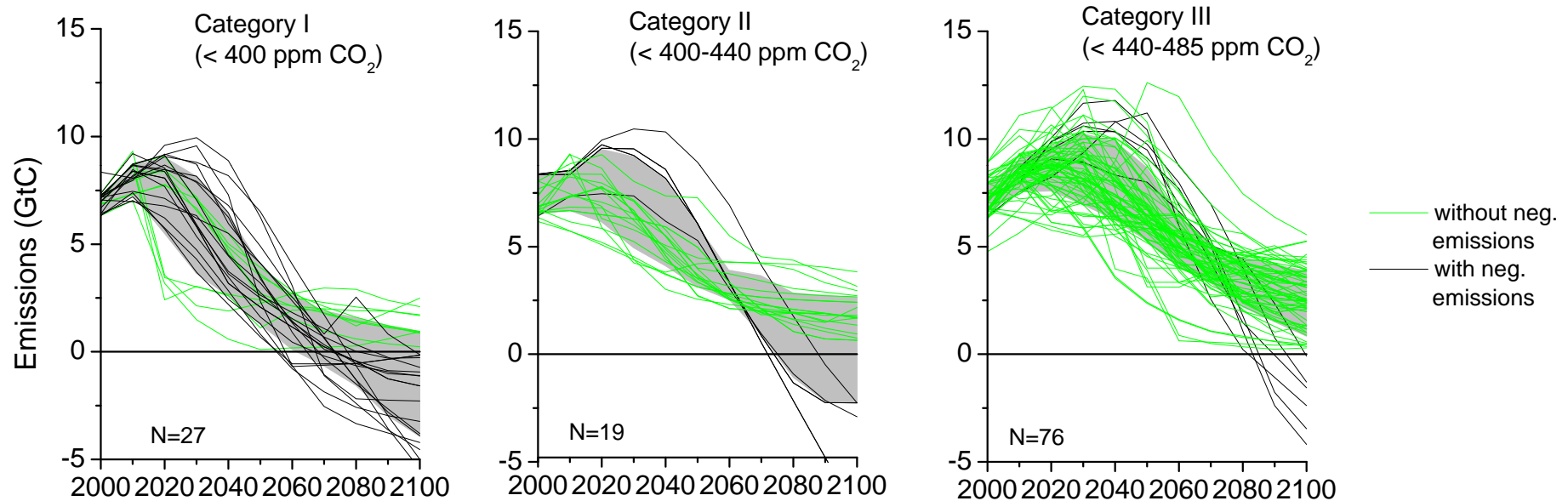


Merge Modelling Study and Policy Making Process

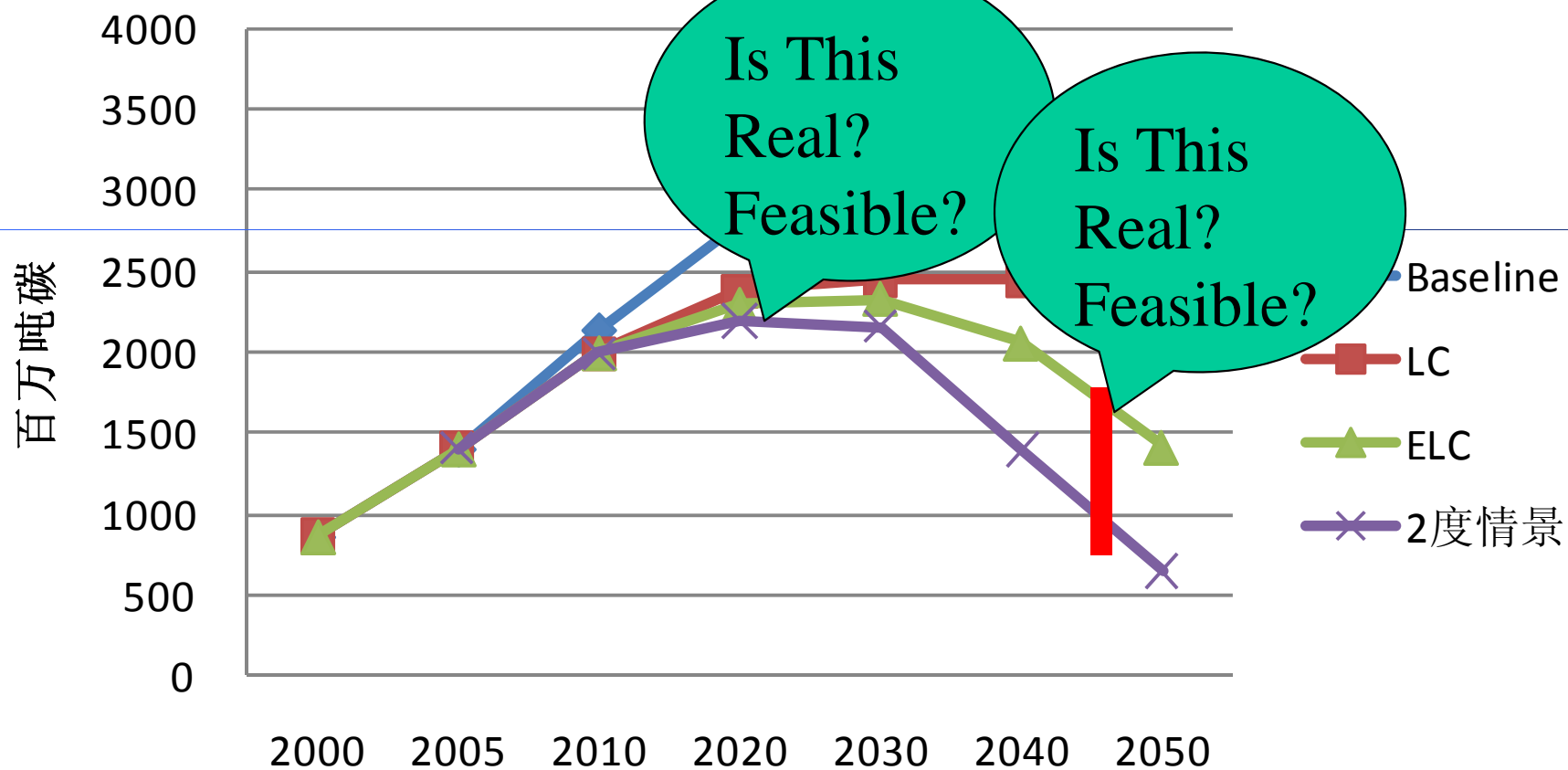
Kejun JIANG
Kjiang@eri.org.cn

Energy Research Institute, China

Keyword: Transition – mitigation to reach some climate change targets



CO2 排放量



Go much behind the pictures

Present in detail for key factors

Join modeling forums/workshops/projects

Make study on key factors: economy structure change, carbon pricing, roadmap for new technologies, CCS etc.

Make data transparency

Publication/public available

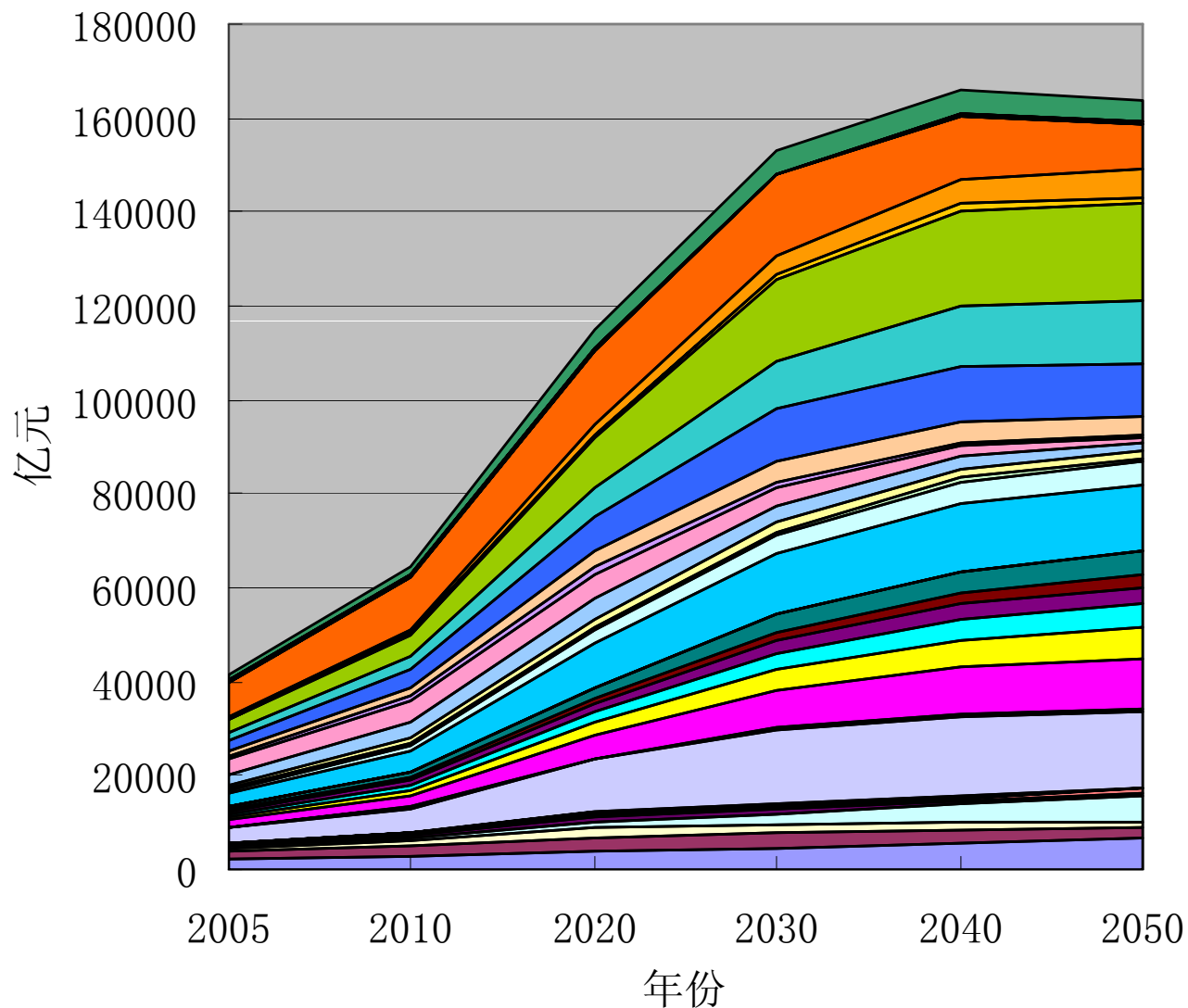
Keep a good modeling research team for long time

What's the future of China's low carbon policy: key factors

- Economic structure optimization policies
- Energy efficiency policies
- Renewable energy/nuclear power generation oriented policies
- CCS
- Low carbon consumption/ lifestyle
- Land use emission reduction policies: so far relatively poor
- Climate change target: China is key part of that
- Can we pay for it? Cost and benefit

Investment by industrial sectors

工业分部门投资



- 建筑业
- 自来水的生产和供应业
- 煤气的生产和供应业
- 蒸汽热水生产供应业
- 电力生产供应业
- 其他工业
- 仪器仪表文化办公用机械
- 电气机械及器材、电子及通信设备制造业
- 交通运输设备制造业
- 普通机械、专用设备制造业
- 金属制品业
- 有色金属
- 黑色金属冶炼及压延加工业
- 非金属矿物制品业
- 橡胶制品业, 塑料制品业
- 化学纤维制造业
- 医药制造业
- 化学原料及制品制造业
- 炼焦业
- 石油加工
- 印刷业记录媒介的复制, 文教体育用品制造业
- 造纸及纸制品业
- 木材加工及竹藤棕草制品业、家具制造业
- 服装皮革及其他纤维制品制造
- 纺织业
- 烟草加工业
- 食品饮料加工、制造业
- 非金属矿采选业, 其他矿采选业, 木材及竹材采运业
- 有色金属矿采选业
- 黑色金属矿采选业
- 天然气开采业
- 石油

Products output in major sectors, Low Carbon and ELC

	Unit	2005	2020	2030	2040	2050
Steel	Million ton	355	610	570	440	360
Cement	Million ton	1060	1600	1600	1200	900
Glass	Million cases	399	650	690	670	580
Copper	Million ton	2.6	7	7	6.5	4.6
Ammonia	Million ton	8.51	16	16	15	12
Ethylene	Million ton	5.1	7.2	7	6.5	5.5
Soda Ash	Million ton	14.67	23	24.5	23.5	22
Casutic	Million ton	12.64	24	25	25	24
Paper	Million ton	62.05	110	115	120	120
Fertilize	Million ton	52.2	61	61	61	61
Aluminum	Million ton	7.56	34	36	36	33
Paper	Million ton	46.3	50	50	50	45
Calcium c	Million ton	8.5	10	8	7	4

Unit energy use for key products, LCS Scenario

	Unit	2005	2020	2030	2040	2050
Steel	Kgce/t	760	650	564	554	545
Cement	Kgce/t	132	101	86	81	77
Glass	Kgce/Weight Cases	24	18	14.5	13.8	13.1
Brick	Kgce/万块	685	466	433	421	408
Ammonia	Kgce/t	1645	1328	1189	1141	1096
Ethylene	Kgce/t	1092	796	713	693	672
Soda Ash	Kgce/t	340	310	290	284	279
Casutic	Kgce/t	1410	990	890	868	851
Calcium carbide	Kgce/t	1482	1304	1215	1201	1193
Copper	Kgce/t	1273	1063	931	877	827
Aluminum	kWh/t	14320	12870	12170	11923	11877
Paper	Kgce/t	1047	840	761	721	686
Electricity fossil fuel	Gce/kWh	350	305	287	274	264

2050年的低碳住宅 舒适和节能

太阳能利用

光伏电池

(25-47% 的家庭拥有屋顶光伏电池，
转换效率接近30%)

生态生活教育

减少10-20% 能源需求

太阳热利用

普及率: 20-60%
(目前 6%)

能源检测系统
(家用电器)

