



AIR POLLUTION AND TOTAL COAL CONSUMPTION CONTROL

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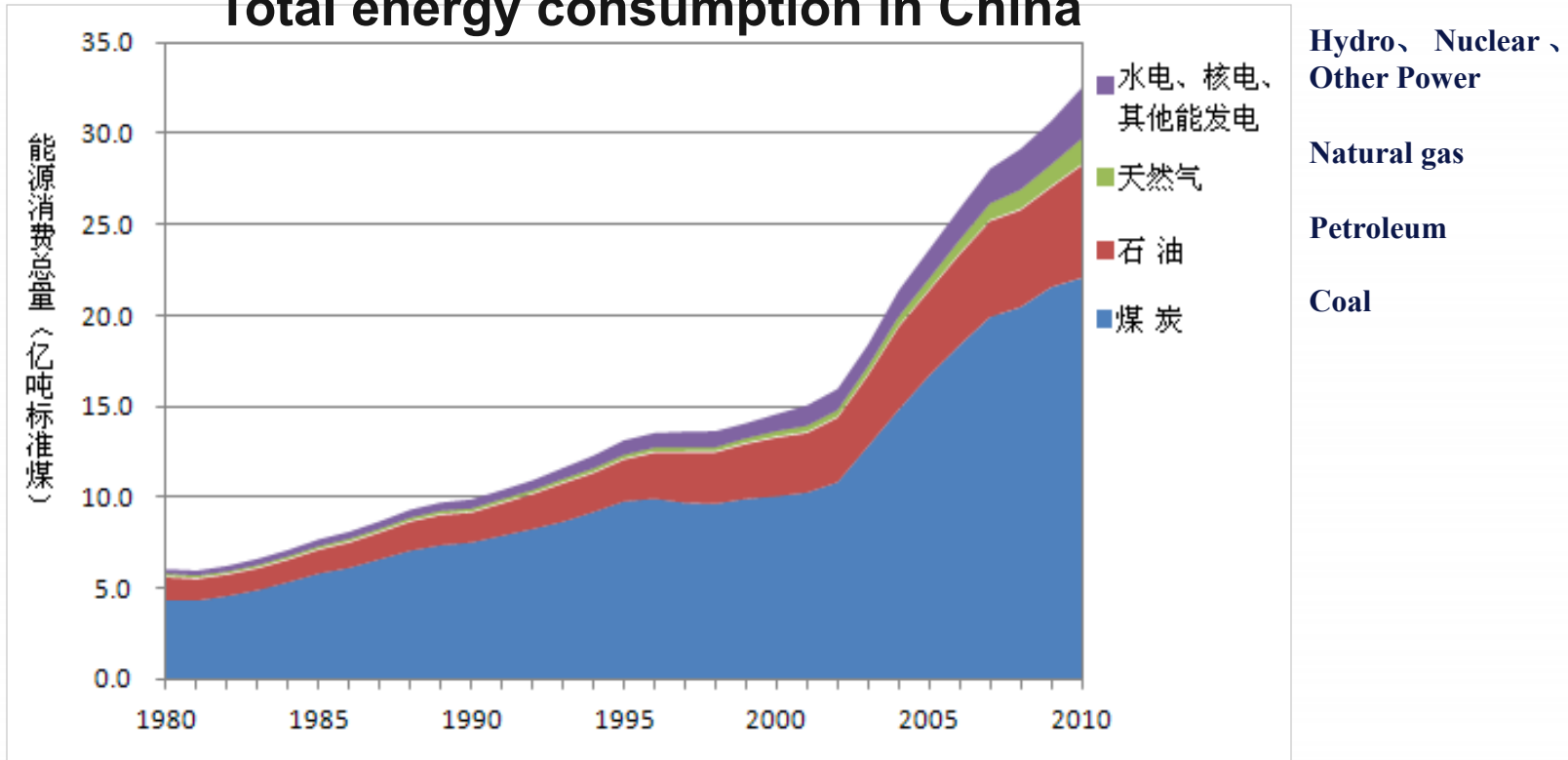
Chinese Academy for Environmental Planning

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- I. Impact of Coal Consumption on China's Atmospheric Environment**
- II. International Experiences in Coal-burning Pollution Control**
- III. Policy Measures for Total Coal Consumption Control**

1. Total coal consumption growth

Total energy consumption in China



- Coal consumption increased from 1.4 billion tons in 2000 to 3.4 billion tons in 2011, a rise of **143%** in 11 years
- Coal consumption in 2012 accounted for **50%** of the world's total
- The proportion of coal in total energy consumption is nearly **70%**, much higher than the average in OECD countries (20%)

2. The coal combustion: an important source of air pollutants emission

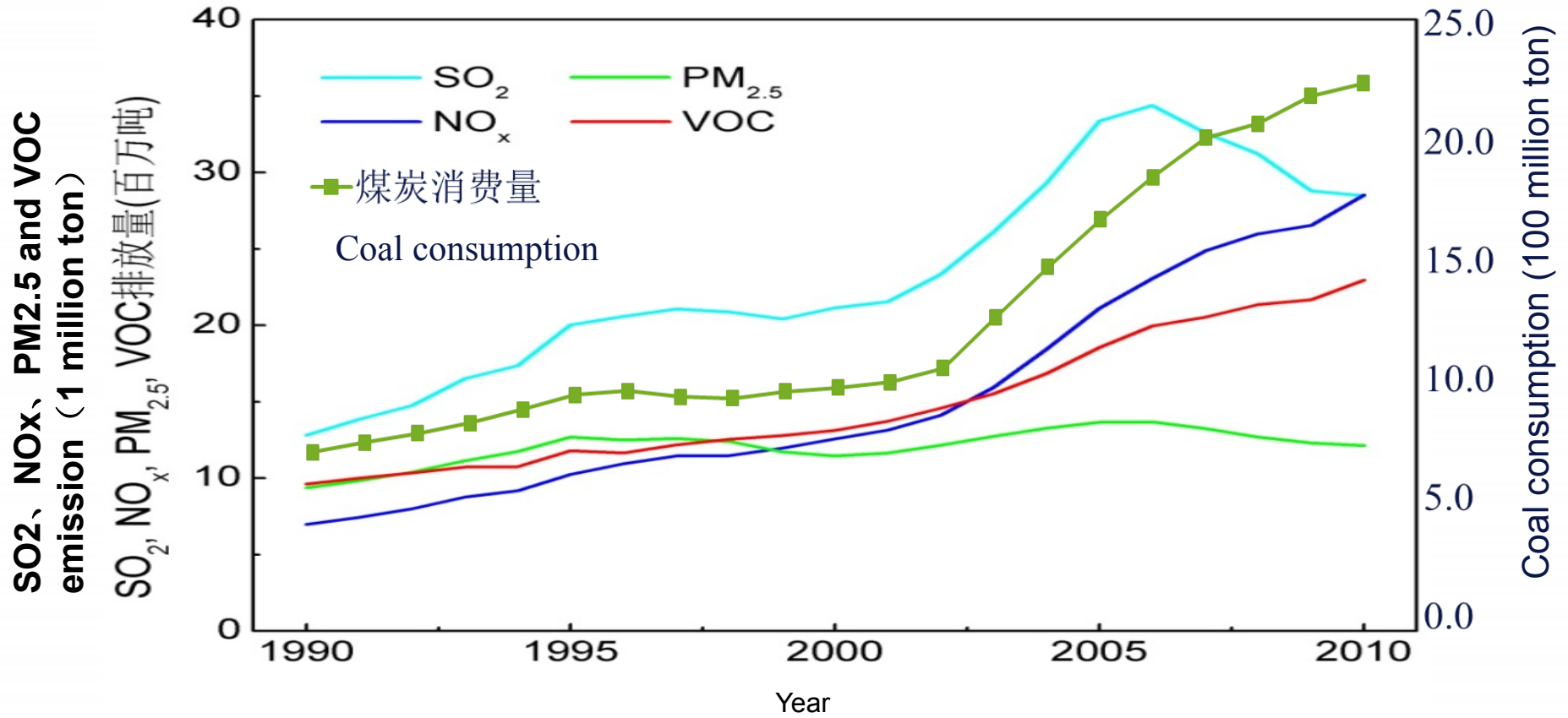
- Nearly **90%** of SO₂ emissions, **67%** of NO_x emissions, **70%** of dust emissions, **40%** of atmospheric mercury from anthropogenic sources, and **70%** of CO₂ emissions come from coal combustion .
- China's major air pollutant emissions ranked first in the world. . In 2010, SO₂ emission was **2.6 times of U.S.** and **4.5 times of EU**, and NO_x emission was **1.8 times of US** and **2.4 times of EU**.

