

Perspective on Modeling Work on Emissions Trading in China

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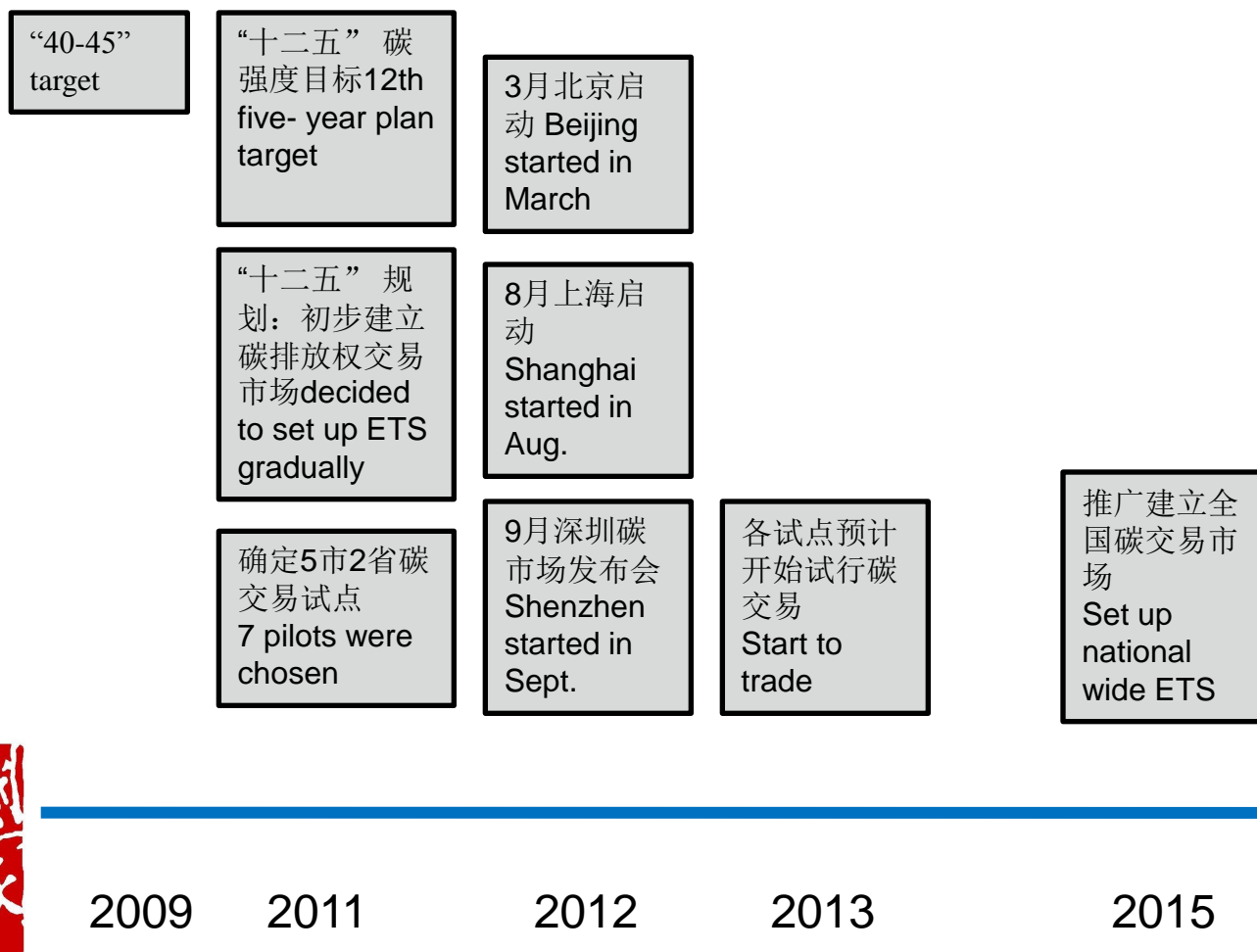
Current progress of ETS pilots

