

# Policy Direction on Climate change in China and modelling tools to answer questions

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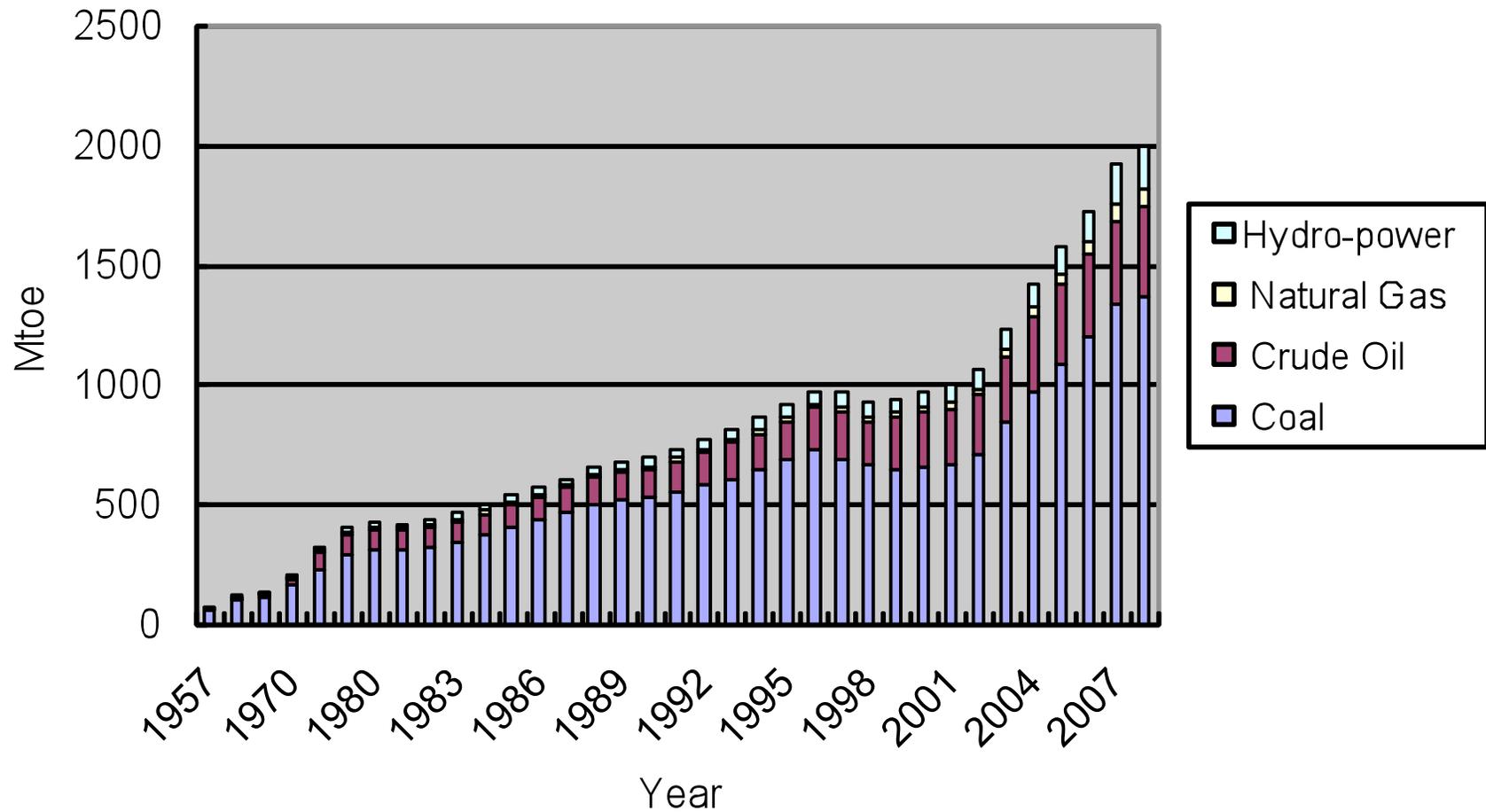
## ENERGY MODELING FORUM

Workshop on Climate Change Impacts and Integrated Assessment  
(CCI/IA)

Snowmass, Colorado

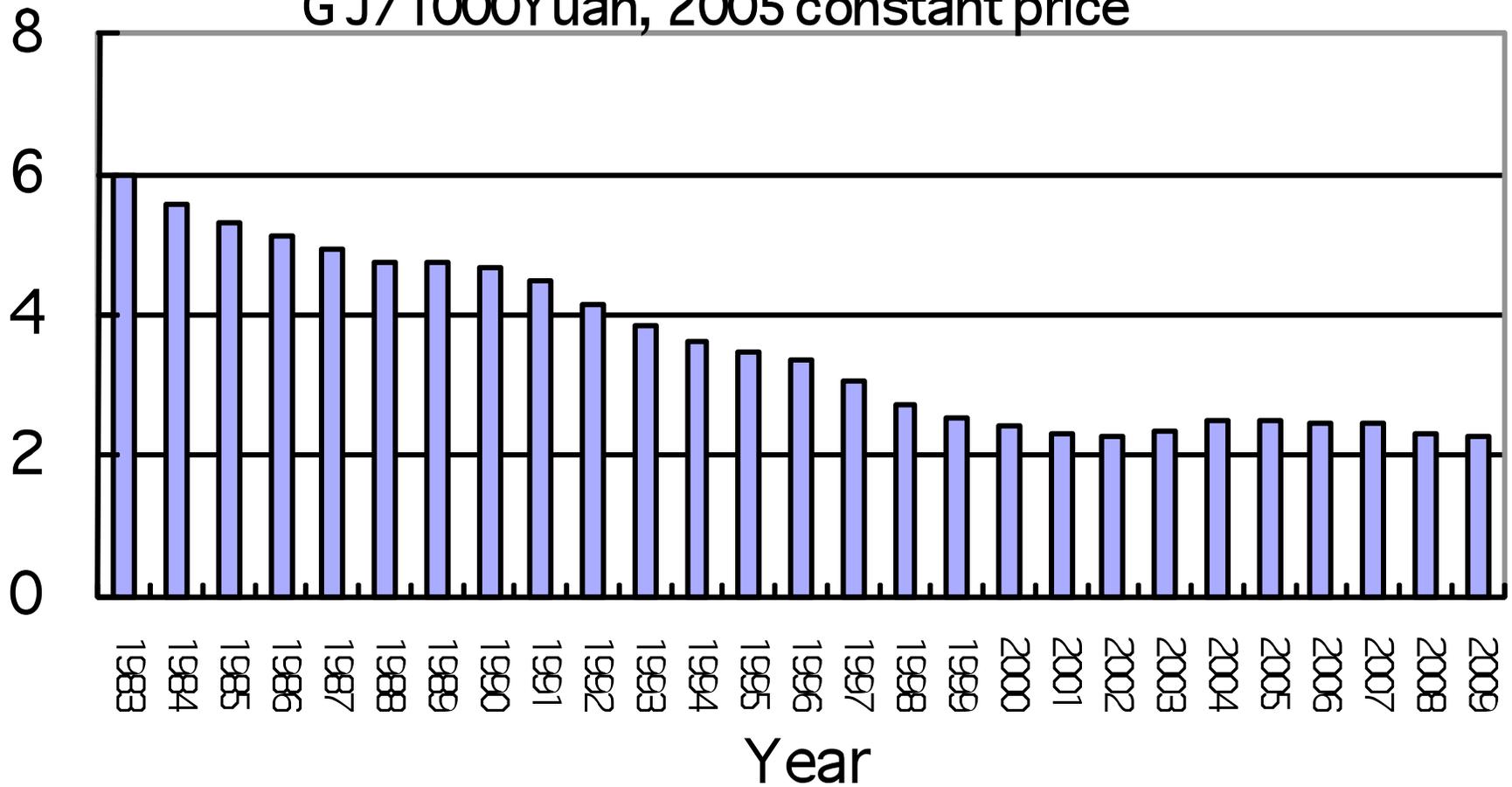
July 27–August 4, 2010

Energy consumption by fuels(1957-2008)

