AIM/China: Progress in 2005

ERI AIM Project team

Prepared for 11th AIM Workshop
Feb.19-20, 2005, NIES, Tsukuba

Application of AIM/China in 2005-2006

- Energy and GHG Emission scenario up to 2030
- Urban Transport Development Study
- Energy Fiscal Policy Assessment
- Energy Five Year Plan for Hainan Province
- Beijing Energy and Environment Analysis
- Climate and Development: Clean Coal technology Assessment
- Long-term Emission Scenarios up to 2050
- APEIS

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Energy and GHG Emission scenario up to 2030

- Including most recent energy data(up to 2004 and 2005)
- National plan(Economy growth, energy conservation plan, renewable energy plan)
- Circulating Economy Modeling(Process linkage within AIM/Enduse model)
- Results to be finished

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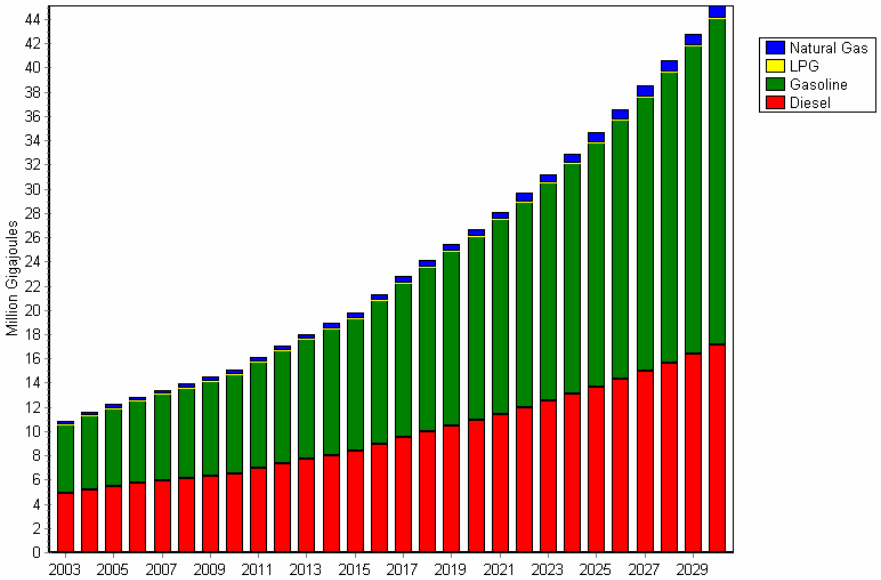
Urban Transport Development Study

- Ultra-Large City: Beijing, Shanghai, Chong Qing
- Large rich city: Hangzhou
- Large Poor city: Taiyuan(?), Yin chuan, Xining
- Small city: ***Lang Fang***

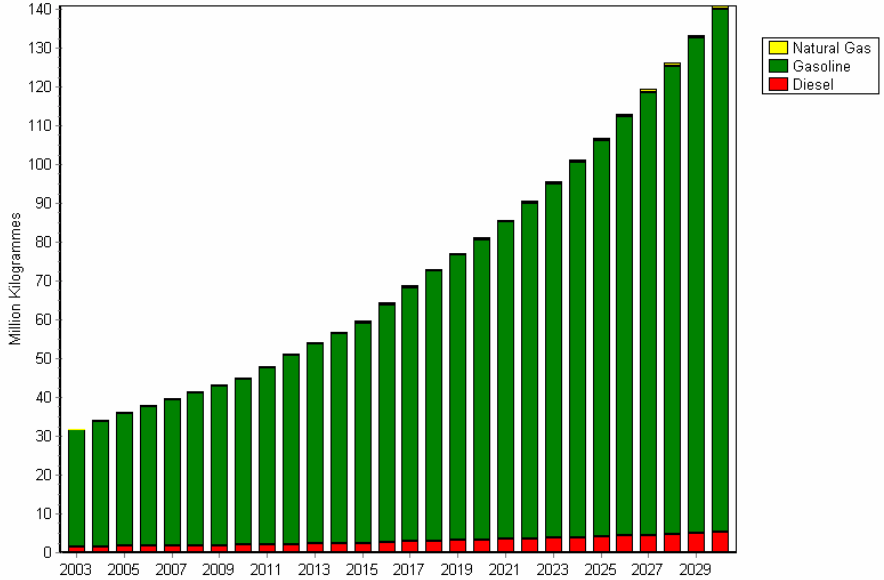
Demand: Energy demand (final units)

