

Energy Use and Environmental Impacts of China's On-Road Transport

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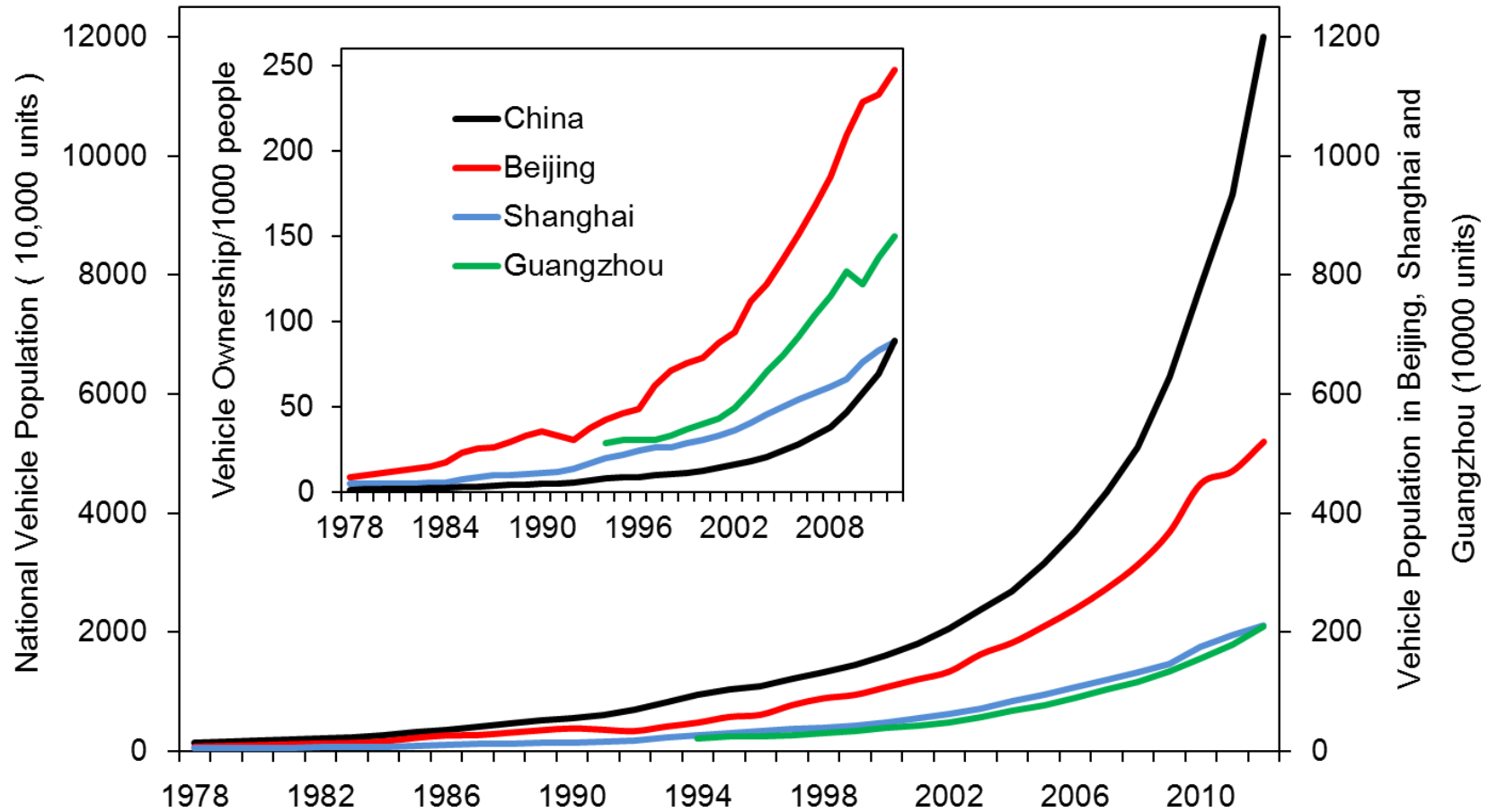
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Climate Policy in an Energy Boom, UC Davis, Aug 6-9, 2013