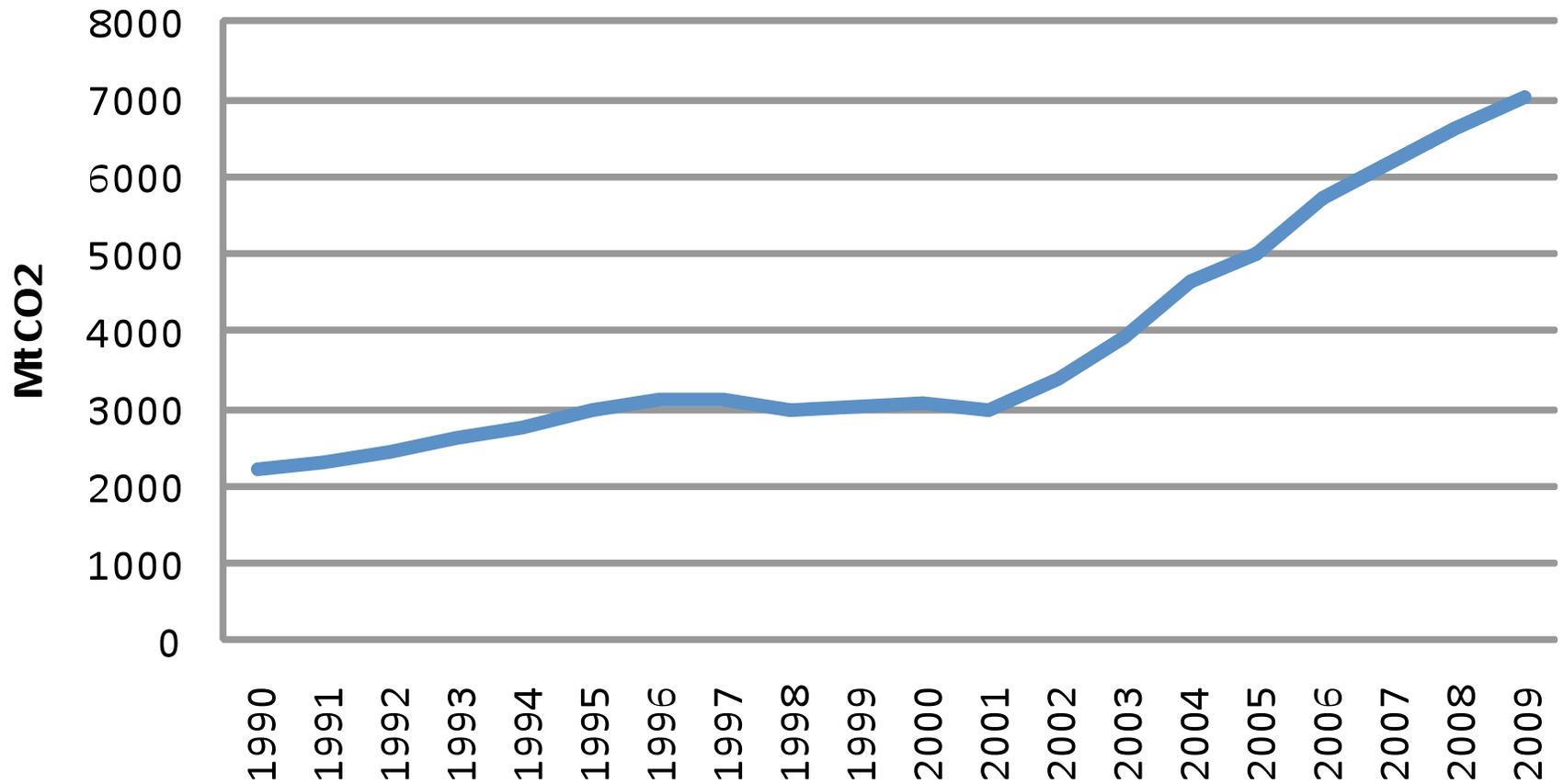


# Energy Consumption per unit of G DP

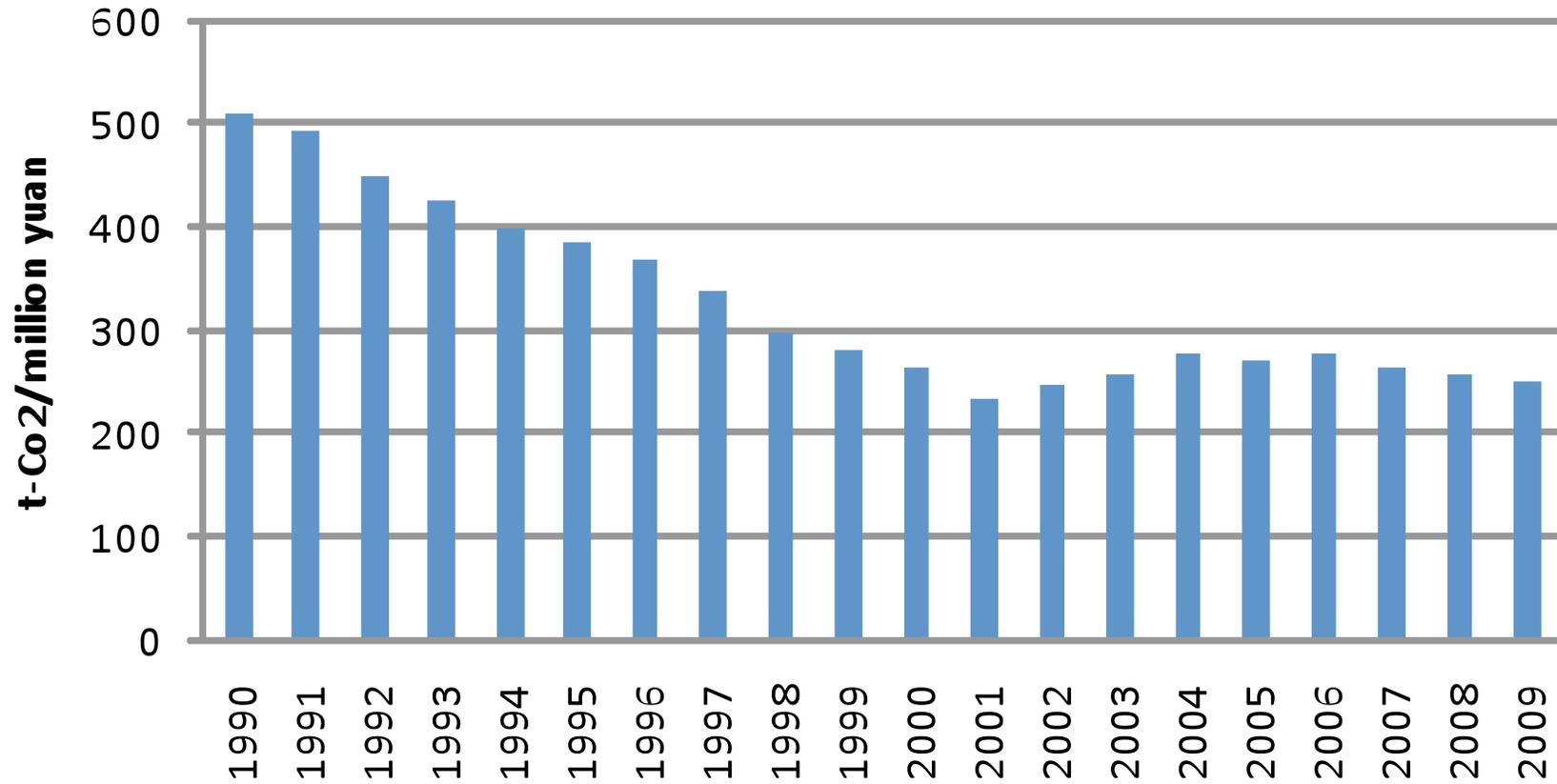
G J/1000Yuan, 2005 constant price



# CO2 Emission in China



# CO2 intensity in China



## *Recent Progress on climate change in China*

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In August 12, 2009, Wen Jiabao hosted state council meeting, announced China will promote green economy development with focus on low carbon industries, and China should put low carbon development into national strategy

In Sep.22, 2009, Hu Jintao gave speech at UN to emphasize China's action on Climate Change:

- Significant reduction on carbon intensity between 2005 and 2020
- Non-fossil fuel share in primary energy by 15% in 2020
- 40million hector of forest increase
- Develop green economy, low carbon economy and circulating economy, develop low carbon technology

## *Recent Progress on climate change in China*

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In Nov.1, 2009, Wen Jiabao said six points for next step China will do:

- Put climate change into China's national economy and social development plan
- Further implementation of national climate change program, in 12<sup>th</sup> Five Year Plan period
- Promote green economy
- Enhance comprehensive capacity building on climate change
- Establish law and regulation system on climate change
- Actively promote international collaboration

## *Chinese targets in Copenhagen*

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- Carbon Intensity reduction of 40% to 45% from 2005 to 2020
- Non-Fossil fuel accounts for 15% in TPE in 2020

## *What is happening now on policy*

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- Negotiation in COPs, Copenhagen and after that
- 12th Five Year Plan on Energy, Climate change
- Low Carbon Development Planning and Strategy
- National long-term energy plan

Table 4. Major policies announced recently

Classification	Policies
Administration	Establishing energy conservation and emission reduction steering group chaired by Prime Minister (June 2006); Distributing targets to each province (September 2006)
Overall National Policies	Synthesizing Working Program for Energy Conservation and Emission Reduction (June 2007); Revised Energy Conservation Law (October 2007); Integrated Resource Utilization Guidance (January 2007); Guidance for Accelerating Energy Conservation Service Industry (2008); Guidance Catalog for industry structure change (annual)
Monitoring	Implementation Program of Energy Intensity Per GDP Statistic Index System (Nov. 2007), Implementation Program of Unit Energy Use Per GDP Exam (Nov. 2007), Implementation Program of Unit Energy Use Per GDP Monitoring (Nov. 2007)
Pricing/Financing	Differentiating energy prices for key energy-intensive industries
Standardization	Second catalog of energy efficiency labeling for consumer products (Sep. 2006); Third catalog of energy efficiency labeling for consumer products (January 2008)
Industry	1000 large energy users monitoring program by national government (April 2006); extending provincial large energy user monitoring program (April 2006); closure of small-size industry in energy intensive sectors including cement, steel, non-ferrous, chemistry etc. (June 2006); approval for new projects based on energy efficiency standard (January 2007)
Transport	Light Vehicle Fuel Efficiency Standard (Sep. 2007)
Buildings	11 <sup>th</sup> Five Year Plan for Energy Conservation in Buildings (February 2006); Building Efficiency Standard Implementation (June 2007)
Power generation	Closure of small power plants (January 2007), regulation for newly installed coal-fired power plants to be most advanced power plants (Super Critical Units, Ultra-super critical units) (2007), power dispatch

## *Negotiation*

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- Targets? By 2020, 2030 or 2050? Intensity or absolute targets?
- Commitment: domestic targets or actions, MRV, sector based approach
- Cost and benefit?
- Technology transfer needs?

## *Domestic climate change strategy*

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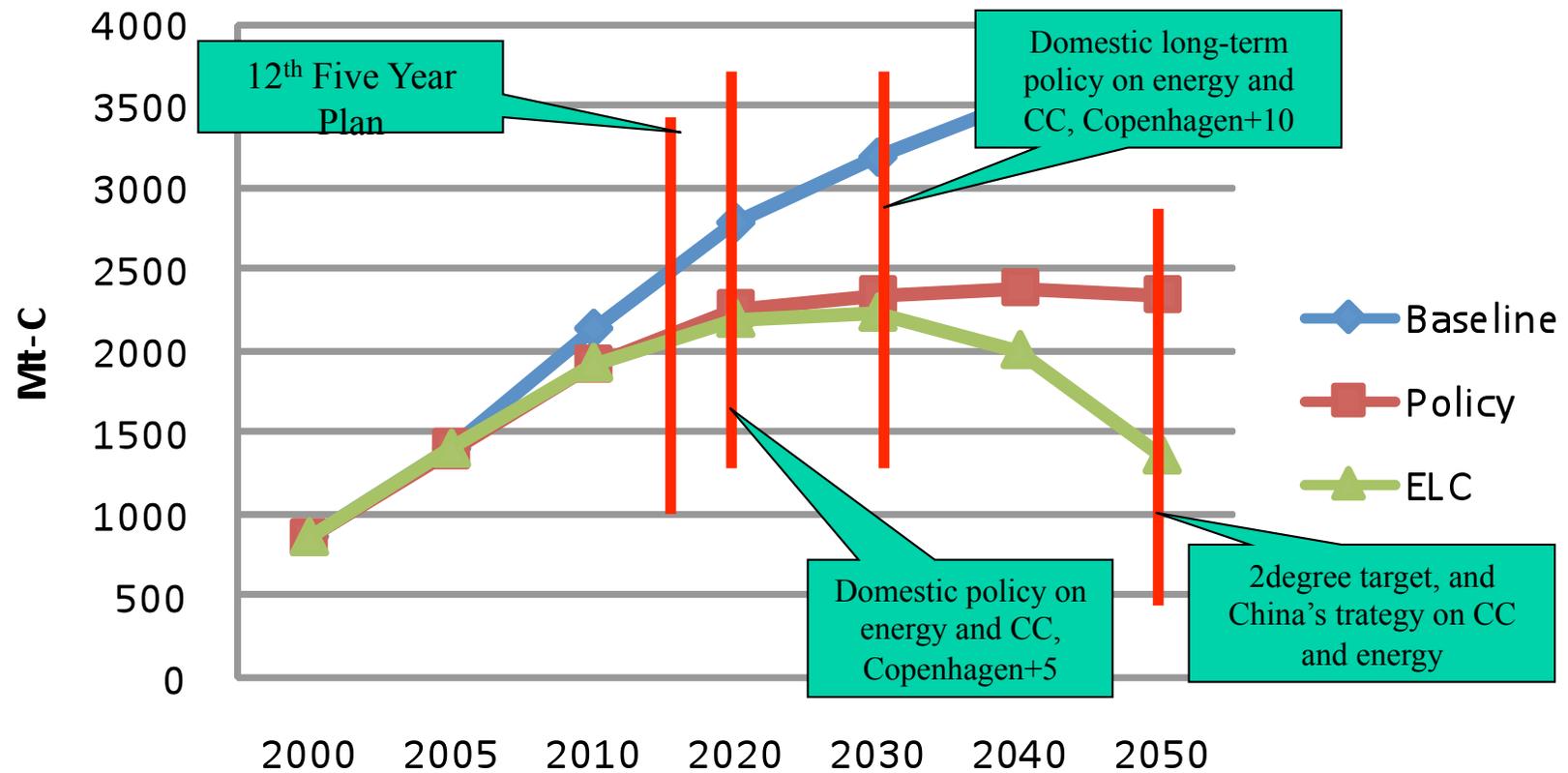
- What are the targets of GHG in China? Short-term and long-term?
- Key policies and countermeasures for low carbon future
- Long-term Energy and emission pathways?
- Economy development pattern?
- Technology R&D strategy? What kind of technologies?
- Near-term action and policies? Cost and benefit of these near-term policies?

## *Other policies*

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- Energy security and supply
- Energy development strategy
- Energy technology development strategy
- Energy investment pathway: power generation
- Energy target: intensity, total amount control
- Environment target
- Environment strategy

# CO2 Emission in China



## *Climate Change Policies in China*

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- Seems not much relationship with COPs
- Much more domestic oriented driving: energy security, local environment
- Role of China in general global issues: political roadmap
- Conflict seen when merge climate change policies with other domestic policies

## *Assessment of Climate Change Policies in China*

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- How much we can do by biggest domestic effort? Not NAMA, need not to link with COP too much.
- 2 degree scenario: possibility and cost, benefit analysis
- Policy benchmark scenario

# MRVing policies and actions

类别/行业	政策/行动	中国			美国		
		政策和行动内容描述	定量指标	可核实	政策和行动内容描述	定量指标	可核实性
排放目标		2005 年到 2020 年 CO2 强度下降 40% 到 45% 非化石能源到 2020 年占到一次能源的 15%	40%-45%  15%	可以  可以	1990 年到 2012 年 CO2 强度下降 18%  2020 年 CO2 排放量比 2005 年下降 17%，到 2050 年下降 83%	18%碳强度下降  17%CO2 排放量下降	可核实  可核实
国家法律		可再生能源法 节约能源法		公布 公布	美国清洁能源与安全法案, June 2009 2005 能源政策法案 国家环境政策法案 国家能源节约政策法	公布 公布 公布 公布	可核实
国家文件		国家应对气候变化方案	2010 年的目标	公布			
碳税							
能源税		石油消费税		可核实			
碳贸易		中国企业参与 CDM			自愿碳贸易：2009 年市场为 8 亿多美元 2009 新法案引入了“总量控制与排放交易”排放权交易机制。根据这一机制，美国发电、炼油、炼钢等工业部门的温室气体排放配额将逐步减少，超额排放需要购买排放权。	交易量	可核实