超高效空调

COP = 8,
普及率 100%

待机电源耗电

降低1/3，
普及率100%

屋顶植被

高效照明
【如 LED照明】

减少50%照明需求，
普及率 100%

高效绝热

减少 60% 采暖需求，
普及率70%

燃料电池

普及率 0-20%

热泵采暖

COP=5
普及率 30-70%

向公众提供经济和环境
信息促使大家成为
低碳消费

高效家用电器

减少能源需求，支持舒适和安全生活方式

Transport, Low carbon scenario

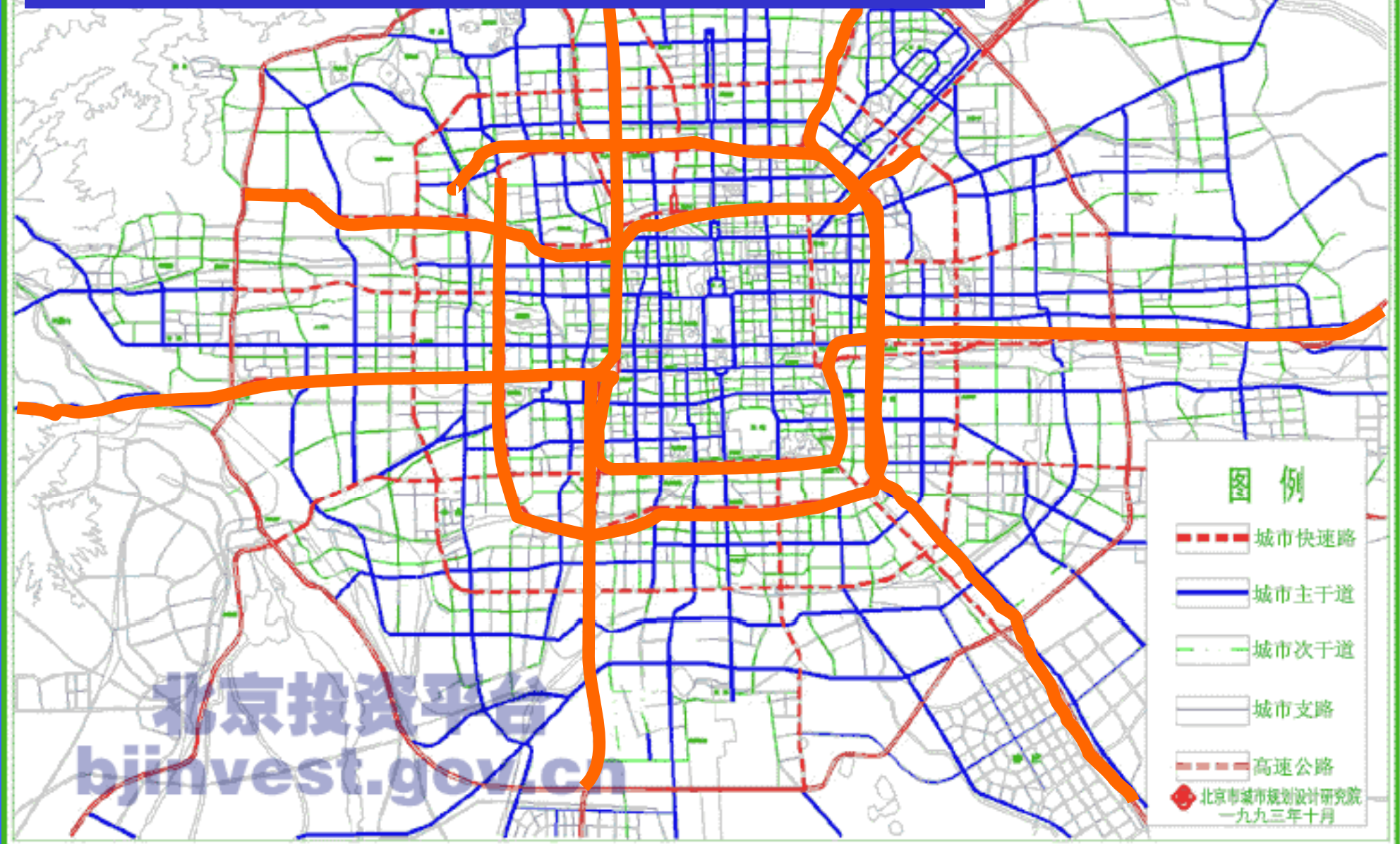
		2005	2010	2020	2030	2040	2050
Family car ownership, per 100HH	Urban	3.37	14	36	65	77	78
	Rural	0.08	0.2	8	38	70	90
Family car annual travel distance, km		9500	9500	9300	8635	8300	7480
Average engine size of family cars, liter		1.7	1.6	1.6	1.6	1.5	1.4
Fuel efficiency of car, L/100km		9.2	8.9	7.1	5.9	4.8	4.1
Share of MRT in total traffic volume, %		0.011	0.016	0.025	0.046	0.1	0.21
Share of Biofuel, %		1.10%	1.30%	4.1%	7.70%	12%	13%
Share of electric car, %		0%	0.12%	3.2%	6.80%	12.5%	19.8%
Share of fuel cell car, %		0%	0%	0.80%	1.60%	4.70%	7.90%