Scenario: BaU



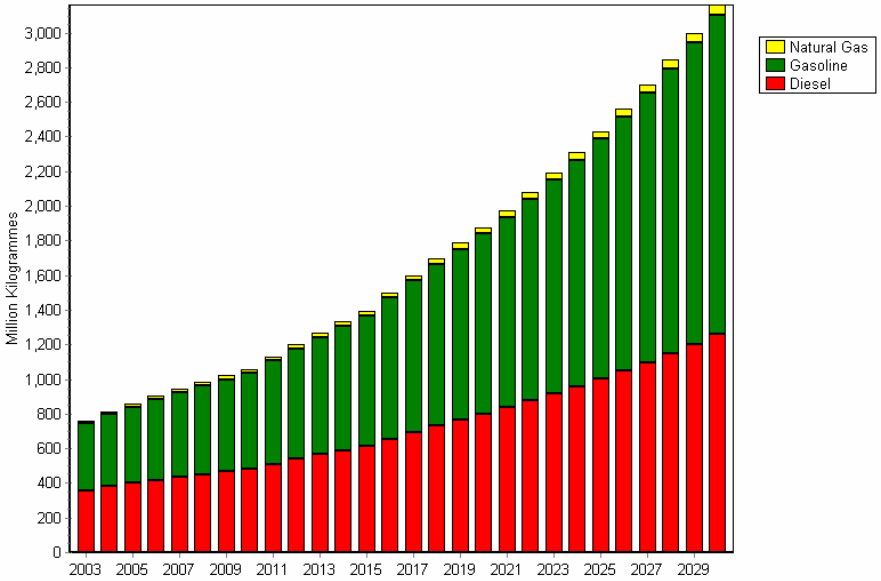
Environment: CO

Scenario: BaU



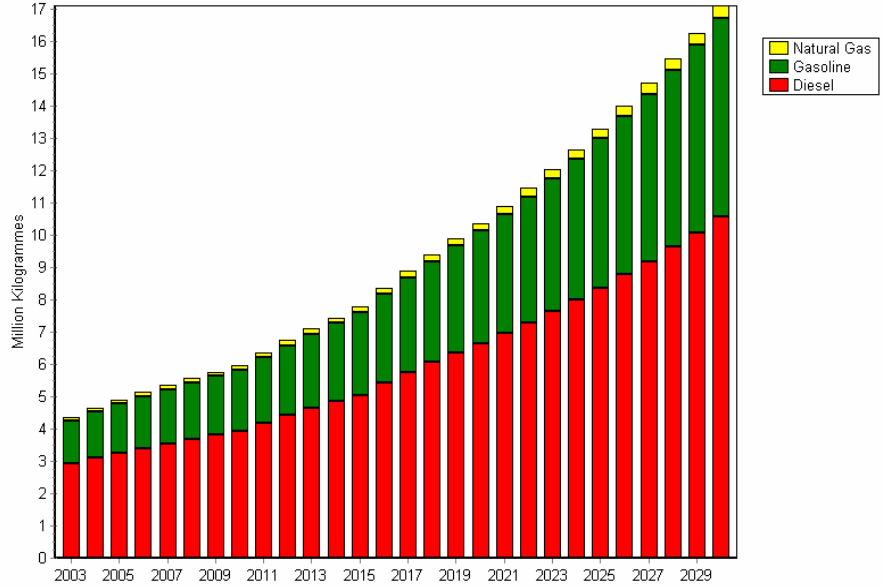
Environment: CO2 Emission

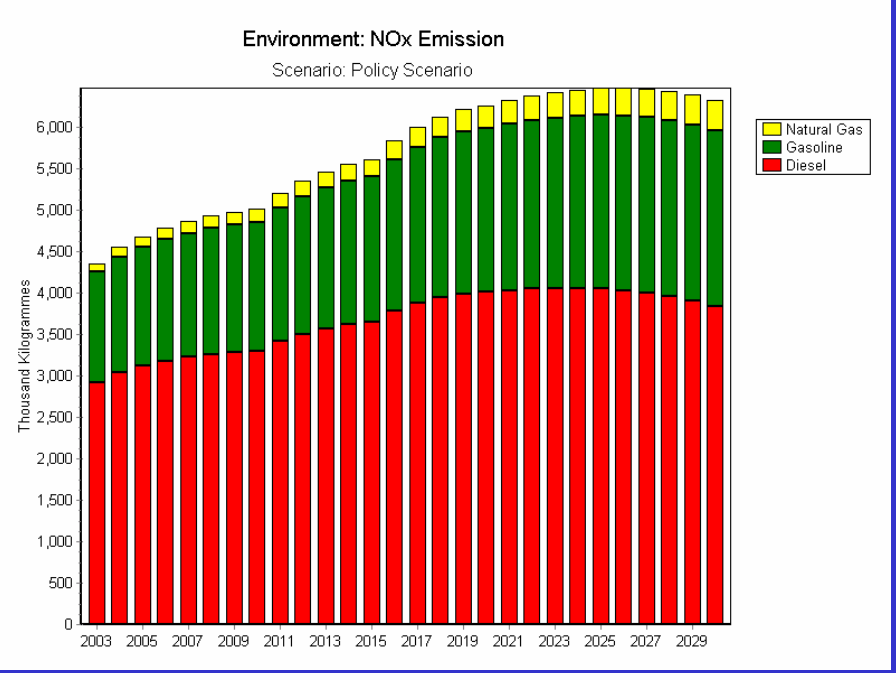
Scenario: BaU

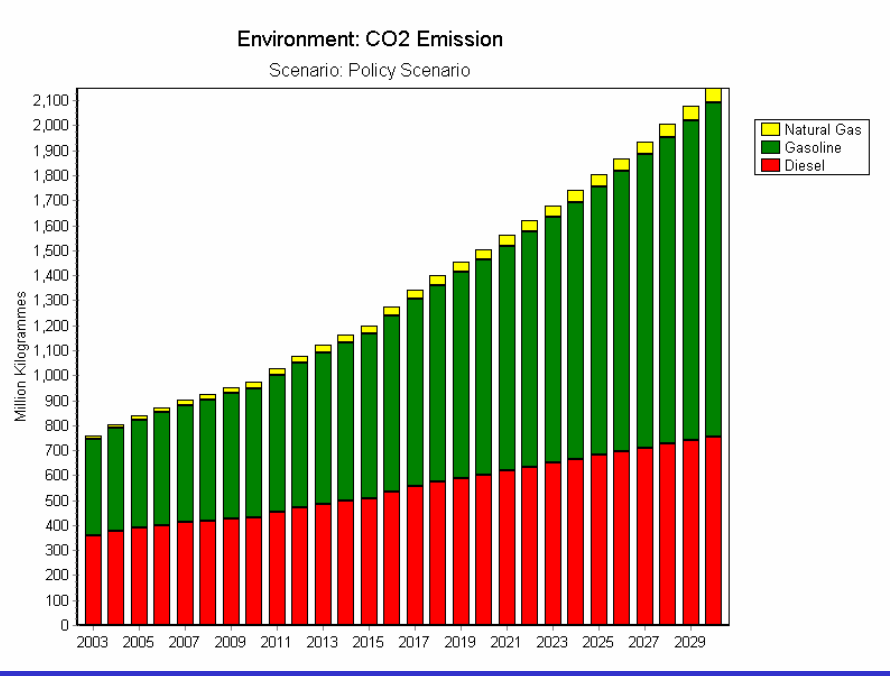


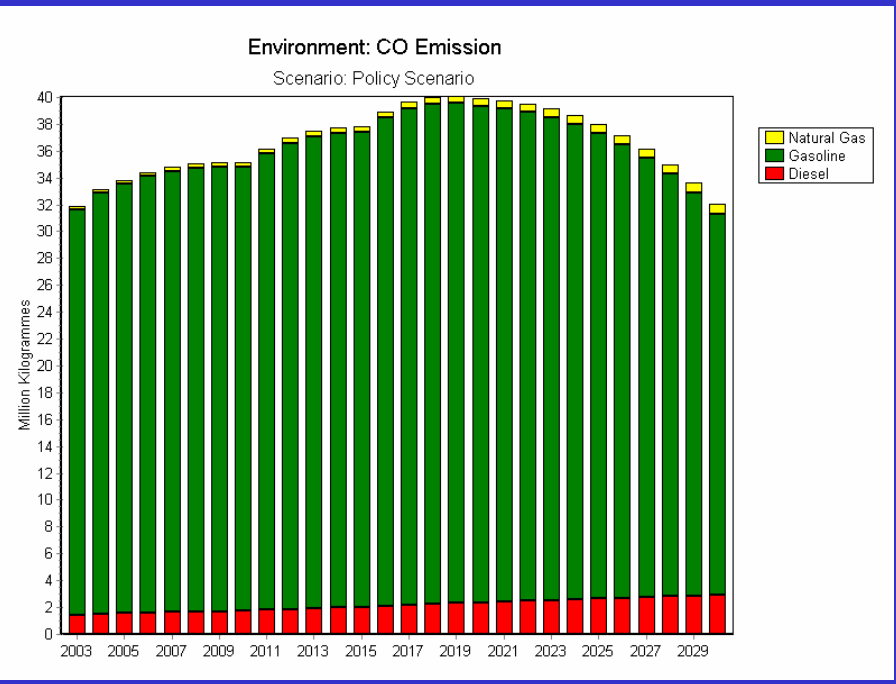
Environment: NOx Emission

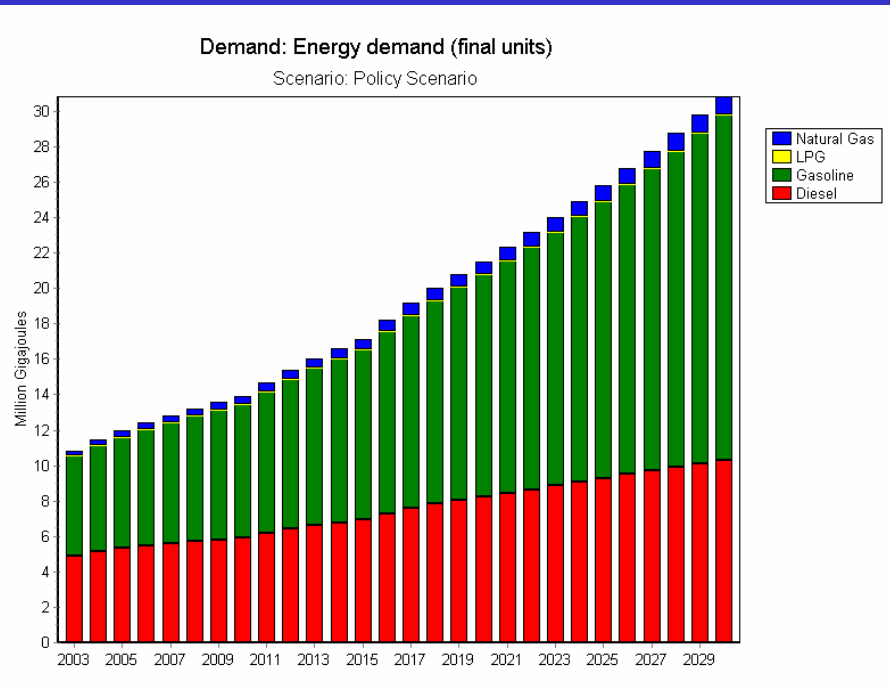
Scenario: BaU




Environment: NOx Emission
Scenario: Policy Scenario
Thousand Kilogrammes
Natural Gas
Gasoline
Diesel


Environment: CO2 Emission
Scenario: Policy Scenario
Million Kilogrammes
Natural Gas
Gasoline
Diesel


Environment: CO Emission
Scenario: Policy Scenario
Million Kilogrammes
Natural Gas
Gasoline
Diesel


Demand: Energy demand (final units)
Scenario: Policy Scenario
Million Gigajoules
Natural Gas
LPG
Gasoline
Diesel

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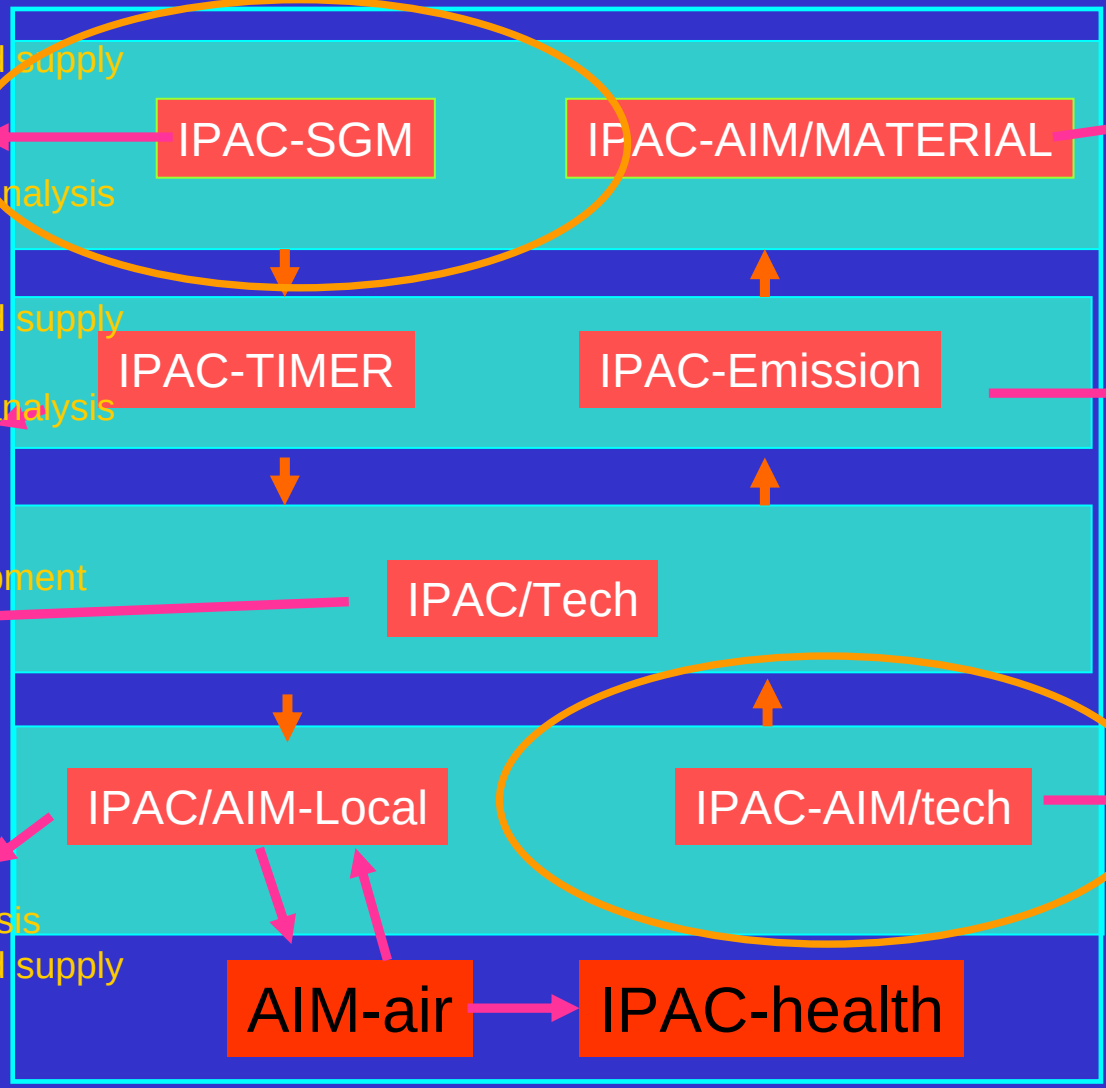
Framework of IPAC



Energy demand and supply
Price/investment
Economic impact
Medium/long-term analysis

Environment industry
Pollutant emission
Medium/long-term analys

Energy demand and supply
Price/investment
Medium/long-term analysis

Energy demand and supp
Full range emission
Price, resource, technolog
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Economic impact

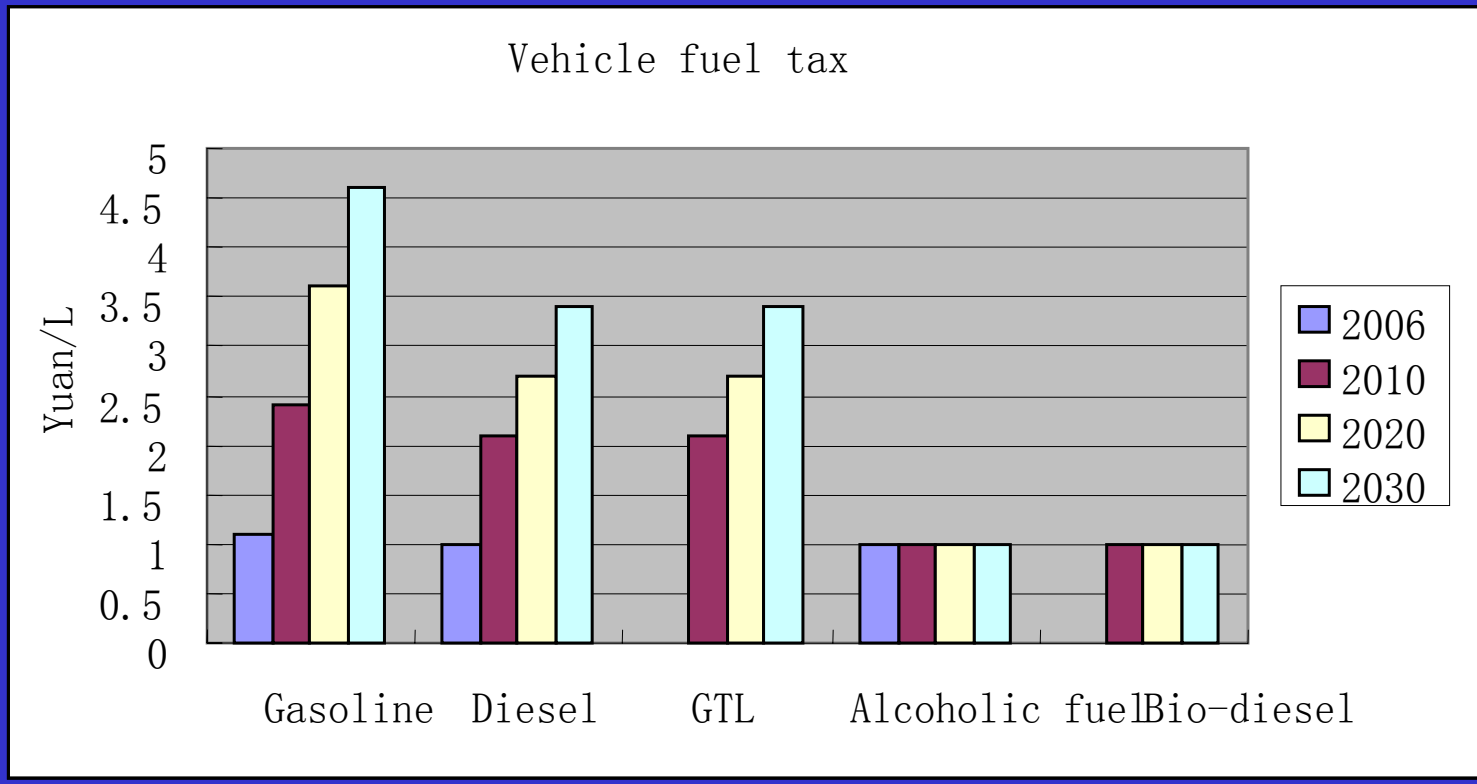
Technology development
Environment impact
Technology policy

Region analysis
Medium/short analysis
Energy demand and supply
Technology policy

Medium/short term analysis
Technology assessment
Detailed technology flow

Establishment of fiscal and taxation policies for energy sustainable development in China

1.Vehicle fuel tax (change fee to tax and vehicle fuel tax)

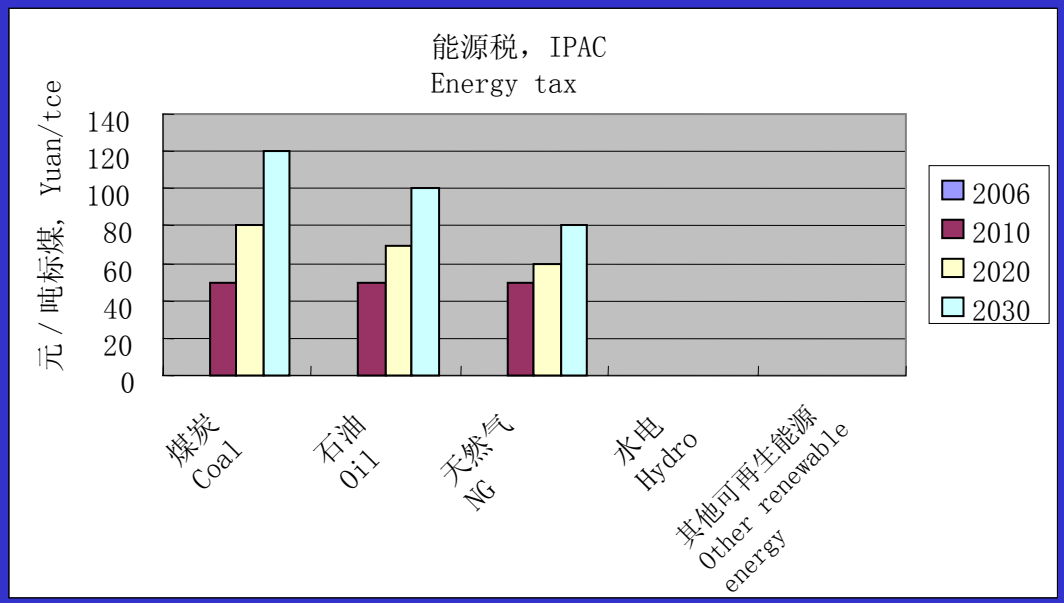


	2006	2010	2020	2030
汽油 Gasoline	1.1(费改税, change fee to tax)	2.4	3.6	4.6
柴油 Diesel	1(费改税, change fee to tax)	2.1	2.7	3.4
GTL		2.1	2.7	3.4
醇类燃料 Alcohol fuel	1	1	1	1
生物柴油 Bio-diesel		1	1	1

