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An event study of price changes in China's national carbon market

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Contents

Development and operation of the national carbon market

Progress of electricity spot market development in China

Method for the empirical analysis and the datasets applied

Test results and the implications

Policy position of the national ETS

Sept. 25, 2015

“U.S.-China Joint Statement on Climate Change”

- Announced to start the national ETS in 2017 (in reality, full-scale construction started from the end of 2017)

Sept. 22, 2021

“Opinions on fully & accurately implementing the new development philosophy and achieving carbon peak and carbon neutrality” (CCCCPC, State Council)

- Stated that the construction of a national carbon market will be accelerated; scope of the market, types of transactions and trading methods will be gradually expanded; and, the management of emissions allowances allocation will be improved.

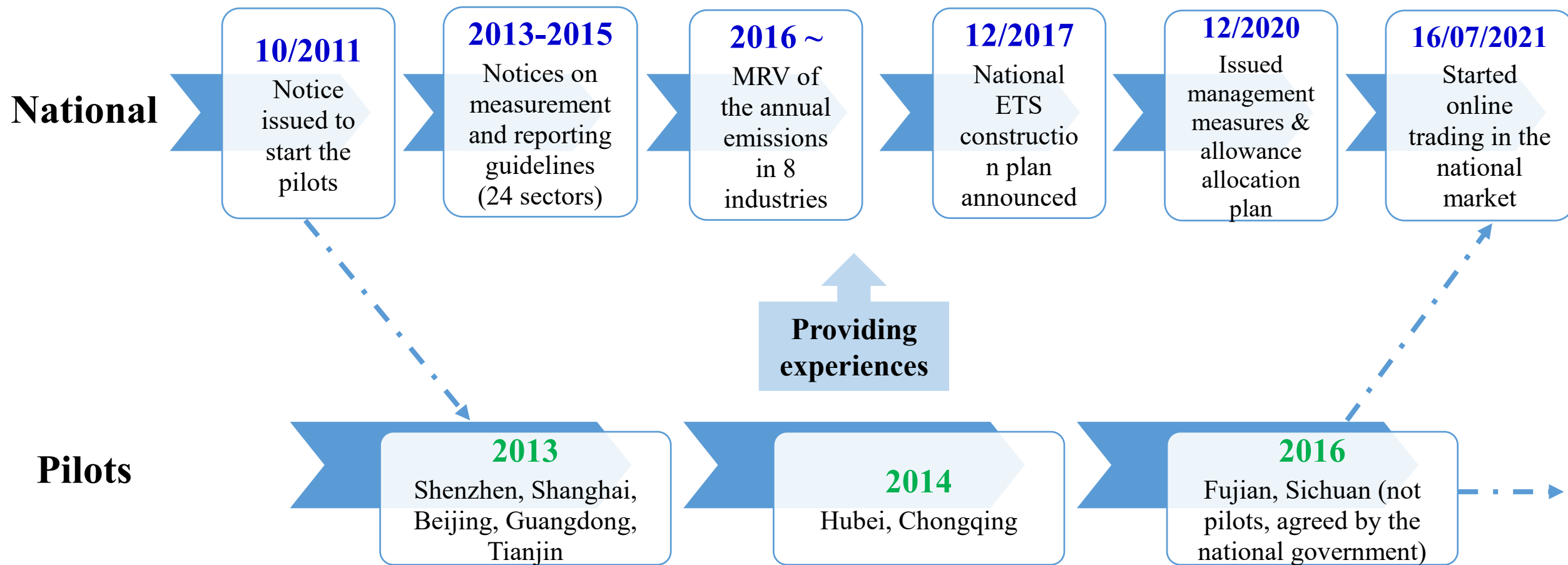
Oct. 24, 2021

“Action Plan for Carbon Peaking before 2030” (State Council)

- To accelerate the development of a unified carbon emissions statistics system; play the role of the national carbon market; improve related systems; expand the target industries; promote the establishment of energy use and electricity markets; and, enhance coordination among various market mechanisms.