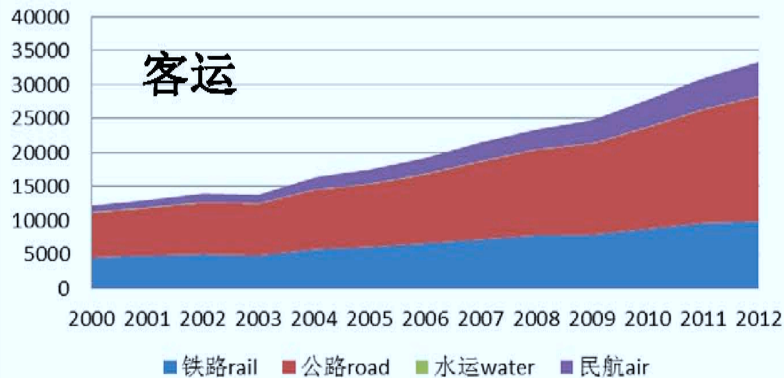


China's Vehicle Population Is Growing Significantly

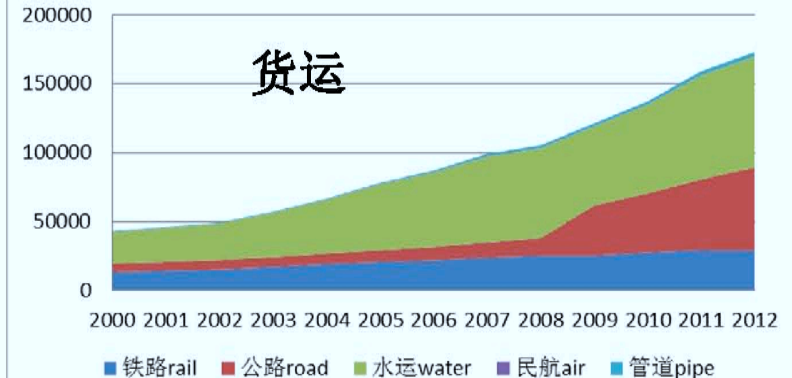


Transportation demand drives oil demand

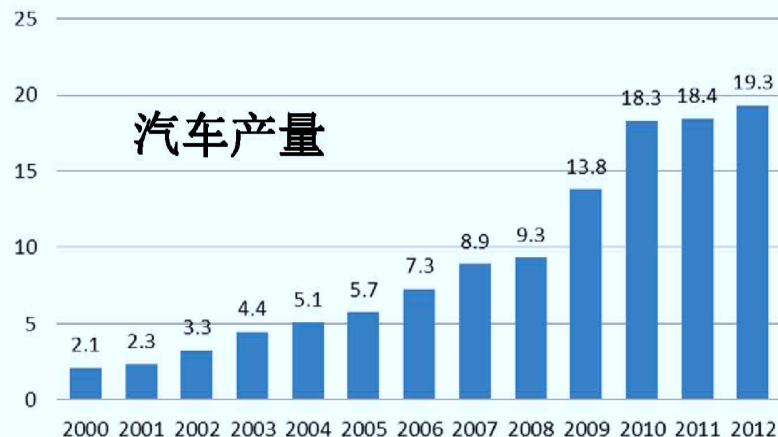
Passenger transport in China
(100M person.km)



Freight transport in China
(100M ton.km)

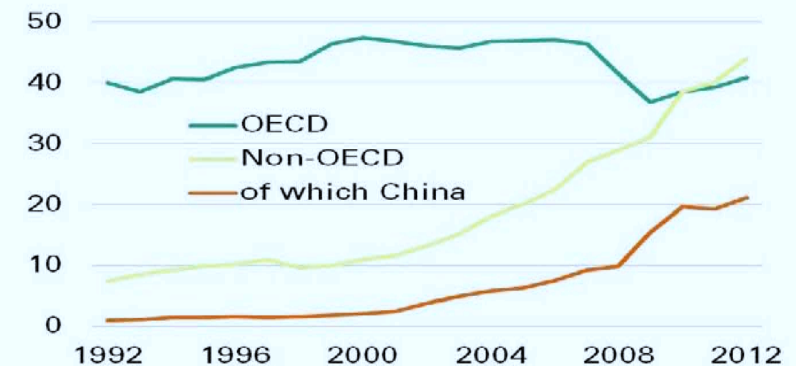


Annual Car Production / million



Vehicle sales

New registrations (millions)

