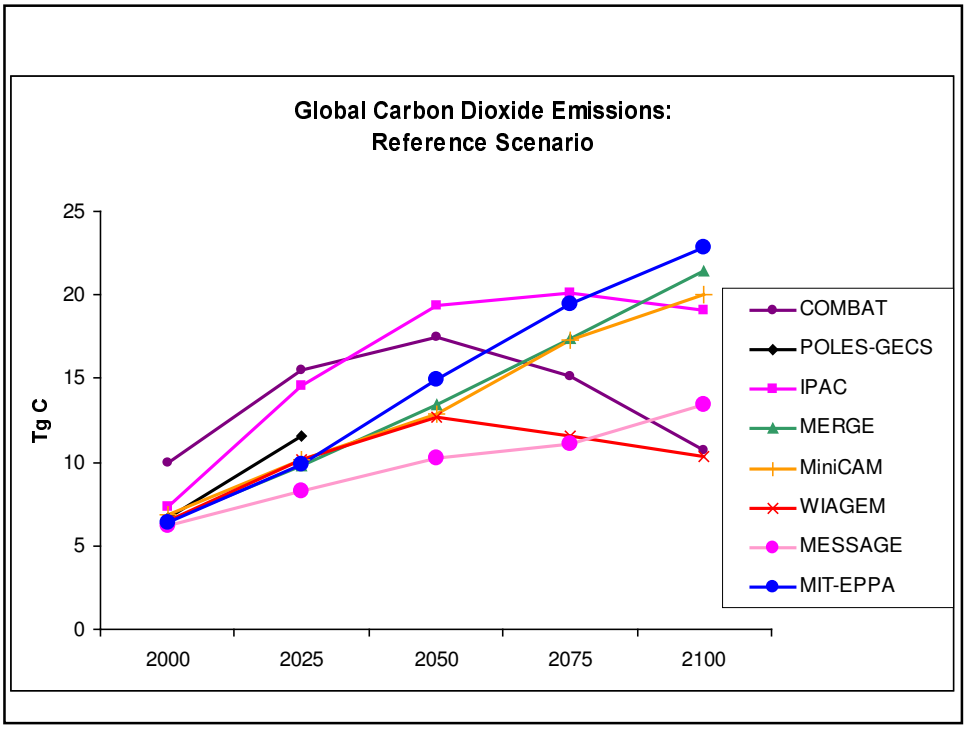
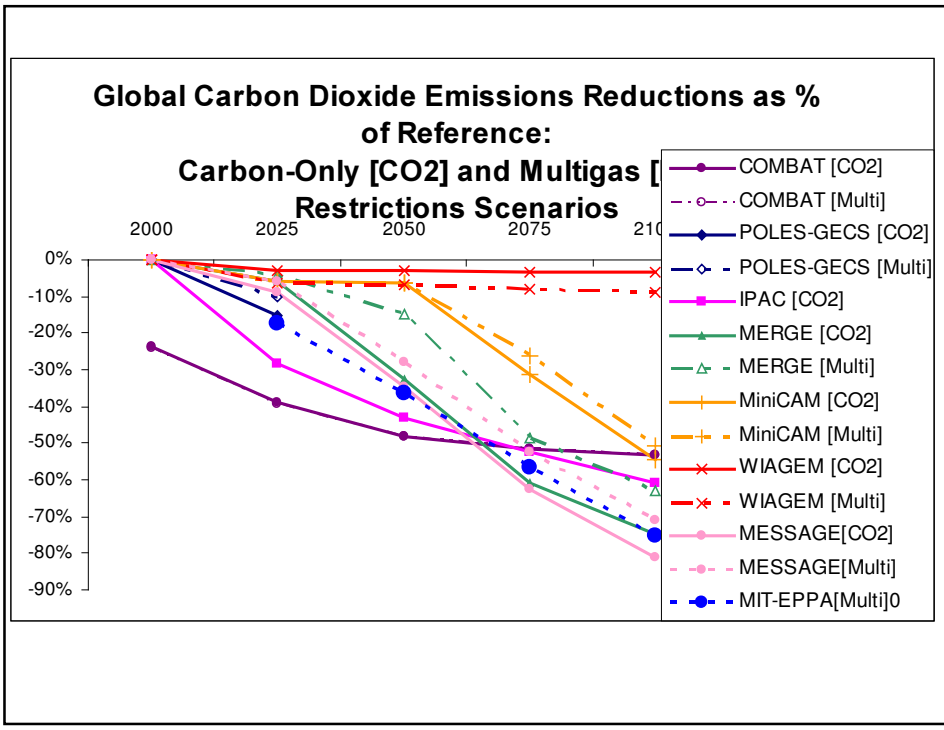
Preliminary Model Comparisons From EMF 21: Multi-Gas Mitigation and Climate Change