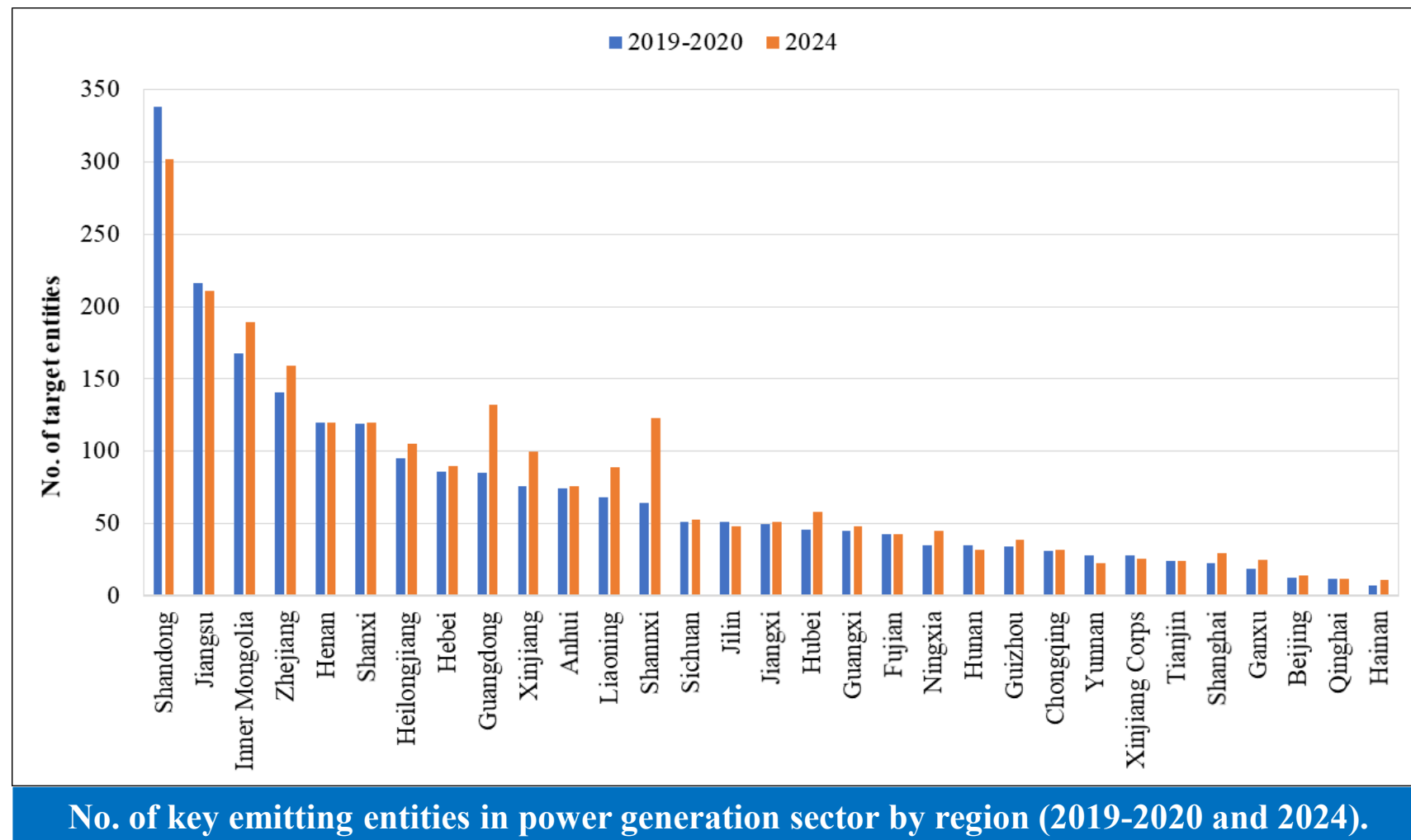
To improve the national ETS while positioning it as one of the policy pillars for achieving carbon peaking and carbon neutrality.

