清华大学能源环境经济研究所
INSTITUTE of ENERGY, ENVIRONMENT and ECONOMY
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The role of carbon pricing in NDC implementation: A modeling perspective in China

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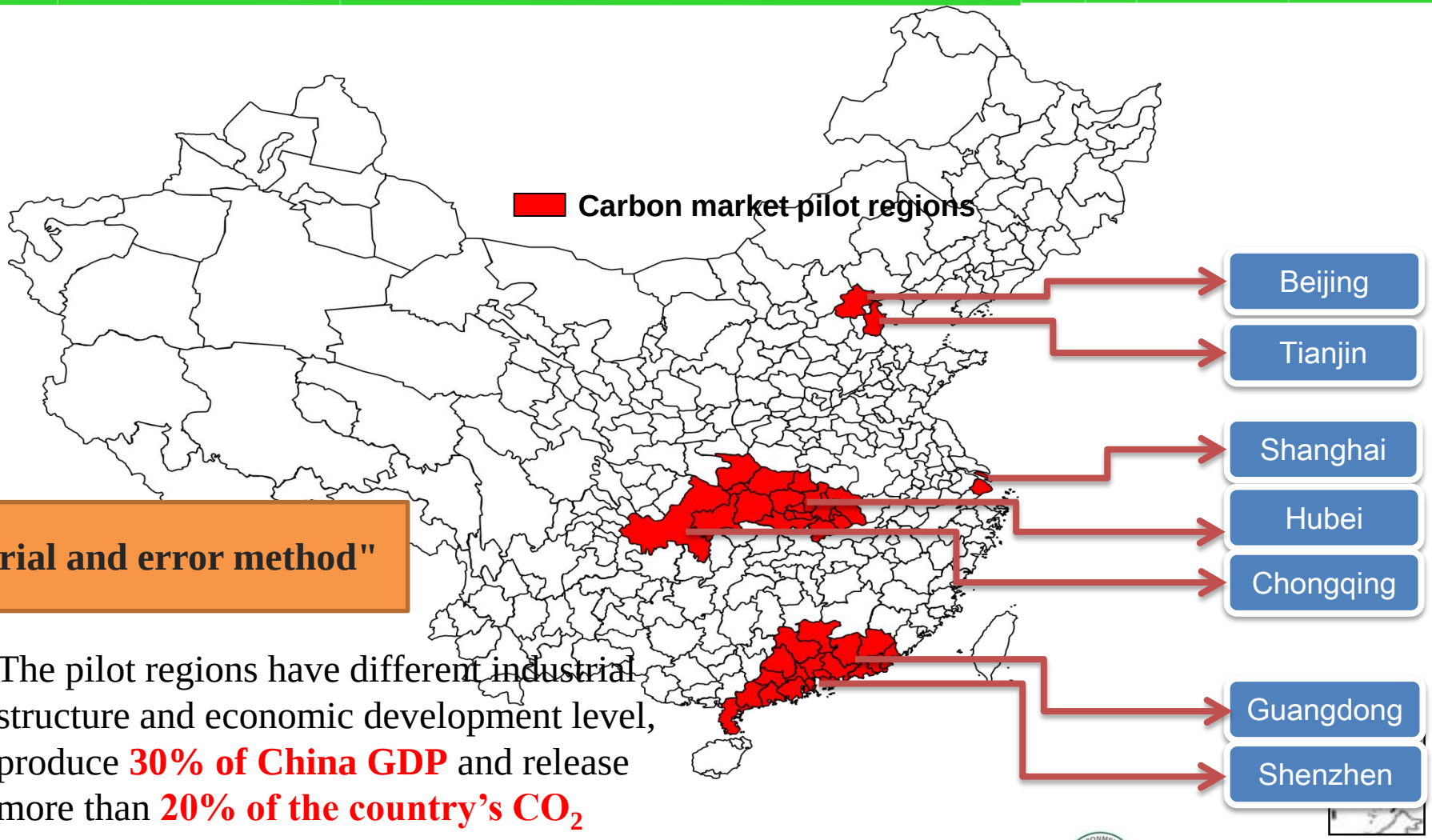
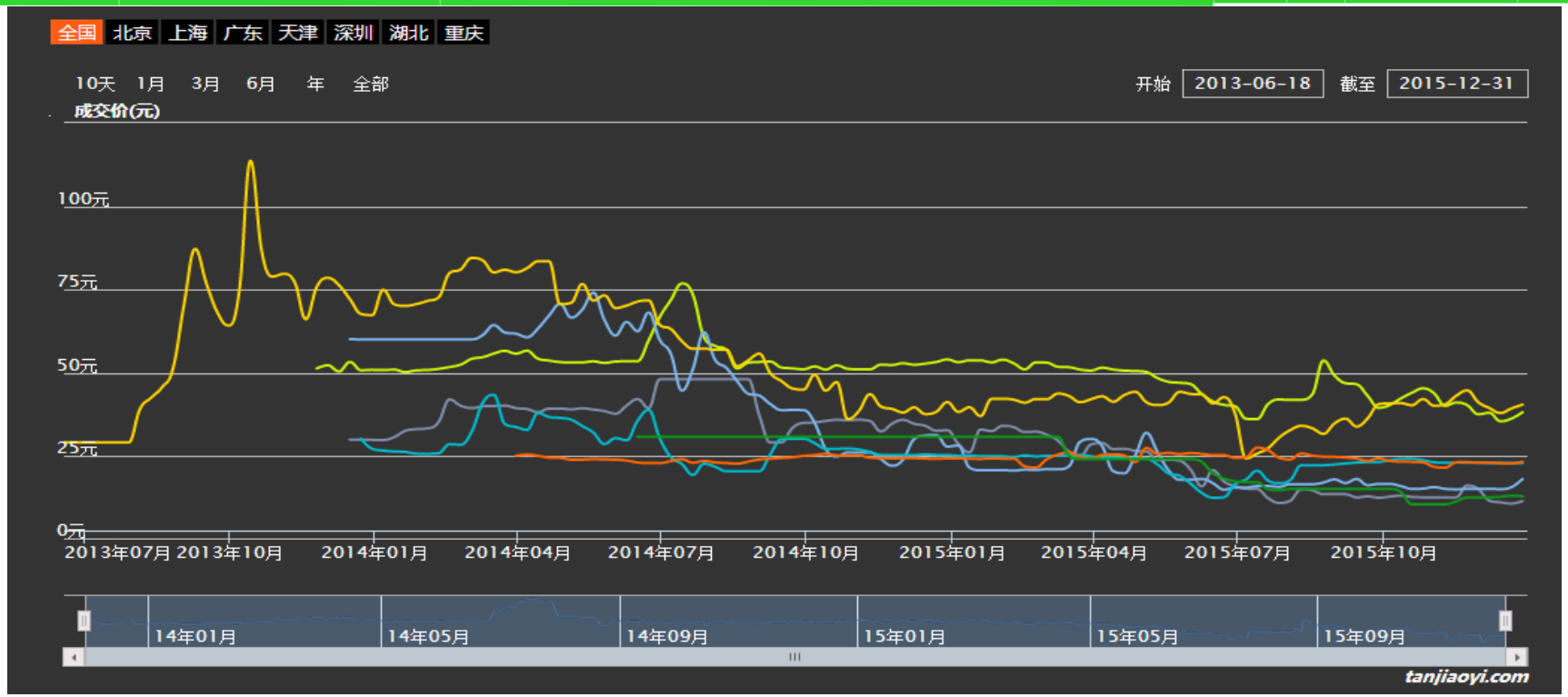
Carbon Emissions Trading Pilot based on the Bottom-up through the "trial and error method"



