Environmental Technology Cooperation between Japan and China:

Evaluation Based on Dynamic GTAP model

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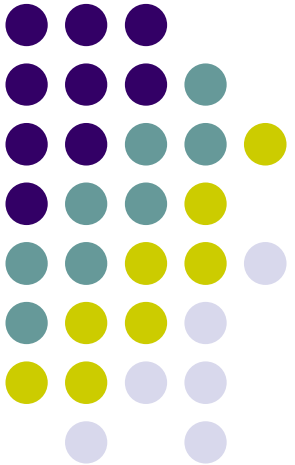


Mr. Fukuda proposed “Cool Earth Promotion Program”

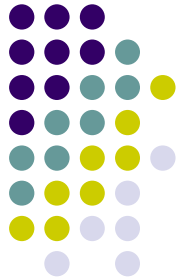
Prime Minister Fukuda
World Economic Forum in Davos
Switzerland
January 26, 2008

A global target of 30% improvement in energy efficiency by 2020

1. A new financial mechanism, Cool Earth Partnership, on the scale of US$10 billion for cooperating with developing countries to reduce emissions by enhancing energy efficiency

2. R & D investment by US$30 billion for improvement in the fields of the environment and energy over the next five years

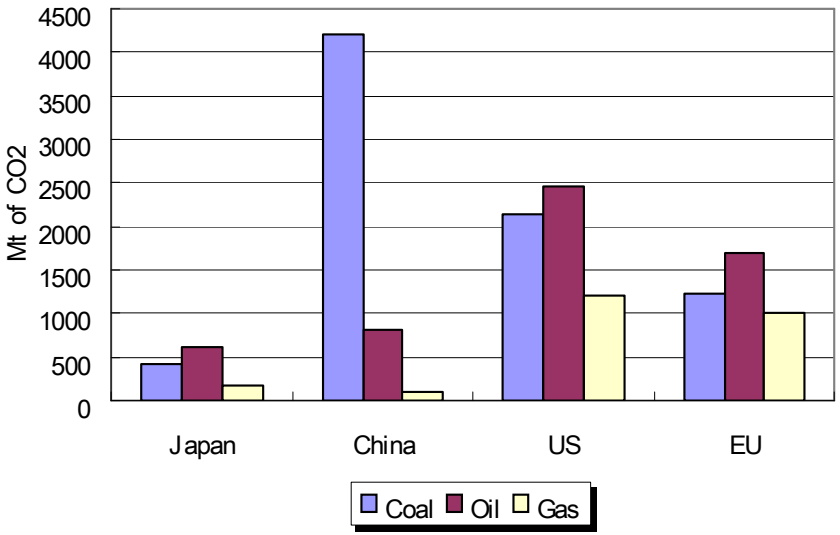
Huge gaps among countries



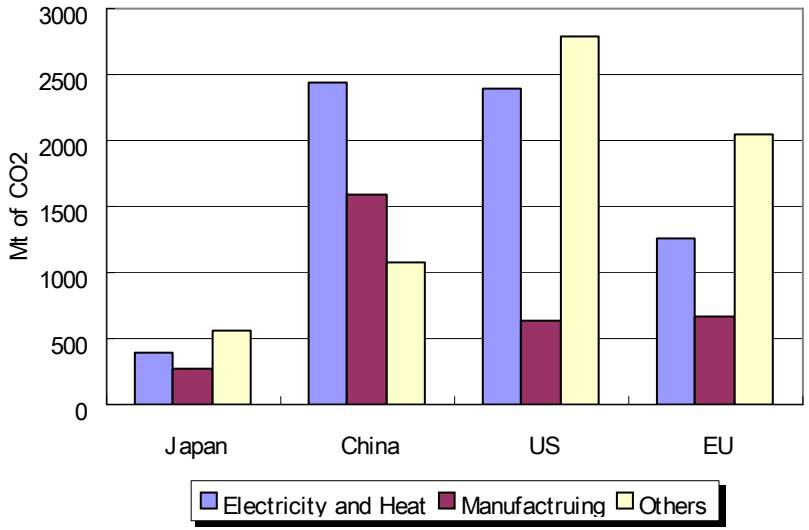
1. Japan
    - Carbon reduction target based on bottom-up sectoral approach
        - Industry specific problems
        - Optimistic view of technology
        - Concerns about competitiveness
2. EU
    - Reduction obligation allocated to each country based on Kyoto accord
3. The US
    - Not participate without obligations to China and India
4. Developing countries led by China and India
    - Oppose emission reduction obligation