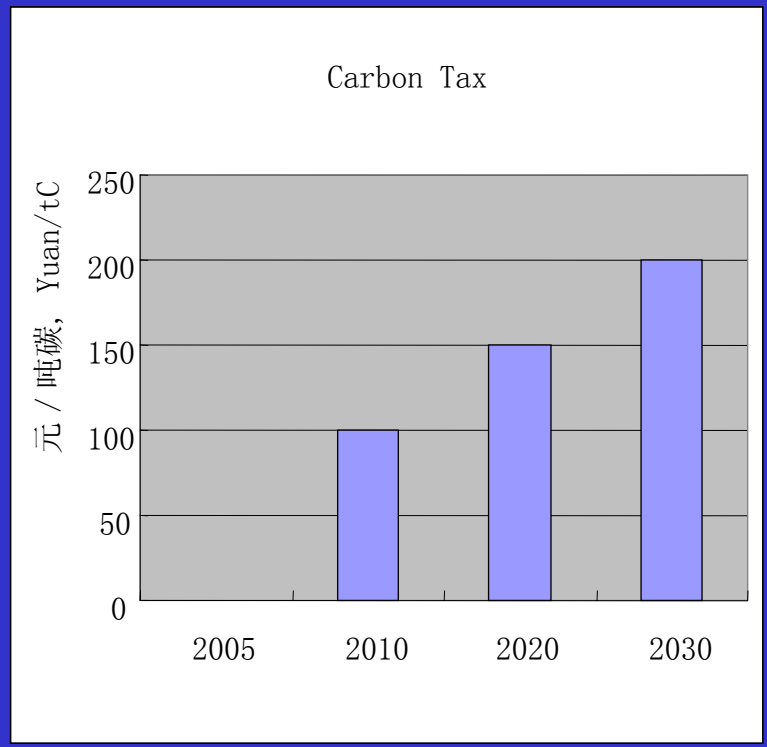
Establishment of fiscal and taxation policies for energy sustainable development in China (Cont.)

2. Energy tax (based on heat value and encourage clean energy)

	2006	2010	2020	2030
煤炭 Coal	0	50	80	120
石油 Oil	0	50	70	100
天然气 Natural Gas	0	50	60	80



3. Carbon tax



Establishment of fiscal and taxation policies for energy sustainable development in China (Cont.)

4. End-use energy price

		2005	2010	2020	2030
石油制品 Oil product	Yuan/Ton	2822	3116	3912	4430
天然气 Natural Gas	Yuan/m^3	1.61	1.6	1.67	1.76
煤炭 Coal	Yuan/Ton	495	496	500	489
电力 Electricity	Yuan/KWh	0.45	0.46	0.47	0.47
醇类染料 Alcoholic Fuel	Yuan/Ton	2900	2900	2900	2900
生物柴油 Bio-diesel	Yuan/Ton	5300	4300	3900	3800

5. Utilization of tax revenue

In modeling:

70% goes to government revenue, as common expense for government

30% goes to expense for energy conservation and new energy development

Indicators for policy assessment

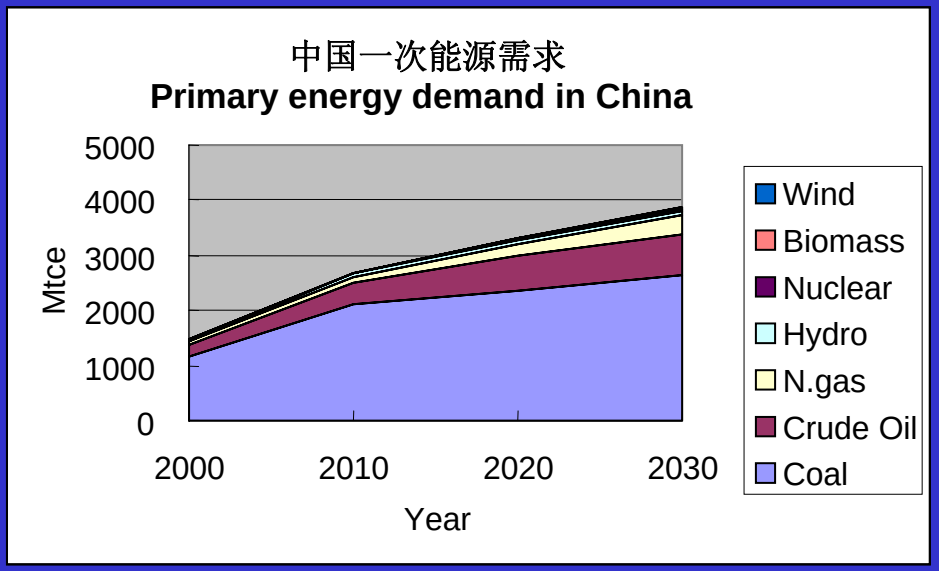
- Cost and benefit
- Energy security
- Rural energy supply
- Poverty
- Production safety
- Emission mitigation
- Water and land damage
- Institutional arrangement
- Economy promotion
- Employment
- Multiple development objectives

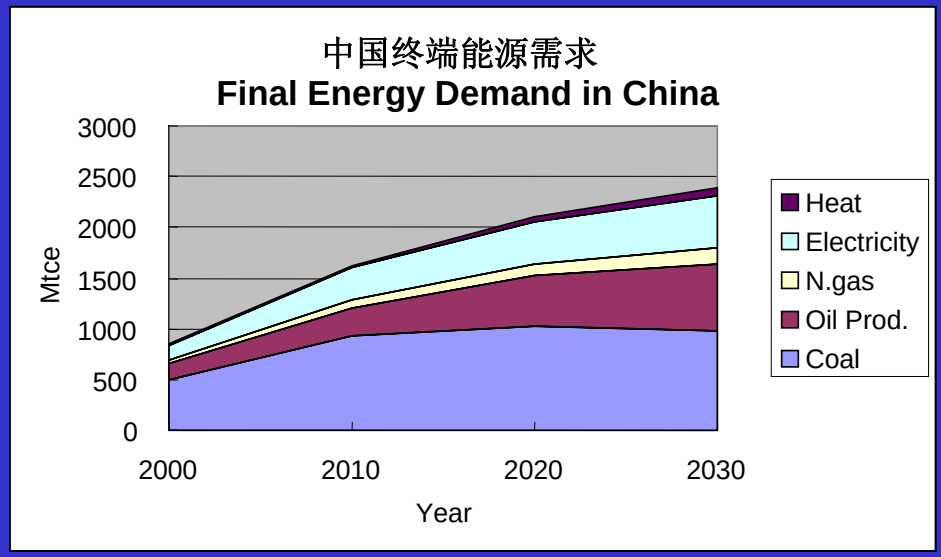
Establishment of fiscal and taxation policies for energy sustainable development in China (Cont.)

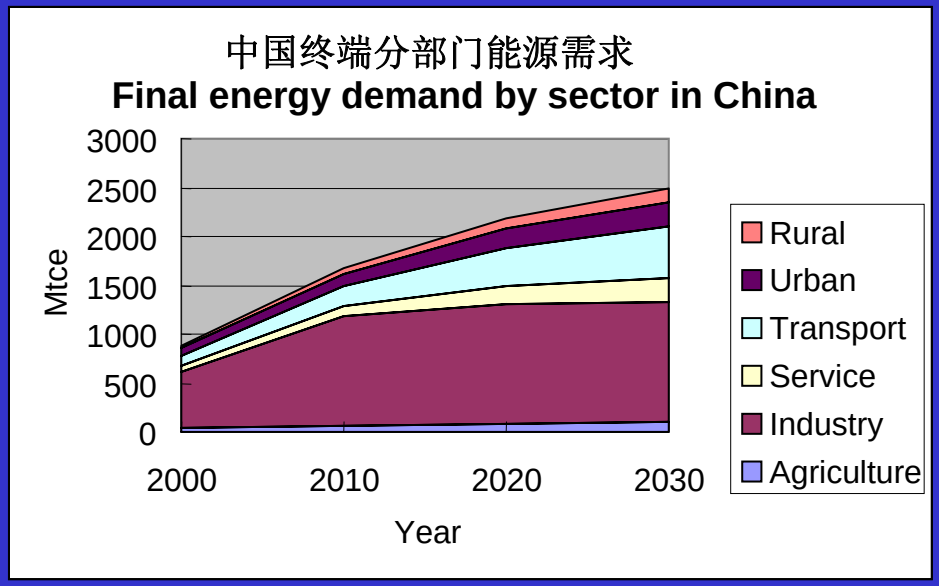
6. Tax neutrality:
Individual income tax: reduced by 5%
Corporation income tax: reduced by 3%

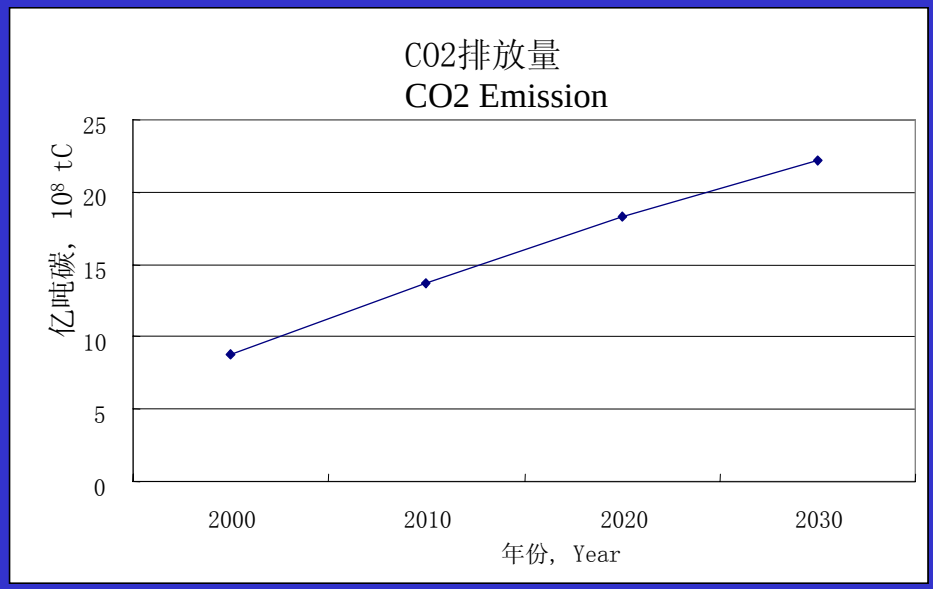
7. Price elasticity:
Mainly used for the analysis for vehicle fuel tax with consideration of impact of price increase on people's traveling. Because of deficit of detailed research on it, the result of other countries's study is adopted, with a value of –0.25