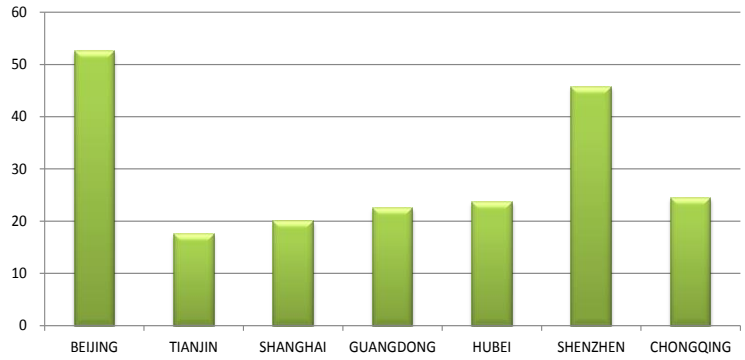
"trial and error method"

- The pilot regions have different industrial structure and economic development level, produce **30% of China GDP** and release more than **20% of the country's CO_2 emissions**.

Regional Differences of Carbon Price in the Pilot Carbon Market



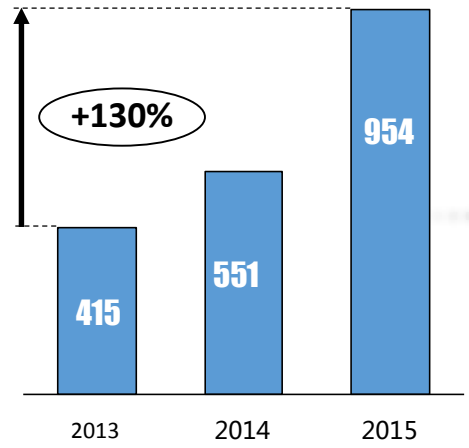
- By the end of 2015 :
  - Issued allowance : 2 billion t
  - Trading volume : 52 million t
  - Trading turnover:1.5 billion Yuan(RMB)



Experiences and Lessons from Pilot Carbon Market

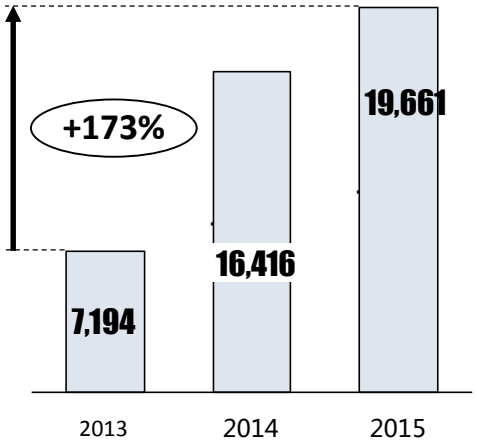
- Legislation is the fundamental guarantee:
  - Double - tier legislation: Beijing, Shenzhen
    - Decision of the Standing Committee of the local people's Congress (the strongest punishment to Non-compliance)
    - & Decree of the local people's Government
  - Single - tier legislation
- Data Quality is the key element:
  - Third party verification
  - Fourth Party Verification & Experts Review
- Allowance allocation is the visible hand of the government（harmony effect）:
  - industry structure adjusting polices
  - energy structure optimizing polices
  - Pollutant treatment polices

Beijing Pilot Carbon Market



Control entity units

- electricity
- heating
- cement
- petrochemical
- service industry
- manufacturing industries
- transportation



BEA Transaction turnover(10,000 yuan)