Comparison of coal consumption, air pollutants and GHG emission between China, U.S. and EU

	Coal (1 million toe)	SO ₂ (10,000 t)	NO _x (10,000 t)	PM ₁₀ (10,000 t)	PM _{2.5} (10,000 t)	Atmospheric Hg (t)	CO ₂ ^a (100 million t)
China	1713.5	2267.8	2273.6	1277.8	—	825.2	67.03
US	524.6	860.0	1243.9	1023.2	413.4	103.0	58.27
EU	269.7	501.5	937.4	197.1	129.3	73.4	40.65

a. CO2 Data sources: The Climate Analysis Indicators Tool developed by the World Resources Institute

3. Coal consumption and pollutant emissions



■ Coal consumption in China during 1990 to 2010 show a strong correlation with SO₂, NO_x, PM_{2.5} and VOC emission.

4. Total coal consumption control for the Air Quality Plan

- **The State Council's new Air Quality Plan (Air Pollution Prevention and Control Action Plan) calls total coal consumption control**

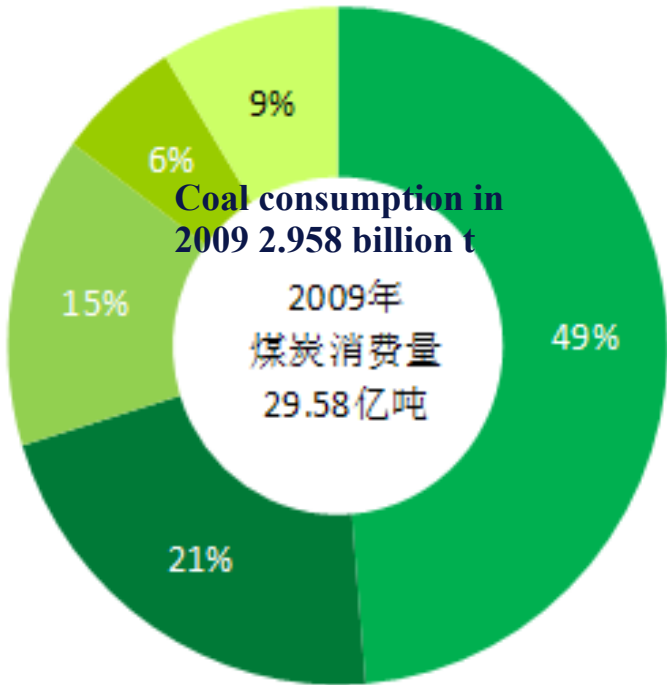
China will develop a national medium and long-term target for coal consumption cap control and implement target responsibility system. By 2017, the proportion of coal in total energy consumption will be reduced to less than 65 percent. Beijing-Tianjin-Hebei, the Yangtze River Delta, the Pearl River Delta will work to reduce total coal consumption and replace coal by gradually increasing the proportion of external power transmission, increasing the natural gas supply, and enhancing non-fossil fuel utilization intensity, among other measures.

- **“Regulations for Implementing the Air Quality Plan in Beijing-Tianjin-Hebei and Surrounding Areas”**

Beijing-Tianjin-Hebei and Shandong will reduce total coal consumption by 83 million tons. Specifically, Beijing will achieve a net reduction of 13 million tons of raw coal, the targets for Tianjin, Hebei, and Shandong are 10 million, 40 millions, and 20 millions tons, respectively.

5. Coal consumption structure and air pollution

At present, power industry coal consumption accounts for about 50 percent of total coal consumption across China far below the U.S. figure of 90 percent. A large amount of coal is consumed in industrial boilers, coke ovens, and kilns of building materials industry, which has exacerbated the “coal smoking type” pollution in urban areas



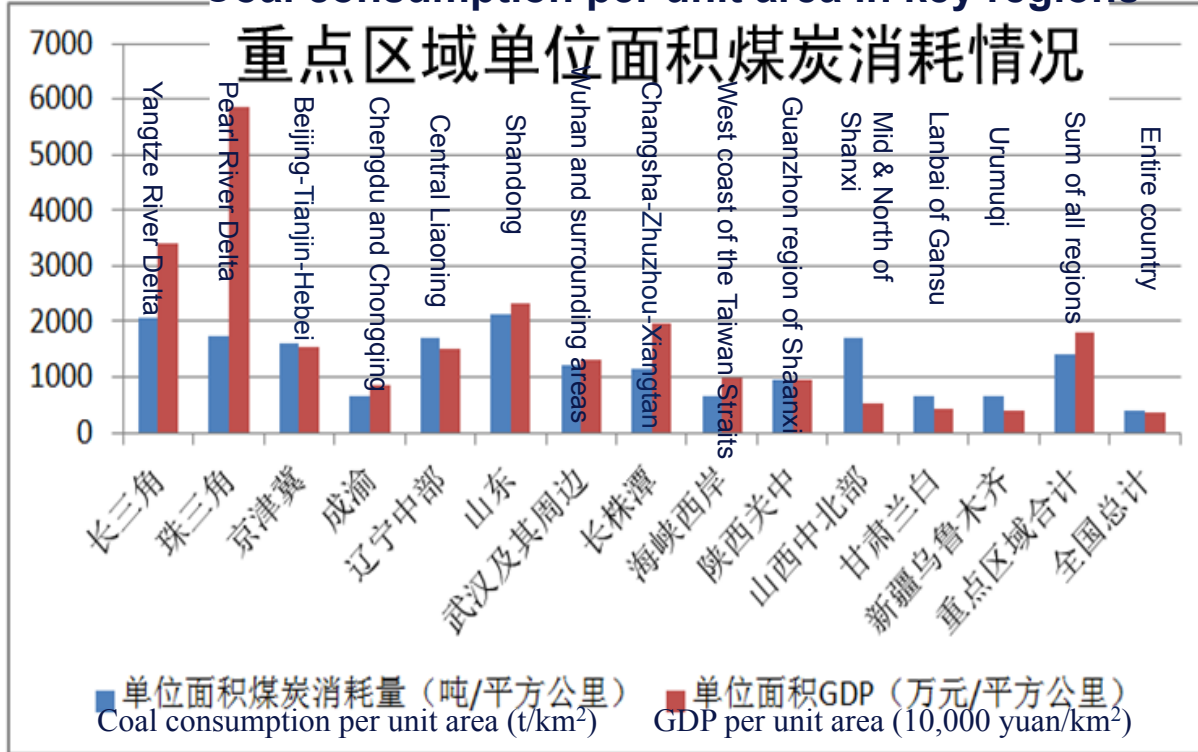
- Power plant boilers
- Industrial boilers
- Coke ovens
- Cement kilns
- Other

