Coal-fired Emission Control of Beijing

Beijing Municipal Environmental Protection Bureau

Aug. 30, 2016

Outline

Introduction and Background
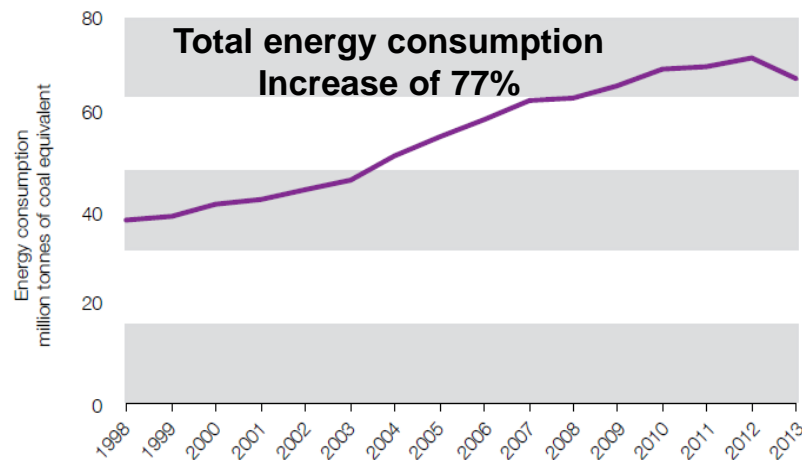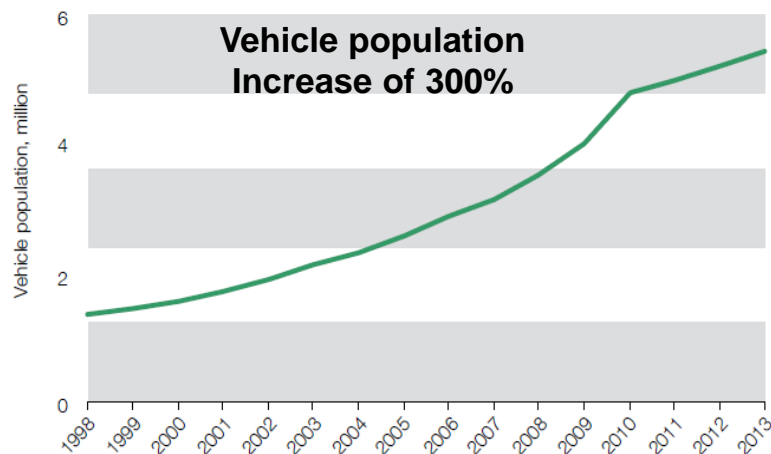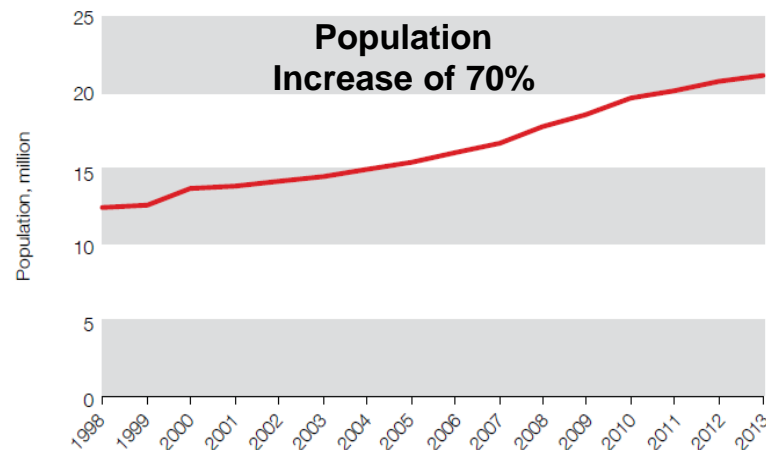
Air Quality in Beijing: Past and Present

