Climate Change and Energy in Asia

Sergey Paltsev

Expert Workshop on Energy and Climate Change Modeling
Korea Energy Economics Institute
Seoul, Korea
November 17, 2011

The MIT Joint Program on the Science and Policy of Global Change

Questions or comments?
Contact: Sergey Paltsev
paltsev@mit.edu

Purpose

An illustration of capabilities of the MIT Integrated Global System Model (IGSM) Framework

Projections of energy mix in Asia

Climate impacts

Economic component – The MIT Emissions Prediction and Policy Analysis (EPPA) Model

Combining Top-Down with Bottom-Up Modeling

Air Pollution Health Effects

Major Points

Temperature increases are substantial.

Most emissions growth is in developing regions.

Emissions in developed regions are flat, so a smaller lever to further impact global emissions.

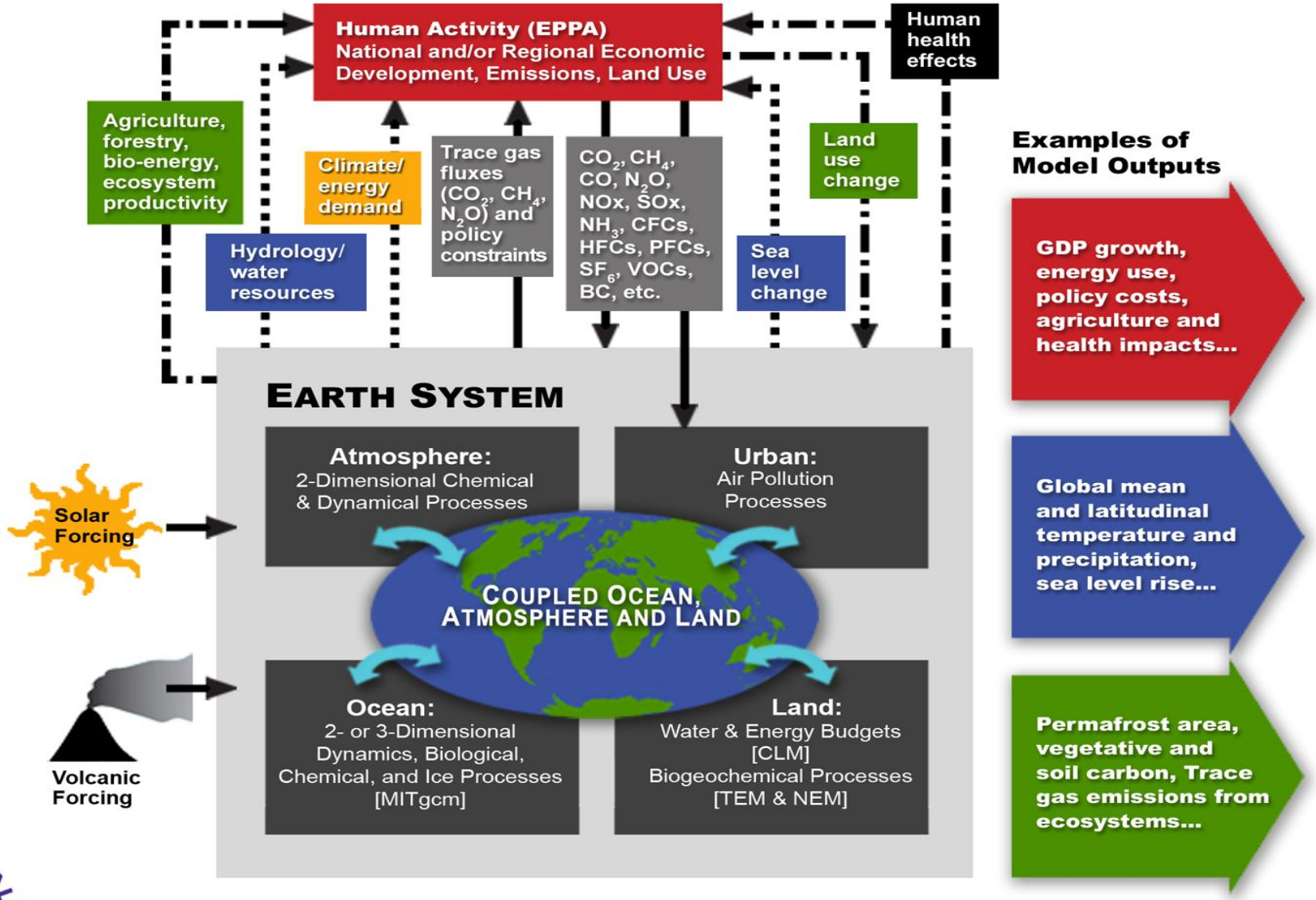
Transition to alternative energy is starting in developed countries and China, but the Copenhagen targets will not complete it.

Vehicle growth is substantial in Asia.

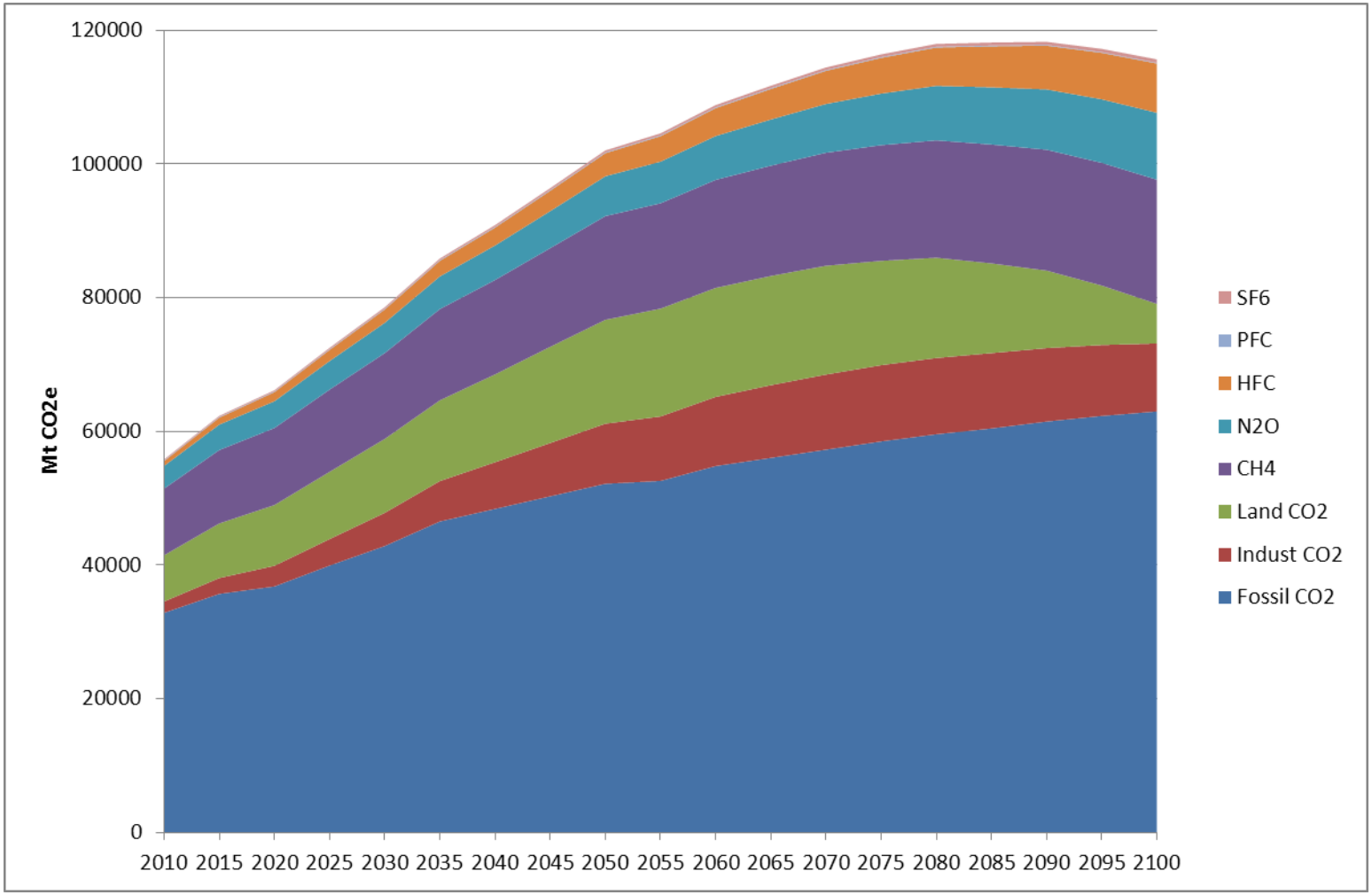
Land emissions are important.

A lot more work is needed if the world wants to avoid substantial climate change.

MIT Integrated Global Systems Model (IGSM)



Global Emissions



Scenario: Copenhagen pledges by 2020 – no further policy

Fossil CO_2 is a major part

But other GHGs are important

Increased role of HFC (air conditioning)

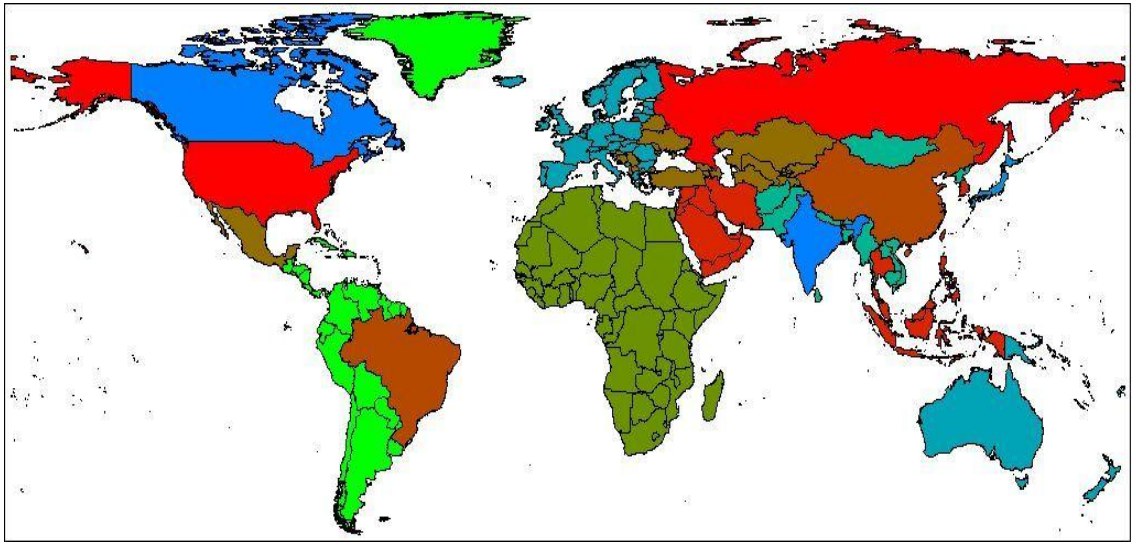
Land use CO_2

Industrial and Cement CO_2

EPPA regions

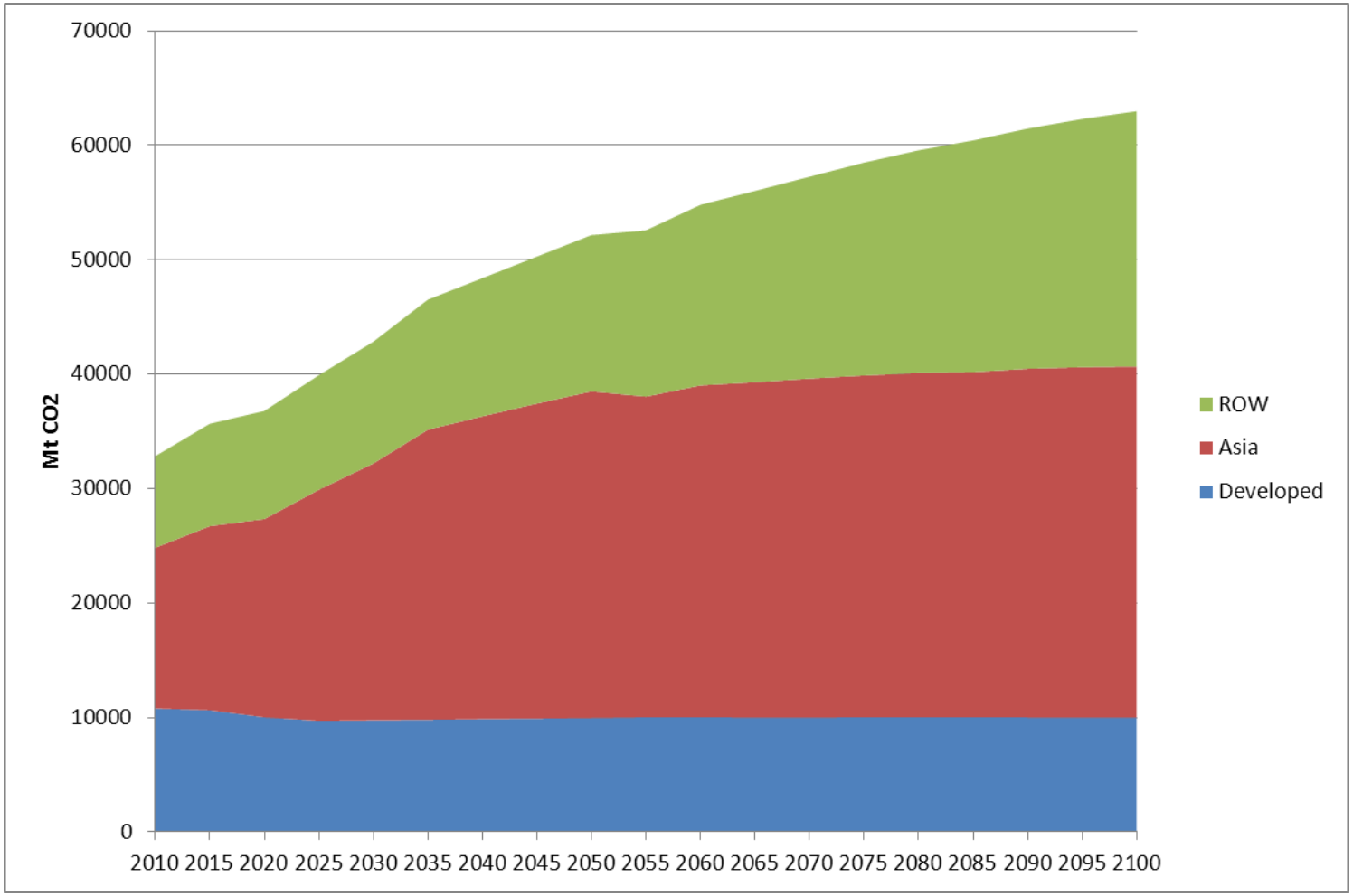
16 regions

- USA
- EU
- Rest of Eurasia
- Canada
- Japan
- Aus. & N.Z.
- Russia
- China
- India
- Mexico
- Brazil