International Energy Workshop
International Institute For Applied Systems Analysis
June 25, 2003

Carbon Dioxide Emissions

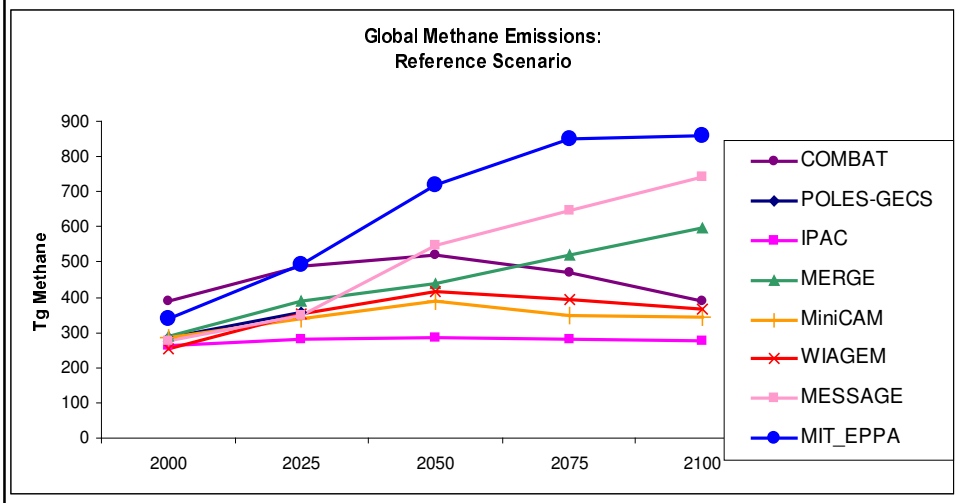
- Significant reductions without multigas restrictions
- Between 5% and 15% of reference case emissions in avoided abatement when multigas restrictions are included
- Slides show fossil fuel emissions only: IPAC and MiniCAM were only models reporting land use change emissions

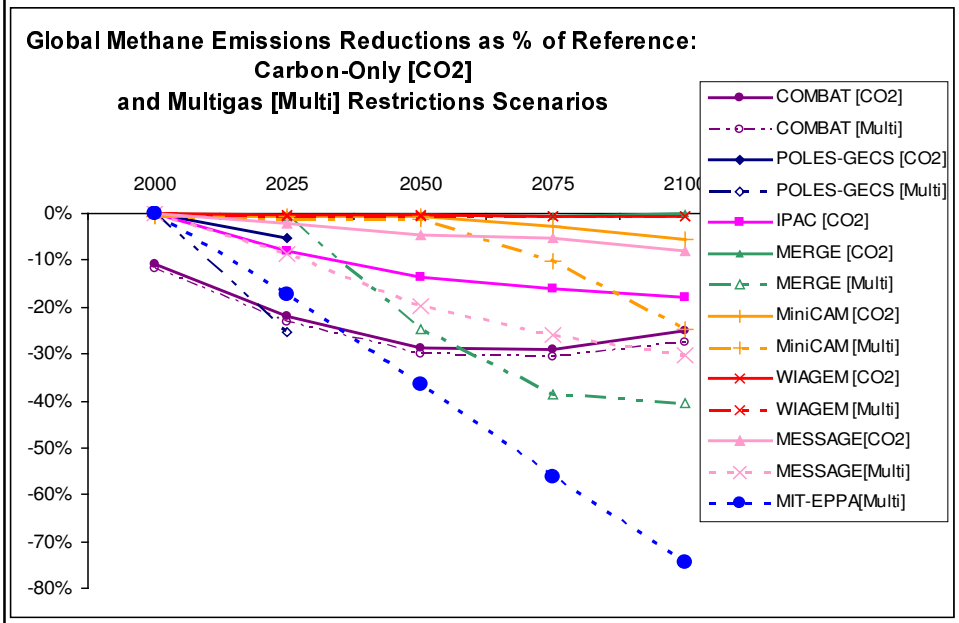

Global Carbon Dioxide Emissions:
Reference Scenario
Tg C
25
20
15
10
5
0
2000
2025
2050
2075
2100
COMBAT
POLES-GECS
IPAC
MERGE
MiniCAM
WIAGEM
MESSAGE
MIT-EPPA


