EMF 21: Multi-Greenhouse Gas Mitigation and Climate Policy

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EMF21 Scenarios

1. Modeler's Reference

Modeler defined with chosen GDP, population, energy prices, etc. The Kyoto Protocol is not in the reference scenario.

2. Long-term, CO_2-only Stabilization Scenario

This scenario will be compared to the modeler's reference and # 3 to evaluate the significance of multigas mitigation, that is, including the non-CO_2 GHGs (NCGGs).

Climate Change / Emissions Target:

(a) For long-term models: *With CO_2-only mitigation*, stabilize radiative forcing at 4.5 Wm^{-2} relative to pre-Industrial times by 2150. This corresponds to an equilibrium temperature of 3.0°C, for a 2.5°C per CO_2 doubling climate sensitivity. (Some models may want to also evaluate sensitivities ±). From 2100 to 2150, the radiative forcing from NCGGs should be held constant at the 2100 level.

(b) For short-term models requiring emissions targets, global total emissions for all GHGs (based on 100-yr GWPs) have been provided by PNNL using the MiniCAM model that match the stabilization target in (a). There is also a corresponding MiniCAM reference case.

Time frame: 2000 to 2100. Reporting is every decade from 2000 to 2100.
Emission targets: Based on meeting the stabilization target at lowest global cost with participating countries as defined below. For the long-term models, emission targets can be endogenously calculated. For the short-term models, emission targets can be derived from a global total GHG budget as provided above in (b).
GWPs: For some models, these are endogenously calculated. For others, modeling teams should use 100-yr GWPs from the IPCC Second Assessment Report.
Country Participation: All countries and regions starting in 2010. This would establish the global, least-cost trajectory to achieve the specified stabilization target. Any contraction in participation would show a divergence from the least-cost trajectory.

3. Long-term, Multigas Stabilization Scenario

This scenario should include as many NCGGs options as available in a model to meet the specified radiative forcing stabilization target. (The addition of Sinks should not be included in this scenario).

Climate Change / Emissions Target:

(a) For long-term models: *With Multigas mitigation*, Stabilize radiative forcing at 4.5 Wm^{-2} relative to pre-Industrial times by 2150. This corresponds to an equilibrium temperature of 3.0°C, for a 2.5°C per CO_2 doubling climate sensitivity. (Some models may want to also

evaluate sensitivities ±). From 2100 to 2150, the radiative forcing from non-CO_2 GHG (NCGG) *does not need* to held constant at the 2100 level.

(b) For short-term models requiring emissions targets, global total emissions for all GHGs (based on 100-yr GWPs) from MiniCAM should be used (same as above).

All other aspects of the scenario are the same as #3.

4. Combined Multigas Scenario

This scenario combines the same long-term target as above and adds a decadal rate-of-change target, all under a multigas scenario. It is defined as:

(a) Hold the global, mean decadal rate of temperature change from 2030 to 2100 at 0.2ºC. (starting in 2030) and meet the long-term target of stabilizing radiative forcing at 4.5 Wm^{-2} relative to pre-Industrial times by 2150. Modelers can relax the rate target if needed to obtain a feasible solution.

5. Additional, Sinks Scenarios

The inclusion of sinks data in modeling scenarios was optional for the core scenarios. The main reasons for this are: (1) the sinks data was developed based on a set of carbon price paths that are not necessarily consistent with the prices resulting from the above mitigation scenarios (see the LANDUSE DATA webpage); and (2) the approaches taken by various modeling teams to incorporate sinks into their analysis are very different, more so than with the NCGGs.

EMF-21 Results

To see the Overview graphs and data from *Energy Journal* Special Issue introduction please follow the link below.

OVERVIEW GRAPHS AND DATA

Energy-Economic Models in EMF-21

To access the results from any of the individual EMF-21 models please follow the links below.

AIM Asian-Pacific Integrated Model	J. Fujino, R. Nair, M. Kainuma, T. Masui (National Institute for Environment Studies, Japan) and Y. Matsuoka (Kyoto Univ., Japan)
AMIGA All Modular Industry Growth Assessment	D. Hansen (Argonne National Laboratory, U.S.), J. Laitner (U.S. EPA)
COMBAT COMprenhensive aBATement	H.A. Aahaim, J.S. Fuglestvedt, and O. Godal (CICERO, Norway)
EDGE European Dynamic Equilibrium Model	J. Jensen (TECA TRAINING ApS, Denmark)
EPPA	J. Reilly, M. Sarofim, S. Paltsev, and R. Prinn

Emissions Projection and Policy Analysis Model	(Massachusetts Institute of Technology, U.S.)
FUND Climate Framework for Uncertainty, Negotiation, and Distribution	Richard Tol (Economic and Social Research Institute, Ireland & Hamburg, Vrije and Carnegie Mellon Universities)
GEMINI-E3/GEMWTrap General Equilibrium Model of International Interaction for Economy-Energy- Environment	A. Bernard (Min. of Equipment, Transport, and Housing, France), M. Vielle (CEA-LERNA , France), and L. Viguier (HEC Geneva and Swiss Federal Institute of Technology)
GRAPE Global Relationship Assessment to Protect the Environment	A. Kurosawa (Institute of Applied Energy, Japan)
GTEM Global Trade and Environment Model	G. Jakeman (Australian Bureau of Agriculture and Resources) and B. Fisher (CRA International, Australia)
IMAGE Integrated Model to Assess The Global Environment	D.P. van Vuuren, B. Eickhout, P.L. Lucas and M.G.J. den Elzen (National Institute for Public Health and the Environment, The Netherlands)
IPAC Integrated Projection Assessments for China	K. Jiang, X. Hu, & S. Zhu (Energy Research Institute, China)
MERGE Model for Evaluating Regional and Global Effects of GHG Reductions Policies	A. Manne (Stanford University, U.S.) and R. Richels (Electric Power Research Institute, U.S.)
MESSAGE Model for Energy Supply Strategy Alternatives and Their General Environmental Impact	S. Rao and K. Riahi (International Institute for Applied Systems Analysis, Austria)
MiniCAM Mini-Climate Assessment Model	S. Smith (PNNL/Univ. Maryland, U.S.) and T.M.L. Wigley (National Center for Atmospheric Research, U.S.)
PACE Policy Analysis With Computable Equilibrium	C. Böhringer, (University of Heidelberg), A. Löschel (Centre for European Economic Research – ZEW), and T. Rutherford (University of Colorado)
POLES-GEGS Prospective Outlook on Long-Term Energy Systems-Global Emissions Control Strategies	Patrick Criqui (Institute of Energy Policy and Economics, France), Peter Russ (EC- Institute for Prospective Technological Studies, Spain), and Daniel Deybe (Cirad-Amis, France & EC Environment DG)

SGM Second Generation Model	A. Fawcett (U.S. EPA) and R. Sands (PNNL/Univ. Maryland, U.S.)
WIAGEM World Integrated Applied General Equilibrium Model	C. Kemfert (German Inst. of Economic Research & Humboldt University), T. P. Truong (Univ. of New South Wales, Australia) and T. Bruckner (Institute for Energy Engineering, Technical University Berlin, Germany)