# MRVing policies and actions

国家规划		<p>十一五节能规划: 能源强度下降 20%</p> <p>中长期节能规划 (2004 年公布): 确定了节能目标, 2002 年到 2010 年能源强度下降 16%, 2020 年比 2010 年下降 31.5%, 14 种主要高耗能产品确定了能源单耗指标</p> <p>可再生能源规划: 确定了 2020 年可再生能源发展目标</p> <p>核电发展规划: 到 2020 年实现装机 4000 万千瓦</p>	20%, 见规划	<p>可核实</p> <p>可核实</p> <p>可核实</p>			可核实
限制高耗能产品		减少出口退税, 并对 56 种产品征收出口税	出口税总量	可核实			
可再生能源	发展目标	<p>根据可再生能源法, 2020 年可再生能源占一次能源比重达到 15%, 2005 年为 6%</p> <p>可再生能源发展规划, 2020 年风电装机 1-1.5 亿千瓦 (新的目标), 太阳能发电装机 2000 万千瓦</p>			《2009 美国复苏和再投资法案》要求所有的电力公司到 2020 年其电力供应中要有 20% 的比例来自于可再生能源和能效改进, 其中 15% 来自风能、太阳能等可再生能源, 5% 来自能效提高。对于可再生能源电力所占比例无法达到 15% 的州, 可将这一目标降为 12%, 但能效目标要提到 8%	定量目标	可核实
	补贴和标杆电价	<p>为可再生能源发电提供补贴, 制定标杆电价</p> <p>生物质能发电每 kWh 发电补贴 0.25 元</p> <p>光伏发电补贴: 1 到 3 元/kWh</p> <p>风电: 2006 年到 2009 年补贴 0.3 到 0.4 元/kWh, 之后更换为标杆电价: 四个级别: 0.51 元/kWh, 0.54 元/kWh,</p>	定量指标	可核实	<p>30 亿美元可再生能源补贴</p> <p>基于《2009 美国复苏和再投资法案》的拨款, 美国财政部和能源部将采取直接付款形式, 对 5000 个生物质能、太阳能、风能和其他可再生能源项目设施进行补贴。美国加州政府出台奖励政策, 对获得新型储能系统资格(AES)的供应商提供每瓦 2</p>	定量数据	可核实

# MRVing policies and actions

	其他经济性 激励措施				对符合条件的用于可再生能源设备的制造、研发设备的安装、设备重置和产能扩大项目，都可按照设备费用的 30% 给予投资税抵免 生产能力小于 6000 万加仑的小型燃料乙醇生产商和生产能力小于 1500 万加仑的小型生物柴油生产商，可以享受 0.1 美元/加仑的生产所得税减免 燃料乙醇的消费税减免标准为 0.51 美元/加仑，对于以农业原料生产的生物柴油，消费税减免额度为 1 美元/加仑，对于使用非农业原料，如动物油脂生产的生物柴油，消费税减免额度为 0.5 美元/加仑	定量数据	可核实
能源效率	国家目标	十一五期间 20% 节能目标			2012 年能源强度比 1990 年提高 25%	下降 25%	可核实
	国家规划	中长期节能规划，提出了到 2020 年的节能定量目标，以及主要产品和行业的节能目标					
	政府投资	2008 年政府投入节能补贴 120 亿元			对消费者，13 亿美元的个人节能消费优惠预算		可核实
					2005 能源政策法案提出，在未来 10 年内，美国联邦政府将向全美能源企业提供 146 亿美元的减税额度，以鼓励石油、天然气、煤气和电力企业等采取清洁能源和节能措施；	减税量	可核实
					为提高能效和开发可再生能源，将给予相关企业总额不超过 50 亿美元的补助	补助额	可核实

# MRVing policies and actions

	其他经济性 激励措施				对符合条件的用于可再生能源设备的制造、研发设备的安装、设备重置和产能扩大项目,都可按照设备费用的 <b>30%</b> 给予投资税抵免 生产能力小于 <b>6000</b> 万加仑的小型燃料乙醇生产商和生产能力小于 <b>1500</b> 万加仑的小型生物柴油生产商,可以享受 <b>0.1</b> 美元/加仑的生产所得税减免 燃料乙醇的消费税减免标准为 <b>0.51</b> 美元/加仑,对于以农业原料生产的生物柴油,消费税减免额度为 <b>1</b> 美元/加仑,对于使用非农业原料,如动物油脂生产的生物柴油,消费税减免额度为 <b>0.5</b> 美元/加仑	定量数据	可核实
能源效率	国家目标	十一五期间 <b>20%</b> 节能目标			<b>2012</b> 年能源强度比 <b>1990</b> 年提高 <b>25%</b>	下降 <b>25%</b>	可核实
	国家规划	中长期节能规划,提出了到 <b>2020</b> 年的节能定量目标,以及主要产品和行业的节能目标					
	政府投资	<b>2008</b> 年政府投入节能补贴 <b>120</b> 亿元			对消费者, <b>13</b> 亿美元的个人节能消费优惠预算		可核实
					<b>2005</b> 能源政策法案提出,在未来 <b>10</b> 年内,美国联邦政府将向全美能源企业提供 <b>146</b> 亿美元的减税额度,以鼓励石油、天然气、煤气和电力企业等采取清洁能源和节能措施;	减税量	可核实
					为提高能效和开发可再生能源,将给予相关企业总额不超过 <b>50</b> 亿美元的补助	补助额	可核实

# MRVing policies and actions

					白宫制订的节能计划要求政府公共设施购置和使用高效节能产品	非定量	计划可核实, 效果难以核实
					为了推动节能工作, 美国在 1991 年至 1998 年期间, 共发布了 10 份行政令和 2 份总统备忘录, 要求政府机构加强节能工作。12902 号行政令还进一步要求各个政府机构 2005 年节能 30%。	定量目标	可核实
					美国政府将在 2009 年推出针对空调、冰箱、洗衣机等家电产品的节能补贴政策, 对于高能效的家电产品将给予一次性 50-200 美元/台的补贴标准, 美国政府的补贴预算规模将在 3 亿美元左右	定量指标	可核实
化石燃料发电	发电效率目标	中长期节能规划和十一五规划确定了火电发电煤耗目标	定量指标	可核实			
	发电技术要求	根据国家发改委当前优先发展的高新技术产业化重点领域指南, 燃煤发电新增生产能力以超临界和超超临界为主	新技术的比例	可核实			
	关闭小电厂	十一五期间关闭 5000 万千瓦小电厂	到 2009 年底, 已经关闭 5400 万千瓦				
	节能调度						
					对新型核能电站提供免税优惠和贷款担	资金额	可核实

# MRVing policies and actions

工业部门	主要高耗能工业节能目标	根据国家中长期节能规划,吨钢可比能耗 2010 年达到 630gce/吨钢,其他主要高耗能产品均确定了具体目标。总体上与 2002 年相比下降 15%到 25%。	每年吨钢可比能耗		2005 年,美国钢铁学会(AISI)宣布到 2025 年美国吨钢的耗能比 2003 年减少 40%	定量指标	可核实
	千家企业节能行动	千家企业能源利用效率大幅度提高,主要产品单位能耗达到国内同行业先进水平,部分企业达到国际先进水平或行业领先水平,带动行业节能水平的大幅度提高。实现节能 1 亿吨标准煤左右。	千家企业能耗量	可核实			
	关闭高耗能小企业	十一五规划制定了关闭五类高耗能工业落后产能,其中电厂和造纸已经提前实现目标	关闭目标	年度数据			
	能源效率标准	制定 53 种工业产品和技术能源效率标准			“能源之星”包含了电器、商业食品设备、制热制冷设备、家用电子产品、家庭房屋外层材料、照明产品、办公设备、其他商业用品等 8 大类 35 项产品。	节能标准	可核实
	节能项目计划和资金支持	十一五期间,国家专项资金支持企业节能技术改造, 2008 年投入 130 亿元  节能技术改造财政奖励资金管理暂行办法:节能量在 1 万吨(暂定)标准煤以上,东部地区节能技术改造项目根据节能量按 200 元/吨标准煤奖励,中西部地区按 250 元/吨标准煤奖励	资金投入量,节能改造项目数 2006 年,支持 111 个大型节能项目 2007 年支持 681 个主要节能项目				

## *Using modeling tools*

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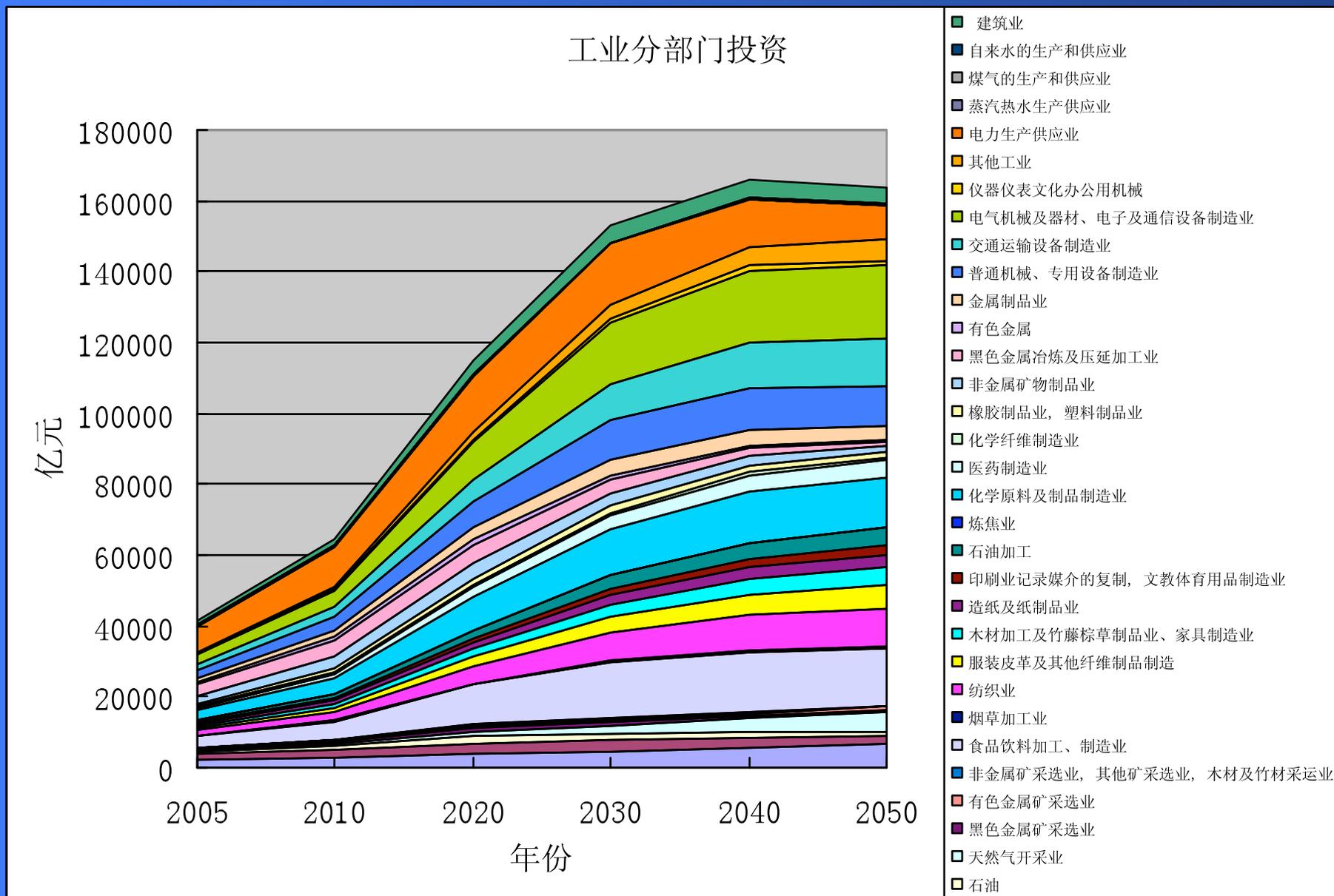
- Scenarios: pathways, targets (intensity and absolute)
- Cost analysis: wide range of cost analysis
- Multi-development targets analysis
- Benefit analysis by taking low carbon economy
- Co-benefit analysis (GHGs, local pollutions, water pollutions, and others)
- Integrated analysis

## *What we are doing*

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- Low carbon scenario up to 2050 for China
- Technology roadmap up to 2050
- Policy roadmap for deep cut in 2050
- Political roadmap for Climate change in China and the world
- Low carbon development for cities and provinces (more than 10 cities and provinces)
- Cost and benefit analysis
- Technology solution