Stockholm: bicycle is coming back



北京市区道路网规划方案

Rapid bus: using existing rapid road







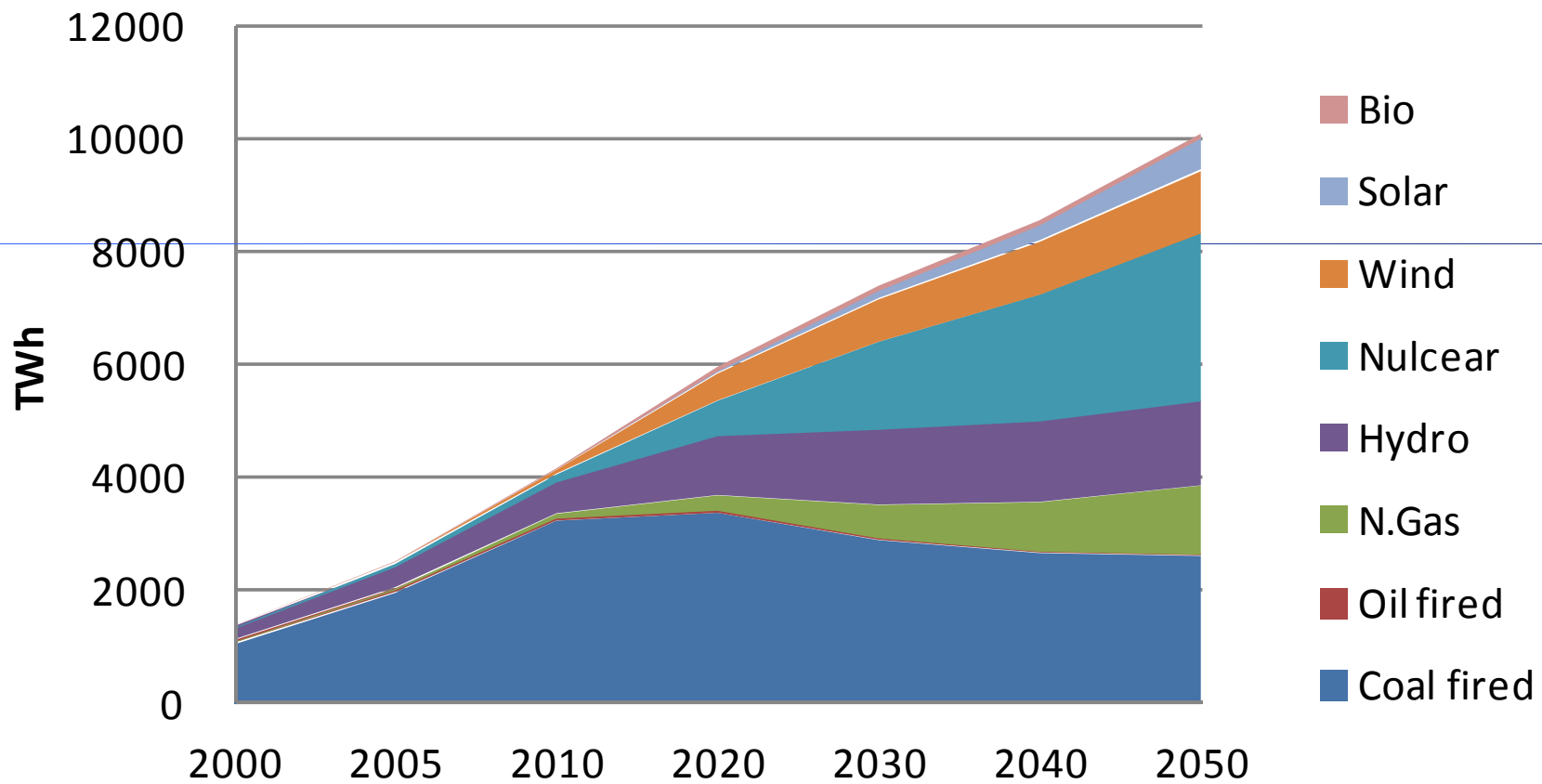
POWER_BOX by Baosteel

2kW wind

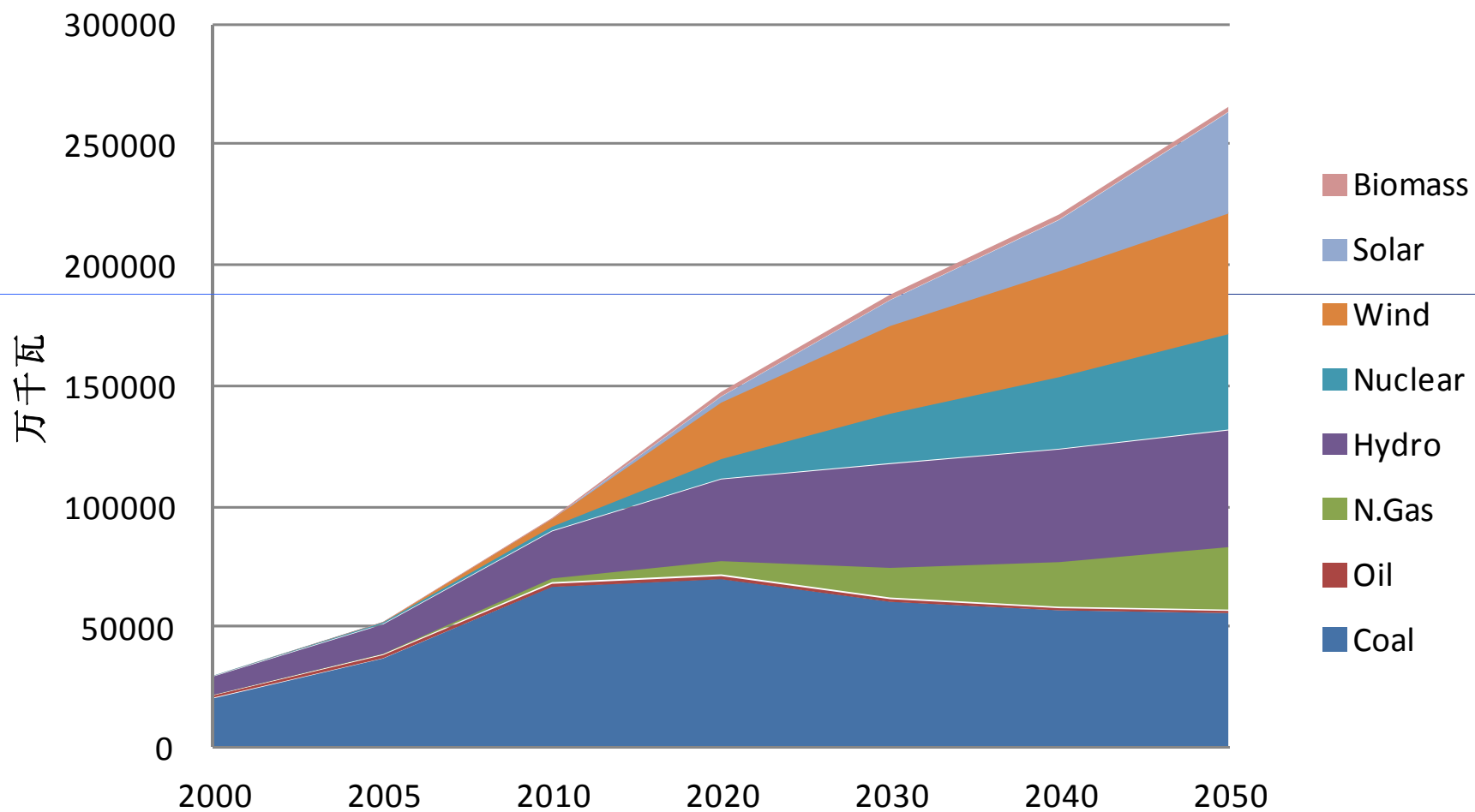
10kW Solar PV



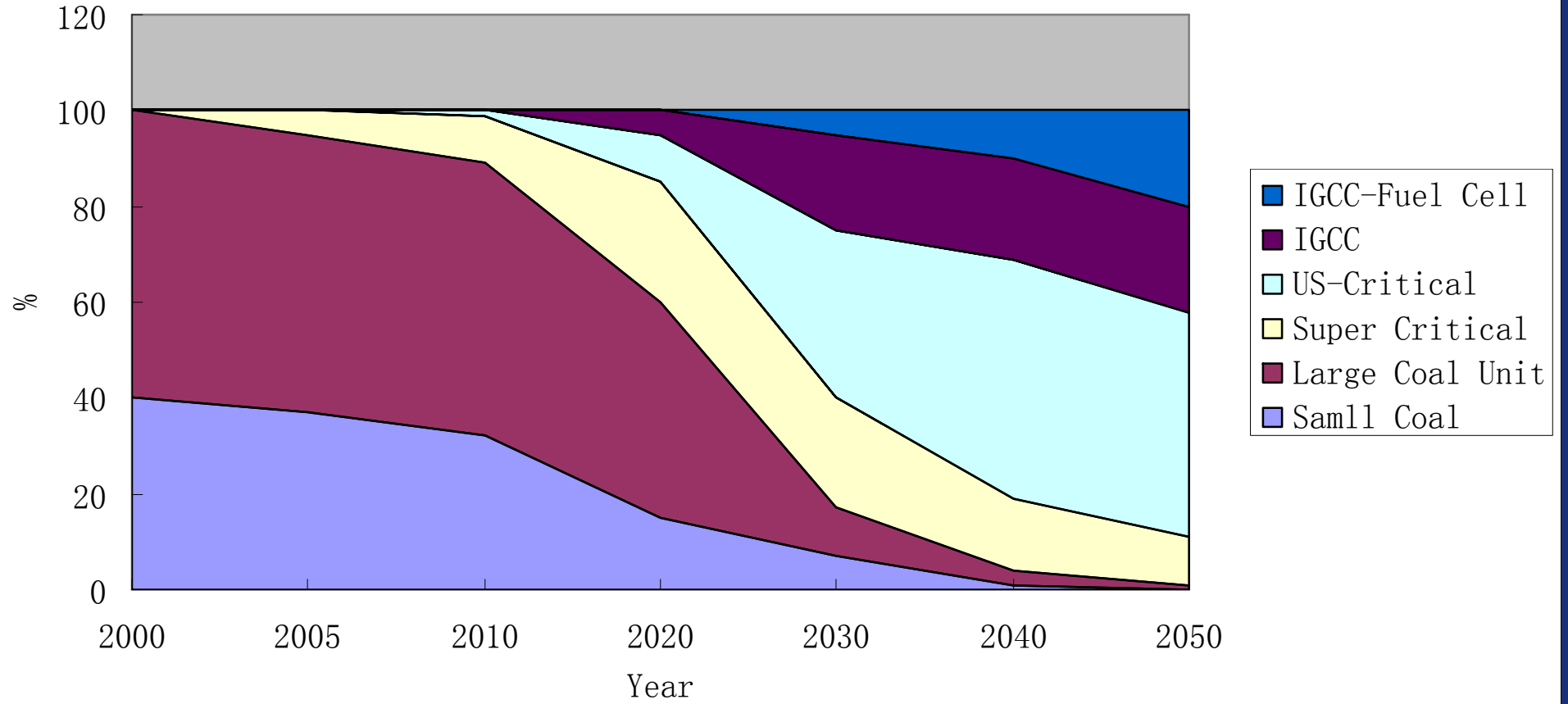
Power Generation



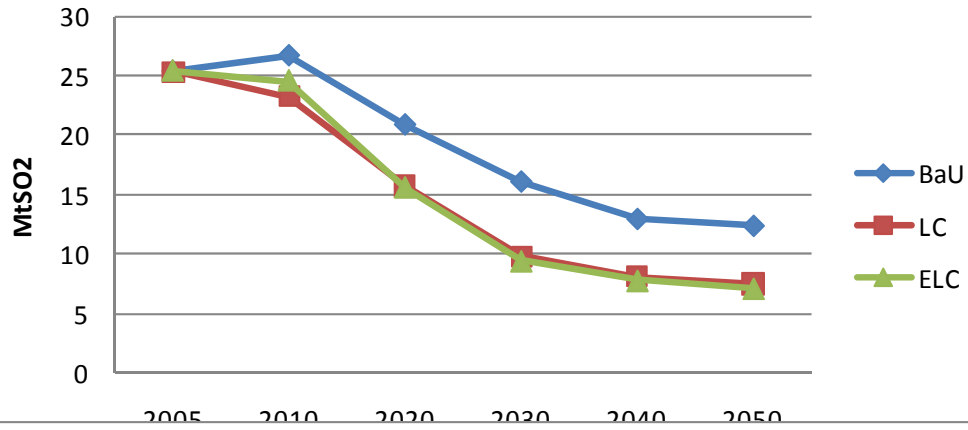
Power Generation Capacity



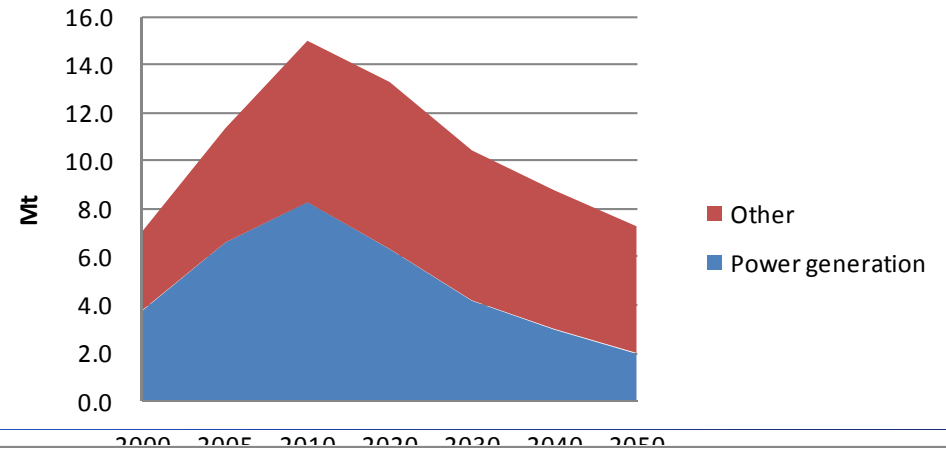
CCS future



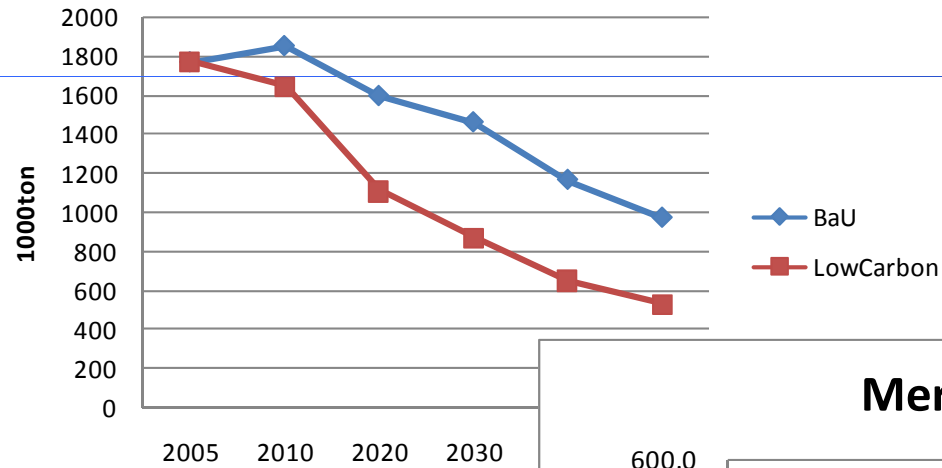
SO2 Emission



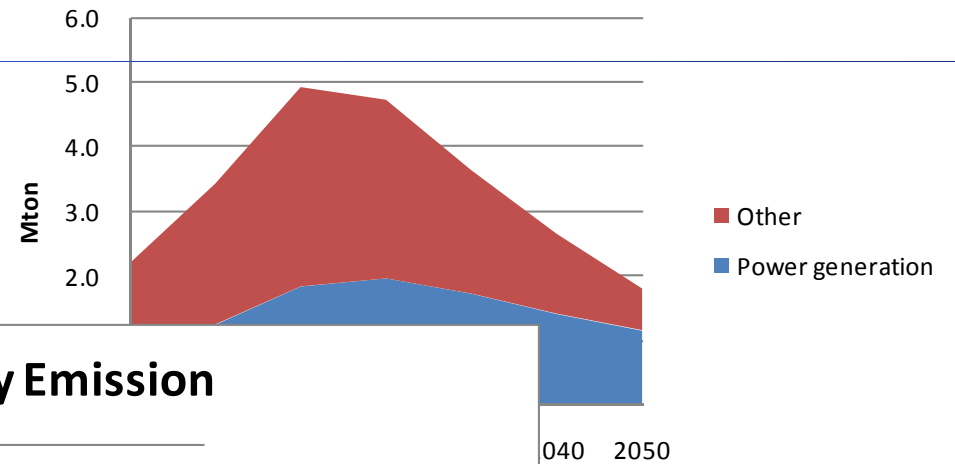
NOx Emission in China, ELC scenario



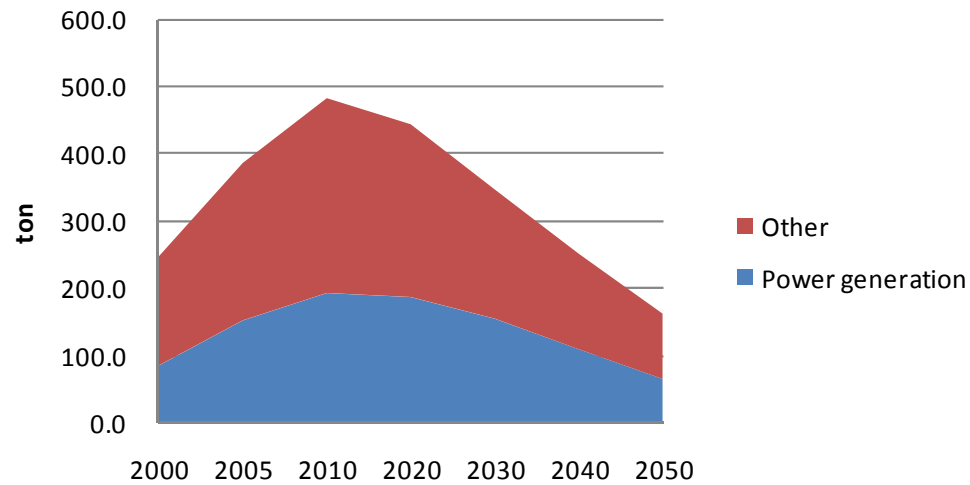
Black Carbon Emission in China



PM2.5 Emission



Mercury Emission



A Snapshot of Selected China Energy Options Today: Climate and Energy Security Impacts and Tradeoffs in 2025

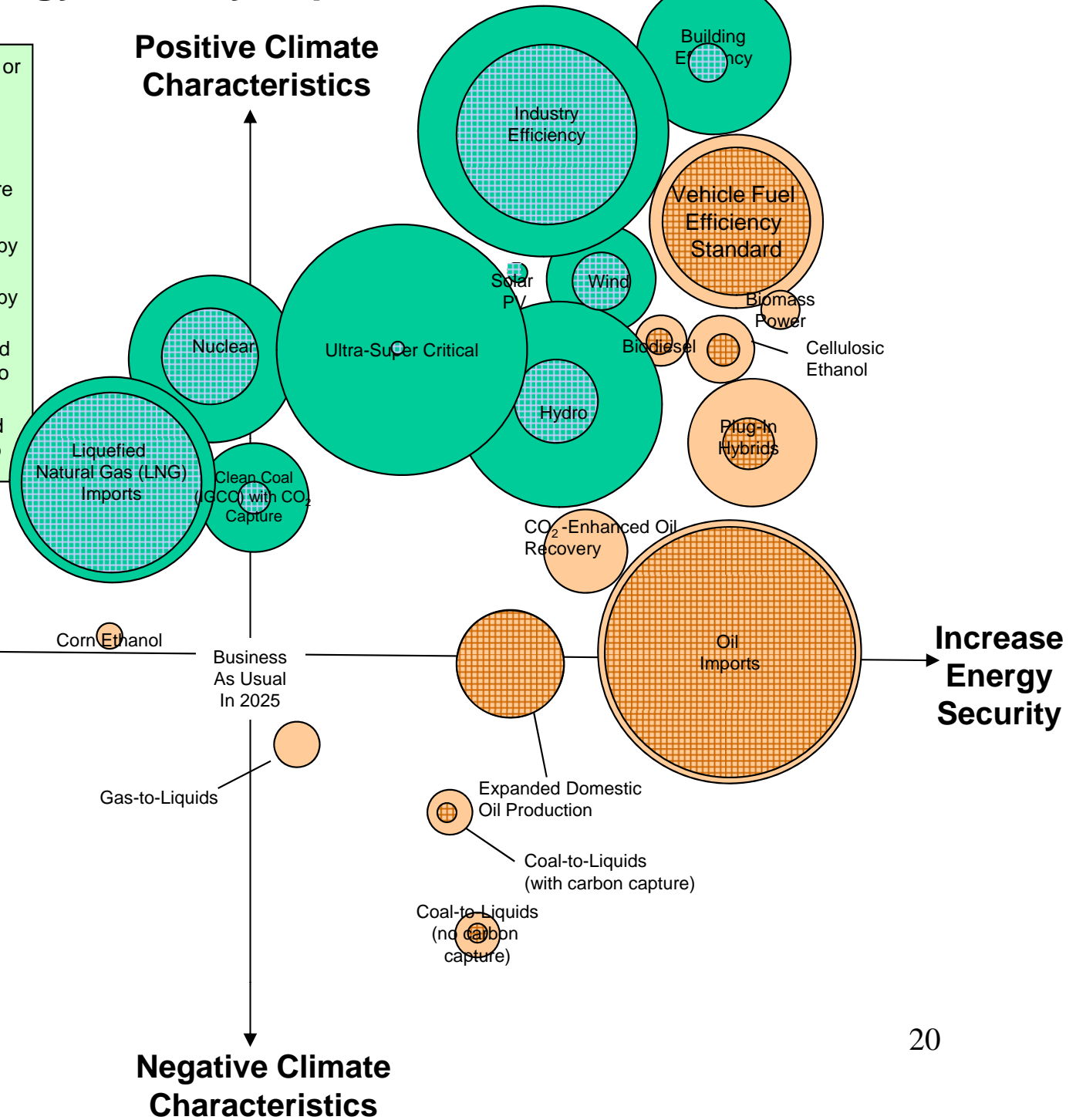
Bubble size corresponds to incremental energy provided or avoided in 2025. The reference point is the "business as usual" mix in 2025. The horizontal axis includes sustainability as well as traditional aspects of sufficiency, reliability, and affordability. The vertical axis illustrates lifecycle greenhouse gas intensity. Bubble placements are based on quantitative analysis and ERI expert judgment.

