TPM11 - Session 3

Control of $PM_{2.5}$ and Short-lived Climate Pollutants in China

Control of $PM_{2.5}$ and Short-lived Climate Pollutants in China

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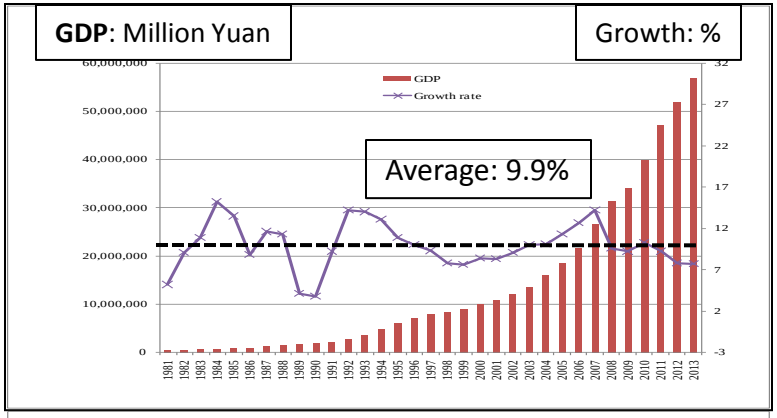
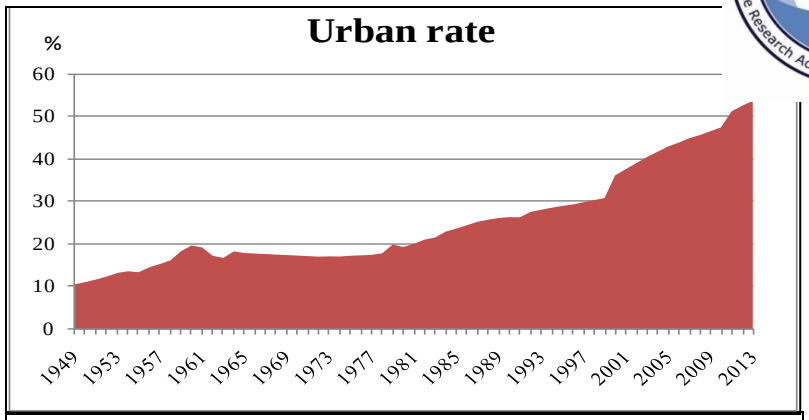
Outline

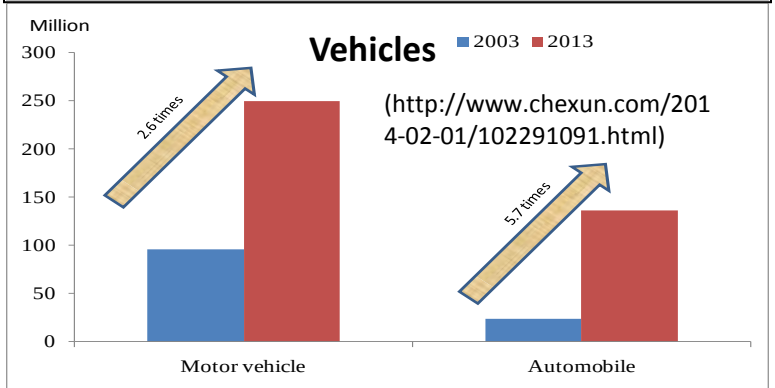
1. $PM_{2.5}$
2. SLCPs
3. Identify the ignored sector:

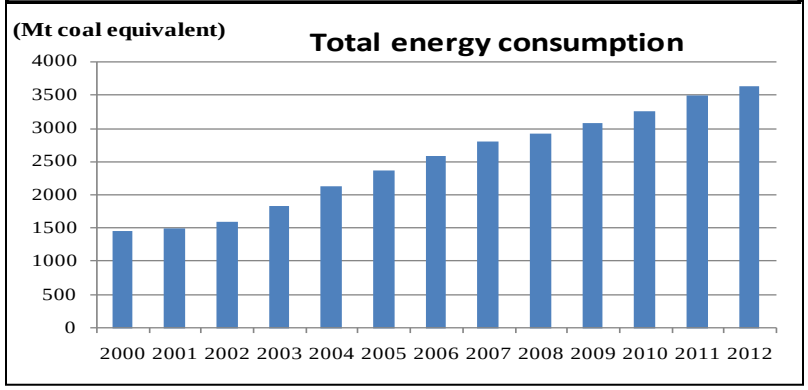
   A chance for fast return

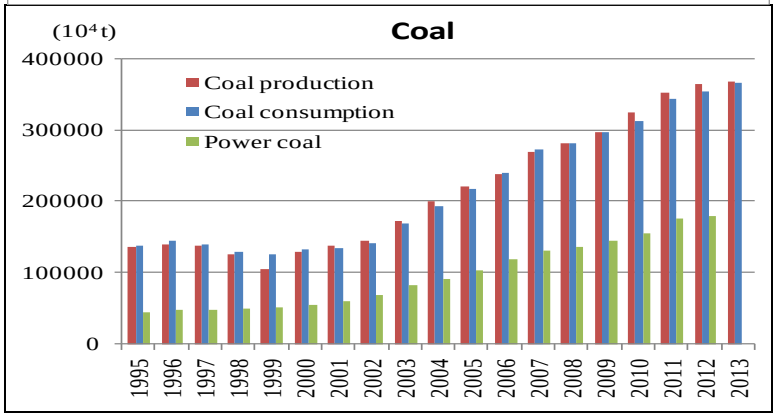
1 $PM_{2.5}$











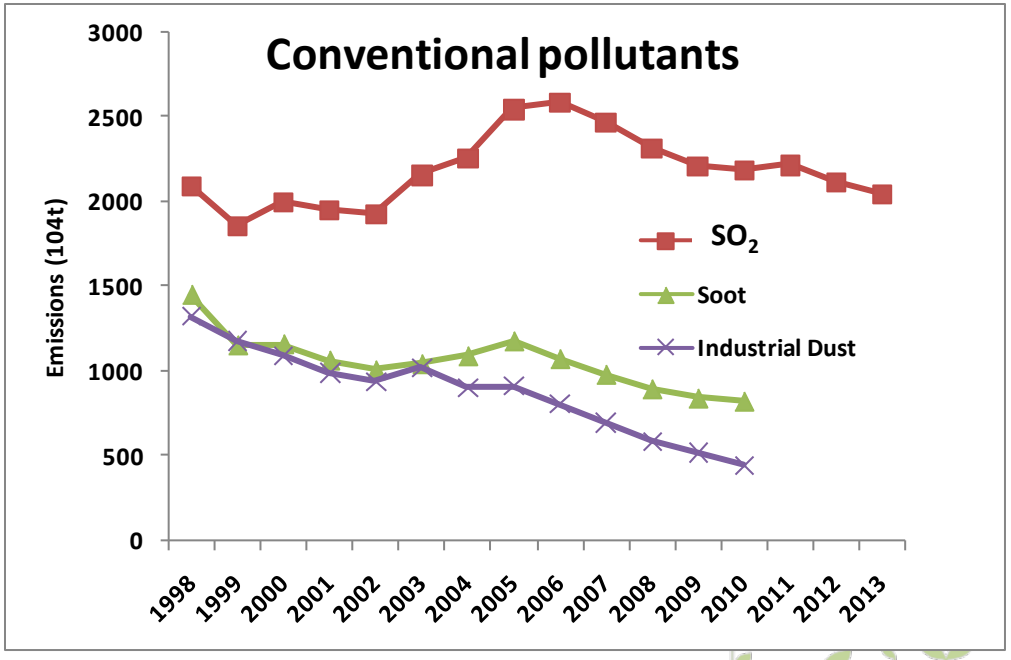
◆China is faced with unprecedented environmental pressure, with air quality problem being the top concern