# Investment by industrial sectors



## 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

## Parameter of Urban Household: by 2030 same life quality as that in developed countries

Service	Unit	Service		
		2020	2030	2050
Household, million		288	336	380
Share of HH with space heating		42%	44%	48%
Index of space heating intensity, 2000=1		1.35	1.5	1.6
Index of space heating time, 2000=1		1.33	1.36	1.4
Share of building with 50% efficiency standard		20%	45%	65%
Ownership of Air Conditioner		130	180	260
Index of Air conditioner intensity, 2000=1		1.3	1.4	1.6
Index of air conditioner utilization time, 2000=1		1.6	1.8	2.2
Ownership of Refrigerator	per 100HH	100	120	130
Average space of refregeretor	L	250	310	390
Efficiency of Refregeretor		0.8kWh/天	0.8kWh/天	0.7kWh/天
Ownership of washing machine	per 100HH	100	100	100
times to use washing machine per week		5.4	8	8
Ownership of TV	per 100HH	180	220	290
Average Capacity of TV		320W	300W	280
Hours per TV per day		3.5	3.2	2.9
Penetration rate of CFL		100%	100%	100%
Light per HH		14	21	27
Ownership of Water heater	per 100HH	100%	100%	100%
Ownership of Solar heater	per 100HH	18%	25%	33%
Ownership of Electric cooking	per 100HH	130	140	260
Hours per day of electric cooking	Minutes	12	30	50
Capacity of other electric appliicance	W	1500W	1800W	2300W
Hours of other electric appliance	Minutes	50	80	100

## 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%

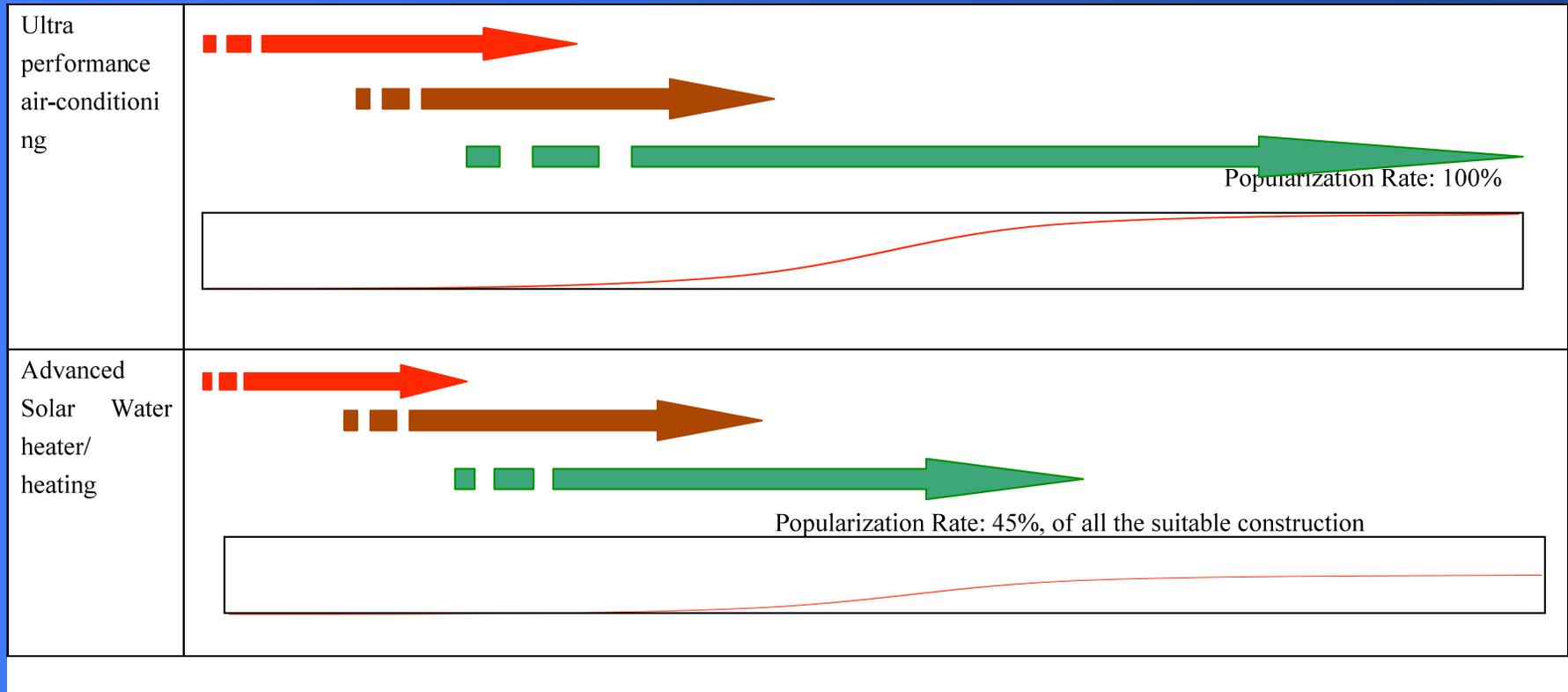
# Comparison of BaU and Low Carbon Scenario

Technology	Efficiency	Ratio in 2030		Ratio in 2050		Note
		Reference scenario	Low carbon scenario	Reference scenario	Low carbon Scenario	
Ed coke	11900 Mcal/ ton coke, with gas production of 1340 Mcal	58%	50%	77%	42%	Fully localization
generation en	10300 Mcal/ ton coke, with gas production of 1420Mcal	17%	47%	23%	58%	
nching	2.4 Mcal/ ton J Recovery	80%	100%	90%	100%	Localization, with promising prospect of market potential
g furnace ternational d level	390 Mcal/ ton sinter lump, saving 42% of energy	45%	85%	67%	90%	Needed to be localization
urnace of onal d level	3750 Mcal/ ton hot metal, saving 21% of energy	40%	65%	64%	87%	
s recovery	Heat and electricity recovery 0.7 Mcal/ ton hot metal	44%	70%	85%	100%	
ous and	Saving 86% of energy	90%	98%	85%	95%	

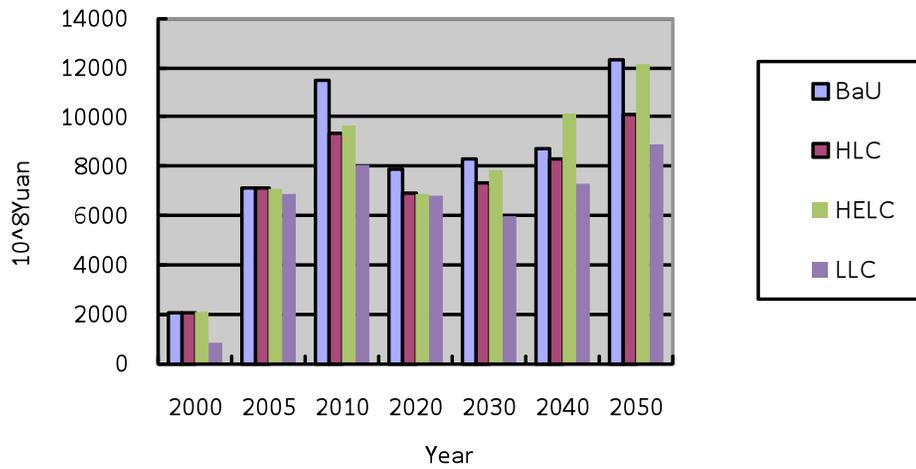
## 28 key technologies in the enhanced low carbon scenario in China

No.	Sector	Technology	Description	Note
1	Industry technology	High energy efficiency 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 <sup>th</sup> 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		

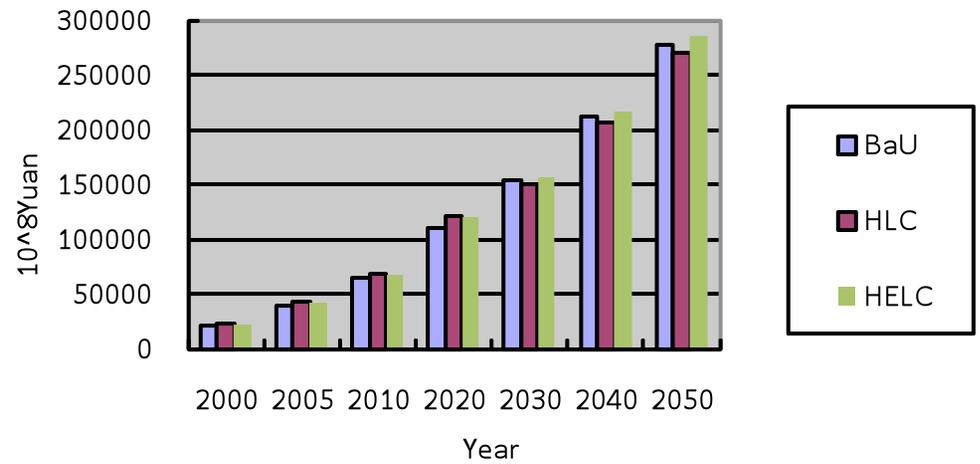
# Technology Roadmap



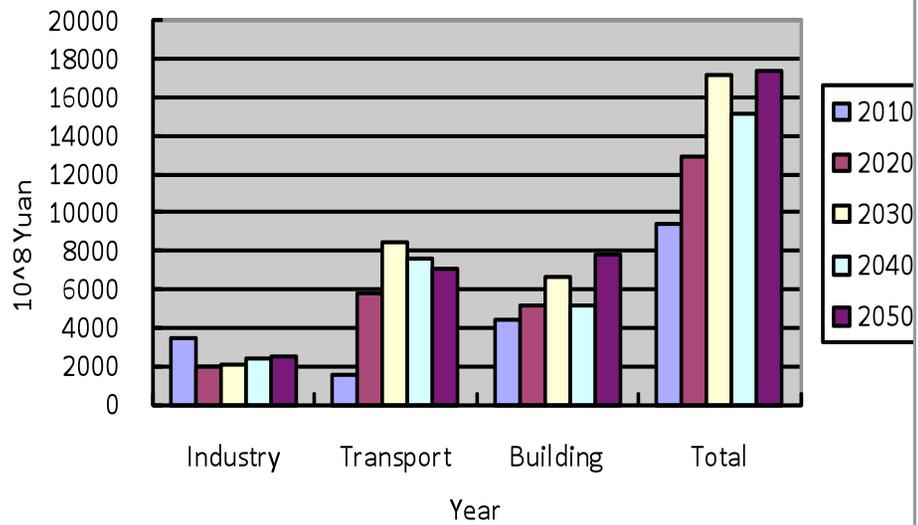
### Investment in Energy Industry in China



