



# **Overview of EMF 22 International Scenarios**

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May 28, 2009

GTSP Technical Workshop

College Park, Maryland

# Overview of the EMF 22 International Scenarios

- Ten modeling teams from North America and Europe.
- Exploring ten possible scenarios, which are combinations of
  - Three concentration goals
    - (1) 450 CO<sub>2</sub>-e, (2) 550 CO<sub>2</sub>-e, and (3) 650 CO<sub>2</sub>-e
  - Two means of achieving concentration goals
    - (1) not-to-exceed and (2) overshoot through 2100
  - Two international policy regimes
    - (1) Full participation immediately and (2) delayed participation by non-Annex I regions and Russia



# Participating Models are From Europe, North America, and Australia

- ETSAP-TIAM (Canada)
- FUND (E.U.)
- GTEM (Australia)
- IMAGE (E.U.)
- MERGE (U.S.)
- MESSAGE (E.U.)
- MiniCAM (U.S.)
- POLES (E.U.)
- SGM (U.S.)
- WITCH (E.U.)

# Non-Coalition Countries: Delayed Participation

<b>Group 1 (Annex 1 – Russia)</b>	<b>Group 2 (BRICs)</b>	<b>Group 3</b>
<p data-bbox="306 607 787 704"><b>Initiating Action after 2012:</b></p> <p data-bbox="369 808 724 922"><b>The Annex 1 (absent Russia)</b></p>	<p data-bbox="894 607 1293 704"><b>Medium-Term Transition (2030):</b></p> <p data-bbox="995 808 1150 1062"><b>Brazil Russia India China</b></p>	<p data-bbox="1419 607 1818 704"><b>Long-Term Transition (2050):</b></p> <ul data-bbox="1356 808 1808 1224" style="list-style-type: none"><li>- Mid-income countries (e.g. Korea, Mexico)</li><li>- OPEC countries</li><li>- Poor countries (e.g. Sub-Saharan Africa)</li></ul>

# The Scenarios Attempted for this Study

650 CO <sub>2</sub> -e		550 CO <sub>2</sub> -e				450 CO <sub>2</sub> -e			
Full Not-to- Exceed	Delay Not-to- Exceed	Full		Delay		Full		Delay	
		Not-to Exceed	Overshoot	Not-To- Exceed	Overshoot	Not-to Exceed	Overshoot	Not-To- Exceed	Overshoot



# Key Issues Addressed by the EMF 22 International Scenarios

- **The difficulty of meeting low concentration levels such as those associated with meeting 2 °C.**
- **The effect of delayed action on meeting concentration goals.**
- **The influence of a recession on meeting concentration goals.**
- **The degree and form of leakage.**
- The role of policies to address carbon in land.
- The importance and role of technology in the U.S. and internationally.
- The implications of overshoot.
- The costs of stabilization.

# Overview of EMF 22 U.S. Scenarios

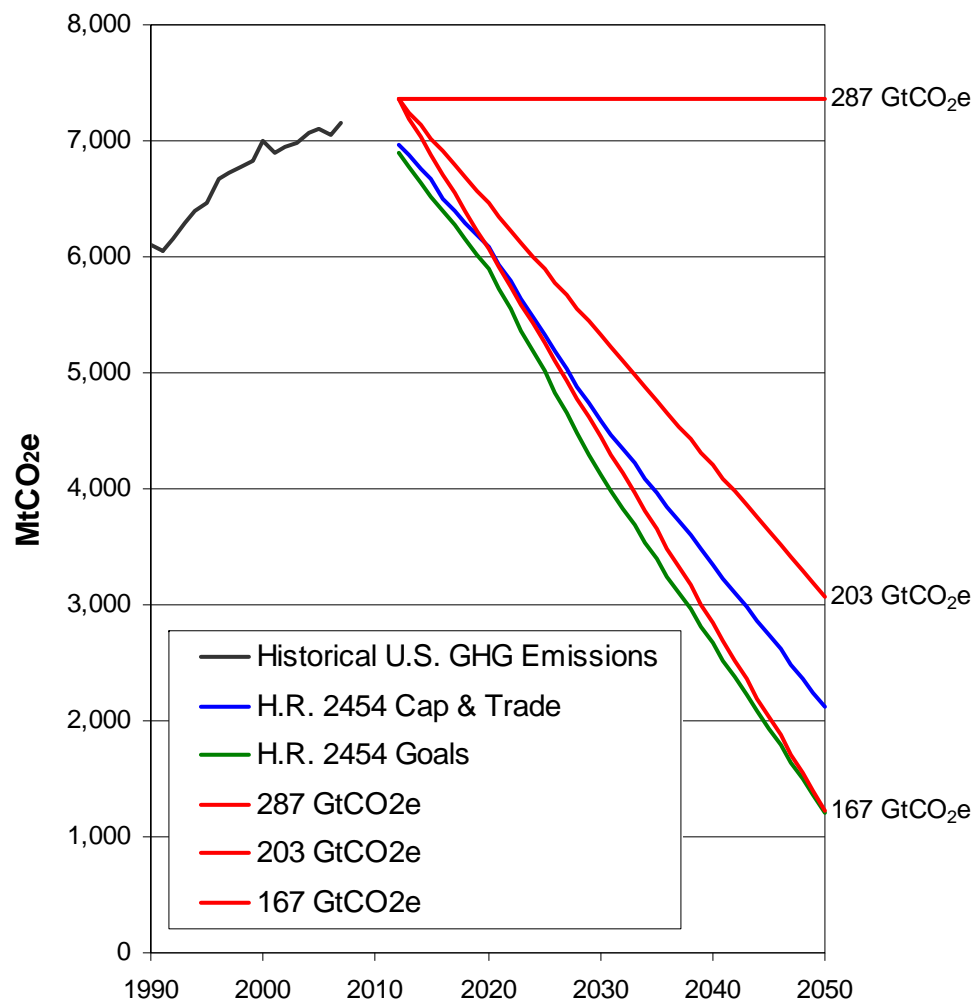
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# The Core EMF 22 U.S. Scenarios