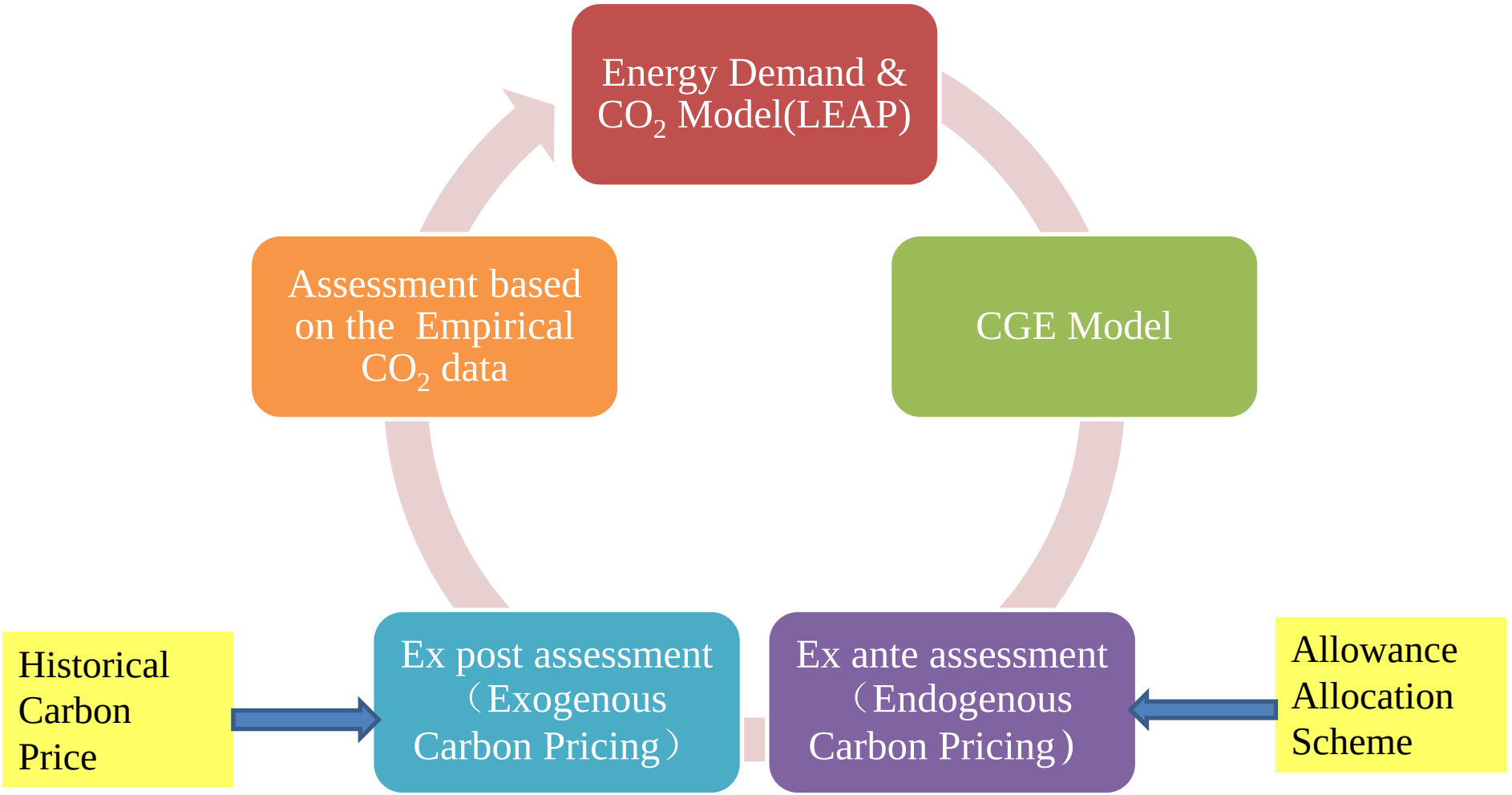
The control entity unit increased by 130%, the turnover of transaction increased by 173%, and the price remained stable

Allowance Allocation in BETS

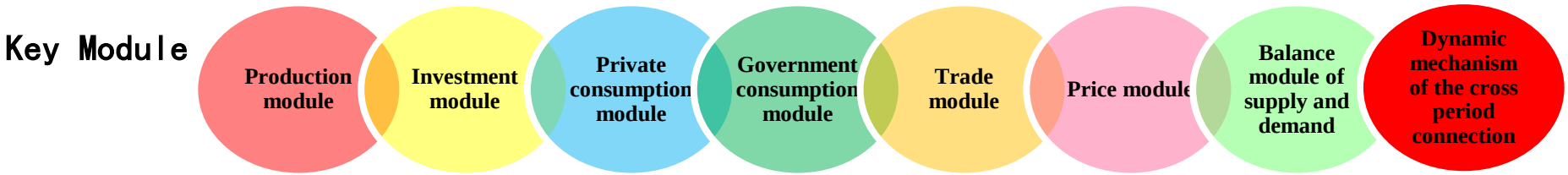
Emission Reduction Rate	2013	2014	2015	2016	2017	2018	2019	2020
Manufacturing industries Cement Petrochemical	98%	96%	94%	93.5%	93.0%	92.5%	92.0%	91.5%
Service industry	99%	97%	96%	95.5%	95.0%	94.5%	94.0%	93.5%
Power: Gas generating units	100%	100%	100%	99.5%	99.0%	98.5%	98.0%	97.5%
Power: Coal-fired units	99.90%	99.70%	99.50%	99.0%	98.5%	98.0%	97.5%	97.0%
Heating: Gas generating units	100%	100%	100%	99.5%	99.0%	98.5%	98.0%	97.5%
Heating: Coal-fired units	99.80%	99.50%	99.00%	98.5%	98.0%	97.5%	97.0%	96.5%

- Historical total emission method
- Historical carbon intensity reduction method

Carbon Pricing Assessment Cycle



Structure of CGE Model



input-output table(2012)

flows-of-funds table(2012)

Energy balance sheet (2012)

balance of payments(2012)