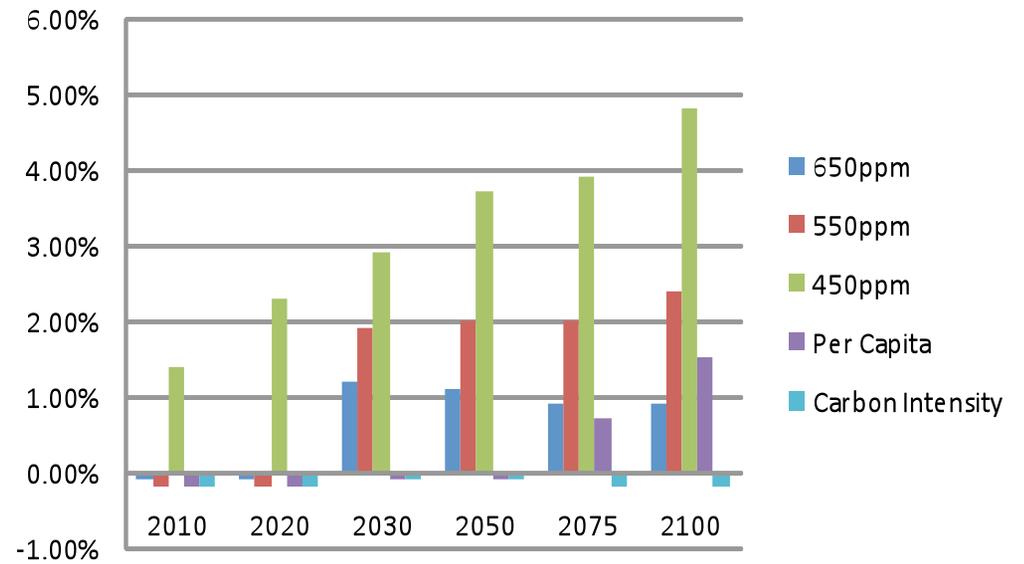
### Energy Expenditures in China



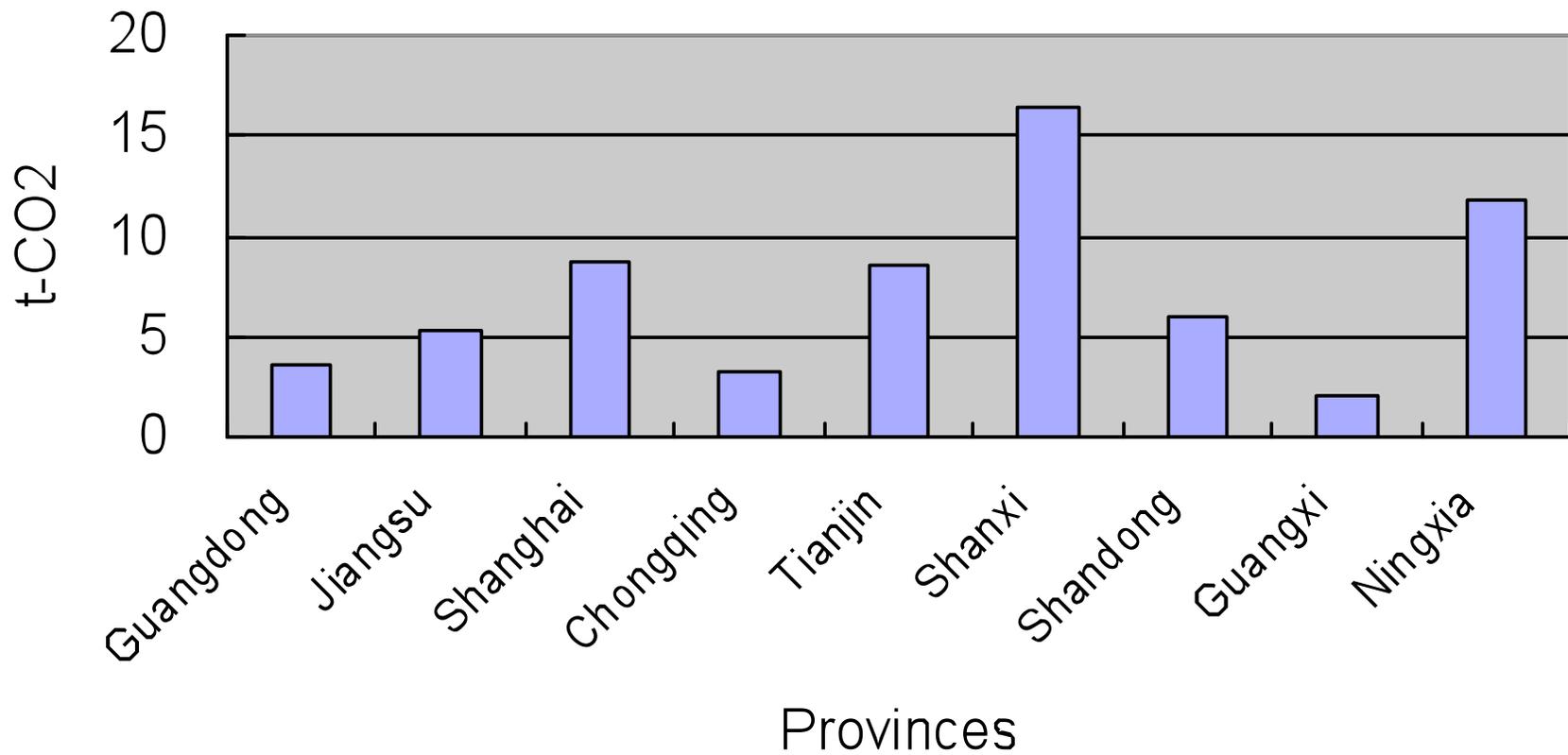
### Additional Investment in end use sectors in ELC



