AIM/CGE for global and country analysis

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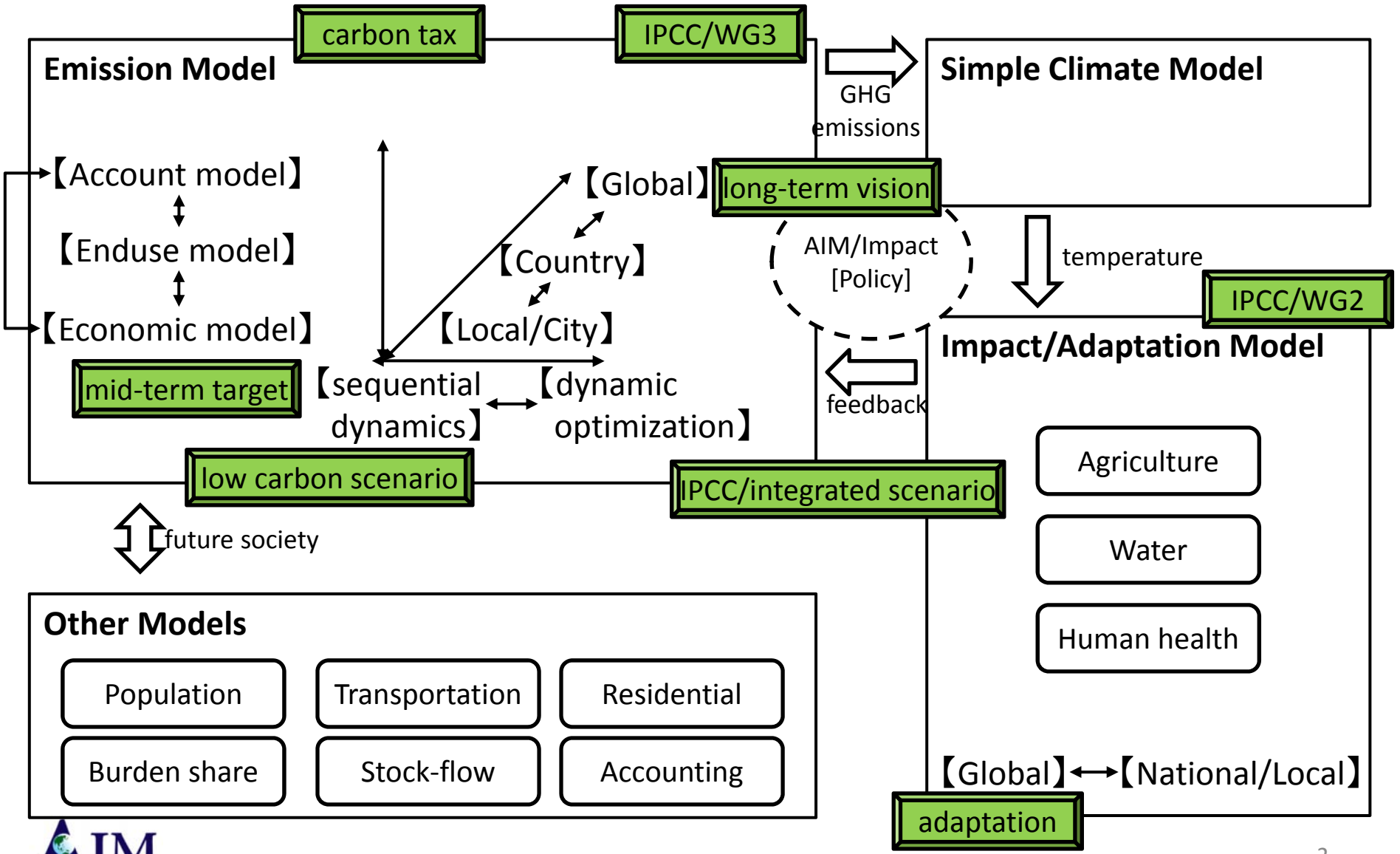
Overall of AIM



CGE models development and their application

- Main purposes of CGE models
  - Consistency check of scenarios
  - Quantification of economic impacts of GHG mitigation policies

- Global model
  - Long-term emission scenarios: RCP and SSP
  - AME and EMF
  - Contribution to other analyses such as LCS study (S-6; Env. research fund, MoE)

- Country model
  - Mid-long term GHG emission reduction target in Japan
  - Application to China

- New model development
  - Global model: more detailed sectors and regions
  - Country model: training workshop toward LCS study

AIM
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Global Model

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Features of present AIM/CGE [Global]

- Global general equilibrium model with recursive dynamics.
- Benchmark data of the economic activity is GTAP6 (the year 2001). IEA energy balance table is introduced for energy
  - Numbers of region: 24
  - Types of commodity: 21
  - Treated Gas: CO2, CH4, N2O, SOx, NOx, CO, NMVOC, BC, OC, NH3
- Production factor: capital, labor, resource and land
- Future scenarios
  - technology change (TFP, AEEI, material inputs, …)
  - consumption pattern change
- Designed to link with the global technology selection (enduse type) model and country CGE model

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Region and commodity in AIM/CGE [Global]

Japan
China
Korea
Indonesia
India
Thailand
Other South-east Asia
Other South Asia
Australia
New Zealand
Rest of Asia-Pacific
Canada
USA
EU-15 in Western Europe
EU-10 in Eastern Europe
Russia
Rest of Europe
Brazil
Mexico
Argentine
Other Latin America
Middle East
South Africa
Other Africa

Agriculture
Livestock
Forestry
Fishing
Mining (except fossil fuels)
Energy intensive products
Metal and machinery
Foods
Other manufactures
Water
Construction
Transport
Communication
Public service
Other service
Coal
Crude oil
Petroleum products
Natural gas
Gas manufacture distribution
Electricity Coal fire*, Oil products fire*, Gas fire*, Nuclear, Hydro, Biomass*, Waste, Geothermal, Solar, Wind, and Other renewables *: with/without CCS