CGE Model

162 sectors

3 factors

32 sources of inputs

7 economy agents

10 marginal investment

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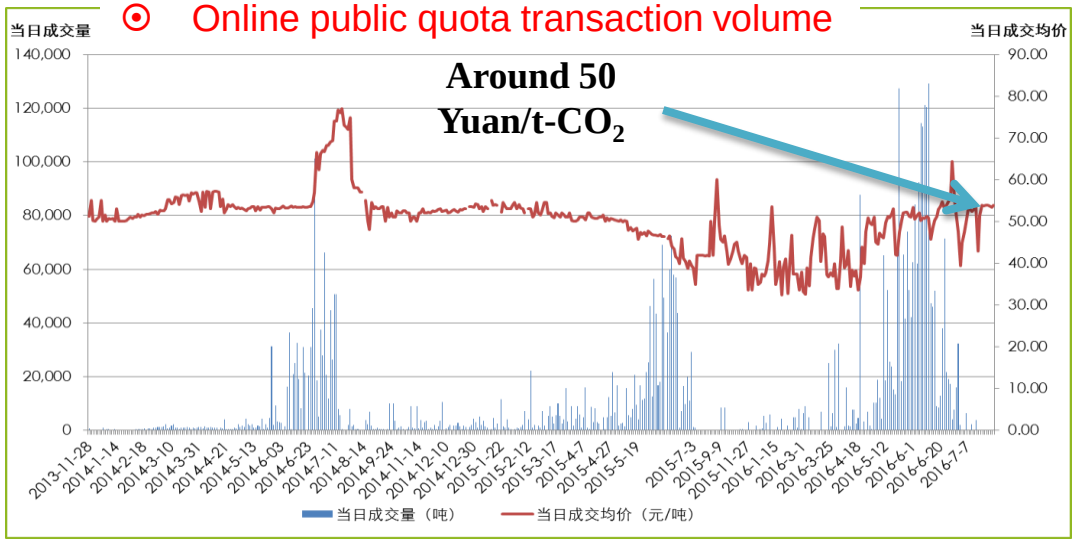
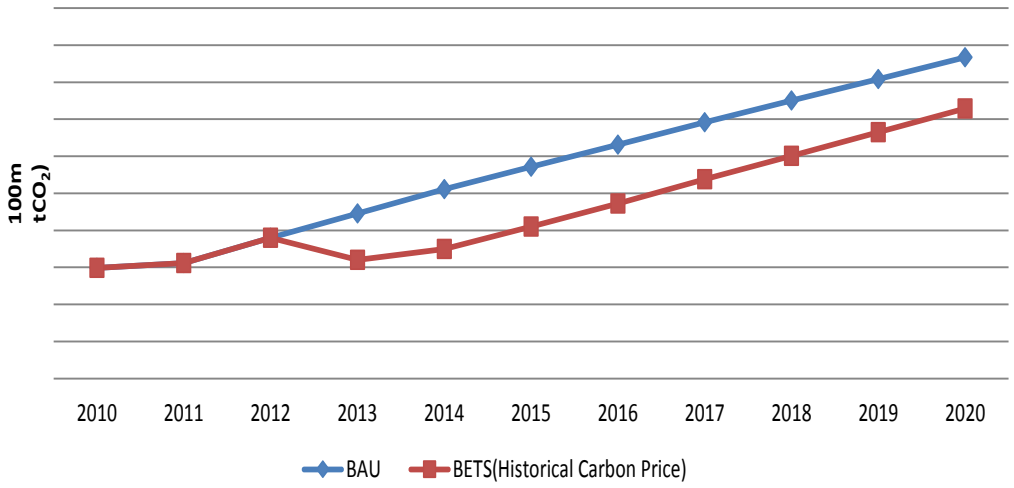
Environmental Effects by BETS

⊙ Online public quota transaction volume





- Endogenous Carbon Pricing
  - $ 8.8 (2013－2014)； $ 6.8 (2015)
  - Compared with the BAU scenario, CO_2 emissions from 2013~2015 were reduced by 3.8%~4.8%.
  - in 2020, CO_2 emissions will be reduced by 3.7%.
- Empirical data：
  - The total CO_2 emissions of the first batch emitters （415） in 2013 reduced by 4.5% than that in the Historical reference year

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Key Thoughts in the National ETS Design