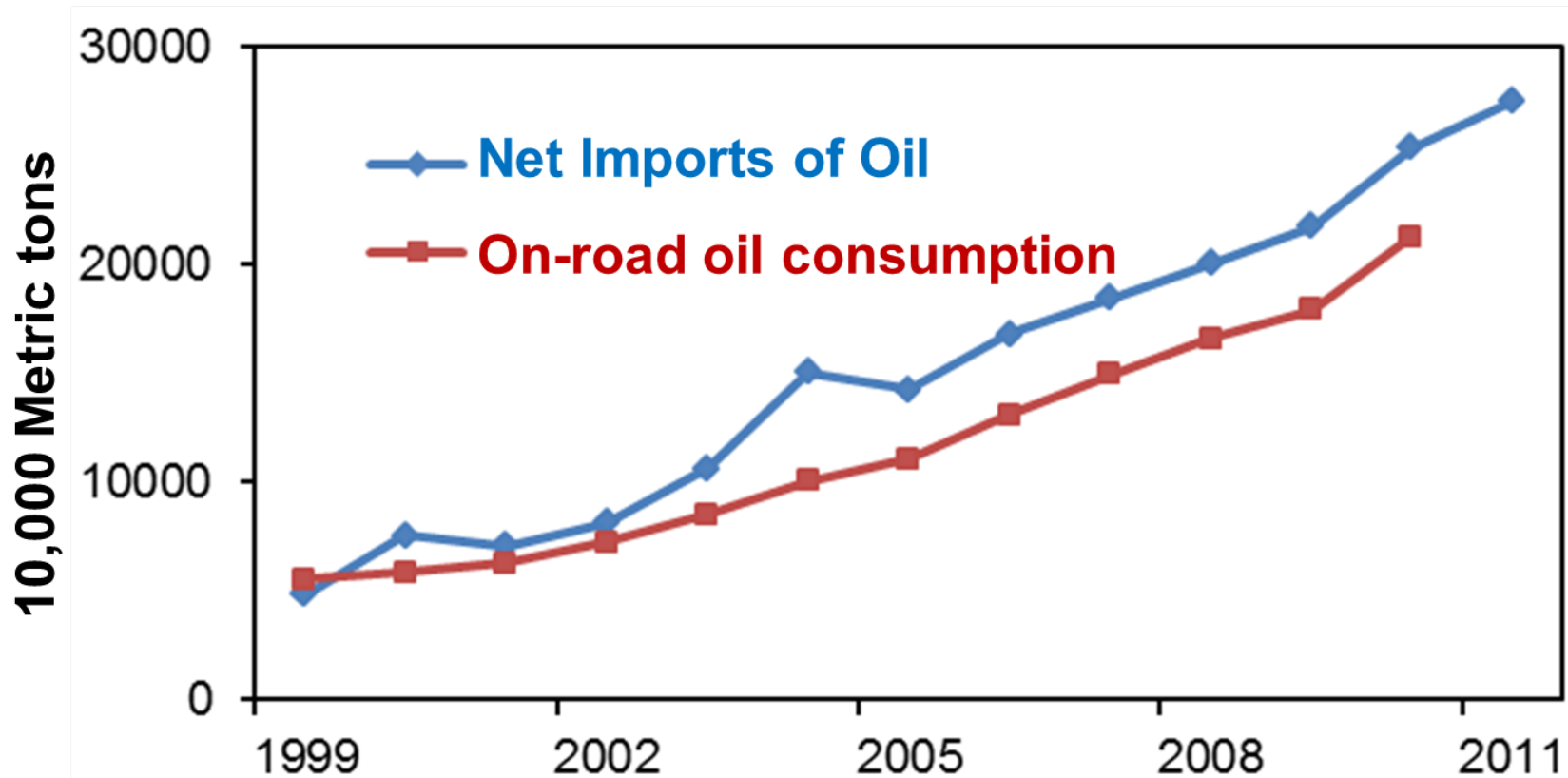


BP Statistical Review of World Energy

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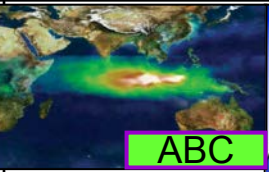






















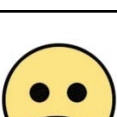



Source: China National Statistical Bulletin 2011

Growth of On-Road Transport Is the Major Driving Force of the Increasing Amount of Oil Import in China

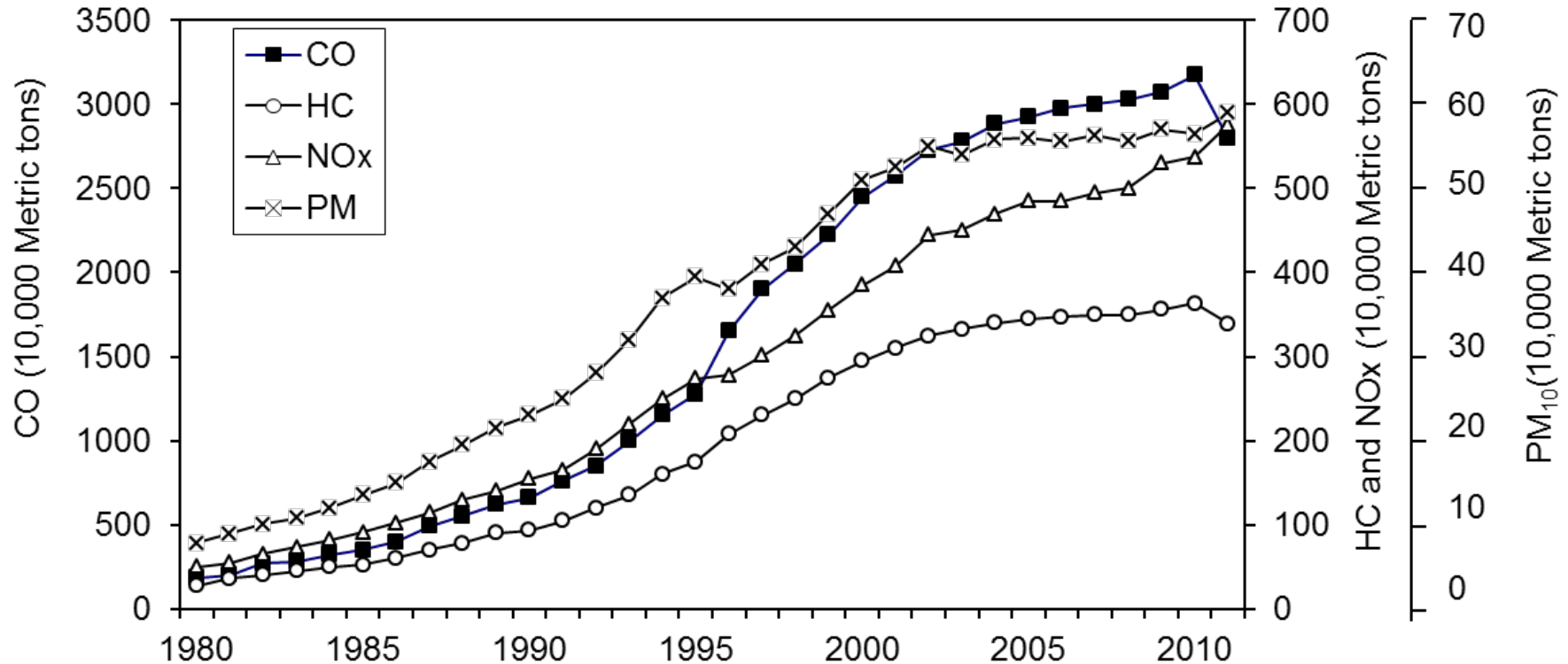


In 1993, China became a net oil-import country, now the dependence on imported oil is close to 60%.

