

# China's Plans to Improve Air Quality

FEAS Lecture Series  
Wesleyan University, Middletown CT

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# What Images Come to Mind When You Think of China and Air Quality?



This November 2011 day was rated “mildly polluted”

# Clean Air is A Goal in China Too



A “Blue Sky Day”. Each of China’s major cities has a targeted number of such days they aim to reach each year



# What Comes to Mind When You Think About China and Economic Development ?



This image is one that China wants to relegate to the dust bin. Hundreds of these plants have already been closed

# This Picture is Another View: Where China is Heading





# As Is This One



# What About China and Its Environment?



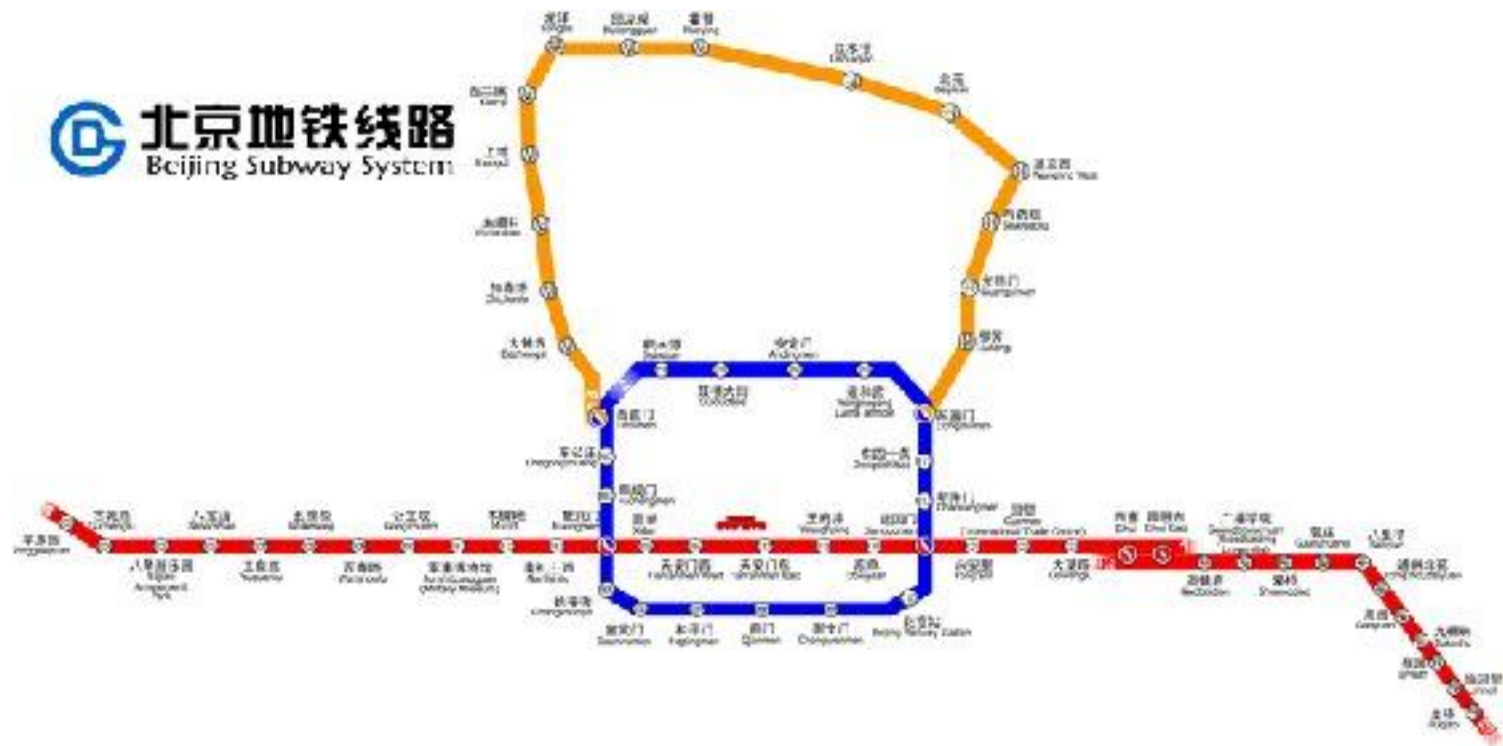
# These Pictures Are Also Accurate





# China Infrastructure Project Example

## Beijing Subway Map 2007





# Overview

- Discussion of China's economic growth framed from environmental and especially air quality perspectives
- Comparison of China and United States economic development
- What indicators compelled each country to act to improve its environment?
- China and the United States actions to reduce air pollution and protect public health
- Role of the public to engage, encourage and advocate for change
- What will China look like in 2030?
- What can the United States and Europe learn from China? And vice versa.



# Rate of Change in China: Environmental Affects and Opportunities

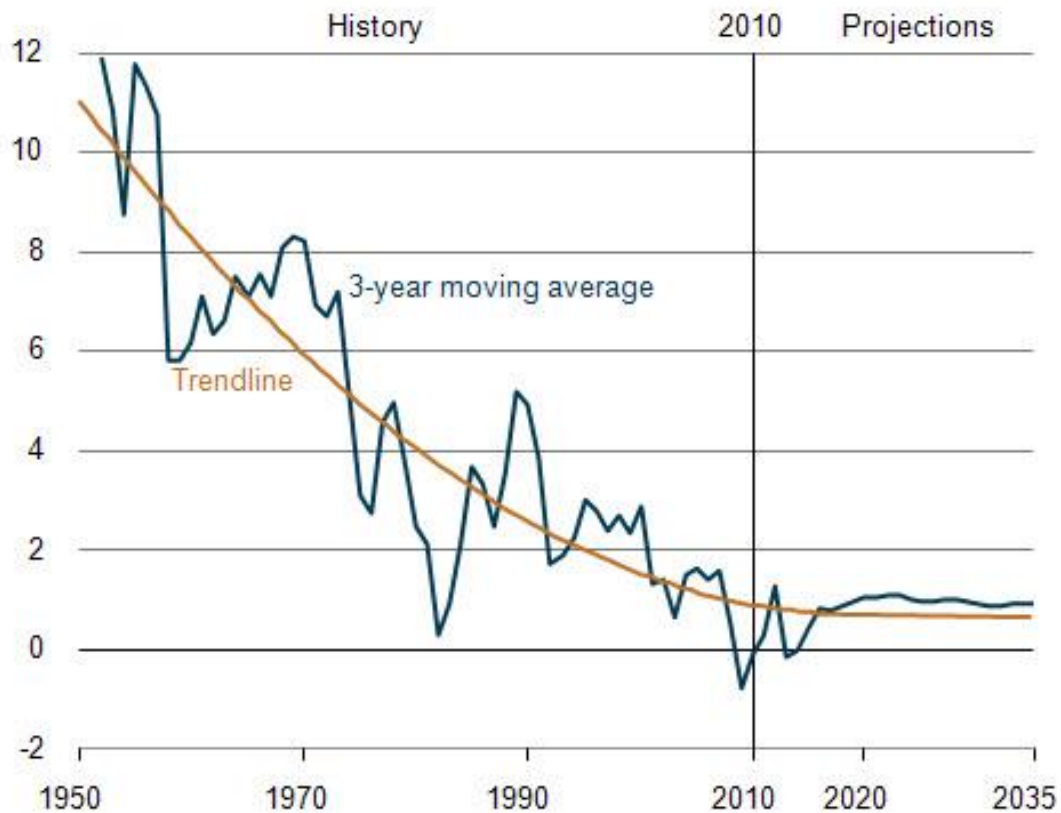
- Equivalent of two United States (600 million people) relocating from rural to urban areas
- Developing middle class: transition from heavy manufacturing to higher value products and service economy
- Annual growth in Gross Domestic Product (GDP) is 7-10%
- Annual electricity growth 10%
- Each ton of cement produced emits about one ton of CO<sub>2</sub>
- Each ton of coal combusted emits slightly more than one ton of CO<sub>2</sub>, along with many pounds of fine particles, sulfur dioxide. Coal combustion also results in mercury emissions.
- Electricity production requires water for cooling and power plant processes. Each kilowatt-hour of electricity produced uses 2.5 liters of water.