Comparison of pollution emission factor of thermal power and small coal-fired boiler (kg/t)

	S02	NOx	PM
thermal power	4.2	5.5	0.9
Small coal-fired boilers	16	2.9	3.2

6. Coal consumption intensity in regions

Coal consumption per unit area in key regions



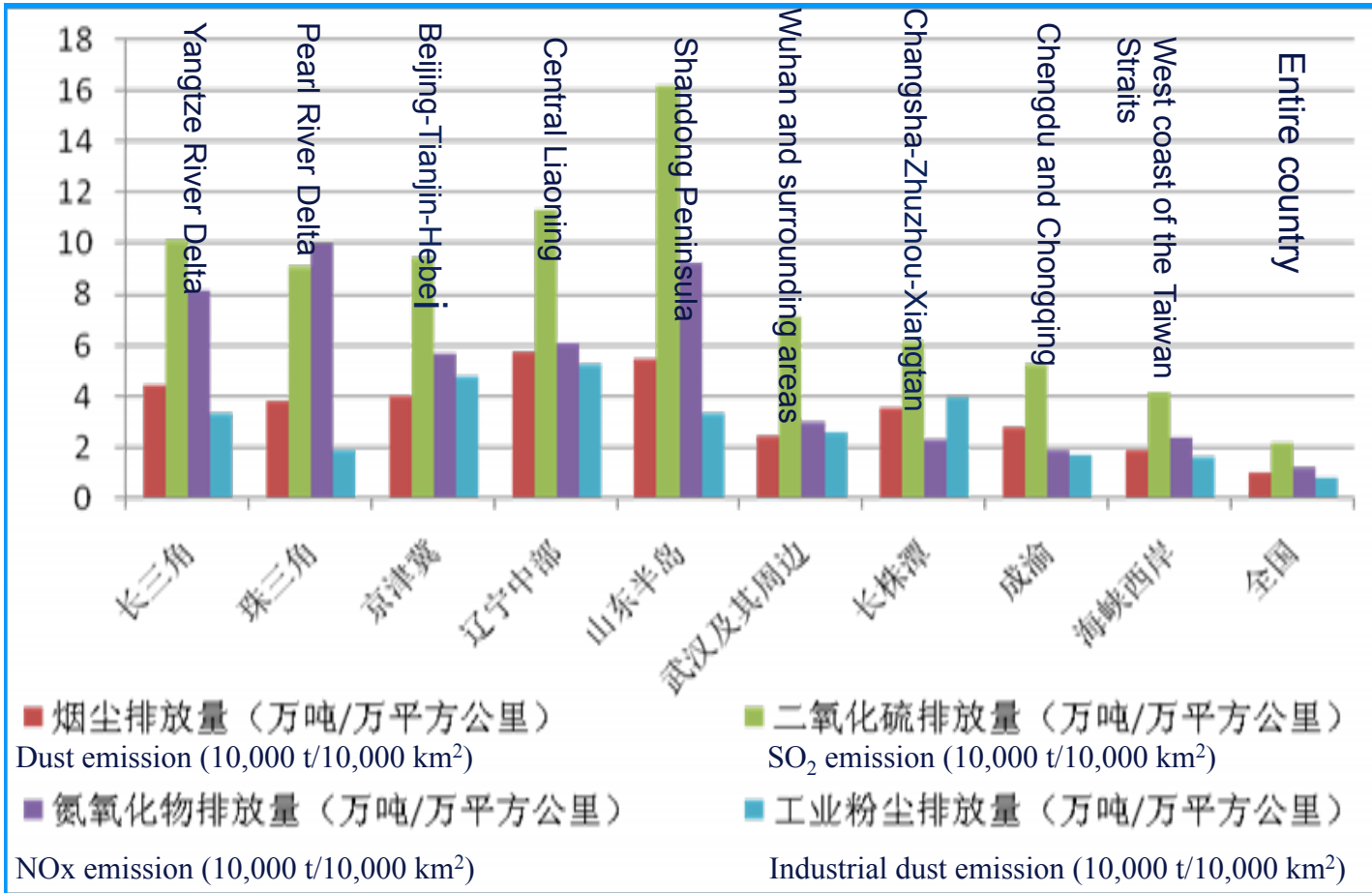
- Key regions (three regions and 10 city clusters) account for **14%** of national area, but consume **48%** of China's total coal. Coal consumption per unit area is 4 times of the national average.

Annual coal consumption per unit area of some provinces and cities in China even exceeds 4000 t/km²

Coal consumption per unit area of certain provinces and cities (t/km ²)	Shanghai	Tianjin	Jiangsu	Shandong	Shanxi	Henan	Hebei	Ningxia	Beijing
	6142	4533	2710	2536	2140	1713	1646	1532	1445

7. Coal consumption and regional air pollution

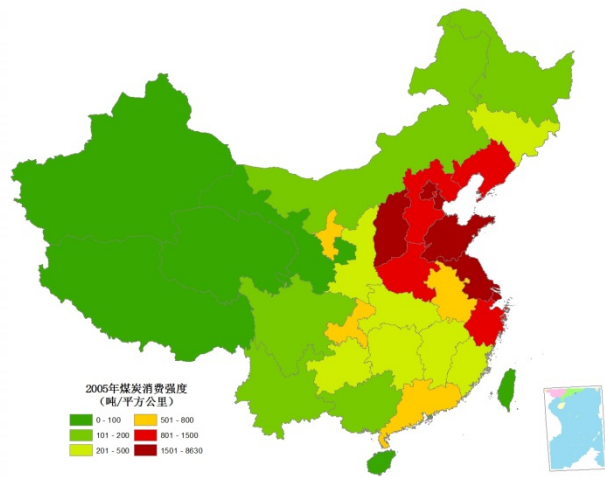
Air pollutant emission per unit area of key regions



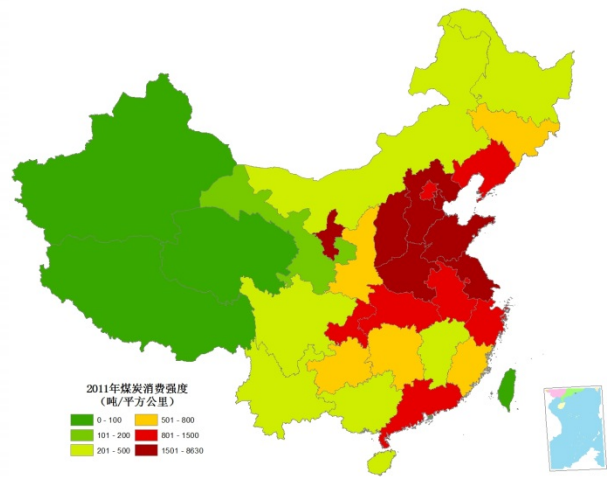
- In China, **47%** of SO₂, **50%** of NO_x, **45%** of smoke&dust, about **50%** of VOC come from key regions.