- Power Sector (this size corresponds to 40 billion kWh) by comparing low energy scenario and BaU
- Power Sector (this size corresponds to 40 billion kWh) by comparing low energy scenario and policy BaU
- Transport Sector (this size corresponds to 200 thousand barrels of oil per day) by comparing low energy scenario and BaU
- Transport Sector (this size corresponds to 200 thousand barrels of oil per day) by comparing policy BaU scenario and BaU

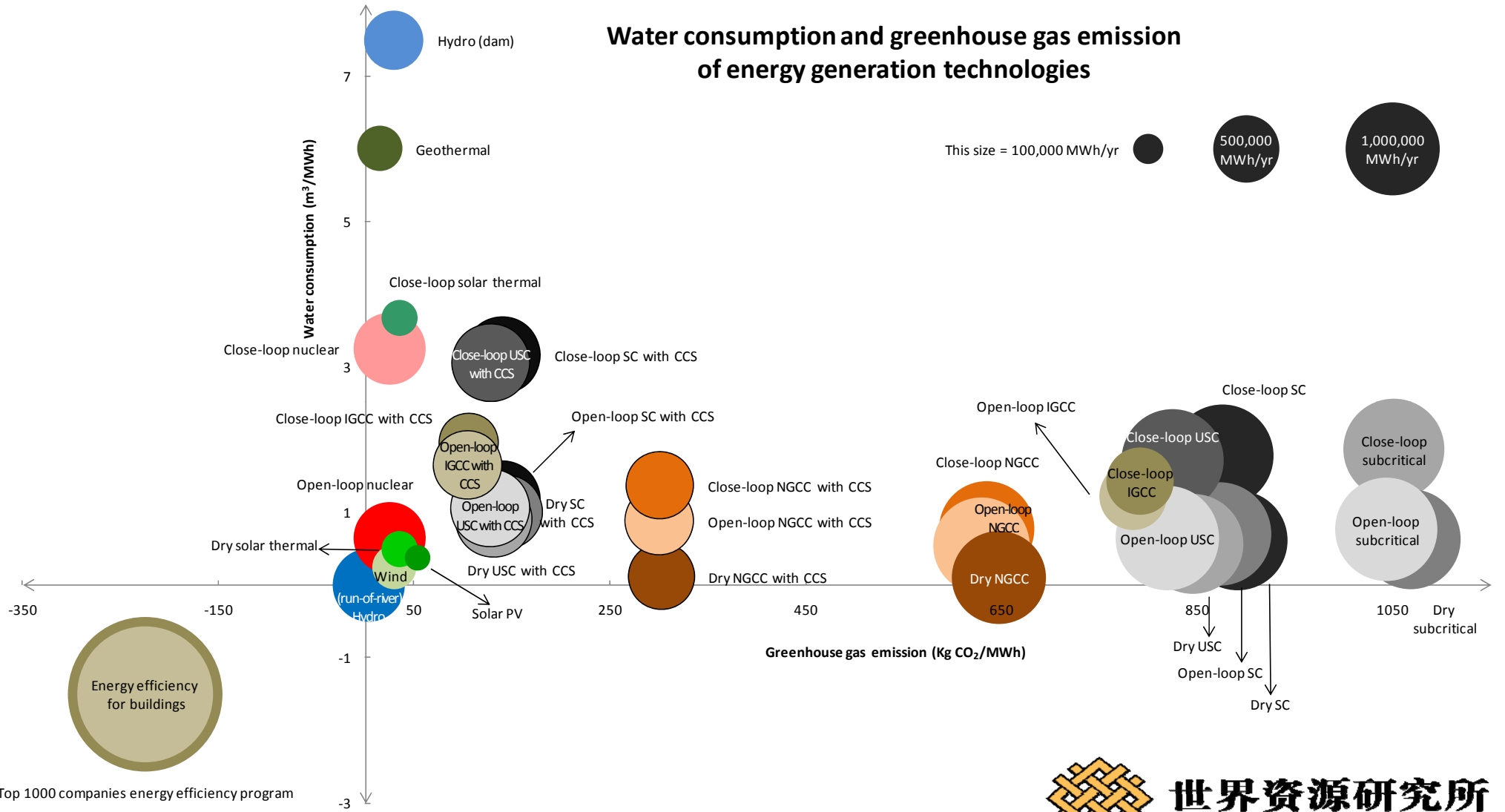
Reduce Energy Security

For specific details on the assumptions underlying the options on this chart, go to www.wri.org/usenergyoptions

Revised 7/10/2008



Water consumption and greenhouse gas emission of energy generation technologies



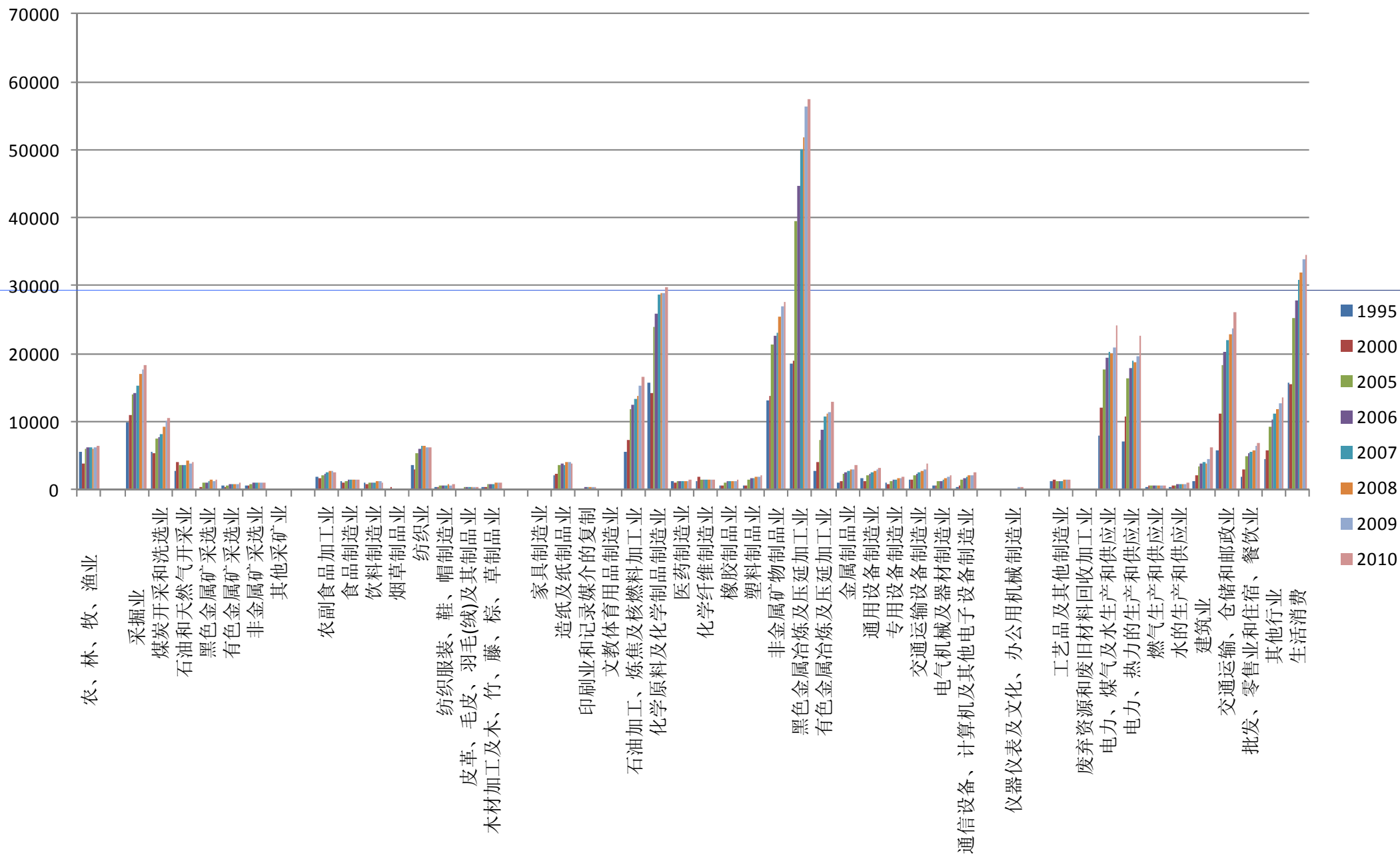
28 key technologies in the enhanced low carbon scenario in China

No.	Sector	Technology	Description	Note
1	Industry technology	High efficiency energy equipment	High efficiency furnace, kiln, waste heat recovery system, high efficiency process technologies, advanced electric motor	Nearly in market
2		New manufacture process technology for cement and steel		
3		CCS	In cement, steel making, refinery, ethylene manufacture	
4	Transport	Super high efficiency diesel vehicle	Advanced diesel hybrid engine	
5		Electric car		
6		Fuel cell car		
7		High efficiency aircraft	30% higher energy efficiency	
8		Bio-fuel aircraft		
9	Building	Super high efficiency air-conditioner	With COP>7	
10		LED lighting		
11		In house renewable energy system	Solar PV/Wind/Solar hot water and space heating	
12		Heat pumps		Mature
13		High isolation building		Mature
14		High efficiency electric appliance		Mature before 2030
15	Power generation	IGCC/Poly-Generation	With efficiency above 55%	
16		IGCC/Fuel cell	With efficiency above 60%	
17		On shore Wind		Mature
18		Off shore wind		Mature before 2020
19		Solar PV		
20		Solar Thermal		
21		4 th Generation Nuclear		
22		Advanced NGCC	With efficiency above 65%	
23		Biomass IGCC		
24		CCS in power generation		
25	Alternative fuels	Second generation bio-ethanol		
26		Bio-diesel	Vehicles, ships, vessels	
27	Grid	Smart grid		
28	Circulating technologies	Recycle, reuse, reducing material use		

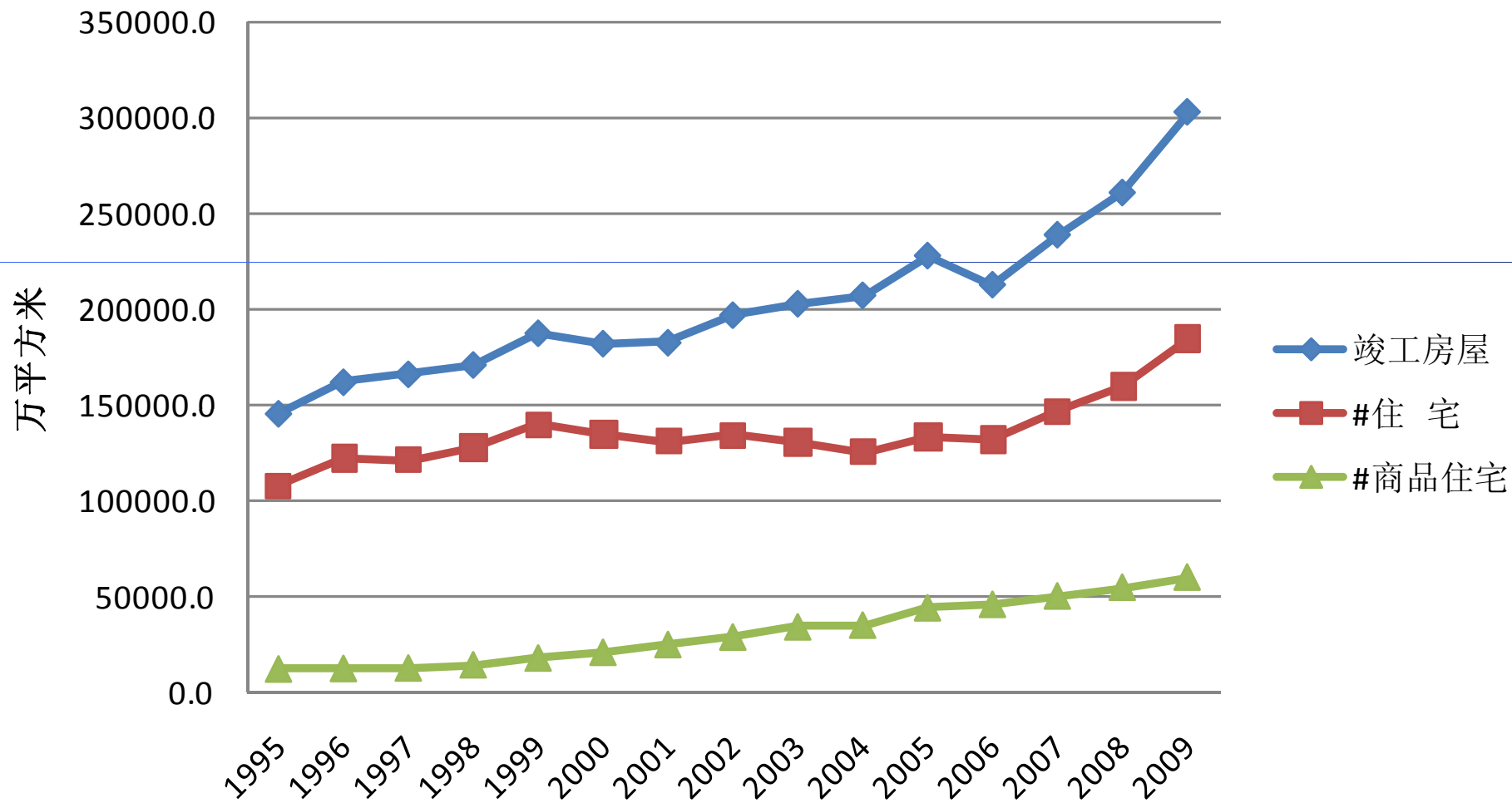
Can we do it: Peak before 2025?