Impacts of Atmospheric Components

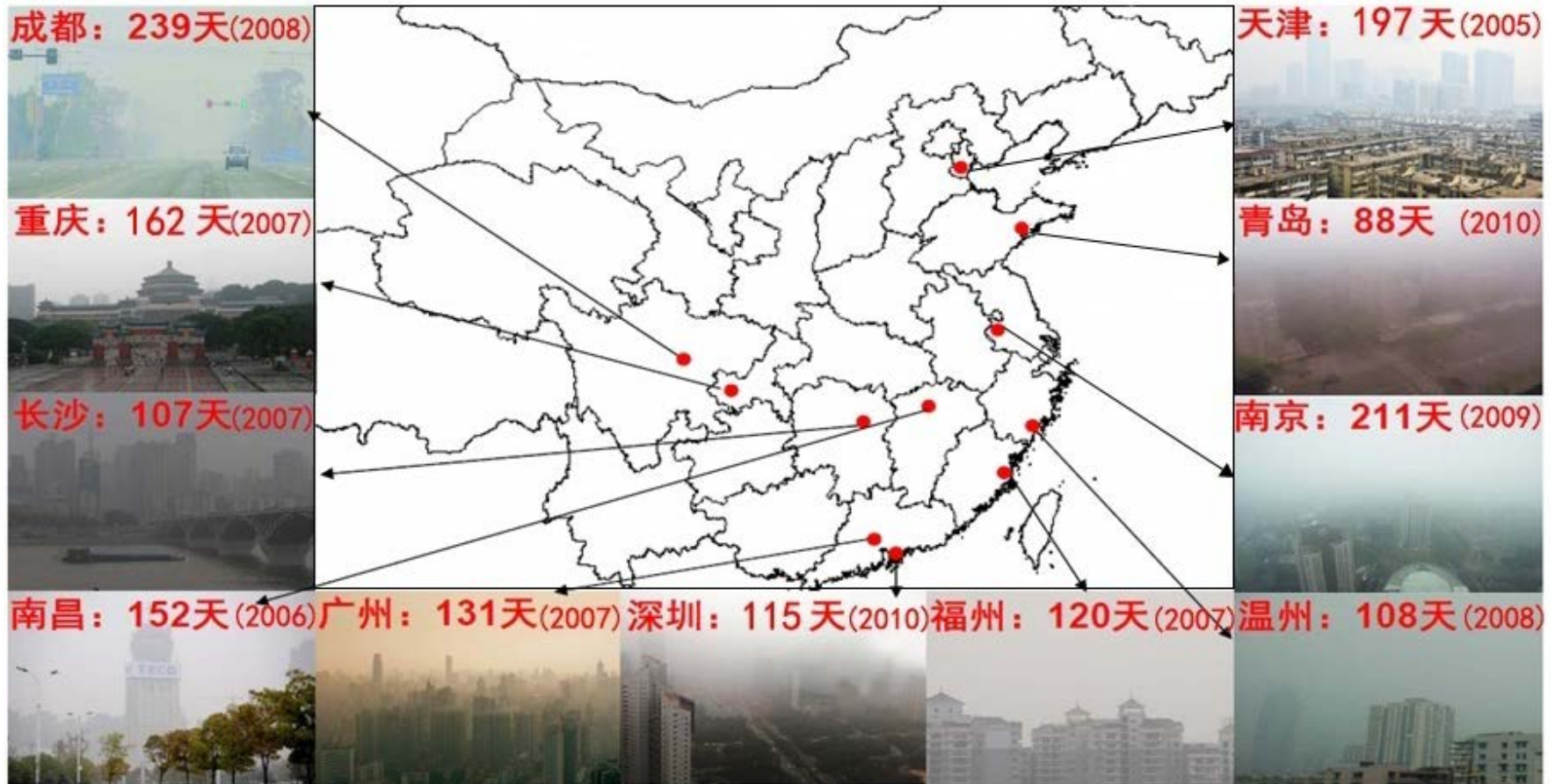
	 health	 Haze	 Acid rain	 ABC	 Climate
SO_4^{2-}					
NO_3^-					
OC					
BC					
O_3					

On-road CO and HC emissions have shown a decreasing trend, but PM and NO_x emissions keep increasing



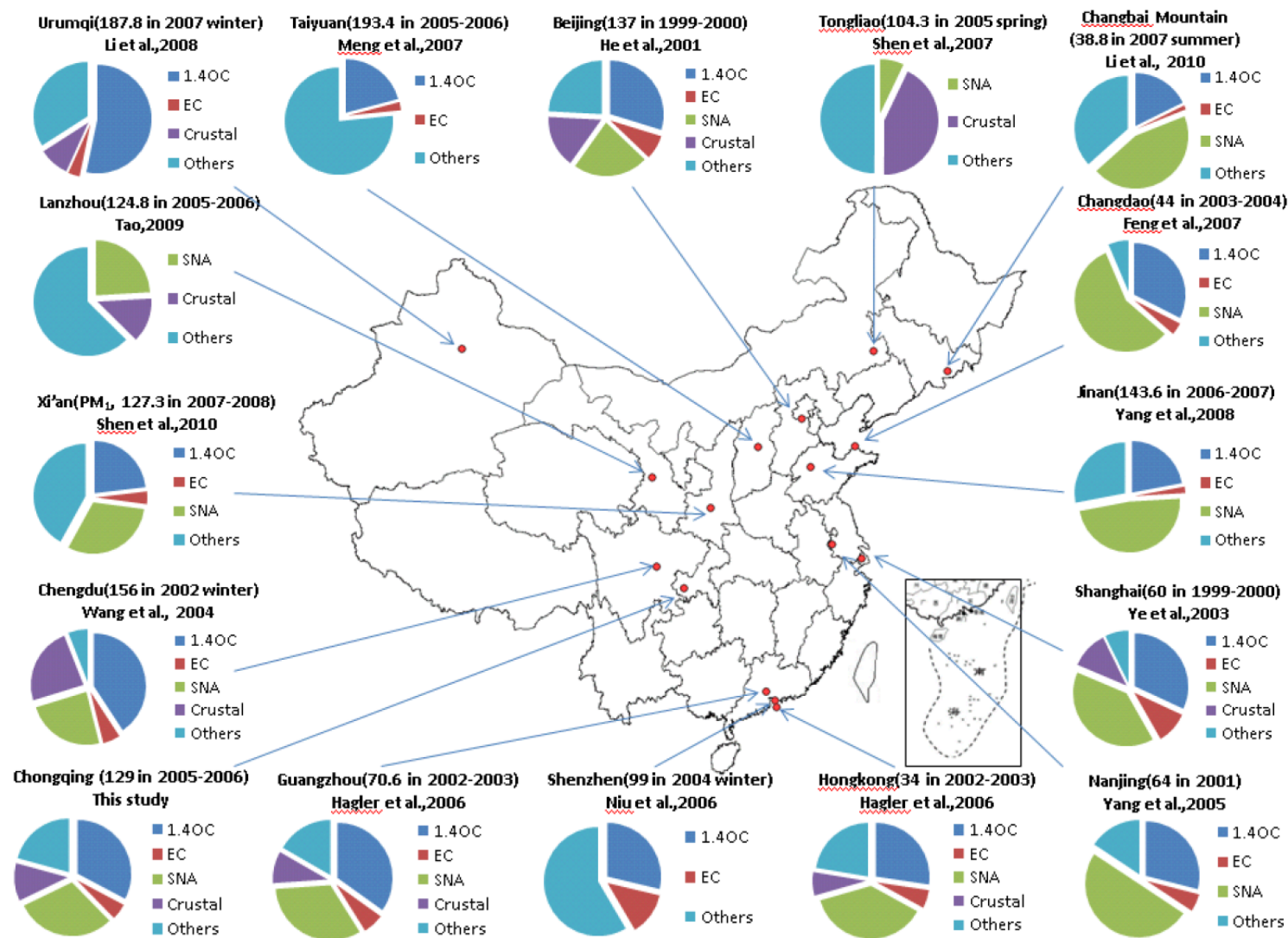
Variation Trend in On-road Emissions from 1980 to 2012 (source: China MEP)