- Major air pollutants emission per unit area in key regions is much higher than the national average.

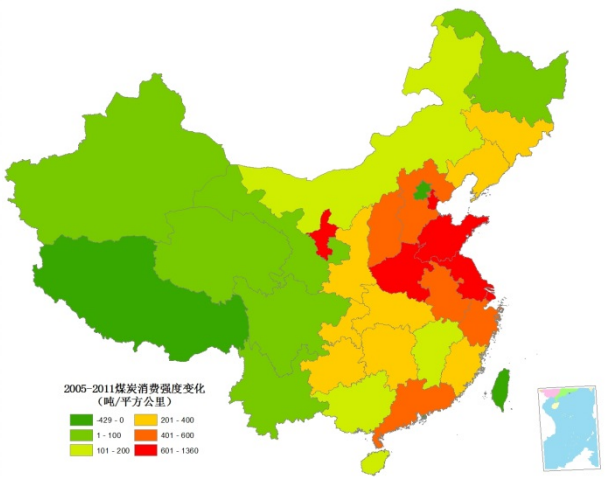
8. Coal consumption and worsening air quality



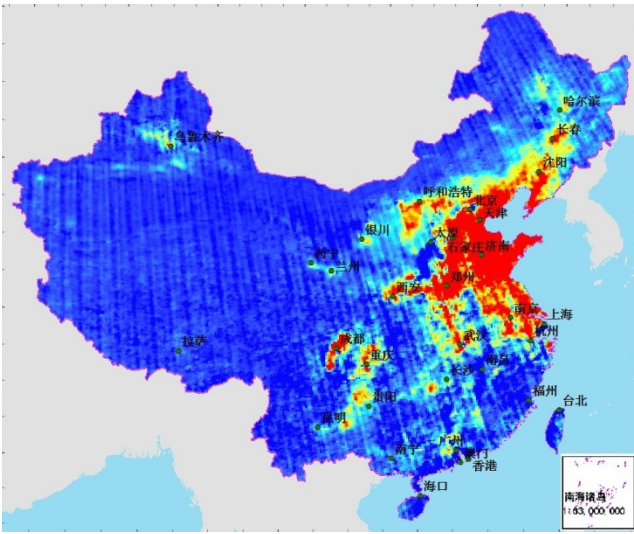
Coal consumption intensity in 2005



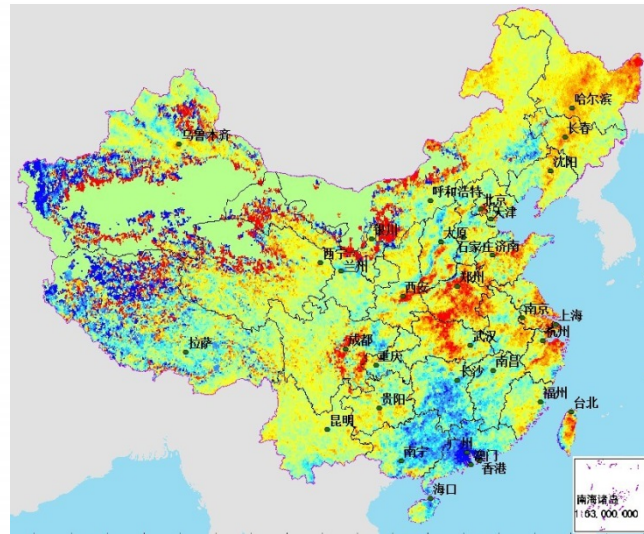
Coal consumption intensity in 2010



Coal consumption intensity (2010-2015)



NO2 column concentration (2010-2015)



AOD (2010-2015)

- In central and eastern areas with rapid increase in coal consumption, air quality is quickly worsening
- The pollution delta with **“Beijing-Xi’an-Hangzhou”** as the main nodes has become the most serious in the world

9. Total coal consumption control for air quality

The total amount, distribution, structure, and technical level of coal consumption in China, among other factors, has severely impacted the atmospheric environment

Pollutant emission reduction is the basic requirements for improving air quality.

In 2010, emission of **SO₂, NO_x, VOCs and PM_{2.5}** stood at **22.68 million, 22.74 million, 22.96 million, and 12.15 million tons respectively in China**. For air quality across the country, only when the emission of various pollutants are cut by 50% based on the 2010 level will nationwide air quality meet the standard.



Severe technological bottleneck hinders reduction in emission intensity per unit of coal consumption.

Assuming that coal consumption and other factors remain unchanged, emission intensity per unit coal consumption **have to reduce by 50%** based on the 2010 level; given newly-added quantity of coal consumption, we estimate the reduction have to be **over 70%**. This is achievable for some industries, but a serious technical bottleneck prevents the entire country from meeting the target;



Total coal consumption control is the only way to reduce coal-burning pollutants.

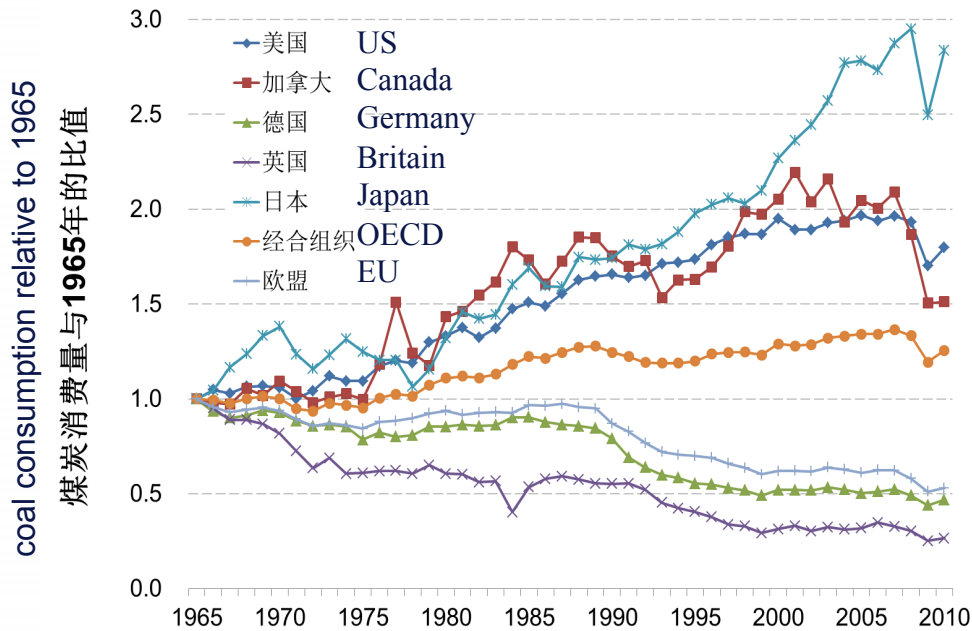
Terminal treatment alone cannot address atmospheric pollution. Total coal consumption control is a necessary.