10 years from the local pilots to a national market



Target entities in early stages of the national ETS

- Criteria of target entities: Companies in power generation sector (including captive power generators in other industries) with emissions in any year since 2013 being 26,000 t-CO₂ or above.
- To cover a total of 2,225 key emitting entities in power generation sector during 2019 and 2020 → Actually 2,162 entities.
- The No. of key entities became 2,430 in 2024, with a yearly CO₂ emissions of around 5.1 billion tons and a coverage over 40%.
- Along with the expansion to petrochemical, chemical, building materials, steel, non-ferrous metals, paper and aviation sectors, around 8,000 companies will be covered.



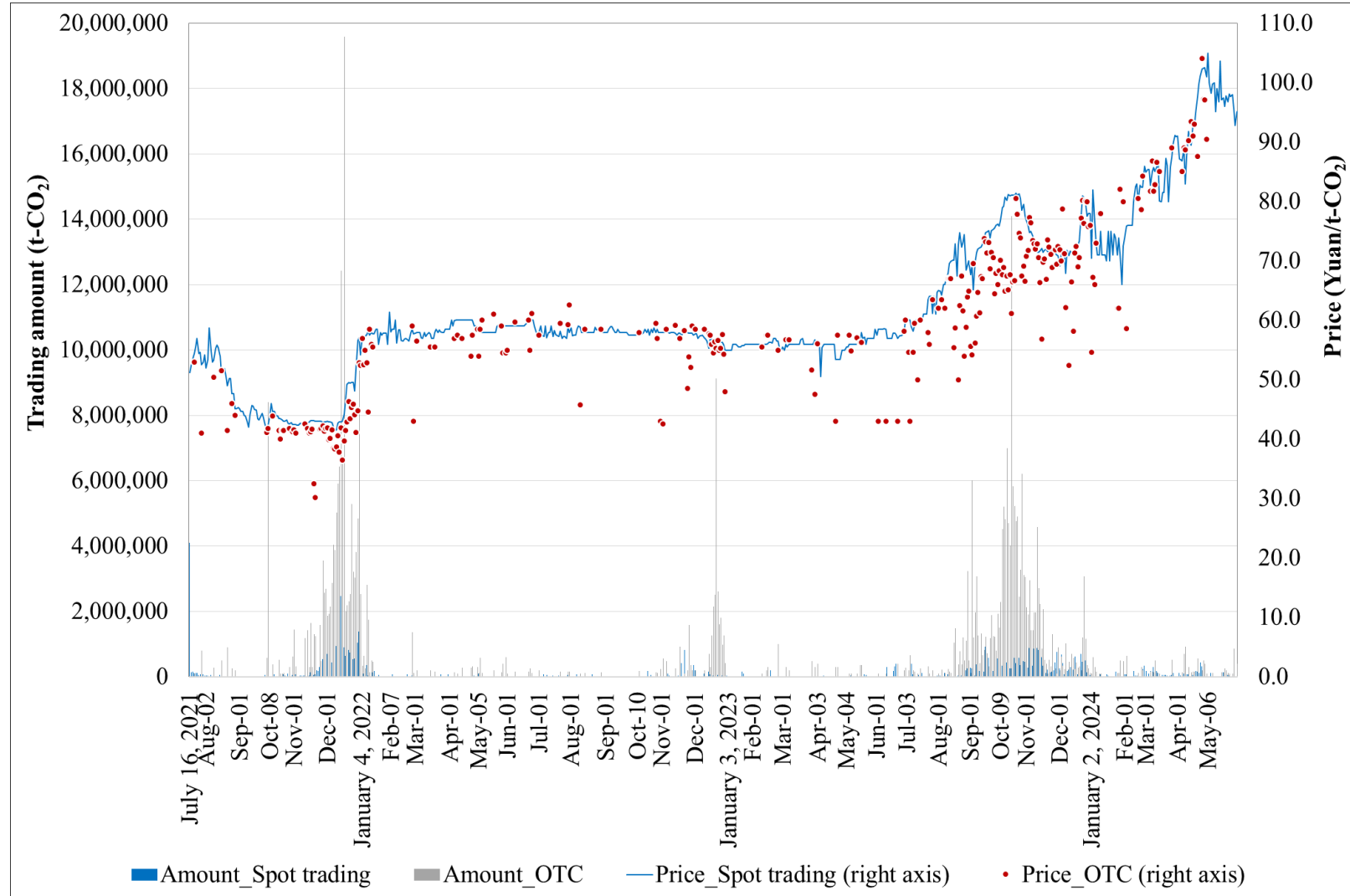
Benchmarks of power sector under the national ETS