Global Carbon Dioxide Emissions Reductions as %
of Reference:
Carbon-Only [CO2] and Multigas [
Restrictions Scenarios
2000
2025
2050
2075
0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%
-80%
-90%
COMBAT [CO2]
COMBAT [Multi]
POLES-GECS [CO2]
POLES-GECS [Multi]
IPAC [CO2]
MERGE [CO2]
MERGE [Multi]
MiniCAM [CO2]
MiniCAM [Multi]
WIAGEM [CO2]
WIAGEM [Multi]
MESSAGE[CO2]
MESSAGE[Multi]
MIT-EPPA[Multi]0

Methane Emissions

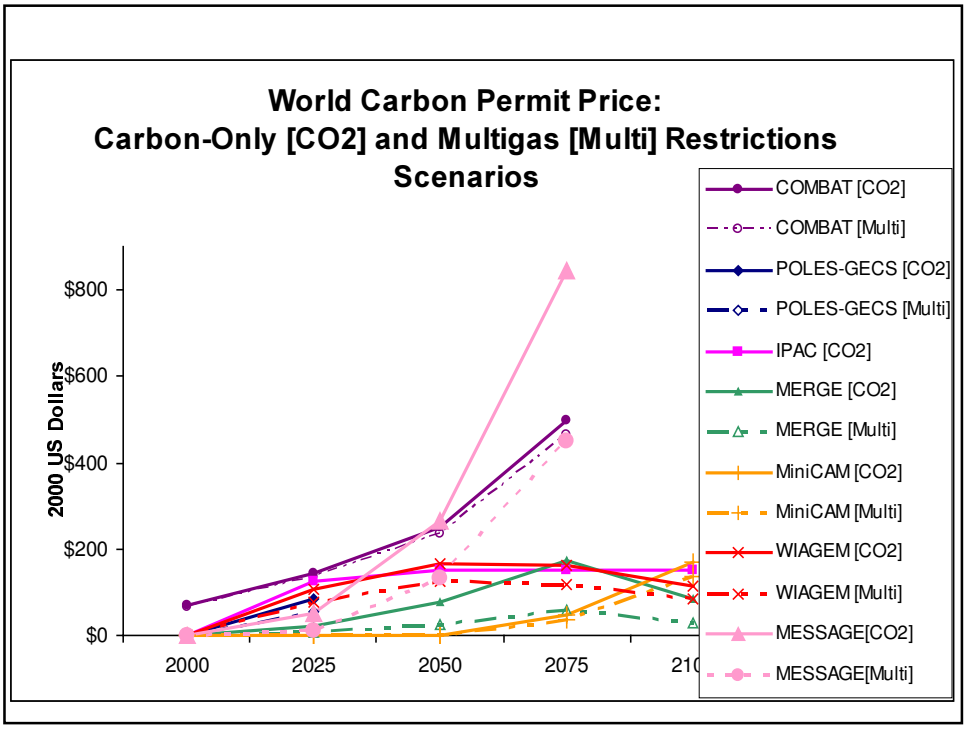
- Moderate reductions without multigas restrictions
- Significant reductions in the first half of the century when multigas restrictions are included
- Comparison with carbon dioxide reductions shows leakage effect: without multigas policy, warming from methane grows to substantial fraction of that from carbon dioxide