1 $PM_{2.5}$

Coal fired power plants

2000	2005	2010	2015
ESP 90%	ESP 97%	ESP 95%	ESP 86%
WET 10%	FF 3%	FF 5%	FF >14%
	FGD 15%	FGD 86%	FGD 100%
		De-Nox 13%	De-Nox >80%

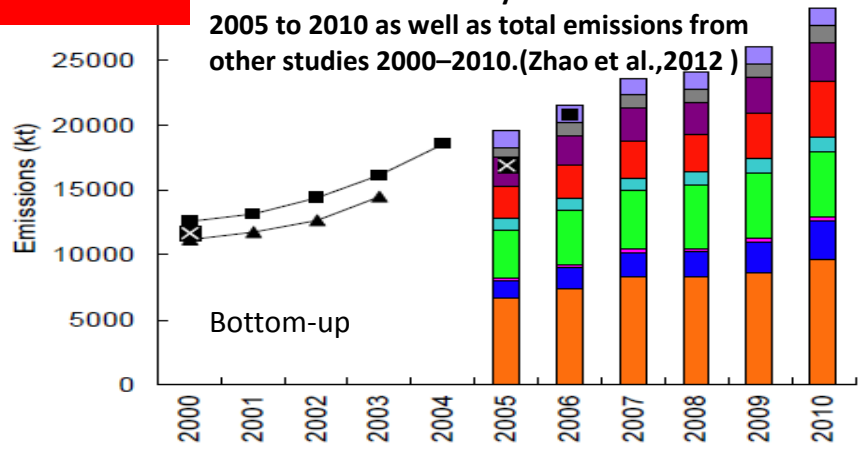
China's control efforts have seen significant reduction in traditional pollutants emissions, yet the total emission quantity is still high



1 $PM_{2.5}$

NOx

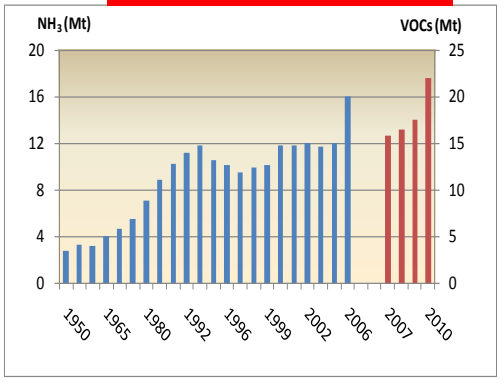
The annual emissions by sector in China from 2005 to 2010 as well as total emissions from other studies 2000–2010.(Zhao et al.,2012)



Other studies
- Klimont et al.(2009); GAINS
- Ohara et al.(2007)
- Zhang et al.(2007; 2009)
- Lei et al.(2011a)
- Lu et al.(2011)
- CDIAC
- USEIA
- PBL
- IEA

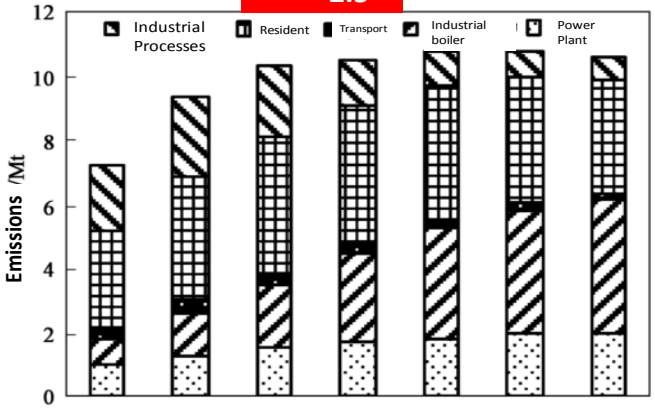
This work
- Residential & commercial (Biofuel/biomass)
- Residential & commercial (fossil fuel)
- Non-road transportation
- On-road transportation
- Other industrial processes
- Other industrial boilers
- Iron & steel production
- Cement production
- Coal-fired power plants

NH_3 and VOCs



Sun et al., 1997;Li et al., 2012; Ye, 2010

$PM_{2.5}$



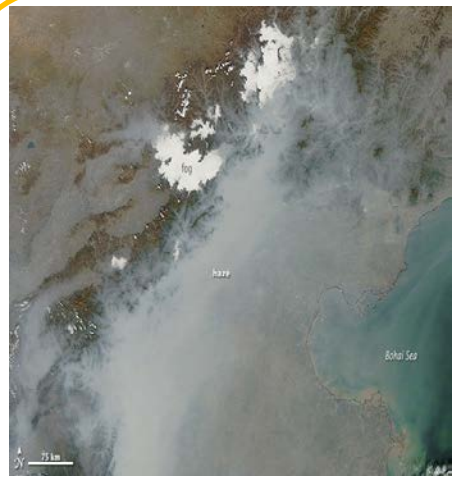
ZHANG et al., 2009

Ambient $PM_{2.5}$

http://www.chexun.com/2014-02-01/102291091.html

1 $PM_{2.5}$

Current Characteristics



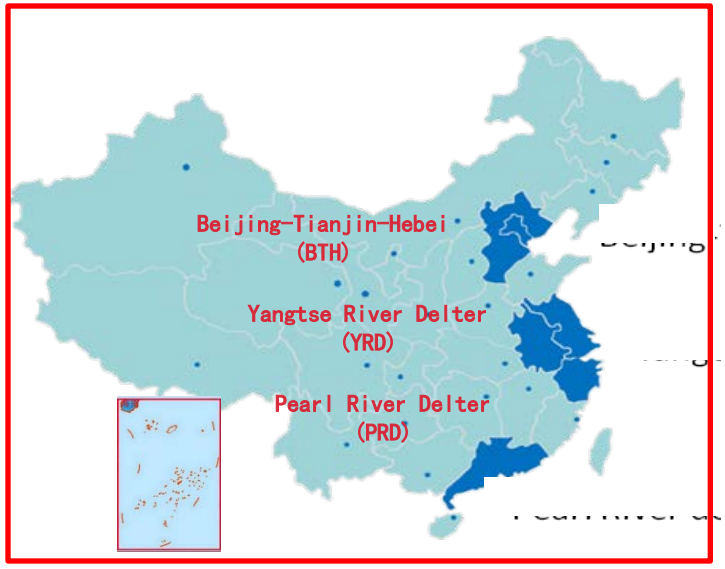
NASA's Earth Observatory released an image of north China's haze taken from space. The image shows that a thick layer of haze blanketed the North China Plain on Oct 9.

- **AlthoughThe traditional pollution of SO_2 and PM_{10} remains unresolved; it is now superposed by new problems of $PM_{2.5}$, NOx, VOCs and NH_3, which exacerbates the air pollution situation**
- **Regional atmospheric haze and photochemical smog serve as new forms of atmospheric pollution**

1 $PM_{2.5}$

Report on the State of the Environment in China 2013

Air quality status of the 3 Key Areas 2013y



2013, in key areas, attainment city numbers for each pollutant

Key areas	SO_2	NO_2	PM_{10}	CO	O_3	$PM_{2.5}$	Attain
BTH	7	3	0	6	8	0	0
YRD	25	10	2	25	21	1	1
PRD	9	5	5	9	4	0	0

Attainment percent of days for the 3 Key Areas 2013y

Area	Total cities monitored	Percent of attainment days	PM2.5 ($\mu g/m^3$)
BTH	13	37.5%	106
YRD	25	64.2%	67
PRD	9	76.3%	47

Triple standard

1 $PM_{2.5}$

National strategy and action of air pollution control

- 2010 State Council
  Guiding Opinion on Promoting Regional Joint Prevention and Control of Atmospheric Pollution for Better Air Quality
- 2012 MEP
  Ambient Air Quality Standard (GB3095-2012)
  State Council
  12th Five-Year Plan on Key Area Atmospheric Pollution Prevention and Control
- 2013 State Council
  Action Plan for Atmospheric Pollution Prevention and Control
- 2014 State Council General Office
  Performance Evaluation Measures on Implementation of Action Plan against Atmospheric Pollution
- 2014 NPC (To be examined)
  Law of Atmospheric Pollution Prevention and Control