PM_{2.5} Pollution has become a serious concern in China and vehicles are an important contributor

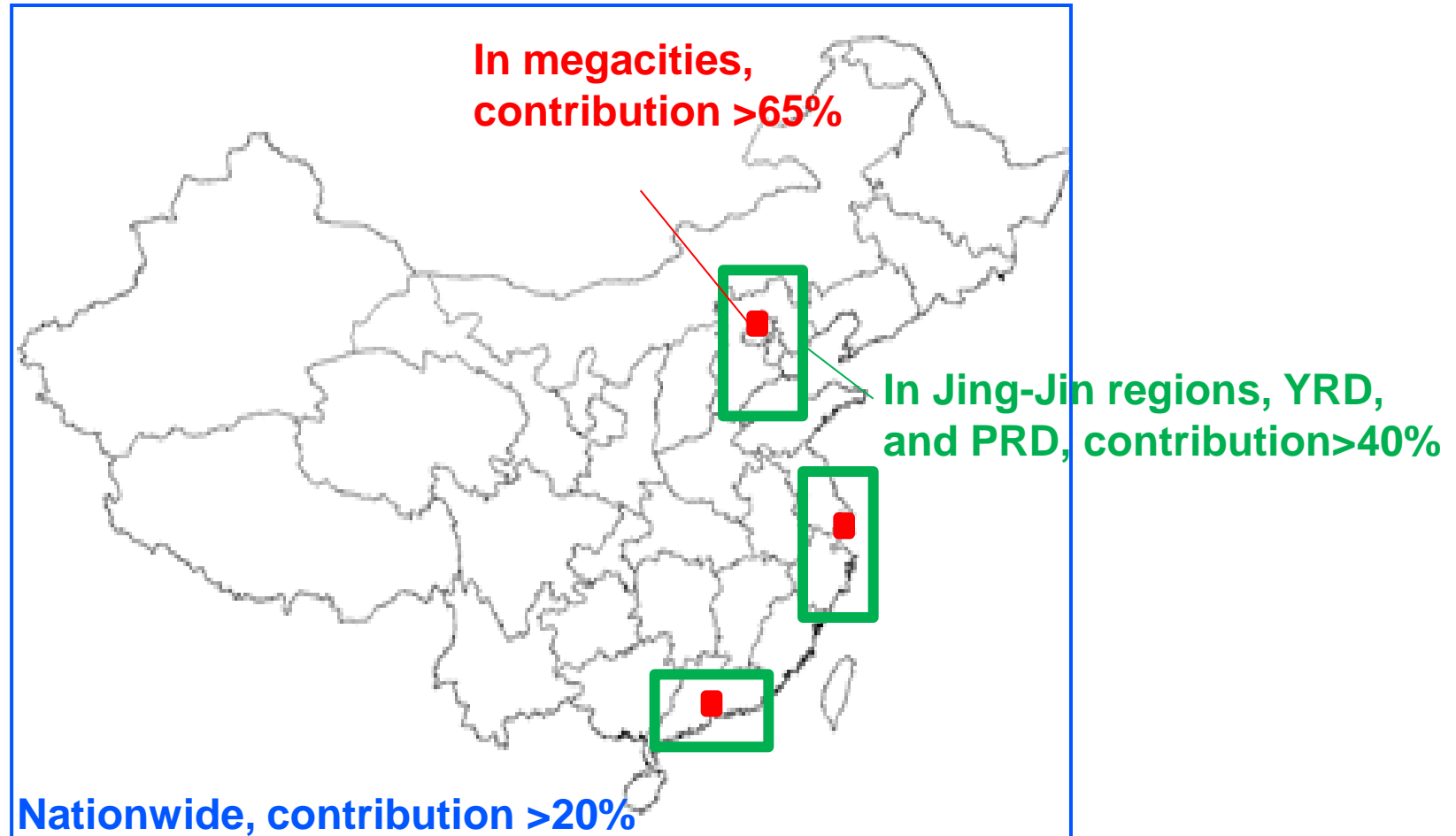


- ❖ 40% days of nonattainment.
- ❖ Daily concentrations were 4 times higher than AAQS
- ❖ It has caused great attentions from the government and the public

SNA (sulfate, nitrate and ammonium) is the major component in $PM_{2.5}$ of Eastern China