# Comparison of China to United States in the 1950s and 1960s

- Post-World War II: US GDP growth rate reached 13% in 1950, was 6-7% per year for many of years 1950-1964
- Automobile driven expansion: “Eisenhower Interstate Highway System” led to rapid suburbanization, expansion of urban areas
- Chemical manufacturing and power generation increased

# US Electricity Growth Rate

Figure 93. U.S. electricity demand growth, 1950-2035  
(percent, 3-year moving average)



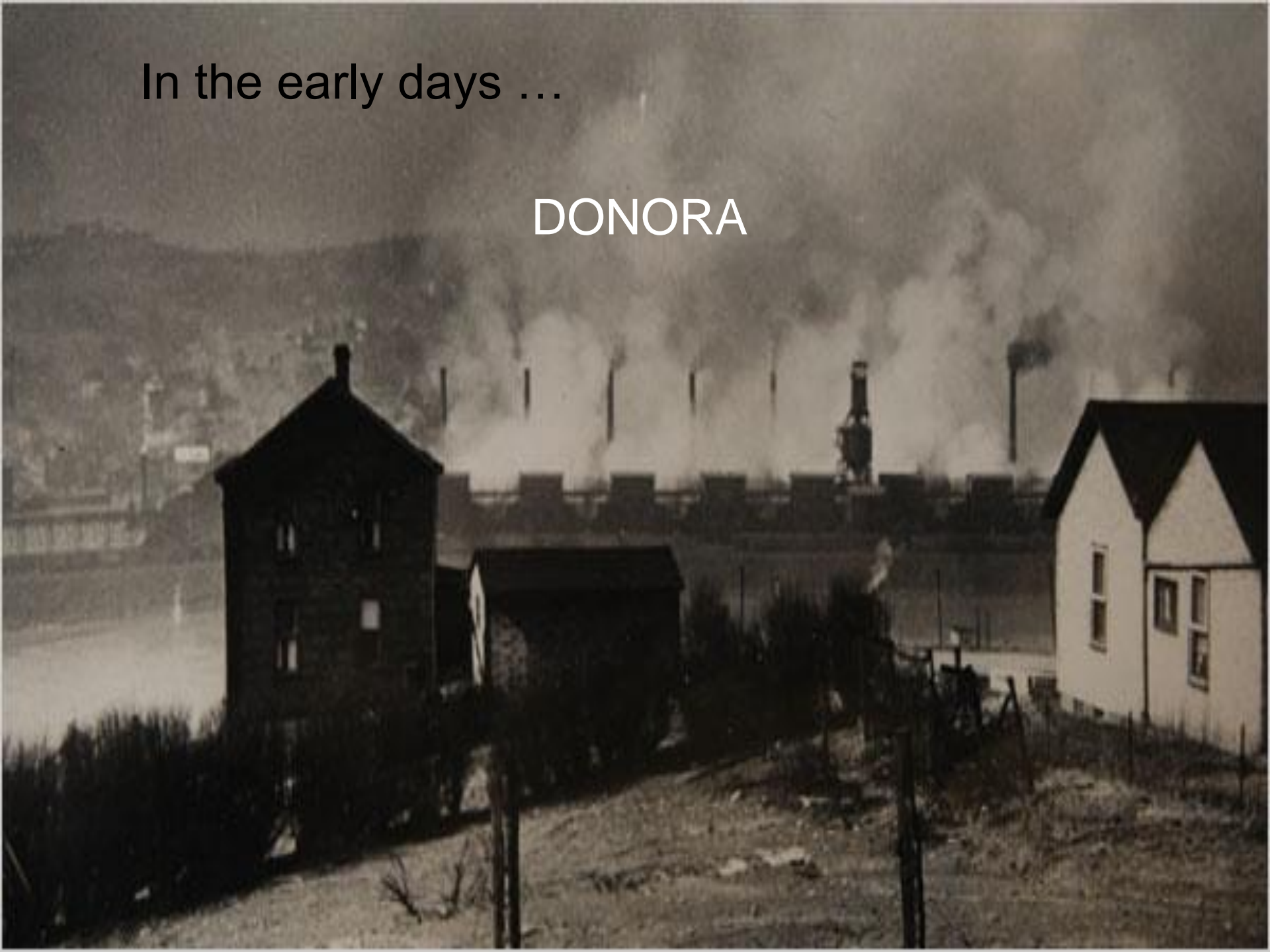


# Environmental Impact of Growth in US Post- World War II

- Severe air pollution in most urban areas
- Degradation of water
  - Cuyahoga River in Cleveland caught on fire
- Degradation of land
  - Coal and uranium mining impacts
- Cavalier personal attitudes

In the early days ...

DONORA









# The 13<sup>th</sup> Time the Cuyahoga River Caught Fire Was Pivotal to Action to Clean Up US Waterways



# This Ad Spurred Americans to Action on Earth Day 1971

**GET INVOLVED  
NOW.  
POLLUTION  
HURTS  
ALL OF US.**

You can help by becoming a community volunteer. Write:  
**Keep America Beautiful, Inc.**  
99 Park Avenue, New York, New York 10016

   
A Public Service of Transit Advertising & The Advertising Council.

**People start pollution.  
People can stop it.**

# State of science and knowledge about environmental affects

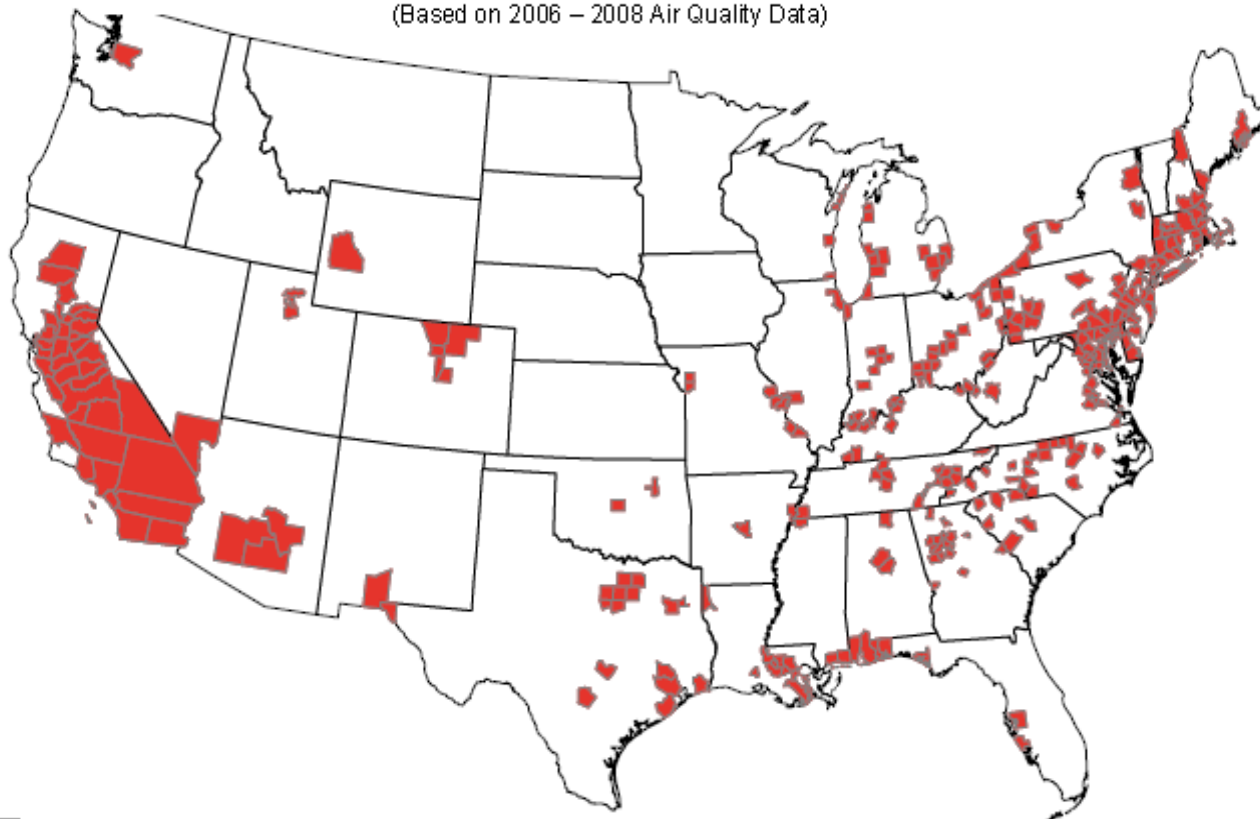
- 1950s/1960s: USA- focus on “black soot” and smoke. Particulate collected in buckets
- Today: we know that human lungs do not distinguish between pollutants, that cumulative affects of pollutants are important
- United States has been regulating air pollution since 1970, our economy is considered developed
- Great progress has been achieved, but today one-half of US citizens still live in areas that exceed one or more health-based air quality standards.