CO2 emissions in 2005

Emissions by fuels



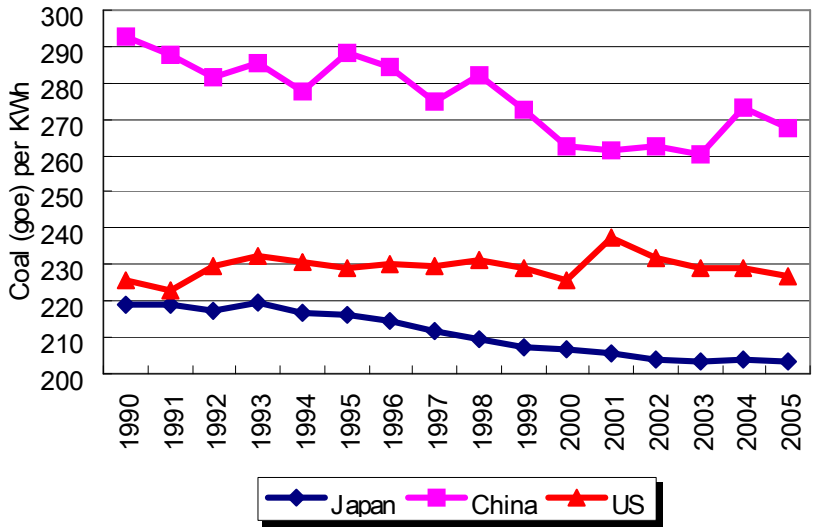
Emissions by sectors



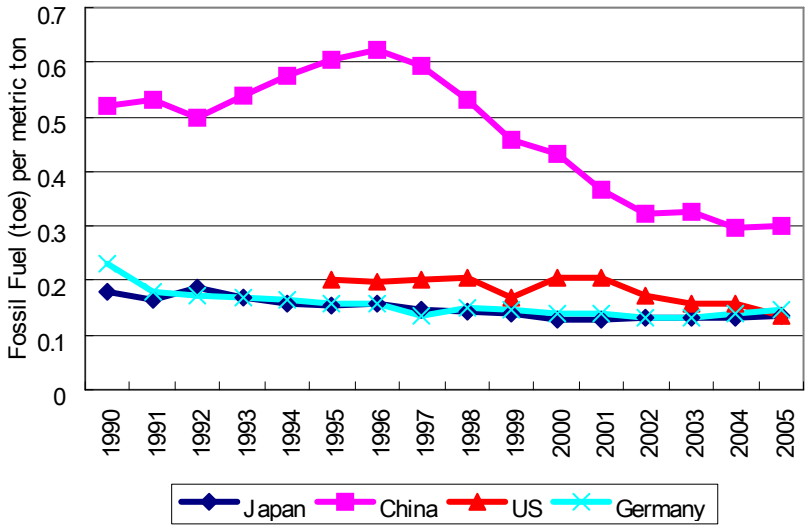
IEA, CO2 Emissions from Fuel Combustions (2007)

Energy efficiency

electricity



Iron & steel



IEA, CO2 Emissions from Fuel Combustions (2007)

EIA, Electricity Power Annual (2007)