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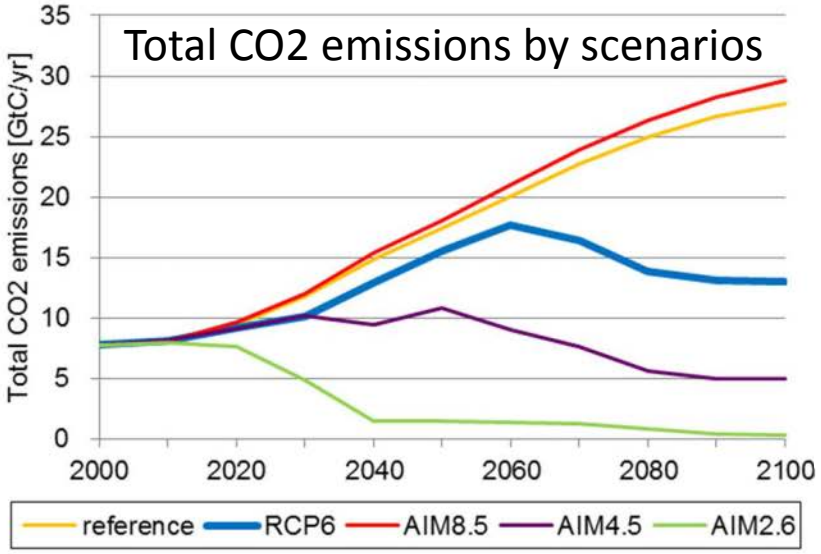
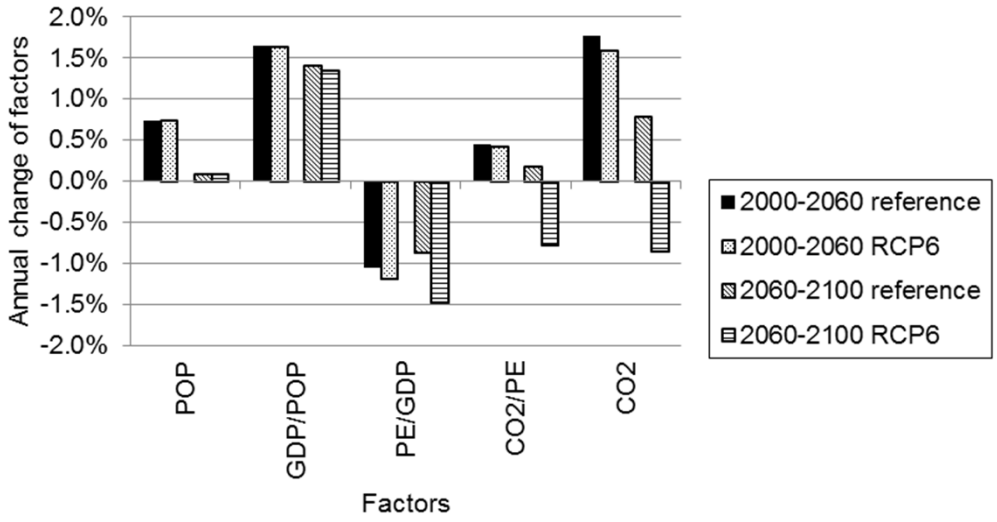
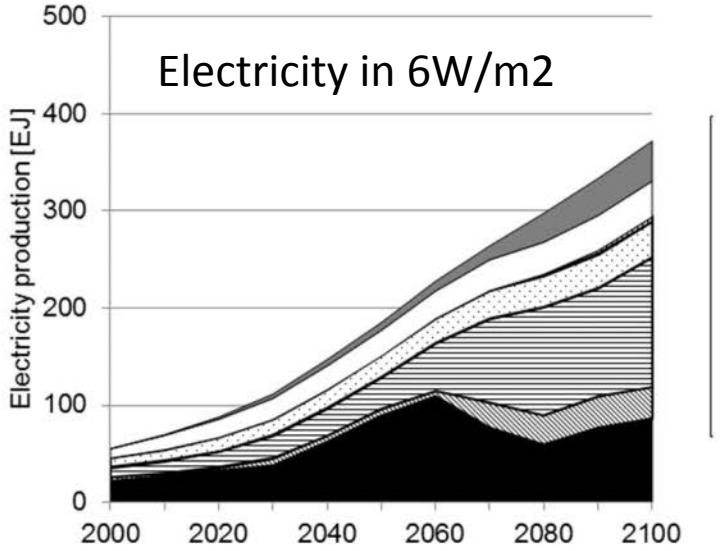
RCP and SSP toward IPCC/AR5

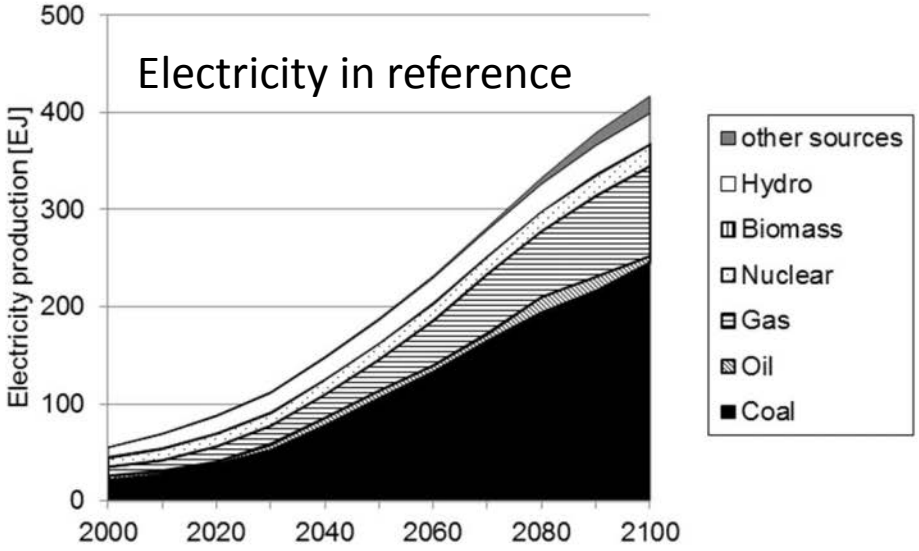
- RCP: Representative Concentration Pathways
  - Inputs to climate models: Concentrations of GHGs, land use change, ...
  - Following model teams are contributing;
    - 2.6W/m2 IMAGE
    - 4.5W/m2 MiniCAM
    - 6.0W/m2 AIM
    - 8.5W/m2 MESSAGE
  - NIES (climate modeling team), JAMSTEC and Ibaraki Univ. support AIM team.
  - Emission forecasts and historical data for RCP: http://www.iiasa.ac.at/web-apps/tnt/RcpDb
- SSP: Shared Socio-economic Pathways
  - Inputs to impact models: Socio-economic activities
  - Different future directions: Adaptive Capacity and Mitigation Capacity

Results on RCP









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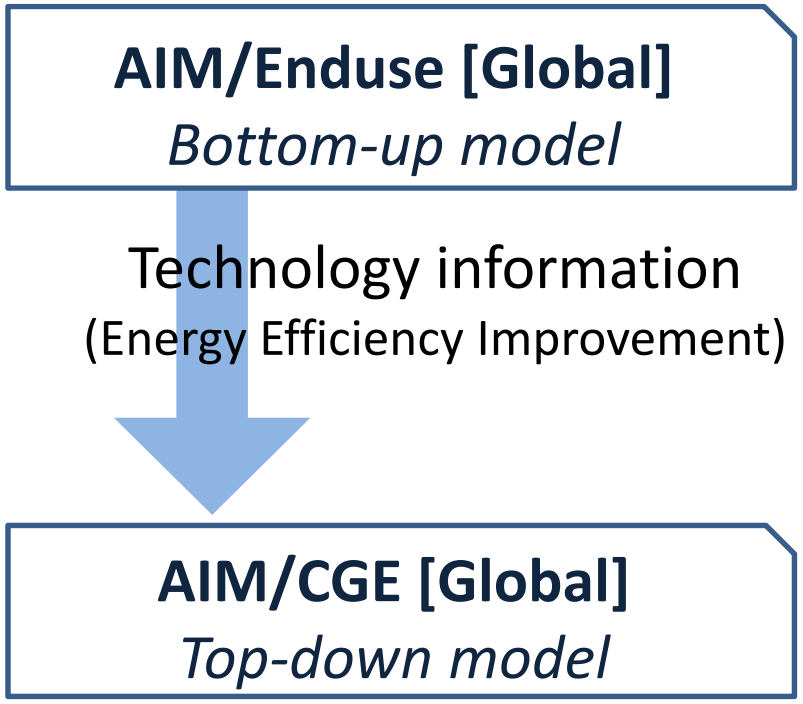
Asian Modeling Exercise