# 2008 Ozone NAAQS

Counties With Monitors Violating the March 2008 Ground-Level Ozone Standards

0.075 parts per million

(Based on 2006 – 2008 Air Quality Data)



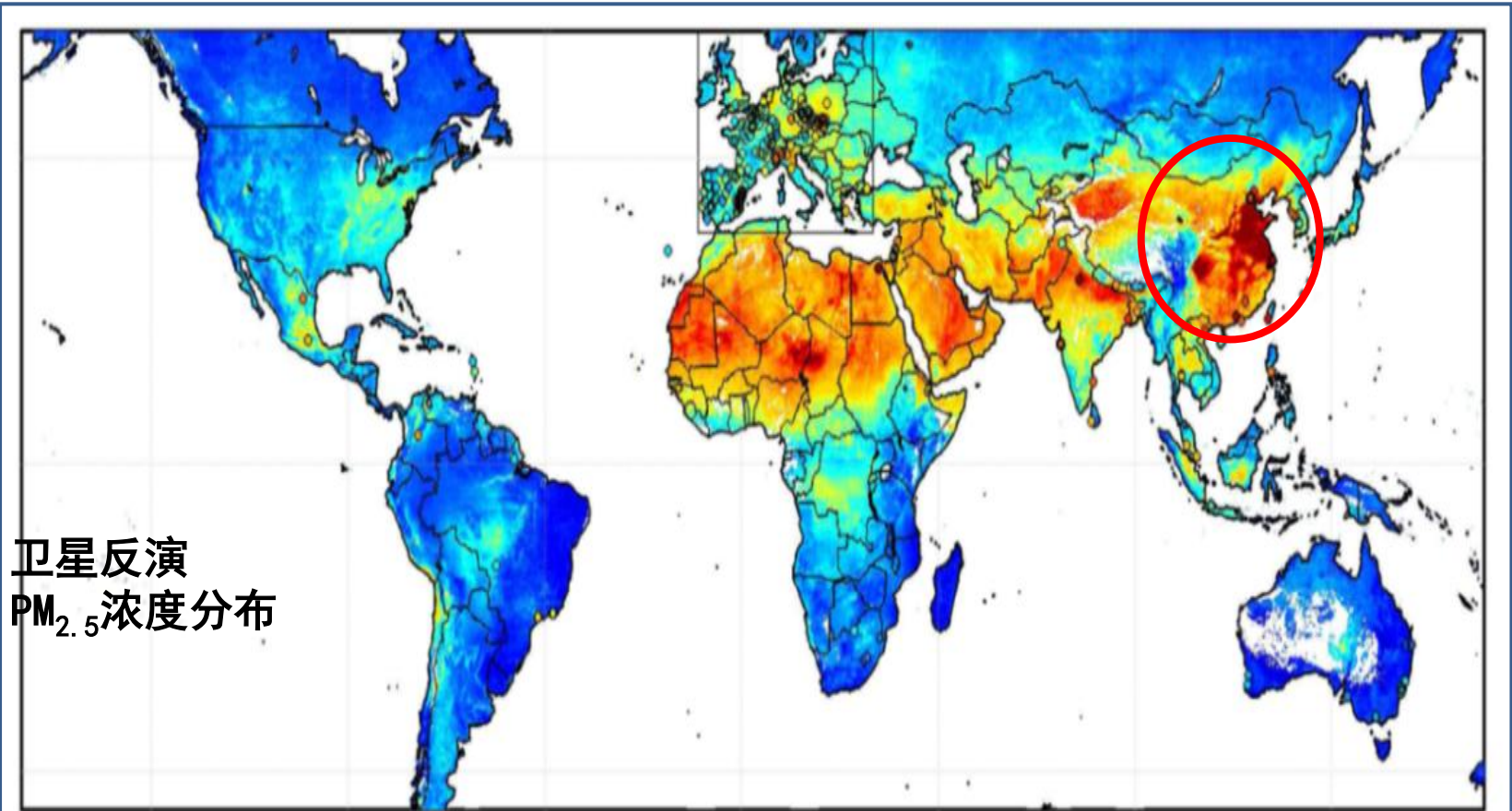
322 of 6751 monitored counties violate the standard



# Effects of China's Economic Development on Air Quality

- Nearly all of 113 key cities have pollution that exceeds World Health Organization (WHO) and China's air quality standards
- PM<sub>2.5</sub> concentrations are high throughout China, and especially in Eastern China
- Urban ozone concentrations are rising

# PM2.5

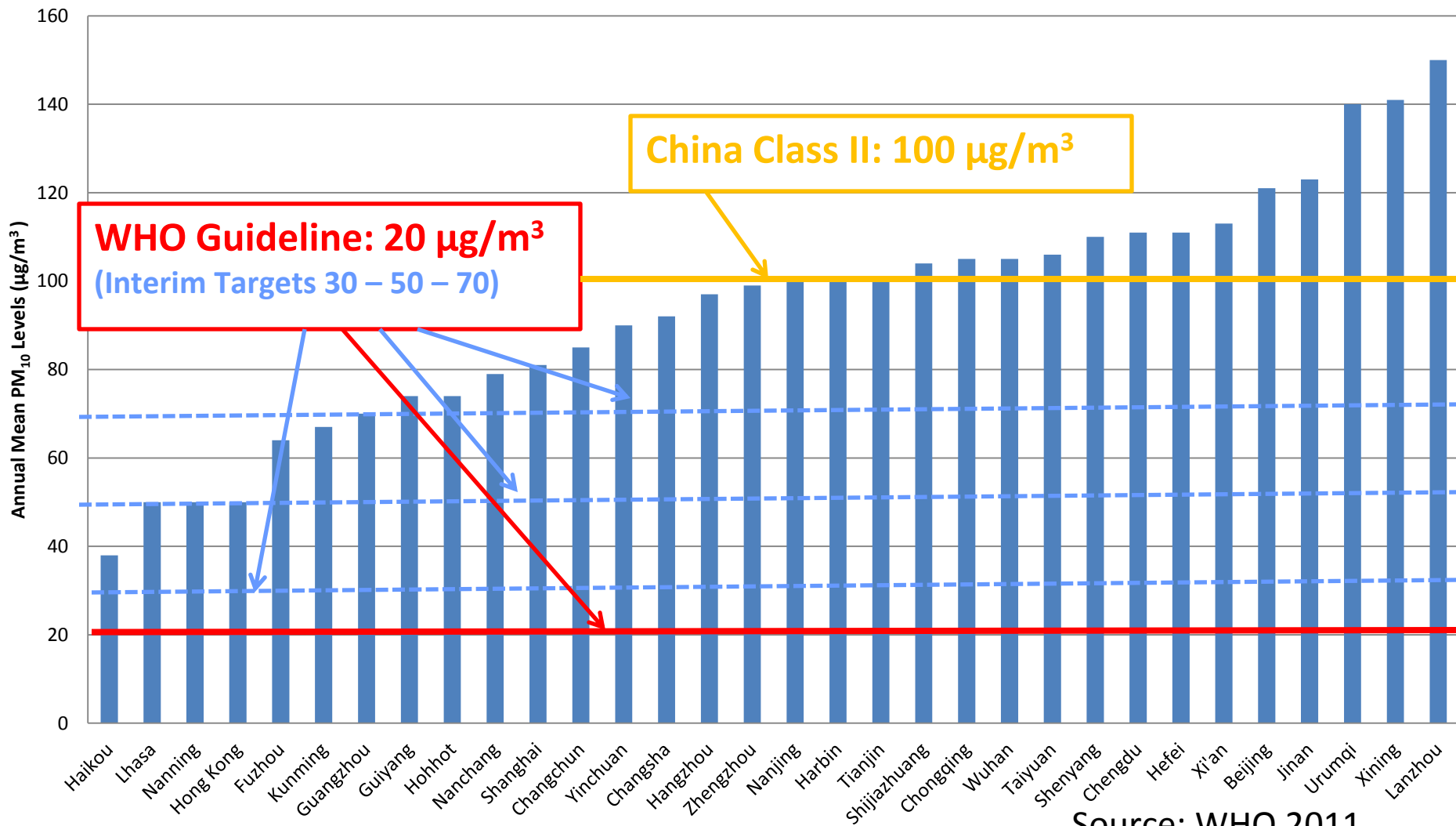


卫星反演  
PM<sub>2.5</sub> 浓度分布

Van Donkelaar et al. (2010)