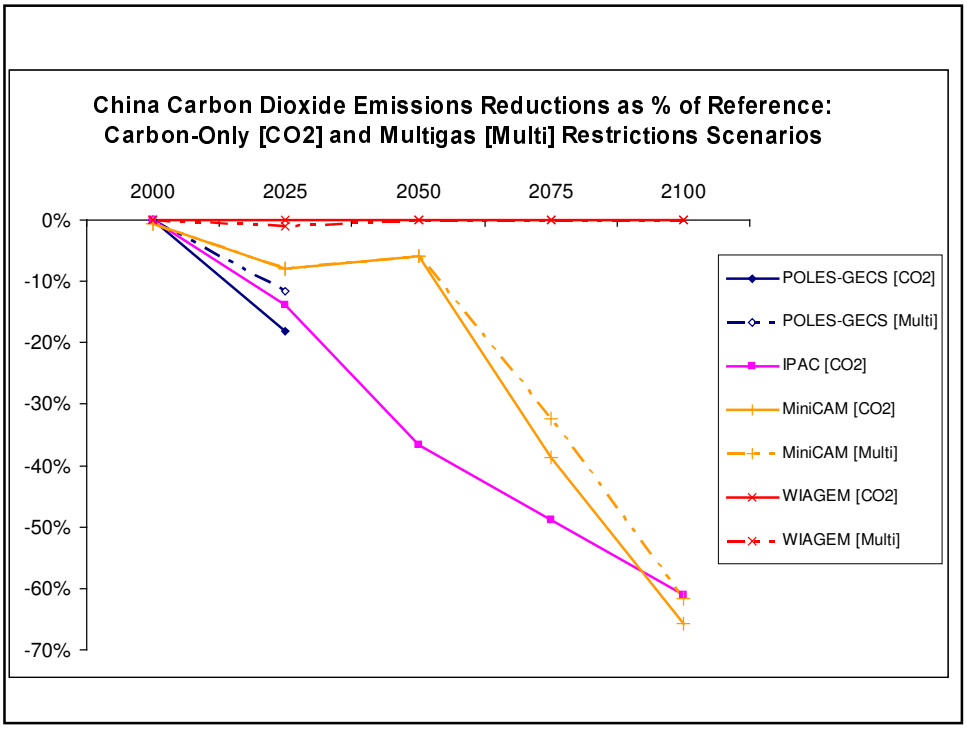
Economic Indicators

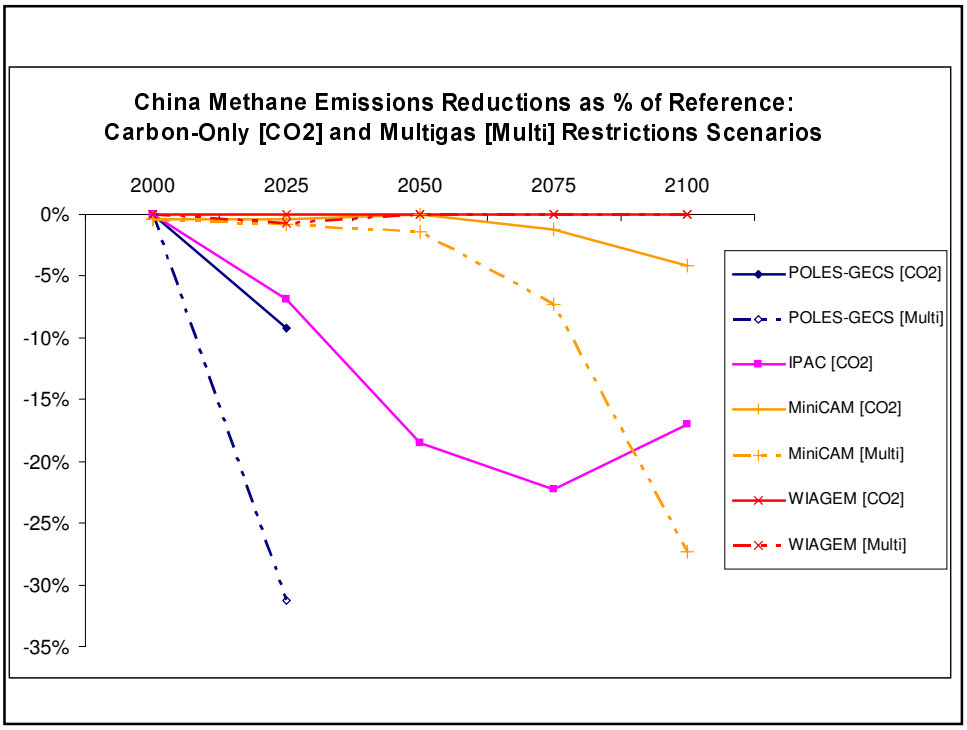
- Global aggregate GDP declines from tenths of a percent to several percent, with generally lower production losses when multigas restrictions are included
- World carbon permit price falls when multigas restrictions are included, while oil price rises
- Consumption changes are generally smaller than GDP losses



Regional Focus: China

- Sharp reductions in carbon dioxide emissions, compared to global reductions, in some models regardless of restrictions on other gases
- Methane reductions parallel global trajectory
- Significant leakage effect demonstrated under carbon-only restrictions scenario; disparity is stronger than global average