- Model comparison project

- Final goals
  1. Asian scenarios toward low carbon society (-2100)
     - Policy options and their costs in Asia
  2. Input outcomes to AR5

- Schedule
  - 1st meeting in Tsukuba, Sep 2009
  - 2nd meeting in Beijing, Mar 2010
  - 3rd meeting in Seoul, Sep 2010
  - Final data submission, Jan 2011
  - The 4th meeting in Xian, Mar 2011
  - Paper deadline: June 1st 2011



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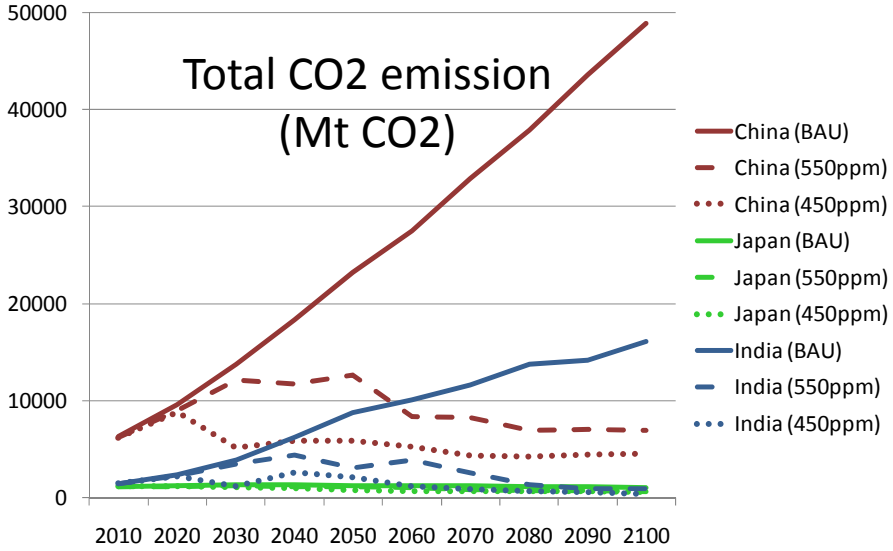
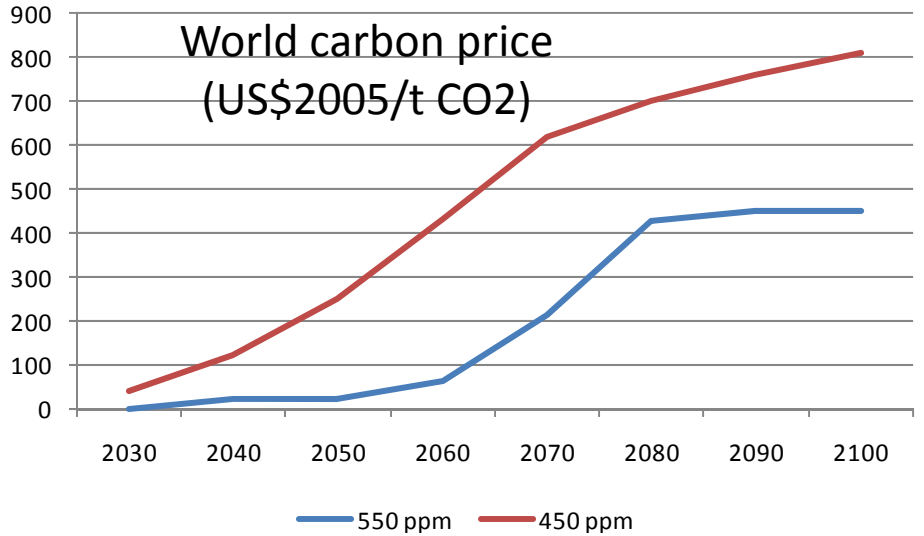
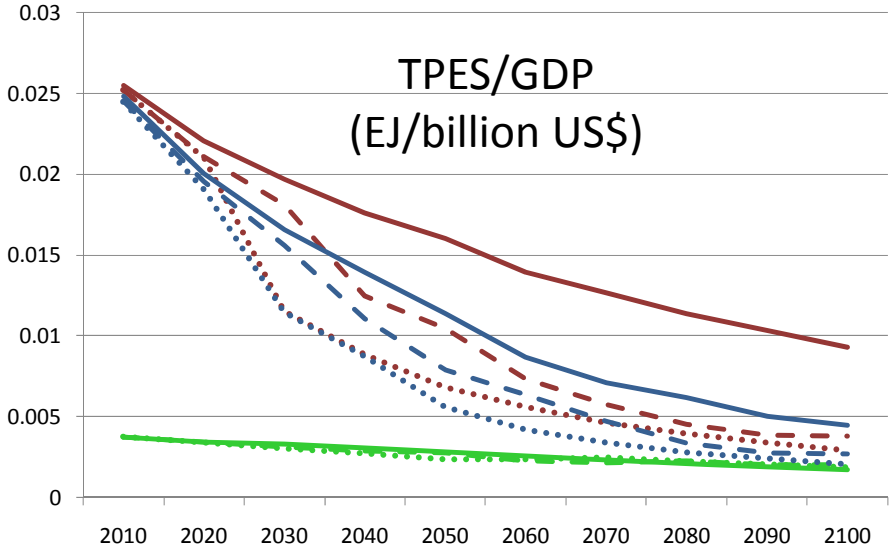
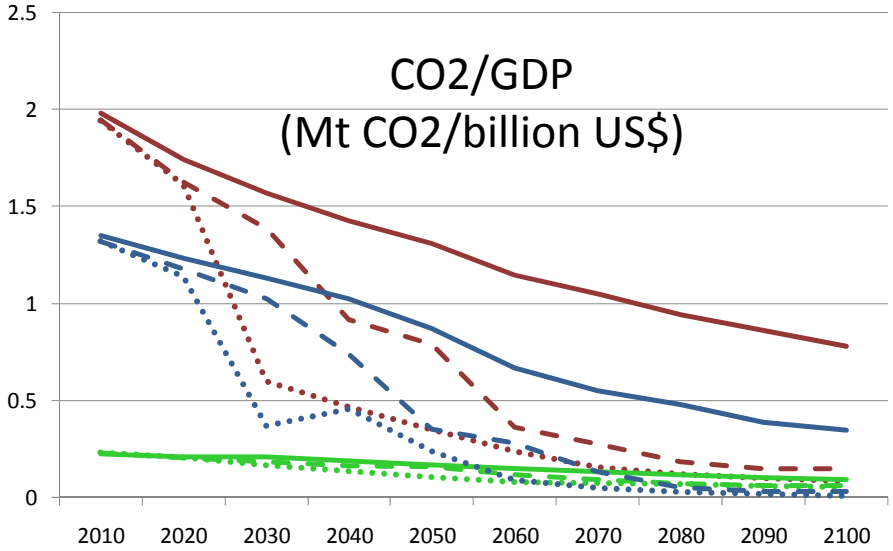
Results from AIM/CGE [Global]