No.	Unit category	Power supply (t-CO ₂ /MWh)			Heat supply (t-CO ₂ /GJ)		
		2019-2020	2021	2022	2019-2020	2021	2022
I	Conventional coal-fired unit above 300 MW class	0.877	0.8218	0.8177	0.126	0.1111	0.1105
II	Conventional coal-fired unit of 300 MW class and below	0.979	0.8773	0.8729			
III	Unconventional coal-fired unit burning coal gangue, coal slime, coal water slurry (including coal-fired circulating fluidized bed unit)	1.146	0.9350	0.9303			
IV	Gas turbine	0.392	0.3920	0.3901	0.059	0.0560	0.0557

Source: MOEE (2020a; 2023).

- A significant change of benchmarks for power and heat supply by coal-fired power units in 2021 from 2019-2020.
- The values for coal-fired power supply were tightened by 6.3% to 18.4%, and that for heat supply was tightened by 11.8% in 2021 compared with the levels of 2019-2020.
- No change for gas turbine power supply in 2021.
- Benchmarks of 2022 were further tightened but very slightly by around 0.5% from the levels of 2021.

Operation result of the national carbon market



- Still at an early stage and the trading purpose is mainly for the compliance.
- Recovery in trading amount around December 2022 and a significant increase during August to December 2023.
- Daily carbon prices in 2023 ranged at 50.5 to 81.7 Yuan/t-CO₂ and averaged at 68.2 Yuan/t-CO₂, an increase of 23.2% from the average of 2022.
- The accumulated trading amount: Around 459.6 million t-CO₂; Total transaction amount: Around 26.47 billion Yuan; Average carbon price: Around 57.6 Yuan/t-CO₂ (by May 31, 2024).
- Share of spot trading: 16.9% by trading amount and 18.5% by transaction amount.

Compliance of key emitting entities of the national ETS

The 1st compliance period (2019-2020)

- CEAs share of 4 types of units: 32.4:48.3:18.4:0.9
- 1,833 key entities fully fulfilled obligations and 178 entities could fulfil partially. → An overall compliance rate: 99.5%
- Around 32.73 million tons of CCER were used for the offsetting.

Effects observed from the 1st period

- Questionnaire to 2,162 key entities with 735 responses
- Over 80% appointed full-time staffs to manage carbon assets.
- Nearly 90% have given greater emphasis on data quality and management.
- 45.7% planned to invest the revenues in mitigation.

The 2nd compliance period (2021-2022)

- CEAs for 2021 and 2022: 5.096 and 5.104 billion tons
- Verified emissions: 5.094 and 5.091 billion tons → Balanced CEAs supply and demand
- Compliance rates for 2021 and 2022: 99.61% and 99.88%

The progress in developing electricity spot market in China



Pilot projects

- Officially launched in 2017.
- Firstly in 8 regions: Southern (from Guangdong), West Inner Mongolia, Zhejiang, Shanxi, Shandong, Fujian, Sichuan, Gansu.