Coal-fired Emission Control of Beijing

The experience and Perspective of Beijing
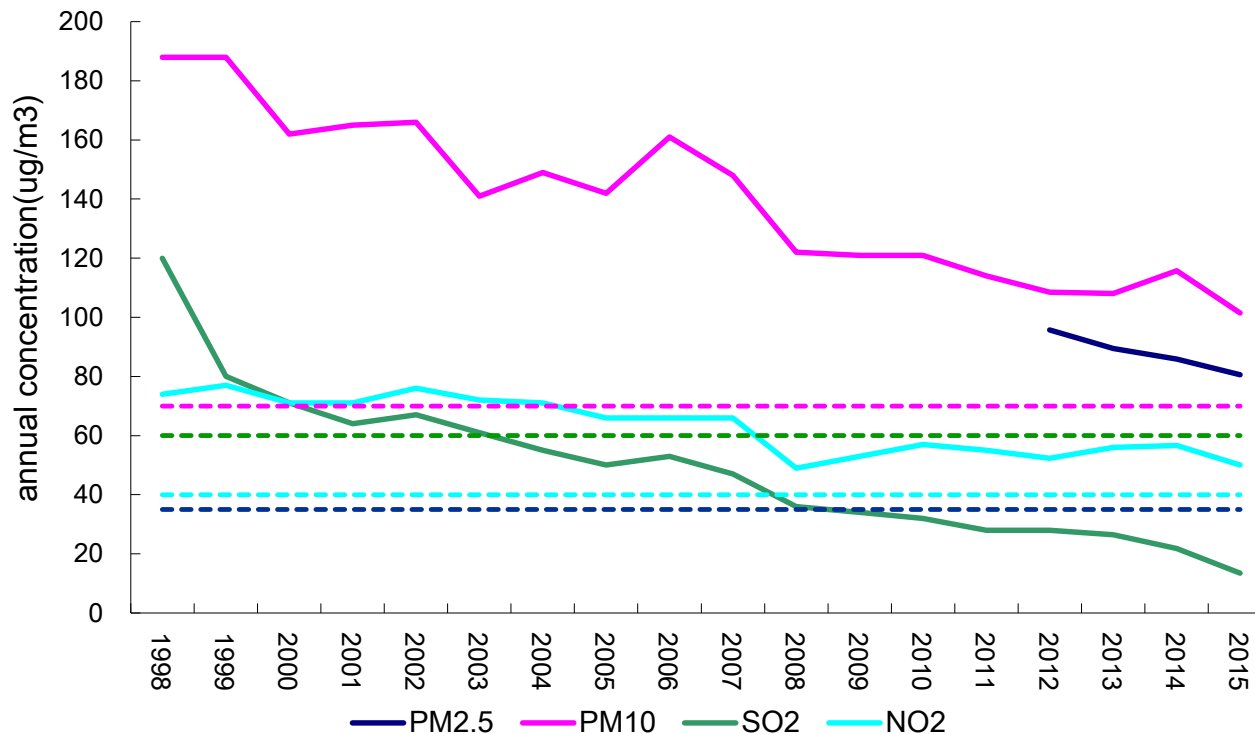
■ Rapid socio-economic development in Beijing has also spurred tremendous increases of vehicle population and energy consumption.

Gross domestic production
Increase of 720%

Population
Increase of 70%

Vehicle population
Increase of 300%

Total energy consumption
Increase of 77%

Data: 1998-2014

- In 1998, Beijing was suffering from a severe mix of coal and vehicle-based air pollution pattern with significant exceedances of major air pollutants.

- During 1998-2015, Annual concentrations of SO_2, NO_2 and PM_{10} in Beijing have been significantly reduced by 89%, 32% and 46%, respectively.

- Particularly, CO and SO_2 now can stably meet the NAAQS.

Air Quality Trends in Beijing: Past and Present

■ In 2012, the Ministry of Environmental Protection of China released an amendment to the National Ambient Air Quality Standard (NAAQS), which added the concentration limits of $PM_{2.5}$.

■ The source apportionment study has identified the major local contributors including on-road vehicles, coal combustion, industrial production and dust.
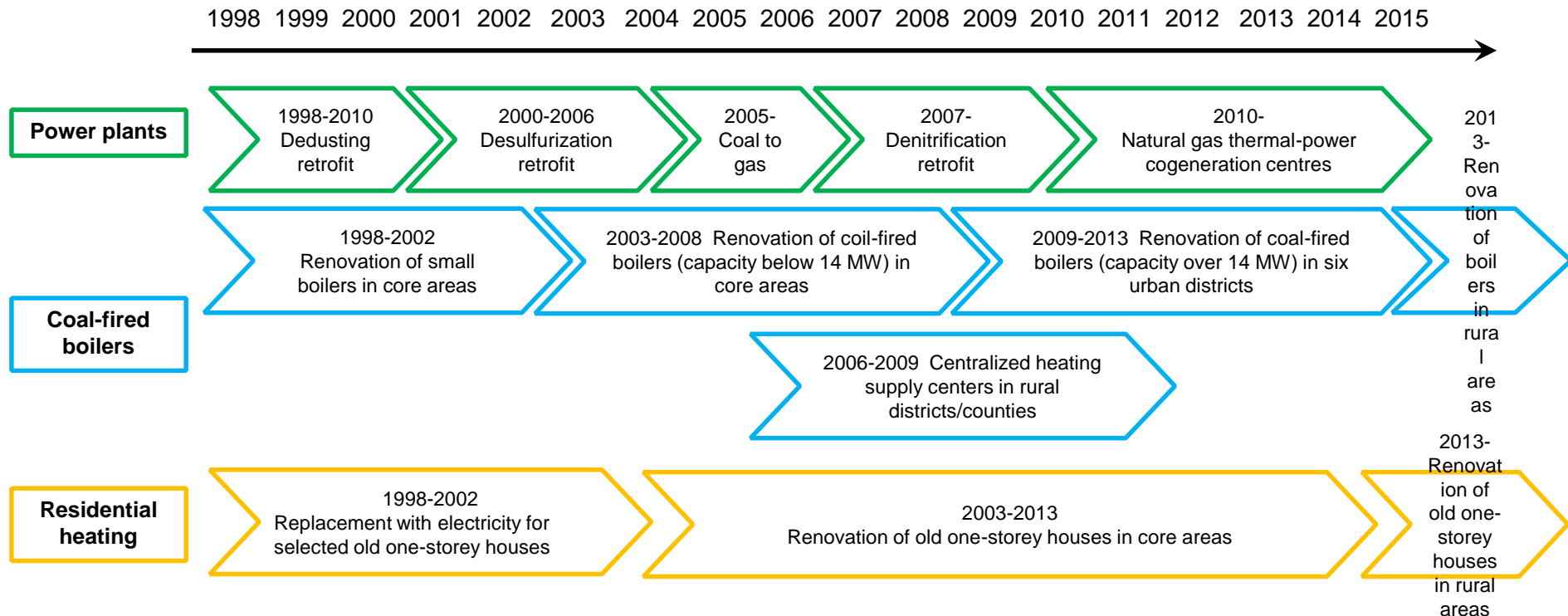