1 $PM_{2.5}$

Phased implementation of the new Air Quality Standard (GB3095-2012)

Pollutants	Mean time	Conc. Limit Level I	Conc. Limit Level II	Unit
SO_2	Annual mean	20	60	$\mu g/m^3$
	24-hour average	50	150	
	1-hour average	150	500	
NO_2	Annual mean	40	40	
	24-hour average	80	80	
	1-hour average	200	200	
CO	24-hour average	4	4	mg/m^3
	1-hour average	10	10	
O_3	8-hour average	100	160	$\mu g/m^3$
	1-hour average	160	200	
PM_{10}	Annual mean	40	70	
	24-hour average	50	150	
$PM_{2.5}$	Annual mean	15	35	
	24-hour average	35	75	

1 $PM_{2.5}$ Action Plan for the Prevention and Control of Atmospheric Pollution

Category	Major efforts	action
Step up reduction capability	1. Step up Comprehensive Pollution Control, Reduce Emissions of Multi-Pollutants	1, 2, 3
	2. Adjust and Optimize Industrial Structure, Promote industrial transformation and upgrading	4, 5, 6, 7
	3. Speed up Technological transformation of Enterprises, Enhance the Sci-tec Innovation Capacity	8, 9, 10, 11
	4. Accelerate the Energy Restructuring, Increase Clean Energy Supply	12, 13, 14, 15
Strengthen supervision	5. Tighten the Entry Criteria in terms of Energy and Environment, Optimize the spatial layout of industries	16, 17, 18
	6. Give Play to Market Roles, Perfect Environmental Economic Policies	19, 20, 21
	7. Perfect the System of Laws and Regulations, Tighten the Supervision and Management According to Law	22, 23, 24, 25
	8. Establish Regional Cooperation Mechanism, Coordinate Regional Environmental Governance	26, 27, 28
Promote participation	9. Set up Monitoring, Early Warning and Emergency Response System, Properly Address Heavy Pollution Weather Events	29, 30, 31
	10. Clarify the Responsibilities of Government, Enterprises and Society; Mobilize the Public to Participate in Environmental Protection	32, 33, 34, 35

1 $PM_{2.5}$

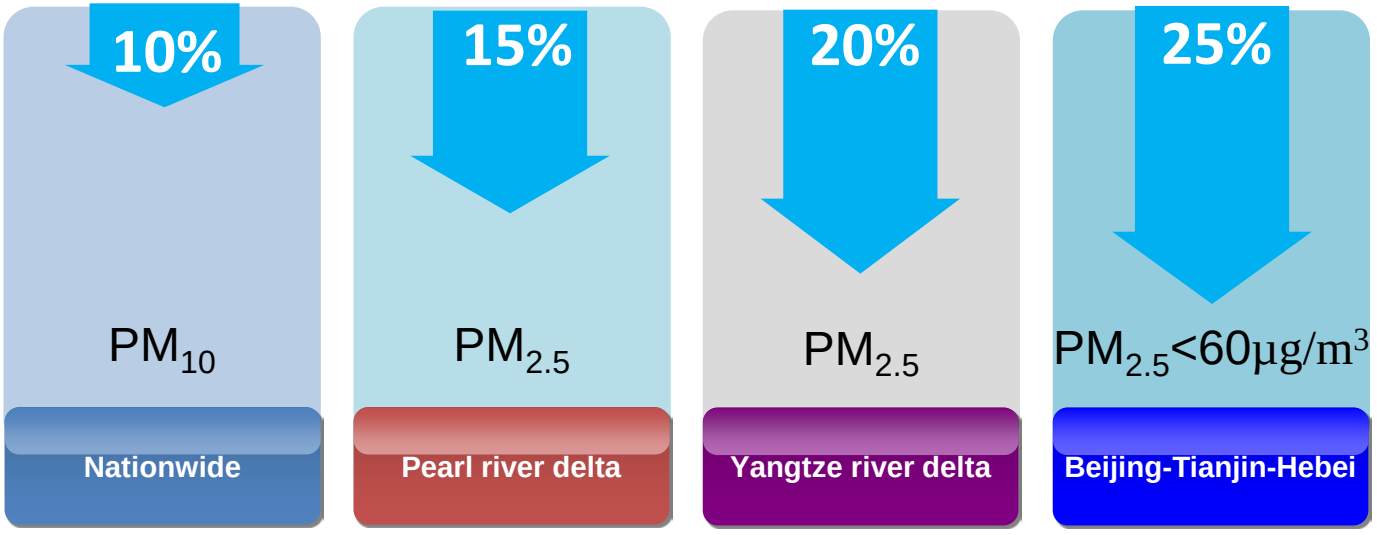
Action Plan for the Prevention and Control of Atmospheric Pollution

General Goal

- Within five years, the air quality improved substantially for whole country, the number of heavily polluted days reduced significantly; air quality improved significantly for three key regions;
- Within ten or more years, gradually eliminate all heavily polluted days and air quality for the whole country improved significantly.