- CHINA NDC:
  - The CO_2 intensity of GDP decreases by 60-65% in 2030 compared with 2005.
  - to achieve the peaking of CO_2 emissions around 2030 and to make best efforts to peak early.
- "13th Five-Year" work plan for controlling greenhouse gas emissions "（ the Sate Council，**2016.10**）
  - By 2020, carbon dioxide emissions per GDP fell by 18% compared to 2015, the total amount of carbon emissions have been effectively controlled.
- Contribution to realize carbon reduction goal from the National ETS in the 13th FYP: above 50%
- Carbon dioxide emissions per GDP in ETS: above 19%
- NETS will cover 50% CO_2 emissions：
  - Scope: Direct emission+ Indirect emission
  - Coverage: 8 sectors(20 sub-sectors)
  - Threshold:10,000 tce/20,000 t CO_2

Guidelines of Allowance Allocation

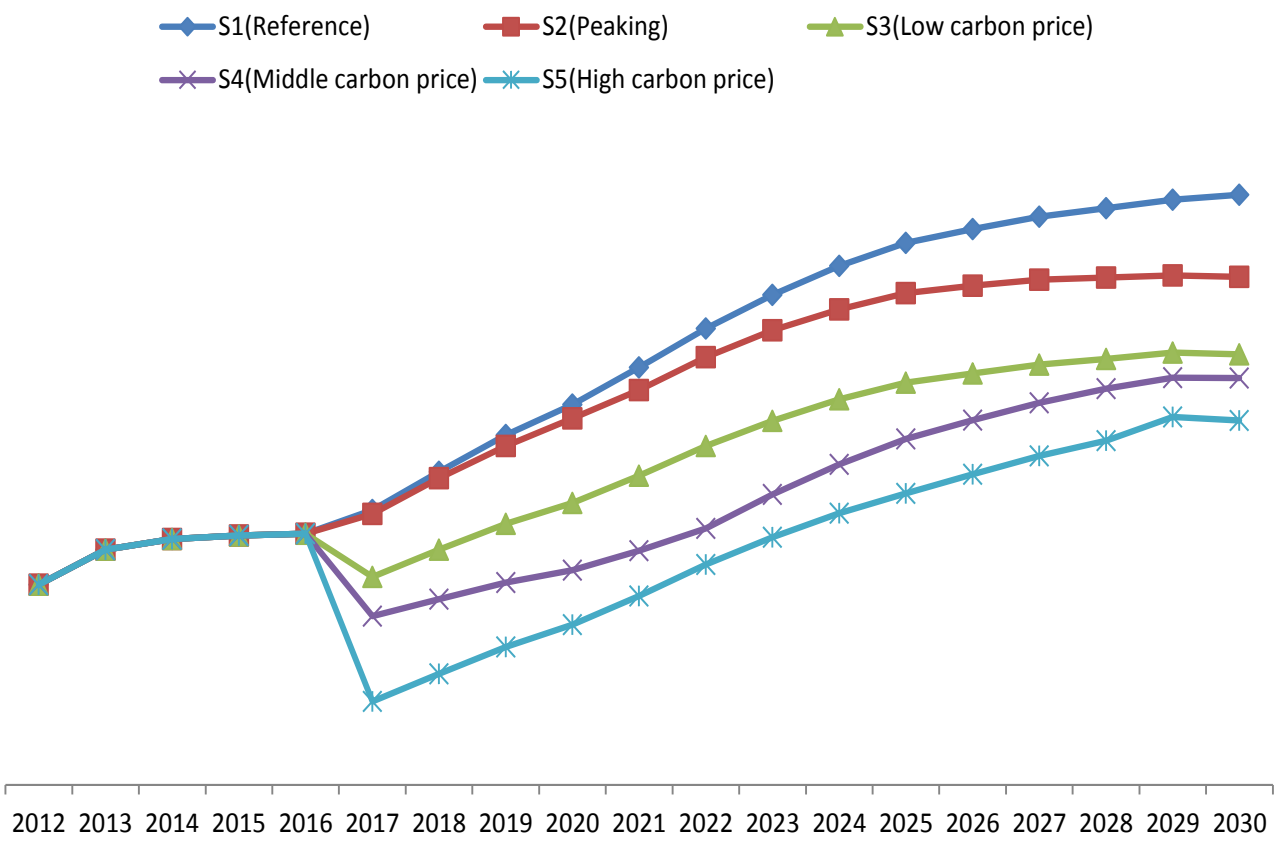
Sector	Sub-sector	Methodology
Production and Supply of Electricity, Heat	Power generation	Bench marking
	heat and power cogeneration	Bench marking
	Power grid	Historical carbon intensity reduction
Processing of Petroleum, Coking, Processing of Nucleus Fuel	processing of crude oil	Bench marking
Manufacture of Chemical Raw Material and Chemical Products	ethene	Bench marking
	Synthetic ammonia	Historical carbon intensity reduction
	Calcium carbide	Historical carbon intensity reduction
	Methanol and others	Historical carbon intensity reduction
Manufacture of Non-metallic	Cement clinker	Bench marking
	flat glass	Bench marking
Manufacture and processing of Non-Ferrous Metals	Electrolytic aluminum	Bench marking
	copper smelting	Historical carbon intensity reduction
Manufacture and Processing of Ferrous Metals	rolling process of Crude steel	Historical carbon intensity reduction
Manufacture of Paper and Paper Products	Pulp manufacturing	Historical carbon intensity reduction
	Paper and paperboard	Historical carbon intensity reduction
Air Transportation	Air Passenger Transportation	Bench marking
	Air Cargo Transportation	Bench marking
	Airport	Historical carbon intensity reduction