IISI, World Steel in Figures 2007

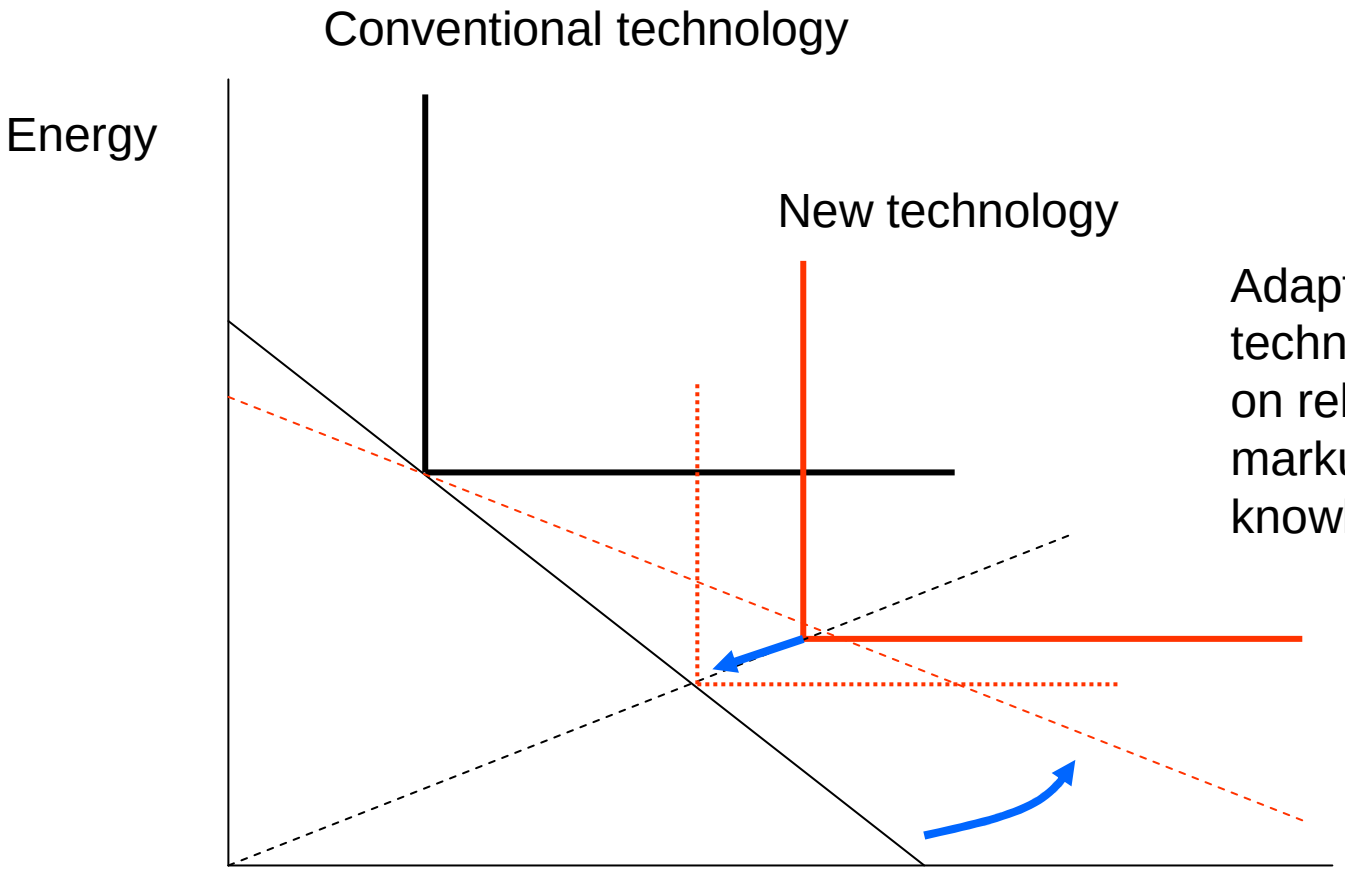
Coal-fired power generation technology in China

Technology	Cost ($ per KW)	Efficiency	Share in China
Subcritical	500-600	30 - 36%	main of current plants
Supercritical	600-900	41%	half of current new order
Ultra-supercritical	600-900	43%	two 1000MW plants
IGCC	1100-1400	45 - 55%	