Modeling analysis result: Baseline scenario

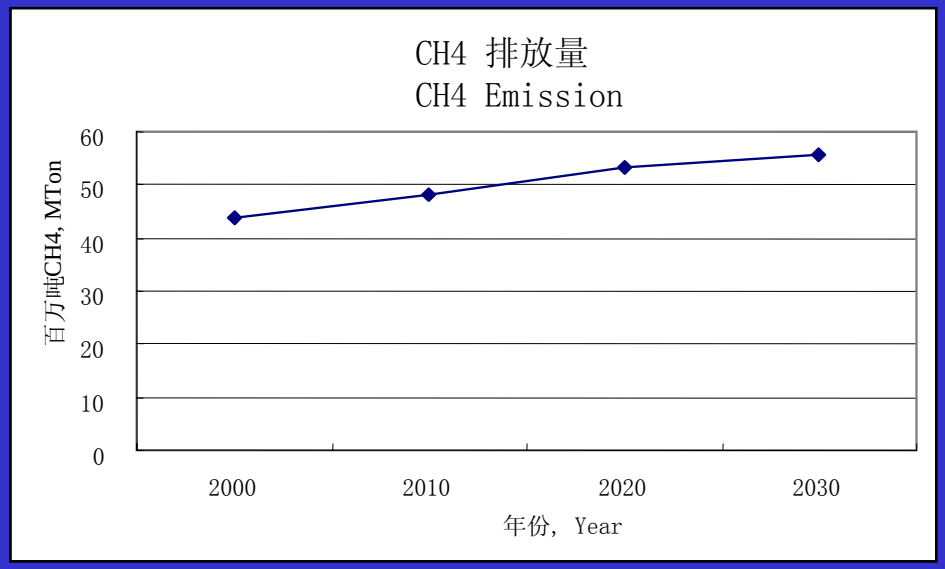


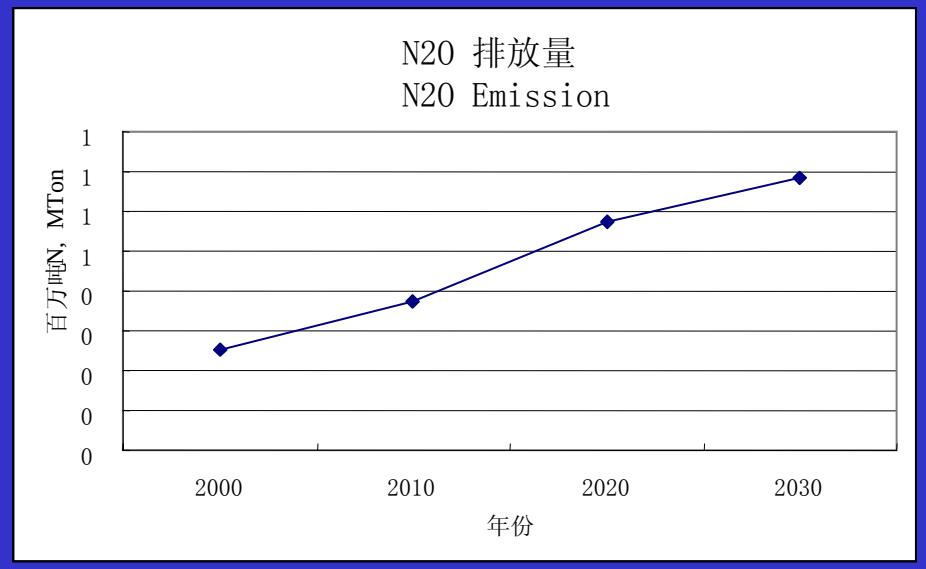


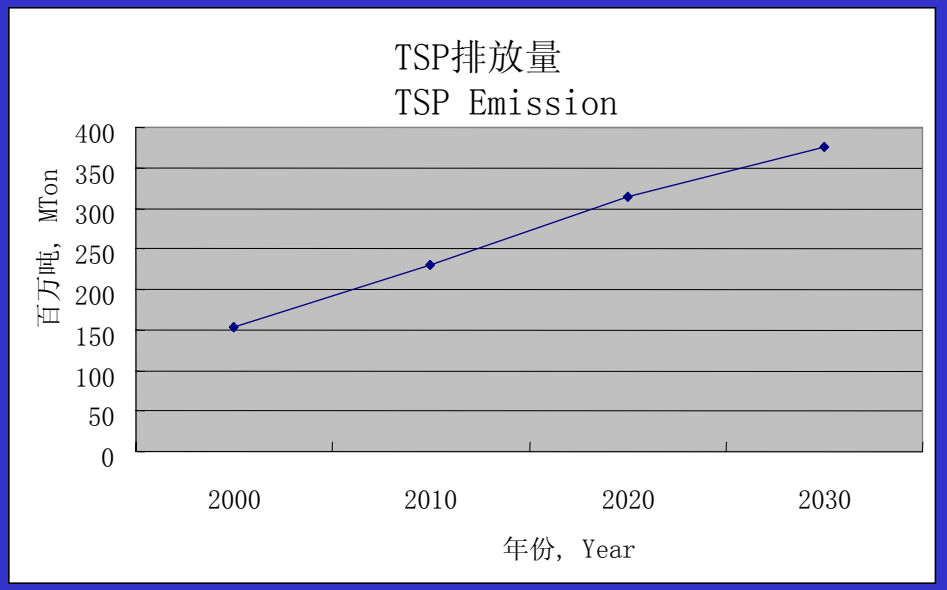


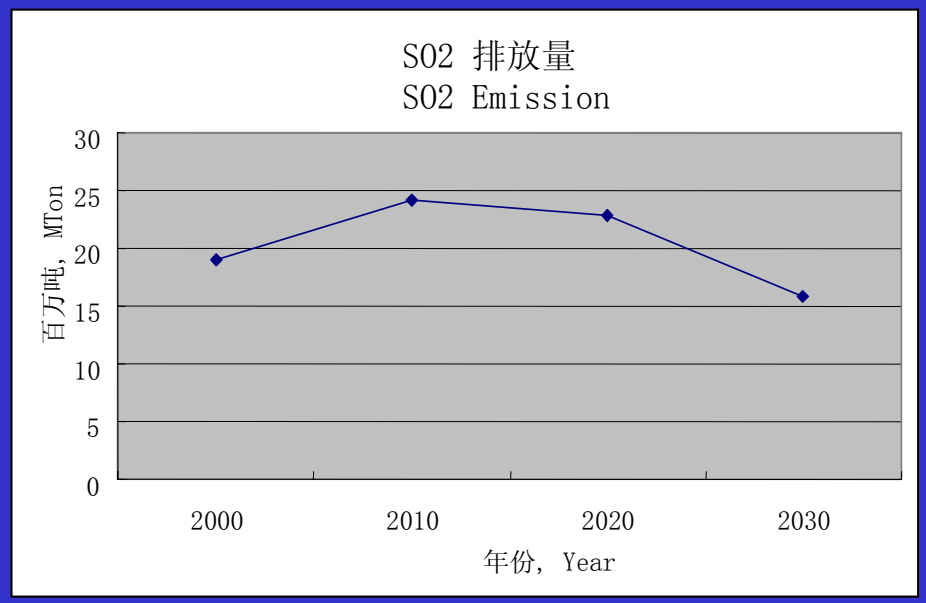


Modeling analysis result: Baseline scenario (Cont.)