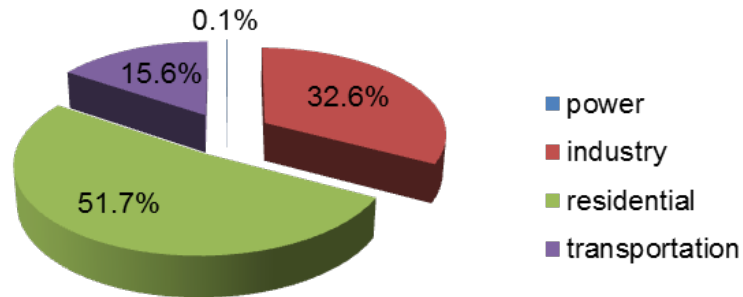


On-Road Transport Has Become a Major Source of Gaseous Pollutants (CO, VOC, and NOx) in China

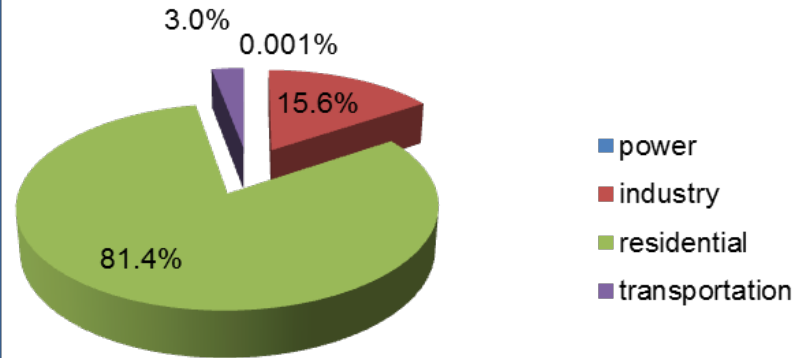


Transportation is an Important Source of BC and NO_x Emissions

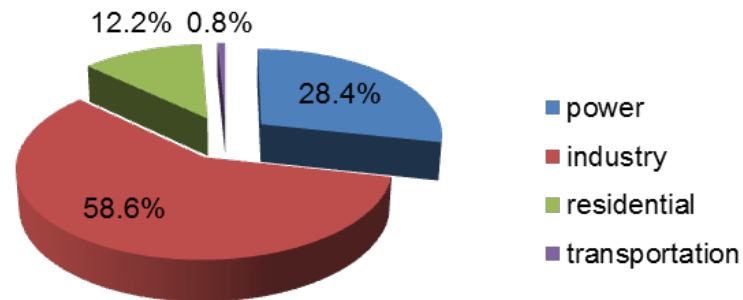
Emission Sources of BC in 2010



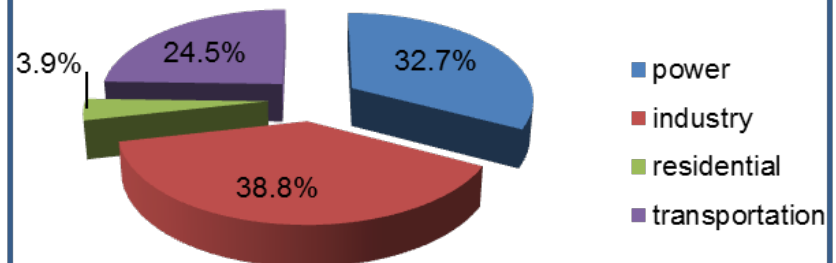
Emission Sources of OC in 2010



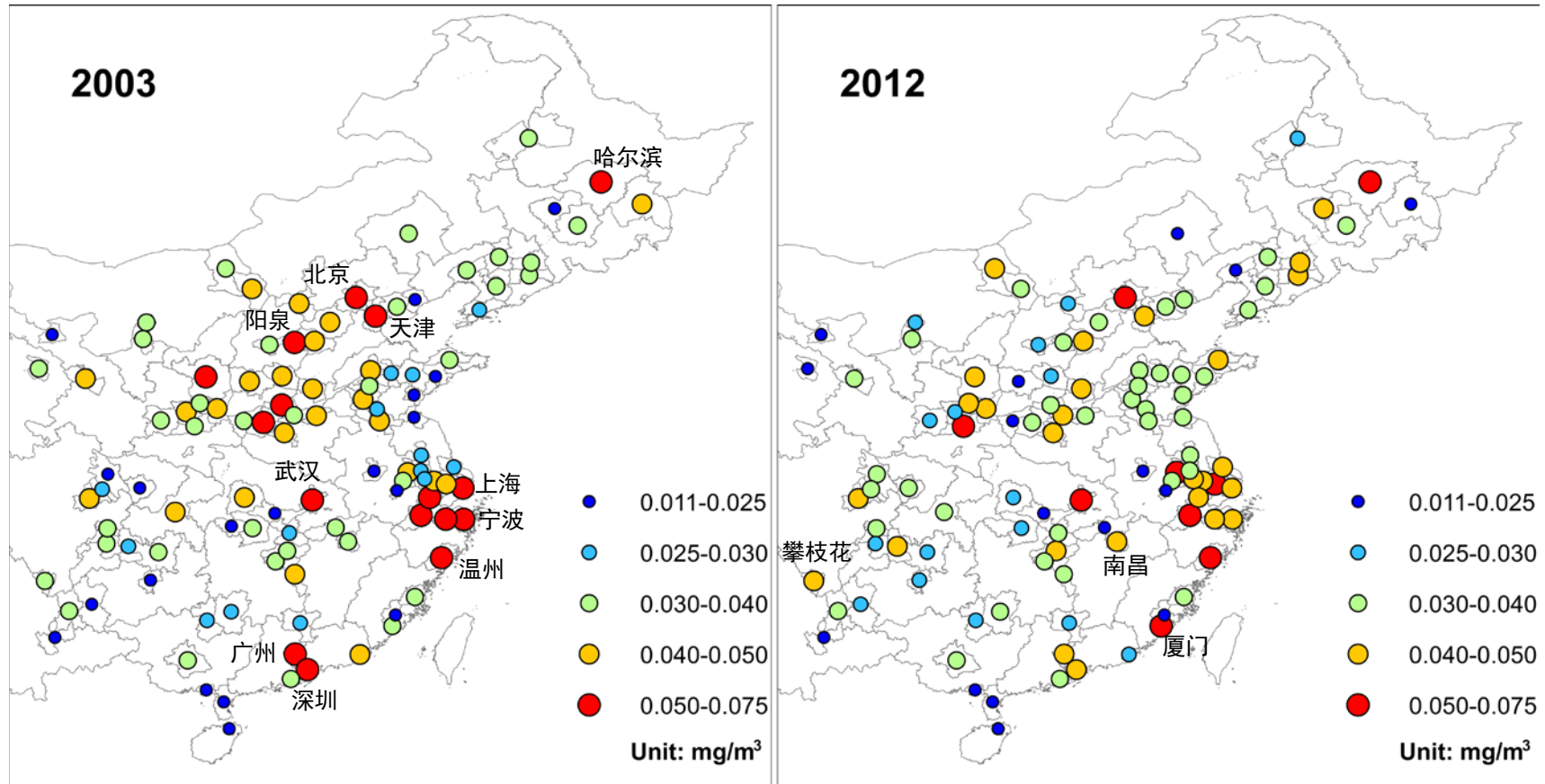
Emission Sources of SO₂ in 2010



Emission Sources of NO_x in 2010