# Air pollution in China is severe, imposing a heavy burden on society

## 2009 Annual Mean PM<sub>10</sub> Levels in Chinese Cities



Source: WHO 2011

# Haze Days

Xi'an: 103 Days



Taiyuan: 225 Days



Shijiazhuang: 184 Days



Beijing: 100 Days



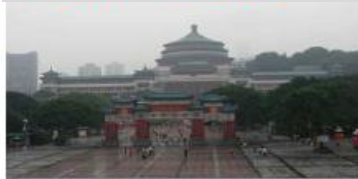
Tianjin: 207 Days



Chengdu: 239 Days



Chongqing: 133 Days



Changsha: 107 Days



Nanchang: 152 Days



Guangzhou: 131 Days



Shenzhen: 164 Days



Fuzhou: 120 Days



Qingdao: 88 Days



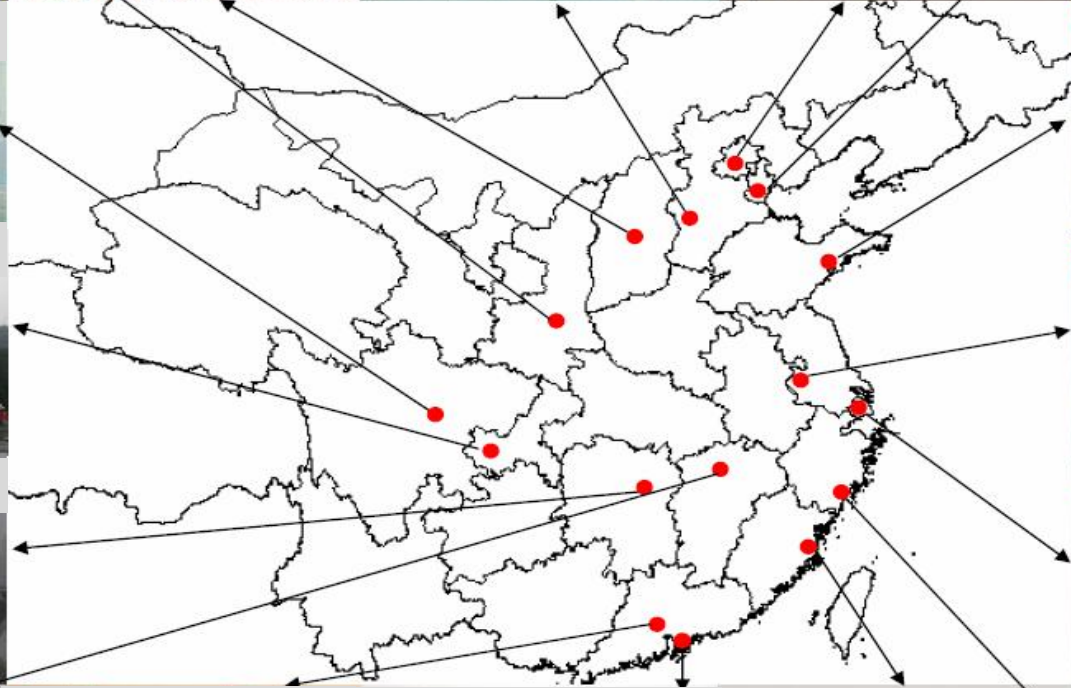
Nanjing: 211 Days



Shanghai: 140 Days



Wenzhou: 108 Days





# Indicators of Change in China

- Beijing Olympics
  - Factories closed in Beijing and surrounding areas
- Shanghai Expo
  - AIRNow: first Chinese application of air quality forecasts available to public in real-time
- Increased transparency
  - Disclosure of industries that violate air and water quality regulations
  - China's 113 key cities are reporting air quality data in real-time (see also smart phone app)

# Change in China After 2009

- Post-Olympics: factories re-opened, or expanded and relocated outside of central business districts
- Pollution levels increase, and type of pollution changes- increased fine particulate, ozone
- Visibility impaired
- Factory closings continue, but rate of closing insufficient to keep pace with rate of economic growth

# Awakening of Public Interest in Air Quality

- Daily air pollution reports: “Blue Sky Days” do not comport with what the public is seeing and breathing. “Why do I have to keep my kid home from school or sports if it’s a Blue Sky Day?”
- US Embassy, Beijing: PM<sub>2.5</sub> monitor installed. Monitor meets US EPA requirements, data collected and reported as service for US employees and ex-pats (US does this routinely in other countries too).
- Twitter-feed, iPhone app: people compare US Embassy data with that being officially reported
- Growing middle class aware of pollution, and wants more say in approval of new plants

# AirNow Operated During the 2010 Shanghai Expo

## AIRNow-International

### Program Goals

- Exchange environmental data Internationally
- Make advances in air quality knowledge and applications
- Build a community of people and organizations
- software same as U.S. system
- Share with interested countries!

- **Shanghai Environmental Monitoring Center for the 2010 World Expo**





# Increased Transparency of Pollution Data

- Government Initiatives
  - hourly air quality data in each monitoring stations in 113 cities
  - AirNow (EPA, Shanghai—other places)
  - Emission information of enterprises
- NGO Initiatives
  - IPE (Institute of Public and Environmental Affairs): “China Air Pollution Map”, non-compliance records+ locate major emitters + air quality data
  - NRDC: rating of cities based on transparency
  - Clean Air Initiative-Asia: scorecard for cities based on quality of air pollution program
  - Choke Point China: Wilson Institute

# China Solid Waste Pollution Map 中国固体废物污染地图

Home

Pollution Map

Green Choice Alliance

IPE Notices

Environment & Health

IPE Reports

Admin Region Pollution Locations Supervised Corporations Pollution Area Diagrams Environ Monitoring River Basin



Quick Search  Supervision Records

[National] Corporate Supervision Records  
Discharge Data

[National] Environmental Quality

[National] Emissions

Current Area: National

- |          |           |           |              |
|----------|-----------|-----------|--------------|
| Beijing  | Tianjin   | Hebei     | Shanxi       |
| Inner    | Liaoning  | Jilin     | Heilongjiang |
| Mongolia | Shanghai  | Jiangsu   | Zhejiang     |
| Anhui    | Fujian    | Jiangxi   | Shandong     |
| Henan    | Hubei     | Hunan     | Guangdong    |
| Guangxi  | Hainan    | Chongqing | Sichuan      |
| Guizhou  | Yunnan    | Tibet     | Shaanxi      |
| Gansu    | Qinghai   | Ningxia   | Xinjiang     |
| Taiwan   | Hong Kong | Macau     |              |

Environmental News [more](#)

- Longyuan to up overseas wind 2010-12-15
- China plays key role in Cancun cli... 2010-12-15
- 61 cities short of sewage treatmen... 2010-12-15

Regional Air Quality Rankings [more](#)

No.	Year	Location	Urban Average Dustfall
1	2009	Xingtai	14.7000 t/km <sup>2</sup> month
2	2009	Chengde	12.9300 t/km <sup>2</sup> month

Regional Pollutant Discharge Rankings [more](#)

No.	Year	Location	Total Wastewater
1	2009	Guangdong	68.7400 10 <sup>8</sup> t
2	2009	Jiangsu	52.3600 10 <sup>8</sup> t