SIC-GE Modeling and applications

Further modeling work needs on ETS establishment in China



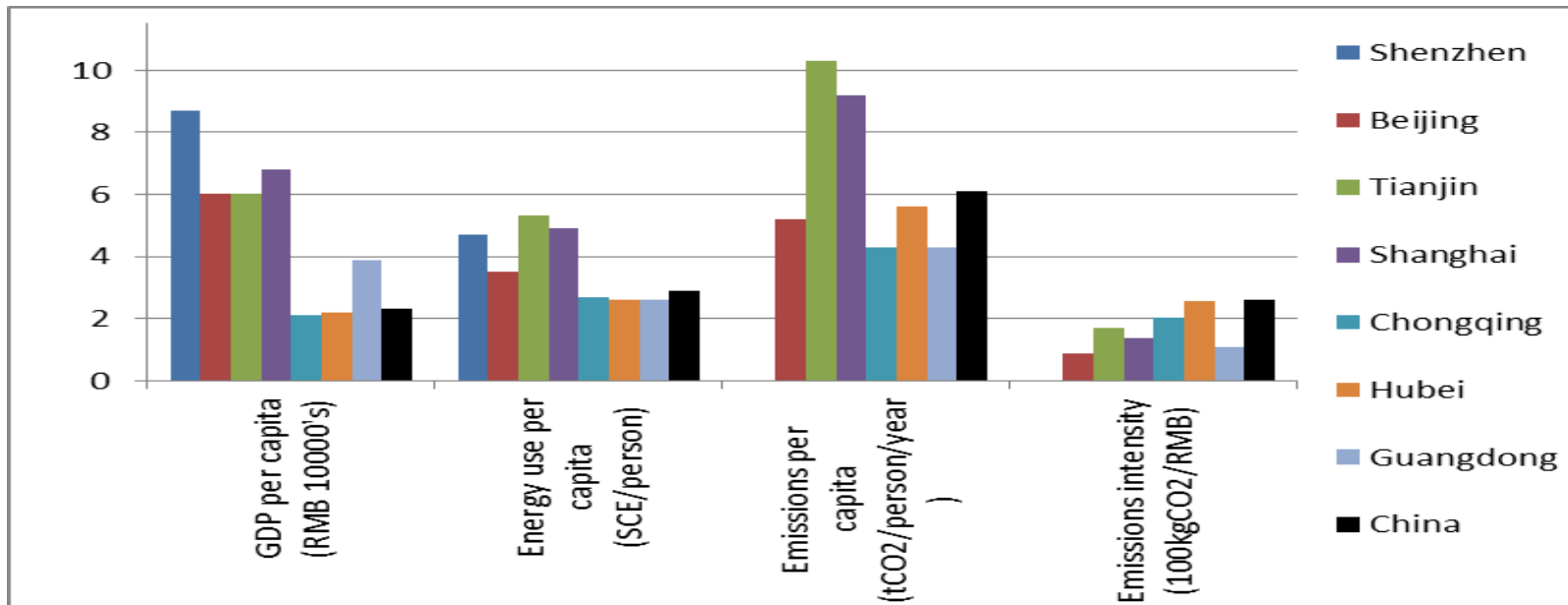
Current progress of ETS pilots



Current progress of ETS pilots

the pilots respectively locate in north, middle, west and east China, and cover the area of 480,000 km² and the population of 199 m. 试点地区分布于中国东、中、西和北部，人口1.99亿，面积48万平方公里

the pilots have different industrial structure and economic development level, produce 30% of China GDP and release more than 20% of CO₂ emission of China. 试点地区具有不同的产业结构和经济发展水平，占中国30%的GDP和20%的CO₂排放量



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SIC-GE研制 SIC-GE Modeling

国家信息中心SICGE model system模型体系

SICGE 国家 (National model) CGE模型

- SICGE-L 劳动力 (Labor)
- SICGE-T 交通 (Transportation)
- SICGE-CO2 能源和碳市场 (Carbon Dioxide)

SICGE-R 区域间 (inter-Regional) CGE模型

- SICGE-R-CO2 能源和碳市场 (Carbon Dioxide)
- SICGE-R-L 劳动力 (Labor)

SICGE 区域/省 (regional/provincial) 模型

- SICGE-TJ (天津) ; SICGE-BJ (北京) ; SICGE-SH (上海)



**State Information Center General Equilibrium Model
(SICGE)**

SIC-GE研制 SIC-GE Modeling

- SICGE-R model is based on the TERM (The Enormous the Regional the Model) model developed by CoPS. It is a bottom-up multi-regional general equilibrium model. In the model, each region is taken as a separate economy, and linked with trade, investment and labor mobility with other provinces.
- Compared with "Top down" regional model, this model could not only analyze the impact of regional demand-side shock, but also simulate regional supply side shock. Another special feature is that it allows for regional re-export flow.
- We have added the carbon tax and emission trade module, so it can simulate the impact of regional carbon tax or emission trading market.



Static: 31 Provinces 193 Sectors
Dynamic: 8 Regions 35 Sectors

SIC-GE研制 SIC-GE Modeling

- SIC-GE核心模型 structure of the SIC-GE core model
 - 基于2007年投入产出表
based on 2007 China input-output data
 - 涵盖150个生产部门和产品
cover 150 industries/commodities
 - 包含农业劳动者、农村非农业劳动者、农民工、城镇非技能从业者、城镇技能从业者共5类就业人员
5 kinds of labors: agriculture, rural non-agriculture, rural-urban migrant workers, urban low-skill employment and urban high-skill employment
 - 包含劳动力、资本和土地三种初始投入
3 kinds of primary factors: labor, capital and land
 - 包含8种运输、商业等费用部门
8 kinds of margin commodities, which includes water, air, railway and road transportation, pipeline, insurance, trade (wholesale and retail) and warehouse
 - 包括生产税、增值税、进口关税、出口税、所得税等五大类税收变量，同时按照征收环节和征收方式详细刻画了中国的22种税收门类
 - 详细的能源和能源替代、CO2排放模块
 - 5 kinds of tax: production tax, VAT, import tariff, export tax and income tax. There are 22 kinds of tax in China, and 20 of them are Indirect tax, which is about 76% of total tax revenue