- Middle East
- Africa
- Rest of Latin America
- Dynamic Asia
- Rest of Asia

Fossil CO_2 Emissions by major group



Developed regions (USA, CAN, EUR, ANZ) have a smaller share over time

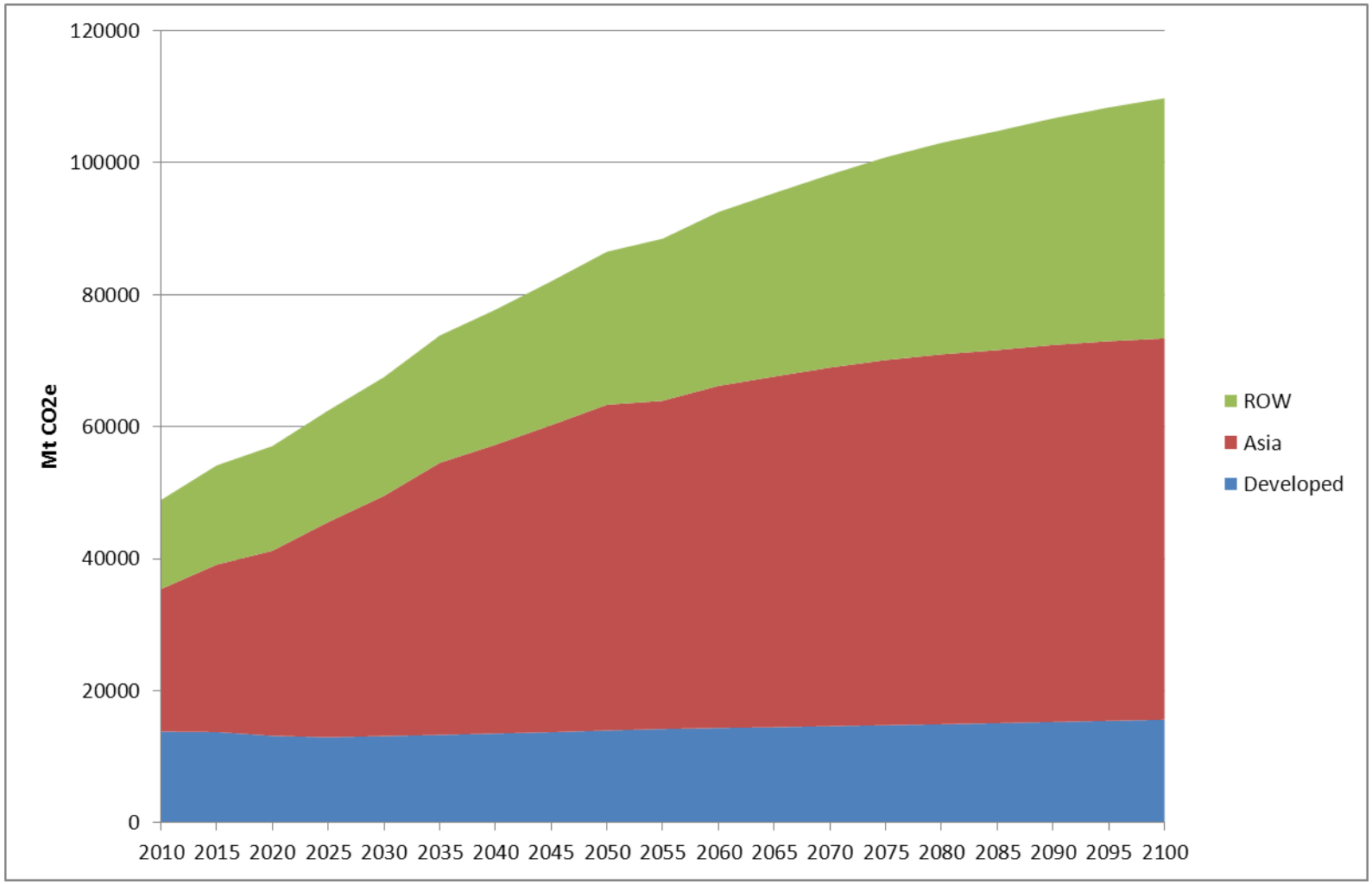
Even if they cut to zero – limited impact

Asia's regions (CHN, IND, JPN, ASI, REA) grow substantially even with intensity targets in China and India

Rest of the world regions grow substantially

Focusing on G20 only will miss a lot of opportunities

GHG Emissions by major group



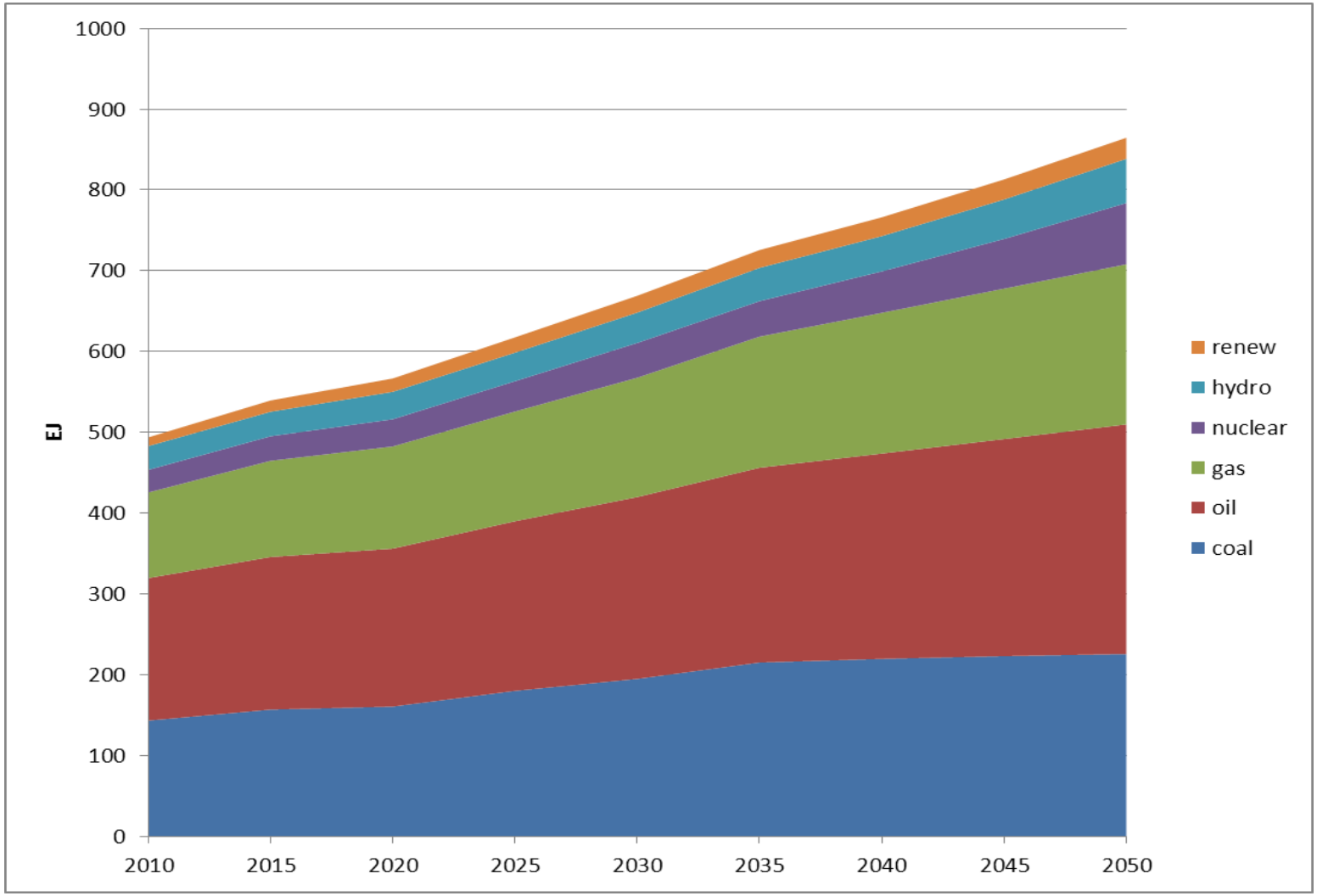
For GHGs the picture is similar

Developed regions have even smaller share for GHGs

Share of developed regions:
2010 – 30%,
2100 – 15%

Share of Asia's regions:
2010 – 45%,
2050 – 60%,
2100 – 55%

Global Energy Use



Scenario: Copenhagen pledges by 2020 – no further policy

Reliance of fossil fuels dominated by developing regions

Coal levels off

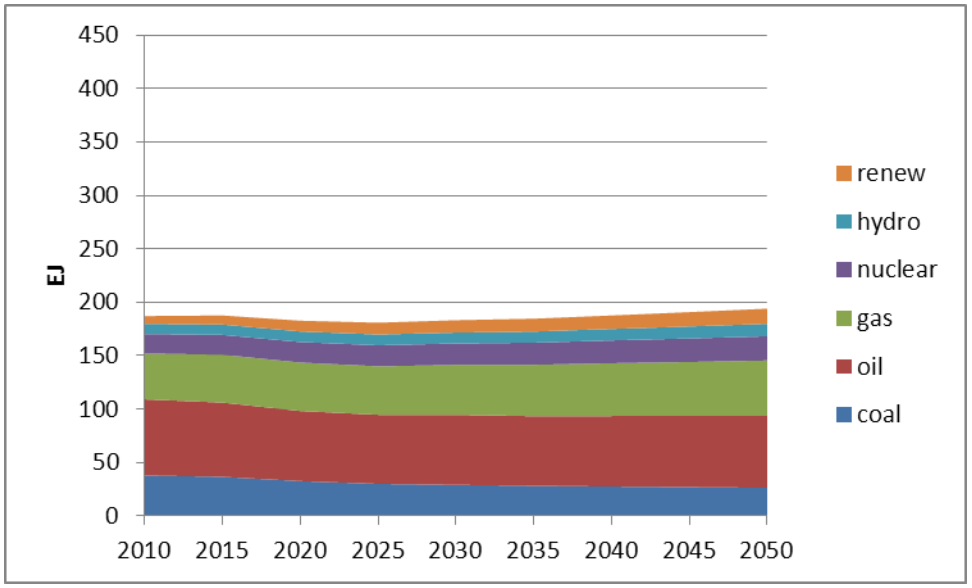
Larger role of natural gas and oil

Renewables increase 2.5 times by 2050

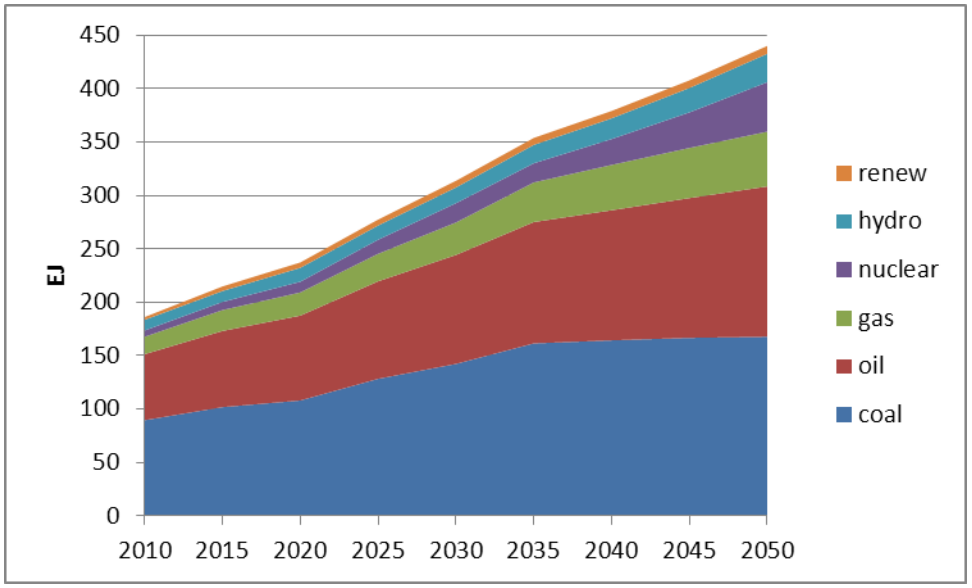
We have not forced renewables by RPS or other mandates