查询

共有2277个点/已显示2216个点

They discharge over 65% of China's water and air pollutants

企业监管记录分布 2010年重点监控企业



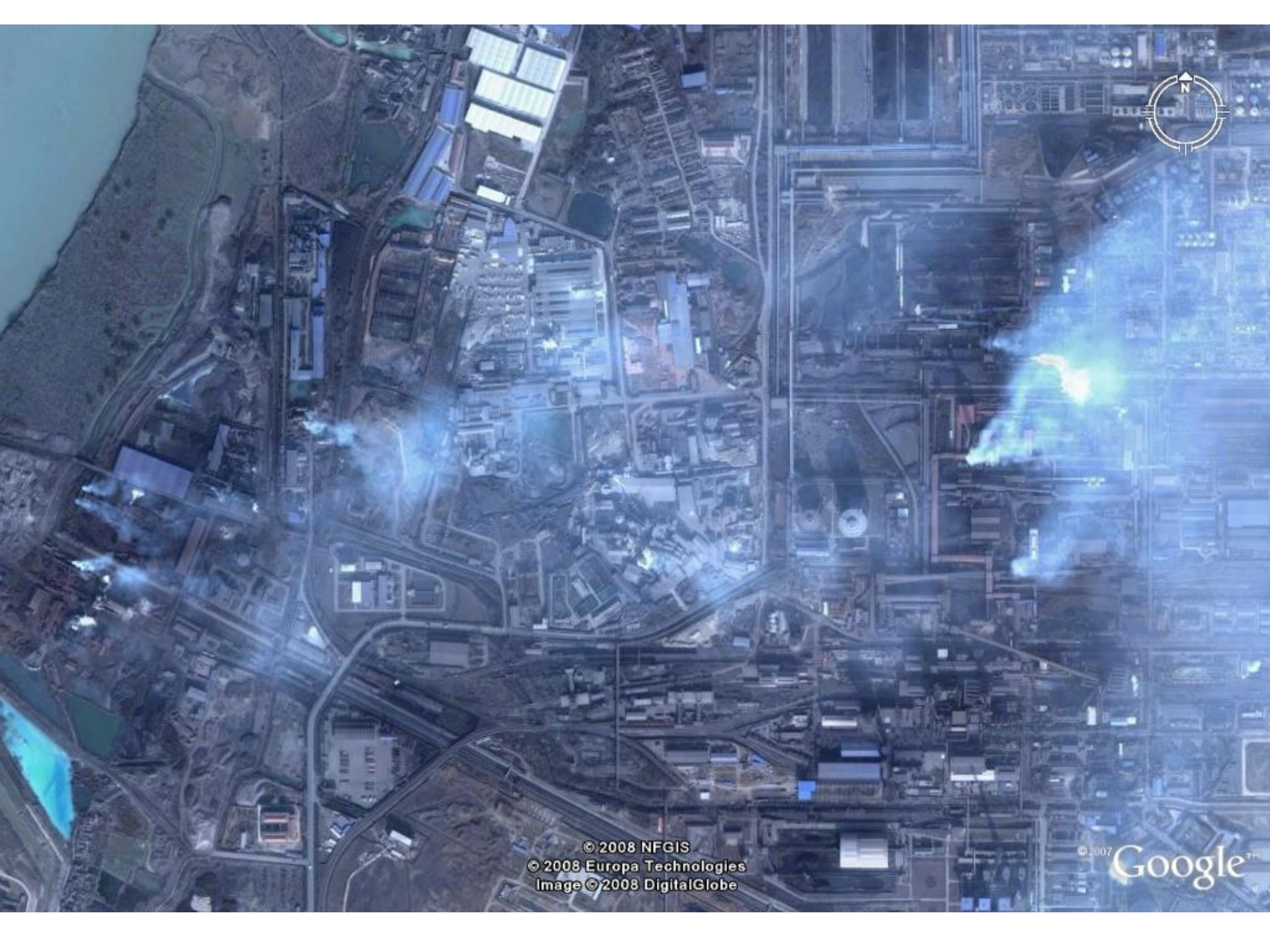




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# Increased Public Pressure



“Thousands of people besieged a government office in a southern Chinese town Tuesday and blocked a highway to demand a halt to a planned coal-fired power plant because of concerns about pollution, protesters said.”

# November 2011: PM2.5 Becomes Cause Celebre

- Beijing air quality in October and November consistently poor
- Over two week period:
  - China demands that US Embassy shut down their PM2.5 monitor
  - China asks US to permit China to monitor at location next to Embassy, or to have US and China co-locate monitors
  - China declares that its PM2.5 data are fine, that the US data are incorrect
  - China announces that PM2.5 pollution is a problem in Beijing, but says pollution is coming from other provinces
  - China announces that PM2.5 will be a major environmental focus during the 12<sup>th</sup> Five Year Plan. Announces plans to accelerate implementation of control measures, cleaner fuel standards, adoption of more protective PM2.5 standard, and adoption of new air quality index to supplement the existing index that is used to calculate “Blue Sky Days”
- Next slide: CCTV video clip at conference featuring top Chinese and American air quality officials



# “China Isn’t Doing Anything About the Environment”

- 11<sup>th</sup> and 12<sup>th</sup> Five Year Plans (2006-2010, 2011-2015)
- 72 GW of older, inefficient power plants shutdown 2006-2010 (more are being closed in 2011-2015) (equivalent to capacity of nearly three New England electricity grids)
- Energy intensity targets: reduce 40-45% by 2020
- Sulfur dioxide reduced by 14.3% between 2006-2010. 12<sup>th</sup> Five Year Plan: requires additional 8% reduction in SO<sub>2</sub> and 10% reduction in NO<sub>x</sub> (2011-2015)
- Plans to install emission to reduce NO<sub>x</sub> emissions from 300 GW of power plants between 2011-2015
- Top 1000 and Top 10,000 programs to improve energy efficiency of industrial plants
- Bonuses and promotions of government officials based on their abilities to meet targets in Five Year Plans
- Differential pricing: power companies that install air pollution controls are paid slightly higher rate and are dispatched sooner



# Key Regions Described in State Council's Regional Air Quality Guidance



- 1. Central Liaoning [Province] (Shenyang etc.)
- 2. Shandong Peninsula (Qingdao etc.)
- 3. Greater Wuhan
- 4. Changsha, Zhuzhou and Xiangtan region
- 5. Chengdu and Chongqing region
- 6. Areas around Taiwan Strait (Xiamen etc.)

- 7. Shanxi [Province] (Taiyuan etc.)
- 8. Shaanxi [Province] (Xi'an etc.)
- 9. Xinjiang [Province] (Ürümqi etc.)
- 10. Gansu [Province] (Lanzhou)

○ = Economic Zones  
○ = City Clusters

# Current Local Coal Cap Pilots: 2020

(3 Regions and 6 City Clusters)

2011-2015:

3 Regions:

Beijing-Tianjin-Hebei region/  
the Yangtze River Delta/  
Pearl River Delta



2016-2020:

6 City Clusters:

Central Liaoning

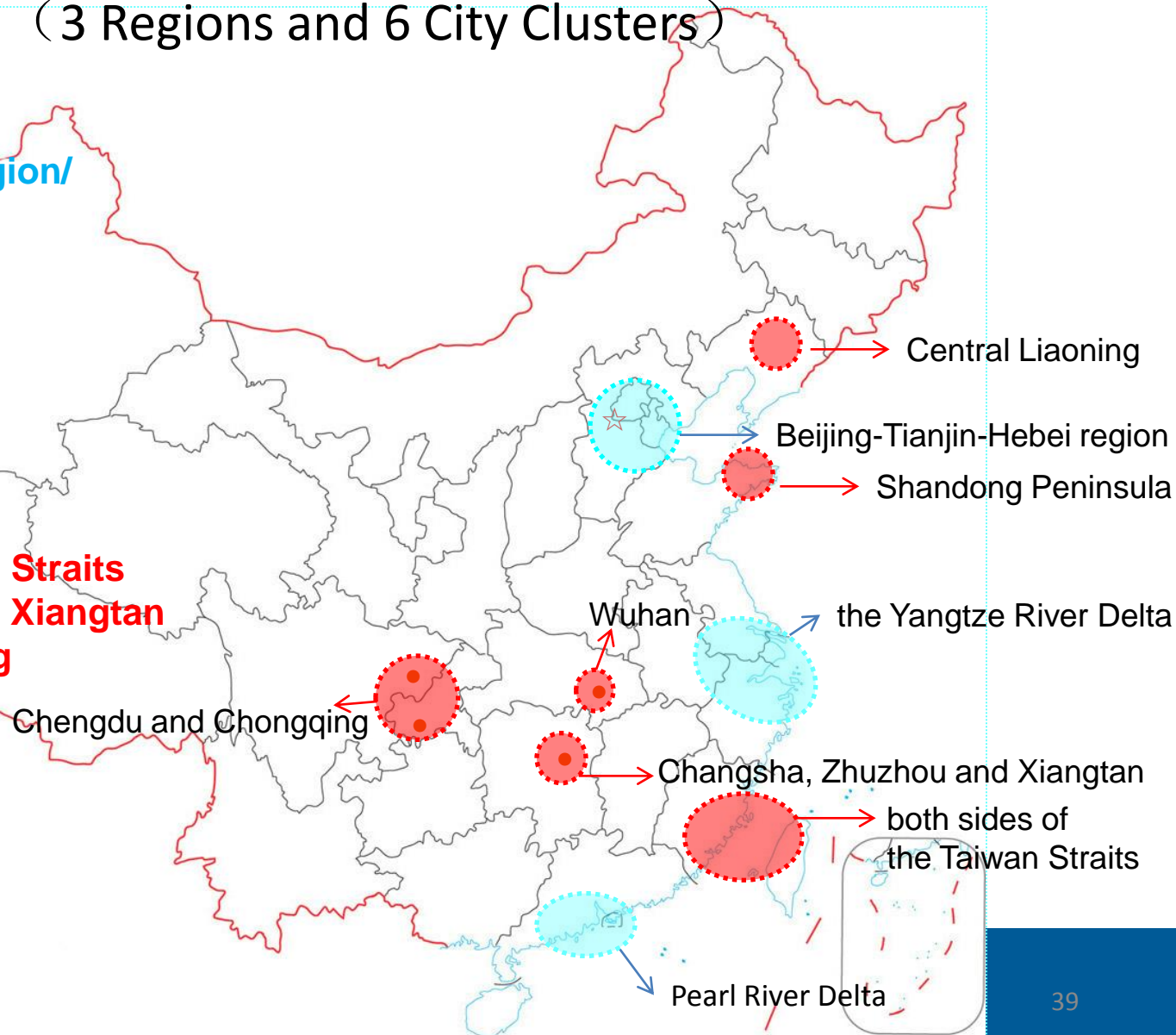
Shandong Peninsula

Wuhan

both sides of the Taiwan Straits

Changsha, Zhuzhou and Xiangtan

Chengdu and Chongqing



# Low-Carbon Demonstrations

## NDRC Pilots in 5 provinces and 8 cities



Coal  
Production:  
Inner  
Mongolia  
and  
Shanaaxi

Coal  
Consumption:  
Jiangsu and  
Guangdong



# Indicative Local Coal Caps: Roadmap 2010-2030

## 2011-2015:

Beijing, Shanghai,  
Guangdong pilot cities and  
all provincial cities in the  
eastern regions