Scenario Assumption

1 USD=6.88 CNY

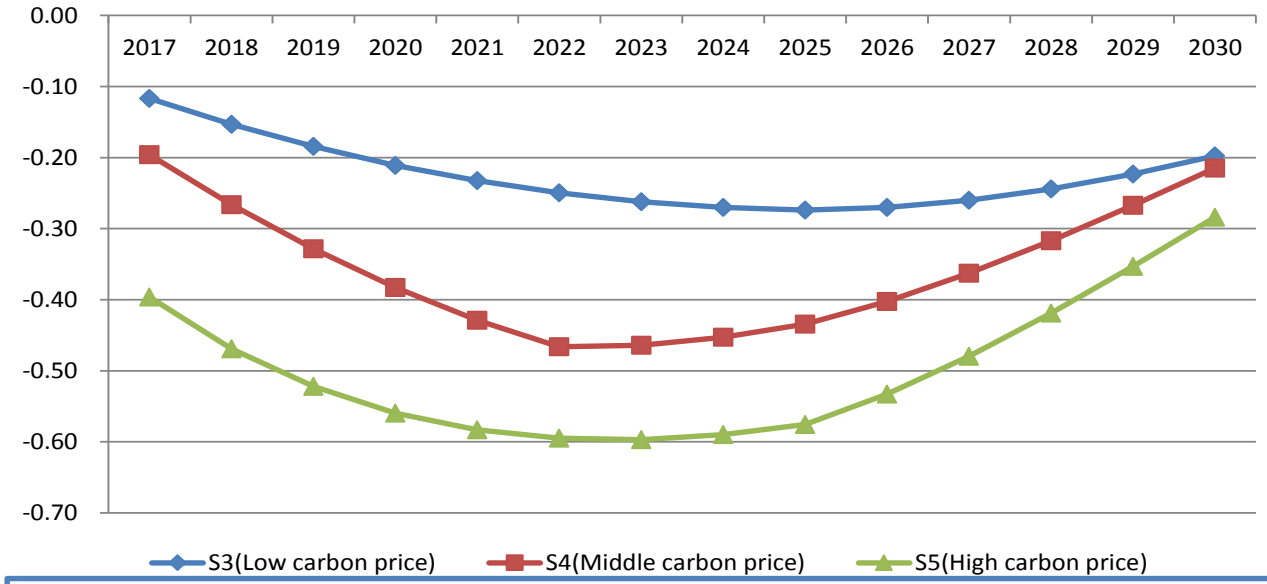
Scenario	Carbon Pricing (USD/t CO_2)	Policy Mix in Controlling CO2 Emissions
S1 (Reference)	N	Continuation of the policy in the 12th FYP
S2 (Peaking)	N	Accelerate the adjustment of industrial structure and energy structure, carbon emissions in 2030 will reach the peak.
S3 (Low carbon price)	4.4(2017-2022) ~14.5(2030)	The historical carbon price level of the pilot carbon market
S4 (Middle carbon price)	7.3(2017) ~14.5(2022-2030）	China will accelerate the development of the carbon market, carbon pricing policy will play a leading role as the primary emission reduction policy tool.
S5 (High carbon price)	14.5(2017-2030）	The most stringent scenario peaking required