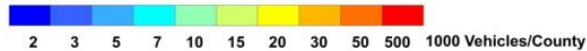
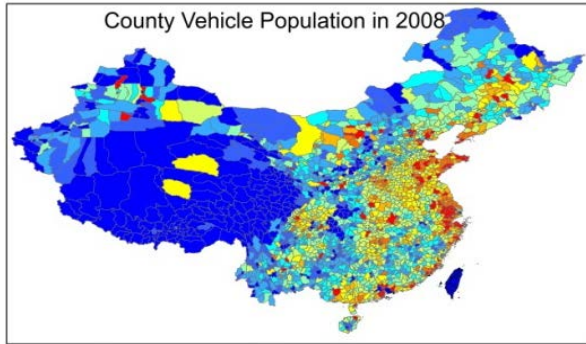
Geographical Pattern of Vehicle Pollution Is Changing



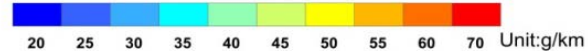
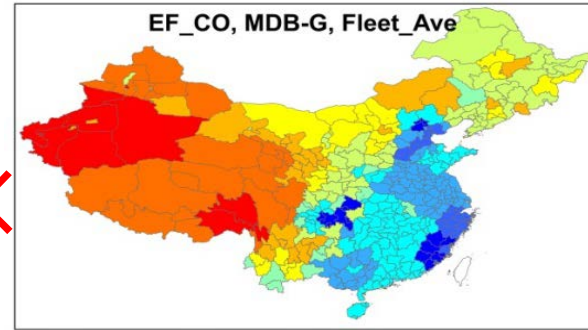
Annual NO_x concentrations of over 100 Chinese cities in 2003 and 2012 shows that annual NO_x concentrations are decreasing in large cities but increasing in medium and small cities.

A High Resolution, County-Level Vehicle Emission Inventory is Developed to Analyze the Spatial Distribution of Vehicle Emissions