- Economic structure will change soon, pushing by policy or wait until market decide(this will cause big problem for low capacity utilization)
- Technology is ready
- Economic ability is getting much stronger to pay for low carbon development
- Global target need us move faster
- Low carbon development is getting to be a main stream in China

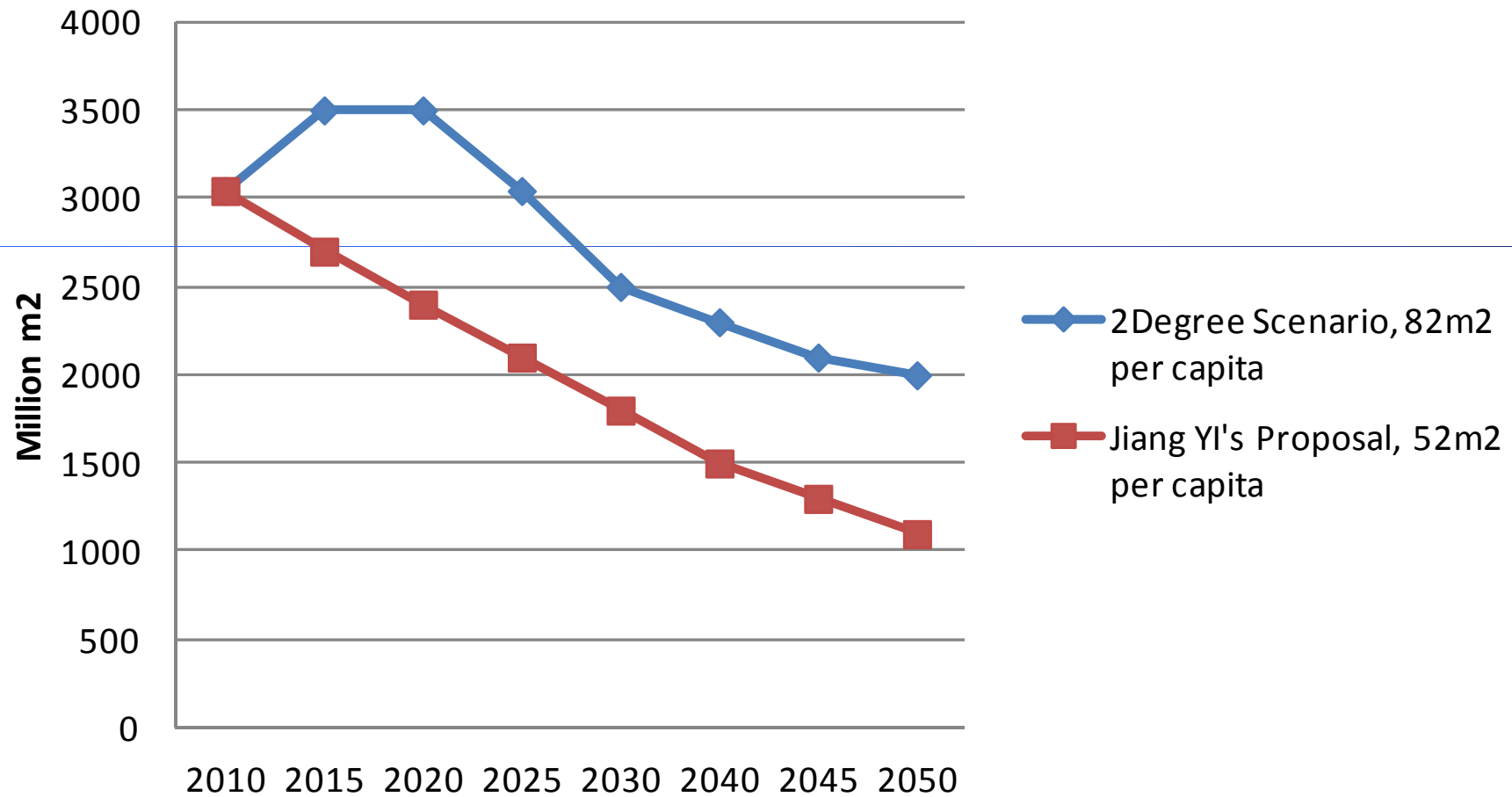
分部门能源消费量, Energy demand by sector, 1995-2010



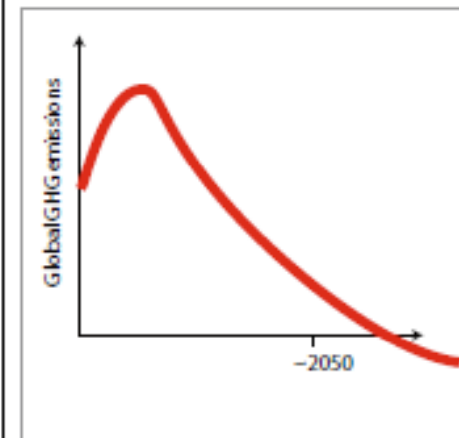
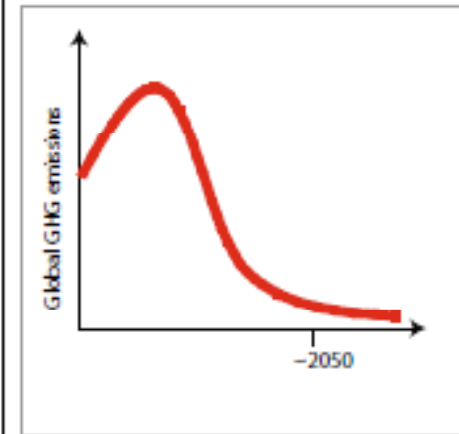
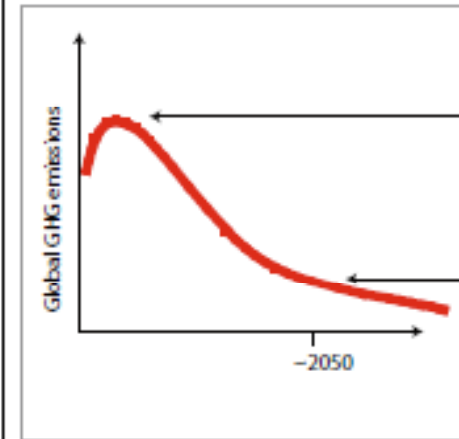
竣工房屋建筑面积



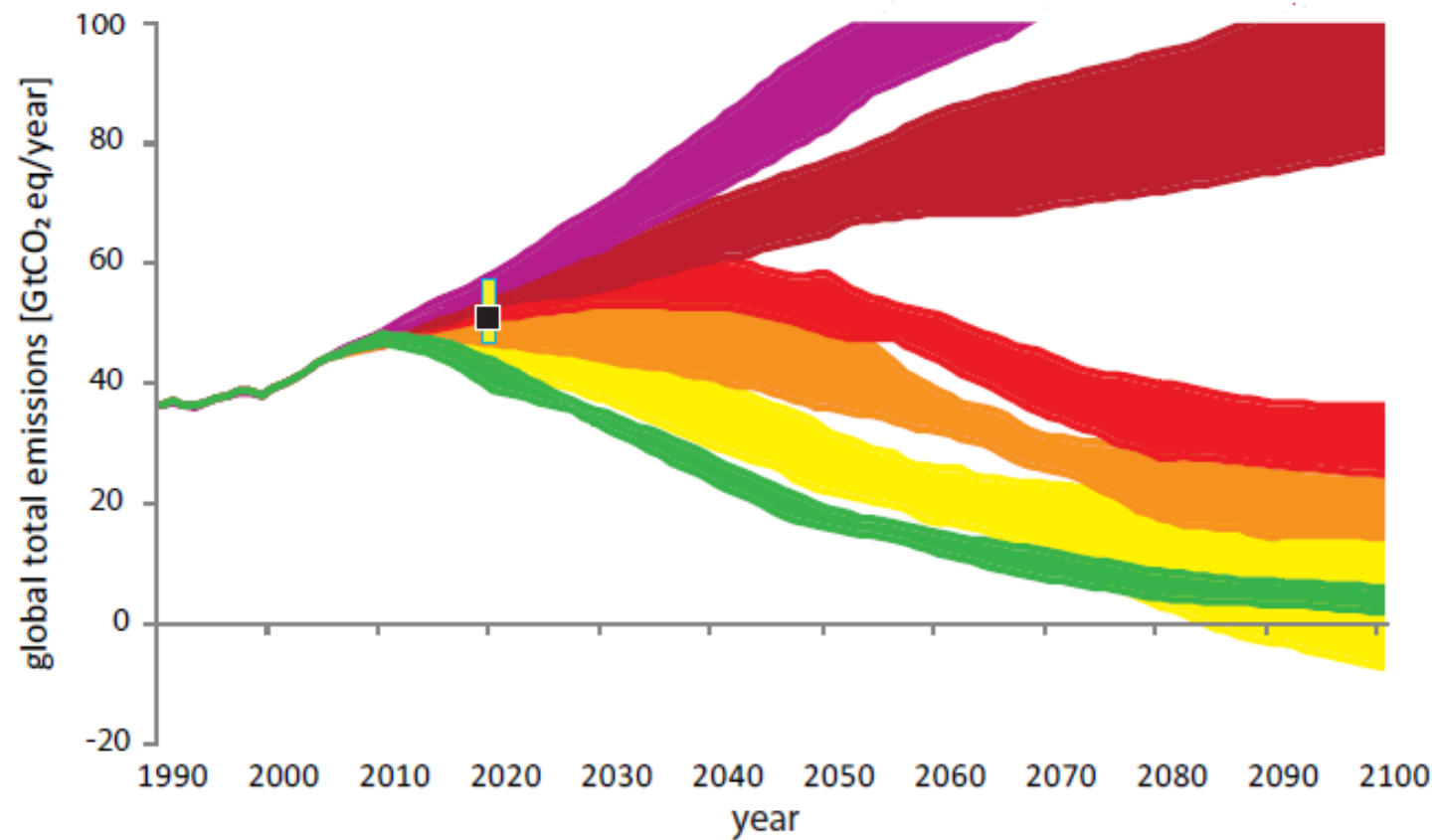
Floor Space of Building Completed



Global Emission: 2 degree



Likely avoided temperature increase of IAM scenarios.
Bar superimposed in 2020 shows expected emissions from the pledges.

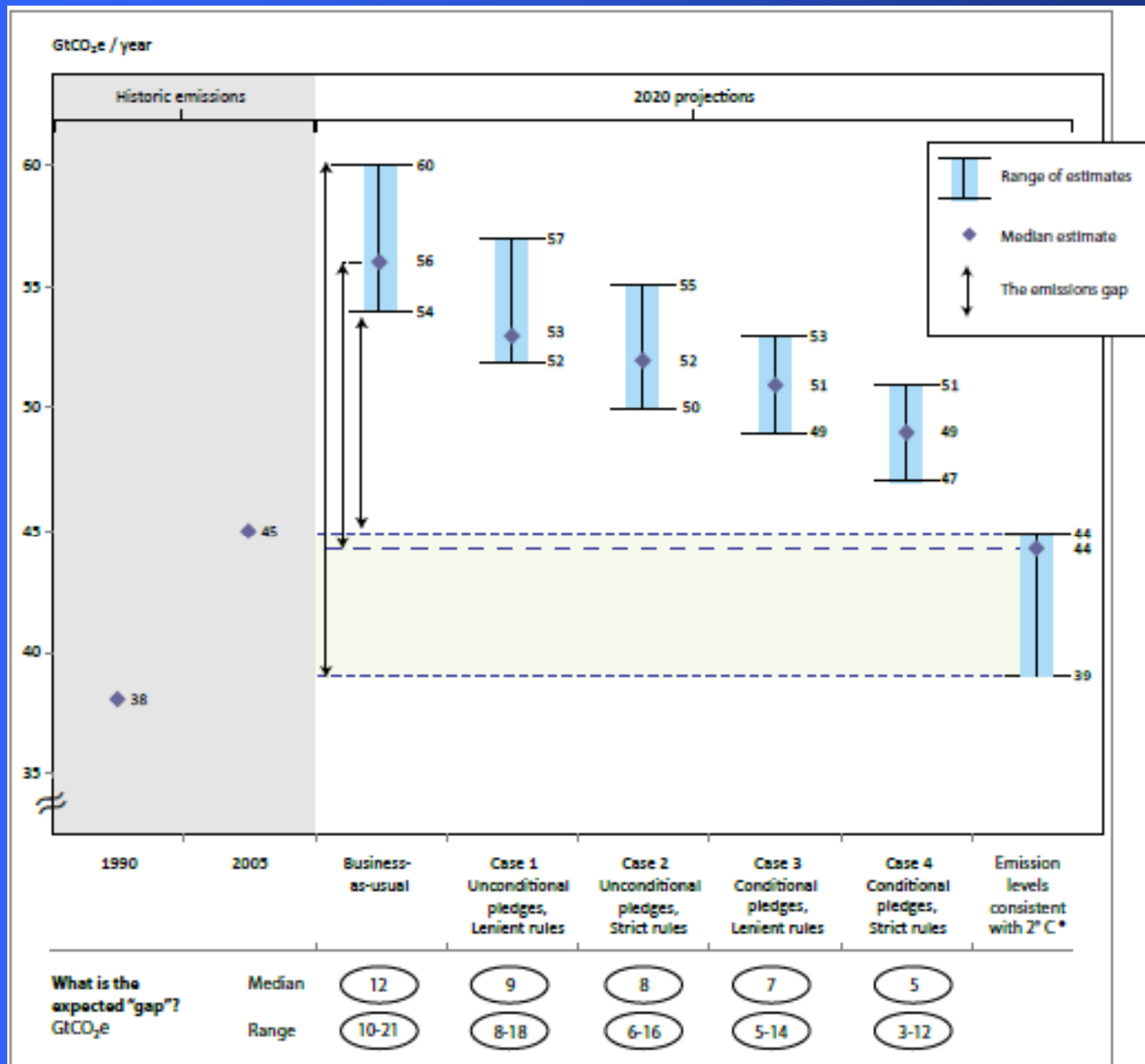


Legend:

Emission levels consistent with a likely temperature increase (T) in the 21st century of:

- T > 5°C
 - 4°C < T < 5°C
 - 3°C < T < 4°C
 - 2.5°C < T < 3°C
 - 2°C < T < 2.5°C
 - T < 2°C
- range of pledge cases
median range of pledge cases

Copenhagen Commitment: the GAP



* A "likely" chance of limiting warming to 2° C by 2100

Several Key research projects on global modeling

EMF24: Technology Strategies for Achieving Climate Policy Objectives

AME: Asia Modeling Excise

RoSE: Roadmaps towards Sustainable Energy Futures. A Model-Based Assessment of Scenarios For Decarbonising the Energy System in the 21st Century