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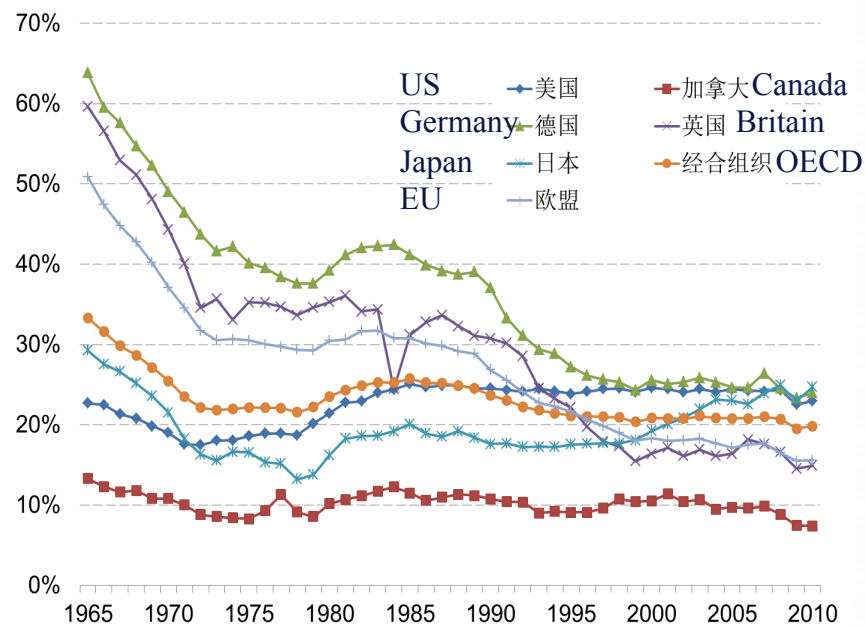
International Experience #1: Energy structure and coal proportion



- The proportion of coal consumption in the Europe, U.S. and Japan is less than **30%** of total energy, but in China the figure stands at about **70%**;
- **Coal consumption in European countries has been declining since the 1960s.**



Coal consumption changes in developed countries



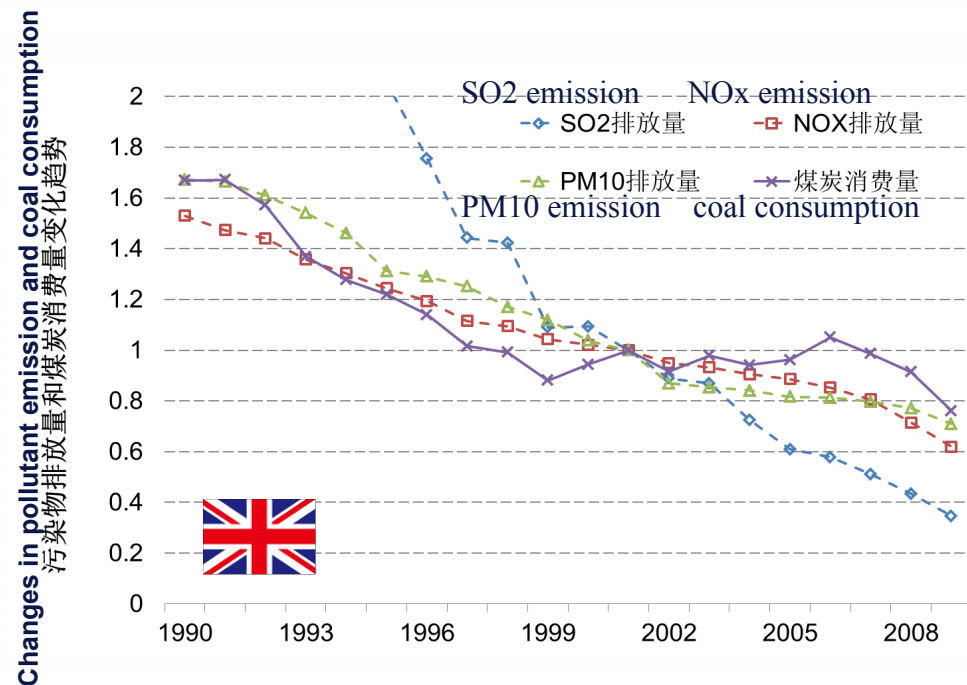
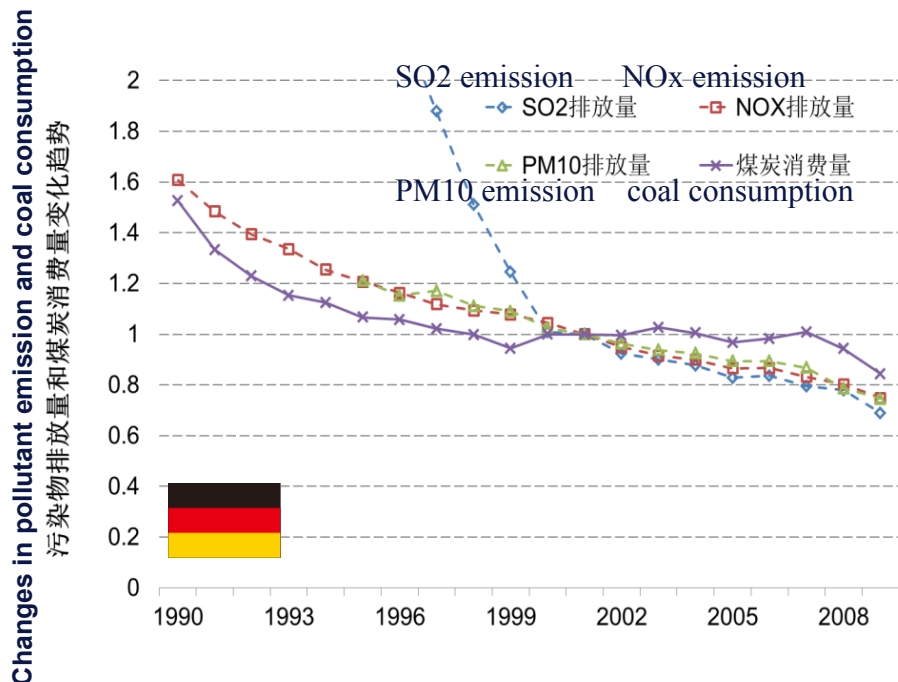
Coal proportion in total energy consumption of developed countries.