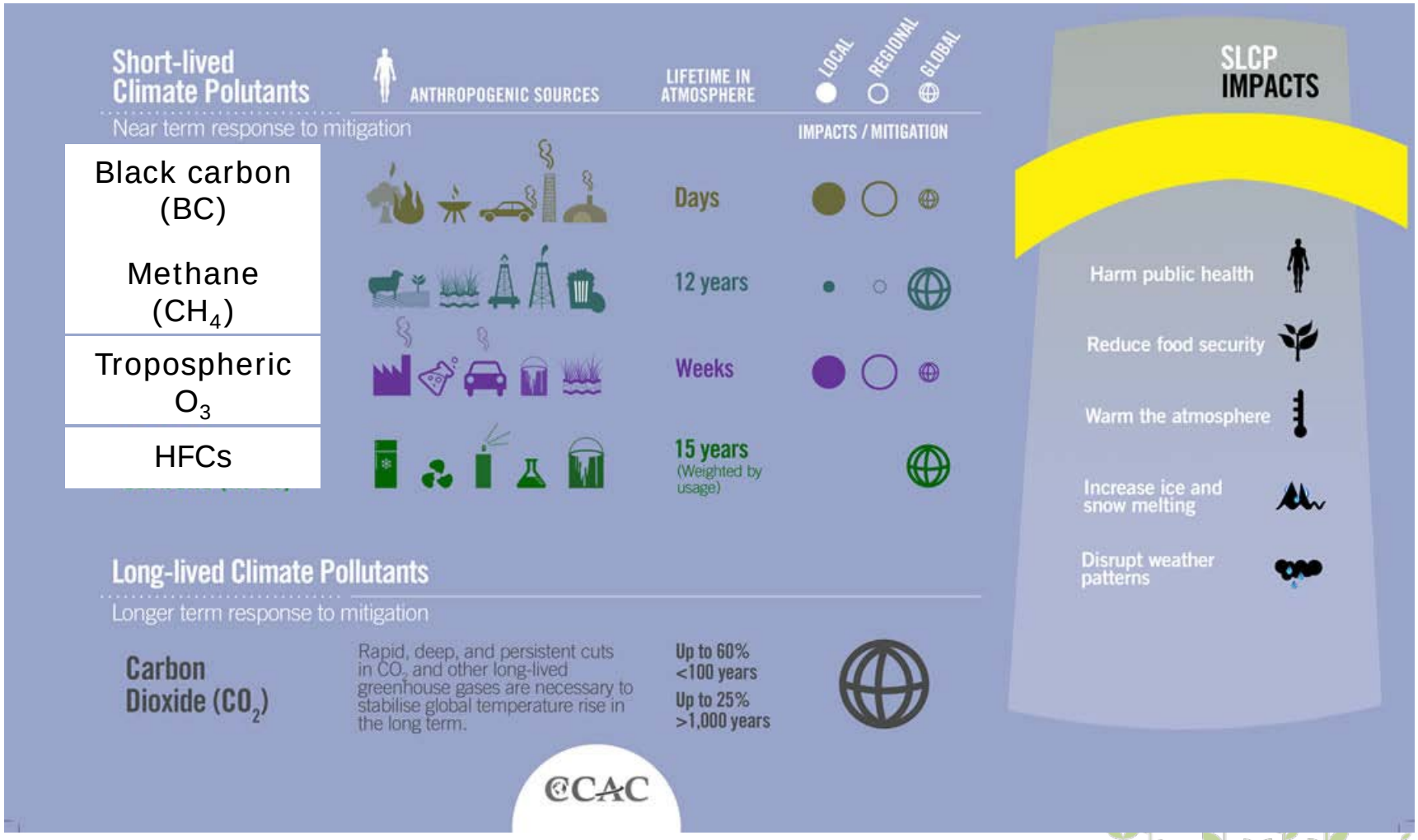
Specific Indicatiors

2017 Compared to 2012



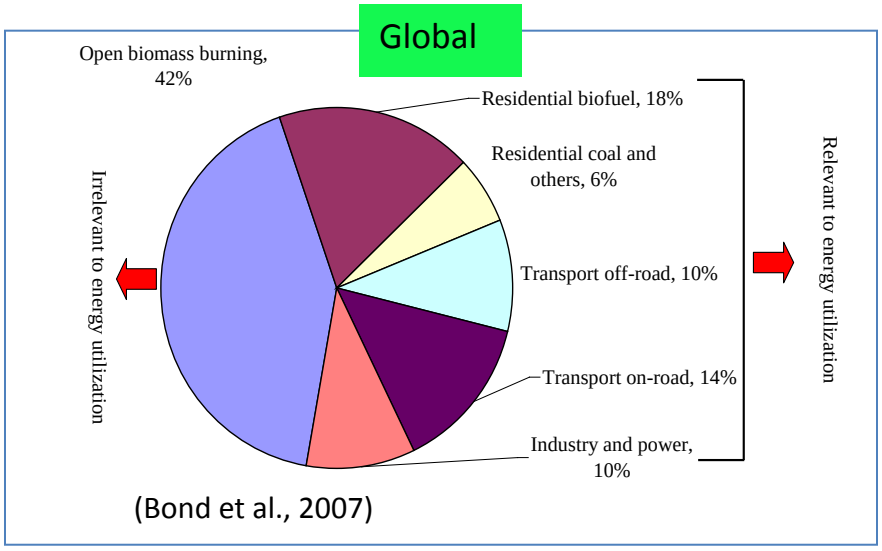
2 SLCPs

Short-lived climate pollutants (SLCPs) are agents that have relatively short lifetime in the atmosphere - a few days to a few decades - and a warming influence on climate.



2 SLCPs

Black carbon



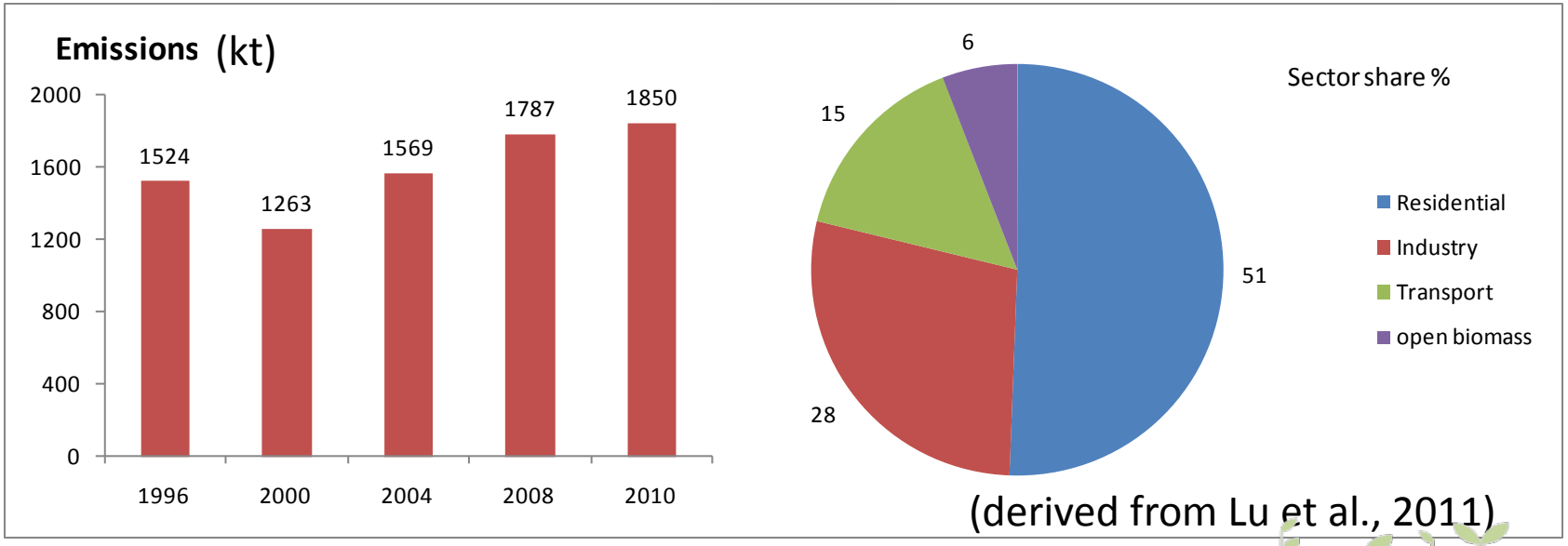
(Bond et al., 2007)