AMPERE: Assessment of Climate Change Mitigation Pathways and Evaluation of the Robustness of Mitigation Cost Estimates

LIMITS: Low climate IMpact scenarios and the Implications of required Tight emission control Strategies

SSP : Shared Social-Economic Pathway

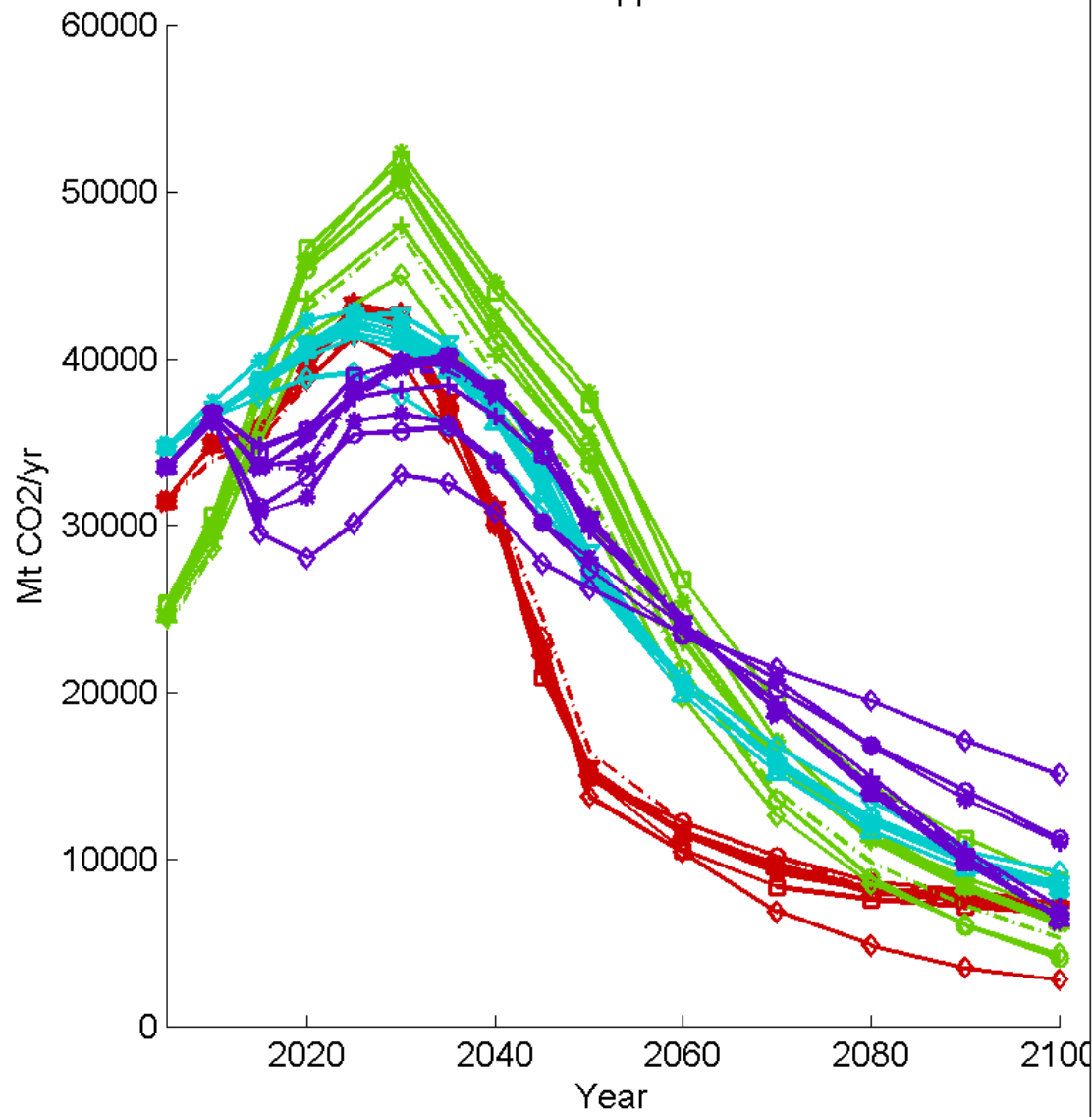
Domestic studies

- Technology roadmap up to 2050
- Policy roadmap for deep cut in 2050
- Low carbon development for cities and provinces (more than 10 cities and provinces)
- Emission trading for China
- Regional impact of carbon pricing in China
- CCS pilot project for Gaojing Power Plant
- Cost and benefit analysis
- Technology solution
- 2 degree scenario for China
- Global mitigation potential study: regions scenarios, US, EU, Japan



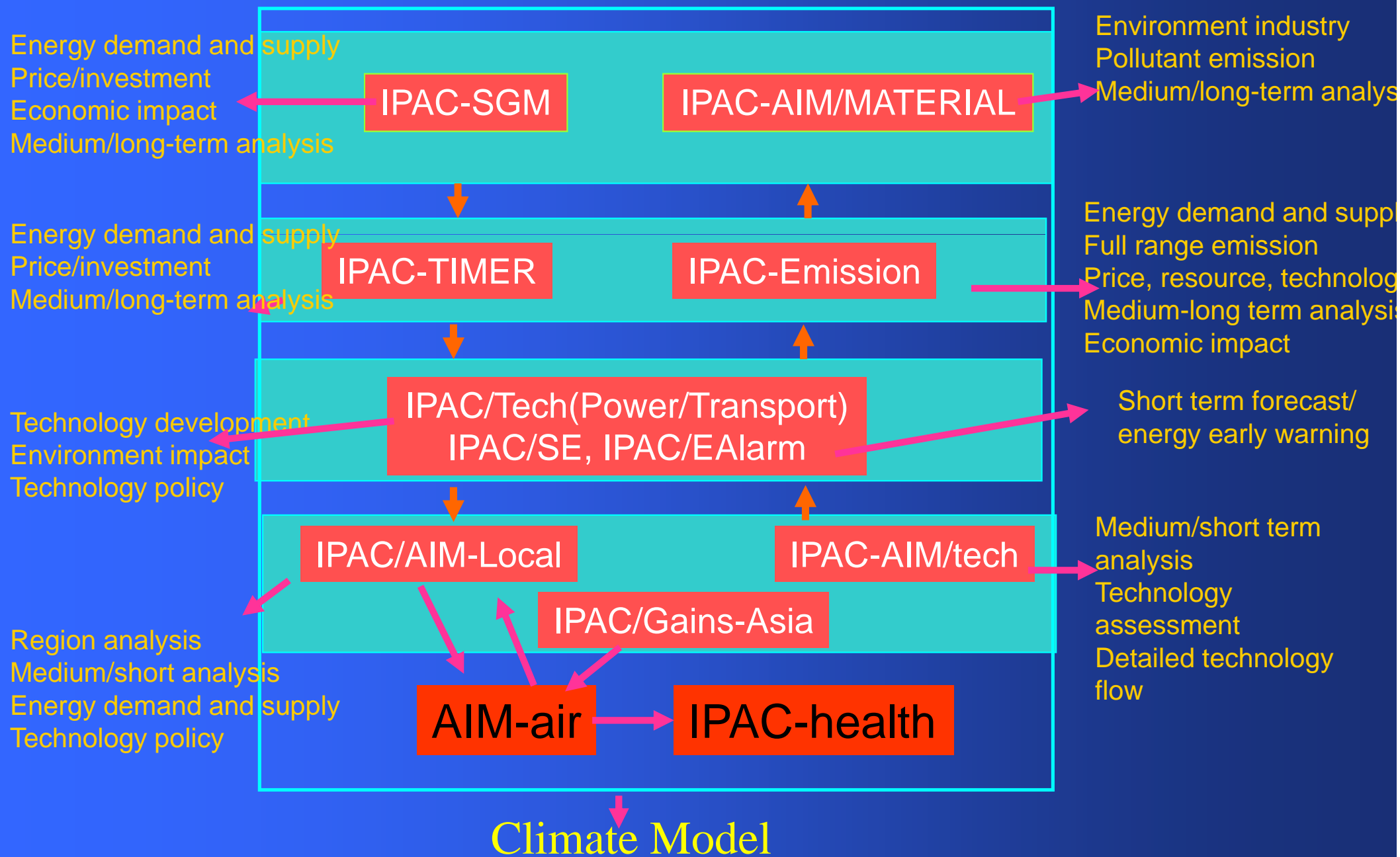
**IAMC Meeting
Tsukuba, Japan
15 – 16 September 2009**

EmiCO2 550ppm World

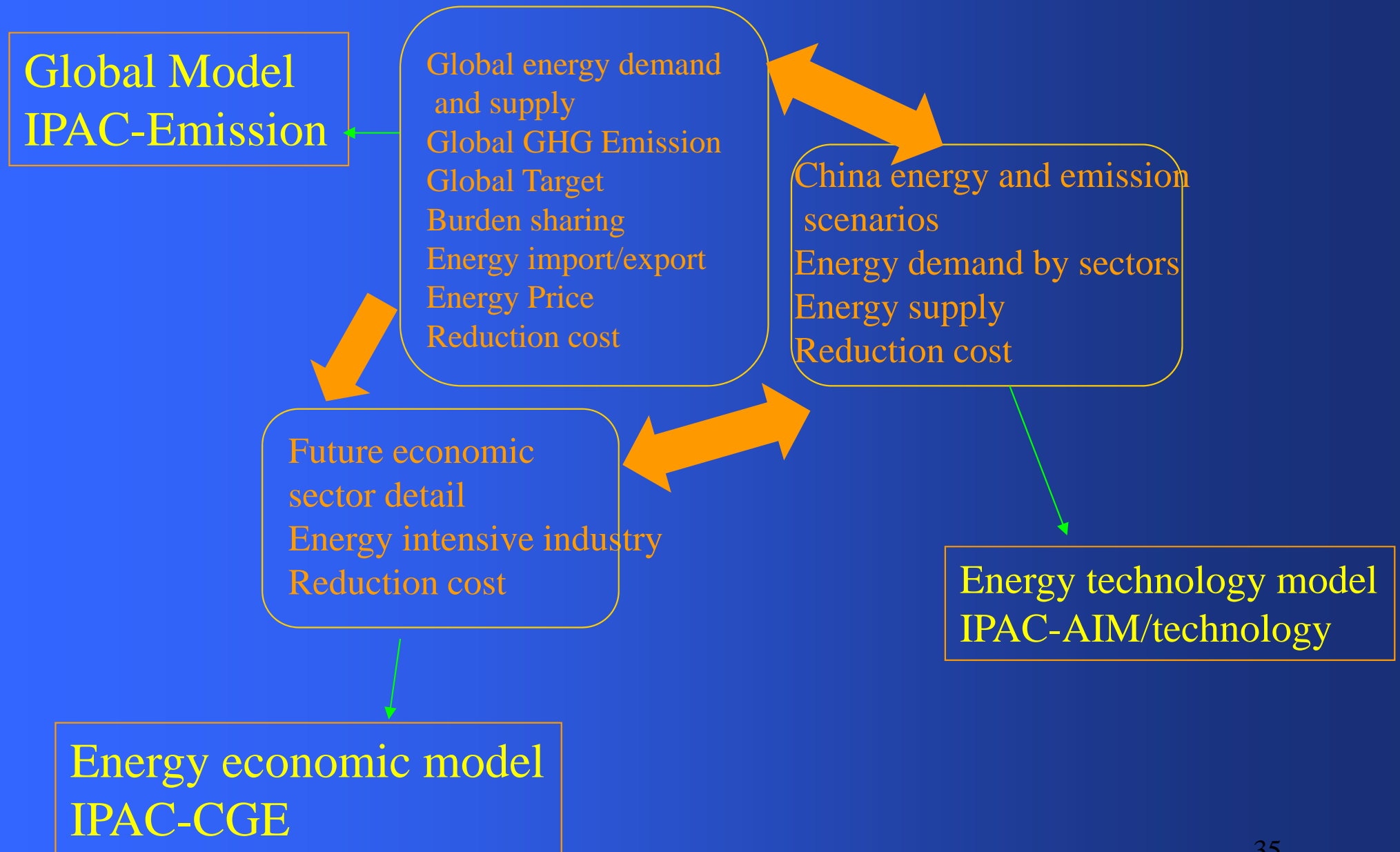


- GCAM 371
- GCAM 381
- GCAM 391
- GCAM 3C1
- IPAC 311
- IPAC 321
- IPAC 331
- IPAC 341
- IPAC 351
- IPAC 361
- IPAC 371
- IPAC 381
- IPAC 391
- REMIND 311
- REMIND 321
- REMIND 331
- REMIND 341
- REMIND 351
- REMIND 361
- REMIND 381
- REMIND 391
- REMIND 3C1
- WITCH 311
- WITCH 321
- WITCH 331
- WITCH 341
- WITCH 351
- WITCH 361

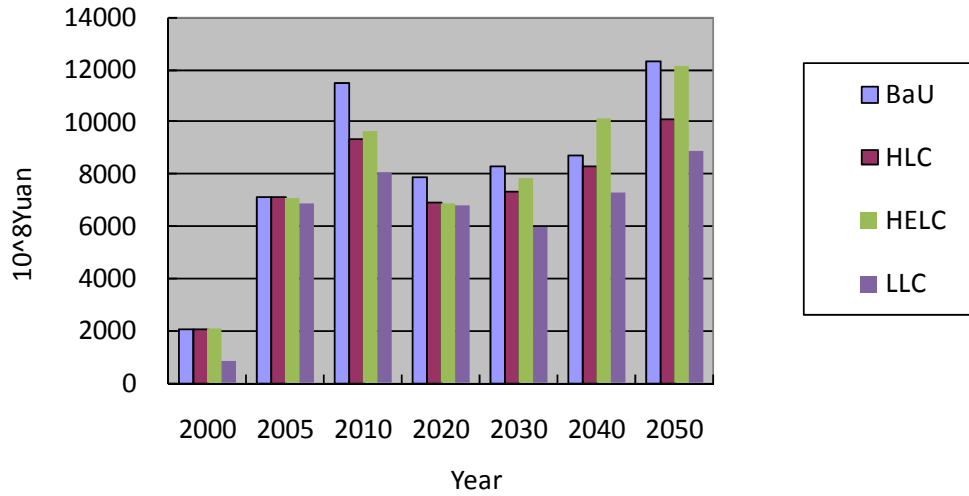
Framework of Integrated Policy Model for China (IPAC)