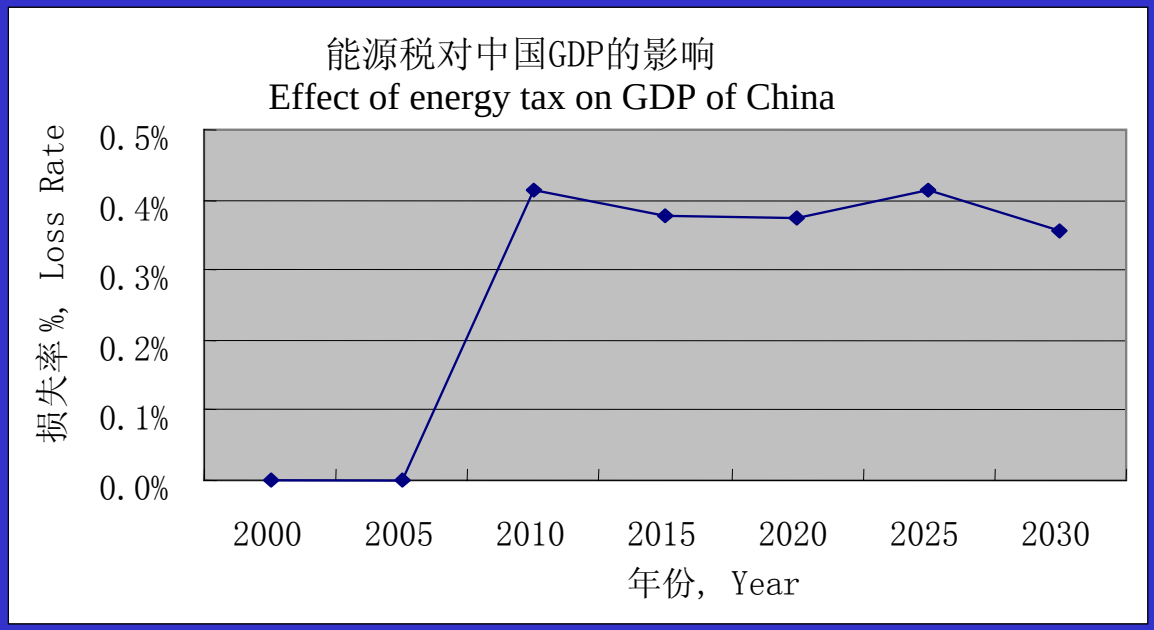


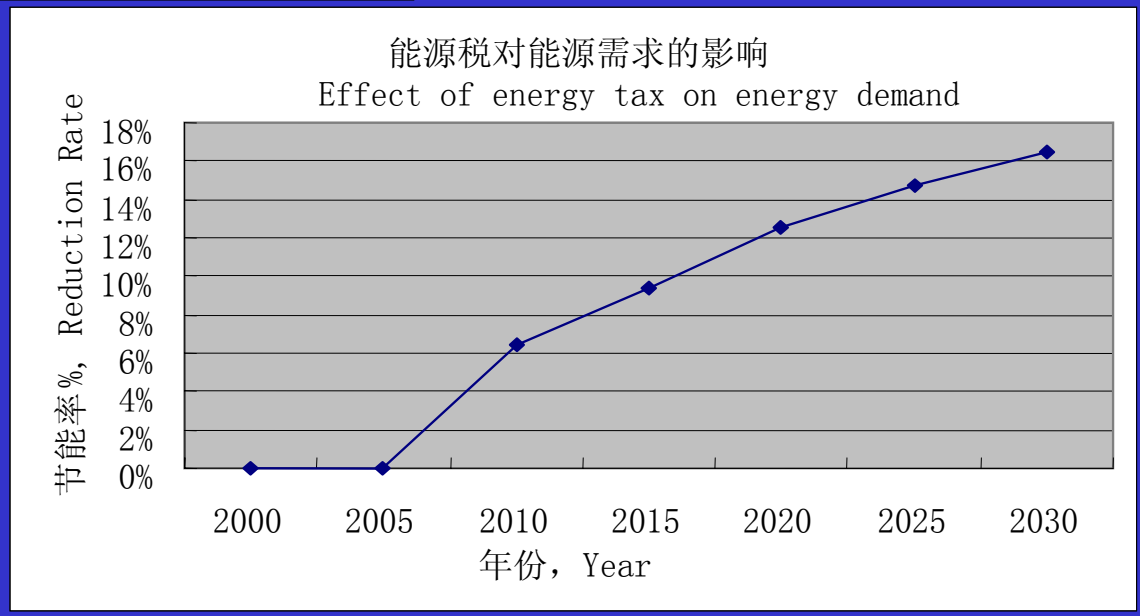




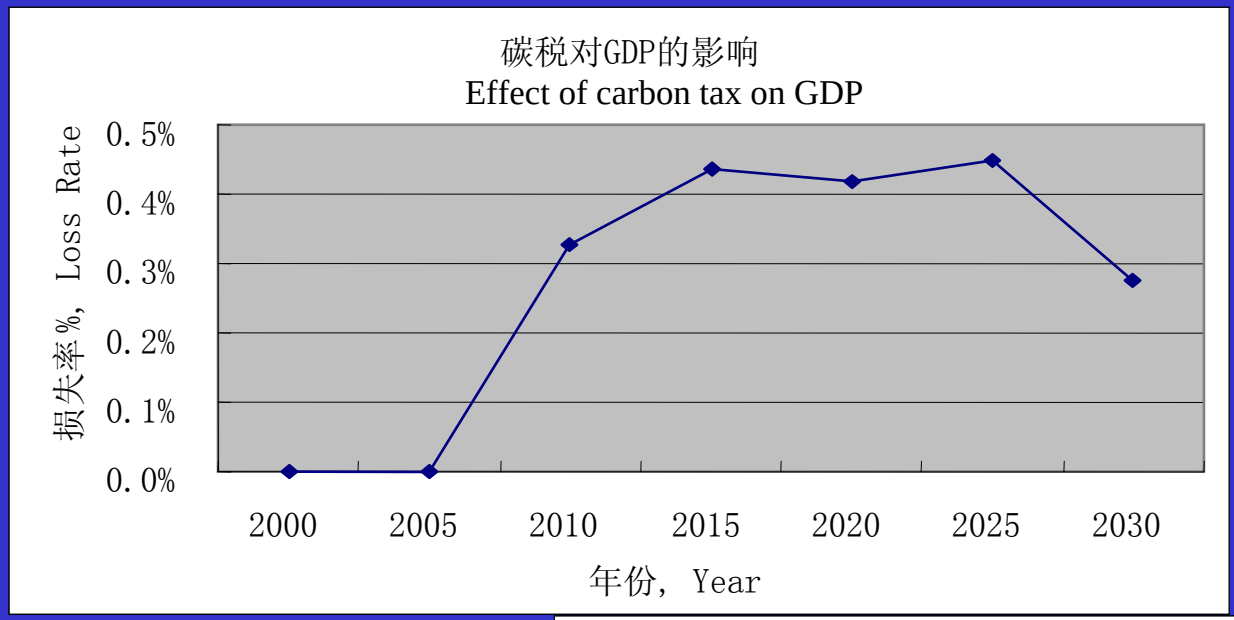


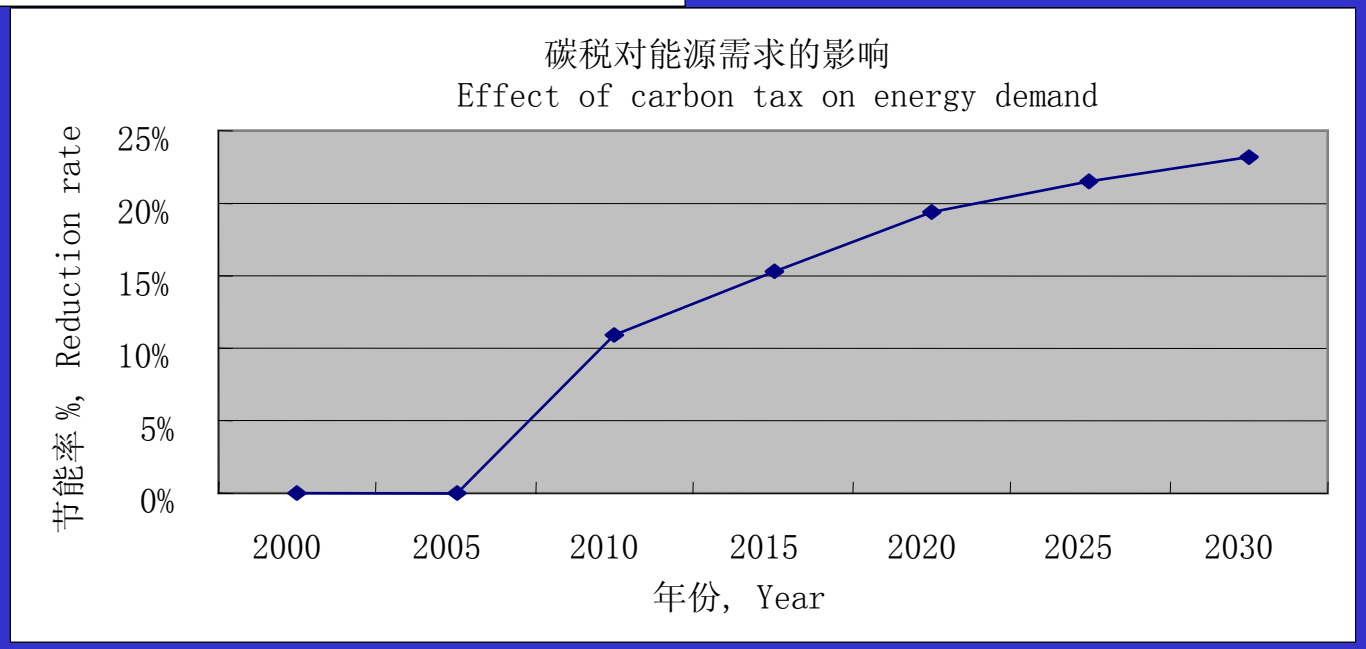
Modeling analysis result: Energy tax scenario



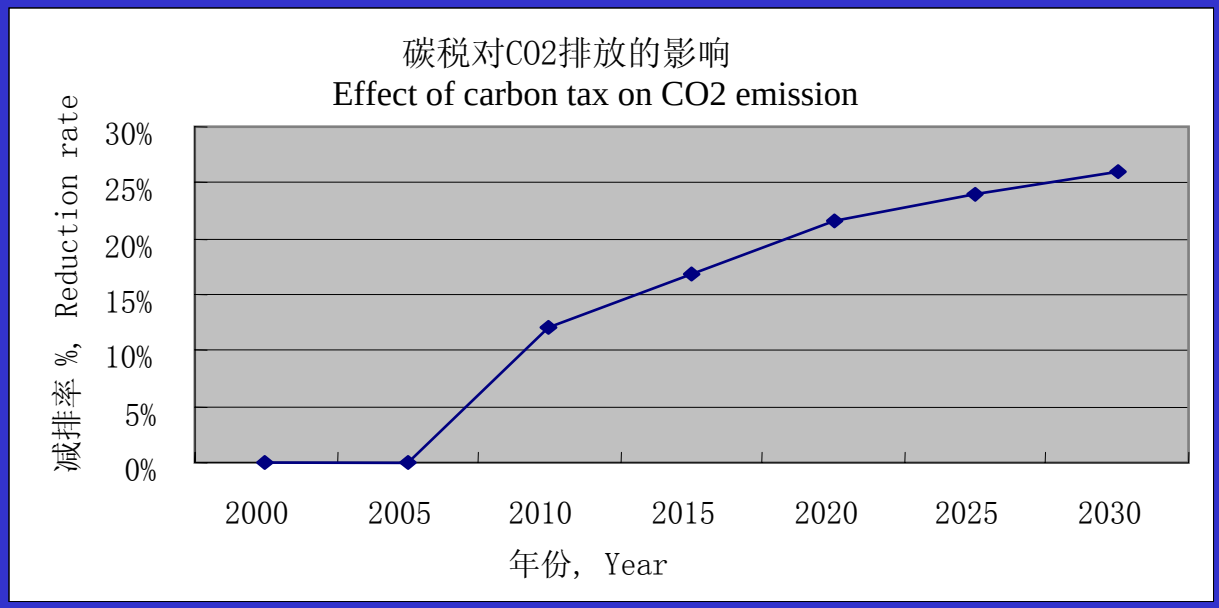


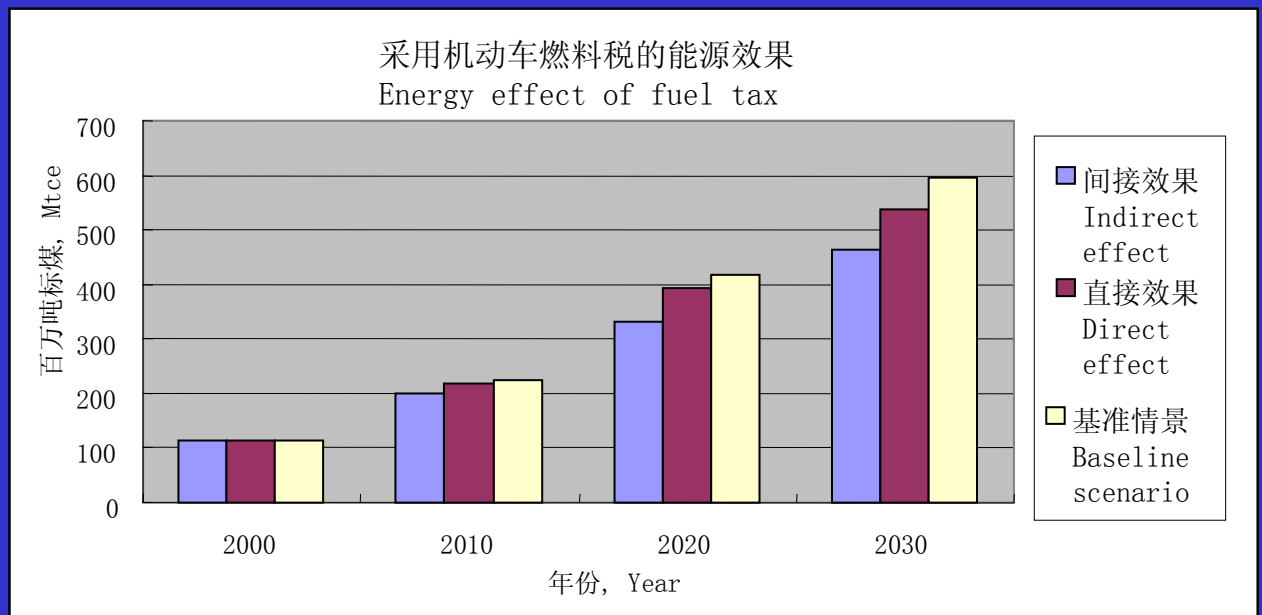
Modeling analysis result: Carbon tax scenario





Modeling analysis result: Fuel tax scenario





Primary conclusion

- According to the primary analysis result, the energy tax has an apparent effect on controlling energy demand. Compared with baseline scenario, in energy tax scenario, energy demand in 2020 will decrease by 12.7%, saving about 400 million tce energy and having an apparent environmental effect

- Due to the energy price increase that restrains the economy development and the decrease of energy industry production, the effect on GDP is negative. The loss rate of GDP is 0.38% (62.2 billion Yuan) and GDP increase rate has a little drop, from 5.6% to 5.579%.

Primary conclusion (Cont.)

- If considering the social cost induced by the fast development of energy system, mainly including energy security cost, cost resulting from the enlargement of international market, environmental cost, etc, the adoption of energy tax will have more apparent impact. Specifically, the recent discussion about adoption of fuel tax give a good opportunity to introduce energy tax. Compared with the current plan of changing fee to tax, adoption of energy tax is much easier.

- Adoption of fuel tax will not only have a directive effect on energy demand through the change of public selection of vehicle, but also in-directive effect through the increase of traveling cost due to fuel tax and corresponding decrease of traveling demand

Further work

- Completion and improvement of model: taxation mode, effect of import and export, effect of tax on consumption behavior, further analysis of IPAC-SGM model
- Use of tax renevue
- Price elasticity
- Parameters / scenario development

Further work (Cont.)

- Further studying on reasonable tax rate. On the basis of current modeling research, make an analysis on the effects of all tax rates and propose an applicable rate
- Further studying on problems encountered by foreign countries in establishing fiscal and tax policies
- Studying on the implementation mechanism of energy-related fiscal and taxation policies (energy tax, fuel tax and carbon tax) in China

Co-Benefit: next

- Work further with policy makers, **quickly**
- How much we can pay for that
- Government budget
- Link with local development: an integrated framework

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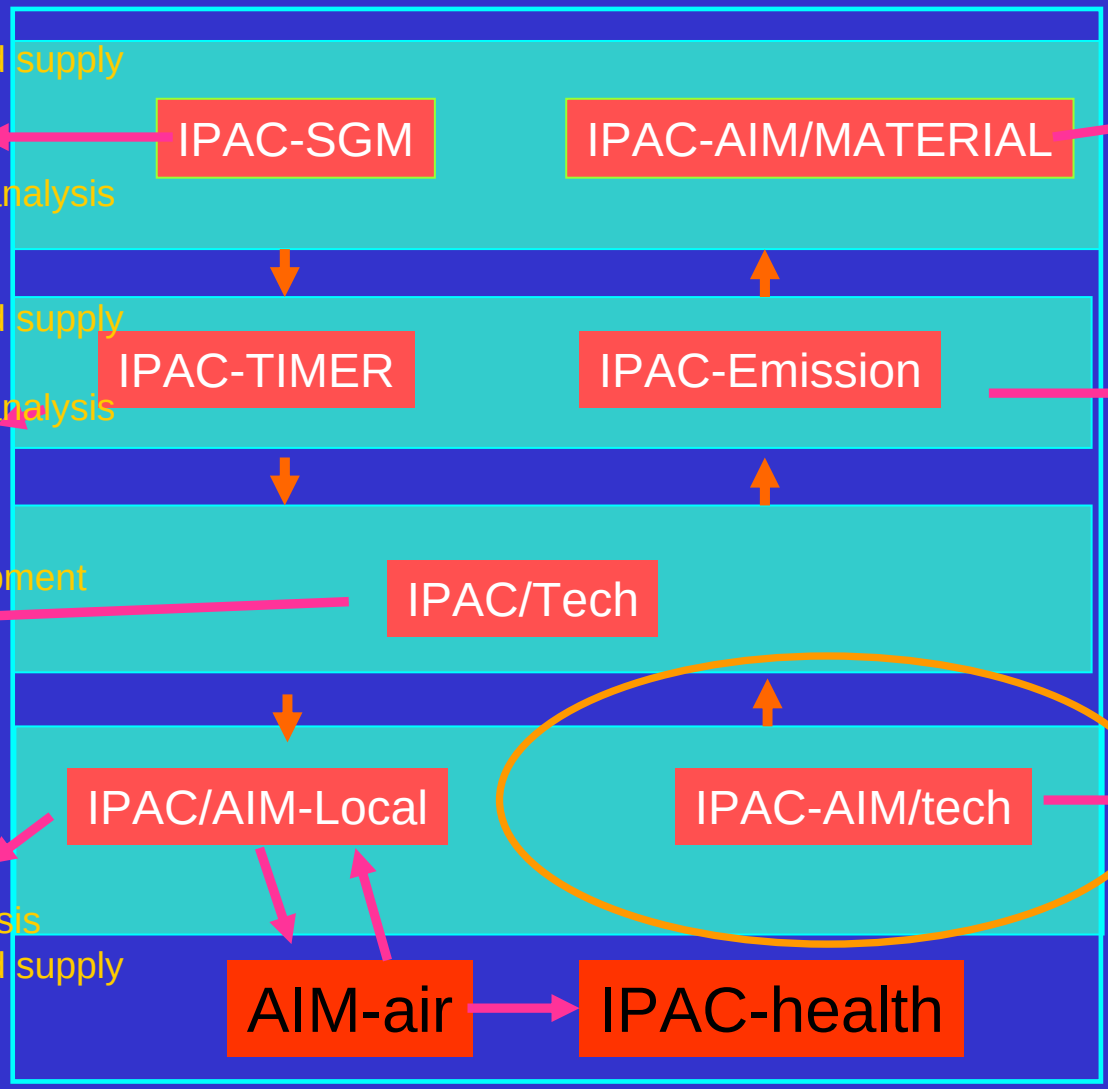