IEA Energy Outlook 2007

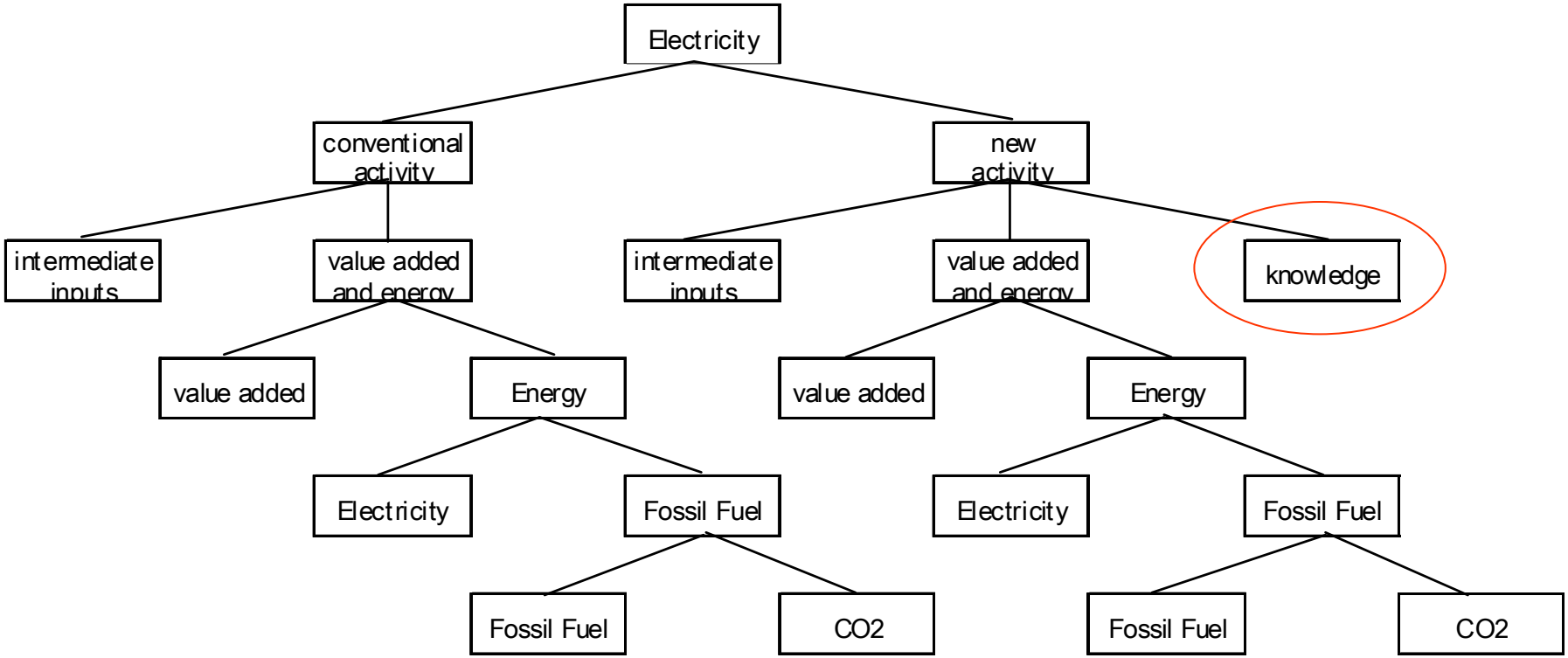
CO2 emissions in China strongly depend on whether China adapt high efficient technology or low efficient technology in the future. Unfortunately, worsening power shortage stimulates to construct smaller plants because of low cost.

Induced Technological Change



Adaptation of new technology depends on relative prices, markup factors and knowledge.

Production structure in electricity generation



Basic equations

Stock of knowledge (advanced equipment, operation and maintenance technology)

$$R_{EL,t+1} = I_{ELR,t} + (1-\delta_R)R_{EL,t}$$

R_{EL} *Knowledge*

I_{ELR} *Investment*

Zero profit conditions

$$P_{EL,t}^{CONV} = \phi_C\left(P_{M,t}P_{E,t}, P_{L,t}, P_{K,t}\right) \perp y_{EL,t}^{CONV}$$

$$P_{EL,t}^{NEW} = (1+\eta)\phi_C\left(P_{M,t}P_{E,t}, P_{L,t}, P_{K,t}, P_{R,t}\right) \perp y_{EL,t}^{NEW},$$

Market clearance conditions

$$y_{EL,t}^{CONV} = \left(\frac{P_{EL,t}}{P_{EL,t}^{CONV}}\right)^{\sigma} y_{EL,t} \perp P_{EL,t}^{CONV}$$

$$y_{EL,t}^{NEW} = \left(\frac{P_{EL,t}}{P_{EL,t}^{CONV}}\right)^{\sigma} y_{EL,t} \perp P_{EL,t}^{NEW}$$