Formal operation

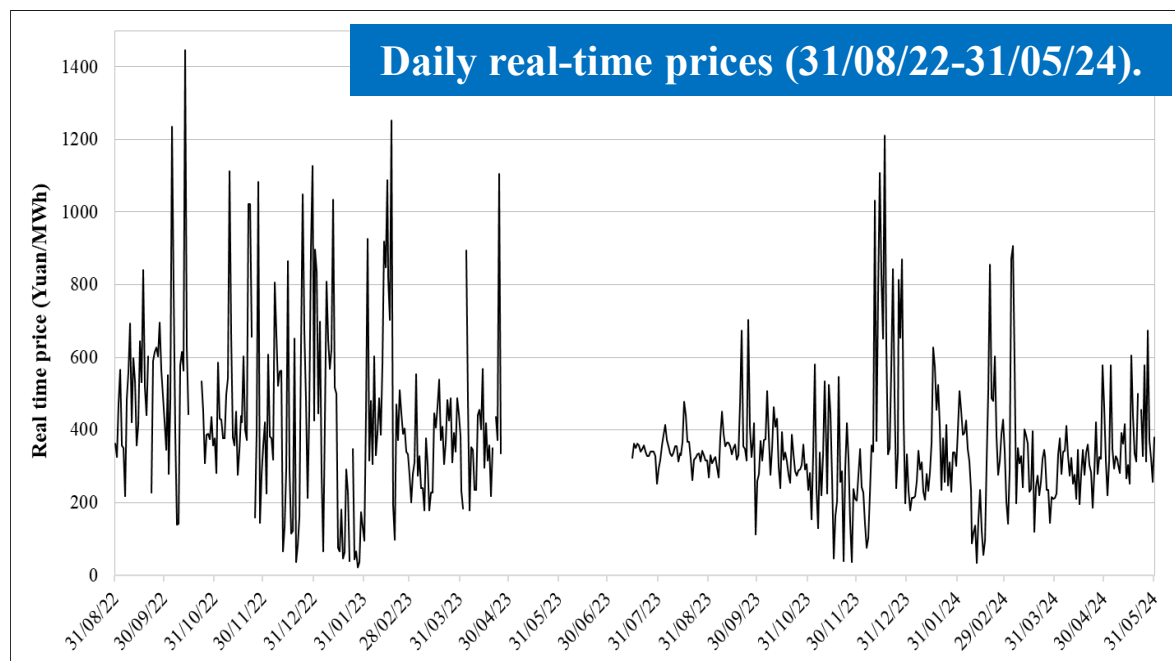
- Shift to formal operation if continuously running for over 1 year.
- Started firstly in Shanxi on Dec. 22, 2023.
- Guangdong: Dec. 28, 2023; Shandong: Jun. 17, 2024; Gansu: Sep. 5, 2024.



Overall target

- By 2025: To initially establish a national unified electricity market system.
- By 2030: To basically complete a national unified electricity market system with full participation of new energy.

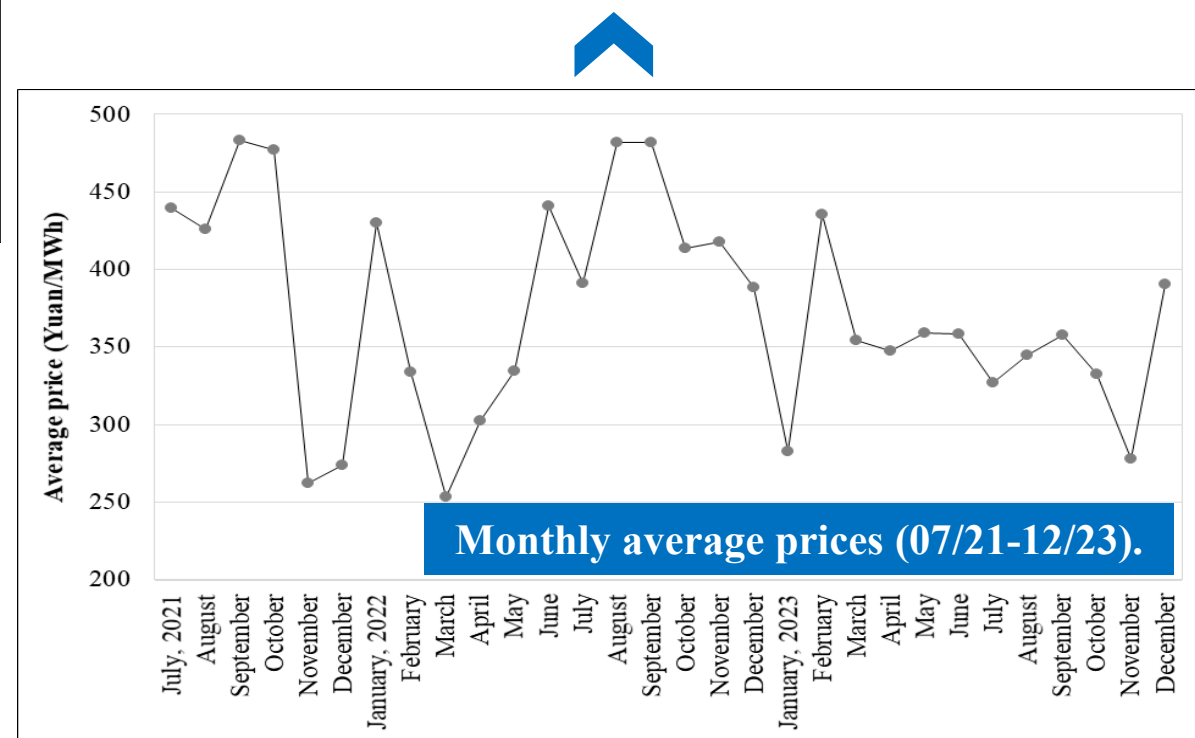
Operation result of Shanxi electricity spot market