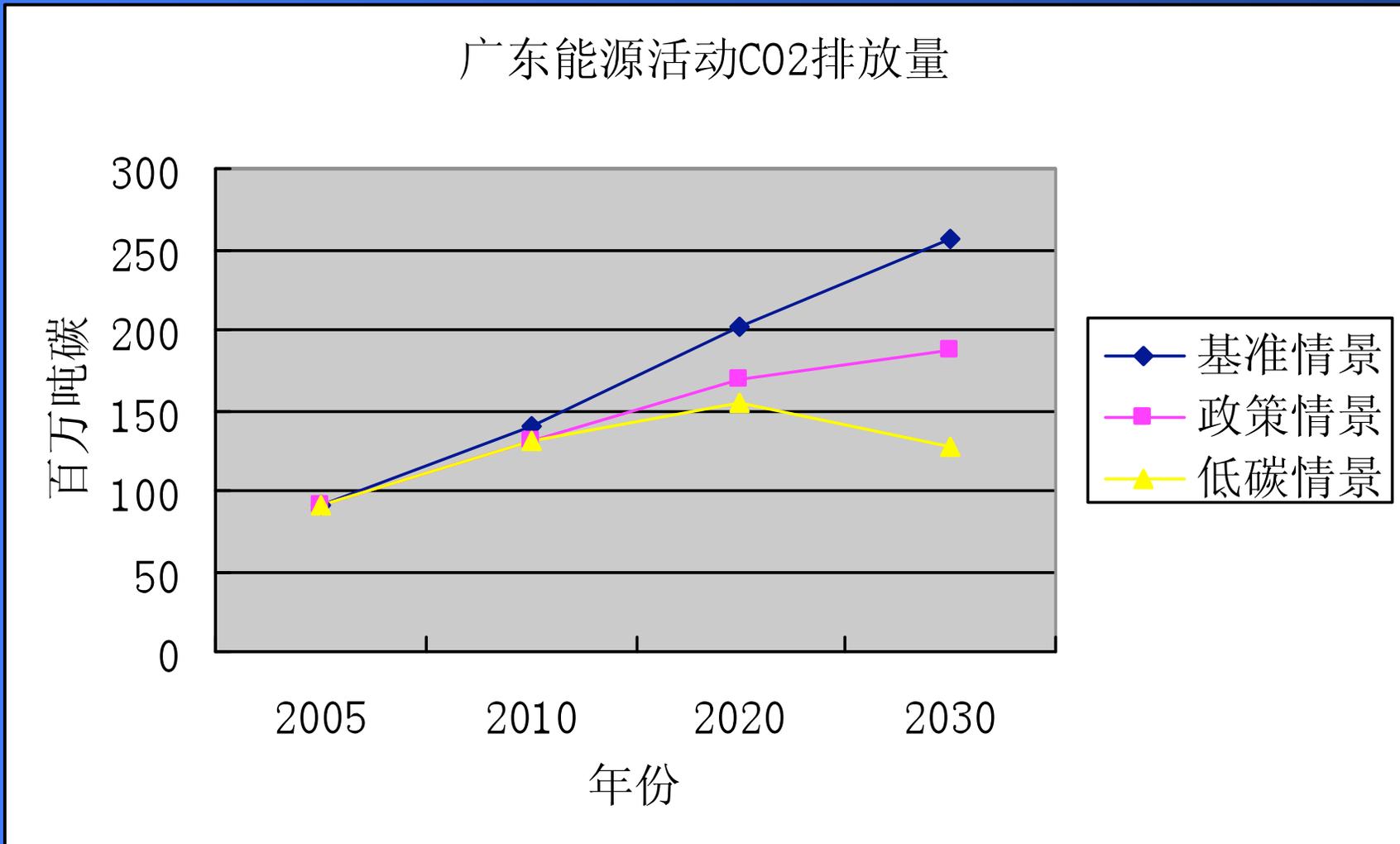
### GDP Loss, %



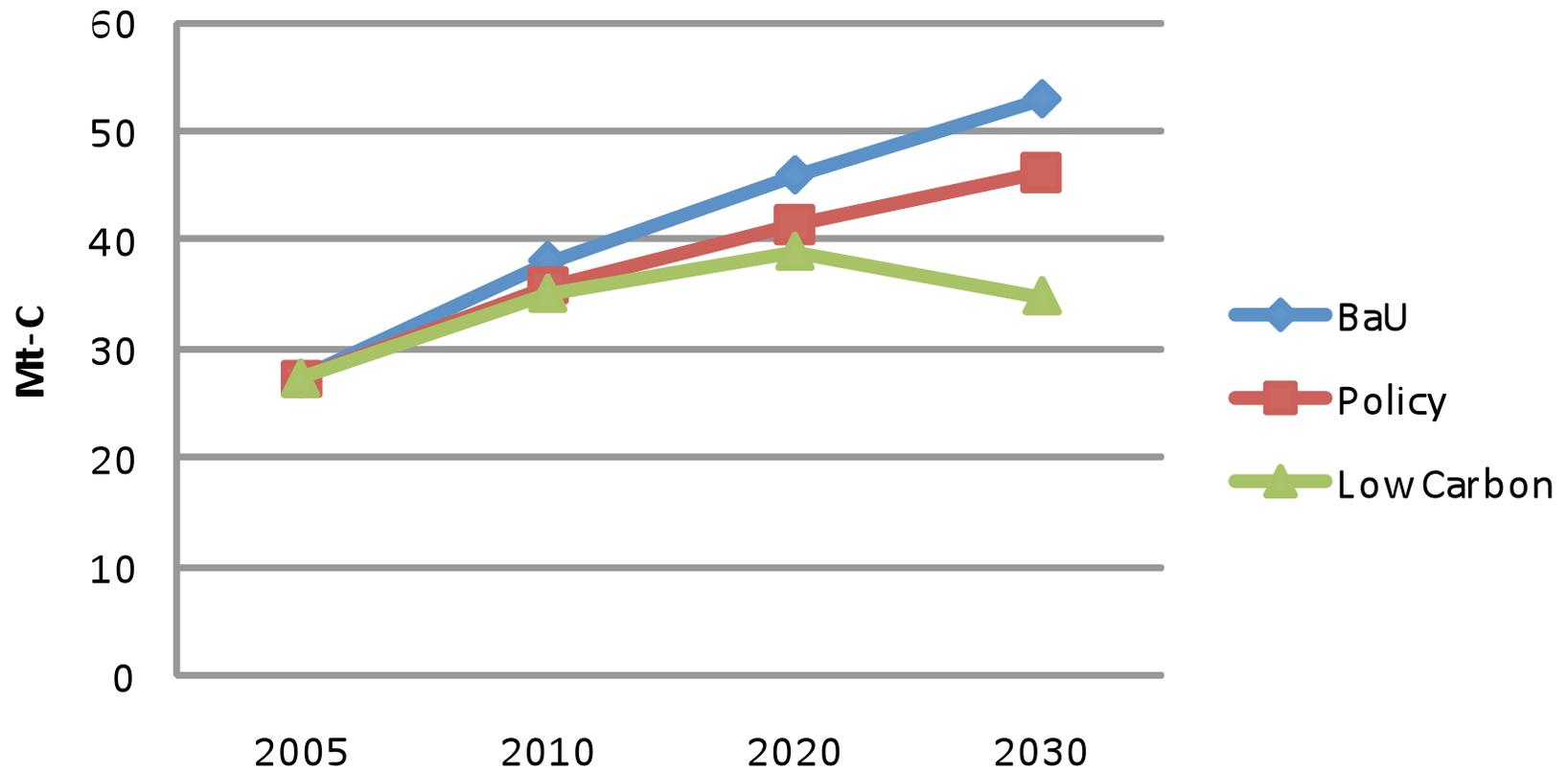
CO2 emission per capita, t-CO2



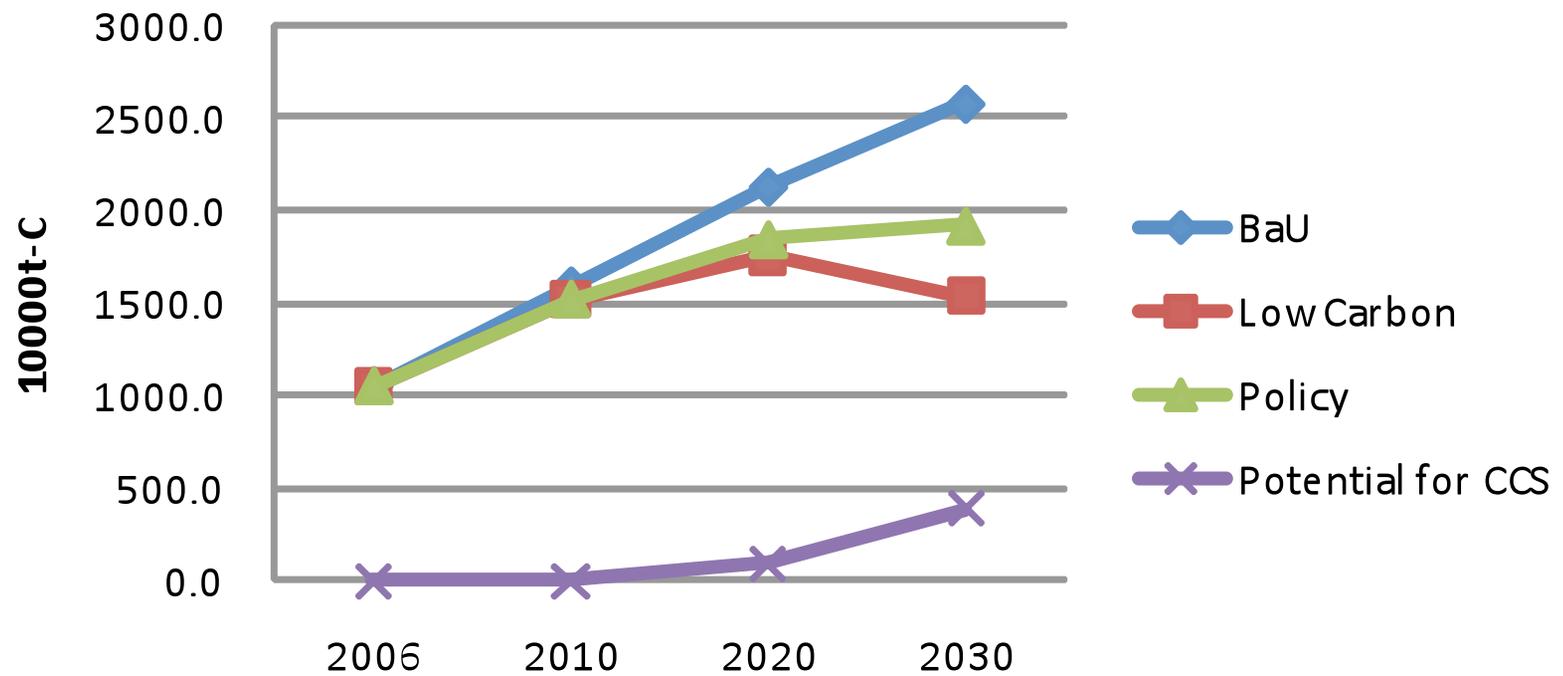
# CO2 emission from energy activities in Guang Dong, mt-C