Open biomass: 42%

Residential: 24%

Transport: 24%

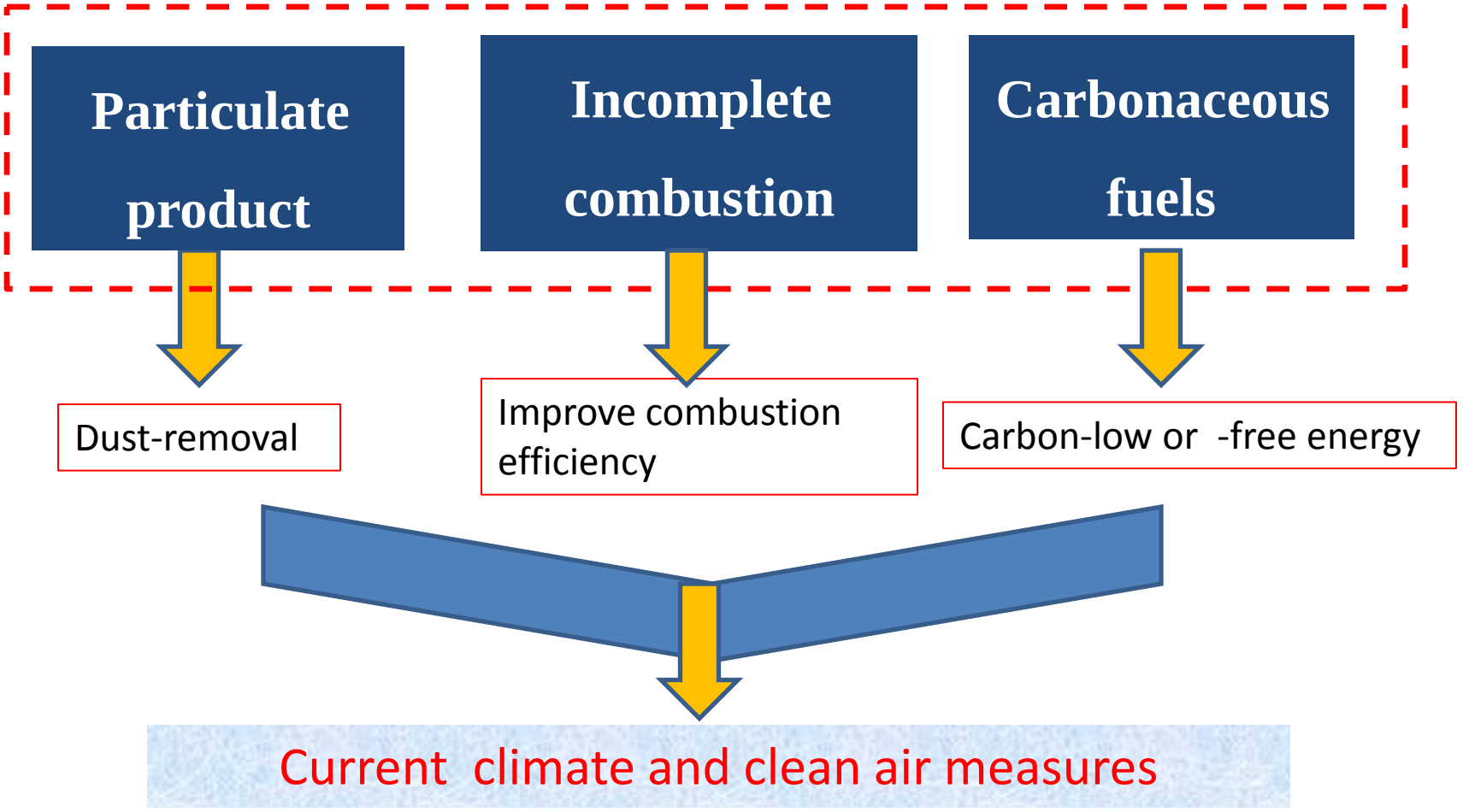
Industrial: 10%



(derived from Lu et al., 2011)

2 SLCPs

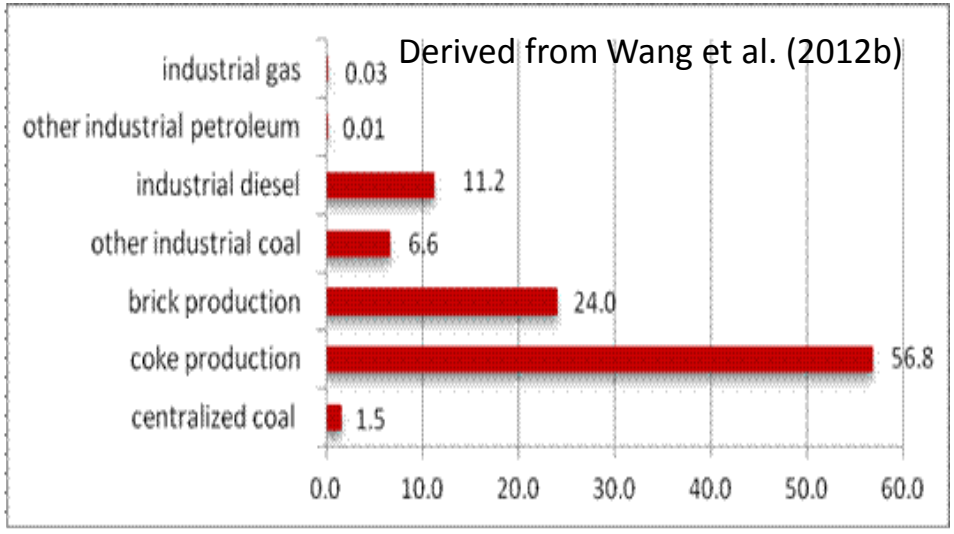
BC control in general



2 SLCPs

Industrial

Tighten Emission standard and market entry criteria, carry out equipment ungrading

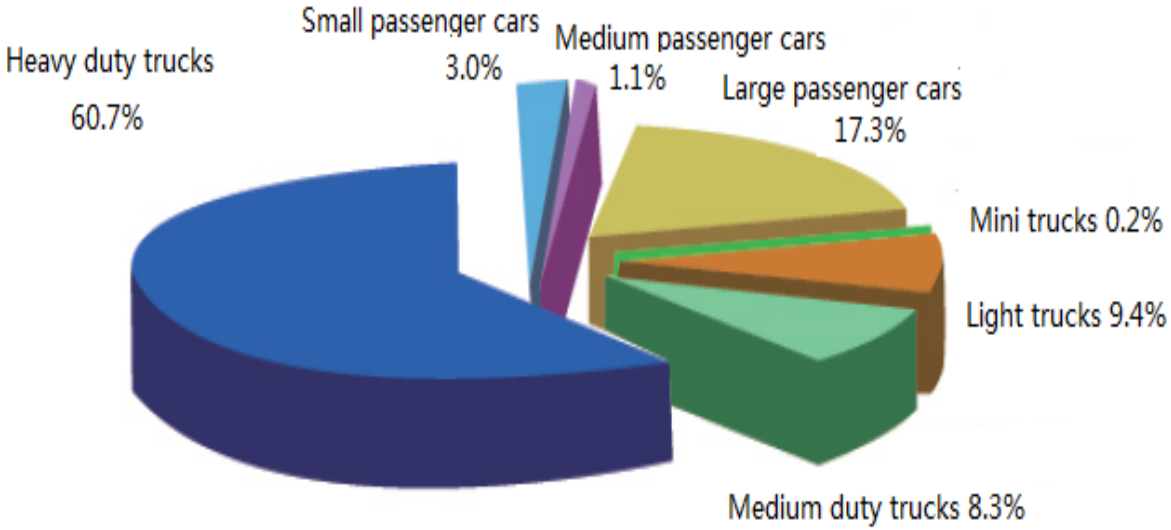


- From traditional coke ovens to modern recovery ovens
- Improvement of end-of-pipe abatement measures
- the implementation of industrial policies such as phase-out of indigenous/modified coke ovens and change in market entry criteria
- mandate the use of technologies with more emission reduction and energy saving such as coke dry quenching and fine particles removal.

- From traditional brick kilns with vertical shaft kilns and Hoffman kilns of small scale
- replace the widely used small annular kilns with modern tunnel kilns
- market entry criteria
- Emission standard

2 SLCPs

Transport



Emission Reduction in Heavy Duty Vehicles through Fuel or Energy Switching

- The use of low-sulphur diesel can be a precondition for various advanced technologies.

  by the end of 2014, the national IV standard (50ppm sulphur content or less)

  By the end of 2015, China's major cities, national V standard (<10ppm sulphur)

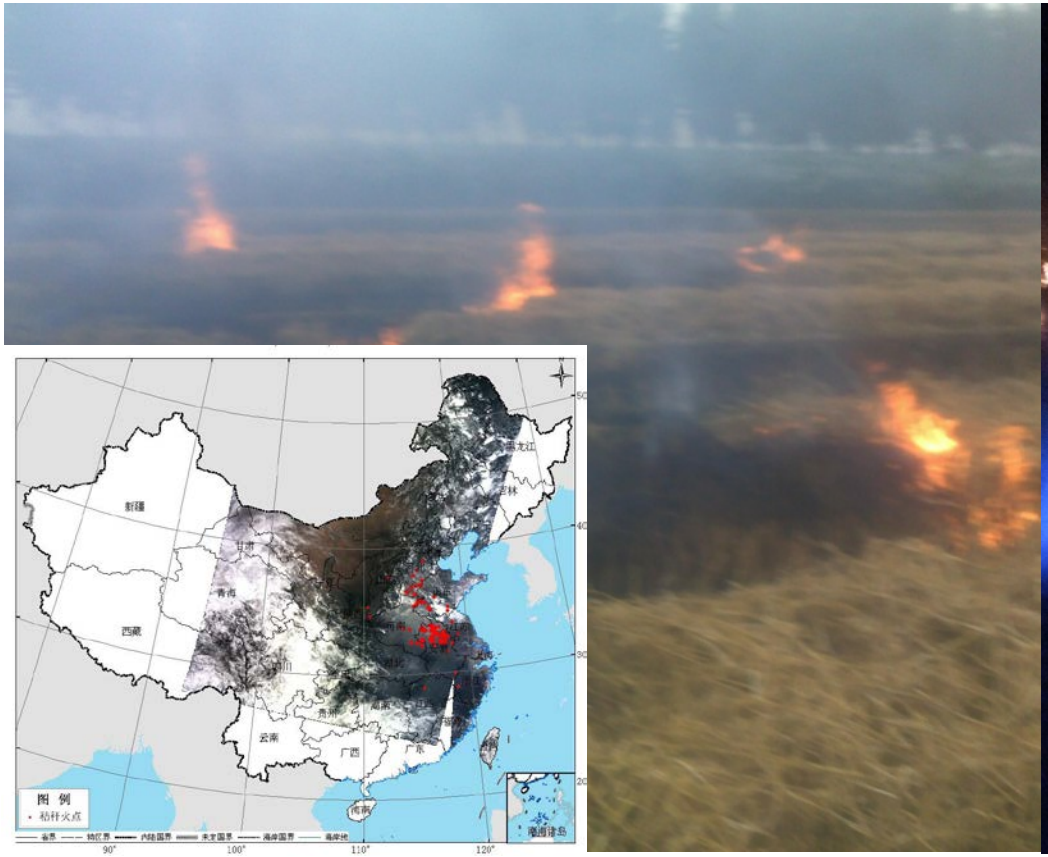
  by the end of 2017, extend to the whole country, in line with practice in EU and US.