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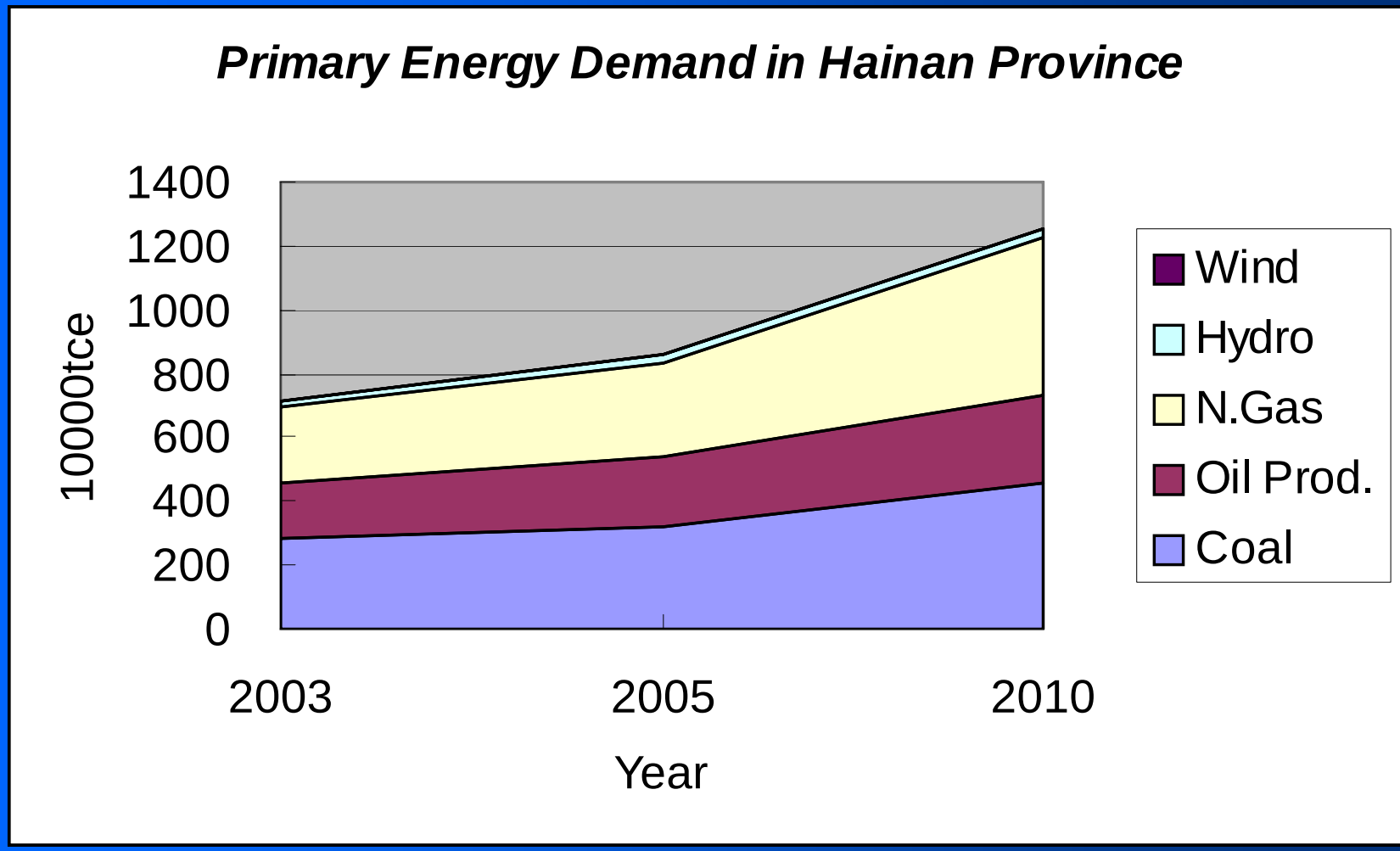
Primary Energy Demand in Hainan Province
1400
1200
1000
800
600
400
200
0
10000tce
2003
2005
2010
Year
Wind
Hydro
N.Gas
Oil Prod.
Coal

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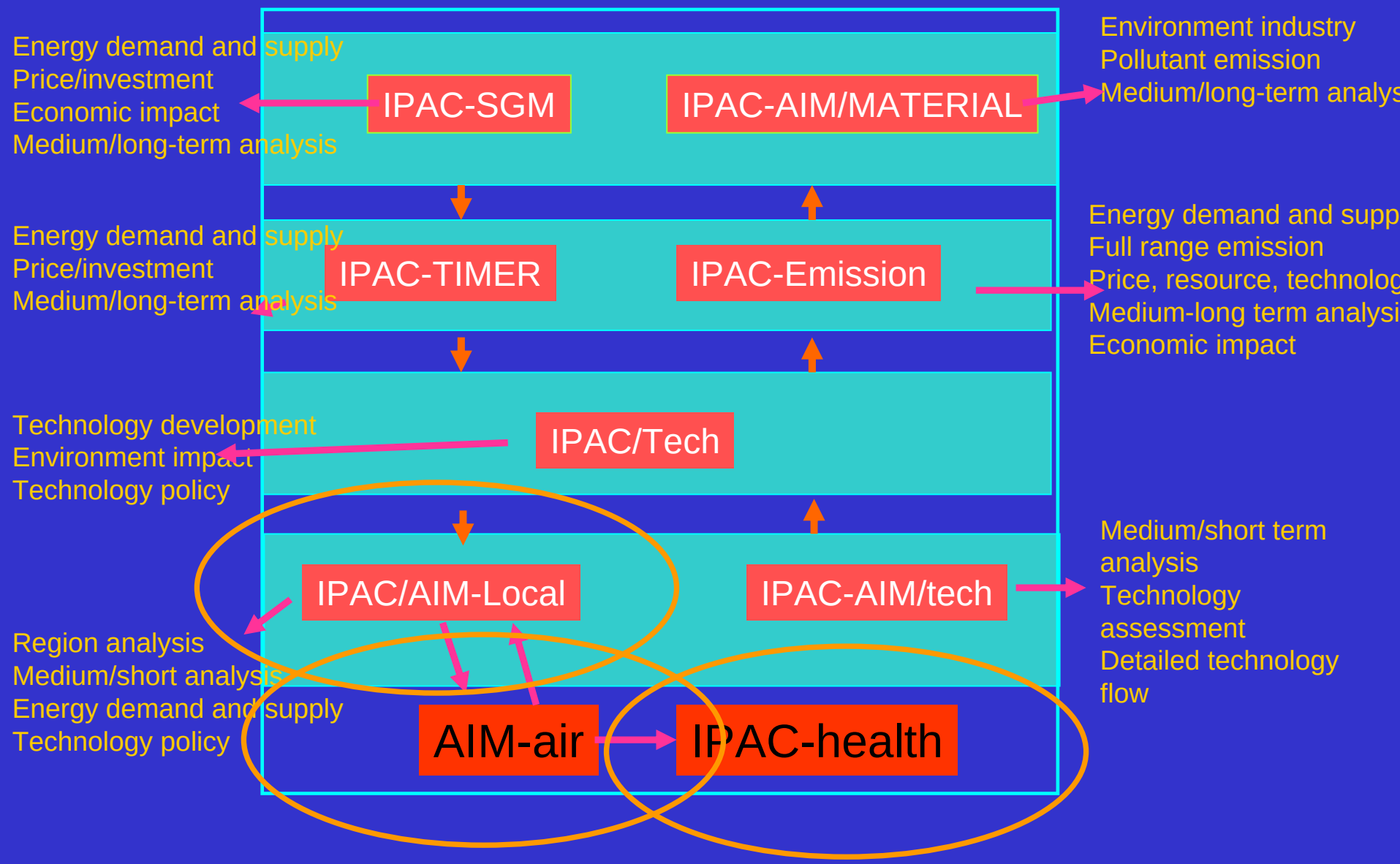


Regions in the model

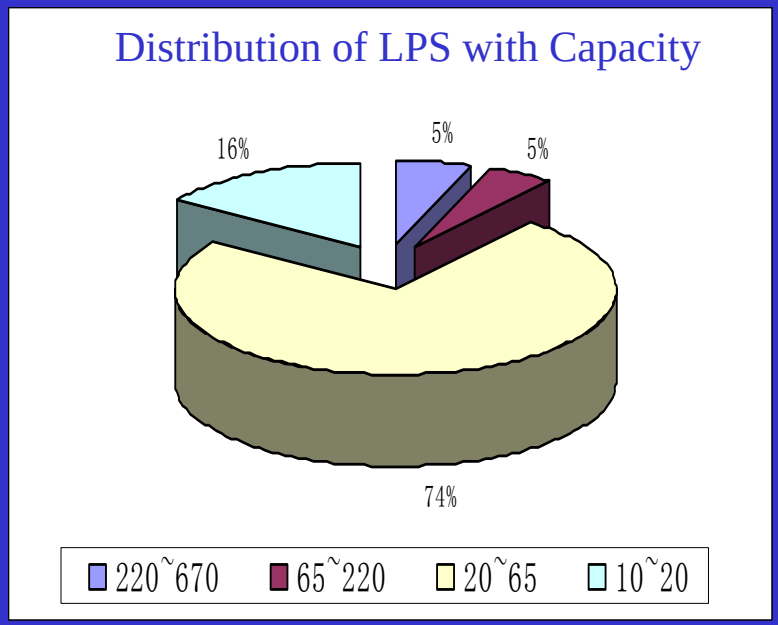
Regional2	Regional1	Regional	Regional1_Cod	GIS_Code
1	BJ	BEIJING	BJ	1
2	HD	HAIDIAN	HD	2
3	CY	CHAOYANG	CY	3
4	FT	FENGTAI	FT	4
5	SJS	SHIJINGS	SJS	5
16	CW	CHONGWEN	CW	16
17	XW	XUANWU	XW	17
18	DC	DONGCHEN	DC	18
19	XC	XICHENG	XC	19
6	MTG	MENTOUGO	MTG	6
7	TZ	TONGZHOU	TZ	7
8	CP	CHANGPIN	CP	8
9	FS	FANGSHAN	FS	9
10	SY	SHUNYI	SY	10
11	MY	MIYUN	MY	11
12	HR	HUAIROU	HR	12
13	YQ	YANQING	YQ	13
14	DX	DAXING	DX	14
15	PG	PINGGU	PG	15

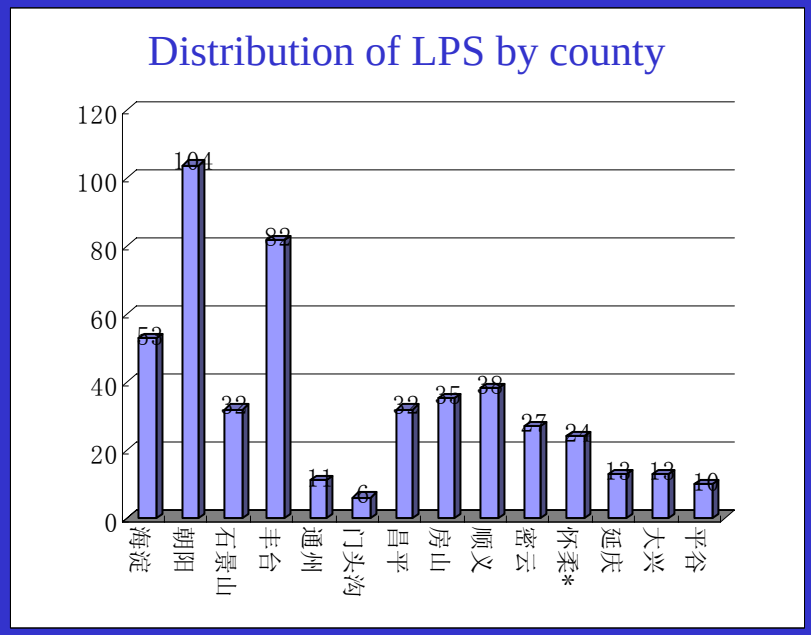
8 districts in urban

Suburb

Select of LPS

Base one data survey, 480 boilers with capacity between 10t/h - 670t/h； in which 112 for hot water, 360 for heating