# CO2 Emission in Beijing

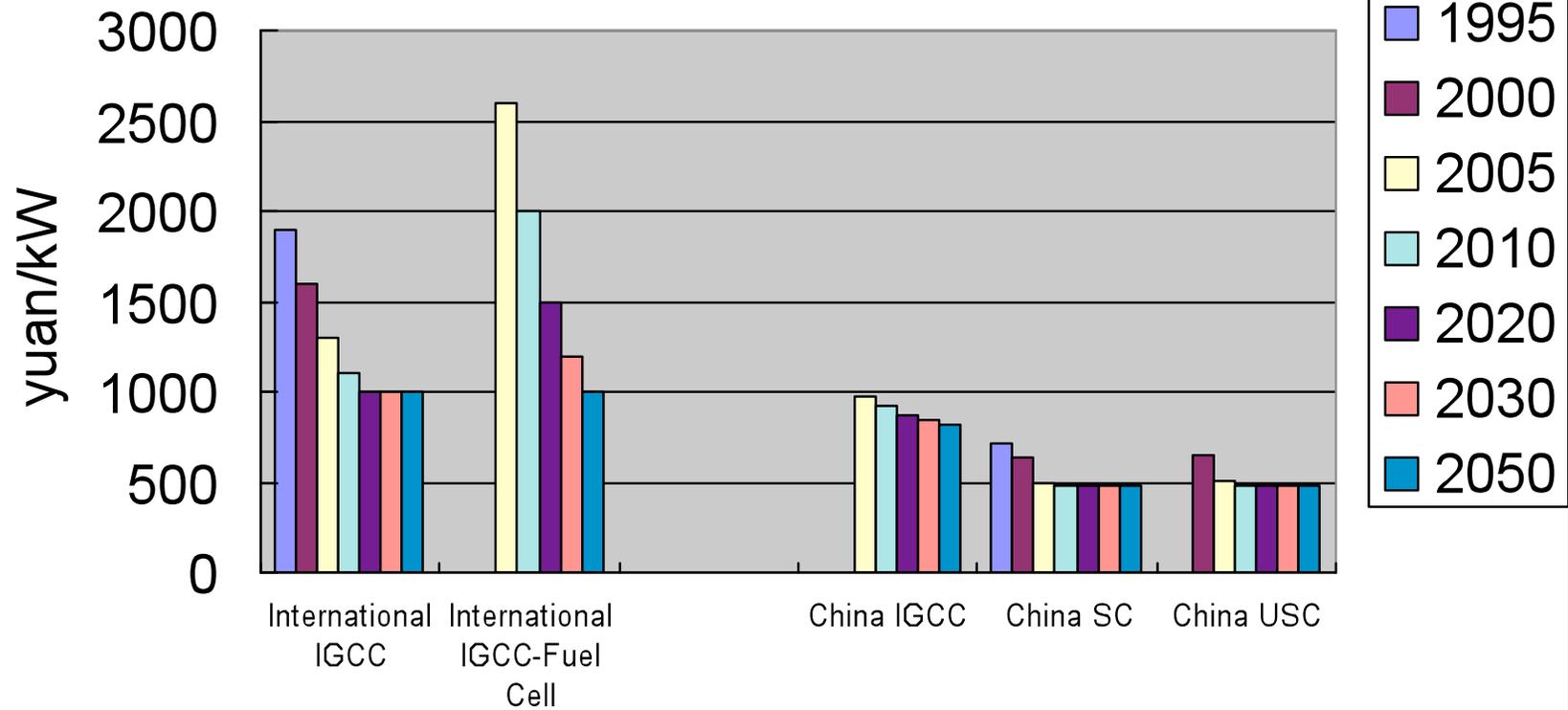


## CO2 Emission from energy use: Jilin City

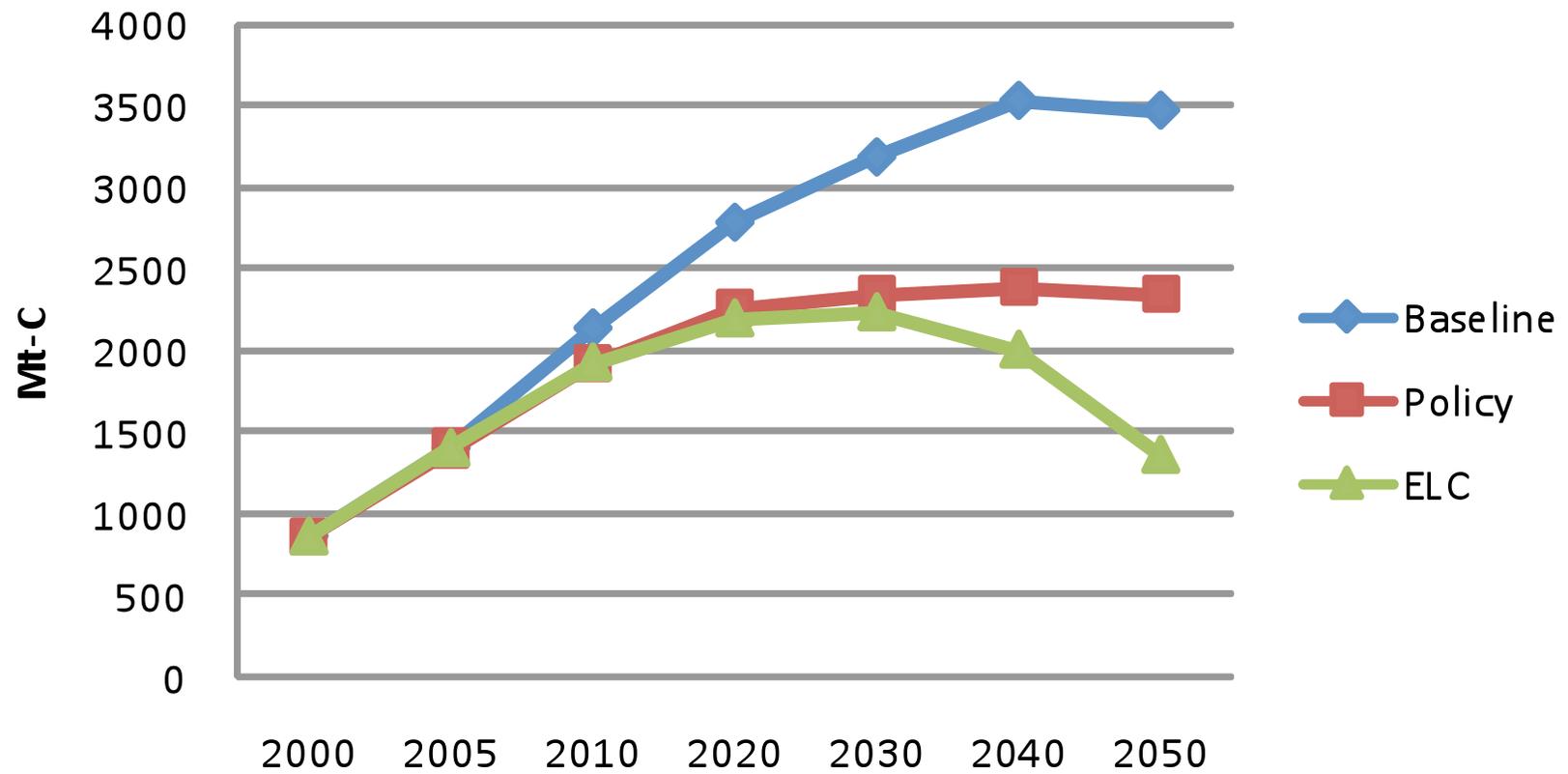




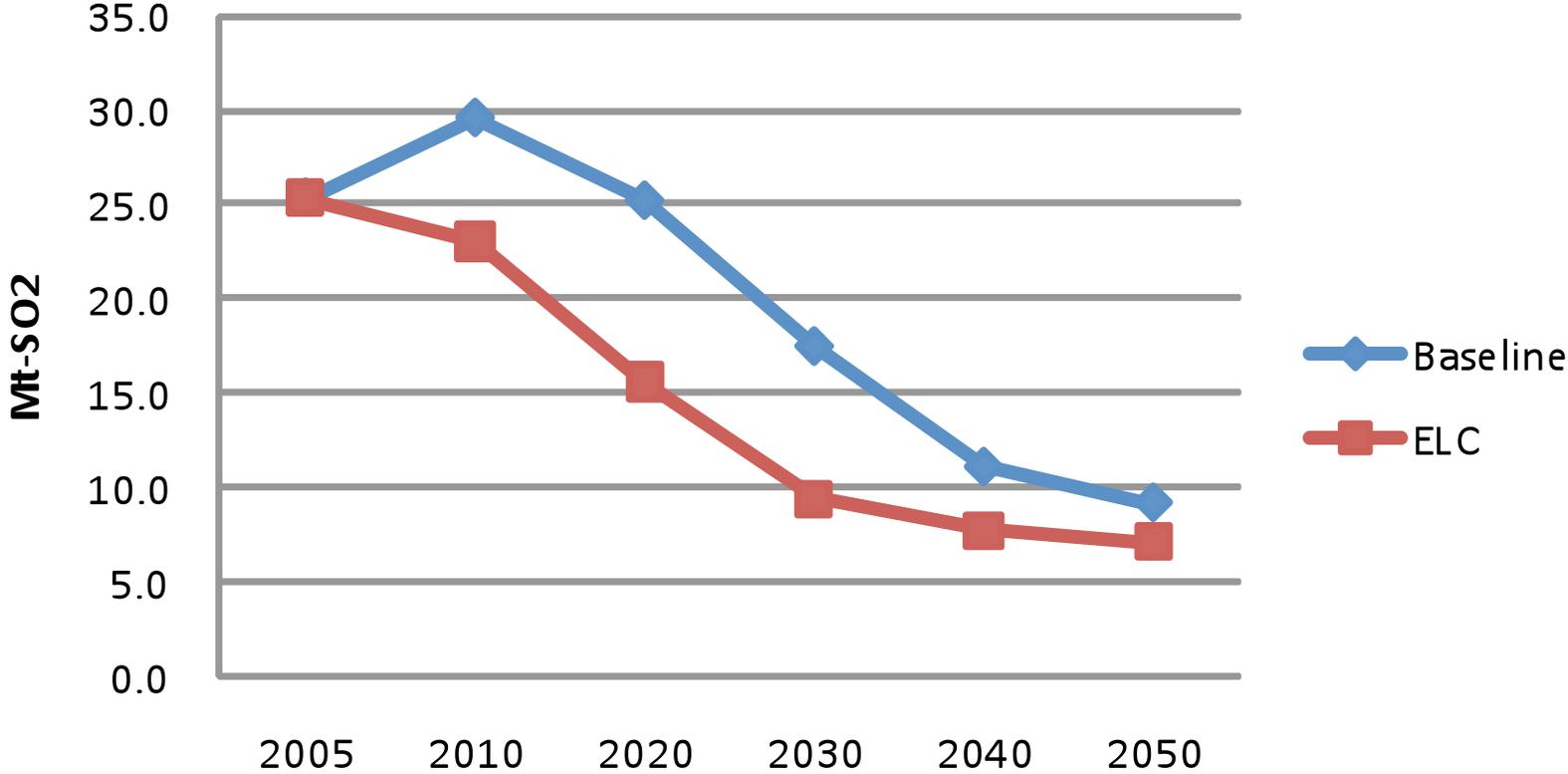
## Fixed Unit Investment



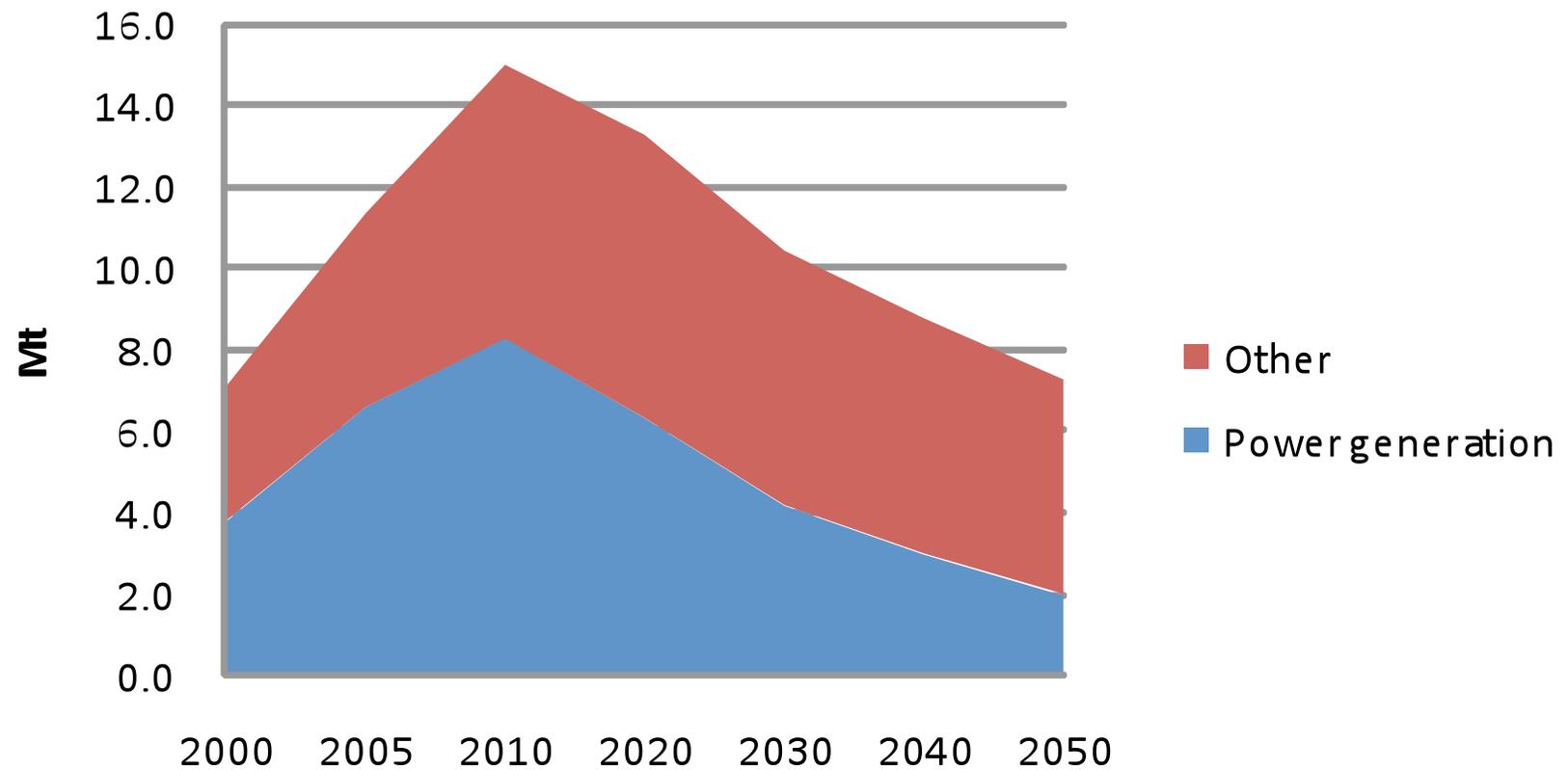
# CO2 Emission in China



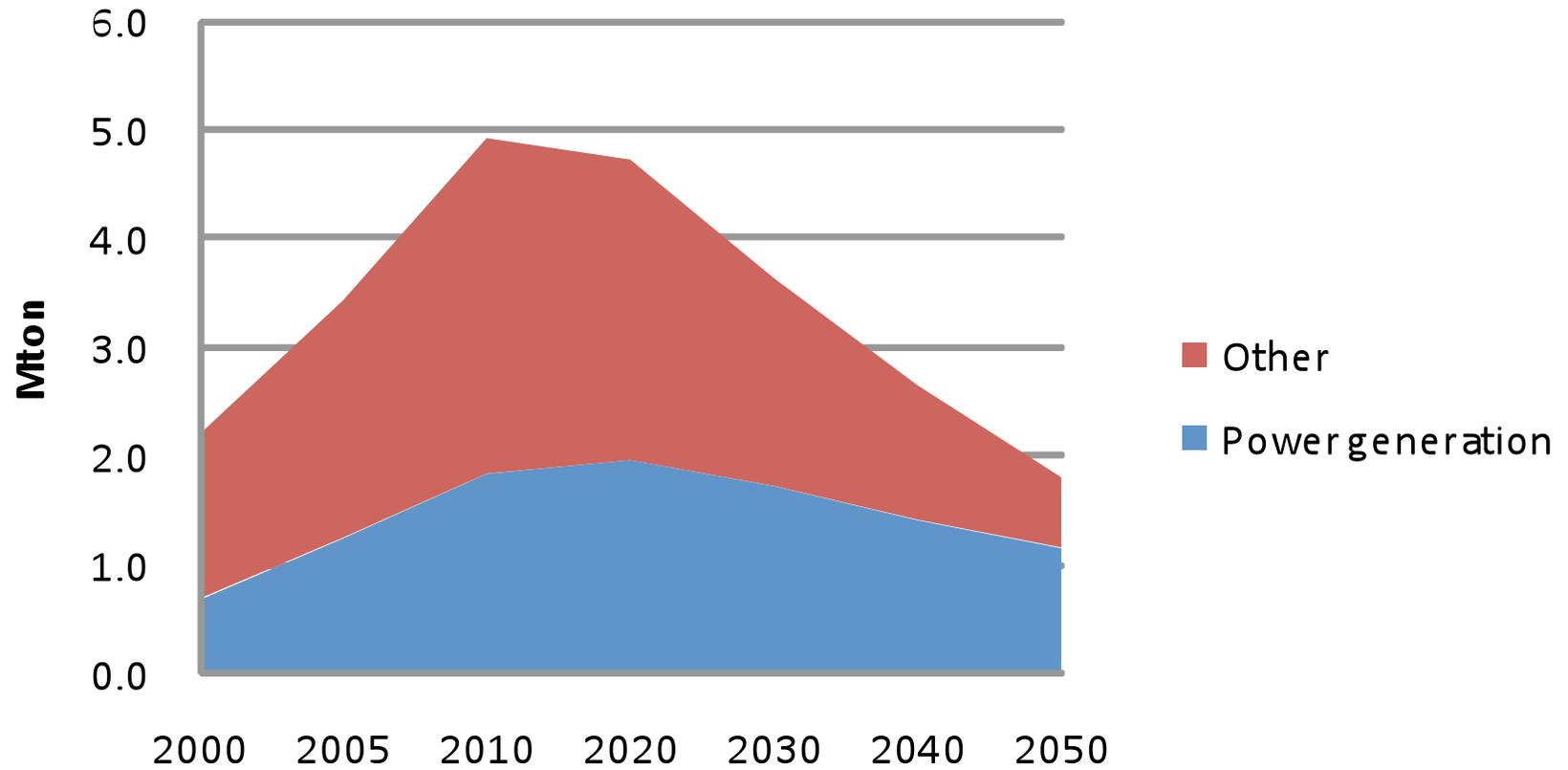
# SO2 Emission in China



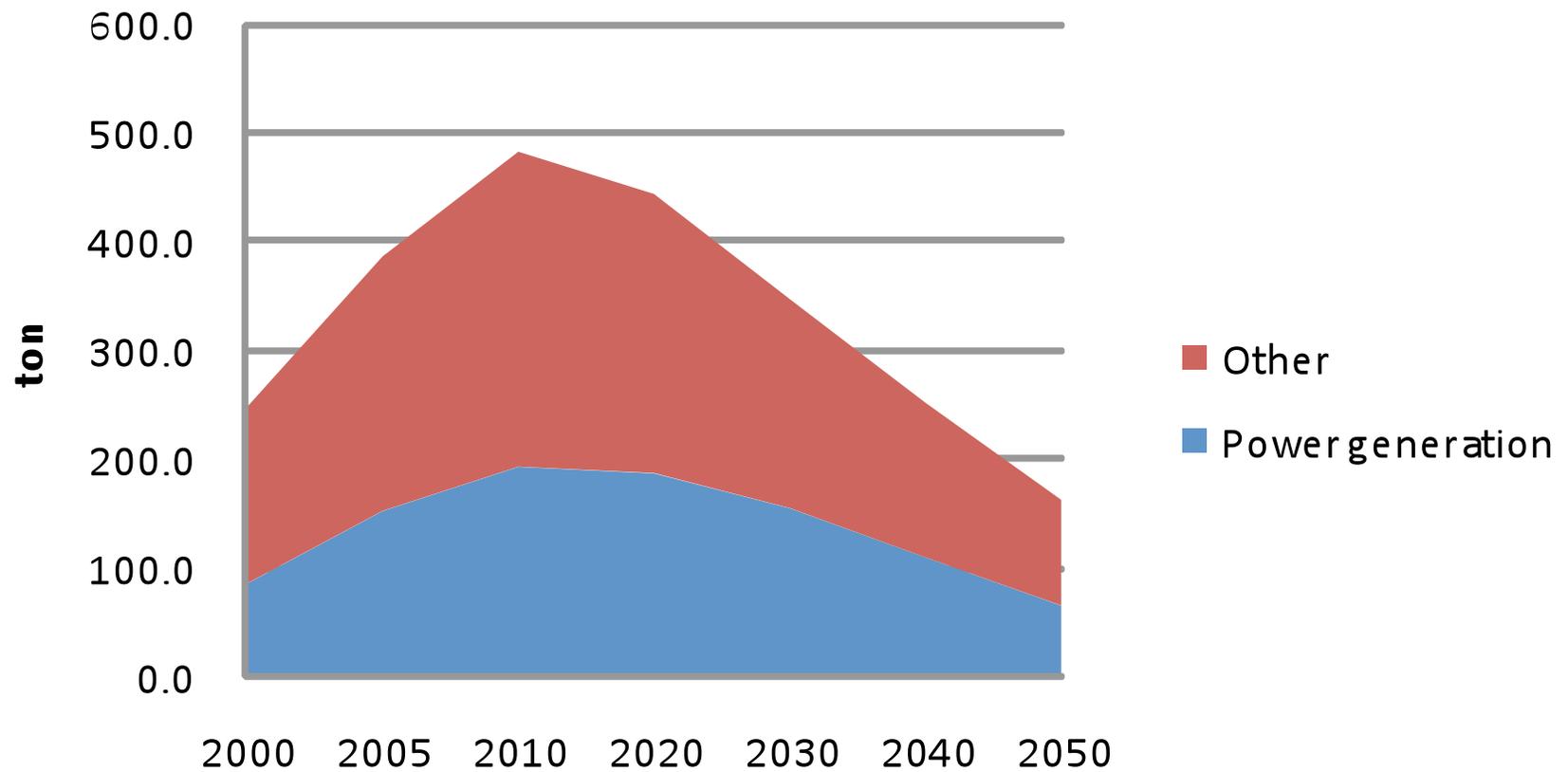
## NOx Emission in China, ELC scenario



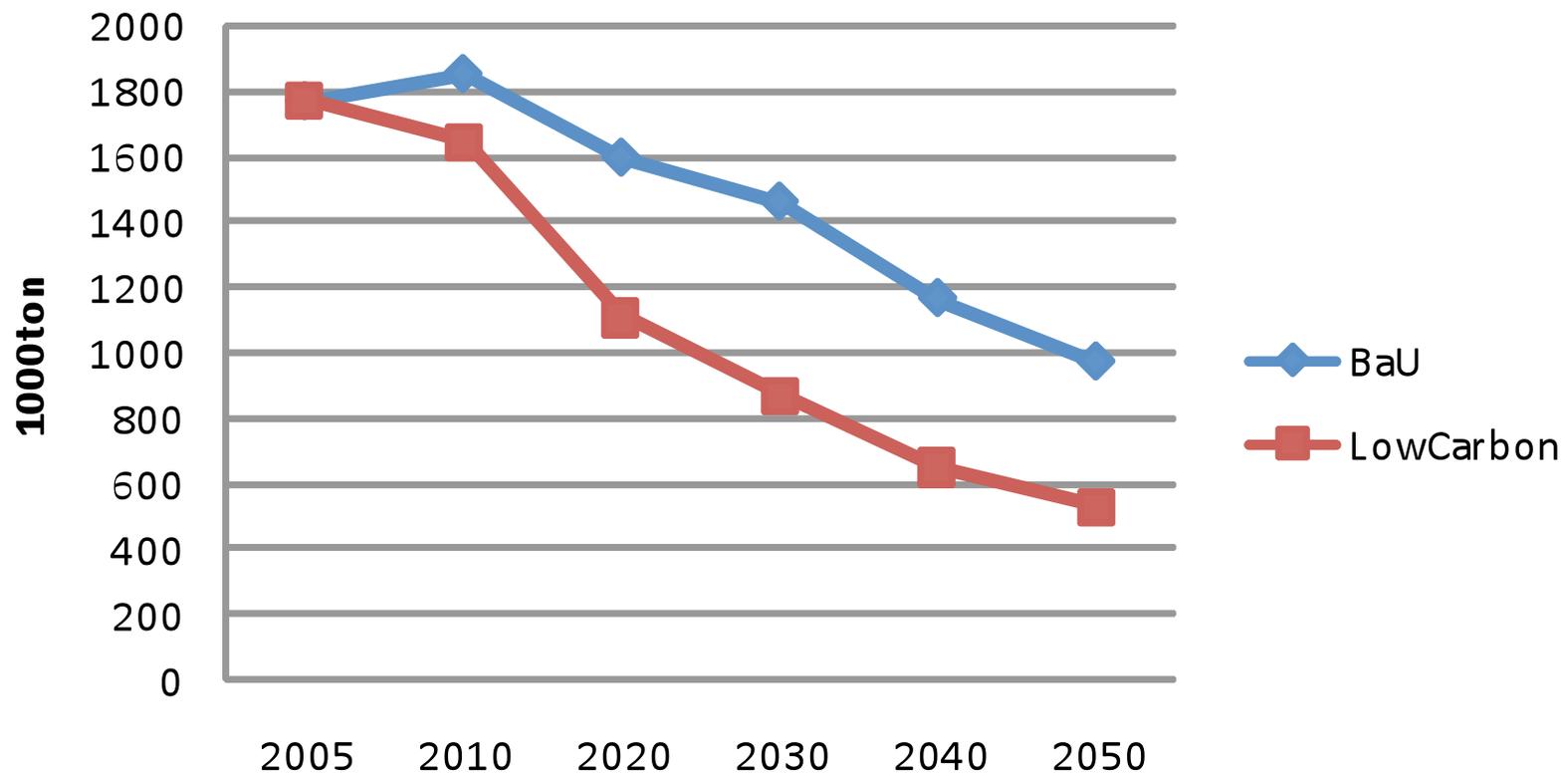
# PM2.5 Emission



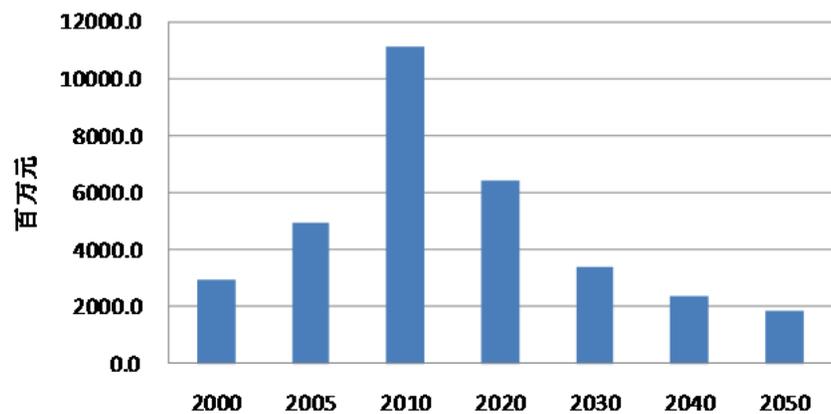