## 2016-2020:

All cities in the eastern  
regions and provincial  
cities in the middle regions

## 2021-2025:

All cities in the middle  
regions and provincial  
cities in the western  
regions

## 2026-2030:

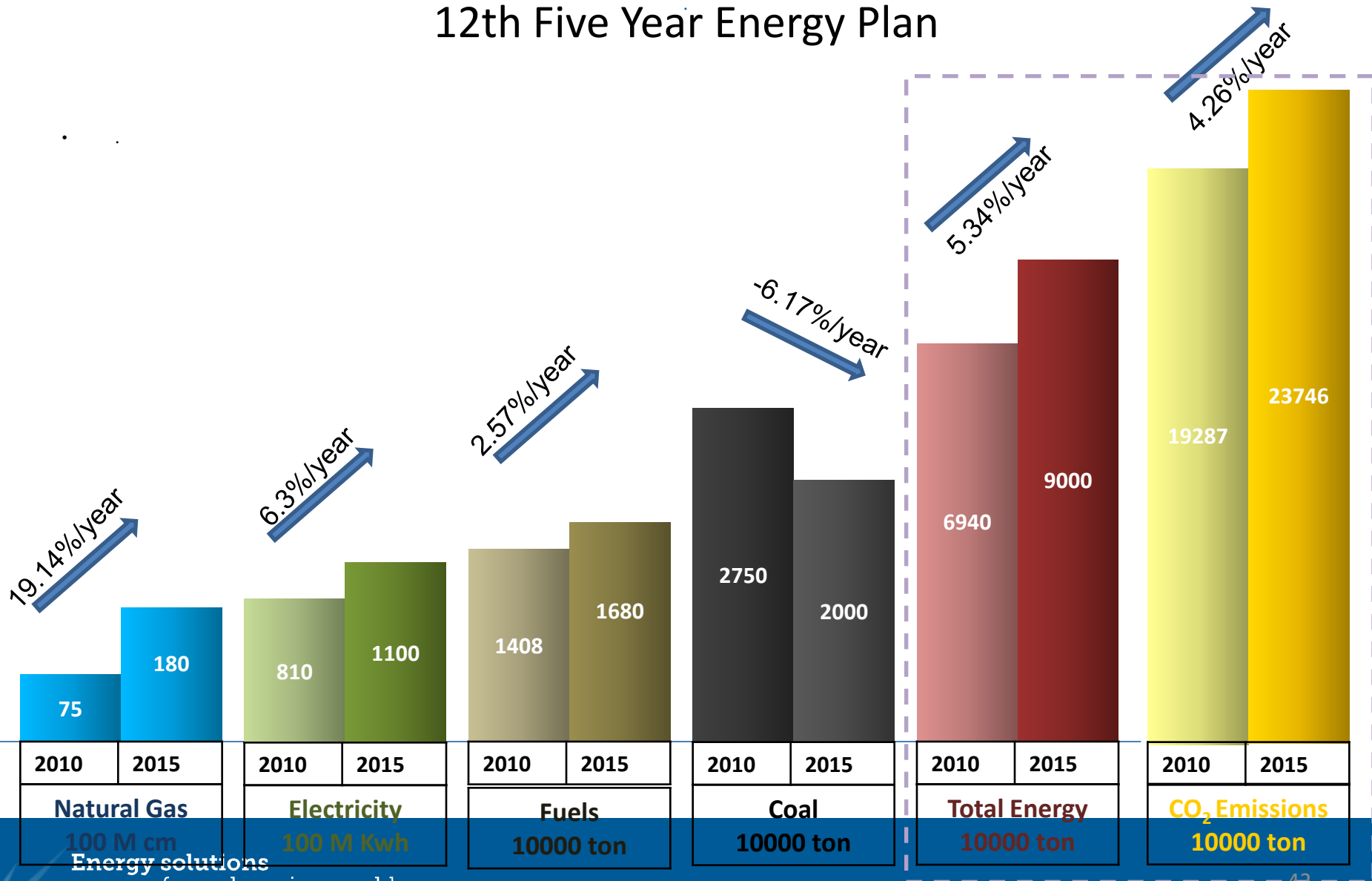
All 650 cities in the country





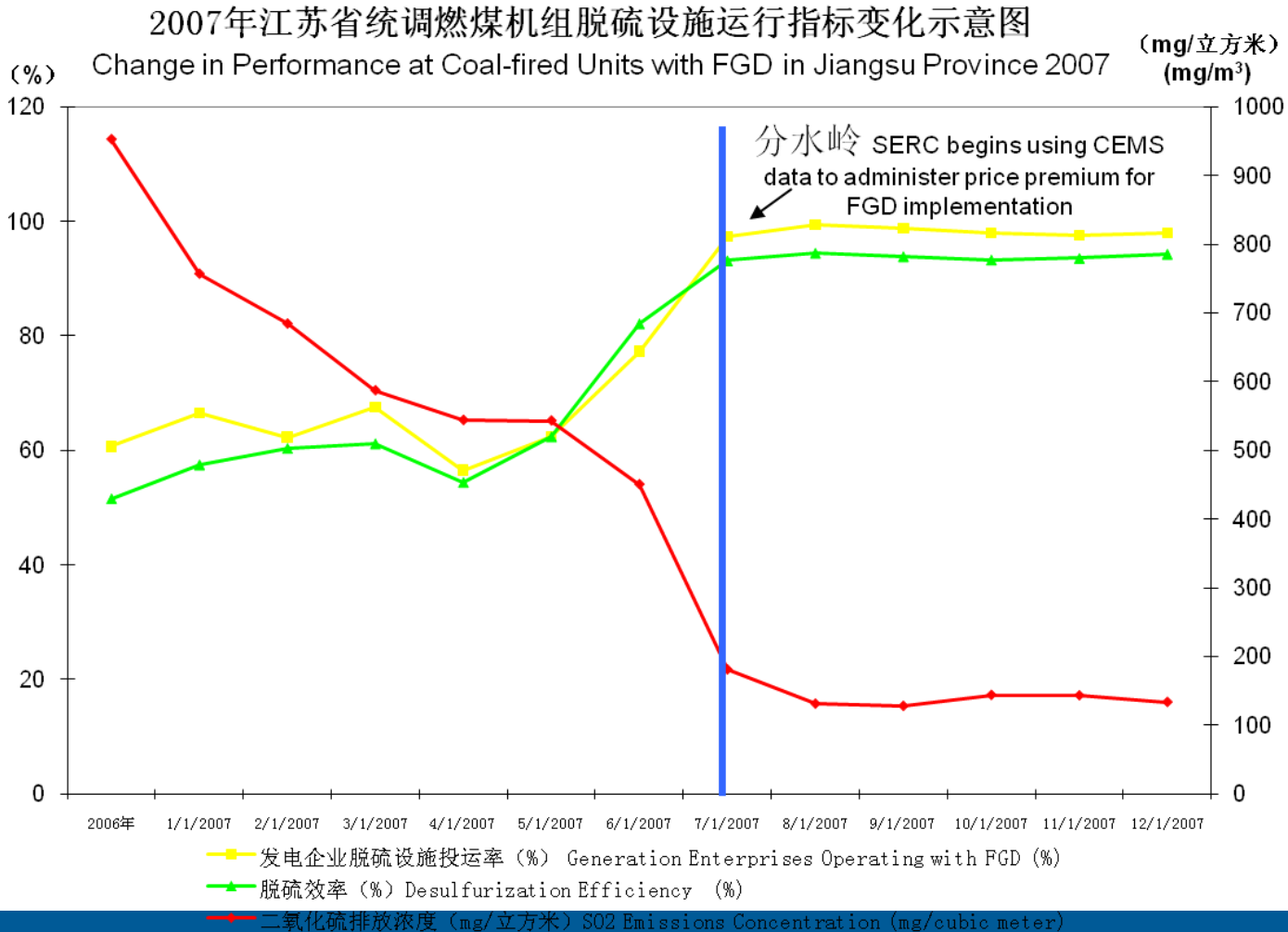
# Current Local Coal Cap: Beijing

## 12th Five Year Energy Plan



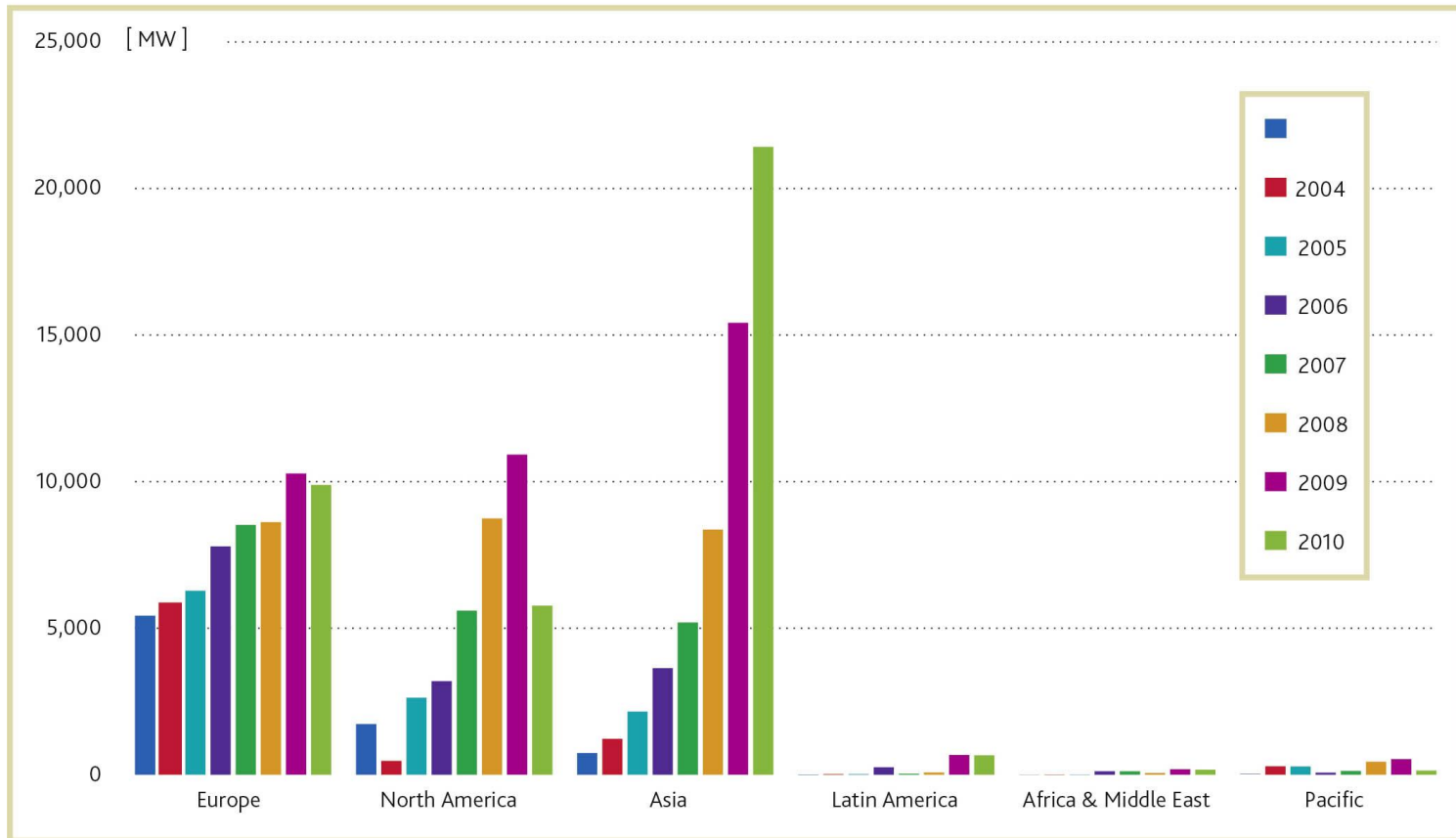
Energy solutions  
for a changing world

# Use of Emissions Data to Administer SO<sub>2</sub> Pricing



# Global Wind Power Installations

ANNUAL INSTALLED CAPACITY BY REGION 2003-2010



Source: Global Wind Energy Council