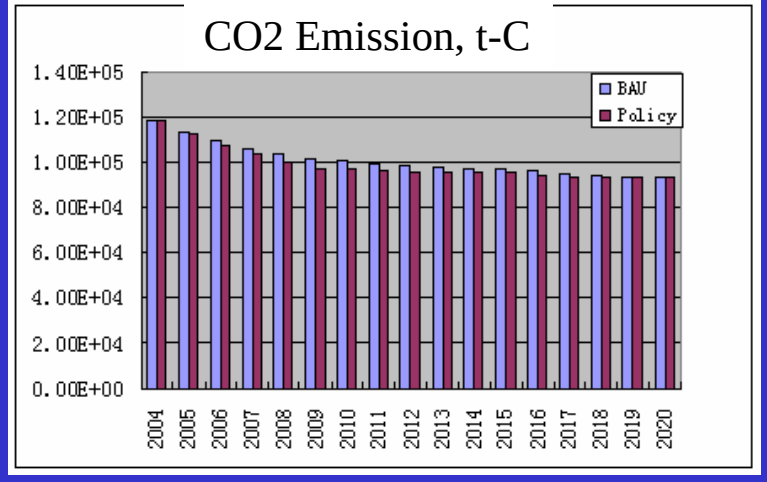
LPS in the model: example

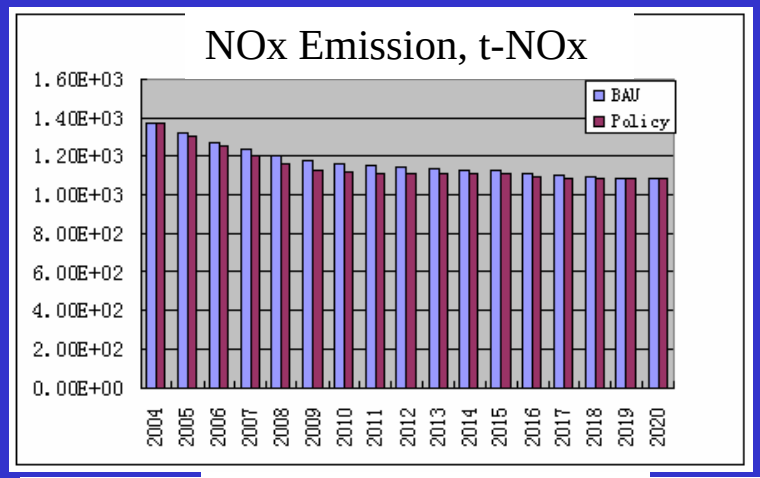
LPS_Numb	LPS_Code	LPS_Name	GIS_Code	Region2	Operation_	Longitude	Latitude	Stack_He
289	BJCP01	beijingshouchuangluntai-com	7	CP	0.32	116.3058	39.0389	75
290	BJCP02	beijingshouchuangluntai-com	7	CP	0.32	116.3058	39.0389	75
291	BJCP03	beijingshouchuangluntai-com	7	CP	0.32	116.3058	39.0389	75
292	BJCP04	beijingbishuiwuye-company	7	CP	1	116.2914	39.0503	50
293	BJCP05	huabeidianli-university	7	CP	1	116.3047	39.0297	50
294	BJCP06	beijingshuntiantongwuye-com	7	CP	1	116.3686	39.0397	75
295	BJCP07	beijingshuntiantongwuye-com	7	CP	1	116.3686	39.0397	75
296	BJCP08	beijingshuntiantongwuye-com	7	CP	1	116.3686	39.0397	75
297	BJCP09	beijingshuntiantongwuye-com	7	CP	1	116.3686	39.04	75
298	BJCP10	beijingshuntiantongwuye-com	7	CP	1	116.3686	39.04	75
299	BJCP11	beijingshuntiantongwuye-com	7	CP	1	116.3686	39.04	75
300	BJCP12	beijingshuntiantongwuye-com	7	CP	1	116.3686	39.04	75
301	BJCP13	beijingnakoujichecheliang-f	7	CP	0.32	116.1772	39.1778	75
302	BJCP14	beijingnakoujichecheliang-f	7	CP	0.32	116.1772	39.1778	75
303	BJCP15	beijingnakoujichecheliang-f	7	CP	0.32	116.1772	39.1778	75
304	BJCP16	beijingnakoujichecheliang-f	7	CP	0.32	116.1772	39.1778	75
305	BJCP17	chengpingkejiyuan-heating-c	7	CP	1	116.1811	39.1778	75
306	BJCP18	chengpingkejiyuan-heating-c	7	CP	1	116.1811	39.1797	75
307	BJCP19	chengpingkejiyuan-heating-c	7	CP	1	116.1811	39.1797	75
308	BJCP20	chengpingkejiyuan-heating-c	7	CP	1	116.1811	39.1797	75
309	BJCP21	chengpingkejiyuan-heating-c	7	CP	1	116.1811	39.1797	75
310	BJCP22	chengpingkejiyuan-heating-c	7	CP	1	116.2306	39.185	100
311	BJCP23	chengpingkejiyuan-heating-c	7	CP	1	116.2306	39.185	100
312	BJCP24	chengpingkejiyuan-heating-c	7	CP	1	116.2306	39.185	100
313	BJCP25	chengpingkejiyuan-heating-c	7	CP	1	116.2306	39.185	100
314	BJCP26	chengpingkejiyuan-heating-c	7	CP	1	116.2306	39.185	100
315	BJCP27	chengpingkejiyuan-heating-c	7	CP	1	116.2306	39.185	100
316	BJCP28	chengpingkejiyuan-heating-c	7	CP	1	116.2306	39.185	100
317	BJCP29	chengpingkejiyuan-heating-c	7	CP	1	116.2306	39.185	100
318	BJCP30	chengpingkejiyuan-heating-c	7	CP	1	116.2306	39.185	100
319	BJCP31	chengpingkejiyuan-heating-c	7	CP	1	116.2306	39.185	100
320	BJCP32	chengpingkejiyuan-heating-c	7	CP	1	116.2306	39.185	100
54	BJCY01	xiaoying-heating-factory	2	CY	1	116.3839	39.9706	100

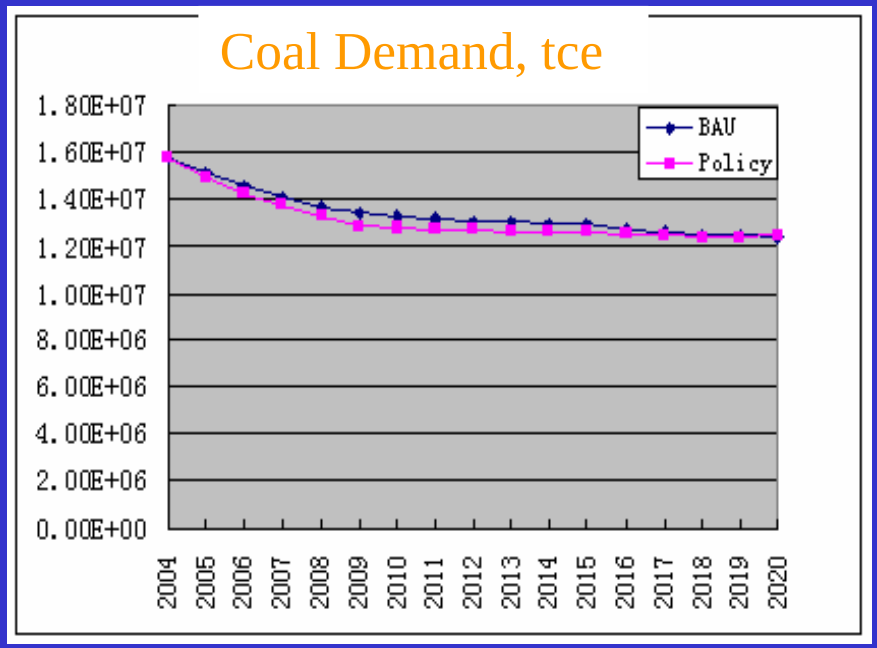
Energy Balance Table 2003

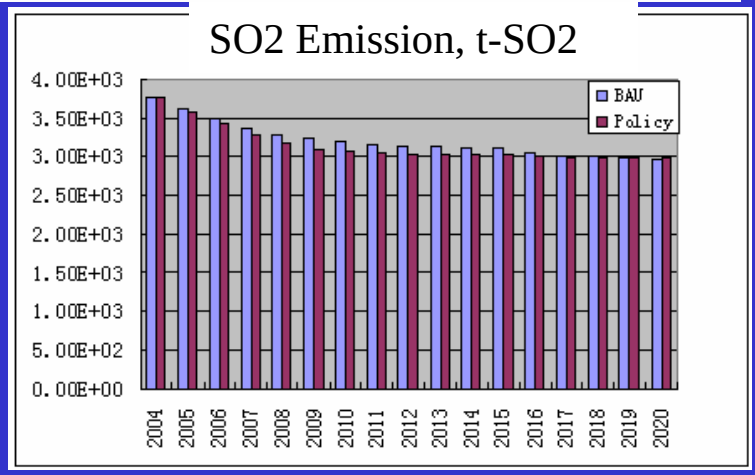
	Coal（10000 tce）	Coal（10000 tons）
Total Primary Energy Supply	1532.24493	2145.1
Indigenous Production		
Recovery of Energy		
Moving In from Other Provinces		
Import		
Chinese Airplane&Ships In Refueling Abroad		
Sending Out to Other Provinces(-)		
Export(-)		
Foreign Airplane&Ships In Refueling Abroad		
Stock Change		
Input(-)& Output(+) of Transformation	-722.000154	-1010.78
Thermal Power	-510.531639	-714.73
Heating Supply	-209.539905	-293.35
Coal Washing		
Coking		
Petroleum Refines		
Gas Works		
Coke Input(-)		
Briquettes		
Loss		
Total Final Consumption	819.23067	1146.9
Farning,Forestry,Animal husbandry,Fishery&water Conservancy	31.936353	44.71
Second Industry	423.901335	593.45
Industry	418.044075	585.25
Non-Energy Use	6.578703	9.21
Construction	5.85726	8.2
Tertiary Industry	171.532002	240.14
Residential Consumption	191.86098	268.6
Urban	46.64379	65.3
Rural	145.21719	203.3
Statistical Difference	-8.978751	-12.57
Total Energy Consumtion	1548.366681	2167.67