Regional transport 28-36%

64% - 72%
Local emission

Miscellaneous
14.1 %

Construction dust
14.3 %

Industrial production
18.1 %

Motor vehicle
31.1 %

Coal consumption
22.4 %
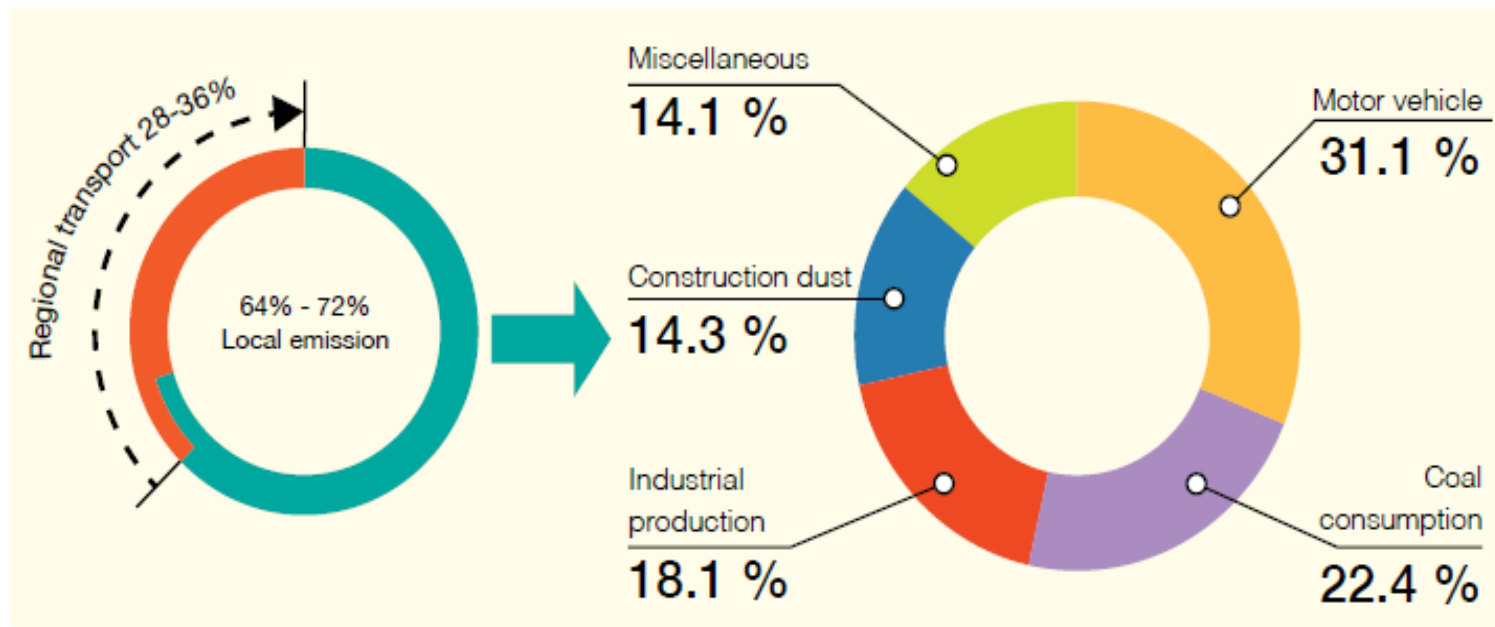
Source: Beijing Municipal Environmental Monitoring Center, 2014

Overview of Air Pollution Controls in Beijing

■ Since 1998, air pollution controls in Beijing has always been one of the prioritized tasks for local governments to improve environmental quality.