- Another black carbon controlling technology for diesel vehicles is the use of clean fuels, such as natural gas

2 SLCPs

Biomass open burning

biomass burning contributes between 4 and 6% to total black carbon emissions in China, much less than the global average of about 40%



Satellite in June 11, 2014

Source: http://hjj.mep.gov.cn/stjc/

2 SLCPs

Biomass open burning

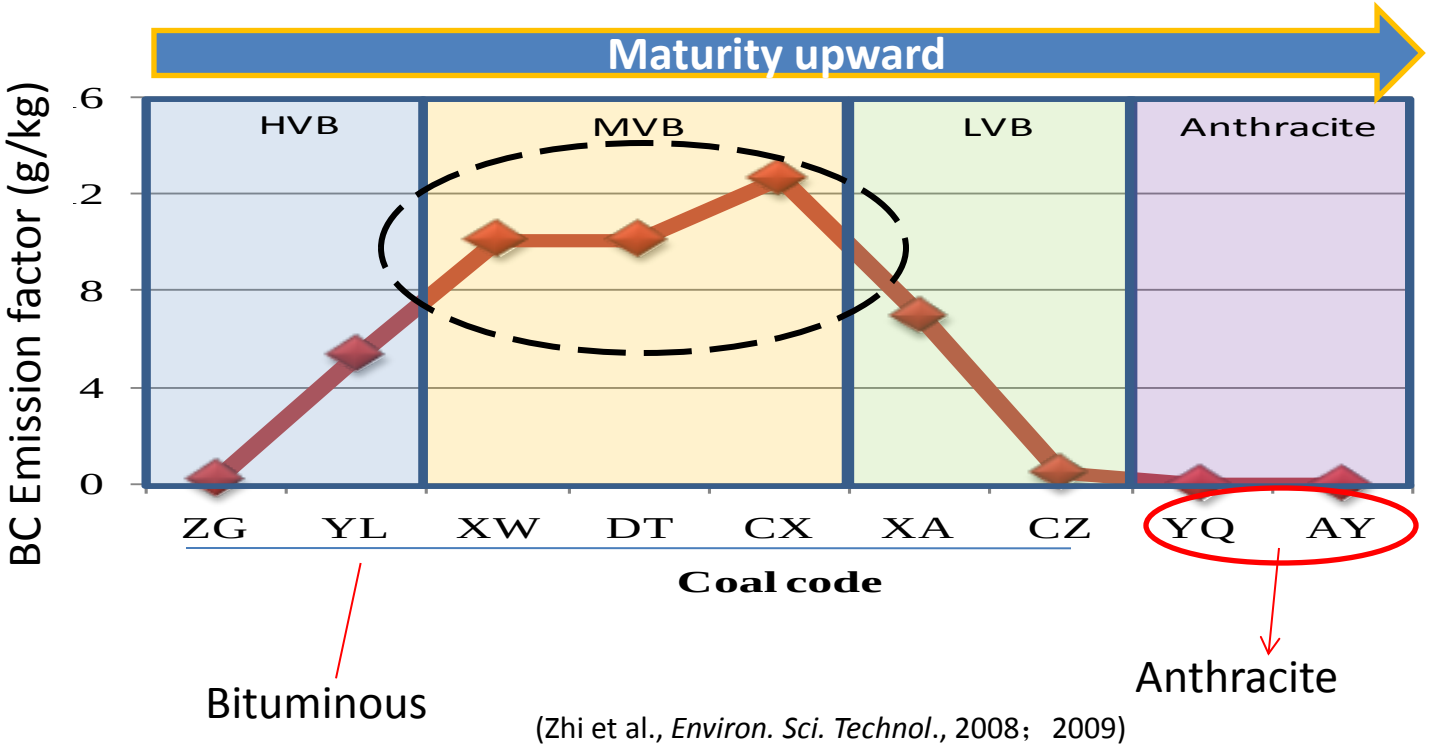
Specific measures for reducing black emissions from biomass burning generally involve seeking alternatives to stalk open burning

- ◆returning straw to field by shattering the stalks
- ◆turning biomass to briquette （pellets）
- ◆turning biomass to biomass gas
- ◆turning biomass to biodiesel
- ◆burying biomass deep underground