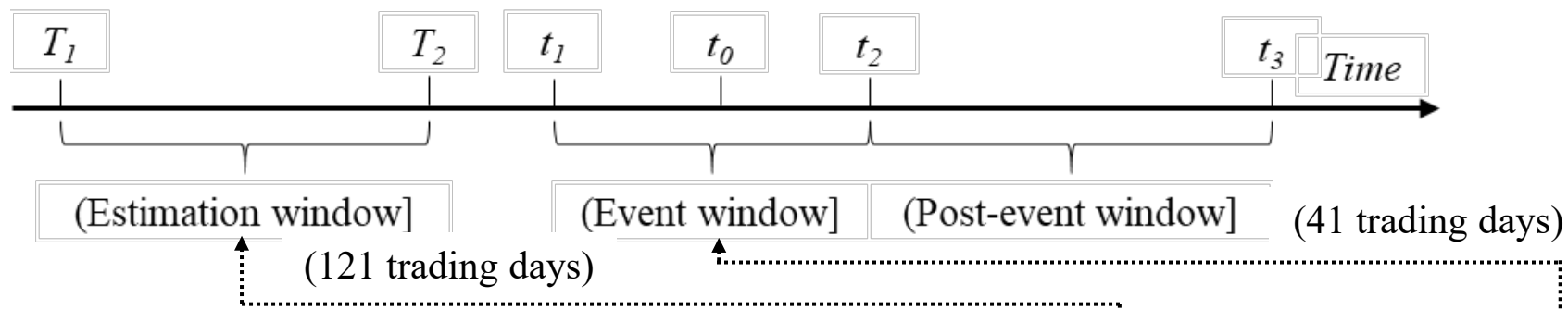
- Registered market entities: 17,435; Power generation companies: 593; Sales companies: 415; Electricity users: 16,427.
- Daily real-time prices ranged from 21.02 to 1,446.44 Yuan/MWh, indicating a large range of fluctuations

Source: Shanxi Power Exchange Center (SXPX).

- With a range at 250 to 500 Yuan/MWh, monthly average prices exceeded 480 Yuan/MWh in summer of 2021 and 2022.
- Whereas, yearly average was below 1.2 times of benchmark price of coal-fired power in Shanxi (332 Yuan/MWh), with lower increases than most other provinces.
- Spot market prices well reflect supply and demand relationships and the changes in power generation costs.