CO_2 Emissions affected by Carbon Pricing



- **S1：cannot reach the peak before 2030**
- **S2：reach the peak in 2030**
- **S3~S5：reach the peak before 2030**
- **reduction rate (relative to scenario 2 in peaking year)**
  - **S3:4.9%**
  - **S4:6.4%**
  - **S5: 8.9%**

GDP Loss by the Carbon Pricing



There is an obvious positive correlation between GDP loss and the carbon price

Cumulative GDP Loss relative to the S1 (2017-2030) (2010 price) :

S3: $ 581 billion

S4: $ 814 billion

S5: $ 1,076 billion

Delay the carbon prices rise to fast will be relatively good economic situation.

GDP Loss per emission reduction:

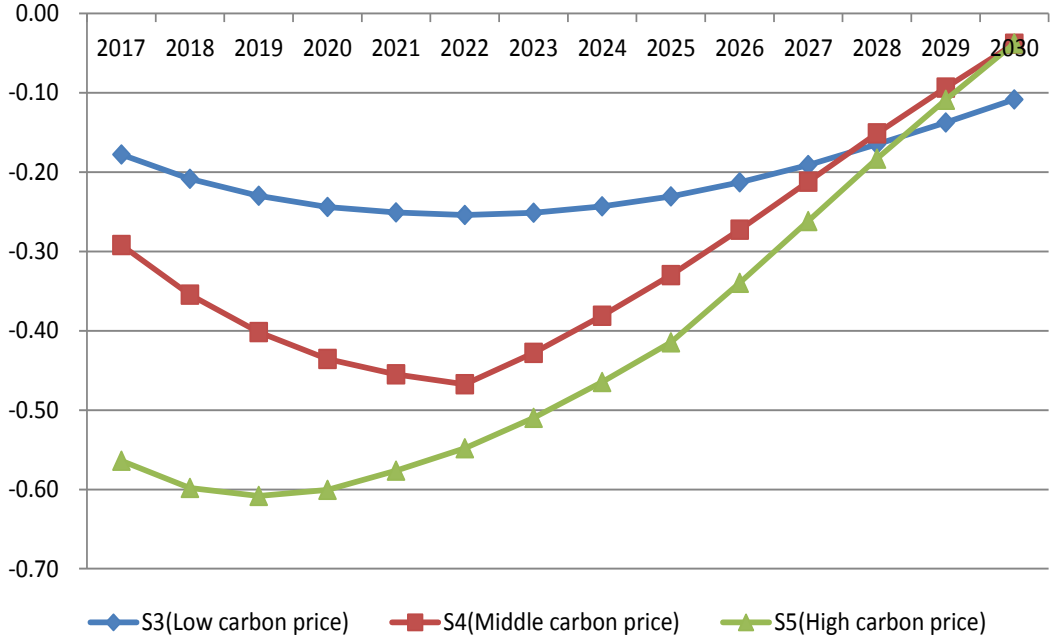
S3: $ 37.2,

S4: $ 37.2,

S5: $ 37.8

Employment impact by the Carbon Pricing

- **Significant difference in the effect of carbon price trend on employment demand.**
- S5: the initial employment demand will be reduced by 5 million people per year, then with the structural adjustment and the actual wage decline, employment demand will return to the level of S1.
- S4: U trends
- the absolute number in employment demand loss from 2.2 million to 3.4 million per year, then the effect decreases gradually and reduce to 650 thousand years in 2030.
- S3: moderate
- almost keep stable 100-200 million per year.



Conclusion: China Carbon Market Construction still on the way

- Considering the economic and social impact, the initial carbon price can not be set too high
- Coordinate the Synergy Effects between the carbon pricing policy and other policy
  - electricity price adjustment mechanism
  - strengthen the guidance of renewable energy investment
- Establish the long-term mechanism of unemployment insurance and reemployment
- Balance the relations among the different Stakeholders
  - the scientificity of the Allowance Allocation Methodology & the availability and verifiability of the data

To determine the optimal carbon price path should satisfy the following three principles:
1) Emissions reduction is economic and effective;
2) the impact of employment is less than the bottom line, which economy can withstand that;
3) encourage emission reduction technology advance investment, reduce the locking effect of investment on carbon emission.

Thanks for your attention!

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