China Carbon Dioxide Emissions Reductions as % of Reference:
Carbon-Only [CO2] and Multigas [Multi] Restrictions Scenarios
2000
2025
2050
2075
2100
0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%
POLES-GECS [CO2]
POLES-GECS [Multi]
IPAC [CO2]
MiniCAM [CO2]
MiniCAM [Multi]
WIAGEM [CO2]
WIAGEM [Multi]


China Methane Emissions Reductions as % of Reference:
Carbon-Only [CO2] and Multigas [Multi] Restrictions Scenarios
2000
2025
2050
2075
2100
0%
-5%
-10%
-15%
-20%
-25%
-30%
-35%
POLES-GECS [CO2]
POLES-GECS [Multi]
IPAC [CO2]
MiniCAM [CO2]
MiniCAM [Multi]
WIAGEM [CO2]
WIAGEM [Multi]

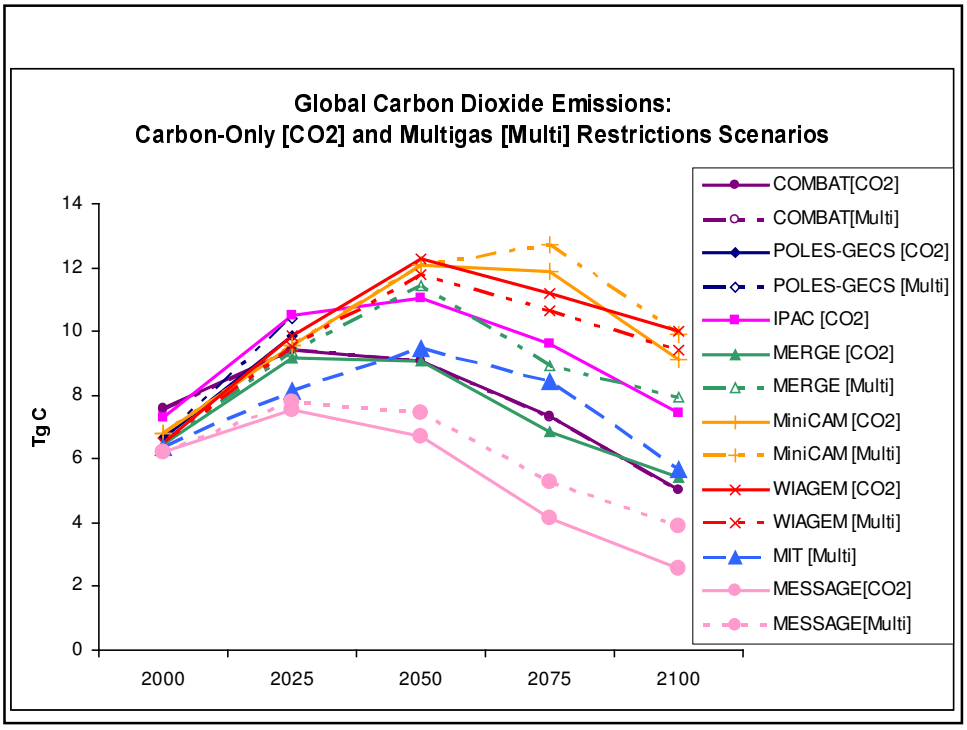
Key Model Comparison/Scenario Issues

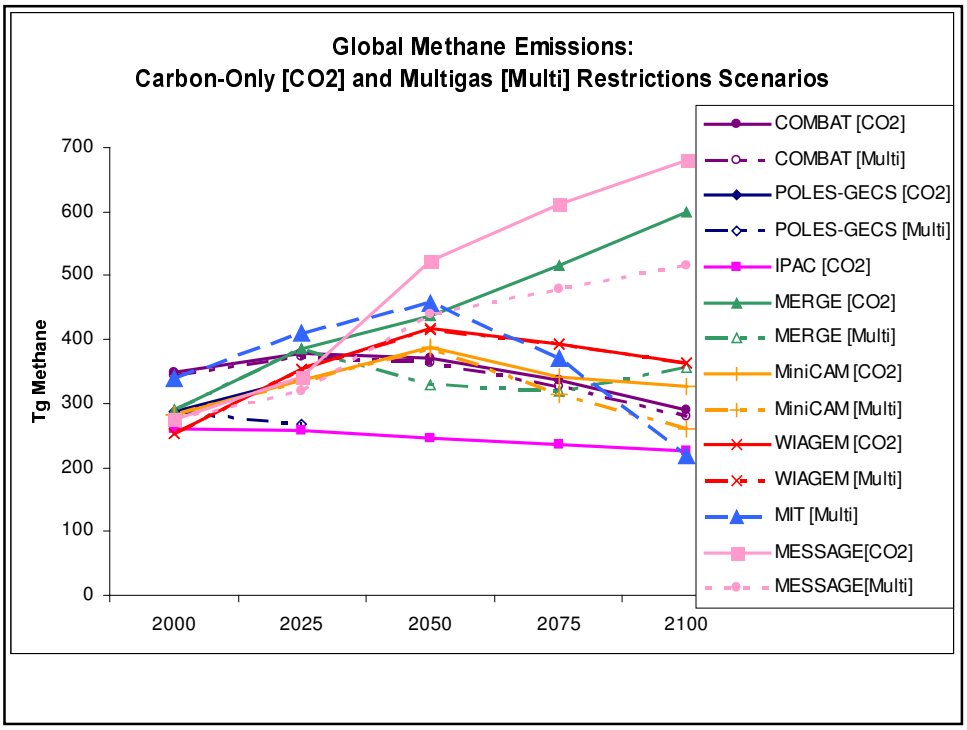
- Stabilization Scenario(s) Formulation(s)
- Reporting of Reference Temp., Etc. Trajectories
- Transition Versus Stabilization Scenarios
- Use of "Covered" and "Non-Covered Sectors
- Timing for Availability of New Data

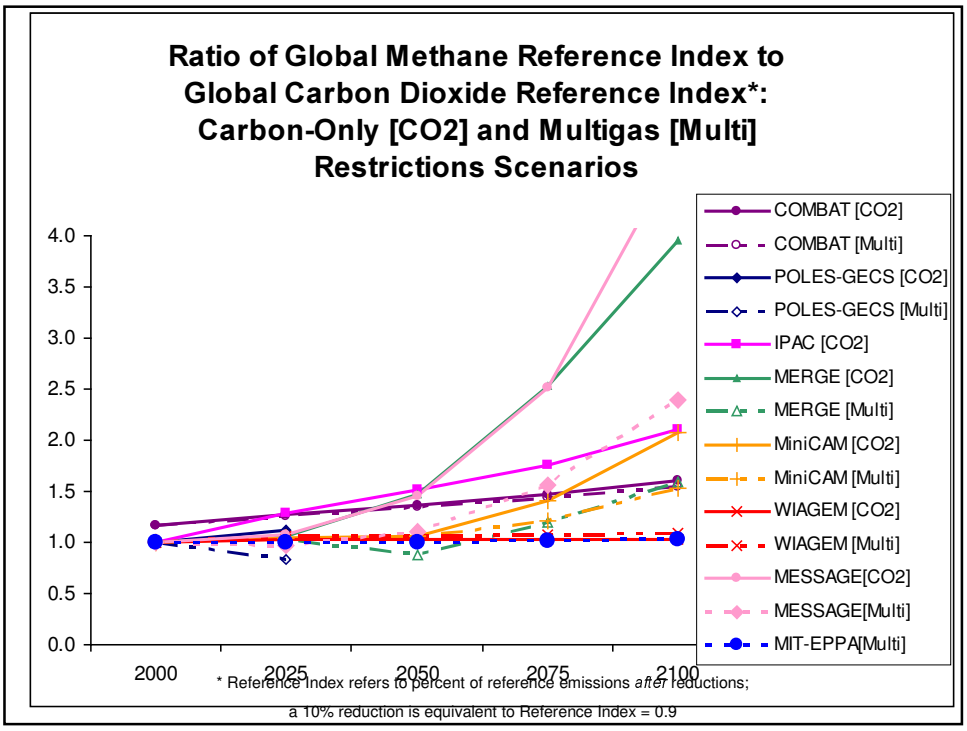
Models Participating in EMF 21:
"Multi-Gas Mitigation and Climate Change"