Aggregations in GTAP6inGAMS

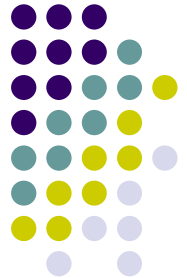


Table 1. Regional Aggregation

jpn	Japan
chn	China and Hong Kong
eas	East Asia countries
anz	Austral and New Zealand
nam	United States and Canada
eu	European countries
rus	Russia and Affiliated Countries
row	Rest of the World

Table 2. Sectoral Aggregation

col	Coal
oil	Oil
gas	Gas
p_c	Petroleum and Coal Products
ely	Electricity
agr	Agriculture
mtl	Metal
mch	Machinery
mfg	Other Manufacturing
srv	Service

Table 3. Endowments

cap	Capital
lab	Labor
land	Land
nres	Natural resources

Assumptions for Recursive Dynamics

Table 4. Growth Rate of Effective Labor (%)

	jpn	chn	eas	anz	nam	eu	rus	row
2001 - 2005	1.6	10.0	4.8	3.5	2.4	2.0	4.8	7.2
2006 - 2010	1.6	8.6	4.6	3.2	2.2	2.0	4.3	6.5
2011 - 2020	1.5	6.4	4.1	3.0	2.0	2.0	3.2	5.4
2021 - 2030	1.5	5.0	3.0	3.0	2.0	2.0	3.0	4.0

the Product of Raw Labor and Level of Technology

Table 5. Limitation of CO2 Emission (% of 1990)

	2008-20012	2013-2017	2020	2025	2030
jpn	94	92 - 88	85	80	75
anz	107	106 - 101	97	92	86
eu	92	90 - 86	83	78	74
nam		108 - 103	99	93	88
rus	100	98 - 95	95	94	93

Baseline Scenario (1)

Table 6. GDP: Baseline Scenario (%)

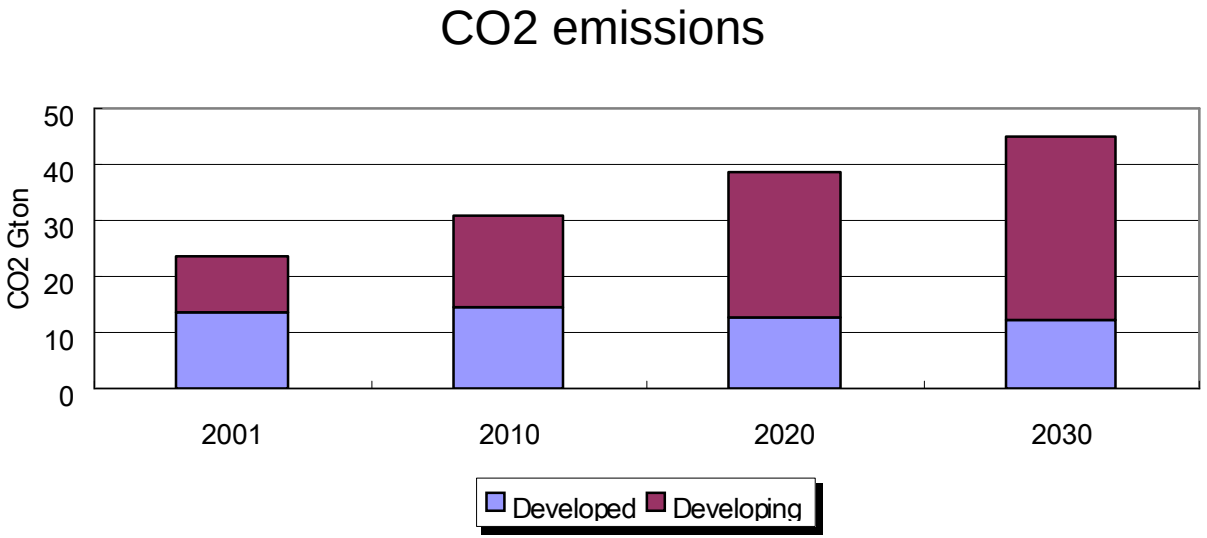
	jpn	chn	eas	anz	nam	eu	rus	row
2001-2010	1.6	9.1	4.7	3.3	2.4	2.0	5.2	6.9
2010-2020	1.5	7.1	4.3	3.0	2.1	1.9	4.0	5.8
2020-2030	1.5	5.4	3.5	2.8	2.0	1.8	3.3	4.6