2 SLCPs

Residential sector

Geological maturity of coal

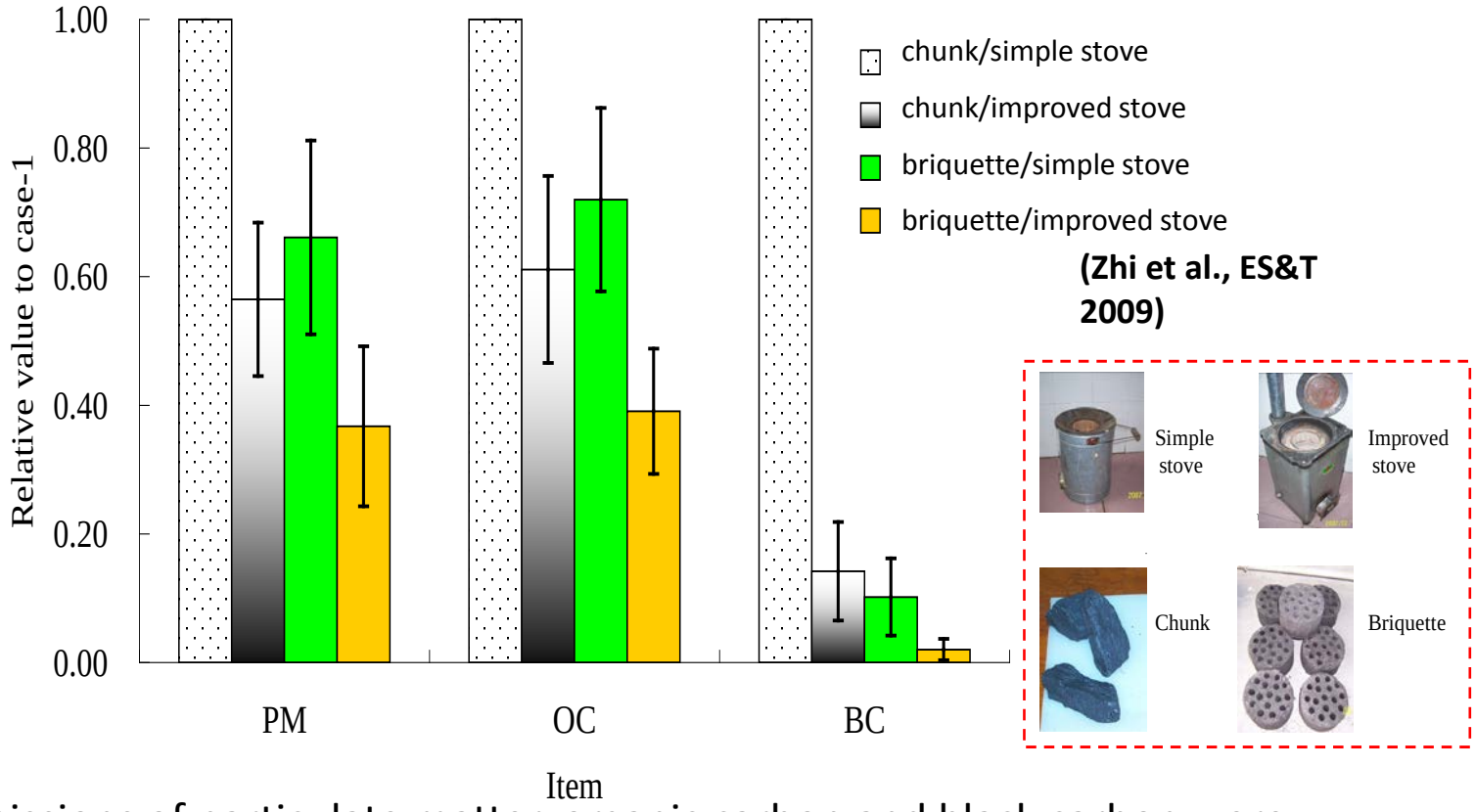


(Zhi et al., *Environ. Sci. Technol.*, 2008； 2009)

If middle maturity coal exit residential stoves, there will be a 60% decrease in China's residential BC emissions

2 SLCPs

Coal and stove improvement



Emissions of particulate matter, organic carbon and black carbon were significantly reduced when briquette coal was burnt in an improved stove as compared to 3 other combinations involving traditional simple stove, improved cookstove and coal chunk

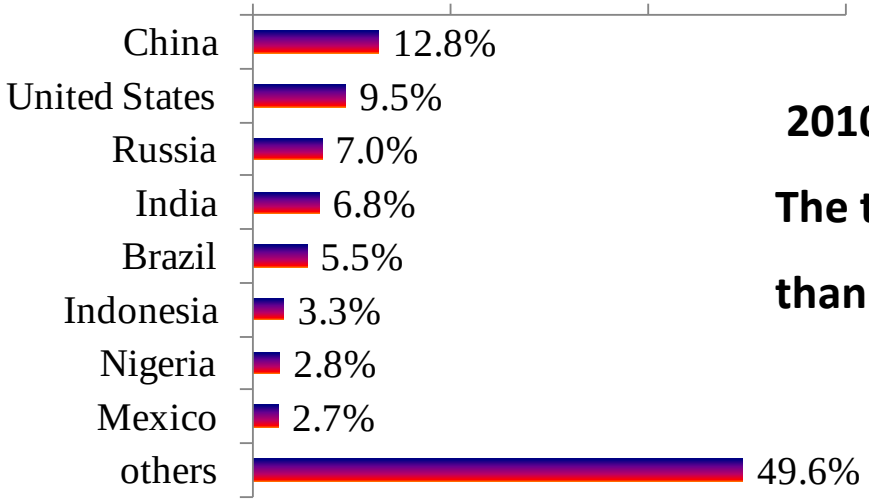
2 SLCPs

Extension of district heating systems in suburbs and villages

In China, district heating in winter is an effective way to abate particulate pollution in urban areas. Through use of large combustion facilities, such as industrial coal boilers, district heating can ensure good ventilation, excellent particle trapping and regular maintenance, and thus result in reduced black carbon emissions . Extension to suburbs and villages could help reduce black carbon emissions from the residential sector. This is expected to happen with rapid urbanization; however effort may be needed to achieve quicker success.