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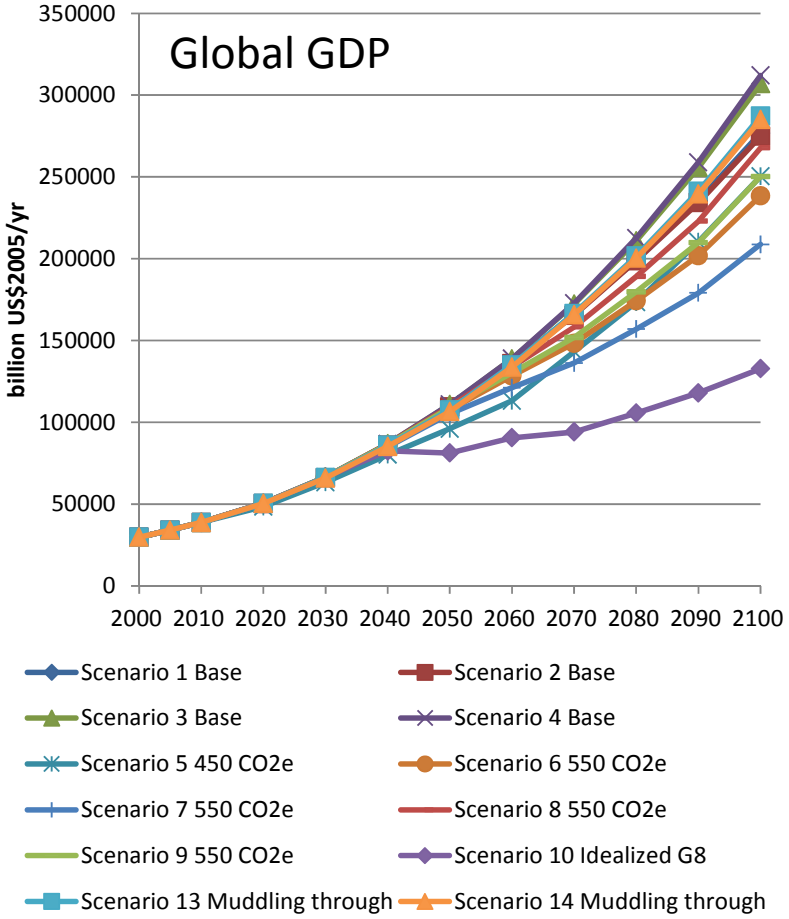
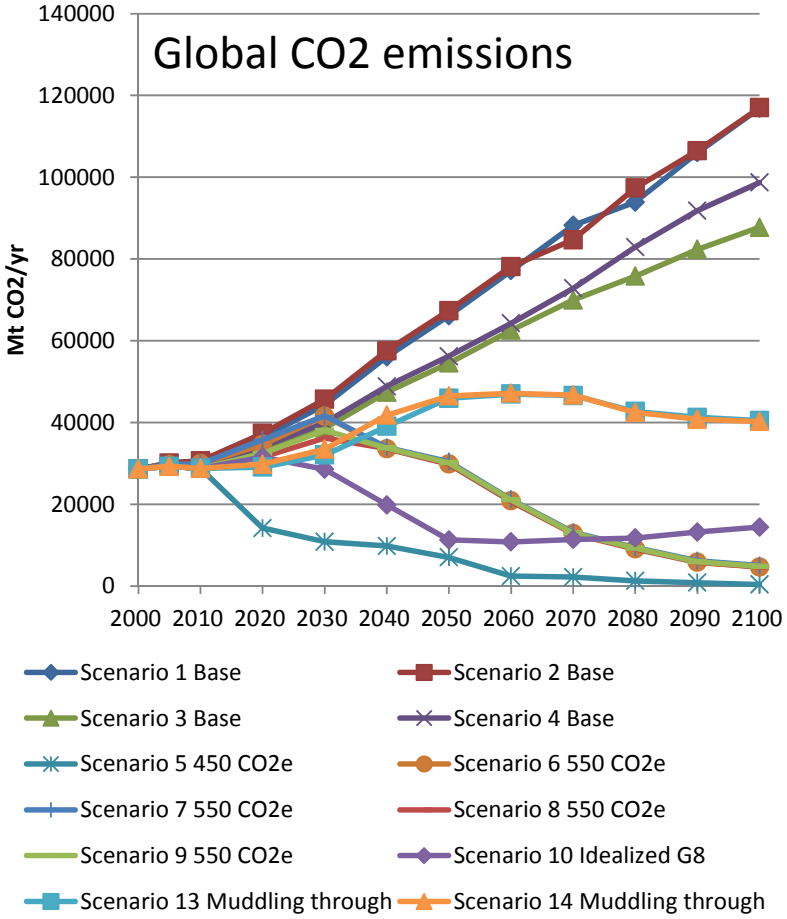
EMF24

Preliminary results for EMF24 (1st round)





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2 approaches toward Low Carbon Society

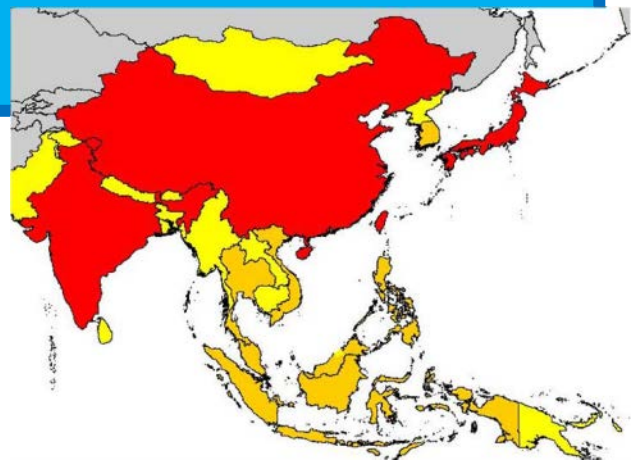
Top-down approach: global model analysis
GHG emissions from Asia region corresponding to global target

Backcasting
to estimate roadmap

Low Carbon
Society

How to bridge
"GAP"?