3. Model Results

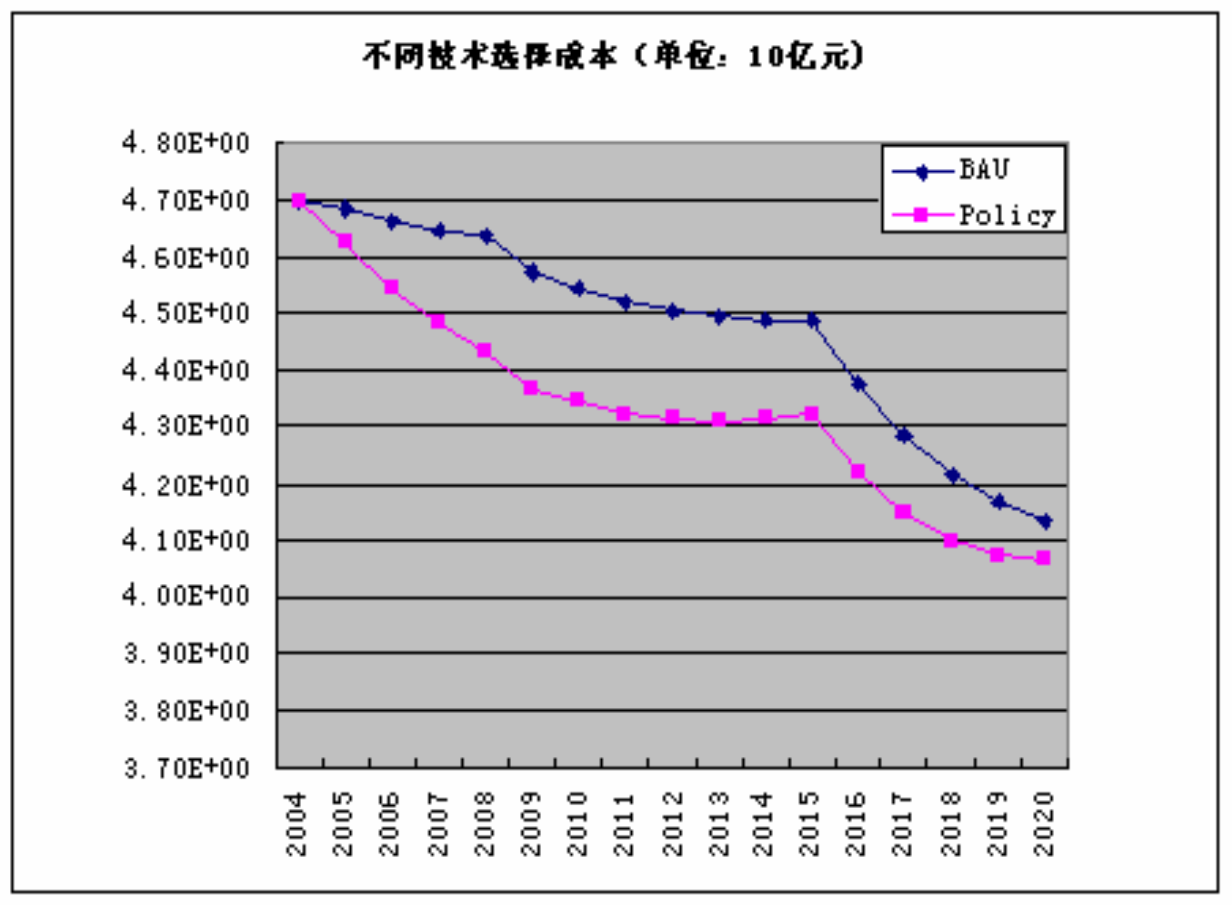






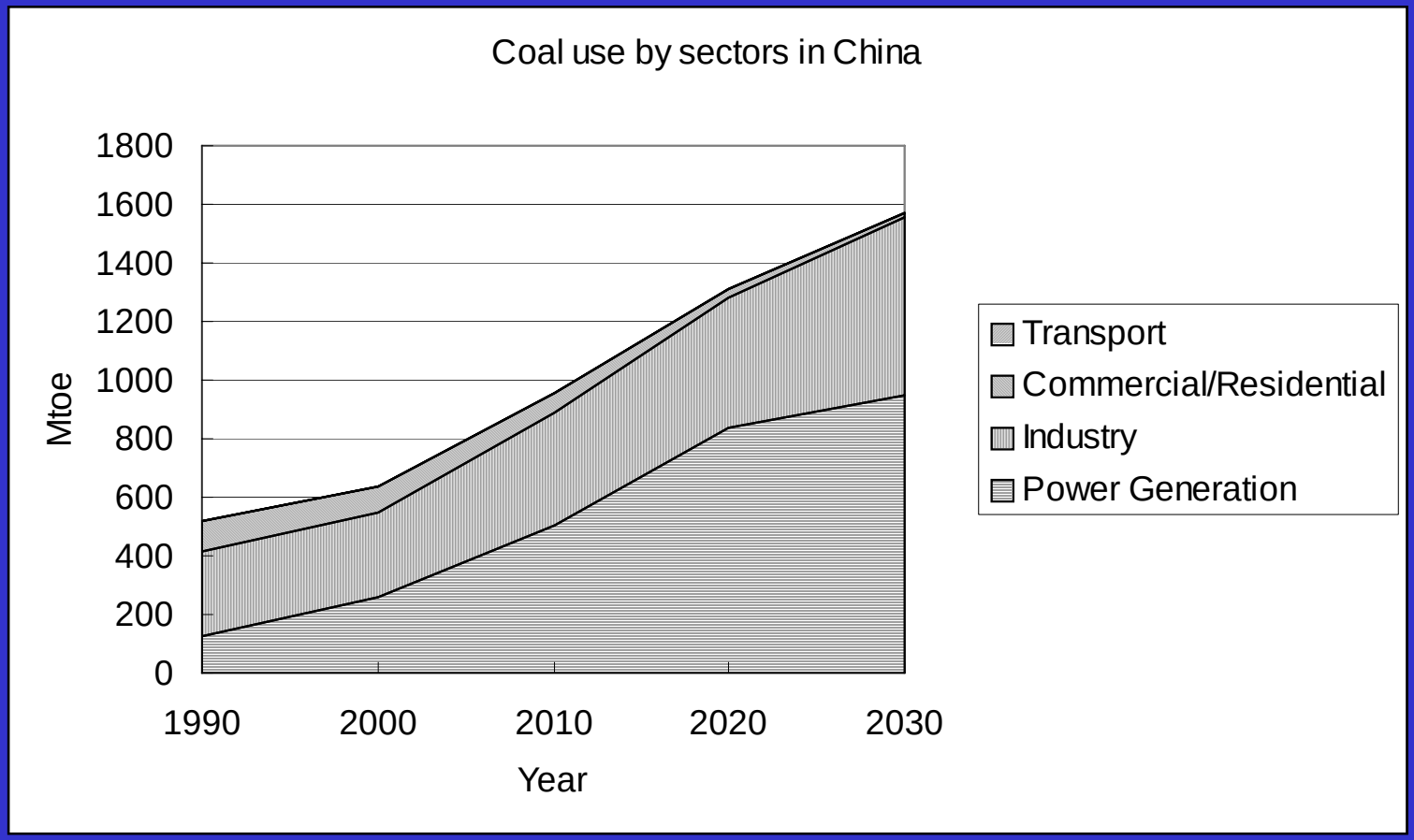


Cost Curve


不同技术选择成本（单位：10亿元）
4.80E+00
4.70E+00
4.60E+00
4.50E+00
4.40E+00
4.30E+00
4.20E+00
4.10E+00
4.00E+00
3.90E+00
3.80E+00
3.70E+00
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
BAU
Policy

Application of AIM/China in 2005-2006

- Energy and GHG Emission scenario up to 2030
- Urban Transport Development Study
- Energy Fiscal Policy Assessment
- Energy Five Year Plan for Hainan Province
- Beijing Energy and Environment Analysis
- ***Climate and Development: Clean Coal technology Assessment***
- Long-term Emission Scenarios up to 2050
- APEIS


Coal use by sectors in China
1800
1600
1400
1200
1000
800
600
400
200
0
Mtoe
1990
2000
2010
2020
2030
Year
Transport
Commercial/Residential
Industry
Power Generation

Clean coal technologies in baseline scenario

Sector	Technology	Share in 2030
Power generation	Super Critical	25%
	IGCC	4%
Industry/Boiler	Advanced boiler	45%
Industry/Kiln	Advanced kiln	38%
Coal processing	Coal liquefaction	2% of total coal
Desulfurazation in power plants		58% of total coal fired power plants

Clean coal technologies in Policy scenario

Sector/Process	Technology	Share in 2030
Power generation	Super Critical	25%
	IGCC	30%
Industry/Boiler	Advanced boiler	75%
Industry/Kiln	Advanced kiln	70%
Coal processing	Coal liquefaction	10% of total coal
Desulphurisation in power plants		80% of total coal fired power plants

Application of AIM/China in 2005-2006

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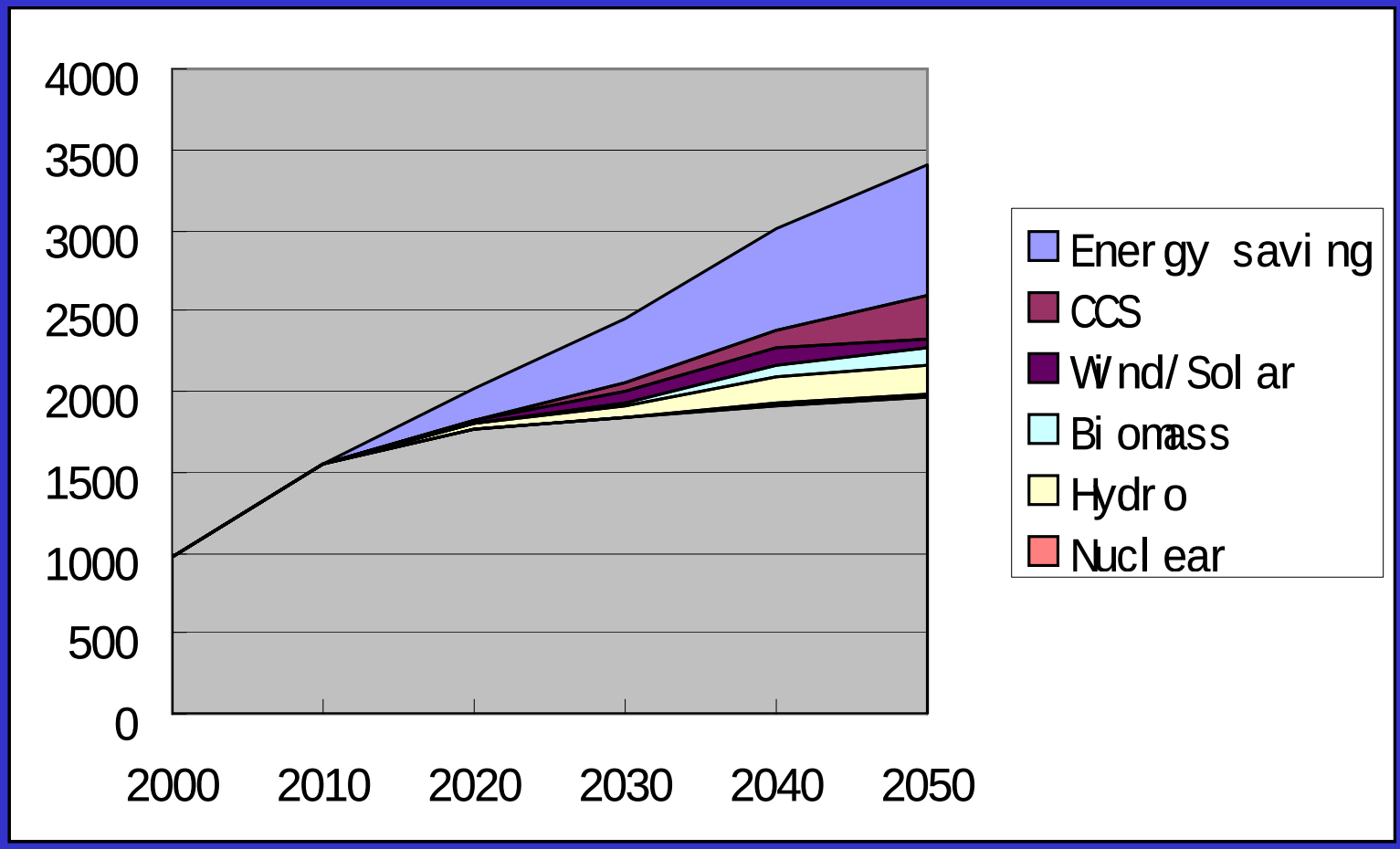
- APEIS(AIM team)

Scenario definition

Options	Sector/options	Baseline scenario	Policy and technology scenario
Enhanced Energy Saving	Energy Intensive Products	Annual average energy saving rate 2.7%	Annual average energy saving rate 3.6%
	Building	Annual average energy saving rate 1.9%	Annual average energy saving rate 3.0%
	Transport	Annual average energy saving rate 1.5%	Annual average energy saving rate 2.8%
Renewable energy	Biomass	Annual average reduction rate of cost by 3.7%	Annual average reduction rate of cost by 5.9%
	Hydro	65% of technical potential by 2050	80% of technical potential by 2050
	Solar/wind	0.7yuan/kWh by 2050	0.5Yuan/kWh by 2050
Carbon Capture and Sequestration	Coal fired power plants	4% by 2050	15% by 2050
	Industry	1% by 2050	5% by 2050
Clean coal technology	Power generation	7% by 2050	35% by 2050
	Industry	5% by 2050	15% by 2050
Hydrogen	Power generation	Distributed power generation system by 3% in 2050	Distributed power generation system by 8% in 2050
	Transport	Fuel cell vehicle 5%	Fuel cell vehicle 15%
Transport	Vehicle	Hybrid vehicle diffusion start from 2010, 10% by 2030	Hybrid vehicle diffusion start from 2010, 70% by 2040
Policies	Carbon tax	No	50yuan/t-C in 2010, 200yuan/t-C in 2050
	Subsidy	No	Power from renewable energy 0.4yuan/kWh
	Investment Energy technology R&D	Annual average growth rate 4%	Annual average growth rate 6.2%

CO_2 emission reduction contribution



Conclusion

- Energy Saving by technology progress and social efficiency improvement is key for future GHG emission reduction
- Technologies including modern renewable energy, advanced nuclear, clean coal+CCS should be emphasized for early R&D
- Fiscal energy policies including energy tax/carbon tax could be a good option

Next Step of IPAC-AIM/China

Energy and Emission Scenario for China
Using AIM/Country for China Energy Scenario Forum
Other pollutant: PM10, water pollution, land damage
Energy Strategy up to 2050
IPCC AR4
EMF-22
Energy regulation and financial measures
Energy planning for Guangdong and Hainan
Global Oil Market in 2030
Energy intensive material model

AIM/Local

Finished:

AIM/Local-Refinery

AIM/Local-Chemical(Ammonia and ethylene)

AIM/Local-Beijing

Under development:

AIM/Chongqing

AIM/Hainan

Inventory

BC:

- Emission factor
- Activities data
- Regional characteristics
- Modeling framework

OC: preliminary work