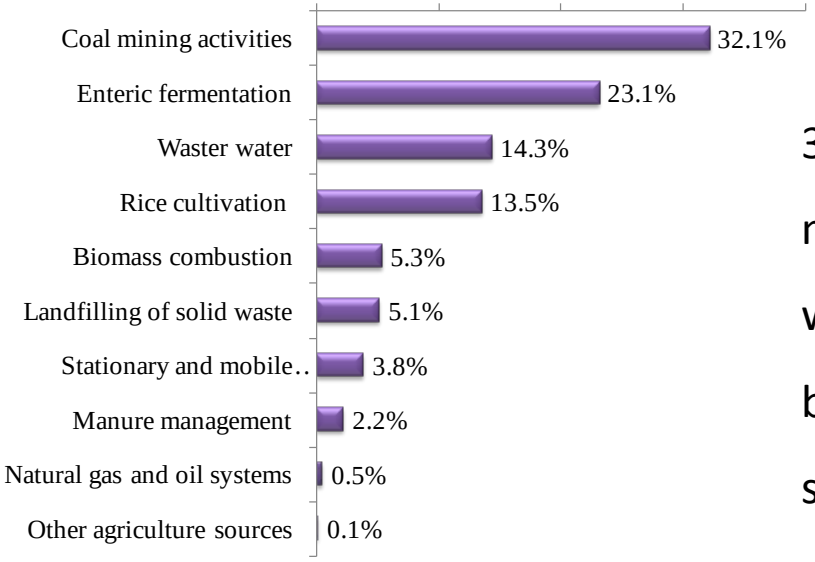
2 SLCPs

Methane



2010 Global total CH_4: 7,195.6 Mt CO_2-eq

The top eight countries account for more than half of the total



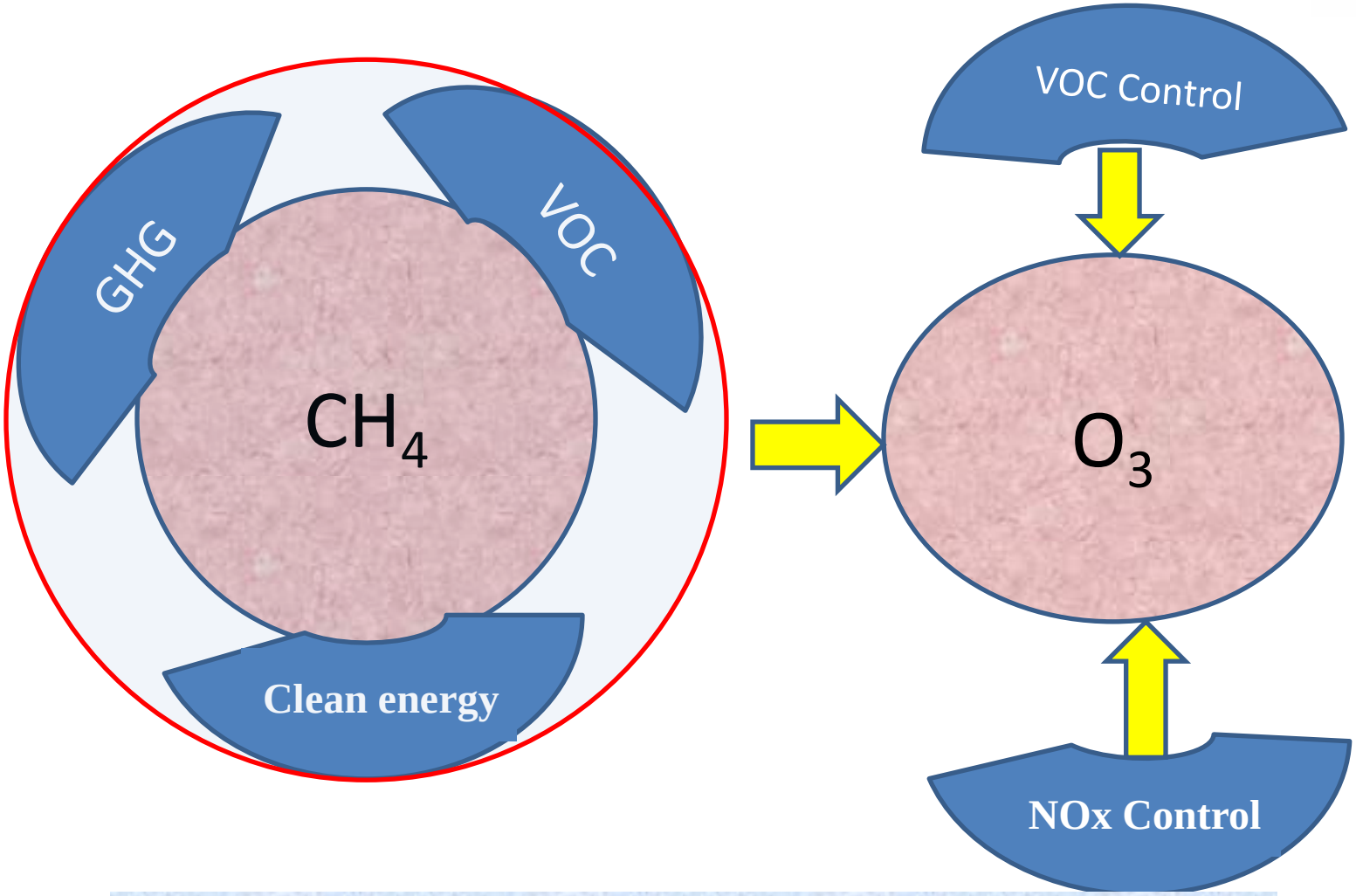
2010 China total CH_4: 920.6 Mt CO_2-eq

38% is from agriculture, 32% from coal mining activities, 14.3% from waste water treatment, 5% from biomass burning and 5% from landfilling of solid waste.

(Source: USEPA, 2012)

2 SLCPs

Methane and O_3 control



Current climate and clean air measures

2 SLCPs

Reducing Methane Emissions from Coal Mine Methane (CMM)

- *Increase the Drainage Volume of CMM*
- Increase the Utilized Volume of Extracted CMM
- *Enhance the Utilization of Low-concentration (<30%) CMM*
- *Promote the Utilization of Ventilation Air Methane (VAM) and CMM Liquefaction*
- *Leakage from Oil and Natural Gas Production*

Reducing Methane Emissions from Agriculture

- from Animal Manure Management
- from Rice Paddies
- from Enteric Fermentation

2 SLCPs

Reducing Methane Emissions from Waste Management

- anaerobic sludge digestion
- biogas capture at existing open air anaerobic lagoons
- installing centralized aerobic treatment facilities or anaerobic lagoons where they do not exist
- installation of gas capture and combustion systems to utilize methane. upgrading of existing primary wastewater treatment plants to secondary/tertiary treatment plants with gas recovery and overflow controls

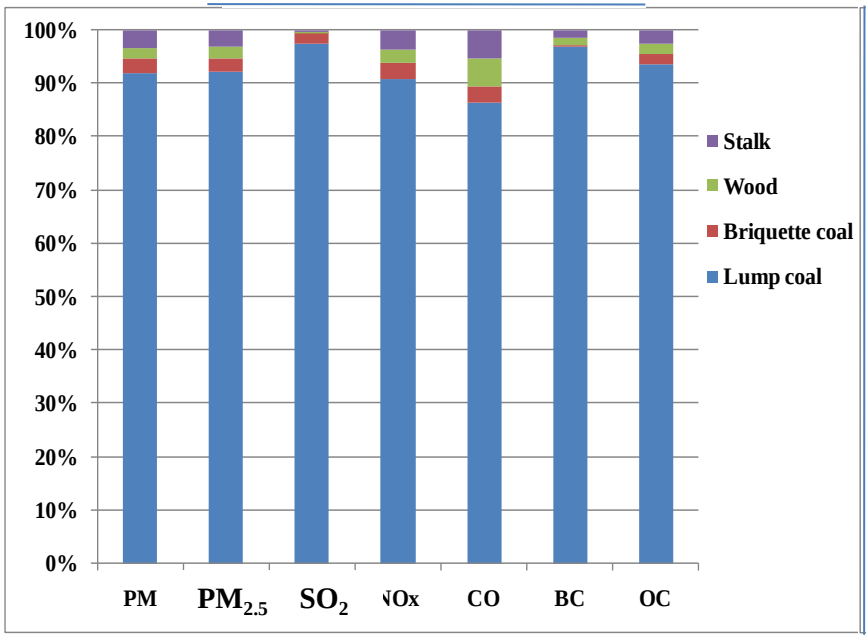
- extraction generated methane for utilization and the separation and treatment biodegradable waste.
- the reduction, recycling and reuse of waste is an important strategy for ensuring that waste does not reach landfills in the first place

3 Identify ignored sector: a chance for fast return

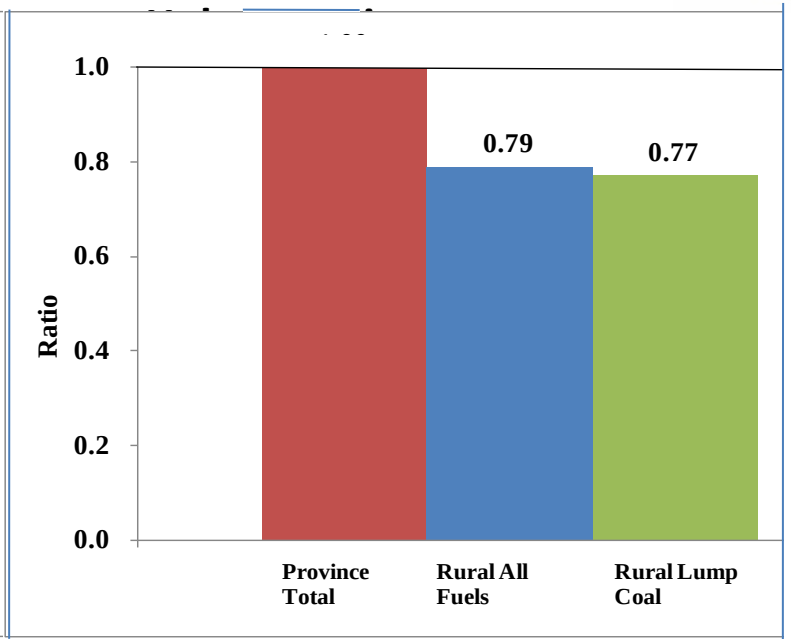
In-village questionnaire

Identify ignored sector: a chance for fast return

Multi-pollutants

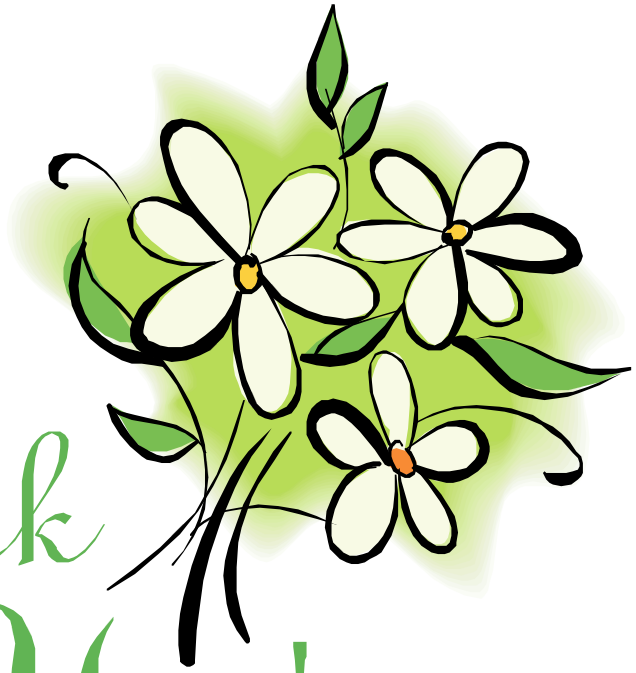


SO_2



Recommendation:

- On the one hand, we should continue our efforts in large point sources
- on the other hand, we are expected to pay special attention to rural energy, in particular, lump coal. This seems to be a fast-approach to $PM_{2.5}$ and BC control, a fast return



Thank You!

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