Nuclear power growth in developing regions

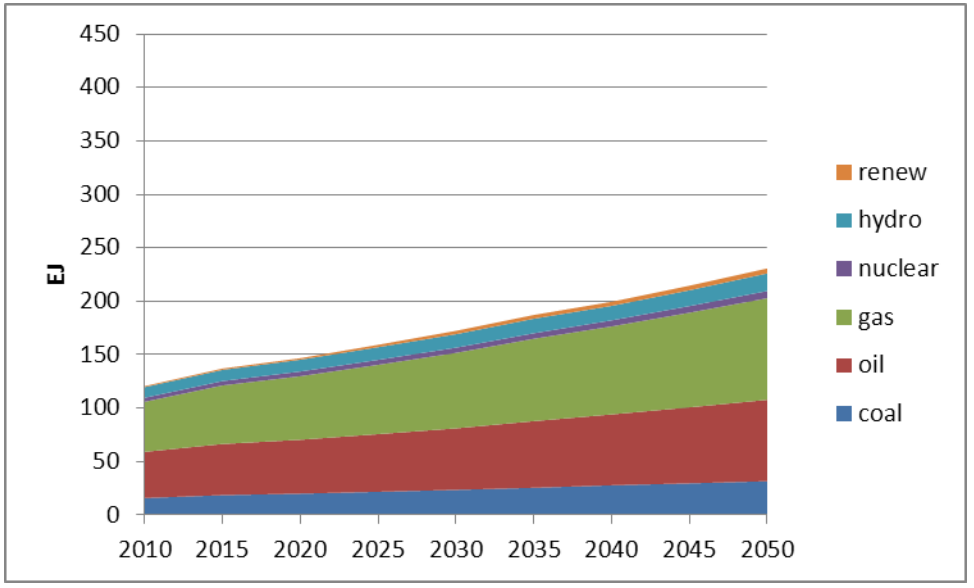
Energy Use by major group



Developed

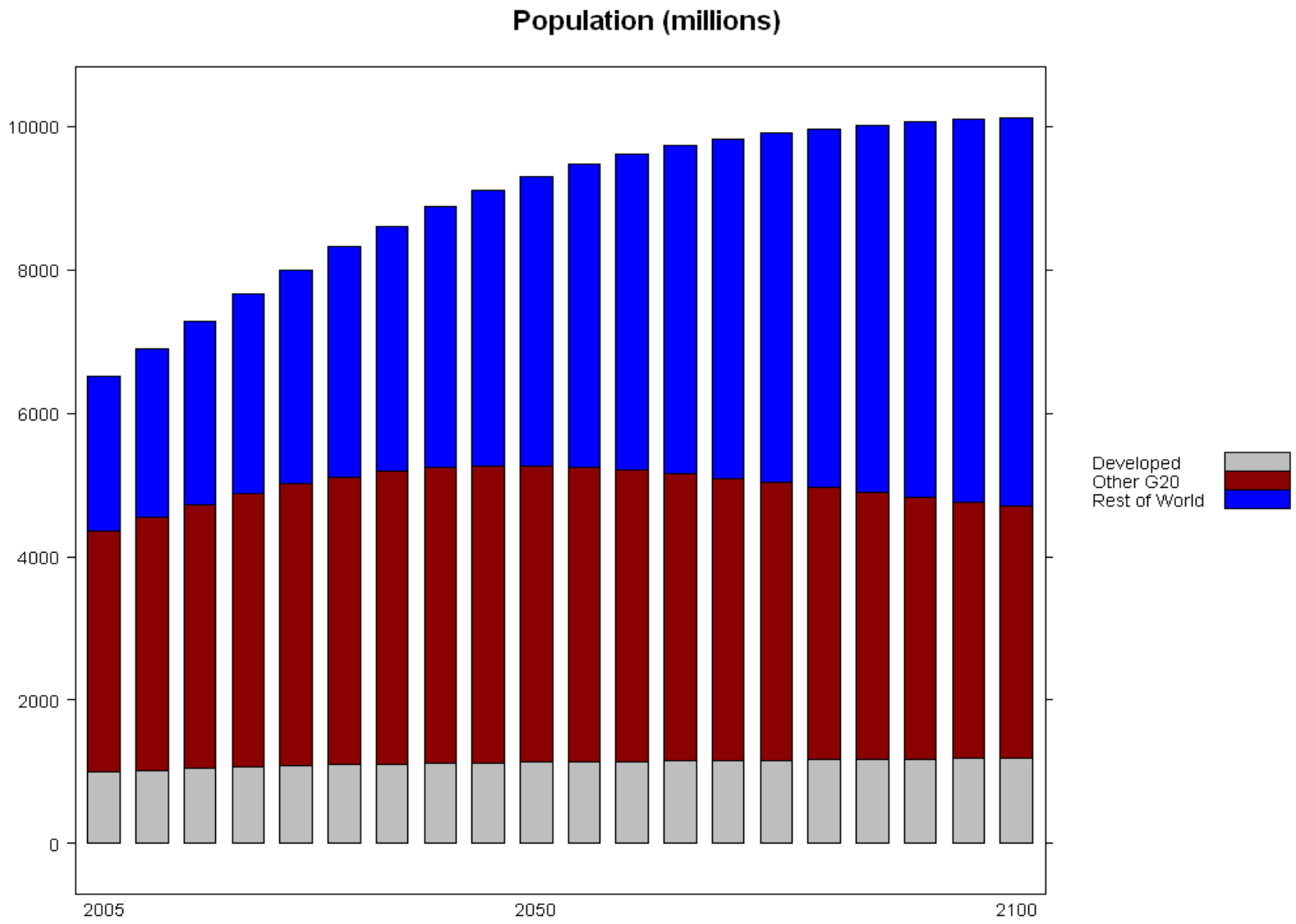


Asia

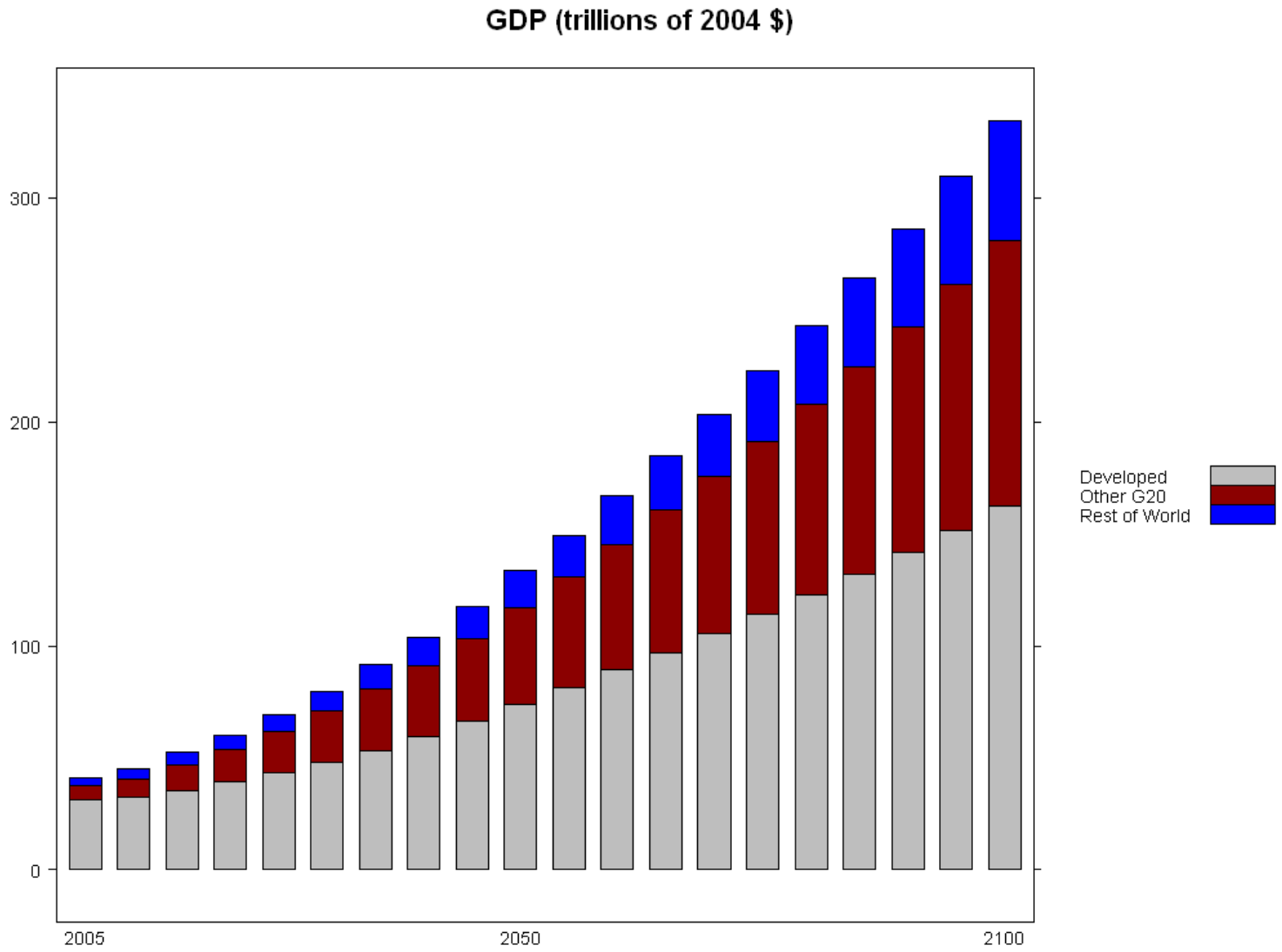


ROW

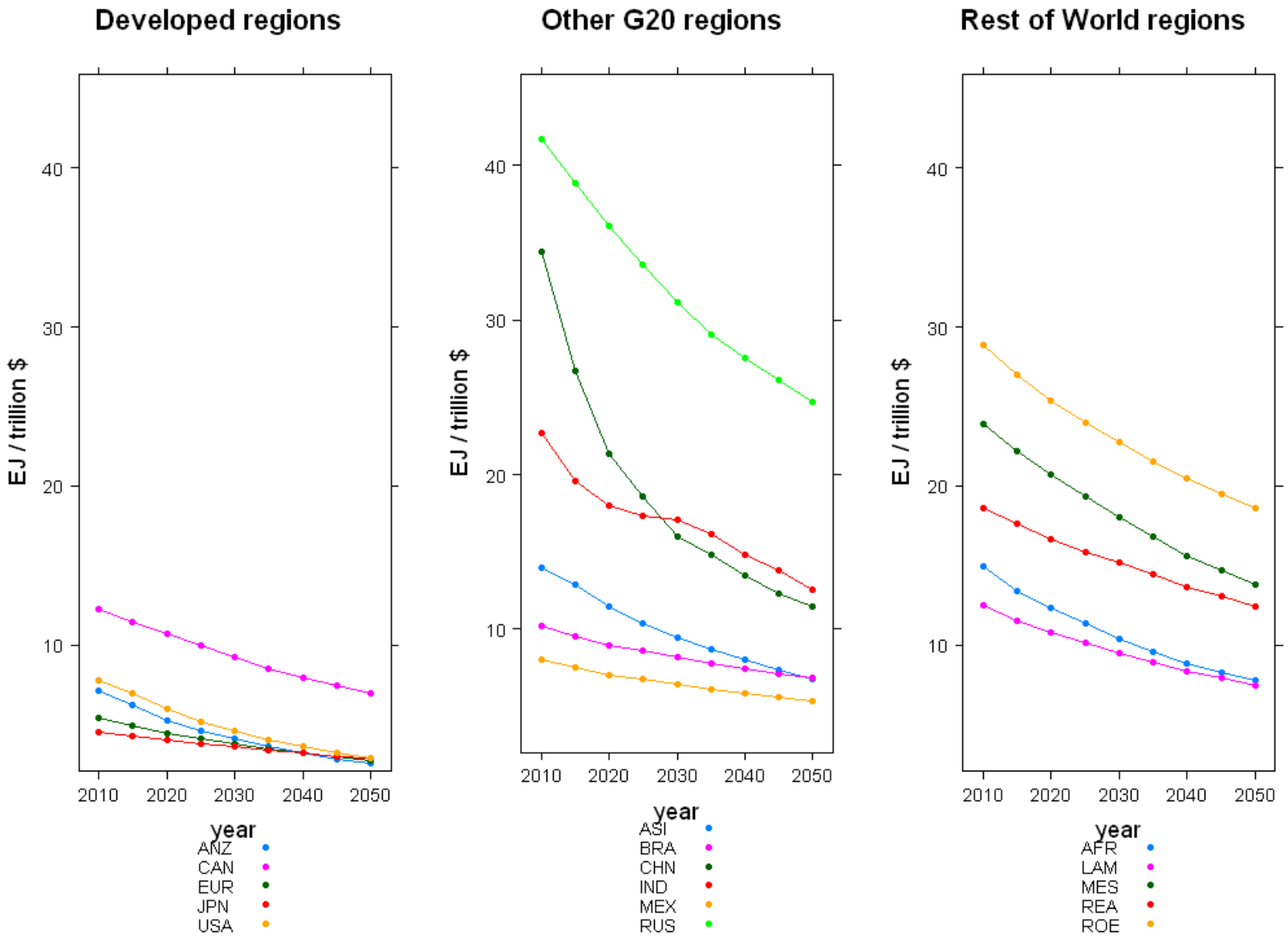
Global Population



Global GDP

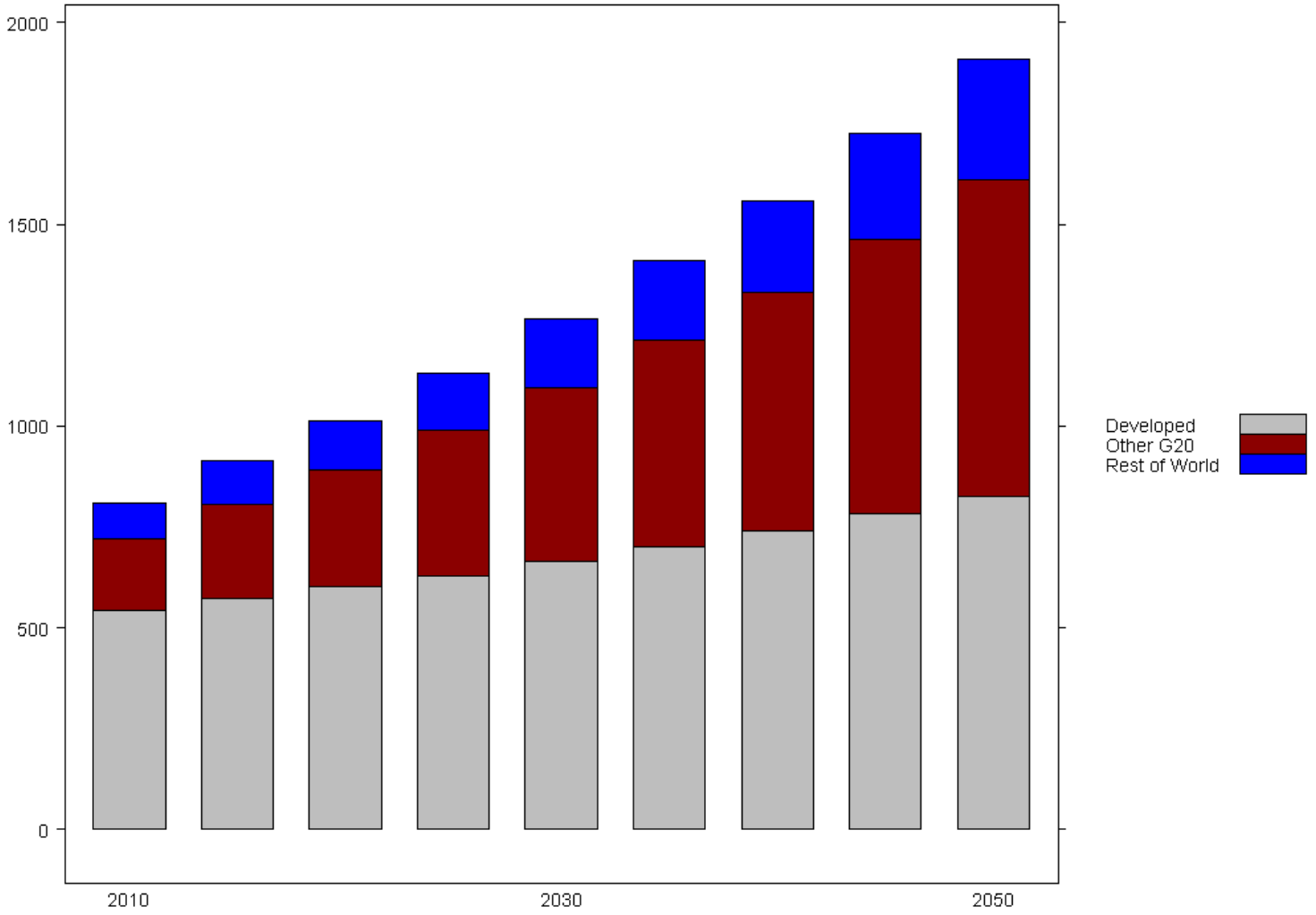

GDP (trillions of 2004 $)
300
200
100
0
2005
2050
2100
Developed