■ Historical: **successive air control measures during 1998-2012** covering a variety of fields

■ Major Events: temporary comprehensive air pollution control measures during the **2008 Olympic Games** and the **2014 APEC Summit**

■ Near Future: **mitigating PM$_{2.5}$ pollution** required by the ***Beijing Clean Air Action Plan (2013-2017)***

Ⅲ Coal-fired Emission Control

- ***Stringent emission standards*** and massive adoption of ***advanced end-of-pipe control devices***;

- ***Residential heating supply***: ***Centralized thermal centers*** and the ***old building renovation*** in the one-storey house area;

1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

Power plants

| 1998-2010 Dedusting retrofit | 2000-2006 Desulfurization retrofit | 2005- Coal to gas | 2007- Denitrification retrofit | 2010- Natural gas thermal-power cogeneration centres | 2013- Renovation of boilers in rural areas |

Coal-fired boilers

1998-2002 Renovation of small boilers in core areas

2003-2008 Renovation of coil-fired boilers (capacity below 14 MW) in core areas

2009-2013 Renovation of coal-fired boilers (capacity over 14 MW) in six urban districts

2006-2009 Centralized heating supply centers in rural districts/counties

Residential heating

1998-2002 Replacement with electricity for selected old one-storey houses

2003-2013 Renovation of old one-storey houses in core areas

2013- Renovation of old one-storey houses in rural areas

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Reduction on Coal Consumption and Increase of NG

- Coal consumption: 27 million tons ⟶ 12 million tons ⟶ 10 million tons
- Natural Gas:　　　　0.3 billion m³ ⟶ 14.8 billion m³ ⟶ 17 billion m³
- Energy Structure Optimization: *Coal to Gas*, e.g., coal consumption in total energy consumption decreased from 54% in 1998 to about 14% in 2015

(Coal consumption)　　　　　　　　　　　　　　　　　　　　　　　　　　(Natural Gas)

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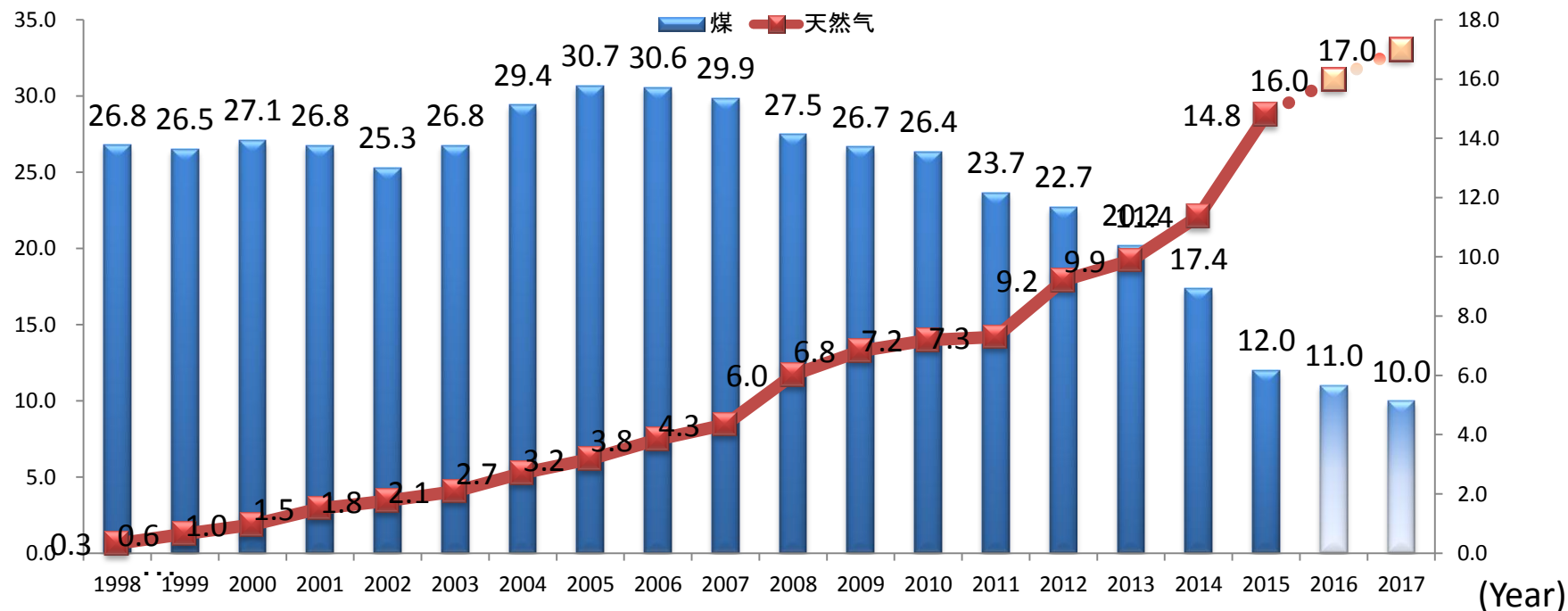
Trend of Coal and Natural Gas Consumption in Beijing during 1998 to 2017