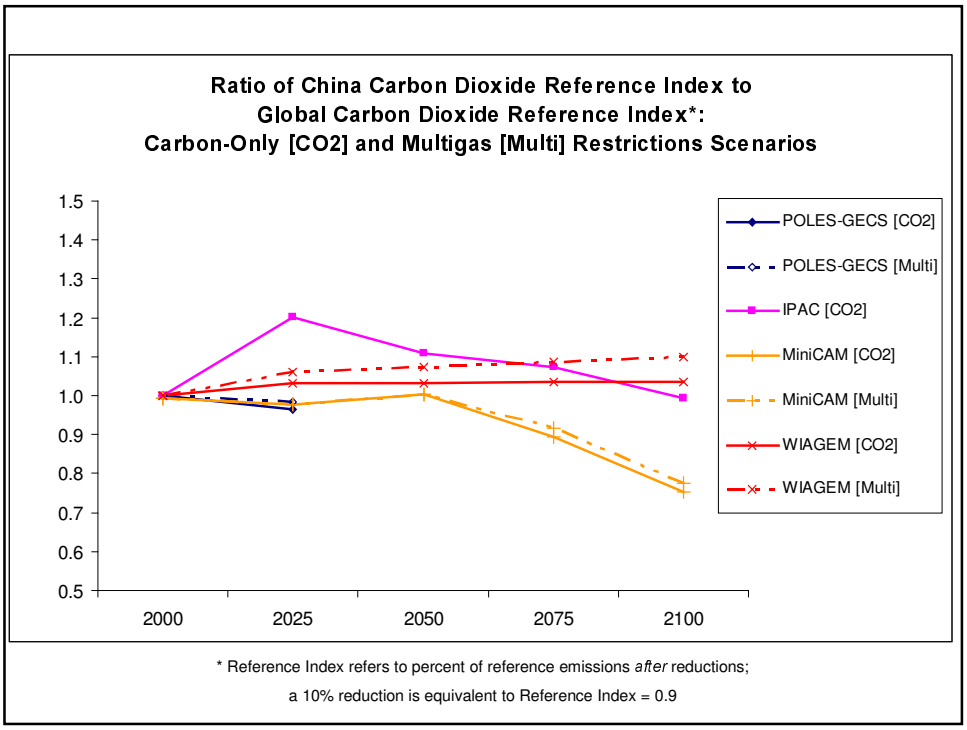
AIM (Asian-Pacific Integrated Model)	T. Morita, M.Kainuma (NIES, Japan) Yuzuri Matsuoka (Kyoto University)
COMBAT* (COMprenhensiceBATement)	H.A. Aahaim (CICERO, Norway) J.S. Fuglestvedt (CICERO, Norway) O. Godal (University of Oslo)
GEMINI-E3/GEMWTrap Model* (A General Equilibrium Model of International Interaction for Economy-Energy- Environment)	Alain Bernard – Ministry of Equipment, Housing and the Environment (France) Marc Vielle – CEA/IDIE (France)
IPAC* (Integrated Projection Assessments for China)	Kejun JIANG (Energy Research Institute, China) Xiulian HU (Energy Research Institute, China) Songli ZHU (Energy Research Institute, China)
MERGE* (Model for Evaluating Regional and Global Effects of GHG Reductions Policies)	Alan Manne (Stanford University) Richard Richels (EPRI)
Mini-CAM* (Mini- Climate Assessment Model)	Jae Edmonds Hugh Pitcher Steve Smith
MIT-EPPA (Emissions Projection and Policy Analysis Model)	Henry Jacoby (MIT) John Reilly (MIT)
POLES-GEGS* (Prospective Outlook on Long-Term Energy Systems-Global Emissions Control Strategies)	Patrick Criqui (IEPE, France)
WIAGEM* (World Integrated Applied General Equilibrium Model)	Claudia Kemfert (SPEED, Oldenburg Univ., Germany)