# Actions/ Next Steps

- Staffing and resources
  - MEP staff: hundreds (need 10x more at least)
  - National air law weak compared to US
  - National level enforcement inconsistent, low penalties
  - Local staff resources better, and some local agencies issue significant penalties
- Multi-pollutant air quality plans can be more cost-effective and achieve same or better environmental outcome
  - Current China work
  - US state approaches



# Big Picture on Staffing 人员编制总览

**US EPA**

**美国环保署**

(thousands 数千)

**State Agencies**

**州级机构**

(10s of thousands 数万)

**Local Governments**

**地方政府**

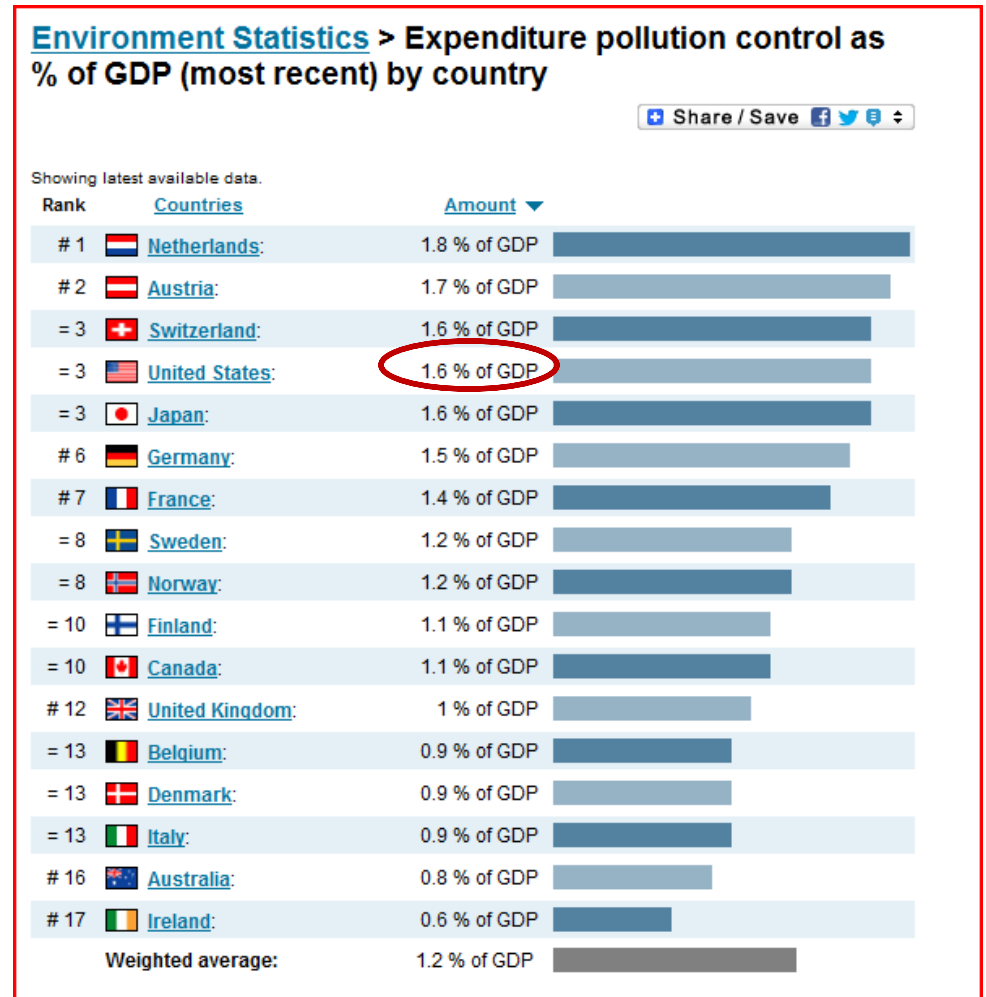
(100s of thousands 数十万)