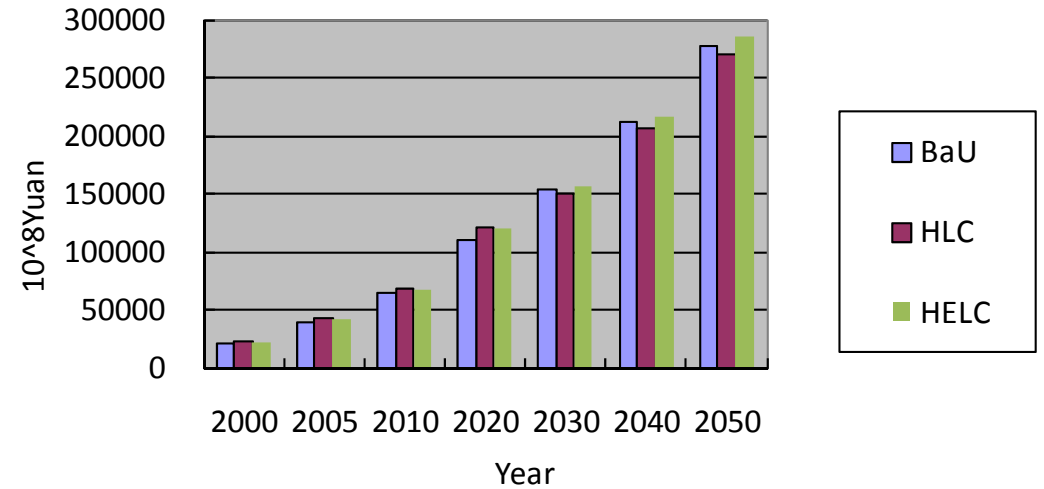
Methodology framework



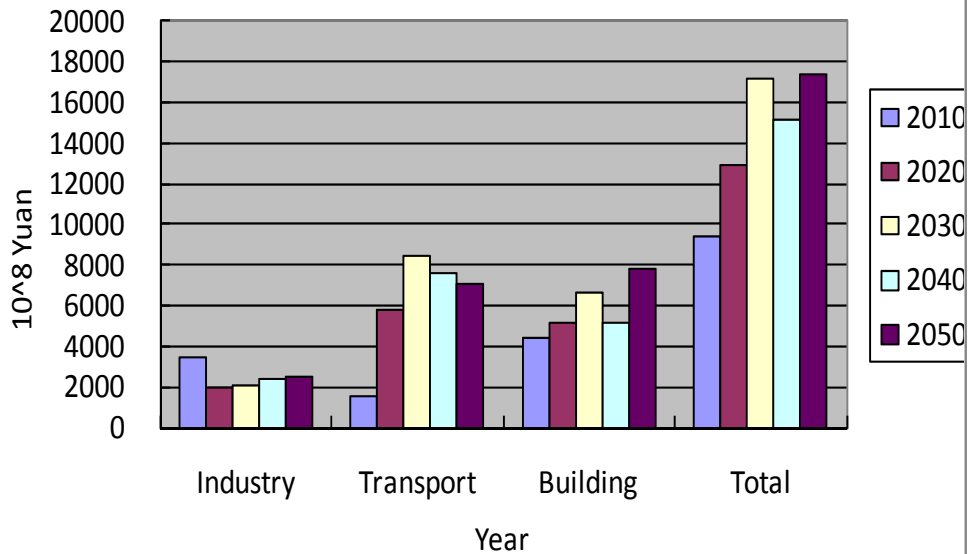
Investment in Energy Industry in China



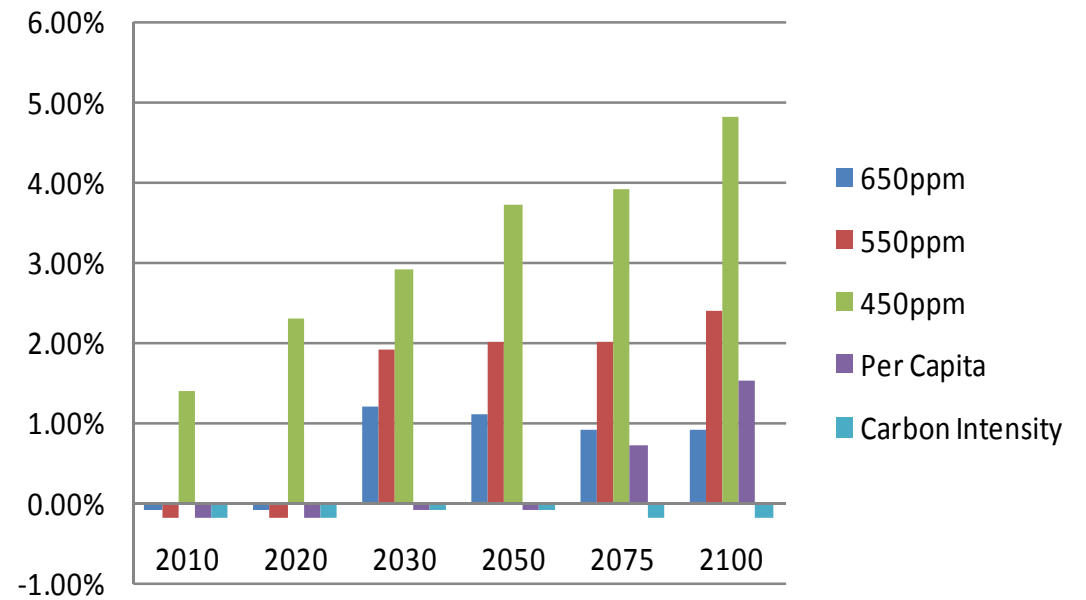
Energy Expenditures in China



Additional Investment in end use sectors in ELC



GDP Loss, %

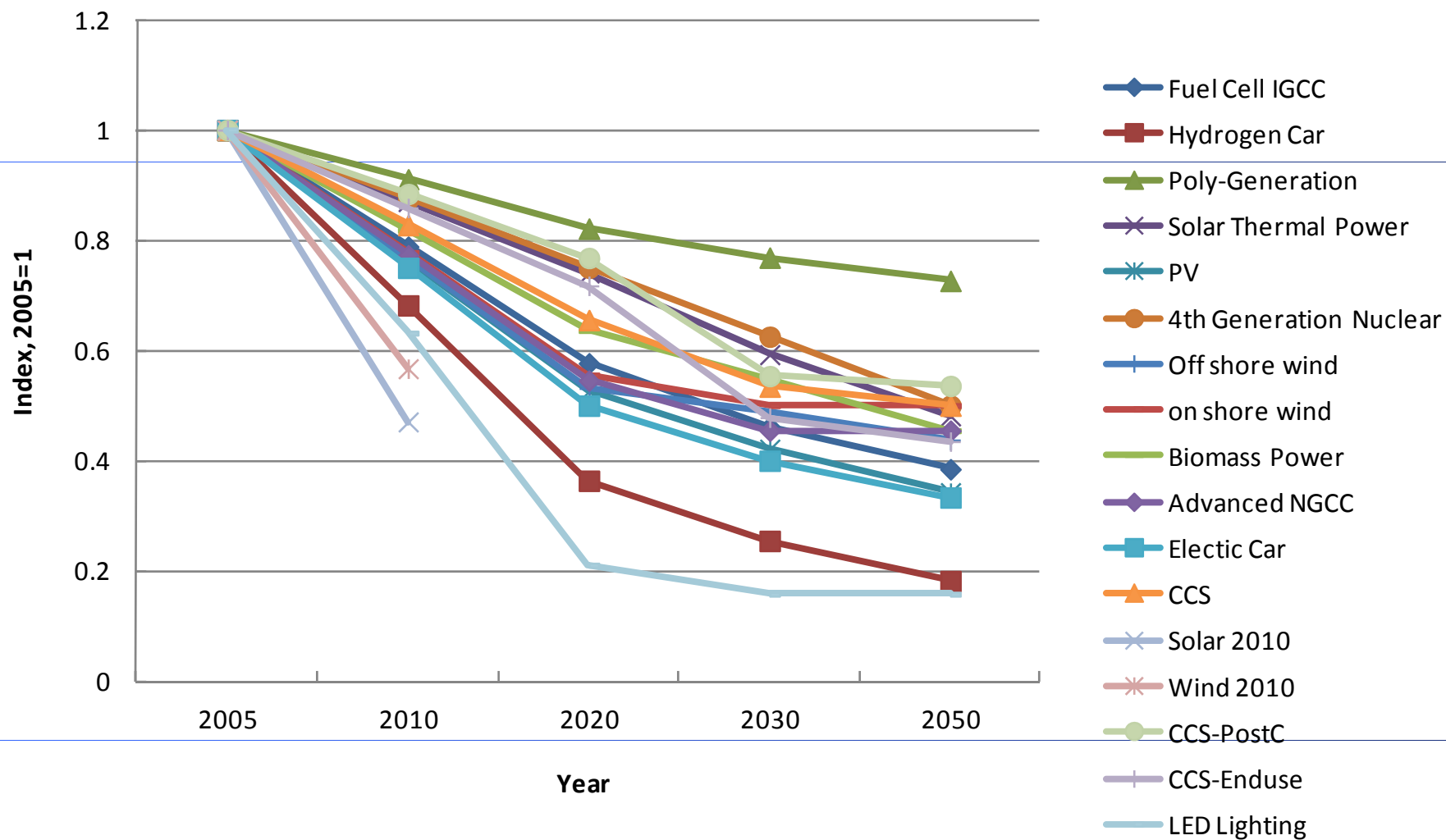


Good News: Rapid GDP growth could provide strong support

- By 2015, GDP in China could reach 75 trillion Yuan (in current value)
- Newly added accumulated GDP is 450 Trillion Yuan
- Cumulated GDP is 860 Trillion Yuan
- All the investment need in all modeling study is much small

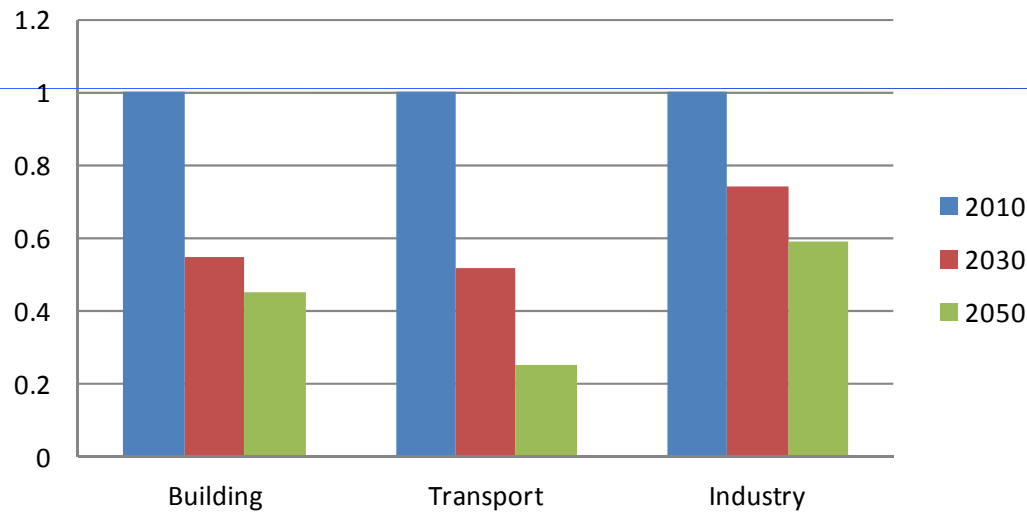
What is the role of technologies in the mitigation?

Technology learning curve

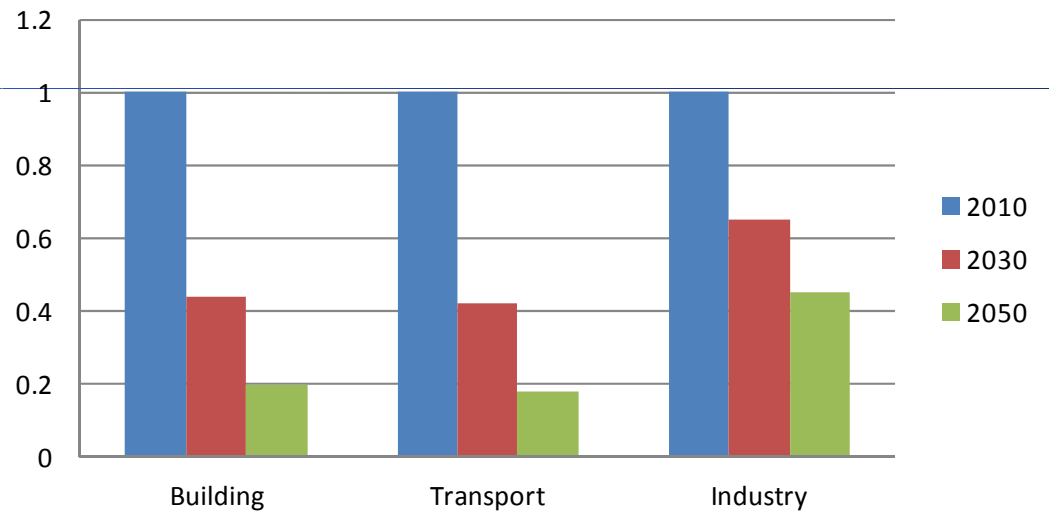


What is the role of technologies in the mitigation?