Other G20
Rest of World

Energy Intensity by EPPA Region



Energy use per unit of GDP

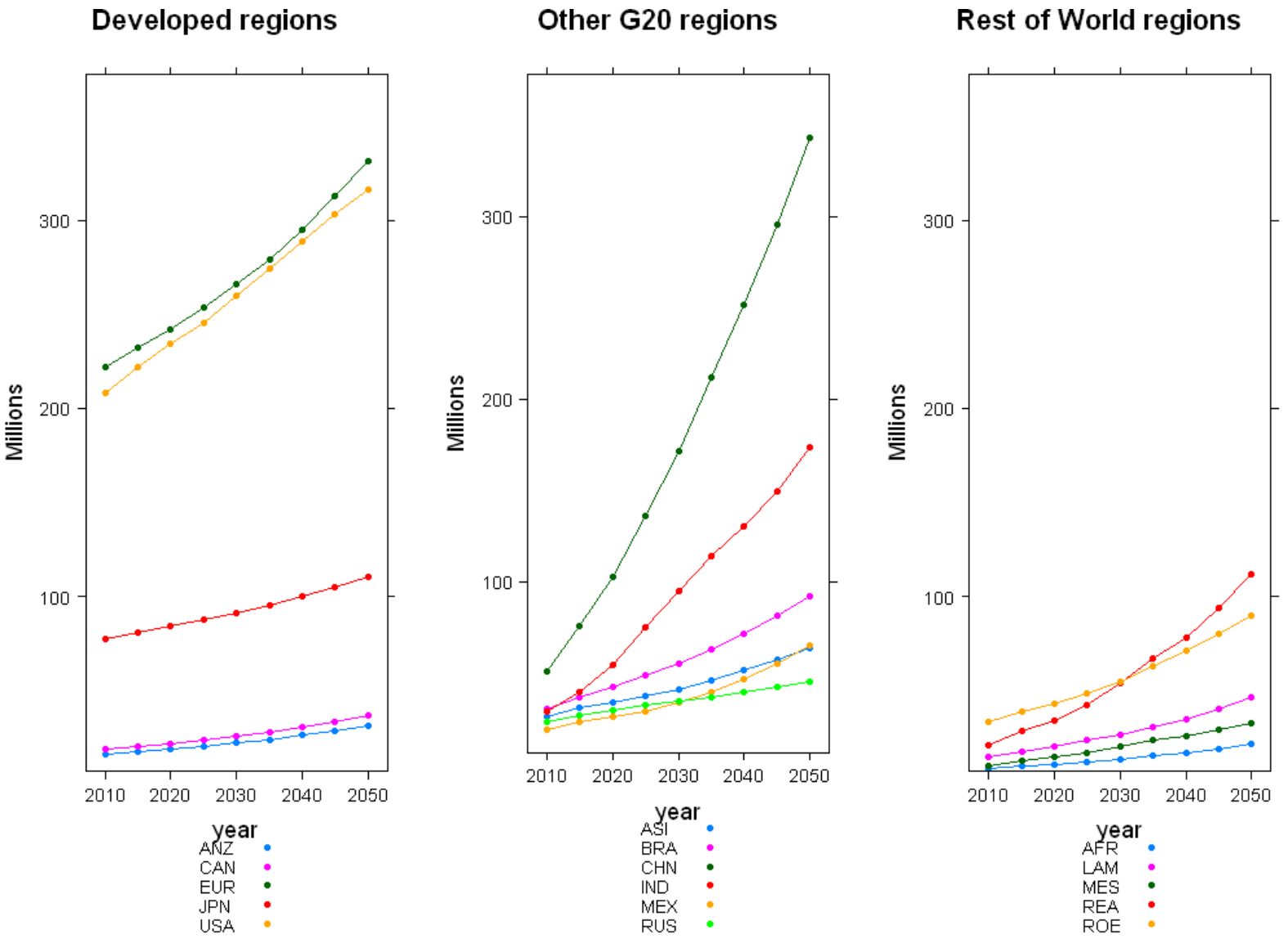
Vehicle Stock



Private Vehicles: cars and light trucks

millions

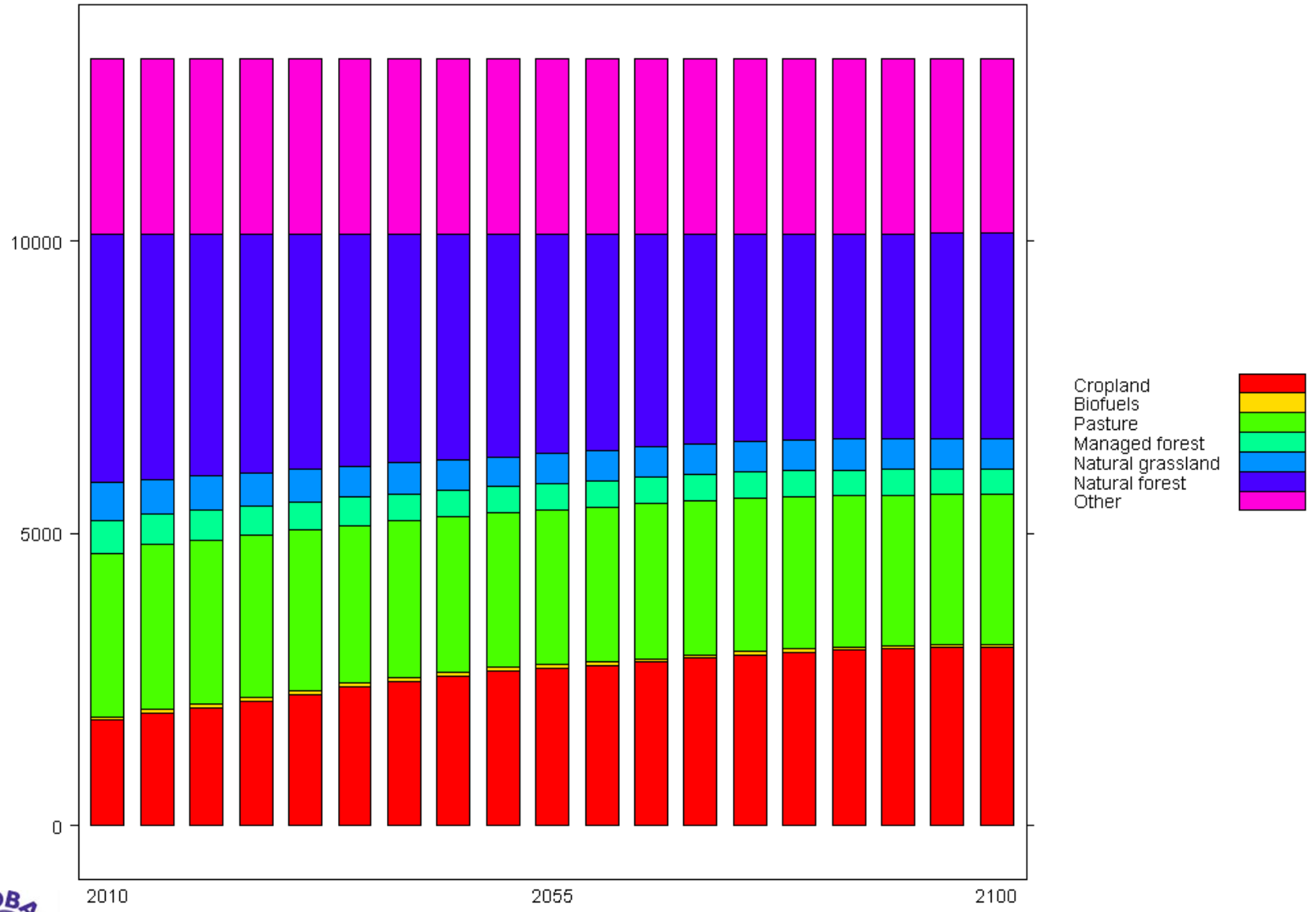
Vehicle Stock by EPPA Region



Private Vehicles: cars and light trucks

millions

Land Use



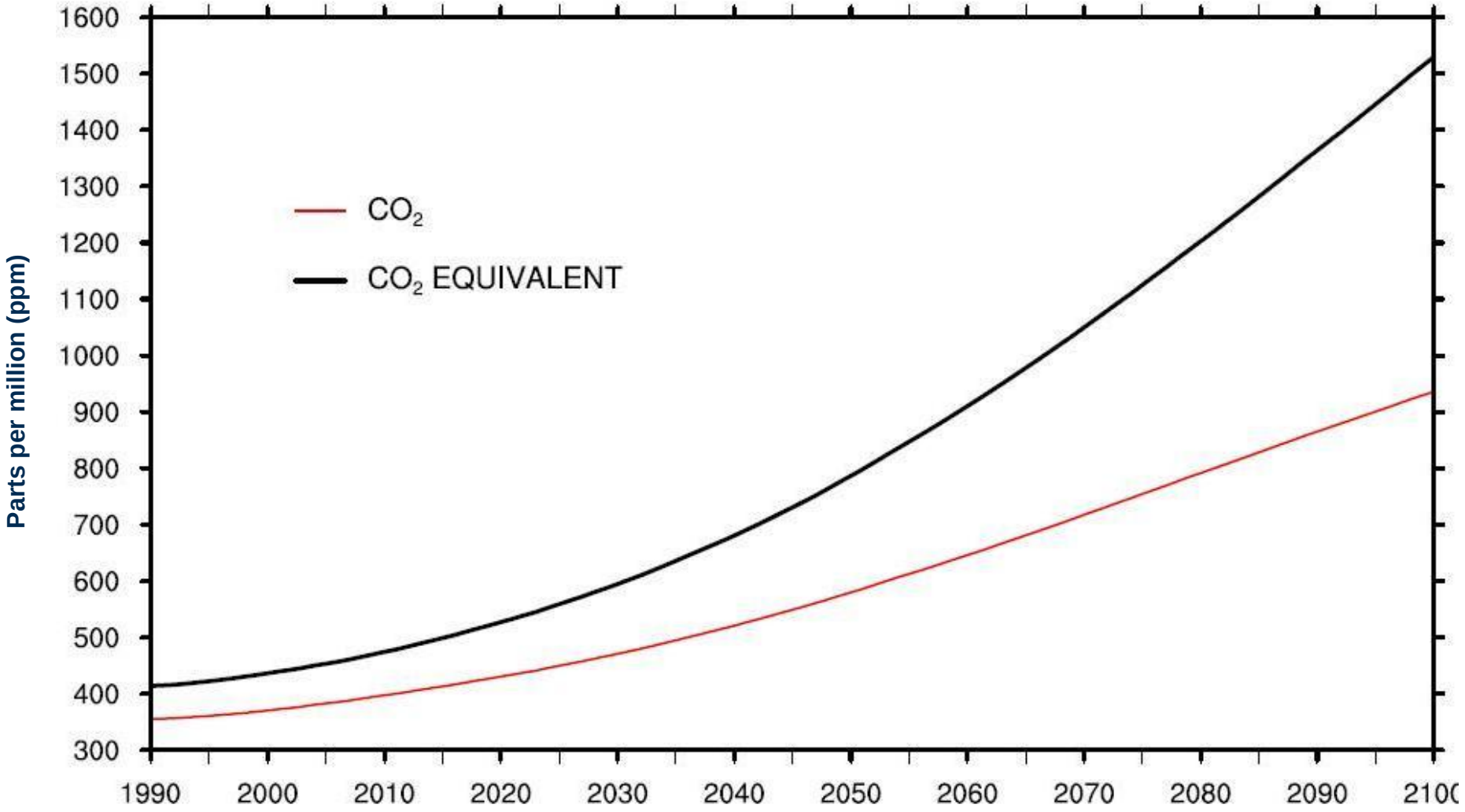
Global Land Use

Megahectares (Mha)