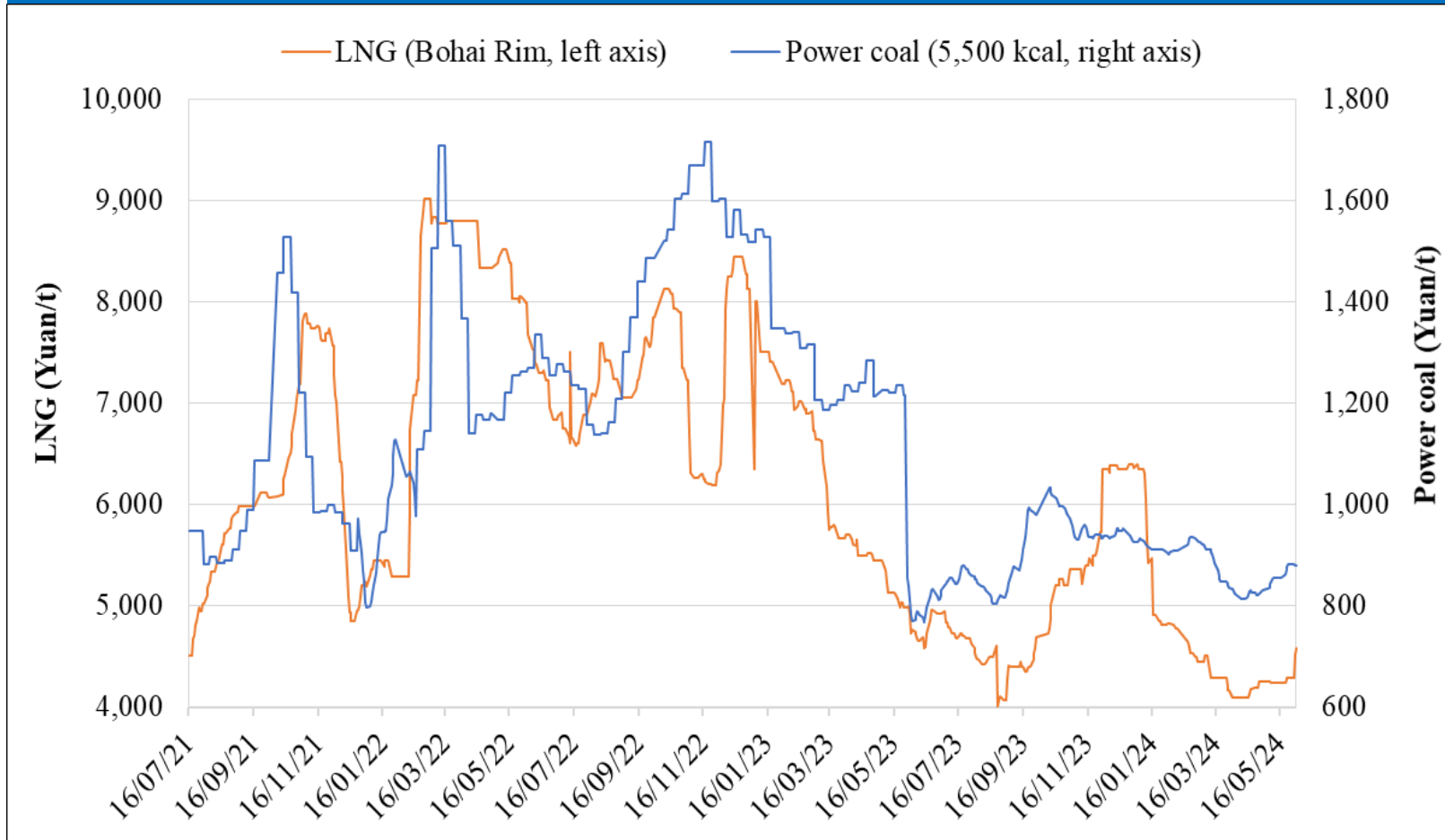
Timeline of an event study and events considered in this analysis



No.	Event	Date	Estimation window	Event window
1	Notice on emission allowances settlement in the initial compliance period	26/10/21	16/07/21-28/09/21	12/10/21-07/12/21
2	Release of draft emission allowances allocation plan for 2021 and 2022 for public comment	03/11/22	14/04/22-13/10/22	20/10/22-15/12/22
3	Release of emissions allowances allocation plan for 2021 and 2022	15/03/23	22/08/22-22/02/23	01/03/23-27/04/23
4	Notice on emission allowances settlement in 2021 and 2022	17/07/23	22/12/22-26/06/23	03/07/23-28/08/23
5	Release of “Interim Regulations on Carbon Emissions Trading Management”	05/02/24	20/07/23-15/01/24	22/01/24-27/03/24

Fossil fuel prices gathered for this study

Prices of power coal and LNG used in this study (16/07/21-31/05/24).