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Adoption of end-of-pipe control technologies by local power plants in Beijing

| Power plants	Dedusting	Desulfuration	Denitration
Gaojing Cogeneration Power	Fabric filter	Wet limestone-gypsum FGD	SCR
Shenhua Guohua International Corporation	ESP	Wet limestone-gypsum FGD	SNCR + SCR
Huaneng Thermal Power	ESP	Wet limestone-gypsum FGD	SCR
Jingneng Thermal Power	ESP, fabric filter, electrostatic-bag precipitator	Desulfurization operation in 1-4 # furnace	SCR

Abbreviations: ESP, electrostatic precipitator; FGD, flue gas desulfurization; SCR, selective catalyst reduction; SNCR, selective non-catalyst reduction;

Energy consumption by the power section in Beijing, 1998-2013
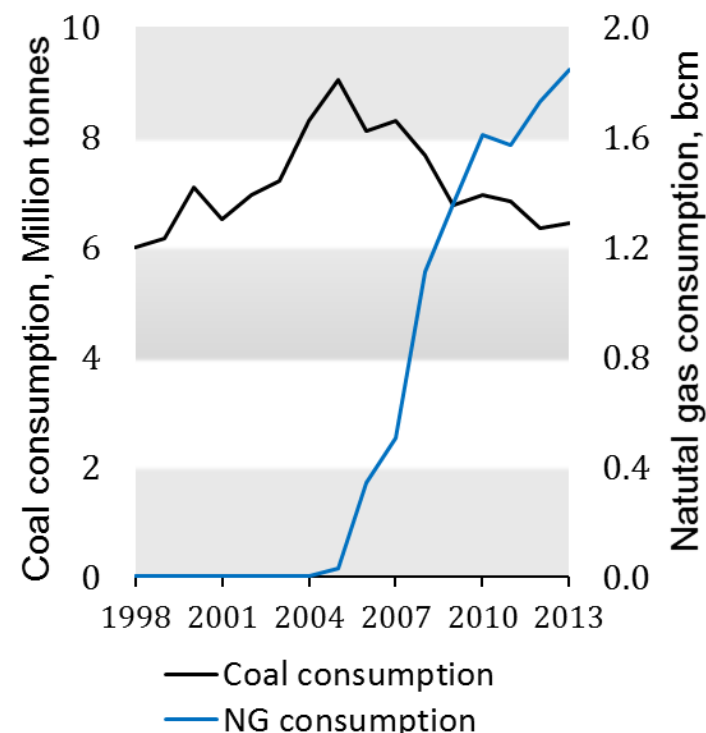
Power Plants: Estimated emission reduction benefits

- Total emissions of $PM_{2.5}$, PM_{10}, SO_2 and NO_X from power plants in 2013 were reduced by 86%, 87%, 85% and 64%, respectively, compared with the 1998 levels.