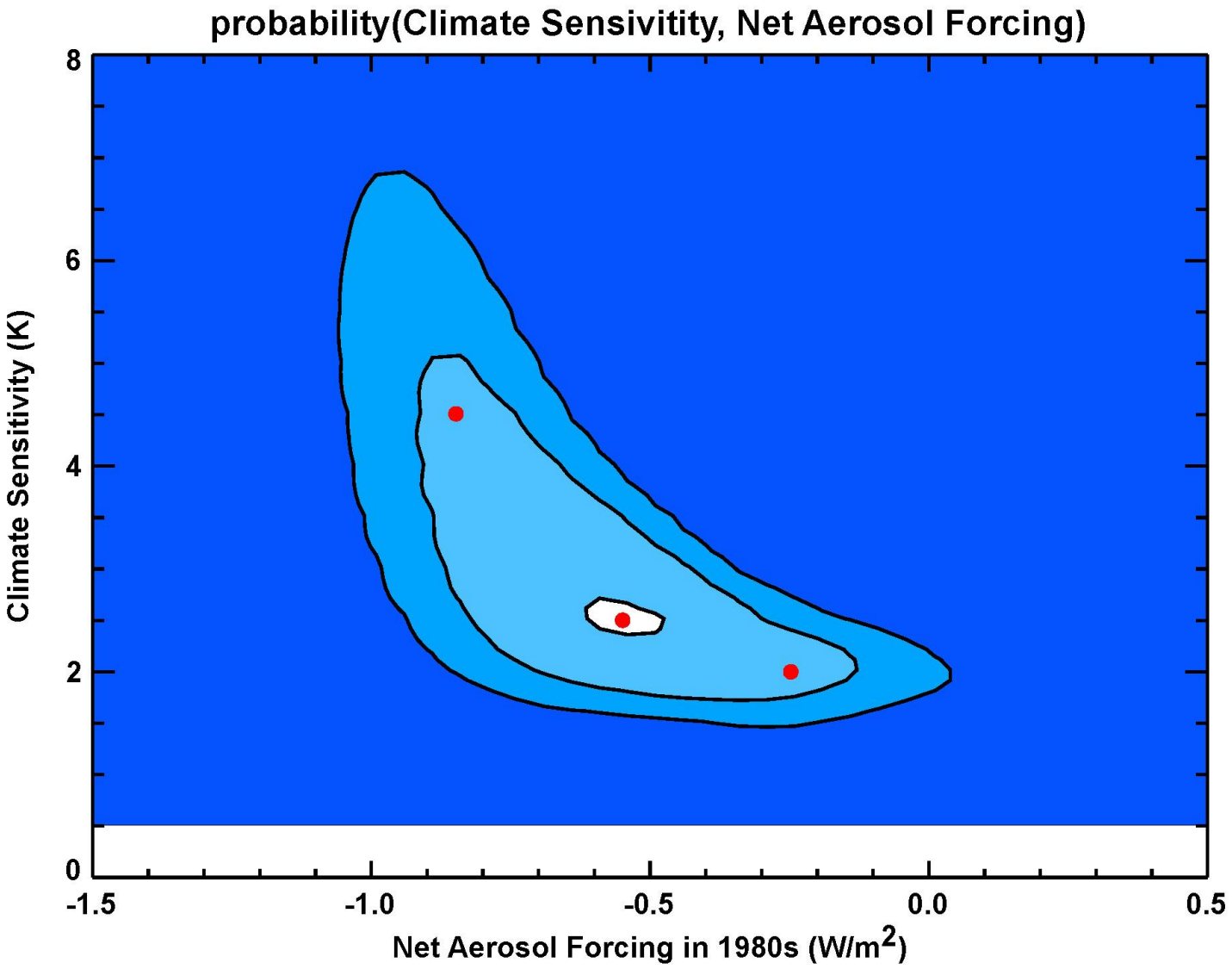
Land Use by major group

Megahectares (Mha)

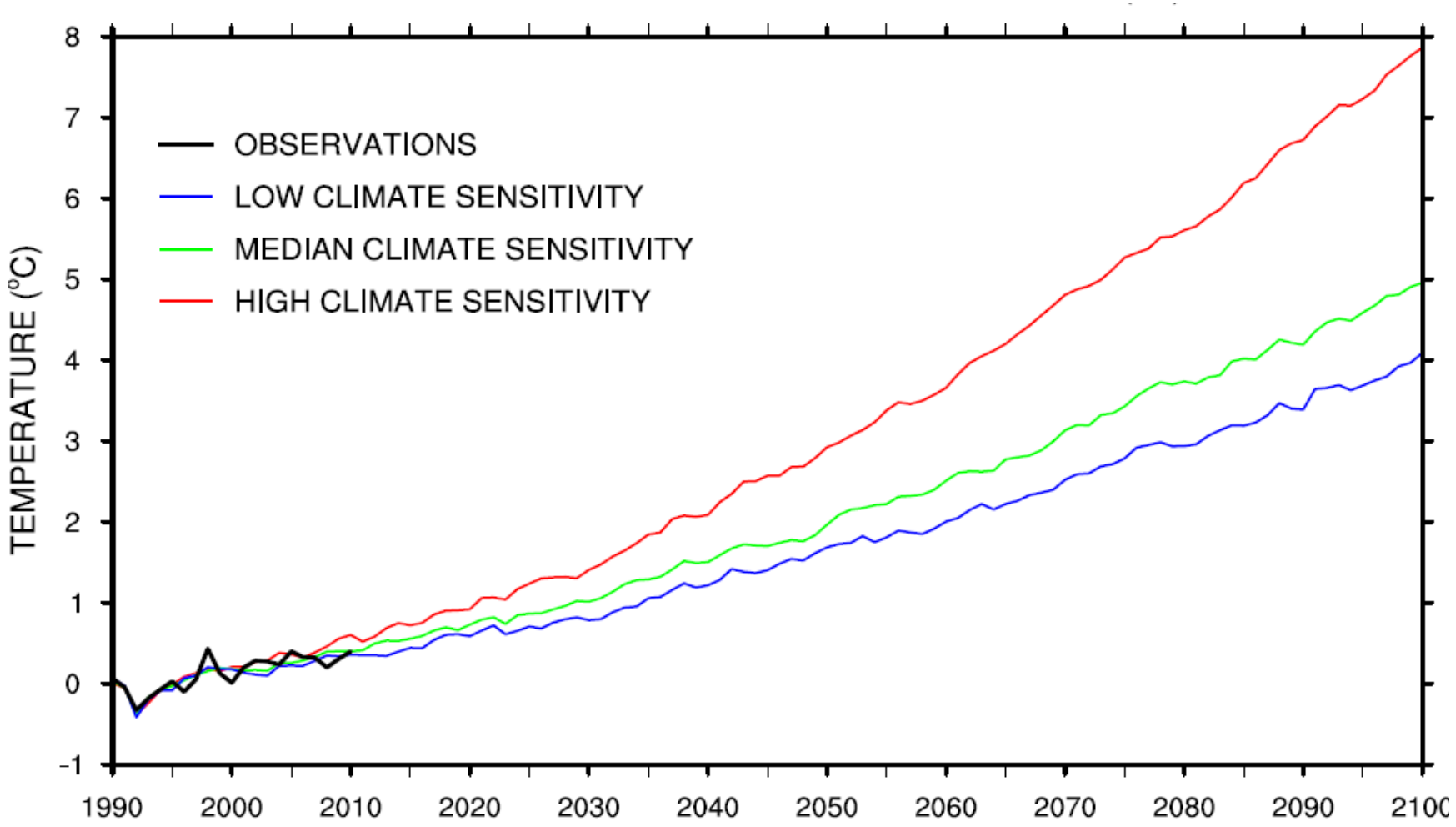
CO_2 and GHG Concentrations



Climate Sensitivity

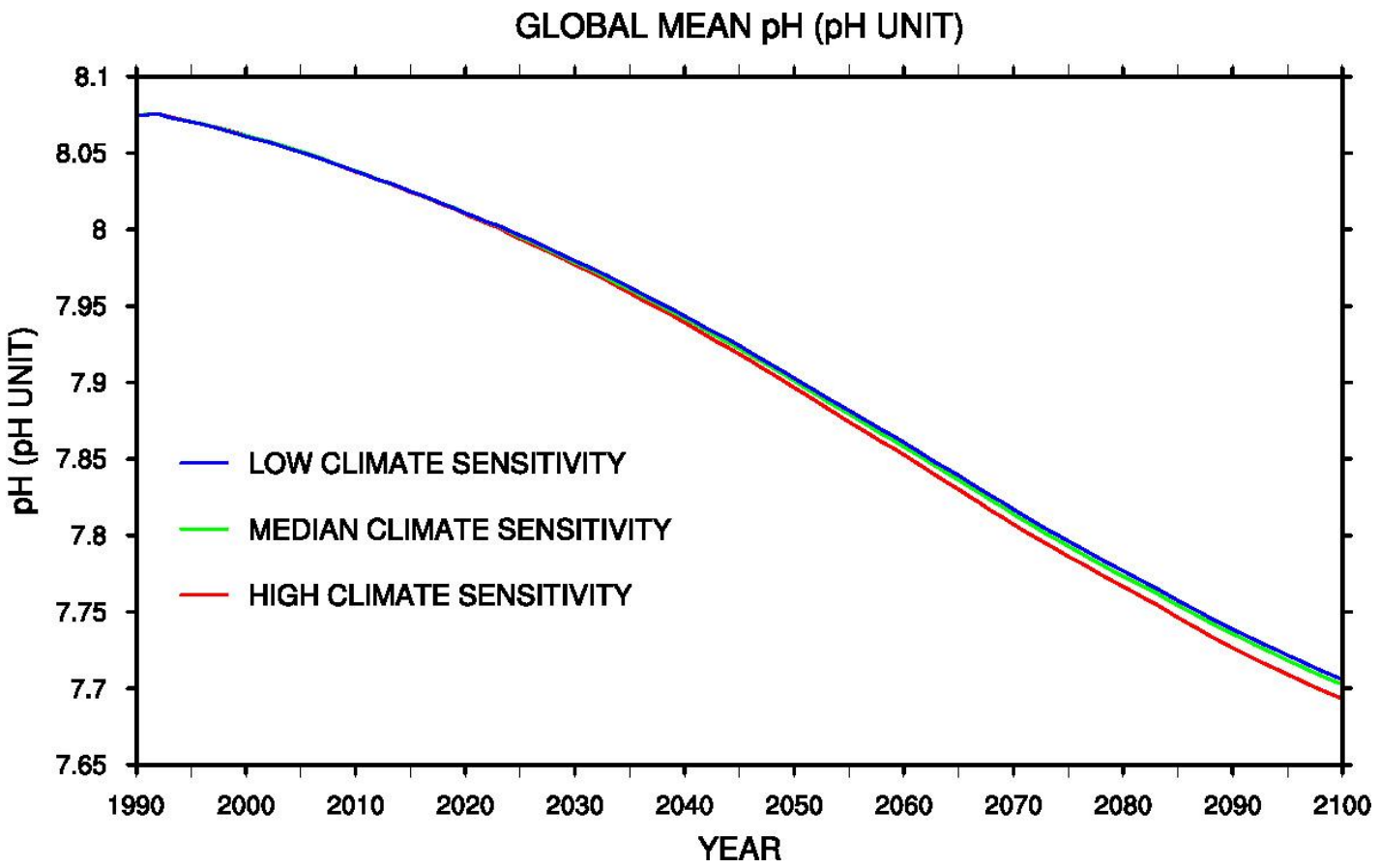


Temperature Increase



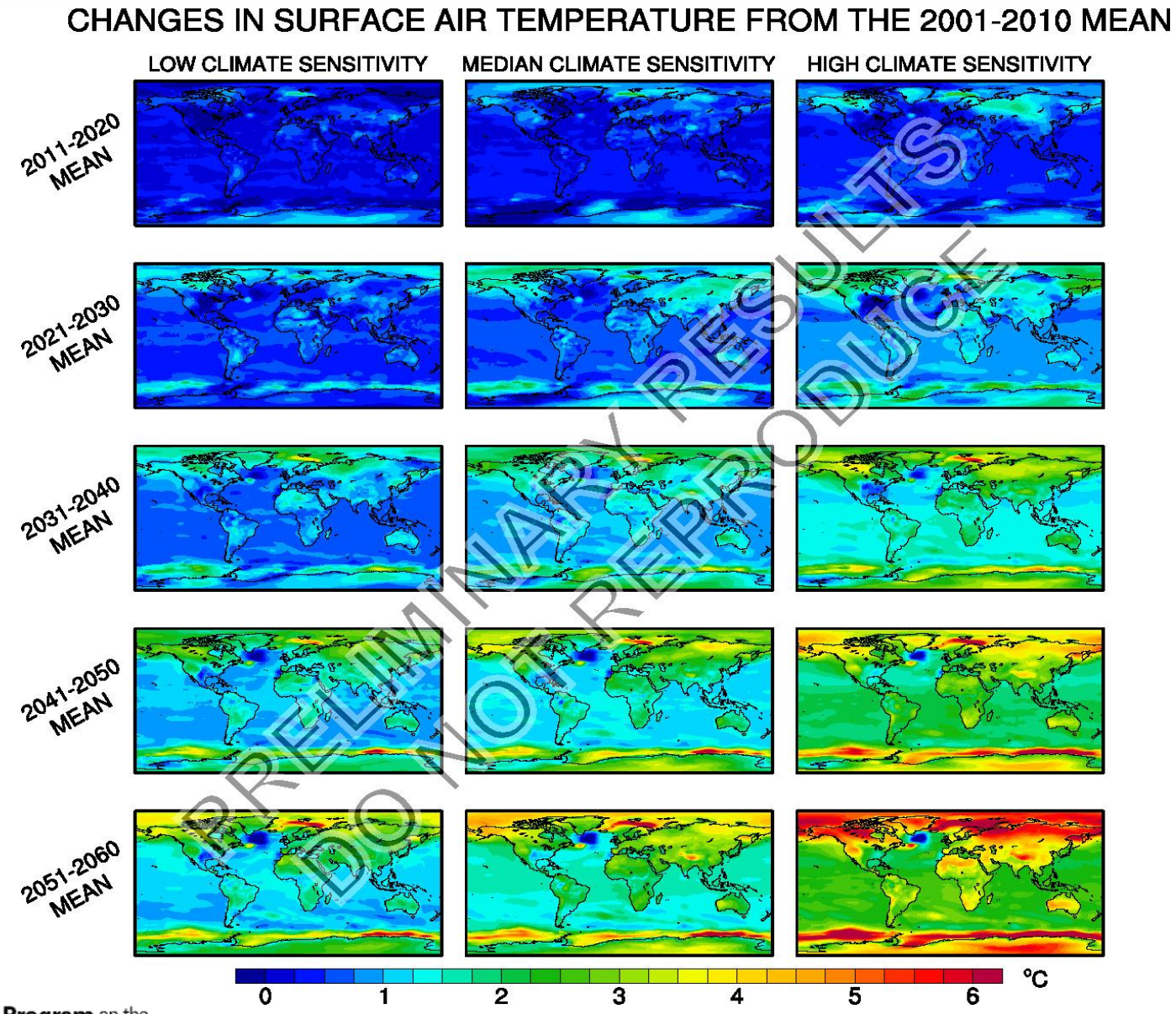
- Global average surface temperature change relative to 2000
- Black line - observations