SIC-GE研制 SIC-GE Modeling

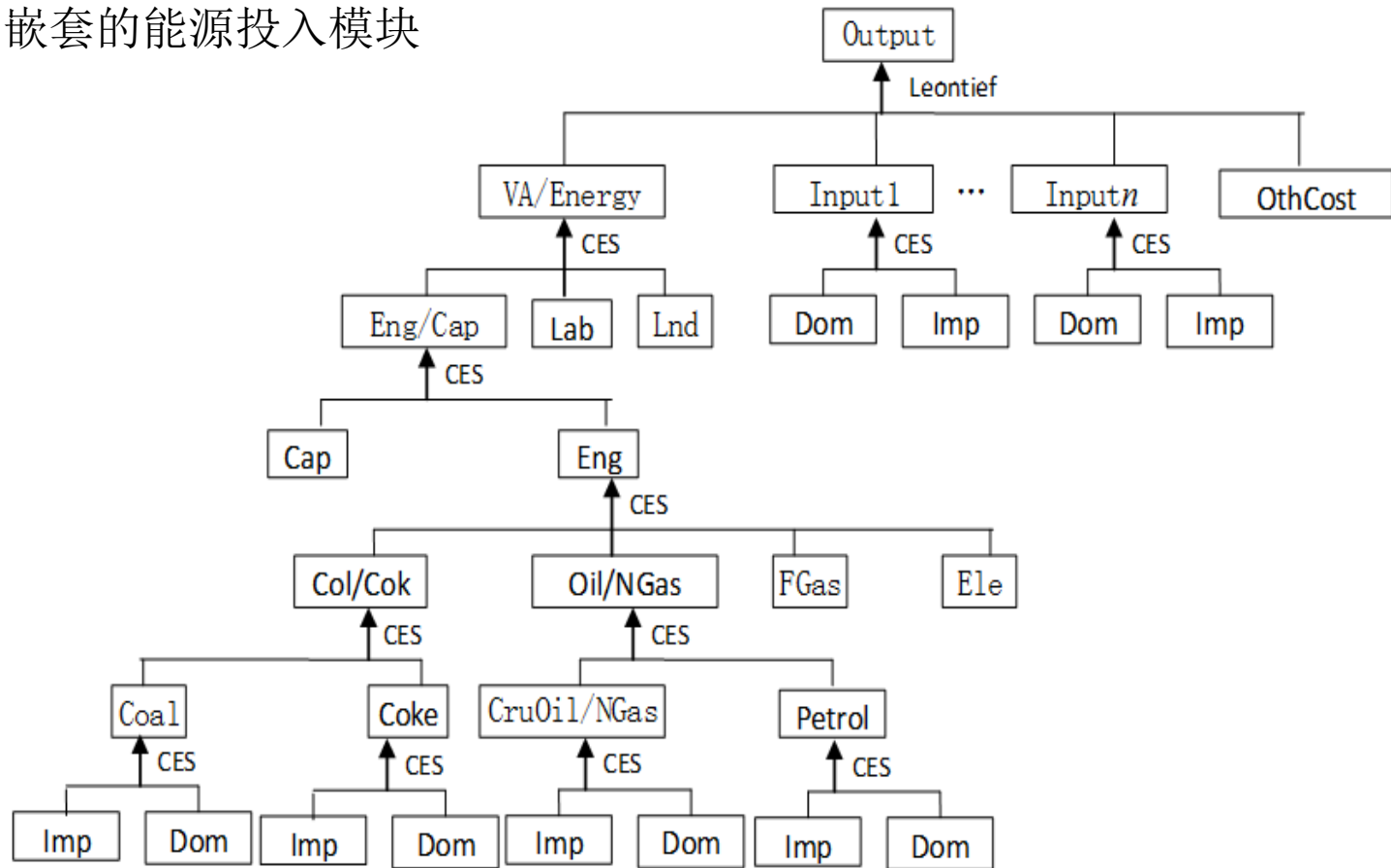
- SIC-GE核心模型 structure of the SIC-GE core model
 - 包含丰富的生产技术进步参数、消费偏好参数以及描述市场扭曲的偏移参数，能够有效模拟我国经济运行状态，便于政策模拟，从而提供有效的决策支持
Including different level technology improvement parameters, consumption preference parameters, and shift variables showing market distortion, to accurately describe the characters of China's economy
 - 通过独有的“历史模拟”，引入历史数据进行校准，提高未来预测情景的准确度
Using the historical simulation, to improve the accuracy of the forecasting simulation
 - 基本情景预测到2050年
baseline forecast is to 2050
 - 基础数据翔实，与国家统计局、发改委等政府部门和国家信息系统各单位密切合作，确保模型数据翔实准确
 - Constructing database under the support by NBS, NDRC and local government agencies, to insure the quality of the data