Estimated emissions, kilotonnes

PM$_{2.5}$

Avoided emissions

PM$_{10}$

Avoided emissions

SO$_2$

Avoided emissions

NO$_x$
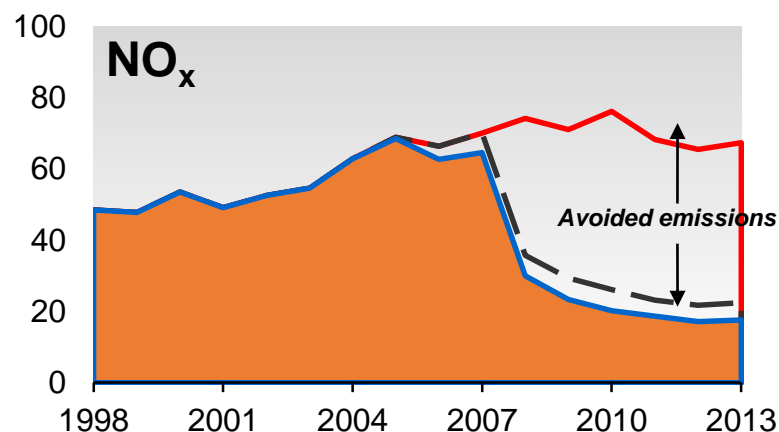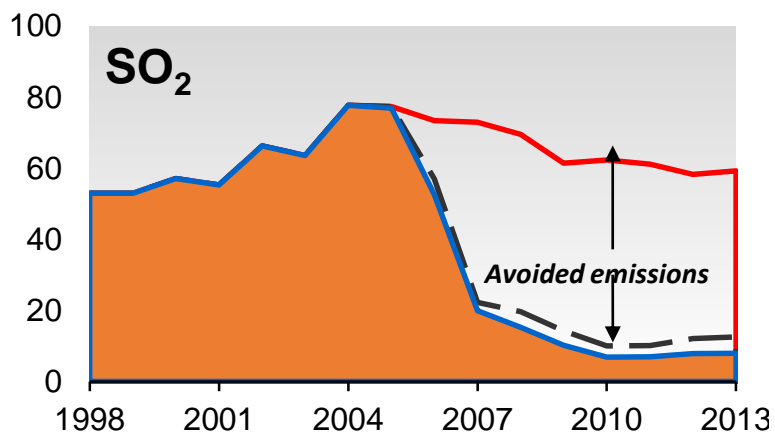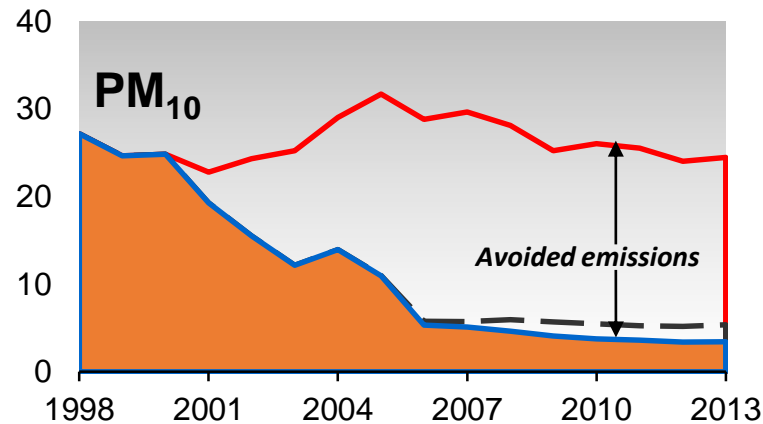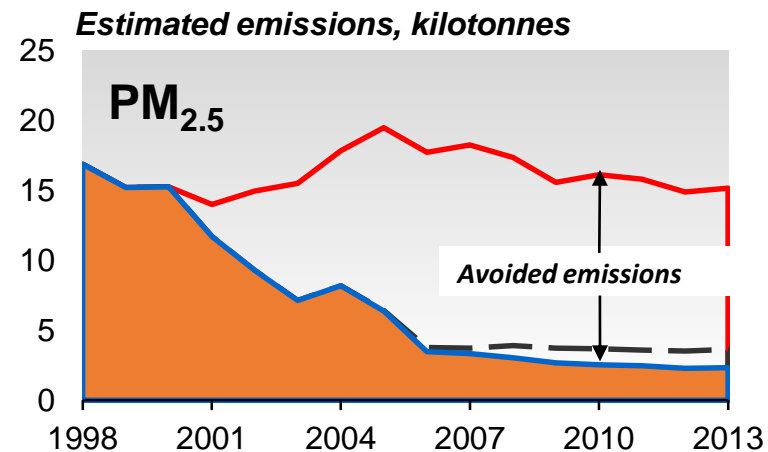
Avoided emissions

— Estimated emissions without control measures

- - - Estimated emissions with flue gas controls and no gas-fired unit

— Estimated emissions with all control measures (acutal emissions)

Note: Assessed by using the MEIC model developed by Tsinghua University

Coal-fired boilers: *three-phase scrappages in urban districts*

Control measures implemented on coal-fired boilers in Beijing, 1998-2013

Period	Area	Focus	Implementation
Phase 1 (1998-2002)	Core areas[a]	Small boilers with capacity less than 0.7 MW	Eliminated 10,633 small boilers, totally phased out capacity of 15,687 MW
Phase 2 (2003-2008)	Core areas	Coal-fired boilers with capacity less than 14 MW	Eliminated 5 704 coal-fired boilers, totally phased out capacity of 15,498 MW
Phase 3 (2009-2013)	Six urban districts[b]	Coal-fired boilers with capacity more than 14 MW	Eliminated 812 coal-fired boilers, totally phased out capacity of 6,436 MW