- No emissions reductions until 2012. After 2012, three allowance pathways
  - A flat allowance pathway from 2012 through 2050 held at 2008 emissions levels.
  - An allowance pathway starting at 2012 levels and decreasing linearly to a 50 percent reduction in emissions below 1990 levels by 2050.
  - An allowance pathway starting at 2012 levels and decreasing linearly to an 80 percent reduction in emissions below 1990 levels by 2050.
- Banking and borrowing is allowed. Therefore, the allowance pathways can be interpreted as cumulative emissions targets from 2012 through 2050 with complete when flexibility. (In the MIT report, these cumulative emissions were  $\approx$  287 bmt CO<sub>2</sub>-e,  $\approx$  203 bmt CO<sub>2</sub>-e, and  $\approx$  167 bmt CO<sub>2</sub>-e.)
- No international trading.
- Caps are based on CO<sub>2</sub>-equivalents, covering all Kyoto gases, and using CO<sub>2</sub>-equivalent emissions factors, and are assumed to have full-economy coverage.
- Guidelines on international assumptions roughly in line with the global delayed participation scenarios and the E.U. transition scenarios.



# The Modeling Exercise is Based on Three Emissions Goals through 2050



- These Goals span a wide range of possible U.S. 2050 targets.
- Converted pathways to cumulative targets and explored with banking and borrowing.
- The Waxman-Markey bill (H.R. 2454) has a stated goal of reducing emissions to 83% below 2005 levels by 2050
  - The green line to the left represents this goal
  - Resulting cumulative emissions are 159 GtCO<sub>2</sub>e
- The bill also establishes a cap & trade program that reduces emissions from covered sources to 83% below 2005 levels by 2050.
  - The blue line in the figure to the left shows the emissions resulting from the cap & trade program alone assuming uncovered emissions remain constant.
  - Resulting cumulative emissions are 177 GtCO<sub>2</sub>e

**DRAFT RESULTS: SUBJECT TO CHANGE: DO NOT DISTRIBUTE**

# With Banking and Borrowing, Emissions Pathways Become Cumulative Goals

*2012 – 2050 cumulative U.S. GHG emissions (GtCO<sub>2</sub>e) assuming linear reductions from estimated 2008 emissions levels in 2012 to specified 2050 target and assuming 100% coverage.*

Base Year	% Below Base Year Emissions in 2050						
	83%	80%	65%	50%	35%	20%	0%
1990	164	<b>167</b>	185	<b>203</b>	221	239	262
2005	167	171	192	213	234	254	282
2008	168	172	194	215	237	258	<b>287</b>

- Notes: numbers in red are scenarios analyzed in the EMF 22 exercise. Emissions data from 1990 and 2005 are based on EPA's 2009, "U.S. Inventory of Greenhouse Gas Emissions and Sinks." 2008 emissions projections are based on the MIT report, "Assessment of U.S. Cap-and-Trade Proposals."

# Discussion

- Emissions pathways – banking and borrowing behavior
- Economic implications of different levels of action
- Energy system implications of different levels of action
- Role of technology
- Role of domestic offsets
- Cost implications of baseline assumptions
- Relation between coverage and percentage reduction goals
- Importance of market based approaches
- Leakage and competitiveness
- Cost incidence in different sectors