SIC-GE研制 SIC-GE Modeling

SIC-GE模型的基本结构

- 多层嵌套的能源投入模块



选择对碳价格反应敏感的行业

Coverage of industries

电力部门是对碳价格反应最敏感的部门，是进入碳市场的首选。

除此之外，钢铁部门、煤炭开采部门、化工部门等高耗能部门也都较为敏感。

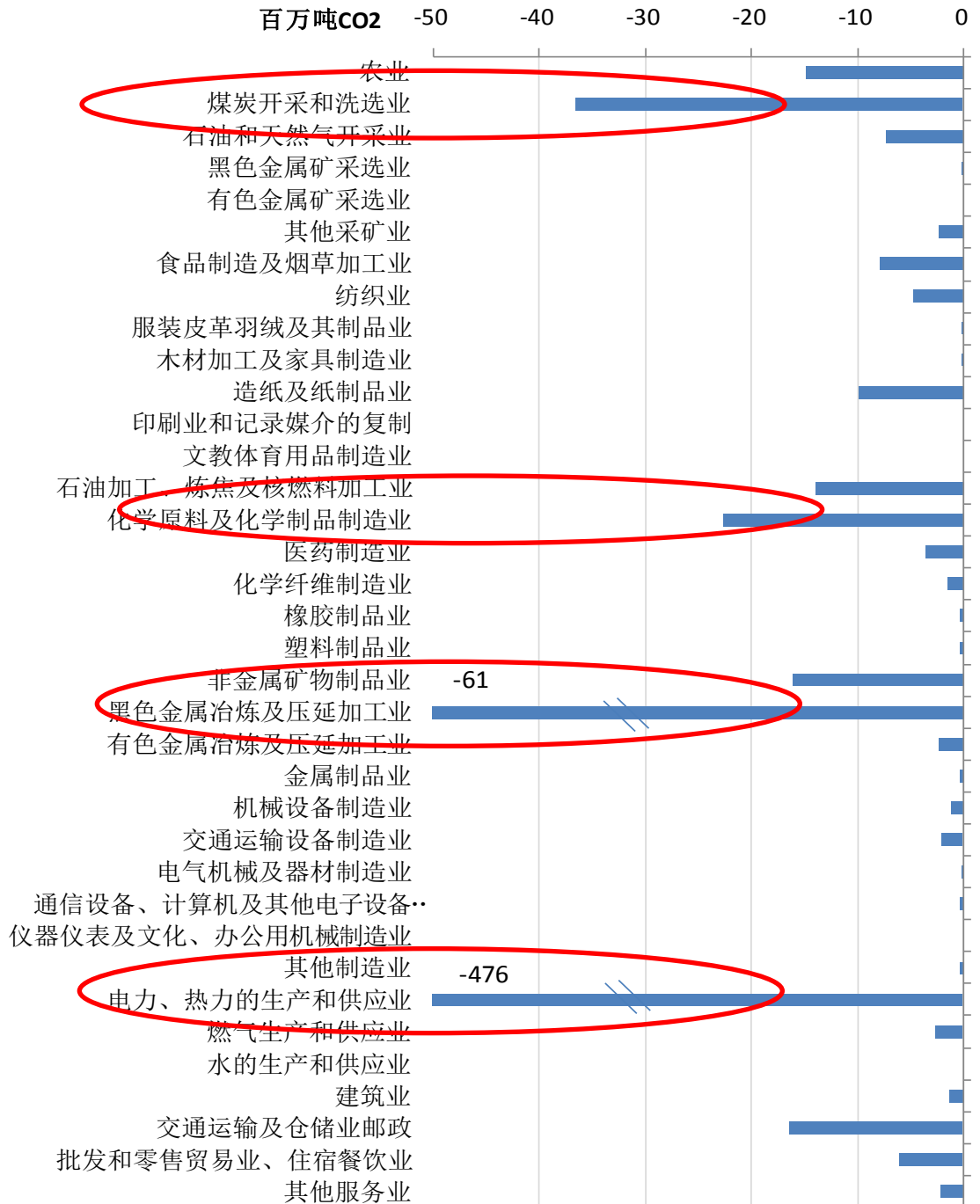
The first coverage should be electricity generation sector, besides, Iron and steel, coal mining, chemistry, etc. also need to be included.