Ocean Acidity

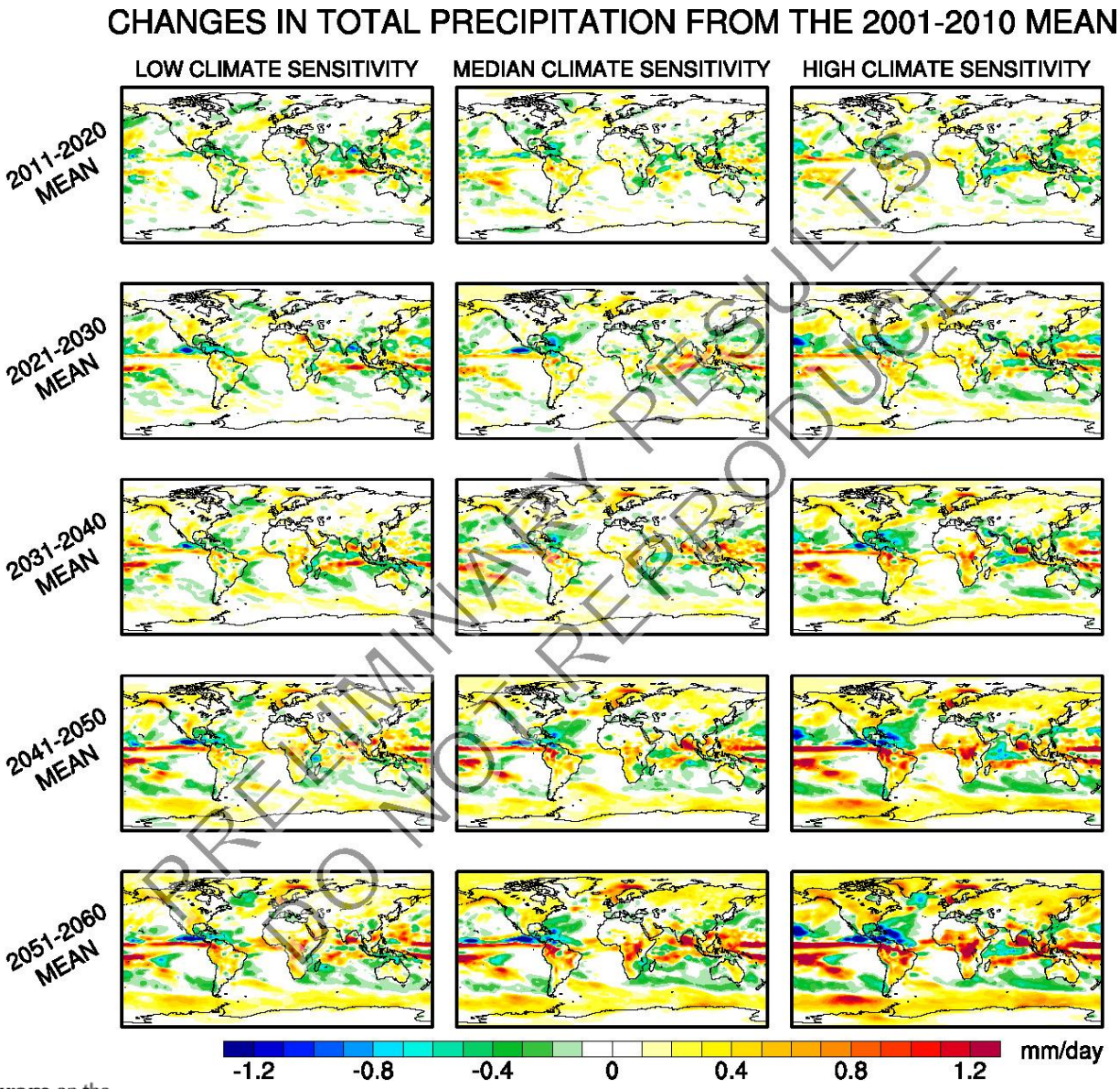


- A decrease of 1 in pH scale corresponds to a factor of 10 increase in acidity.

Regional Temperature Change

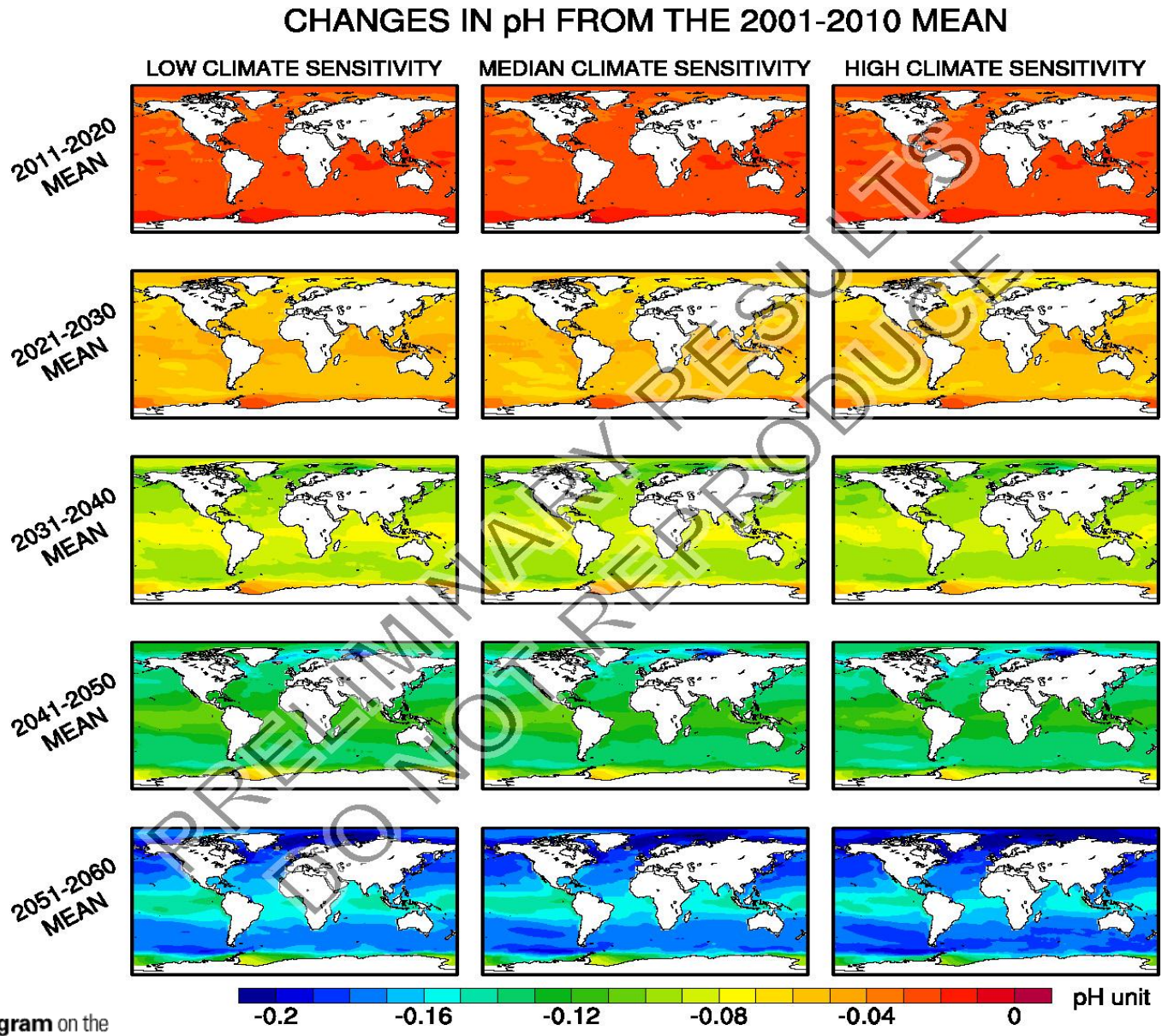


Regional Precipitation Change



Currently the average global precipitation is about 3 mm/day

Regional Ocean Acidity



Major Points

Temperature increases are substantial.

Most emissions growth is in developing regions.

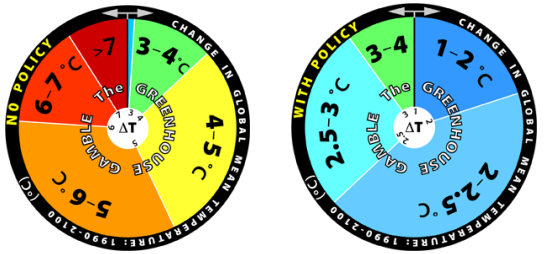
Emissions in developed regions are flat, so a smaller lever to further impact global emissions.

Transition to alternative energy is starting in developed countries and China, but the Copenhagen targets will not complete it.

Vehicle growth is substantial in Asia.

Land emissions are important.

A lot more work is needed if the world wants to avoid substantial climate change.



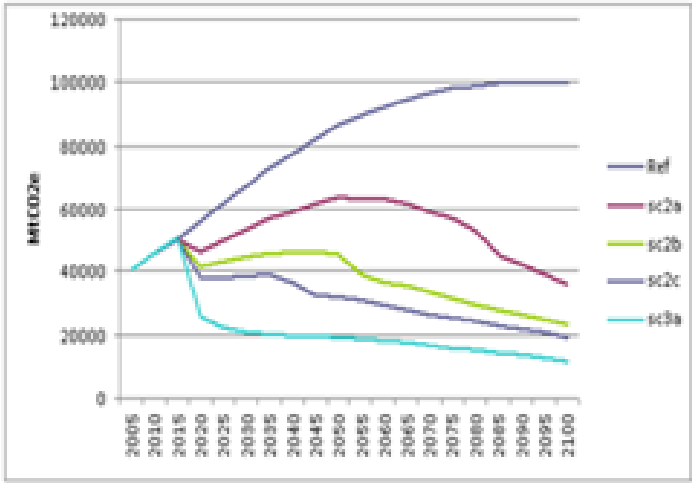
Thank you!

Additional information available at:

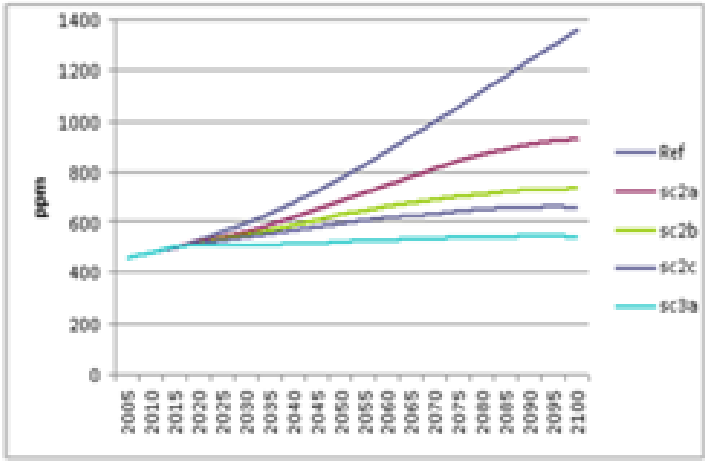
http://globalchange.mit.edu

Additional Slides for Discussion (1)

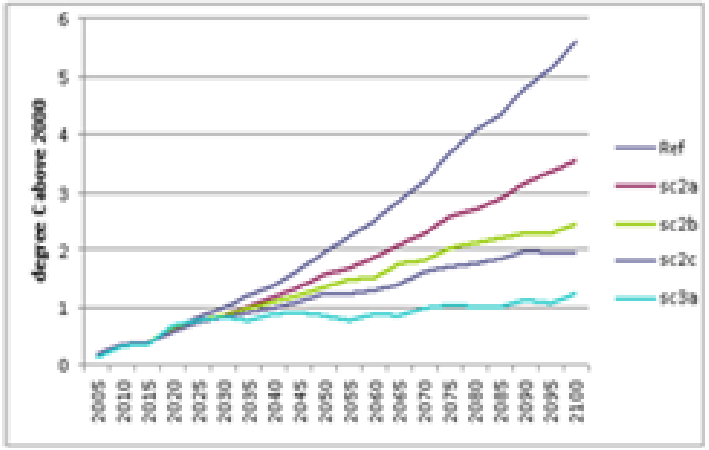
Asian Modeling Exercise Scenarios



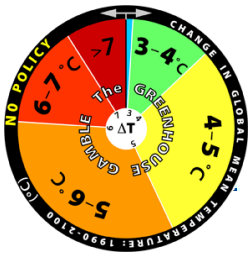
Emissions ($MtCO_2$-e)

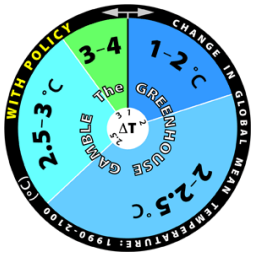


Concentrations (ppm)