- Power coal prices fluctuated frequently with a range of 768 to 1,714 Yuan/t.
- Power coal price exceeded 1,000 Yuan/t in mid-September, and continued to increase to over 1,500 Yuan/t in mid-October, 2021.
- In spite of short decreases, this number remained at a high level with a range of 1,200 to 1,600 Yuan/t until the end of May, 2023.
- Power coal prices became relatively stable and remained at lower levels of 800 to 1,000 Yuan/t till now.
- The prices of LNG indicate a similar trend as prices of power coal.

Test result of price overreaction in the national carbon market

- The market price indicates an overreaction to the notices on emission allowances settlement (event No.1 and No.4) and, the release of emissions allowances allocation plan and the interim management regulations (event No.3 and No.5).
- Market transparency and information disclosure should be improved.
- Capacity building for the target entities should be enhanced and the participation of institutional investors should be allowed to maintain lower price volatility.



The result of price overreaction to the considered events						
No. of event	Average price volatility (\bar{V})	$V_t - \bar{V}$				
		Mean	Std. dev.	t-value	p-value	Degree of freedom
1	2.27%	-0.0184	0.0058	-20.38	0.000***	40
2	0.52%	0.0002	0.0067	0.14	0.445	40
3	0.42%	0.0054	0.0222	1.57	0.062*	40
4	0.64%	0.0123	0.0206	3.83	0.000***	40
5	1.90%	0.0088	0.0265	2.12	0.020**	40

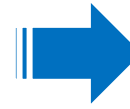
Note: *, ** and *** denote a significance level of 10%, 5% and 1%, respectively.

Regression result with electricity spot price as the dependent

Results of ADF and PP unit root tests

Variable	Level		Variable	First difference	
	ADF	PP		ADF	PP
P _{-power}	-12.463*** (0)	-12.675*** (5)			
P _{-Carbon}	-2.727 (0)	-1.887 (6)	$\Delta P_{-Carbon}$	-37.569*** (0)	-39.001*** (5)
P _{-Coal}	-3.101(13)	-2.374 (6)	ΔP_{-Coal}	-25.643*** (0)	-25.769*** (5)
P _{-LNG}	-3.656** (7)	-3.152* (15)			

Note: 'Δ' refers to the first difference of sequential data. The number in parenthesis is the optimum lag.
 *** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.



- Electricity and LNG prices are stationary while the other two input price series are non-stationary.
- The price series of carbon and power coal have stationary first differences at a 1% significant level.

- Electricity spot price in Shanxi is significantly and positively associated with LNG price and the first difference of coal price.
- No significant relationship between the electricity spot price and the first difference of carbon price.
- The change in carbon prices is still not a factor influencing a power company's bidding in electricity spot market



Regression result of electricity spot price and the input prices

Variable entered	Regression 1			Regression 2		
	Coefficient	t-Statistic	P-Value	Coefficient	t-Statistic	P-Value
β_0	399.58	35.91	0.000	172.95	3.52	0.000
$\Delta P_{-Carbon}$	-1.08	-0.20	0.845	0.36	0.07	0.946
ΔP_{-Coal}	1.49	2.24	0.026	1.55	2.39	0.017
P _{-LNG}				0.04	4.73	0.000
F-Value	2.51			9.24		
R-squared	0.014			0.073		

Implications for the improvement of national ETS

Initial policy effects

- The preparation and actual involvement are useful for promoting carbon management of target companies.
- Measurement and statistics of carbon emissions in energy-intensive sectors have been largely improved in recent years.
- A majority of target entities have assessed their emission reduction potentials and costs.
- National carbon market raised society-wide low-carbon awareness.

Direction for policy to function better

- Obviously not enough from a climate policy perspective.
- Measures should be taken for the formation of higher prices and pass-through of carbon costs.
- A simpler and stricter benchmarking approach is suggested for the allocation of emission allowances in power generation sector.
- An increasing portion of emission allowances should be allocated by auctioning under the national ETS to give substantial cost pressure.
- Carbon market would change power sector fundamentally if carbon price could be maintained at a much higher level.



***Thank you for the
kind attention!***