图：100元/吨CO₂碳价格引起各行业碳排放量的降幅

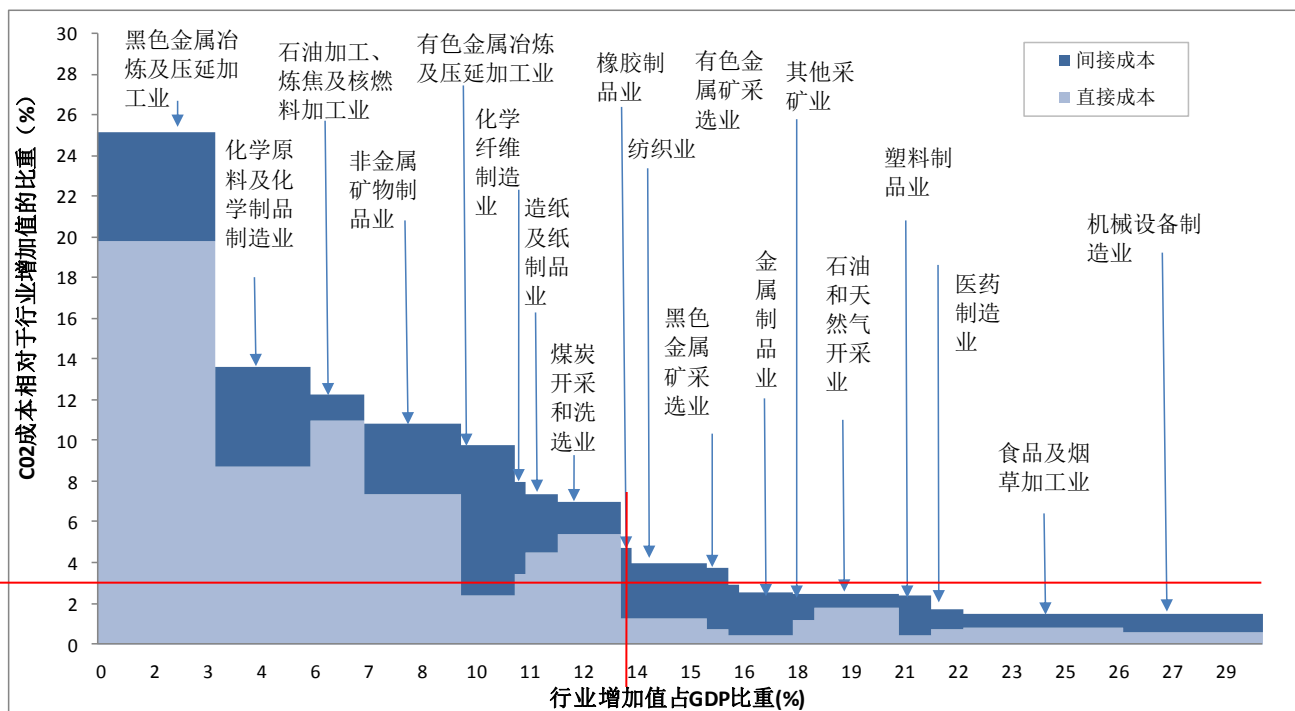
Sectoral CO₂ reduction at 100 Yuan/ton CO₂

数据来源：国家信息中心研究 SIC estimation



150元/tco2对我国行业竞争力的影响程度测算

Impact on sectoral competitiveness of carbon price by 150 yuan/tco2



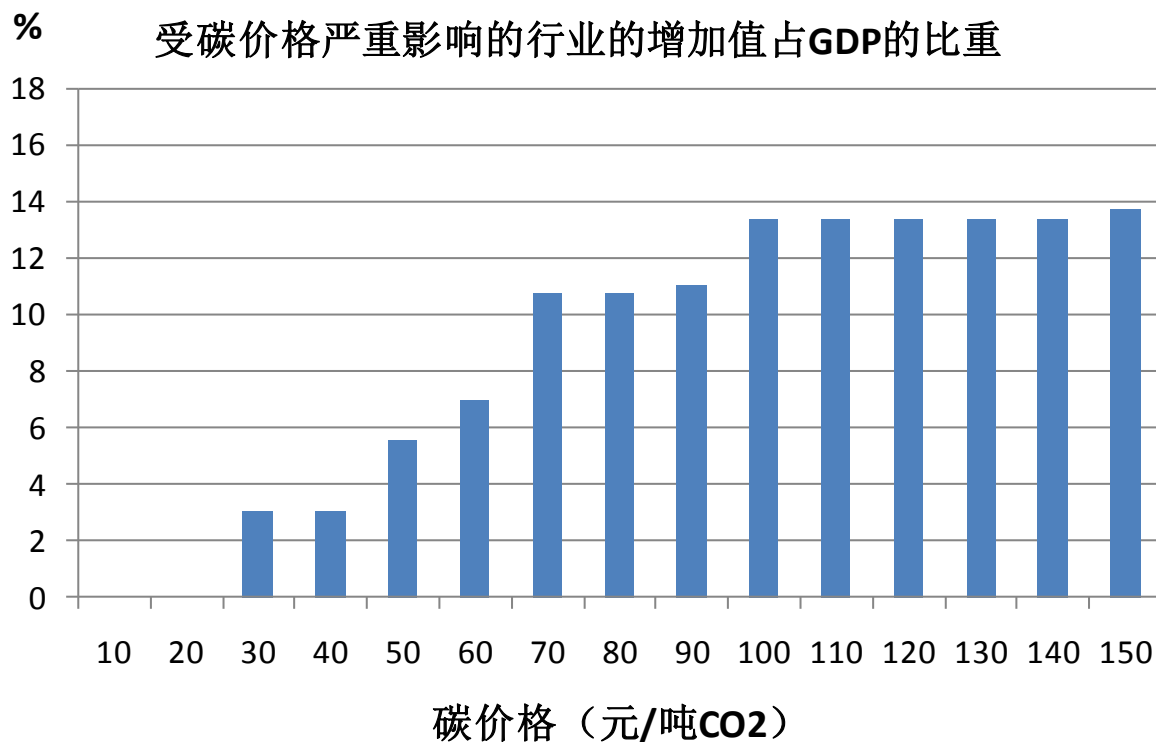
如果采用150元/吨CO₂的碳价格，会使得我国大部分制造业的生产成本上涨明显，竞争力受到较大影响。如果以碳价格引起额外成本占增加值比重超过5%的行业为限，这些行业增加值合计约占GDP的14%。Setting 150 RMB/t CO₂ carbon price, will lead to the big increase of production cost of most manufacture sectors. Setting the benchmark of ratio of carbon cost on value added as 5%, the sum of value added of the sectors above benchmark will be 14% of GDP.