Bottom-up approach: country/local scenario development
Quantification of activity in the future achieving country/local GHG emission reduction target



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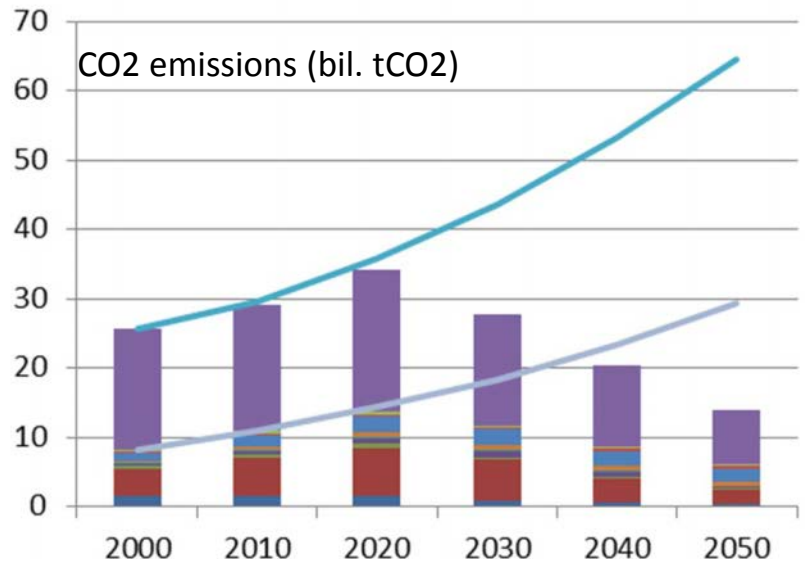
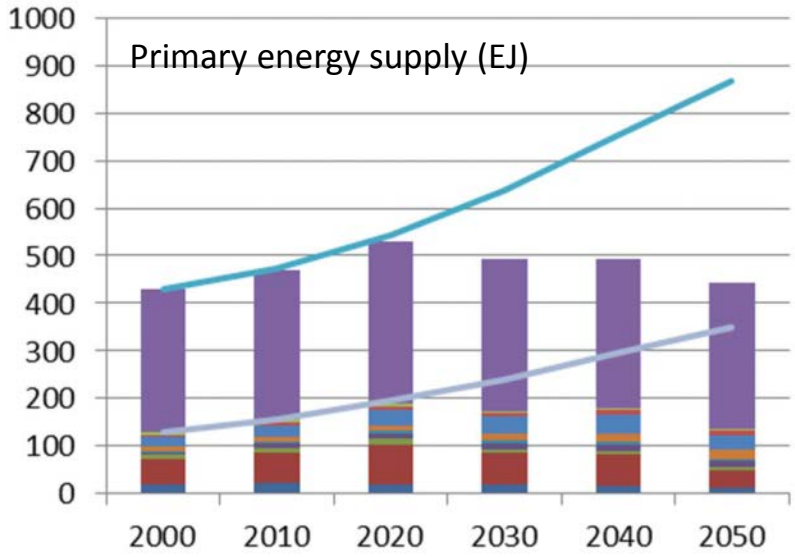
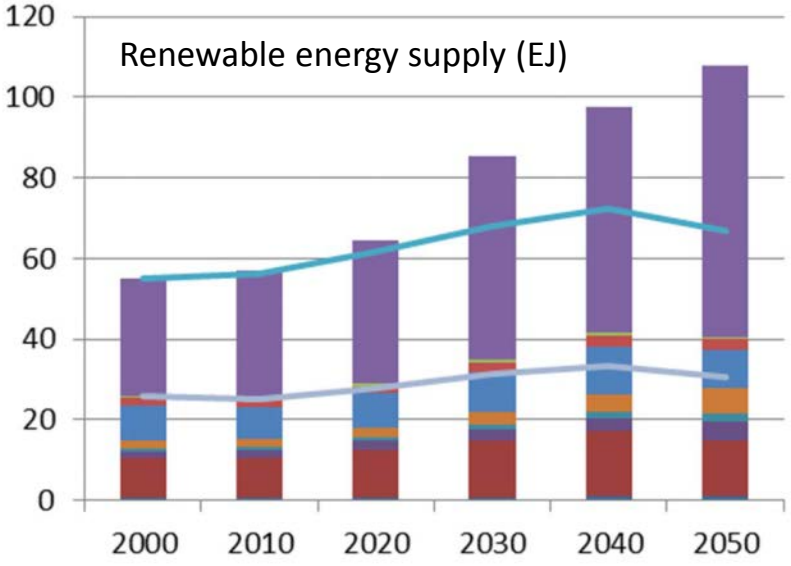
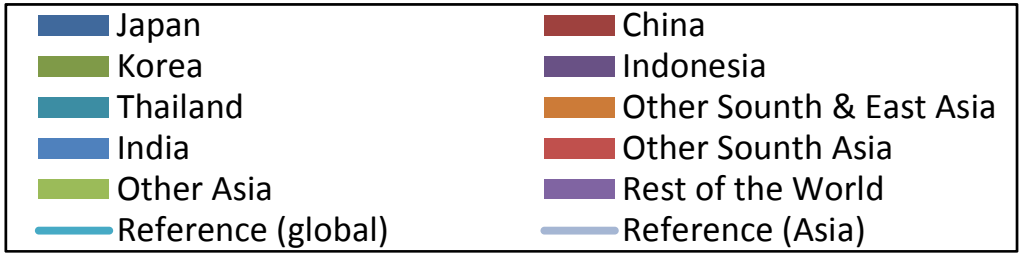
LCS

Asia in scenario of global GHG emission reduction by half







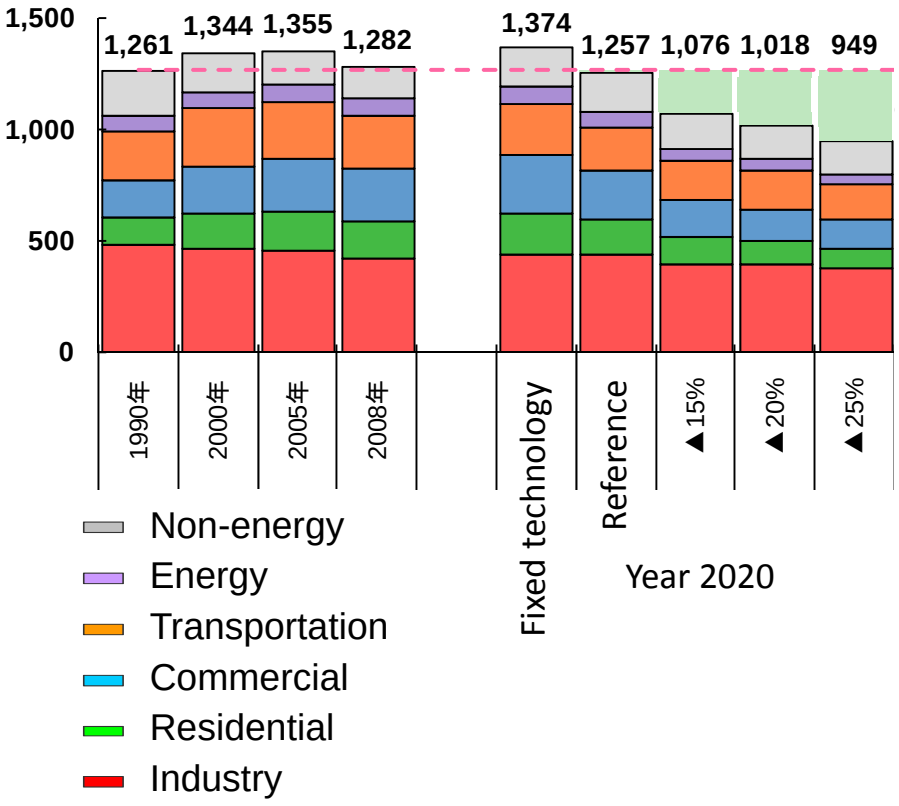


Country Model

Japan

Linkage between AIM/Enduse[Japan] and AIM/CGE[Japan]