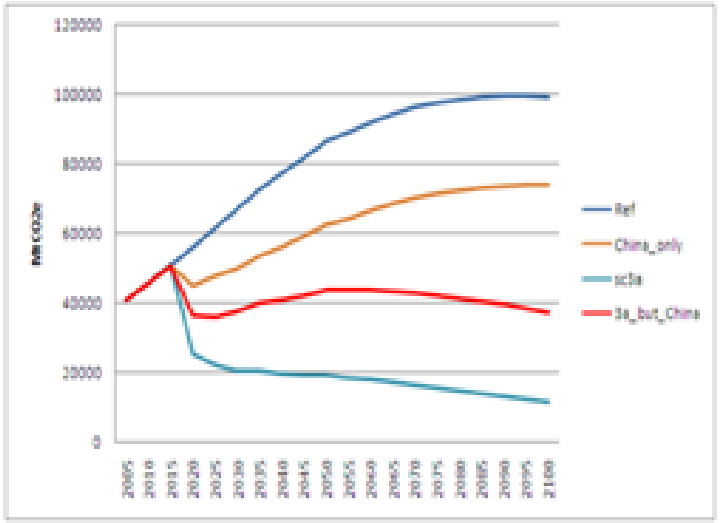
Temp. Increase (°C from 2000)



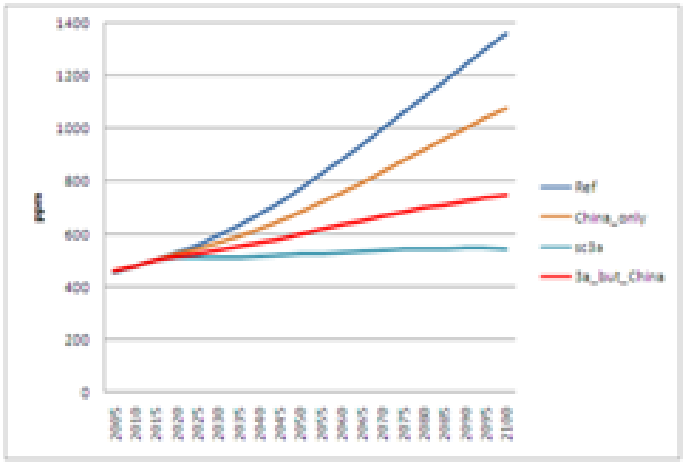


Additional Slides for Discussion (2)

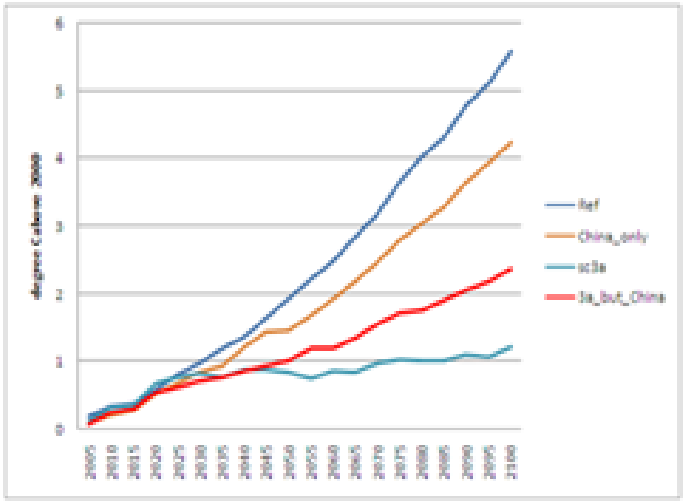
Implications of China's Participation



Emissions ($MtCO_2$-e)



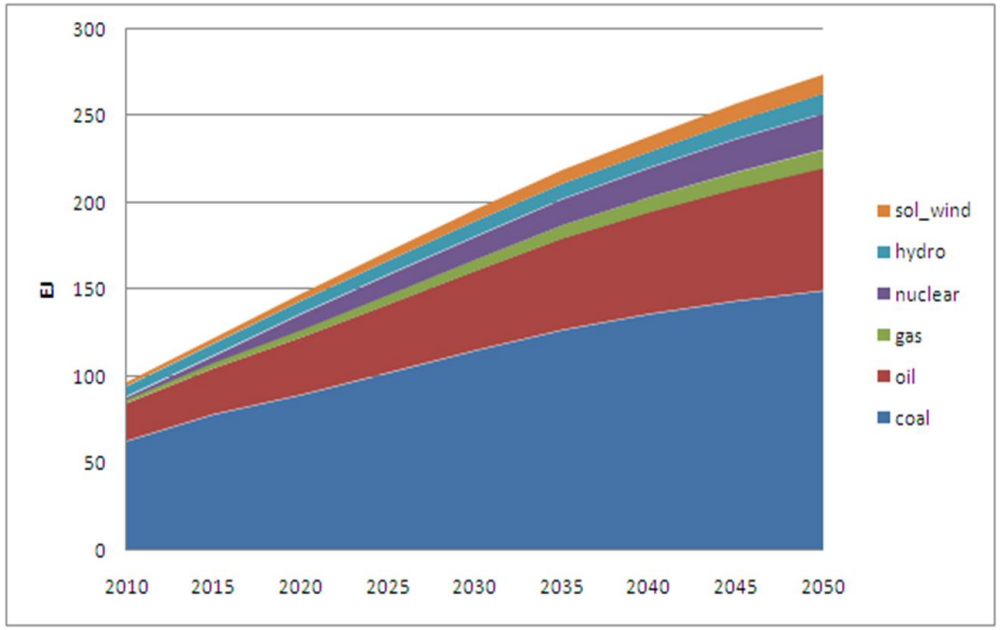
Concentrations (ppm)



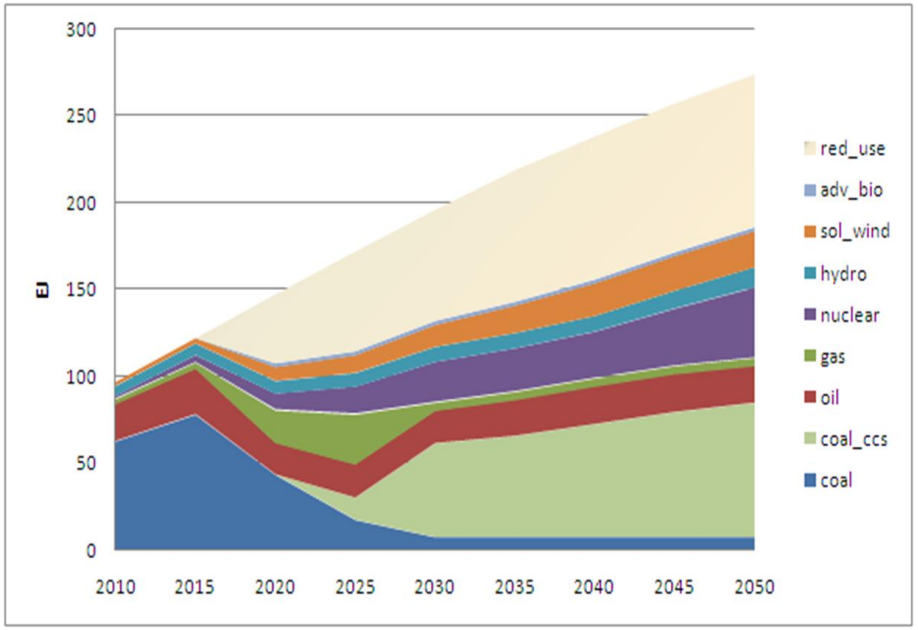
Temp. Increase (°C from 2000)

Paltsev et al., 2011

Additional Slides for Discussion (3)



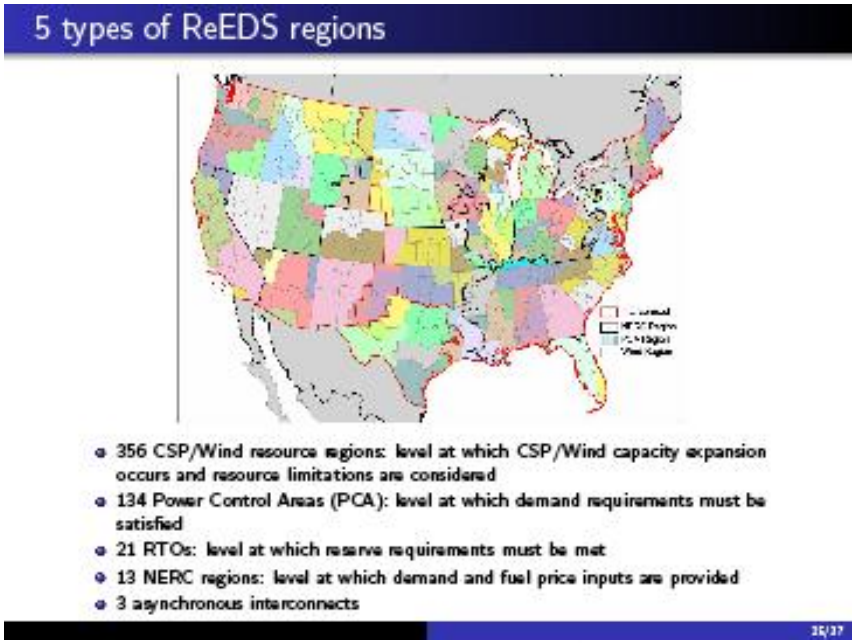
Energy Use in China
No Climate Policy

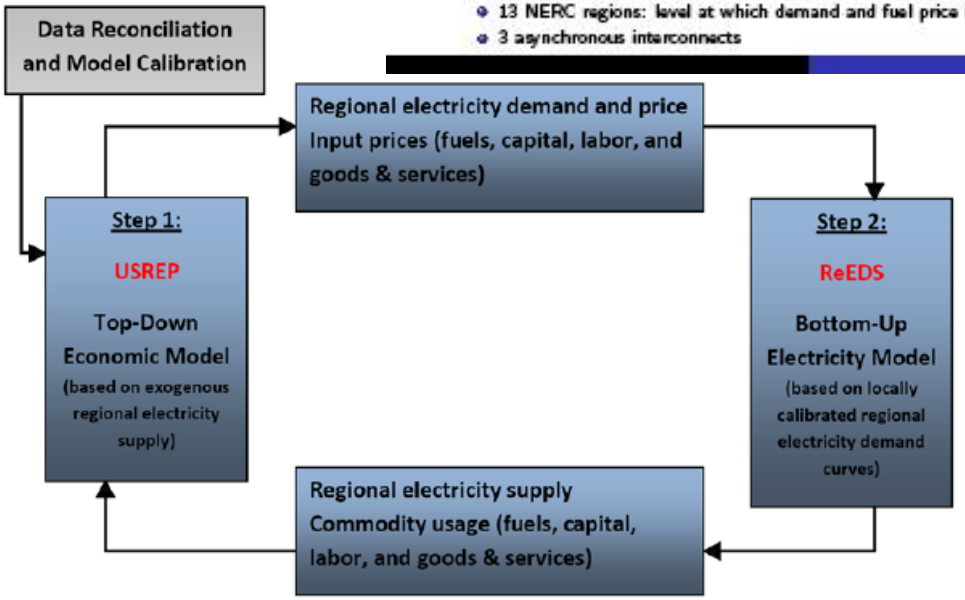


Energy Use in China
550 ppm Stabilization

Additional Slides for Discussion (4)

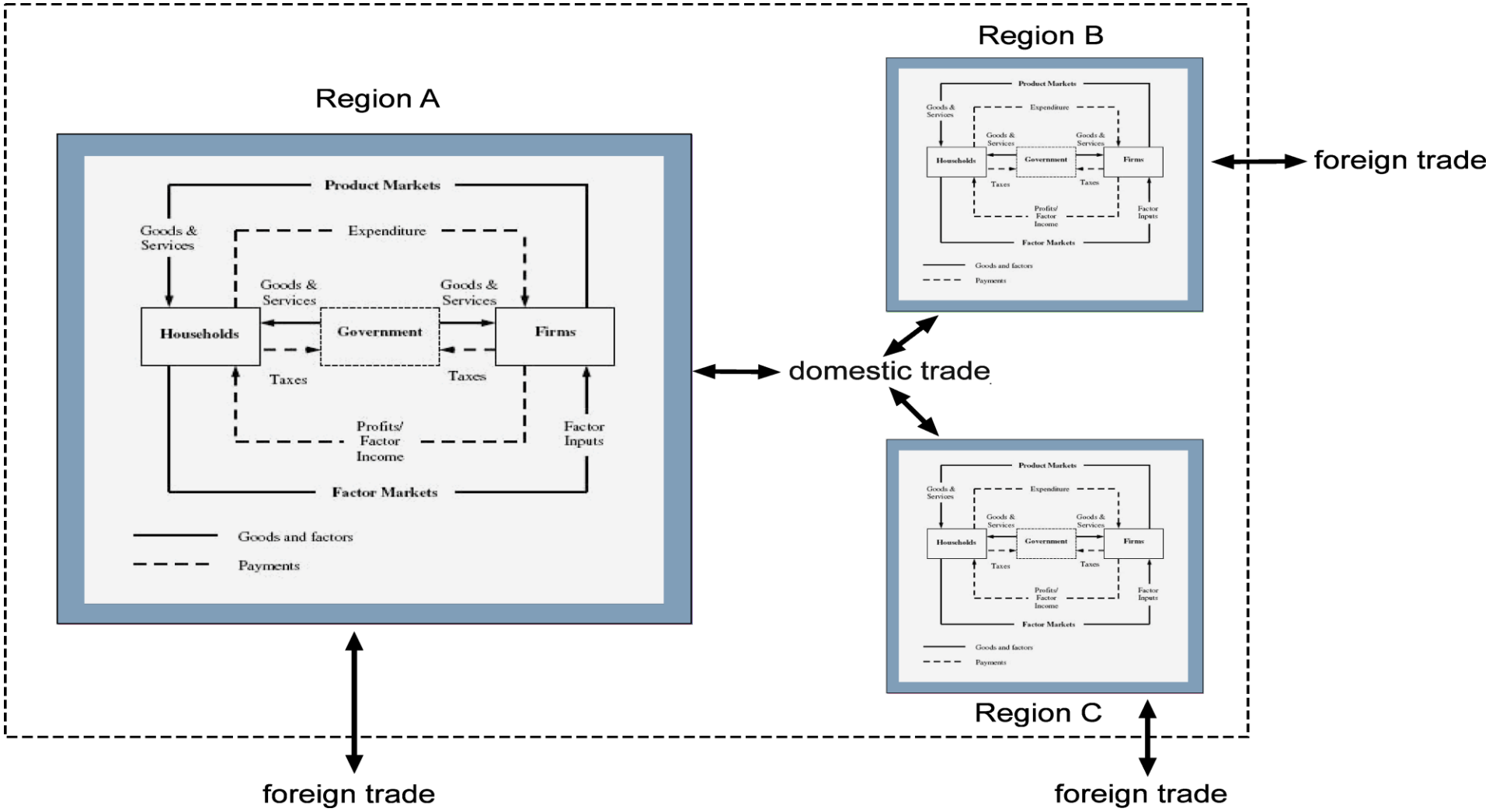
U.S. Regional Energy Policy (USREP) Model