[a] Core areas refer to Dongcheng and Xicheng districts.
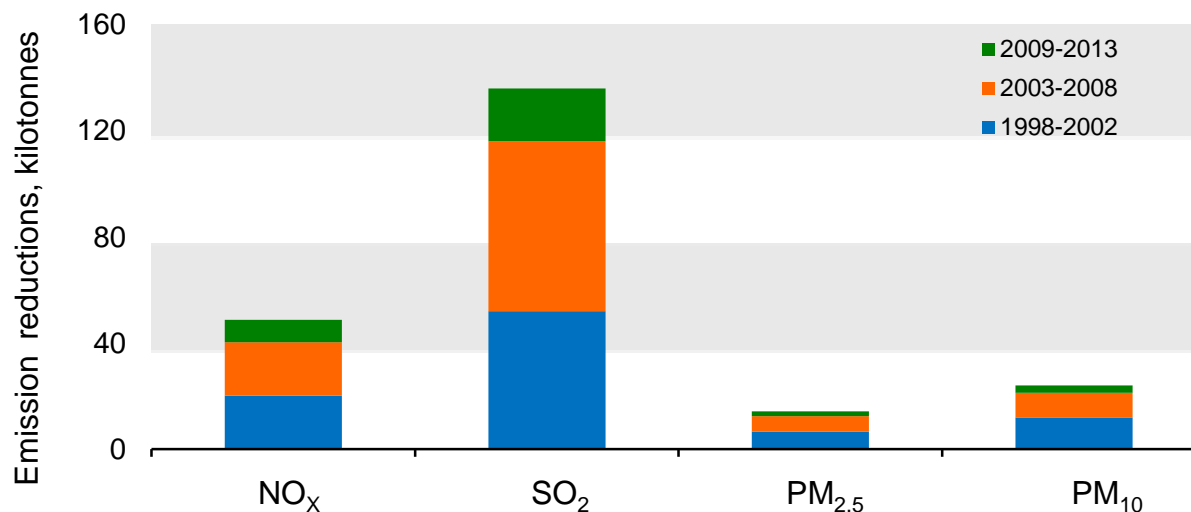
[b] The six urban districts include Chaoyang, Haidian, Fengtai, Shijingshan, Dongcheng and Xicheng.

Small-capacity boilers, core areas

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High-capacity boilers, all urban districts

Source: Beijing Environmental Protection Bureau

Avoided emissions from control measures on coal-fired boilers in Beijing, 1998-2013

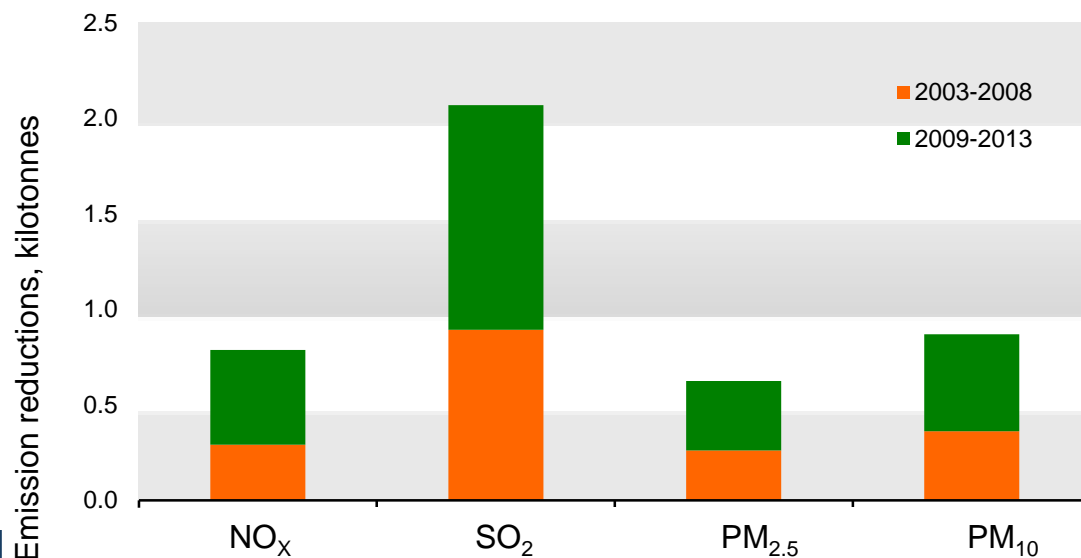*Note: Assessed by using the MEIC model developed by Tsinghua University*

Residential heating: *renovation projects in old house area*

Residential heating conventions (i.e., *Coal to Electricity*) in the old city centre traditional residential area of Beijing, 1998-2013

Period	Area	Household
Phase 1 (1998-2002)	Pilot projects in selected neighbourhoods	256
Phase 2 (2003-2008)	Selected neighbourhoods	93 500
Phase 3 (2009-2013)	Whole core areas	150 000

Source: Beijing Environmental Protection Bureau

Avoided emissions from residential heating renovations in the conventional old house areas of Beijing, 1998-2013

Note: Assessed by using the MEIC model developed by Tsinghua University

■ **Experiences--Comprehensive measures to control air pollution from coal burning**

■ Cleaner fuels (e.g., Coal to Gas and Electricity);

■ Stringent emission standards;

■ End-of pipe emission control devices;

■ Economic Incentives: e.g., subsidies to scrappage coal-burning boilers;

In a certain period of future, high speed economic growth in Beijing will sustain, the scale of city construction, vehicle fleet, and population will continue to increase. The conflicts among population, natural resources, and environment continue to be dominant.