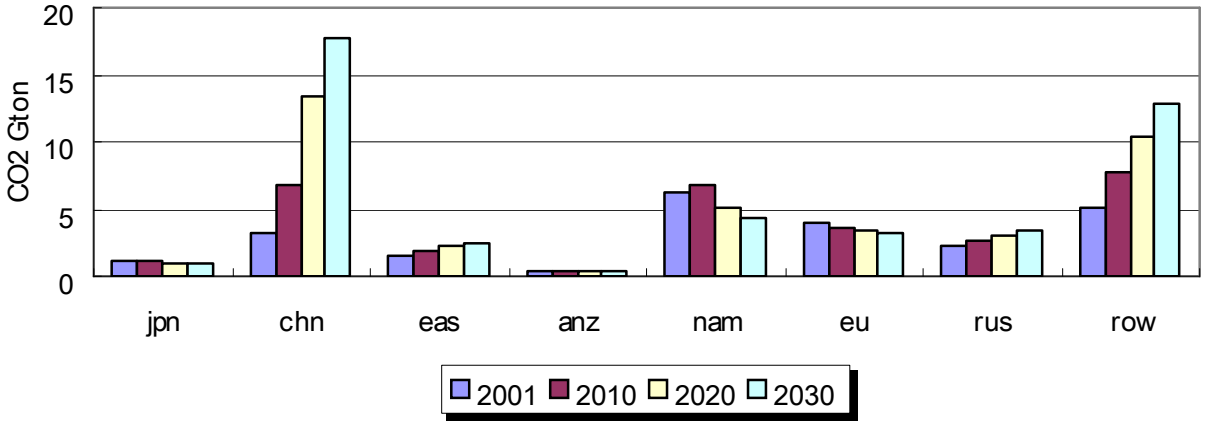
Table 7. CO2 Emission: Baseline Scenario (%)

	jpn	chn	eas	anz	nam	eu	rus	row
2001-2010	-0.4	9.0	2.7	-0.1	1.1	-1.0	1.9	4.6
2010-2020	-1.0	7.0	1.5	-0.8	-3.0	-0.5	1.4	3.0
2020-2030	-1.4	2.9	1.2	-1.1	-1.3	-0.9	1.4	2.1

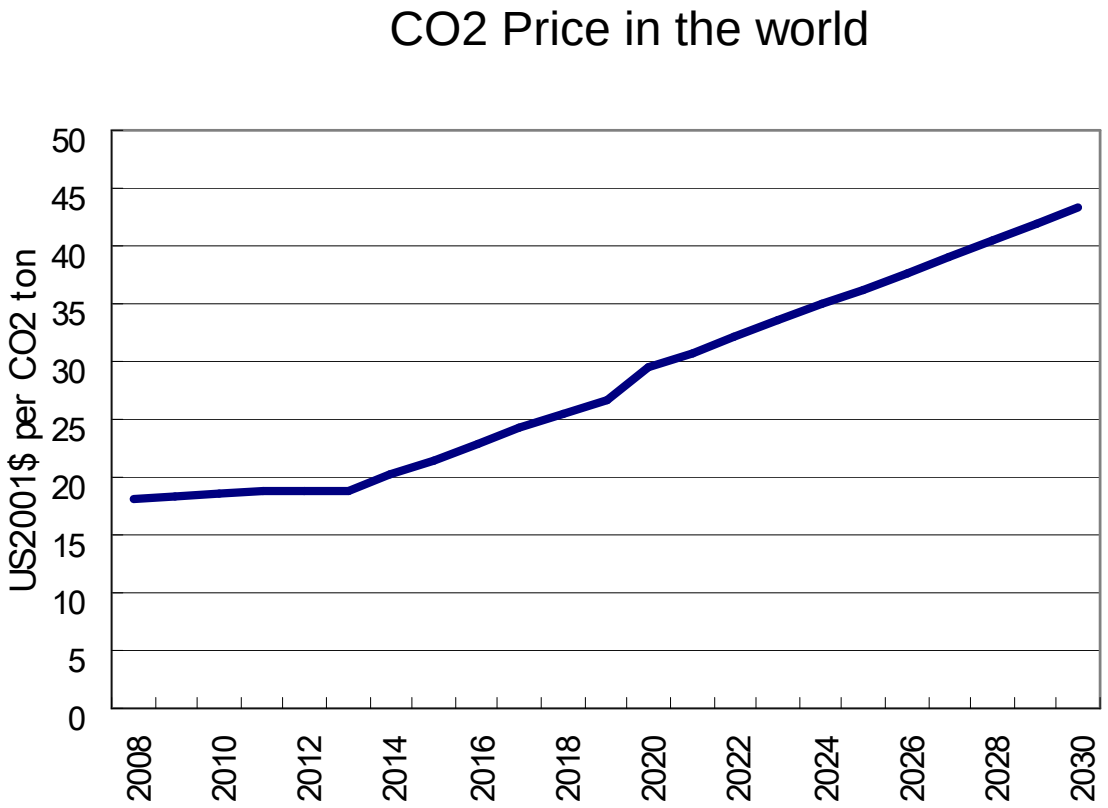
AEEI is exogenous in the model.