International Experience #1: Energy structure and coal proportion



Major reasons of coal consumption reduction in European countries:

1. Rapid development of clean energy, new energy, and renewable energy technologies
2. Basically accomplished industrialization, and reduction in energy demand of high coal consumption industries
3. High energy consumption phase finished, and energy efficiency increased gradually

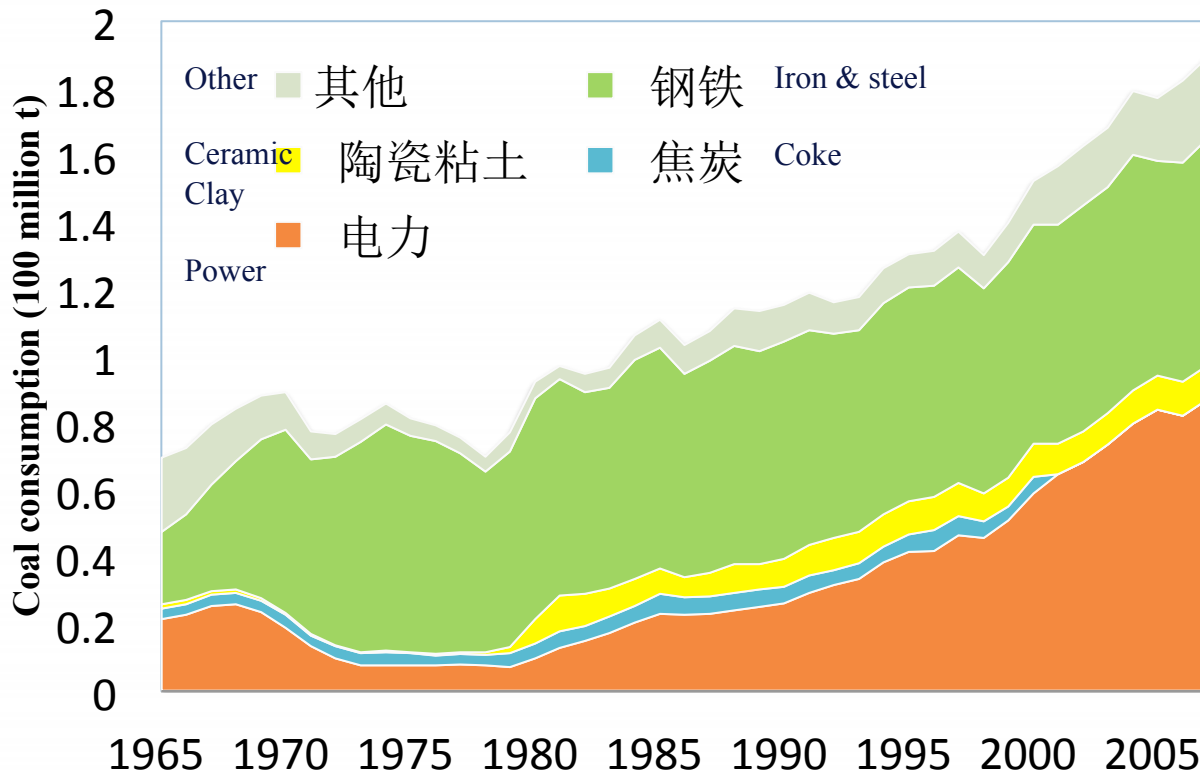


Changes in coal consumption and air pollutants in Germany and Britain (1990-2008)

International Experience #2: Coal consumption structure



- **Japan: coal consumption increment mainly centers on the power industry**



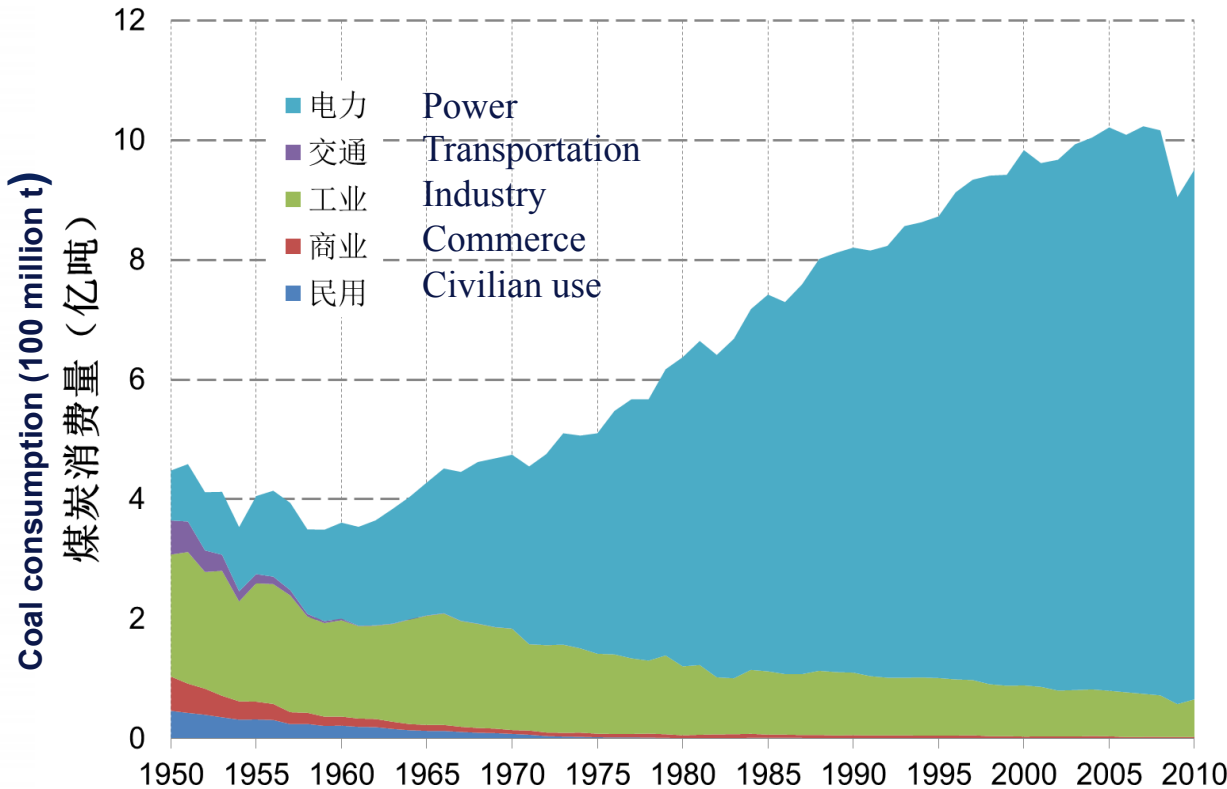
Coal consumption changes by sector in Japan (1965-2005)

- Coal consumption of iron & steel and electricity accounts for 60-90% of Japan's total.
- Since the late-1970s, iron & steel, ceramic clay, coke and other industrial sectors have witnessed stable coal consumption and **coal consumption increment has centered on the power sector.**