(as of 21 December 2010)



Additional investment to reduce GHG emissions		2011-2020 ▲15%	▲20%	▲25%
industry	Energy intensive industries	1.8	1.8	1.8
	Industrial furnace, boiler, etc	1.2	1.2	1.4
		3.0	**3.0**	**3.3**
residential	High insulation house	10.1	15.3	19.9
	High efficient & solar water heater	6.1	7.9	9.6
	High efficient appliances & HEMS	4.8	7.9	11.3
		21.1	**31.1**	**40.8**
Commercial	Energy efficient building	3.6	5.8	6.1
	High efficient & solar water heater	0.4	1.1	1.5
	High efficient appliances	2.0	2.7	3.6
		6.0	**9.7**	**11.2**
Transportation	Next generation vehicles	7.0	7.9	8.7
	Low fuel consumption	0.8	0.8	0.8
		7.8	**8.7**	**9.5**
energy	PV	11.0	13.0	15.2
	Wind power	2.8	2.8	2.8
	Small scale hydro & geo-thermal	1.7	3.2	5.3
	Biomass power	1.0	1.0	1.0
	power system stabilization	2.3	3.6	5.1
	Gas pipelines	0.3	0.3	0.4
	CCS	0.0	0.0	0.1
		19.0	**23.8**	**29.9**
Non-CO2	Agriculture	0.1	0.1	0.1
	Waste	0.3	0.3	0.3
	F-gas	0.6	1.4	1.8
		1.0	**1.8**	**2.1**
Total from 2011 to 2020		**58.2**	**78.3**	**96.8**
Annual average		**5.8**	**7.8**	**9.7**

unit : trillion yen

This information estimated from AIM/Enduse [Japan] is input into AIM/CGE [Japan].

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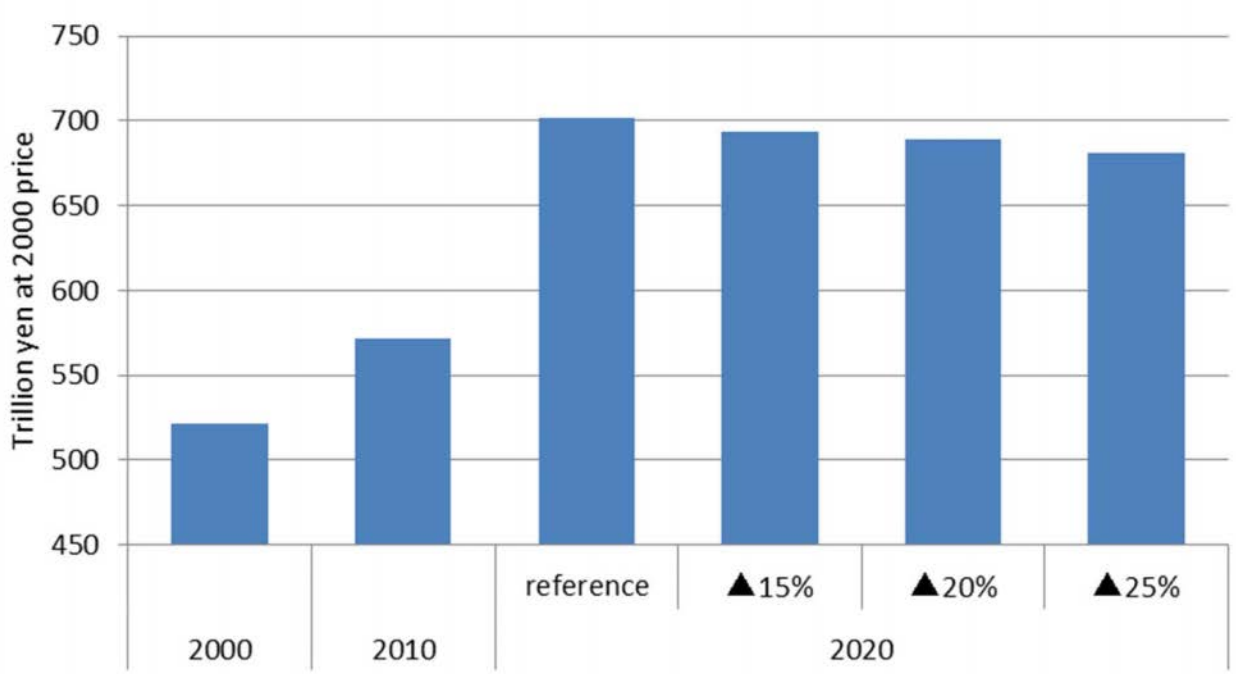
Japan

GDP and carbon price from AIM/CGE [Japan]

(as of 21 December 2010)

Within 10 years, GDP growth rate will slow down, but new industries related energy saving equipment and renewable energy will be activated.



	2020			
	reference	▲15%	▲20%	▲25%
GDP growth rate (2010-2020 ; %/year)	2.07%	1.96%	1.89%	1.77%
GDP change from reference in 2020 (%)		-1.11%	-1.78%	-2.94%
CO2 price (yen at 2000 price/tCO2)		14,643	21,198	41,446

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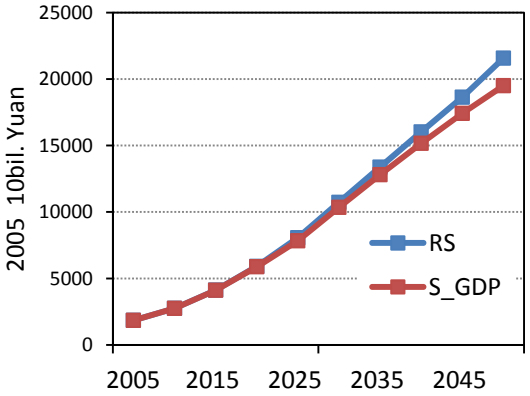
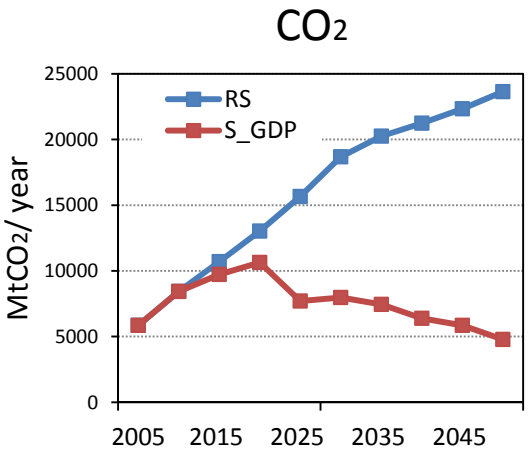
China Dynamic CGE Model Features