# Mercury Emission



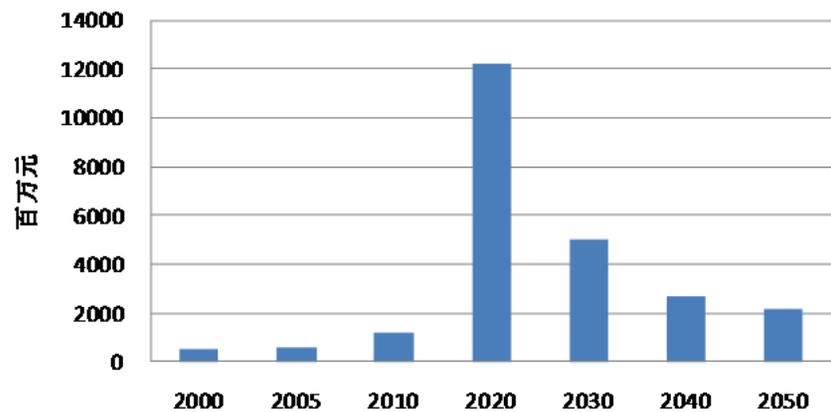
## Black Carbon Emission in China



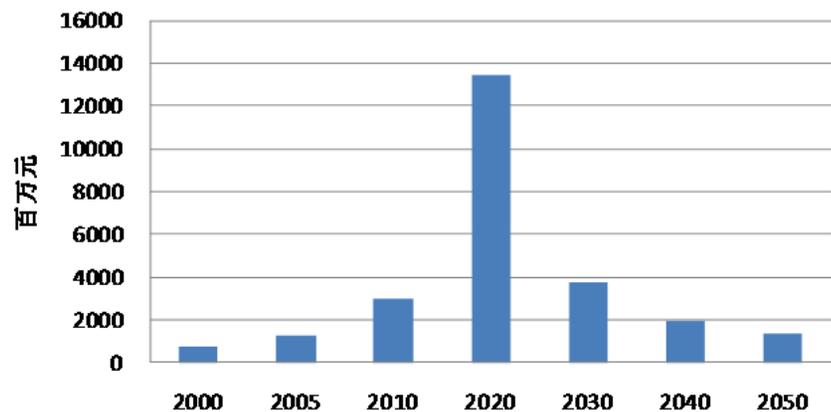
### SO2减排固定资产投资



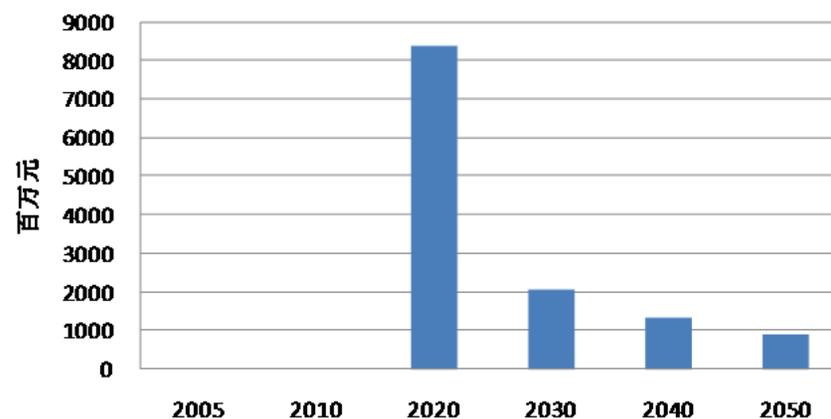
### PM2.5 减排固定资产投资



### NOx 减排固定资产投资



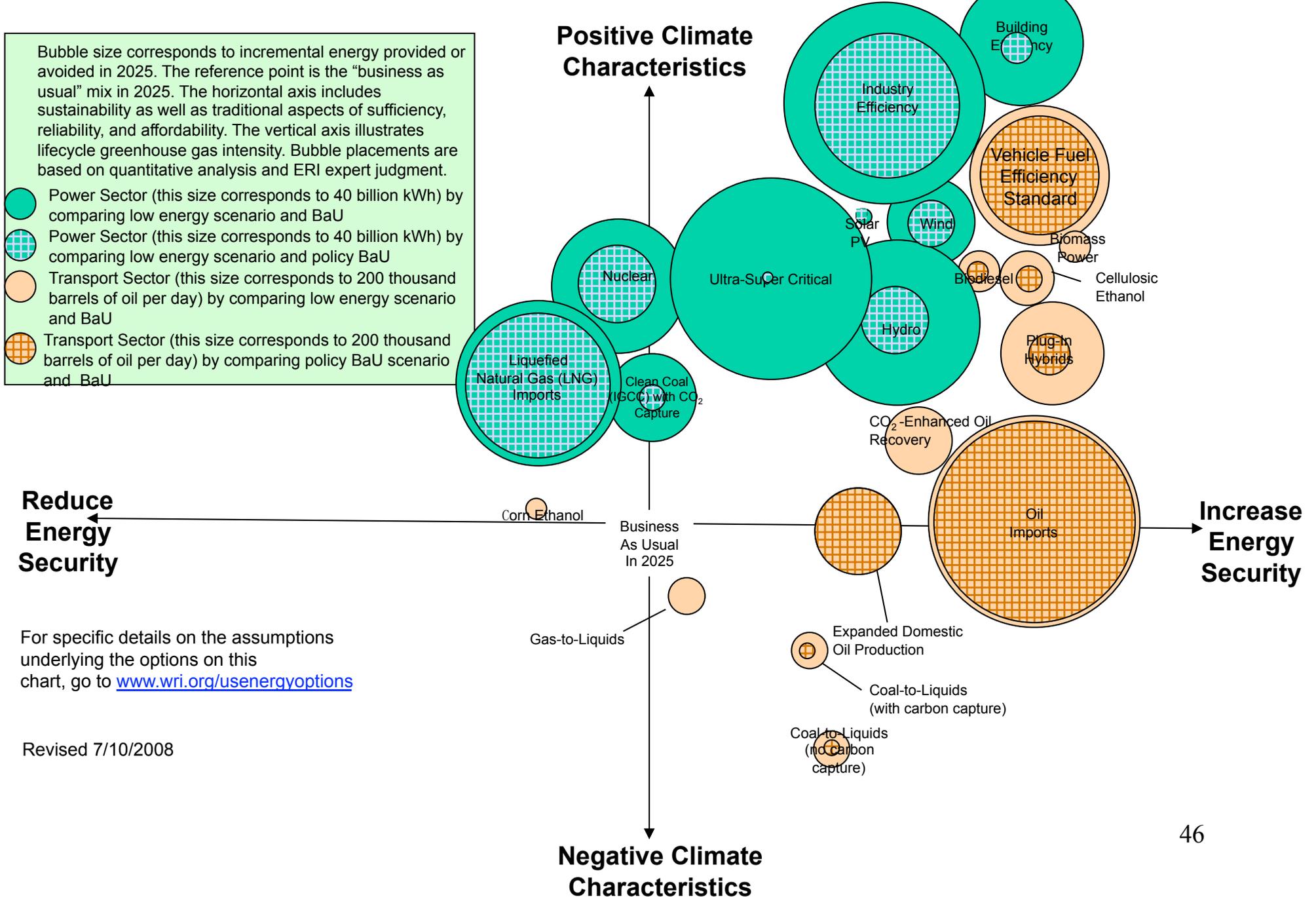
### 汞 减排固定资产投资



# 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



For specific details on the assumptions underlying the options on this chart, go to [www.wri.org/usenergyoptions](http://www.wri.org/usenergyoptions)

Revised 7/10/2008

## 发电设备用水需求和温室气体排放