International Experience #2: Coal consumption structure



• U.S.: coal consumption shifts to power industry



Great changes in coal consumption structure

Power: 20% 93%

• Industry: 40% 6%

• Civilian use and commerce: 30% 1%

• Transportation: 10% 0%

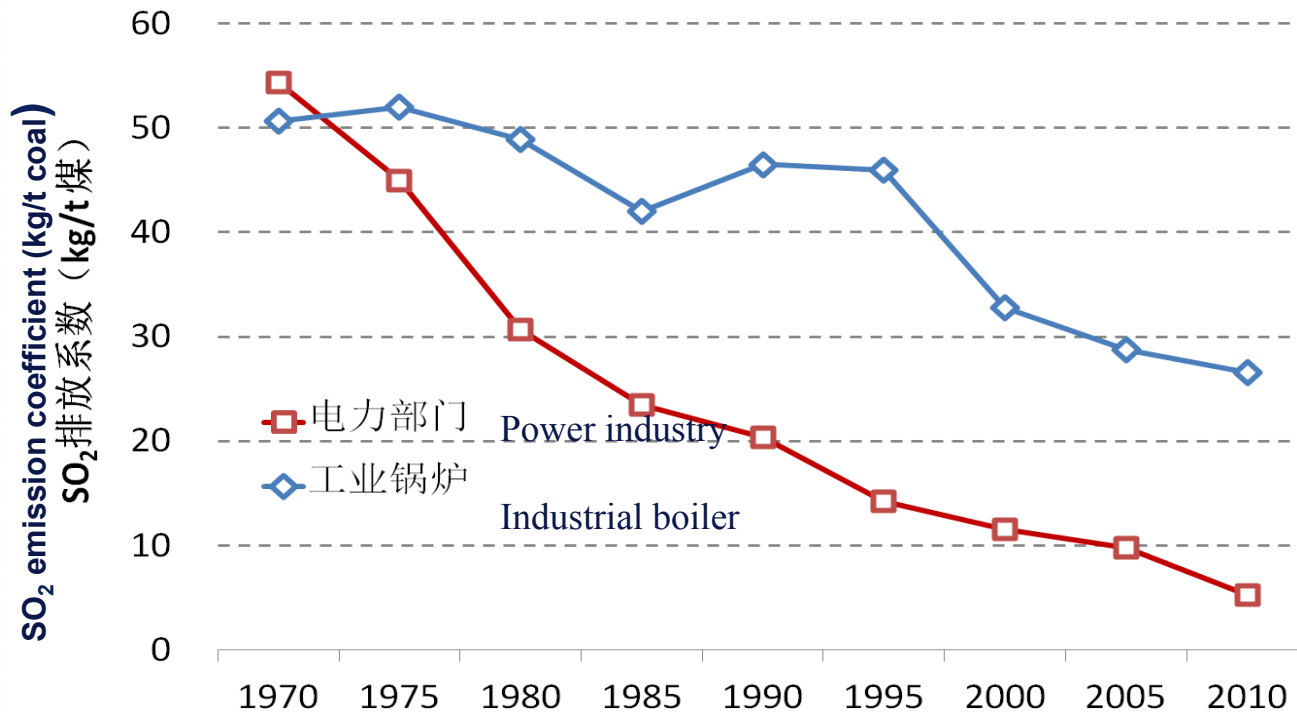
Coal consumption changes by sector in the U.S. (1950-2010)

International Experience #3: Technological advancement



Major reasons behind remarkable reduction in coal burning pollution emission in the US

- Power industry: reduce emission coefficient through technological advancement
- Industrial sector: cut back on emission by reducing coal consumption

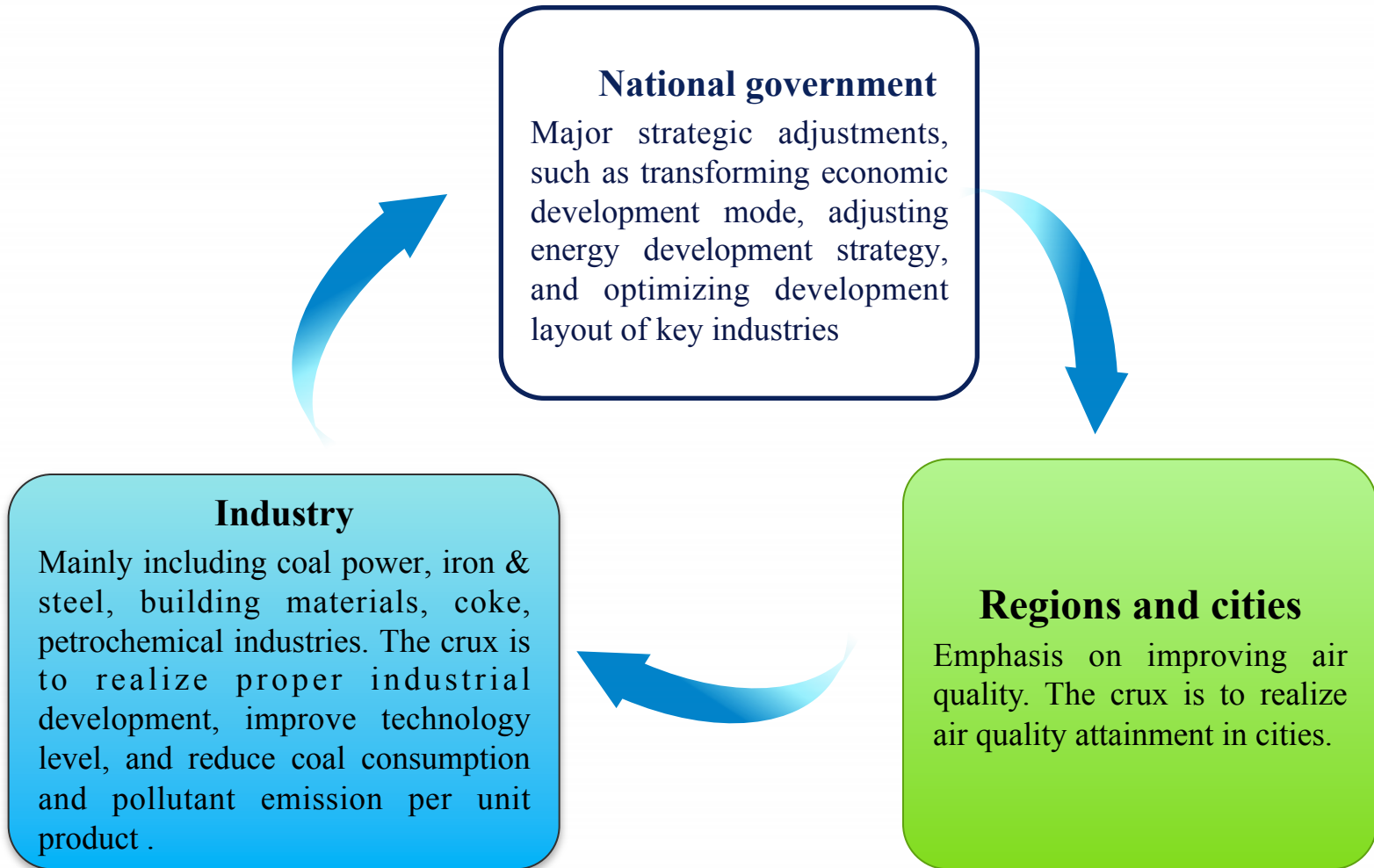


Rigid air pollution control regulation has facilitated the shift of coal consumption to the power sector which has lower cost of emission reduction.