150元/吨CO₂碳税引起的额外成本占行业增加值比重
carbon cost on value added (150 RMB/t CO₂)

根据对行业竞争力的影响程度确定合理碳价格水平

Defining carbon price by assessing the impact on sectoral competitiveness



■随碳价格上升，受到严重影响（碳成本>5%的行业增加值）的部门逐渐增加。Sectors with carbon cost above 5% of VA will increase step by step by increasing carbon price

■20元/吨CO₂以内时，没有部门竞争力受到的影响达到了“严重影响”程度 if carbon price lower than 20 rmb/t co₂, there are sectors with carbon cost above 5% of VA



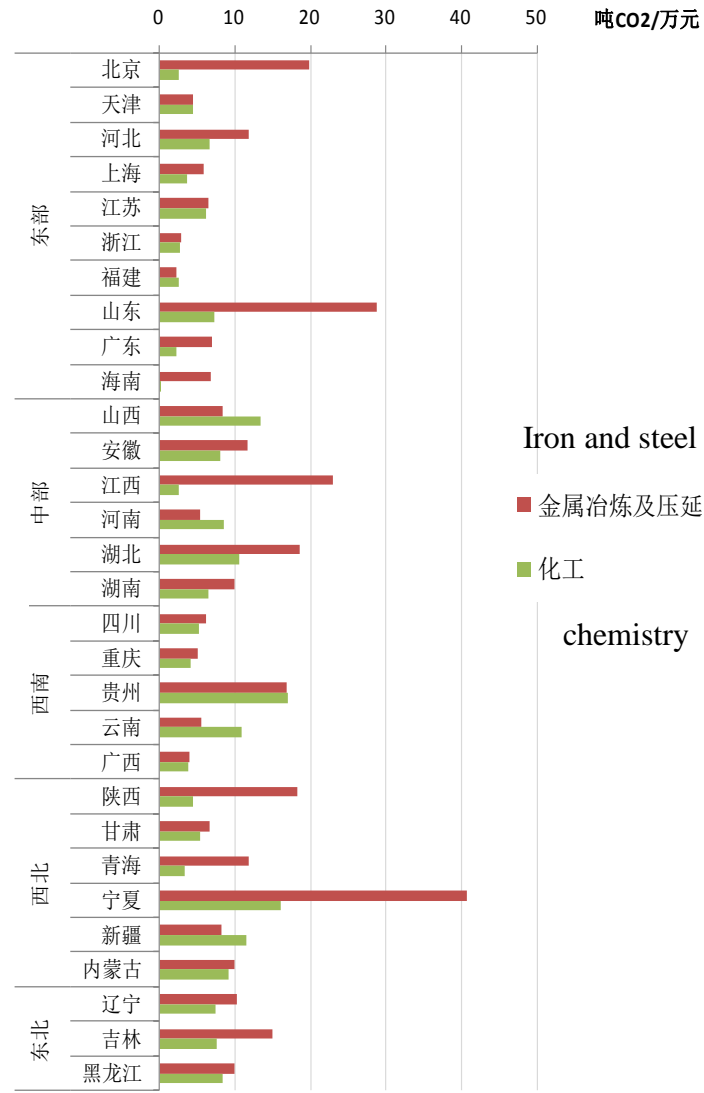
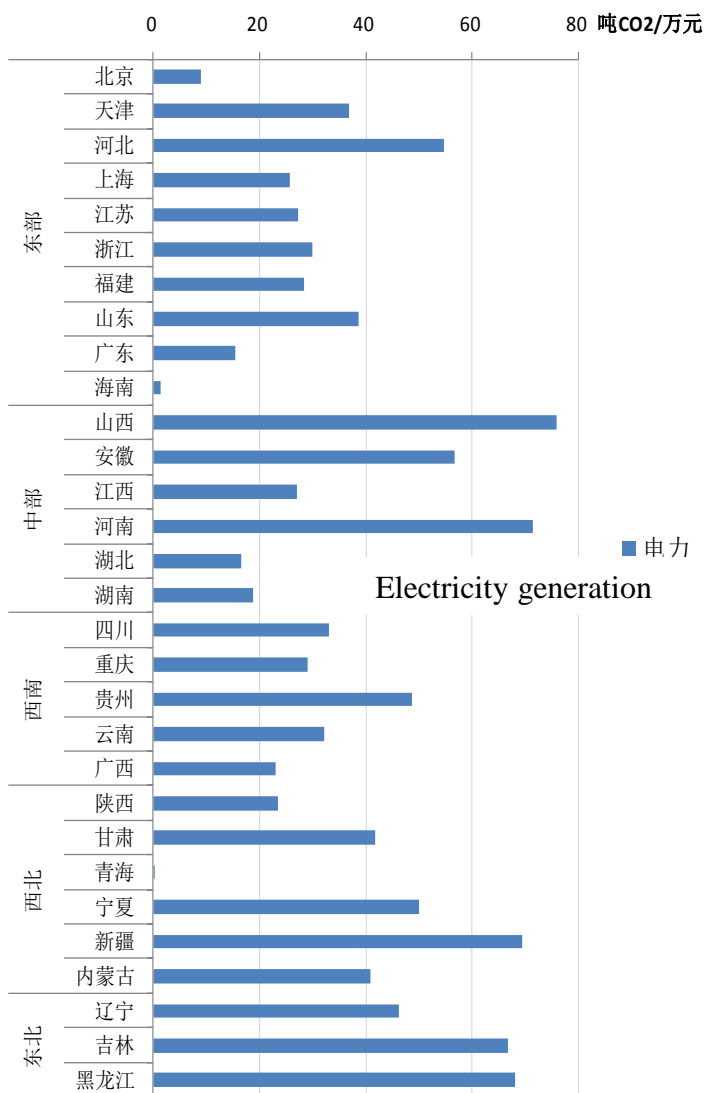
■40元/吨以内时，竞争力受到严重影响的部门的增加值占GDP比重不超过4%。
Summing up the VA of sectors in which the carbon cost is 5% higher than VA, when carbon price is 40 yuan/t CO₂, the ratio of VA on GDP will be about 4%, similar to the case in Europe with 20 Euro/t co₂

尽快实现跨地区交易 towards setting up the national scheme

同样的高排放行业，
在欠发达地区的单位增加值排放量明显高于发达地区

The high CO2 intensity industries tend to show higher emissions in under-developed provinces