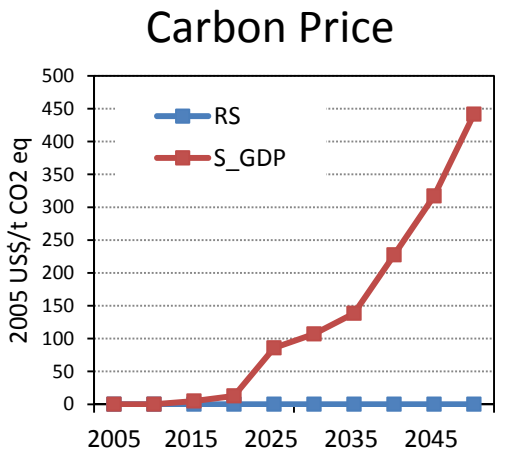
- **Model**: Recursive dynamic CGE model, 41 sectors
- **Time period**: 2005-2050, 5 year step
- **Gas**: Energy related CO_2, Process CO_2, other GHGs
- **Technology**:
  - **12 power generation technologies**
    - 7 fossil and 5 non-fossil
  - **CCS technology in:**
    - Coal and gas fired electricity sectors, sectors of cement, chemistry, iron and steel.

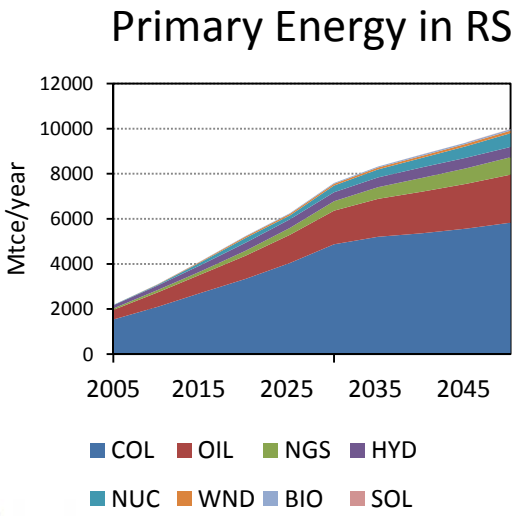
China

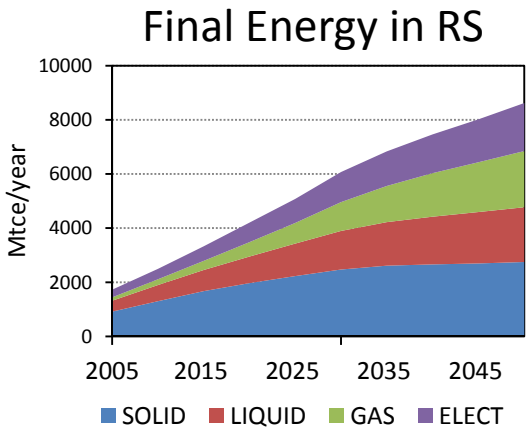
China Dynamic CGE Model: Preliminary Results

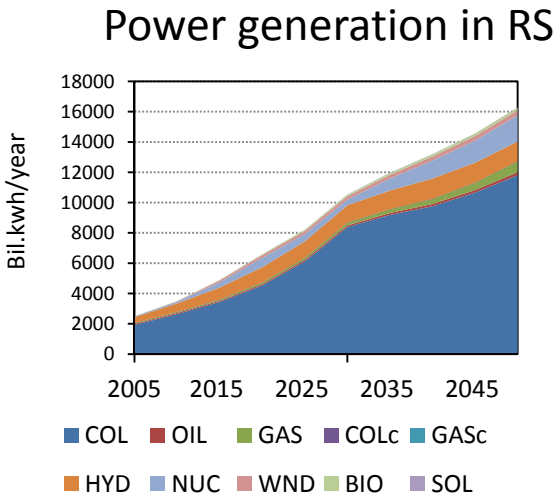












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New model development

Global

Main features of a new Global CGE model

	New model	Present model
Region	35 (Asian countries; 14)	24 (Asian countries; 8)
Industry	38 (manufacture sector is disaggregated in detail)	20
Emissions	CO2, CH4, N2O, NH3, SOx, NOx, BC, OC	
Institution	Household, government, Enterprise	Representative household
Dynamics	Recursive dynamic (1 year step)	Recursive dynamic (10 year step)
Base year	2005	2001
Base data	Original energy balance and SAM (data reconciliation system)	GTAP and IEA energy balances
Program	GAMS / MCP	GAMS / MPSGE

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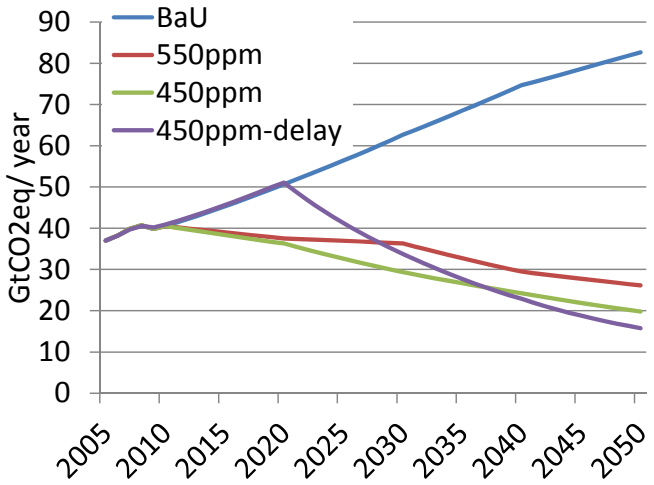
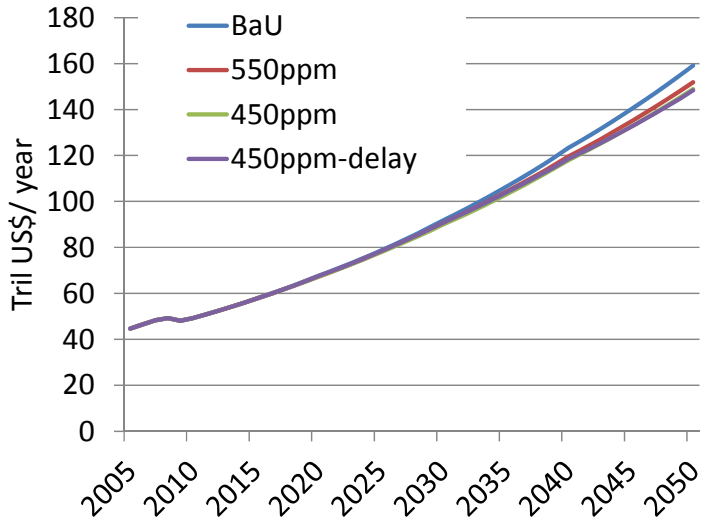
Global