Baseline Scenario (2)





Baseline Scenario (3)



Assumption of New Technology

Table 8. CO2 Emissions per Fuel Inputs in Electricity (CO2 ton per US2001$)

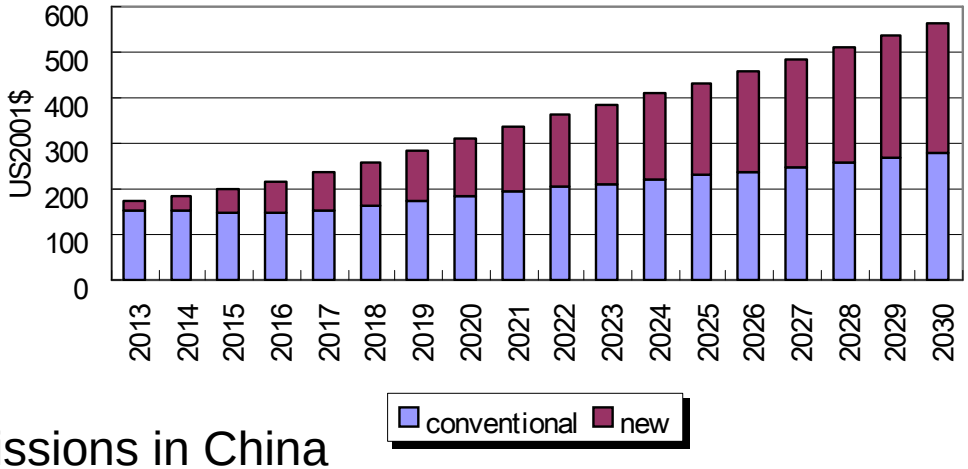
	chn	jpn	rus	asia	anz	nam	eu	row
col	0.241	0.059	0.073	0.063	0.069	0.067	0.063	0.095
oil	0.025	0.022	0.025	0.028			0.022	0.025
gas	0.023	0.018	0.026	0.022	0.024	0.029	0.022	0.026
p_c	0.014	0.012	0.017	0.015	0.017	0.018	0.017	0.018

Table 9. Two Techonolgies in Elelctrcity in China

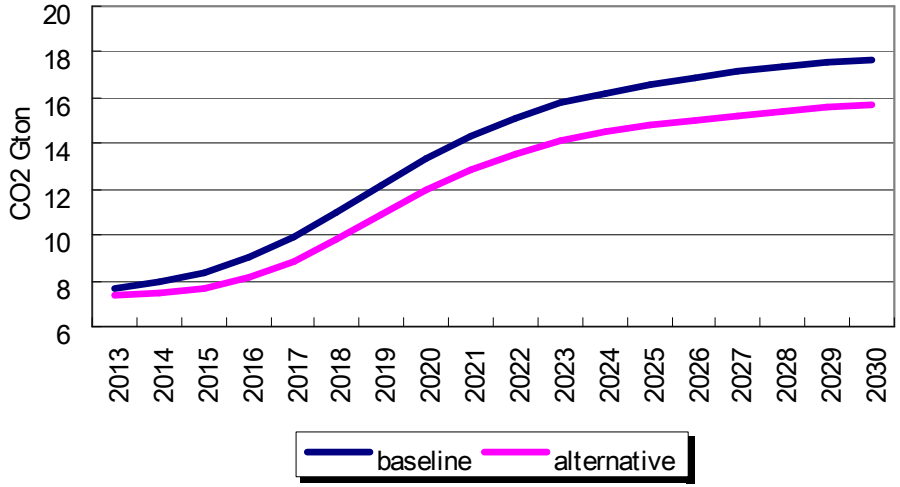
	Conventional Technology	New Technology
col	1.000	0.300
oil	1.000	0.800
gas	1.000	0.800
p_c	1.000	0.500
ely	1.000	0.800
markup factor		1.0868