The developed world spends approximately ~1.2% of GDP on pollution control

发达国家在污染控制方面的支出占本国GDP的~1.2%

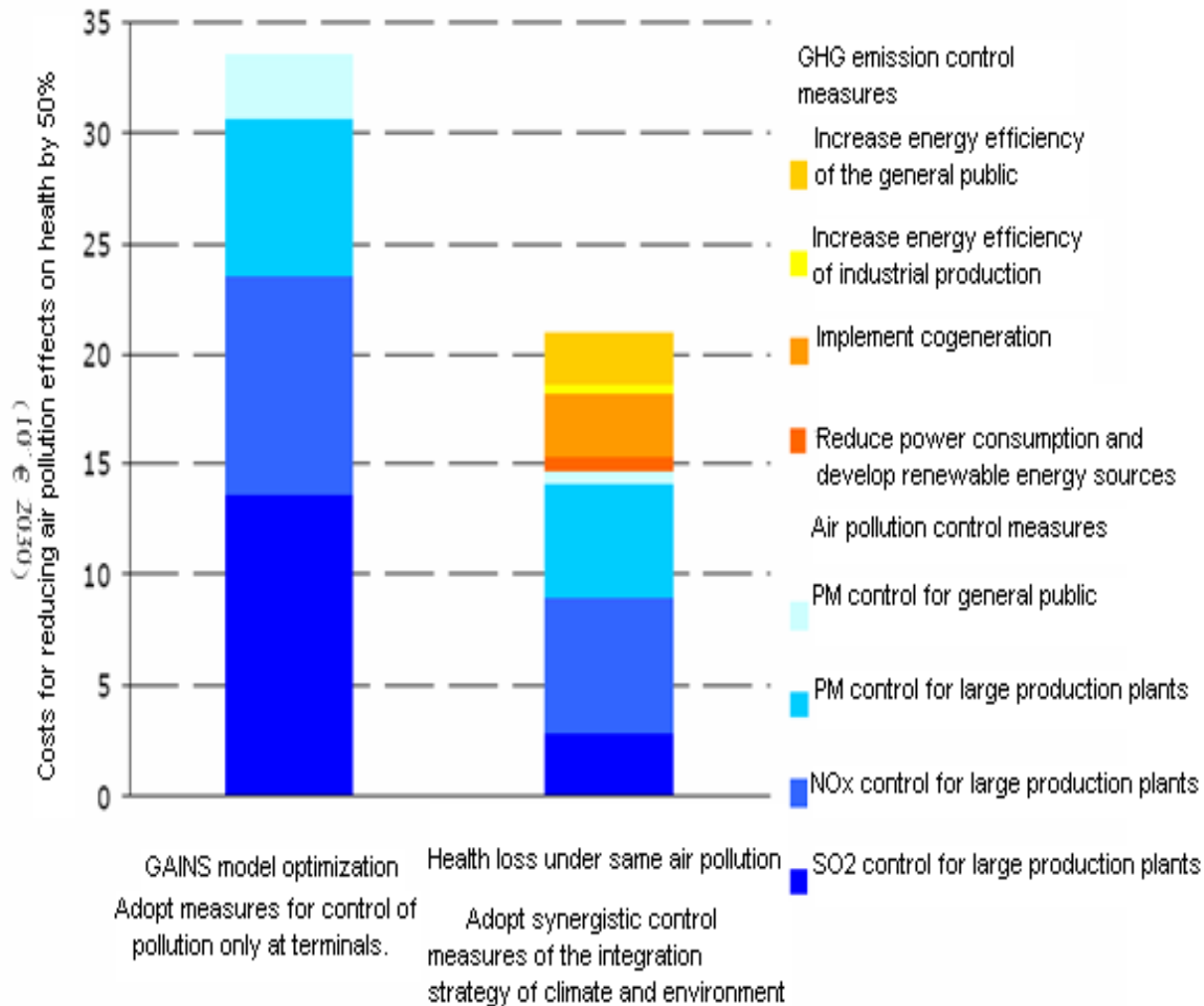
This figure excludes public works projects and private investment

图示信息并不包括在公共工程及私人投资方面的支出



SOURCE (来源) : OECD Environmental Indicators, p. 104.

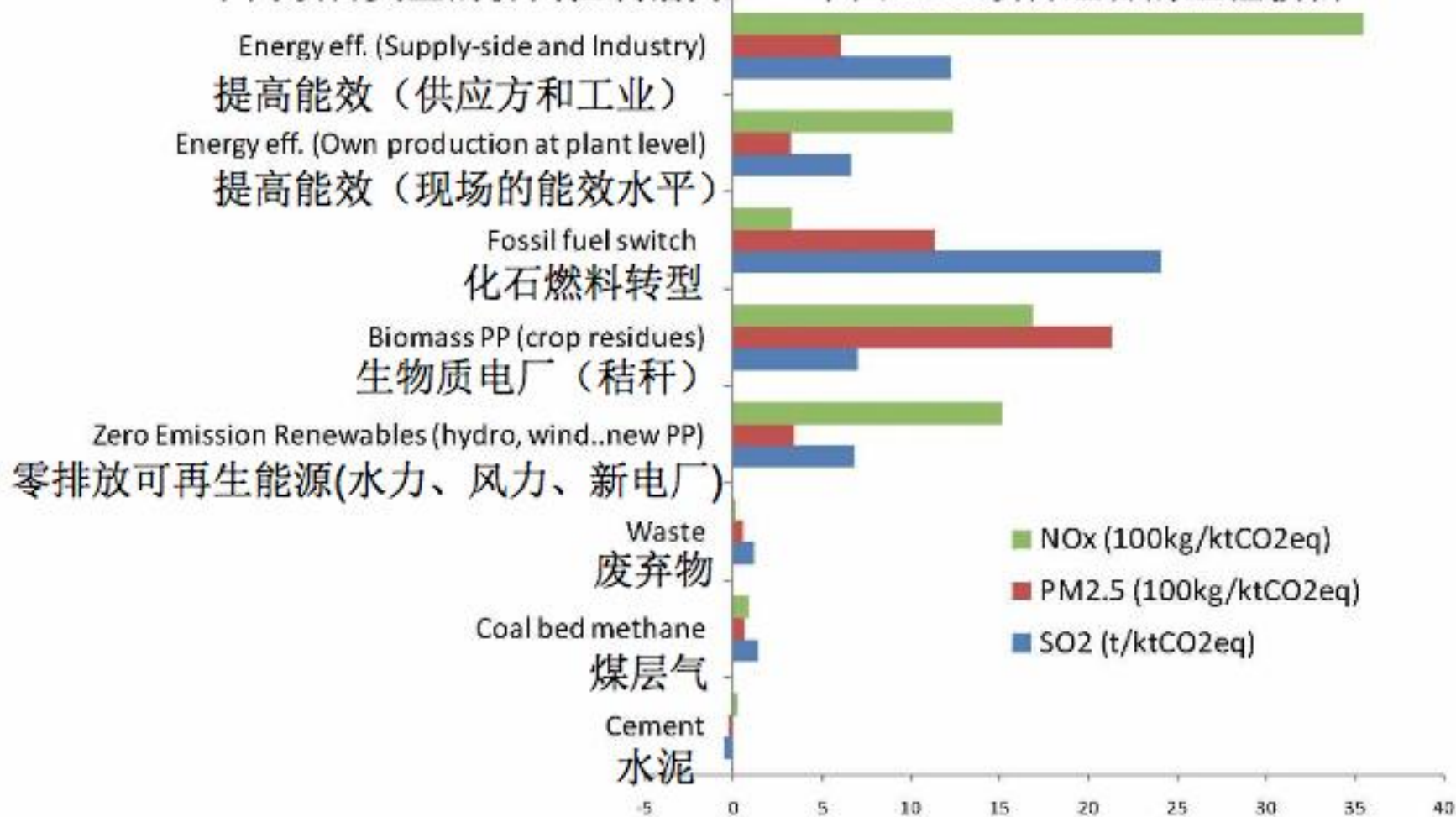
# Synergistic Effects of Multi-pollutant Planning



# Co-control potential for project types

– lessons from China's CDM project portfolio

不同项目类型的协同控制潜力——中国CDM项目组合的经验教训



(Based on Rive and Aunan, 2009, work in progress)



# 2004 NAS Report on Air Quality Management in the United States



# Fewer Episode Days



# China Announces Pilot Cap and Trade Program for Carbon Emissions

- <http://www.eenews.net/climatewire/2012/10/15/99>.
- “China's Guangdong province kicked off a pilot program last month, the largest of seven such programs in the country, with four cement makers buying 1.3 million pollution permits for 60 yuan (\$9.57) a metric ton. Exchanges will be set up on the national market that, in three years, will trade permits to emit 1 billion metric tons of greenhouse gases.
- China's domestic emission trade will cover 800 million to 1 billion tons in emissions, close to half the 2.18 billion tons in the E.U. system”

# Conclusions

- China's growth, expansion of middle class, causing serious environmental problems
  - We know more than we did in 1960. Problems can be solved simultaneously instead of pollutant by pollutant
  - Solutions informed, but not burdened by existing approaches
  - Learn from and adapt western models to a Chinese context
  - It's taken US 40 years to significantly improve its environment. China needs the same sustained commitment to improve over the long-term, with short-term review and progress assessment.



# Discussion Questions

- What policies could China implement to accelerate the timing when coal consumption peaks? Is there a role for other countries? If so, what?
- Much environmental damages are created from emphasis on short-term economics, how can countries properly account for environmental affects of development?
- The public pays for environmental damage and public health effects (hospital visits, lost work days, etc.) from economic inefficiencies. How could this be improved?

## About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power and natural gas sectors. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

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