数据来源：国家信息中心
Data source: SIC estimations



ETS: cost-effective mitigation mechanism

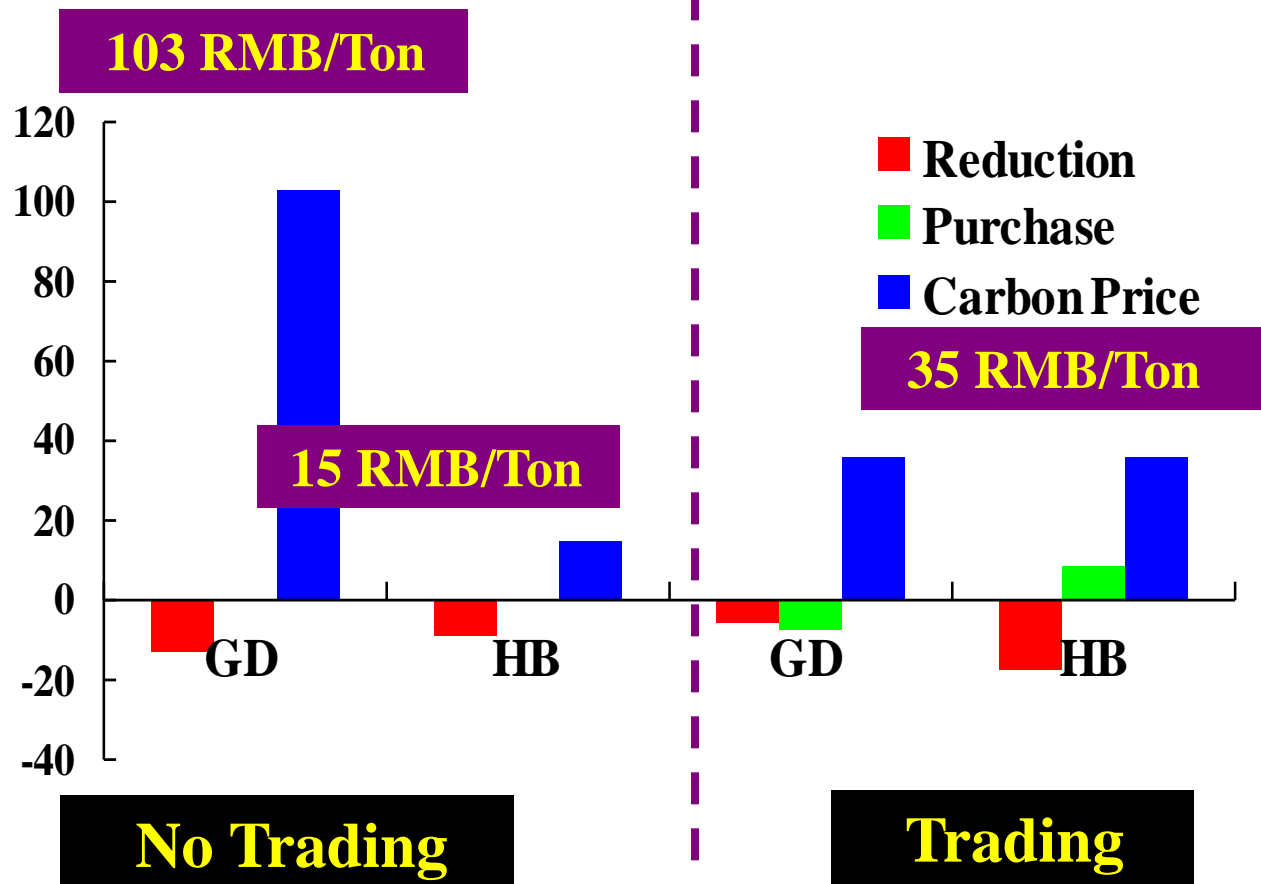
Introducing ETS in Guangdong and HuBei will reduce the abatement costs in both provinces

	GDP annual growth rate (2010-2015, %)		GDP loss in 2015 (100 Million Yuan, % of GDP)			
	Guangdong	Hubei	Guangdong		Hubei	
Baseline	8.00%	10%	0	-	0	-
Simulation 1	7.12%	9.39%	2724.61	4.03	699.48	2.72
Simulation 2	7.43%	9.44%	1778.10	2.63	650.61	2.53



- Simulation 1: CO₂ reduction without ETS and within province
- Simulation 2: CO₂ reduction with ETS and within province
- Simulation 3: CO₂ reduction with ETS and between provinces

ETS: cost-effective mitigation mechanism



GuangDong will buy 23 MT CO₂ (824 Million RMB) from HuBei

碳市场试点:同时涵盖发电企业和主要用电企业

For pilots: Cover power generation and consumption

- 电力市场特殊性 Specialty of power sector in China
(1) 电力价格由政府确定; electricity Price is under control by government (2)
电网及发电企业均以大型央企为主; Main power generation enterprises are state owned.
- 对策建议 Policy suggestions :

发电企业 power plant:
设置直接排放权 allocating
direct emission permit

1单位的直接排放权可简单对应
1单位的直接二氧化碳排放量
 $1 \text{ unit direct emission permit} = 1$
 $\text{unit direct co2 emission}$

用电企业 electricity user:
设置间接排放权 allocating
indirect emission permit

1单位的间接排放权所对应的间接排放量可按照如下公式设置:
1 unit indirect emission permit is setting following such formula: $IP = IE * S$
1单位间接排放权 IP 应等于1单位间接排放量 IE
乘上允许碳成本向下游转嫁的比例 S
 $1 \text{ unit } IP = 1 \text{ unit indirect emission } IE \times$
the share of cost passed through to users S



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Towards National ETS...

Cap setting and trajectory, sector covering, allowance allocation

- Price level and its impact
- Key sectors study: power generation industry
- Revenue use

To help current pilots and beyond...

Impact studies: growth (mitigation cost) and structure change,
industrialization pattern, regional effects/impacts

Policy assessment and decomposition (historical and forecasting)



Further modeling work needs on ETS establishment in China

Modeling system: a comprehensive simulation and assessment tool for economic and social development impact study

- SICGE as a core model
- SICGE-R-CO2 model improvement
- Building with detailed modules, including labor mkt. transportation, energy intensive industries, income distribution, etc
- Linking with other tech. models, including electricity mkt. other bottom-up models

对模型数据库进行更新调整 database issue

- 采用试点省市调查数据 pilot data
- 采用行业MAC调查数据 MAC data



谢谢 Thank you!

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