SO₂ emission coefficient of coal consumption in power and industrial sectors in the US

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Three control modes

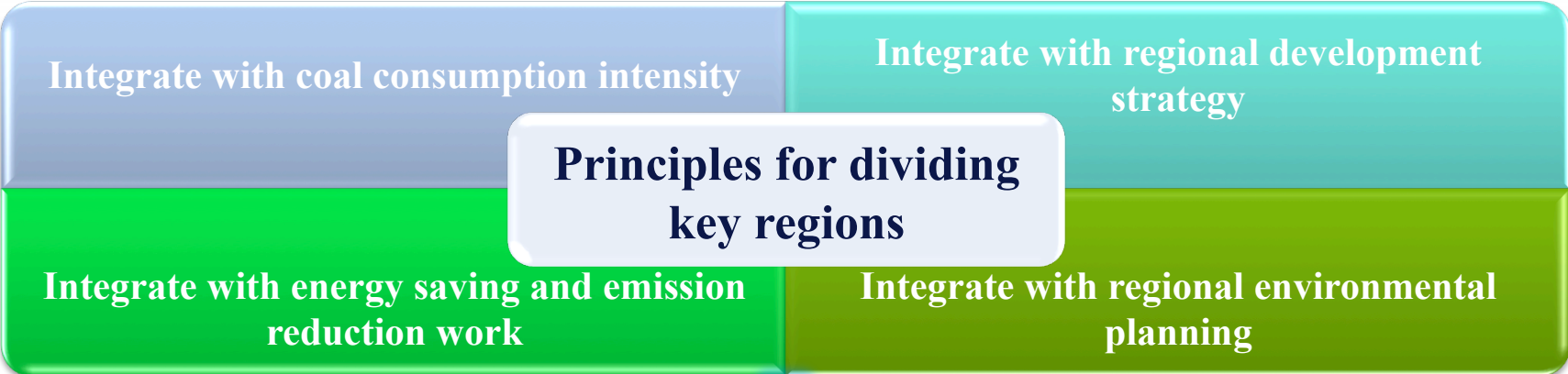


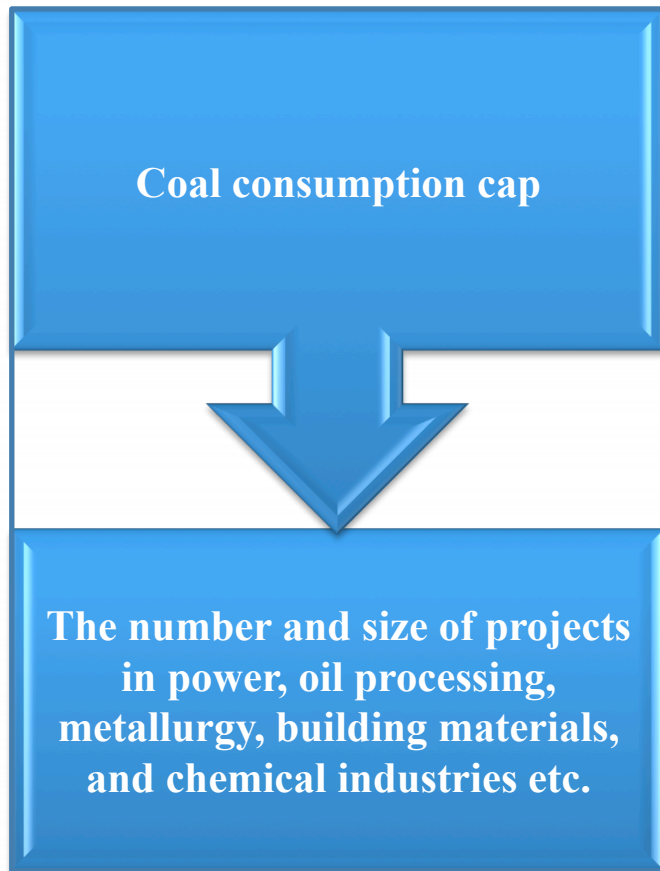
Seven measures



- 1. Develop coal consumption cap control regions and define control targets**
- 2. Optimize industrial structure and industrial layout**
- 3. Implement diversified energy supply and increase natural gas and electricity in key regions**
- 4. Adjust coal consumption structure and reduce coal consumption of small coal burning facilities**
- 5. Apply advanced technologies and improve coal processing and conversion efficiency**
- 6. Improve coal quality and increase the proportion of steam coal washing**
- 7. Promote diversified policies and facilitate adjustment in energy consumption structure and coal utilization method**

1. Coal consumption cap control regions and control targets





2. Industrial structure and industrial mode

Optimize industrial structure

Strive to develop the tertiary industry and
optimize internal structure of the secondary industry

Strictly control new energy consumption
sources and raise entry threshold

Actively phase out backward productivity
and optimize current industrial structure

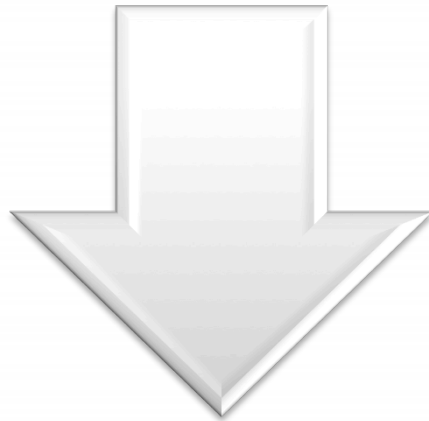
Optimize industrial layout

- Optimize energy development layout
- Design coal-consuming industries in a scientific and reasonable manner

3. Diversified energy supply and natural gas



Increase clean energy utilization
Strive to develop low-carbon energy
Increase the proportion of power transmitted from outside



Reduce the proportion of coal consumption

4. Reducing coal consumption of small coal burning facilities



Combined heat and power plant (CHP) and natural gas replace scattered small coal-burning boilers

- **New industrial parks use CHP as the source of heat supply. Existing industrial parks of all kinds and industrial clusters carry out CHP or centralized heating reform and built-up areas of cities implement centralizing heating;**
- **Scattered coal-burning boilers covered by heating networks will be totally dismantled.**

5. Advanced technologies and efficiency

Apply advanced boiler combustion technologies and improve coal utilization efficiency

- **Use efficient and environment-friendly pulverized coal boilers, and efficient energy-saving coal combustion technology, reduce coal consumption of boilers.**

Popularize clean coal power generation technology and achieve win-win outcome of energy saving and emission reduction

- **Develop advanced power generation technologies;**
- **Develop efficient, clean coal conversion technologies;**

6. Coal quality and steam coal washing

- **Strictly restrict the exploration and utilization inferior coal with high-sulfur, high ash content.**
- **Increase the proportion of coal washing**
- **Facilitate the construction of the low-sulfur and low ash content coal distribution center**
- **Preferentially use high-sulfur coal in coal chemical industry and combustion facilities equipped with efficient desulfurizers**

7. Integrated policies

(1) Improve regulations and standards and provide support for coal consumption cap control

Amend China's Act on Air Pollution Control at a proper time, improve standard system to reflect the concept of regional total coal consumption control;
Study medium and long-term targets for total coal consumption control, divide and implement the targets, and put in place a forecast and early warning mechanism

(2) Improve management system, identify and implement the task of total coal consumption control

Strictly control new high energy-consuming and high pollution projects, implement coal equivalent or decrement replacement of new projects, develop energy saving evaluation indicators of typical coal-consuming industries, such as power, metallurgy, building materials and chemical industries etc.

(3) Employ economic polices and promote clean development of the energy industry

Reform energy price policy, improve environmental-friendly financial polices and power generation dispatching mechanism



THANK YOU!