Simulation Results

Output of electricity in China

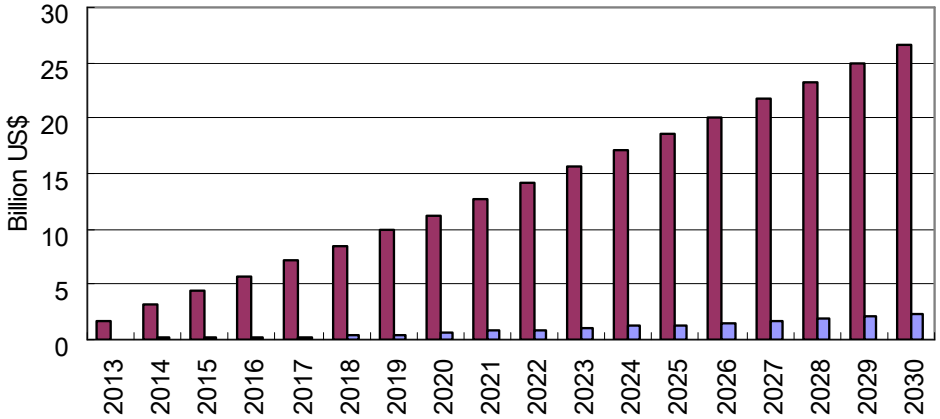


CO2 Emissions in China

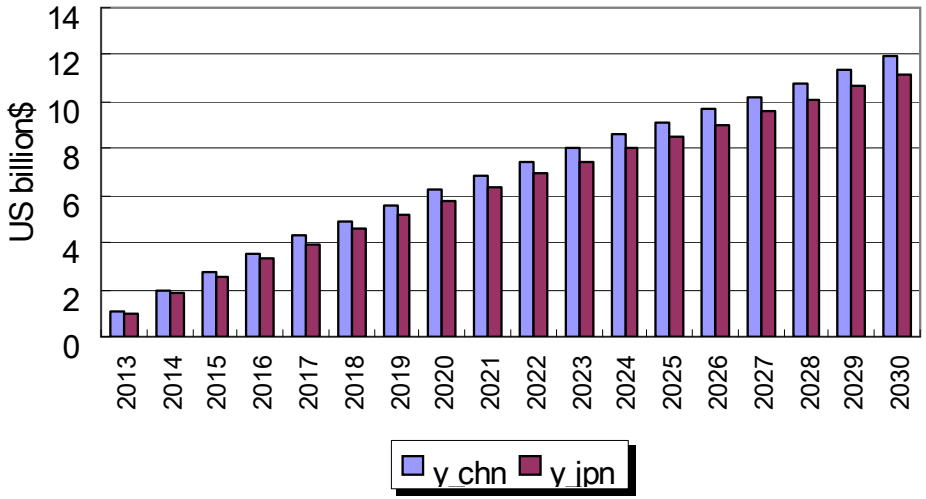


Benefits from Cost Sharing

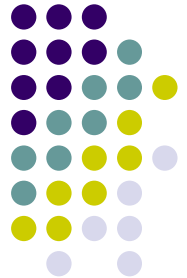
Increase in GDP



Income from knowledge



Reduction in China admitted as CDM by 10 %



	CO2 Price		Increase in GDP in Japan	
	No CDM	CDM	No CDM	CDM
2015	26.5	20.0	0.2	2.0
2020	29.6	26.0	0.6	8.1
2025	36.3	30.8	1.4	19.4
2030	43.3	35.8	2.2	38.0
	US$/CO2 ton		Billions US$	

If reduction in China is admitted as CDM, then CO2 price in the world will decline and GDP in Japan will increase.