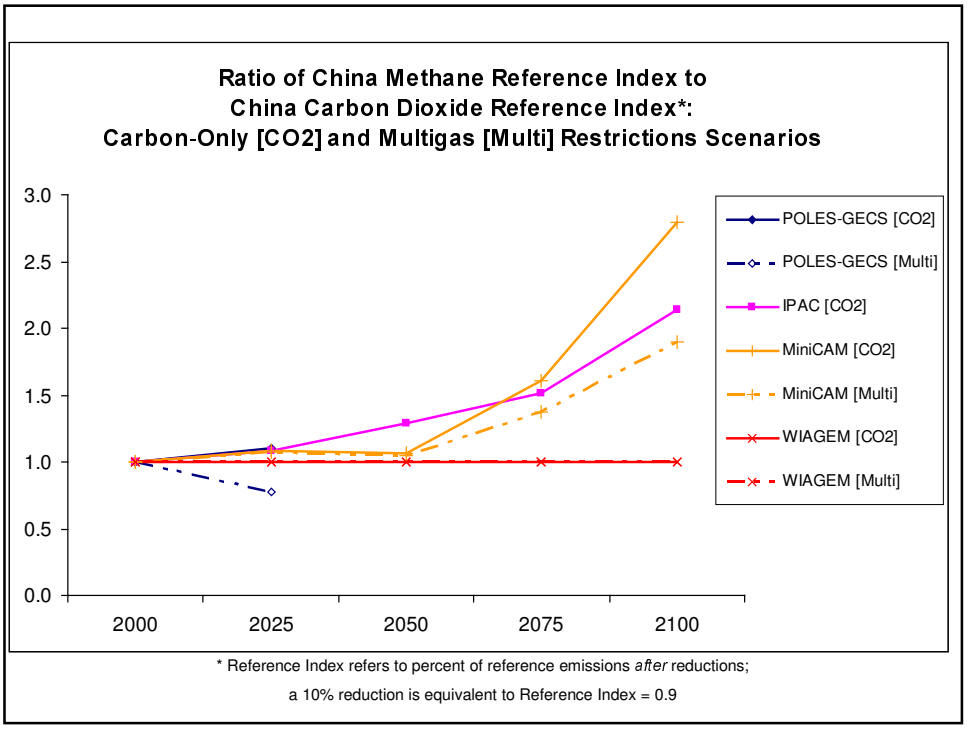
- * Submission of Results for May 19-21 , 2003 Meeting
- + Presentation at EMF 21 Mtg.


Global Carbon Dioxide Emissions:
Carbon-Only [CO2] and Multigas [Multi] Restrictions Scenarios
Tg C
0
2
4
6
8
10
12
14
2000
2025
2050
2075
2100
COMBAT[CO2]
COMBAT[Multi]
POLES-GECS [CO2]
POLES-GECS [Multi]
IPAC [CO2]
MERGE [CO2]
MERGE [Multi]
MiniCAM [CO2]
MiniCAM [Multi]
WIAGEM [CO2]
WIAGEM [Multi]
MIT [Multi]
MESSAGE[CO2]
MESSAGE[Multi]


Global Methane Emissions:
Carbon-Only [CO2] and Multigas [Multi] Restrictions Scenarios
Tg Methane
0
100
200
300
400
500
600
700
2000
2025
2050
2075
2100
COMBAT [CO2]
COMBAT [Multi]
POLES-GECS [CO2]
POLES-GECS [Multi]
IPAC [CO2]
MERGE [CO2]
MERGE [Multi]
MiniCAM [CO2]
MiniCAM [Multi]
WIAGEM [CO2]
WIAGEM [Multi]
MIT [Multi]
MESSAGE[CO2]
MESSAGE[Multi]


Ratio of Global Methane Reference Index to Global Carbon Dioxide Reference Index*: Carbon-Only [CO2] and Multigas [Multi] Restrictions Scenarios
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2000
2025
2050
2075
2100
COMBAT [CO2]
COMBAT [Multi]
POLES-GECS [CO2]
POLES-GECS [Multi]
IPAC [CO2]
MERGE [CO2]
MERGE [Multi]
MiniCAM [CO2]
MiniCAM [Multi]
WIAGEM [CO2]
WIAGEM [Multi]
MESSAGE[CO2]
MESSAGE[Multi]
MIT-EPPA[Multi]
* Reference Index refers to percent of reference emissions after reductions;
a 10% reduction is equivalent to Reference Index = 0.9


Ratio of China Carbon Dioxide Reference Index to Global Carbon Dioxide Reference Index*: Carbon-Only [CO2] and Multigas [Multi] Restrictions Scenarios
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
2000
2025
2050
2075
2100
POLES-GECS [CO2]
POLES-GECS [Multi]
IPAC [CO2]
MiniCAM [CO2]
MiniCAM [Multi]
WIAGEM [CO2]
WIAGEM [Multi]
* Reference Index refers to percent of reference emissions after reductions;
a 10% reduction is equivalent to Reference Index = 0.9


Ratio of China Methane Reference Index to
China Carbon Dioxide Reference Index*:
Carbon-Only [CO2] and Multigas [Multi] Restrictions Scenarios
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2000
2025
2050
2075
2100
POLES-GECS [CO2]
POLES-GECS [Multi]
IPAC [CO2]
MiniCAM [CO2]
MiniCAM [Multi]
WIAGEM [CO2]
WIAGEM [Multi]
* Reference Index refers to percent of reference emissions *after* reductions;
a 10% reduction is equivalent to Reference Index = 0.9