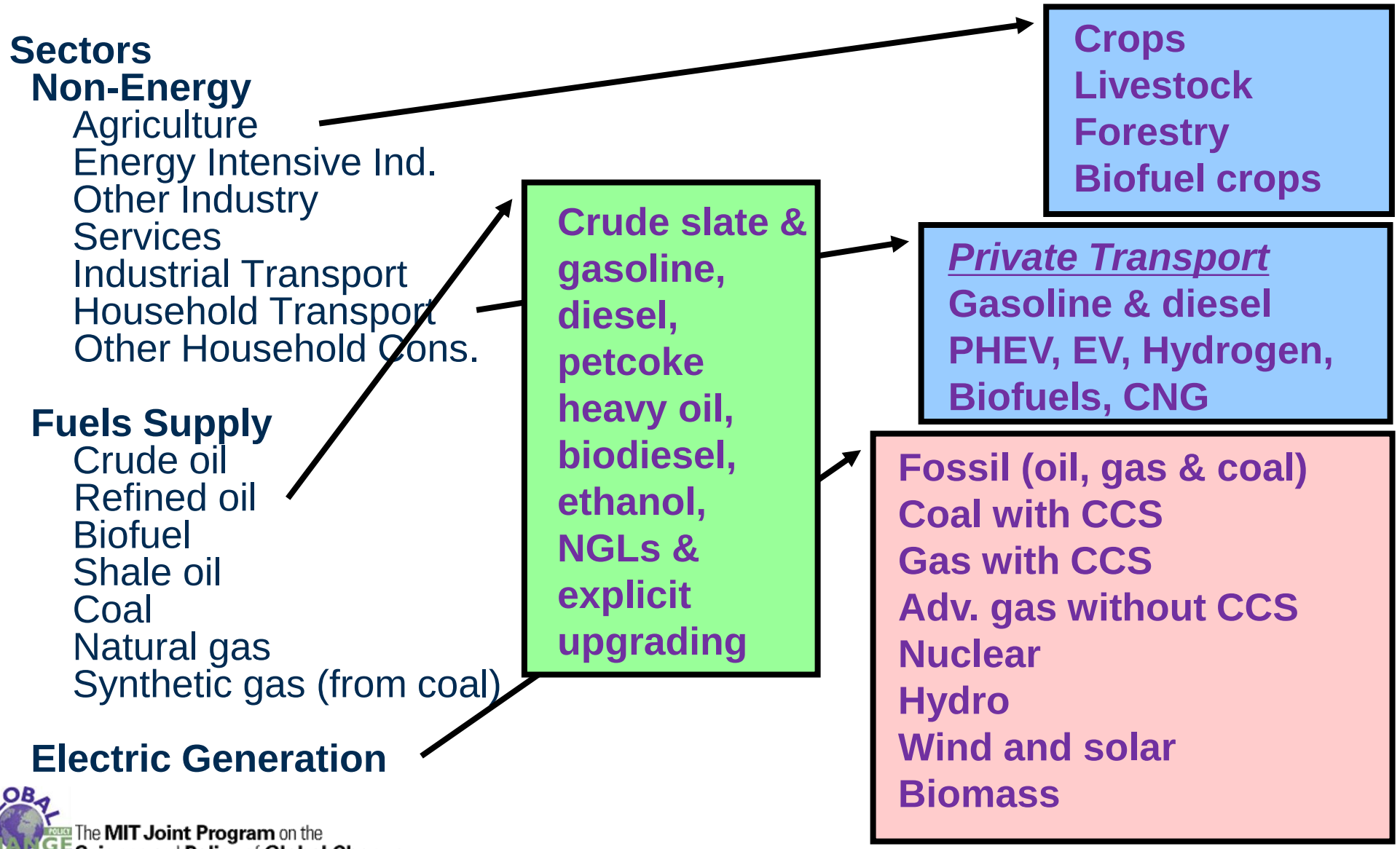


Source: Rausch et al (2011)

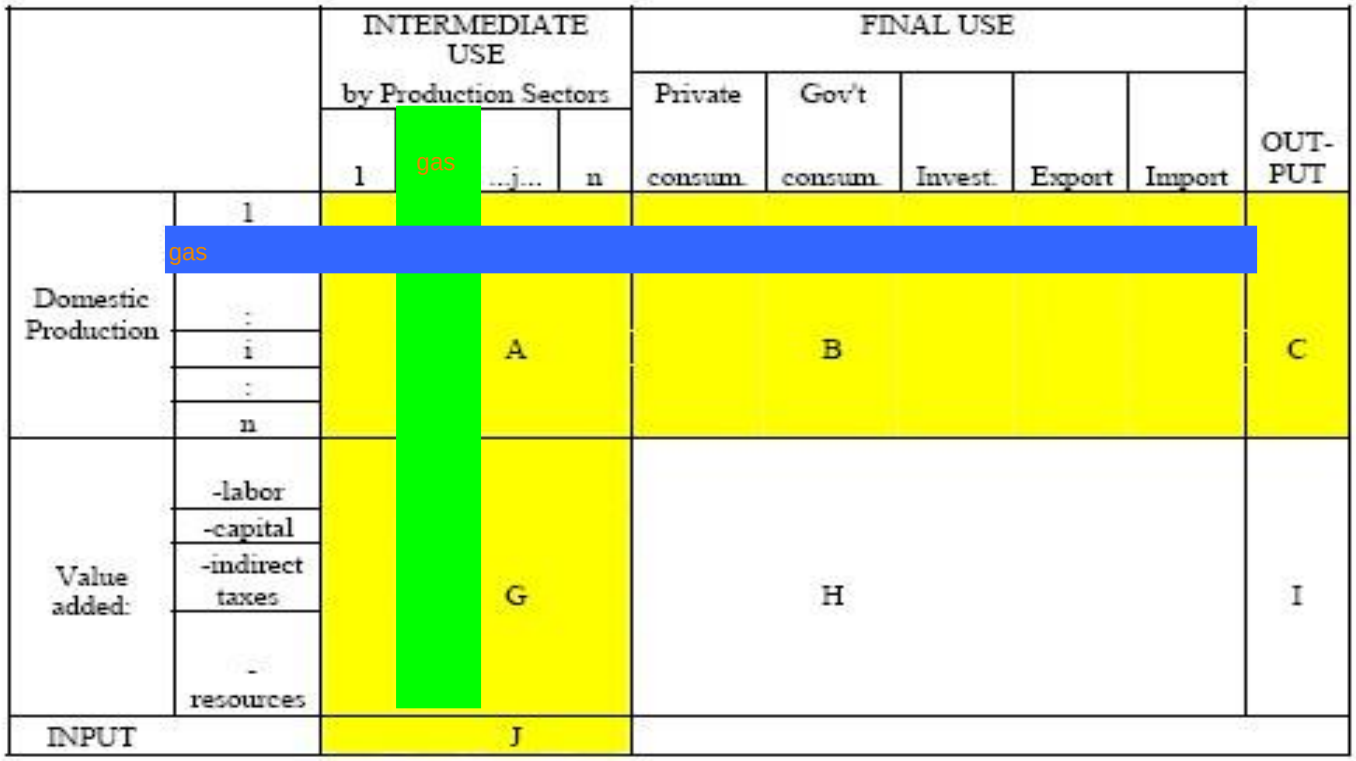
Additional Slides for Discussion (5)



EPPA Model Sectoral Structure



Input-Output Table

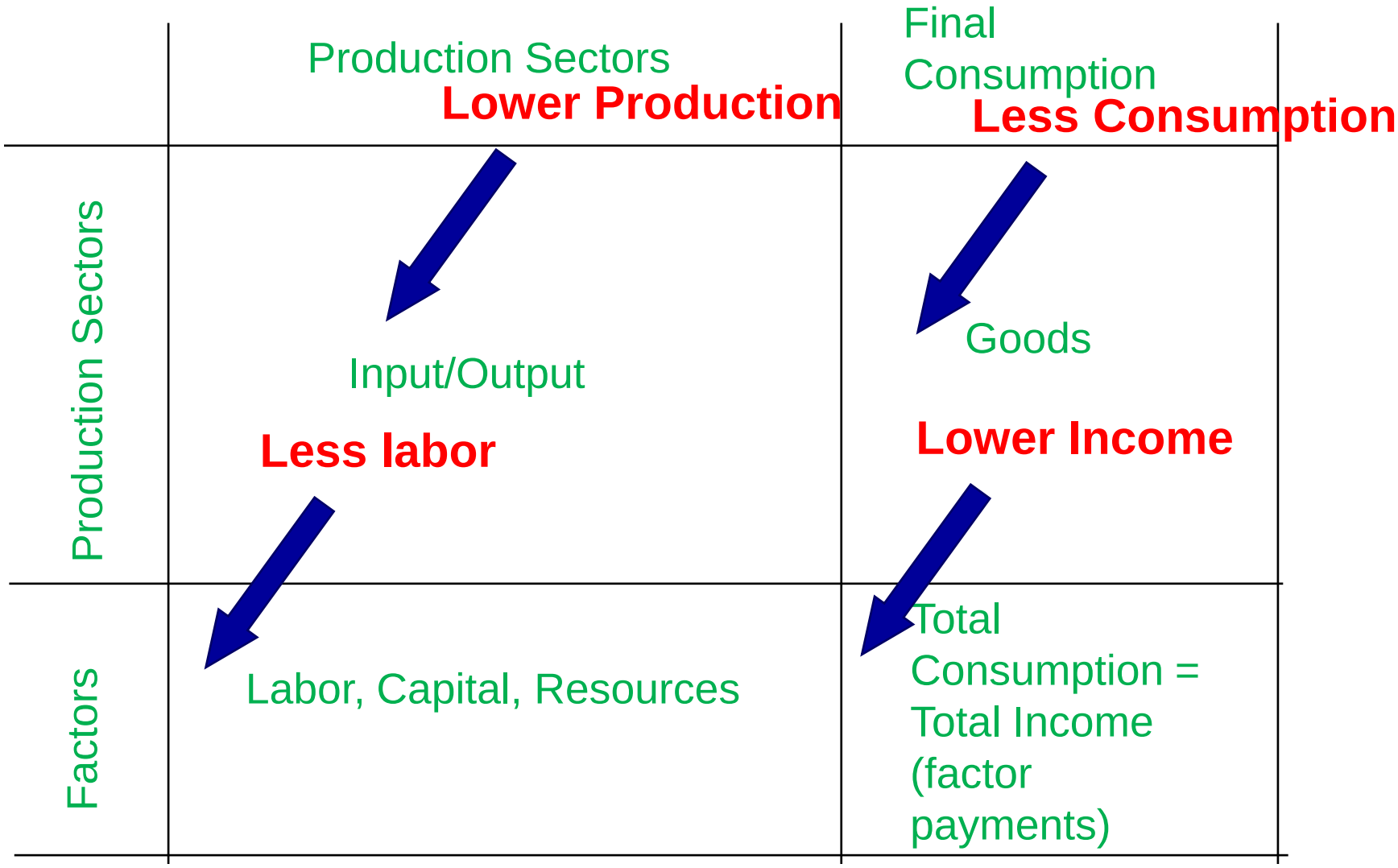


Input-Output Table provides information about production structure (inputs to production – green line) and output use (blue line).

Full accounting (examples): Expansion of biofuels leads to expansion of agriculture production that uses fertilizer and energy inputs; Expansion of solar panel or wind mills production requires energy and capital.

Additional information about elasticities is needed for a CGE model: in contrast to input-output models, consumers respond to price changes, firms change output and inputs as markets shift.

Standard CGE SAM With Mortality & Morbidity



Air Pollution Health Effects

		INTERMEDIATE USE by Production Sectors				*Household Services*		FINAL USE				OUT-
		1	2	...j...	n	*Mitigation of Pollution Health Effects*	*Labor-Leisure Choice*	Private consum.	Gov't consum.	Invest.	Export	PUT
Domestic Production	1											
	2											
	:											
	i			A					B			C
	:											
	Medical Services for Health Pollution					***Medical Services***		***Health Services***				
	n											
Imports	1											
	2											
	:											
	i			D					E			F
	:											
	n											
Leisure							***Leisure***	***Leisure***				
Value added:	-labor					***Labor***	***Labor***	***Labor***				
	-capital			G					H			I
	- natural resources											
INPUT				J								

Added components are in bold italic.

http://globalchange.mit.edu

USA: Report 113 (2004)

Europe: Report 178 (2009)

China: Report 196 (2011)

Global Aerosol: Report 203 (2011)

MIT Joint Program on the Science and Policy of Global Change

Health Damages from Air Pollution in China

Kira Matus, Kyung-Min Nam, Noelle E. Selin, Lok N. Lamsal, John M. Reilly and Sergey Paltsev

Report No. 196
March 2011