Energy efficiency improvement index

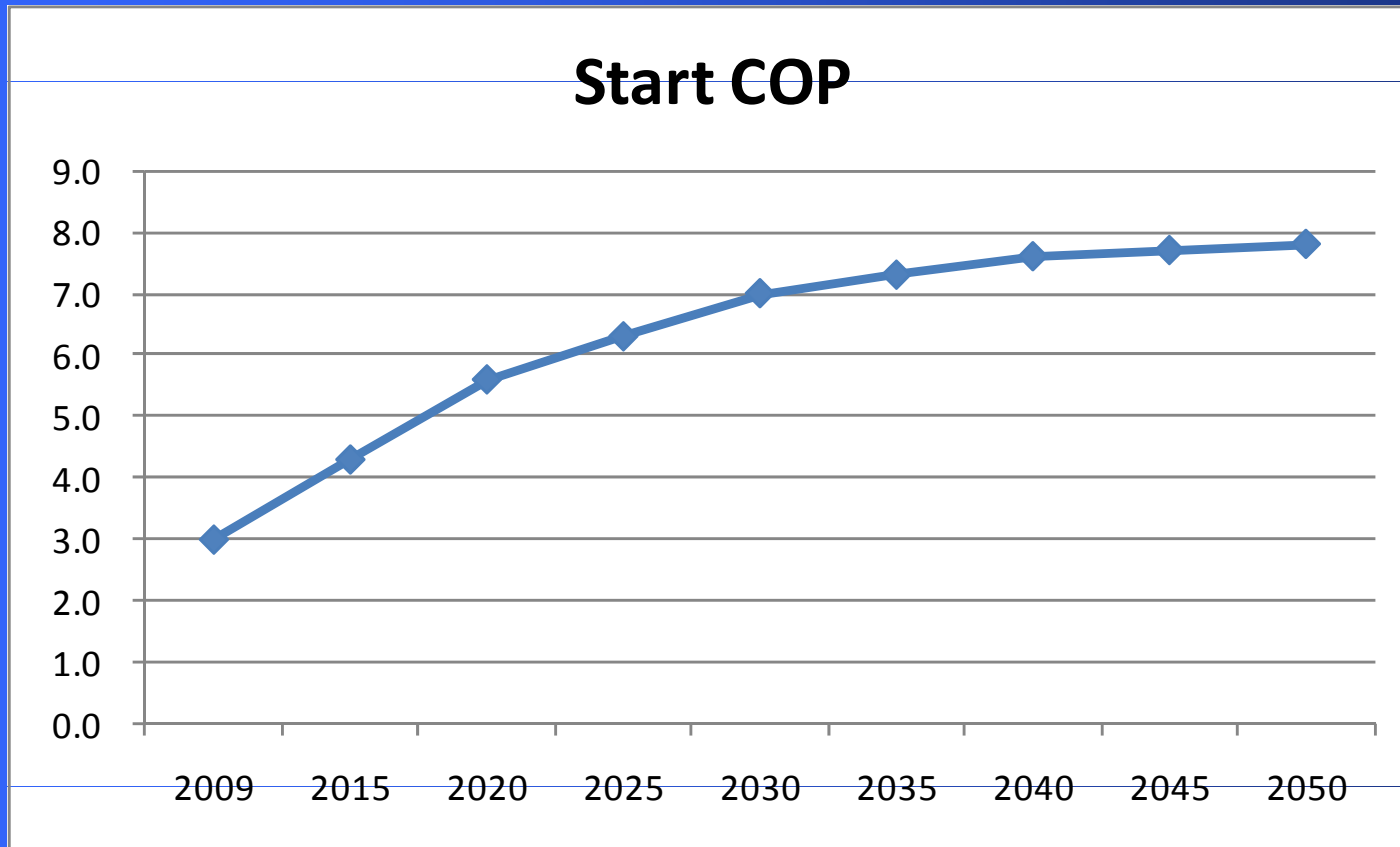


CO2 emission improvement index



Policy roadmap: Super high efficiency air conditioner

- Efficiency Standard: COP, MEPS
- Government Planning
- Subsidy



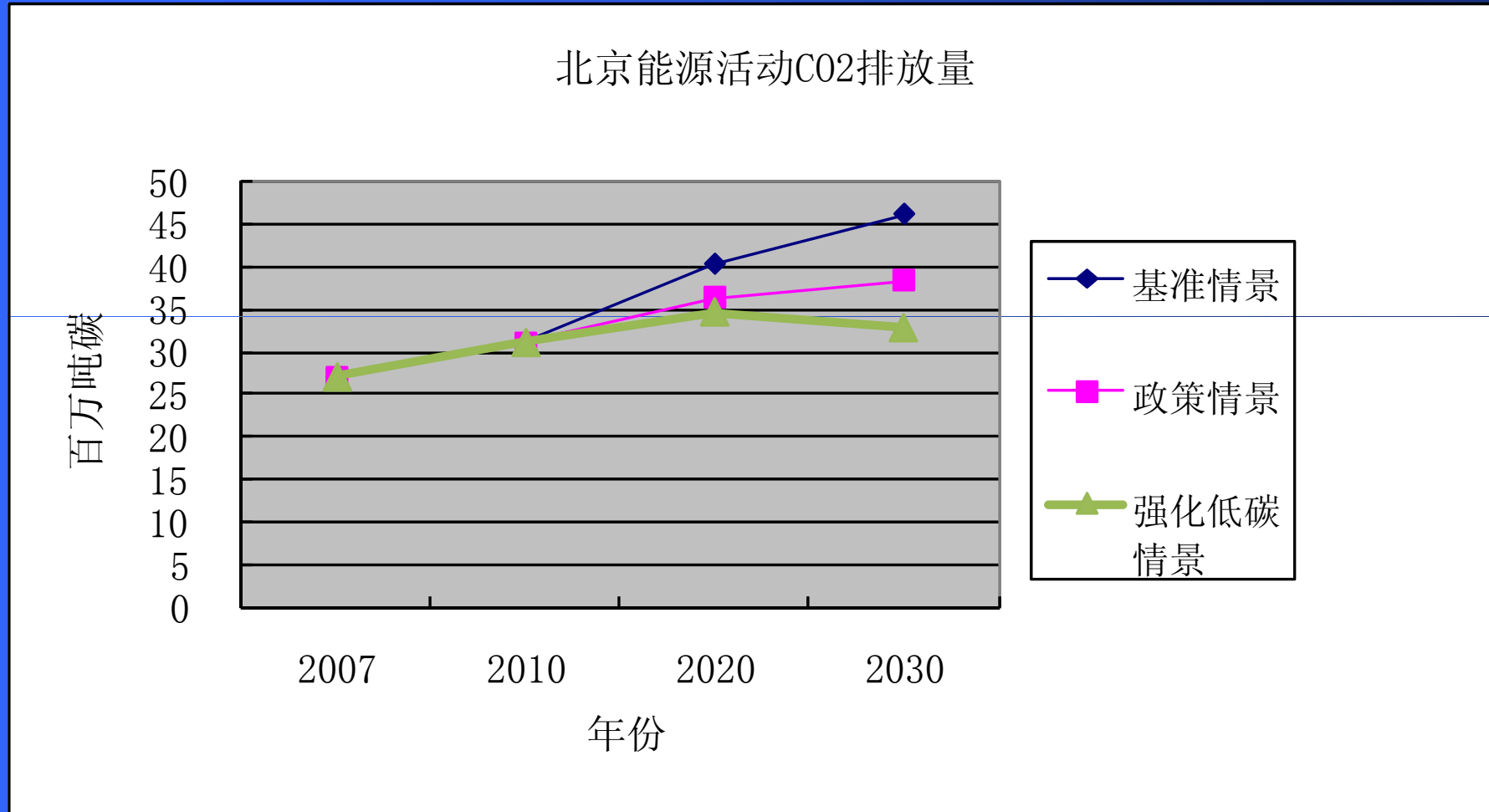
四、影响电动汽车发展的主要制约因素分析

4. Analysis Major Constraints Factors

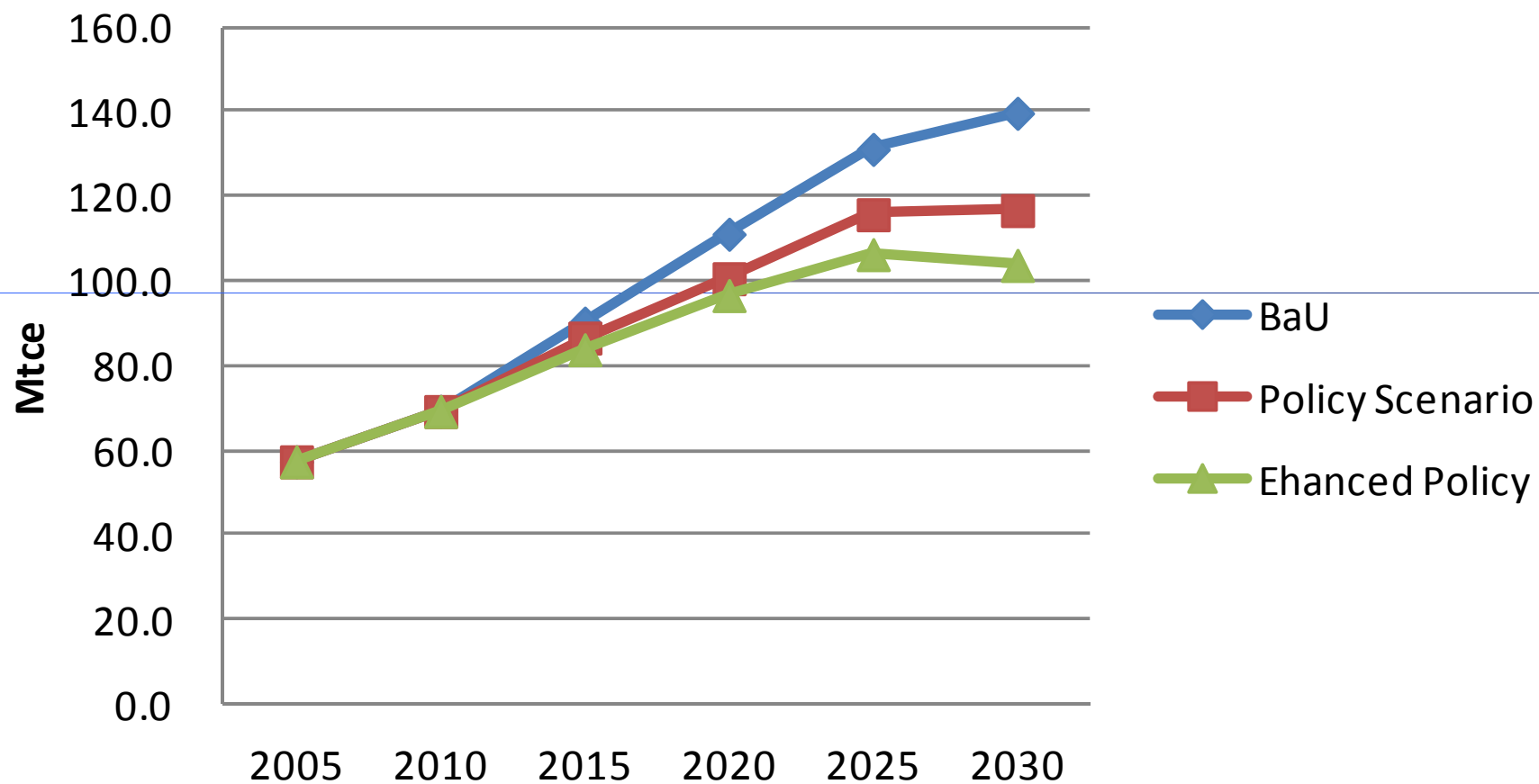
3.3 电动汽车实现经济性的趋势分析 Trend Analysis on EVs

电动汽车与先进汽油和柴油车成本变化趋势分析					
	2006-2010	2011-2015	2016-2020	2021-2025	2026-2030
电动汽车Evs					
电池充满电时总容量kWh	16	24	48	80	112
电力销售价格 (元/kWh)	0.48	0.60	0.75	0.94	1.18
单位里程耗电量 (kWh/km)	0.18	0.13	0.08	0.08	0.07
单位里程耗电费用 (yuan/km)	0.09	0.08	0.06	0.08	0.08
电动汽车燃料成本 (yuan/car)	43200	39067	30104	37694	41299
单位电池容量成本(USD/kWh)	750	375	130	75	30
Evs车电池组成本(yuan/car)	80400	60300	41808	40200	22512
电池组寿命 (年)	3.6	5	11	22	22
电池组更换次数 (set/year)	4.1	2.8	1.4	0.7	0.7
EVs全寿期电池成本 (yuan/car)	413256	226728	99503	67938	38045
EVs全寿期电耗和电池总成本 (yuan/car)	456456	265795	129607	105632	79345
每年费用 (yuan/car)	30430	17720	8640	7042	5290
先进汽油汽车ICE					
汽油销售价格 (yuan/liter)	6.6	8.5	10.2	11.0	11.8
柴油销售价格 (yuan/liter)	6.4	8.3	9.9	10.6	11.4
单位里程耗汽油 (L/km)	0.050	0.039	0.031	0.024	0.020
单位里程耗柴油 (L/km)	0.047	0.038	0.030	0.024	0.020
全寿期行驶里程 (km)	500000	500000	500000	500000	500000
先进汽油车燃料成本 (yuan/car)	165000	167550	158356	133574	117738
先进柴油车燃料成本 (yuan/car)	150400	155333	149317	128100	114170
每年费用	11000	11170	10557	8905	7849
比较 (Evs车费用 - ICE车费用)	291456	98245	-28749	-27941	-38394

Beijing CO2 emission from energy activities: peak by 2015



Primary Energy Demand in Beijing



Peak CO₂ emission by 2015, to be a low carbon city by 2030, comparable with Tokyo

Renewable Energy

- Renewable Energy Planning 2006: wind 30GW, Solar 2GW by 2020
- 2009 Energy Bureau: Wind 80WG
- 2010 Energy Planning: Wind 150 GW, Solar 20GW by 2020
- Now: Wind 200GW to 250GW, Solar 50WG
- Based on the conclusion from Chinese Academy for Engineering, grid in China could adopt these renewable energy power generation in short term.

Natural Gas Scenarios

- In 2010, Natural Gas use 107.2BCM, while 12.2BCM imported.
- In our low carbon scenario: by 2030, 370BCM
- NEA's planning: 260BCM by 2015