To improvement of environment and better air quality, Beijing is insisting on promotion of urban sustainable development, adopting measures to combat climate change and building a resource-saving and environment-friendly society.
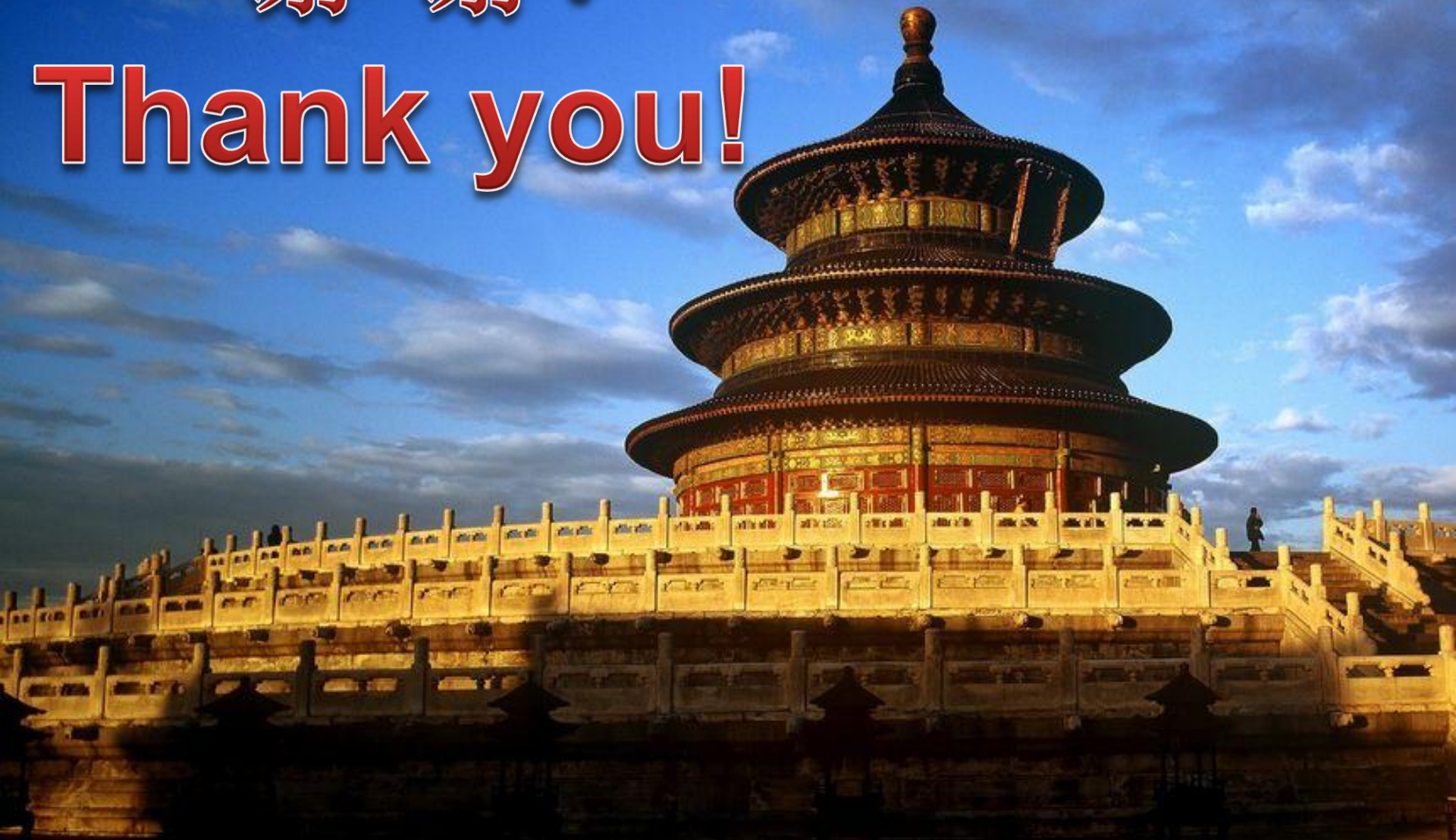
For a better future of all world!

谢 谢！
Thank you!

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Basic Informations

北京遥感图
北京市气象局

- **Landform：Mountains around**
- **Area：16,000 km^2**
- **Climate：Temperate continental monsoon**
- **Annual precipitation：448 mm**
- **Population：> 20 million**
- **Vehicles：> 5.6 million**
- **Annual construction sites：**
  200 million m^2