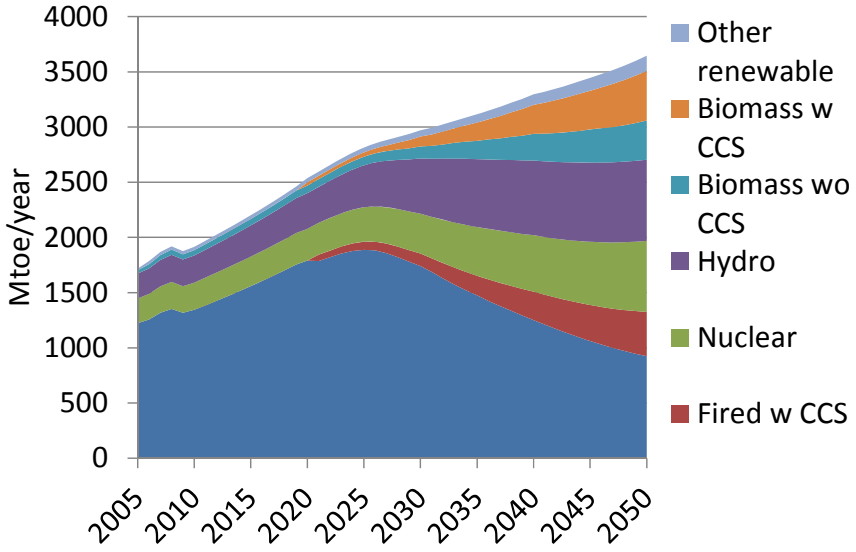
Preliminary results of global CGE model



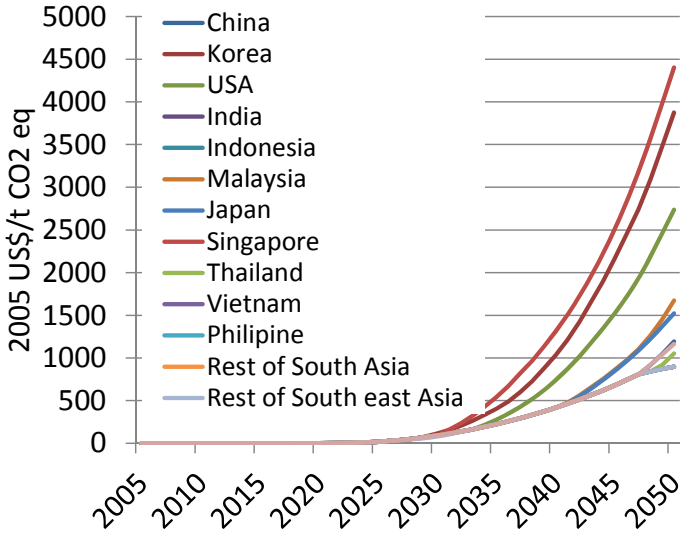
Global GHG emissions



Global GDP



Global power structure (450ppm-delay scenario)

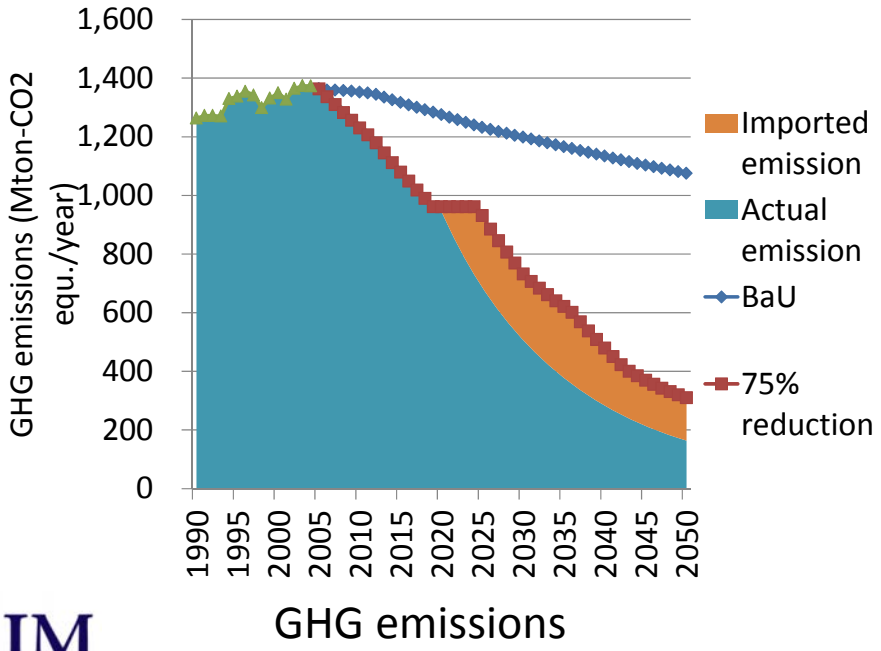


GHG emission price

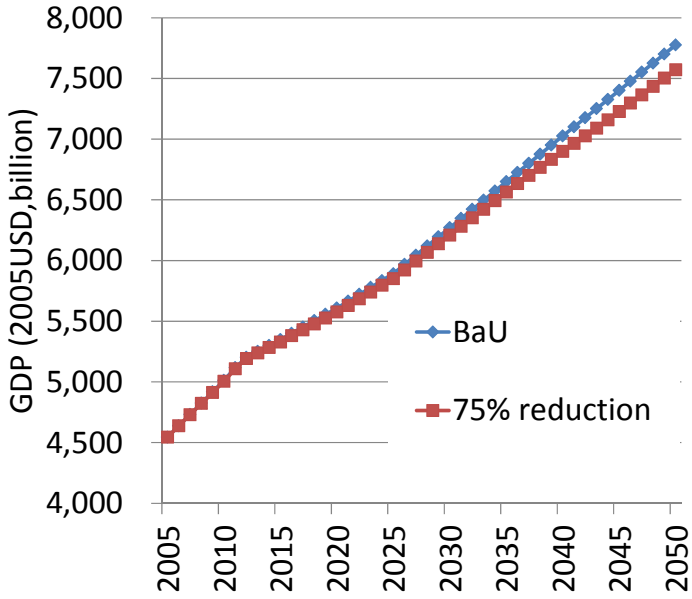
Country CGE model and example of the results

-a case of Japan-

- Most of the features are same as global model.
- Each national characteristic (eg renewable energy potential) should be considered.
- National governmental target and plan will be implemented in the scenario.



GHG emissions



GDP

Training workshop on Country CGE model

- We will have a training workshop for development of country LCS scenario by using a CGE model.
  - Date; June 1 or 2 weeks (Tentative)
  - Location; NIES @ Tsukuba

- Required abilities to attend this training workshop
  - Basic knowledge about microeconomics, input-output analysis and GAMS
  - Experience to publish a peer-reviewed scientific paper
  - Enthusiasm to show the economic aspects of LCS

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