td>
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The integrated assessment community has undertaken a wide range of international multi-model studies since AR4. It is really these multi-model studies that are defining the agenda and the providing the results.
These studies have addressed a number of topics relevant to negotiations.

- Scenarios exploring **450 ppmv CO2-e** and similar.
- Scenarios exploring **non-idealized international policy structures** such as fragmented participation and limited near-term ambition.
- Scenarios exploring the implications of **variations in technology cost, performance, and availability**.

The community has also focused on other elements of scenario development:
- A small but growing set of scenarios and research exploring the **linkage between mitigation and other societal priorities**, 
- An increasingly sophisticated treatment of the role of **land use** in mitigation
- Scenarios exploring **non-market approaches** to mitigation.
- Emerging research on interactions between **mitigation, impacts, and adaptation**.
(1) Many studies have produced 450 ppmv CO2-e scenarios

450 CO2-e Overshoot: Full Participation (EMF 22, 2009)

Concentrations

CO\textsubscript{2} Emissions

(1) Many studies have produced 450 ppmv CO2-e scenarios

450 CO2-e Overshoot: Full Participation (EMF 22, 2009)

Concentrations

CO2 Emissions

(2) 450 ppmv CO2-e has often been used as a proxy for a 2°C goal – but that makes less sense than before

Many studies have produced 450 ppmv CO2-e scenarios. For practical purposes, meeting a 450 ppmv CO2-e in the future involves concentration overshoot. 450 ppmv CO2-e requires very low or negative emissions beyond mid-century.

(5) Emissions mitigation is a risk management strategy in the context of temperature goals

Less ambitious near-term goals lead to higher chances of exceeding 2°C.

In the context of current negotiations, key insights involve the interplay between near-term action and longer-term dynamics.

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World GHG emissions

GHG emissions (GtCO2 equiv.)

Baselines

“Emissions GAP”

Optimal paths to 450 ppm

PRELIMINARY RESULTS

Riahi et al (AMPERE WP2)
Extrapolation of UNFCCC country pledges to 2030 (den Elzen, 2012)

Optimal paths to 450 ppm

PRELIMINARY RESULTS

Riahi et al (AMPERE WP2)
World GHG emissions

“Near-Term” Actions

PRELIMINARY RESULTS

Riahi et al (AMPERE WP2)
World GHG emissions

GHG emissions (GtCO2 equiv.)

“Near-Term” Actions

“Medium-Term” Transition

PRELIMINARY RESULTS

Riahi et al (AMPERE WP2)
World GHG emissions

PRELIMINARY RESULTS

“Near-Term” Actions

“Medium-Term” Transition

“Long-term” reductions

GHG emissions (GtCO2 equiv.)
World GHG emissions

Limited short-term ambition (2030)

Rapid reductions in the medium term

More stringent policies in the long term

PRELIMINARY RESULTS

Riahi et al (AMPERE WP2)
World GHG emissions

2000 2010 2020 2030 2040 2050 2060 2070 2080 2090 2100

GHG emissions (GtCO2 equiv.)

“Medium-Term” Transition

2050 ranges (majority of scenarios)*

Rapid catch up of delayed scenarios

PRELIMINARY RESULTS

*focus on long-term GHG models

Riahi et al (AMPERE WP2)
PRELIMINARY RESULTS

Historical distribution (countries 1900-2010)

Mean Annual CO₂ Emissions Growth Rate Relative to 2005 (%)
Emissions reduction rates (%/year)

- 10.0%
- 7.5%
- 5.0%
- 2.5%
- 0.0%
- 2.5%
- 5.0%
- 7.5%
- 10.0%

Mean Annual CO₂ Emissions Growth Rate Relative to 2005 (%)

Historical distribution (countries 1900-2010)

PRELIMINARY RESULTS

Riahi et al (AMPERE WP2)
Emissions reduction rates (%/year)

Mean Annual CO₂ Emissions Growth Rate Relative to 2005 (%)

-10.0%  -7.5%  -5.0%  -2.5%  0.0%  2.5%  5.0%  7.5%  10.0%

2010-2100

2030-2050

optimal

low

high

emissions growth

emissions declines

30-year averages

PRELIMINARY RESULTS

Collapse of the Soviet Union
2-4 % per year

>4% Europe during WWI & WWII

Riahi et al (AMPERE WP2)
Emissions reduction rates (%/year)

Mean Annual CO₂ Emissions Growth Rate Relative to 2005 (%)

-10.0% -7.5% -5.0% -2.5% 0.0% 2.5% 5.0% 7.5% 10.0%

emissions declines

2010-2100

emissions growth

30-year averages

PRELIMINARY RESULTS

Sweden and France after the oil crisis: 2-3 % per year

>4% Europe during WWI & WWII

Riahi et al (AMPERE WP2)
Emissions reduction rates (%/year)

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<th>Year</th>
<th>Emissions Declines</th>
<th>Emissions Growth</th>
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<td>2010-2100</td>
<td>Low</td>
<td>2.5%</td>
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Mean Annual CO₂ Emissions Growth Rate Relative to 2005 (%)

Delayed action will require to double this rate GLOBALLY!

>4% Europe during WWI & WWII

PRELIMINARY RESULTS

Riahi et al (AMPERE WP2)

GCAM
IMACLIM
IMAGE
MERGE-ETL
MESSAGE
POLES
REMINDE
WITCH
AIM-Enduse
DNE21+
What is the nature of the energy system transition?

PRELIMINARY RESULTS

REMIND
WITCH
GCAM
IMAGE
IMACLIM
POLES
AIM-Enduse
MESSAGE
DNE21
MERGE-ETL

Riahi et al (AMPERE WP2)
How much will it cost to reduce emissions?

Under the most advantageous circumstances, most models can achieve policy costs over the century of a several percentage points in terms of relevant economic indicators such as consumption losses, GDP losses, or area under the MAC curve.

But there is a wide range (e.g., in the AMPERE study, preliminary results indicate a range of about 1%-14%).

Delays or limits on technology can both increase costs, and more so in combination. For example, in the AMPERE project, preliminary results indicate an increase in total cumulative macroeconomic costs of about 25%

Transitional costs are more affected by the near-term actions.
How achievable and comparable might national goals be?

INDIA

Reduction in Emissions Intensity in 2020 Relative to 2005

How achievable and comparable might national goals be?

Other relevant topics addressed by integrated assessment research

- Implications of limited technology portfolios
- Linkages to other societal priorities (e.g., air pollution, energy security)
- Insight into the viability and comparability of national goals
- Investment patterns.
- The effects of burden-sharing regimes.
- The influence of technology limitations on the nature of transformation pathways.
- Linkages between mitigation, impacts, and adaptation.
- Sectoral transitions.
- The role of land use in mitigation.
- Industrial and land use leakage.
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