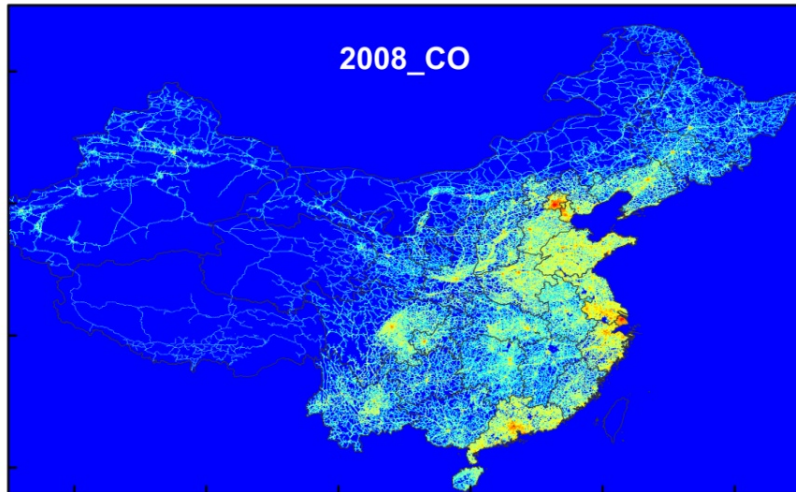
Activity at county level



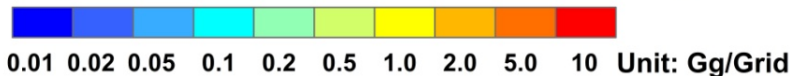
EF with spatial variations



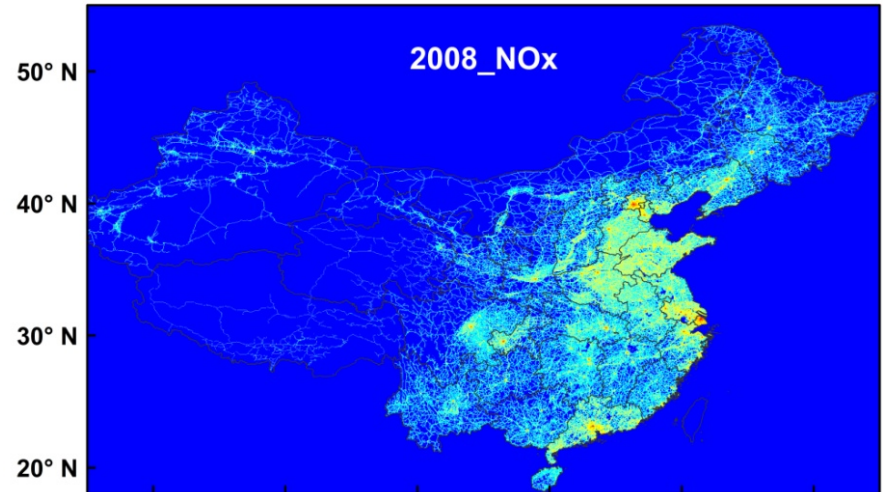
2008_CO



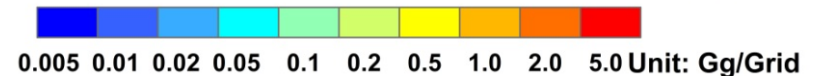
80° E 90° E 100° E 110° E 120° E 130° E



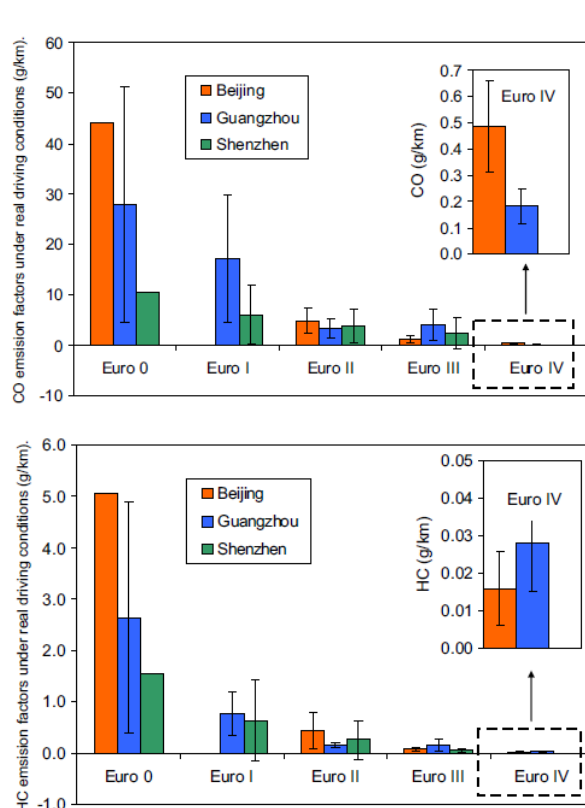
2008_NOx



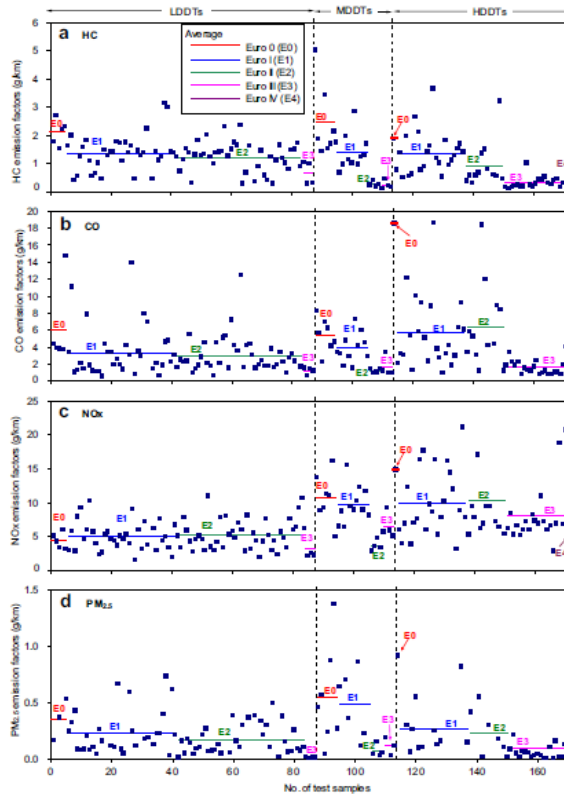
80° E 90° E 100° E 110° E 120° E 130° E



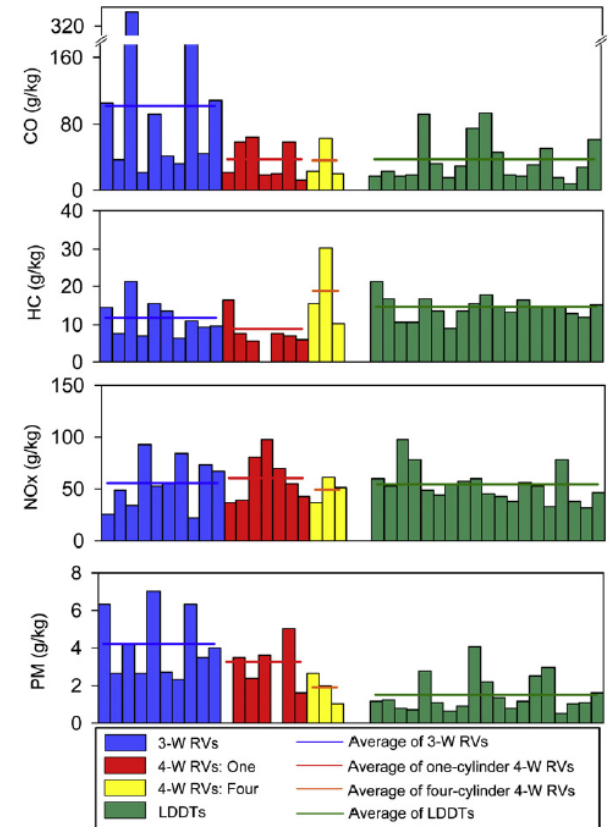
A Large Number of On-Board Emission Measurements on Various Type of Vehicles Have Been Conducted in China



Gasoline Cars

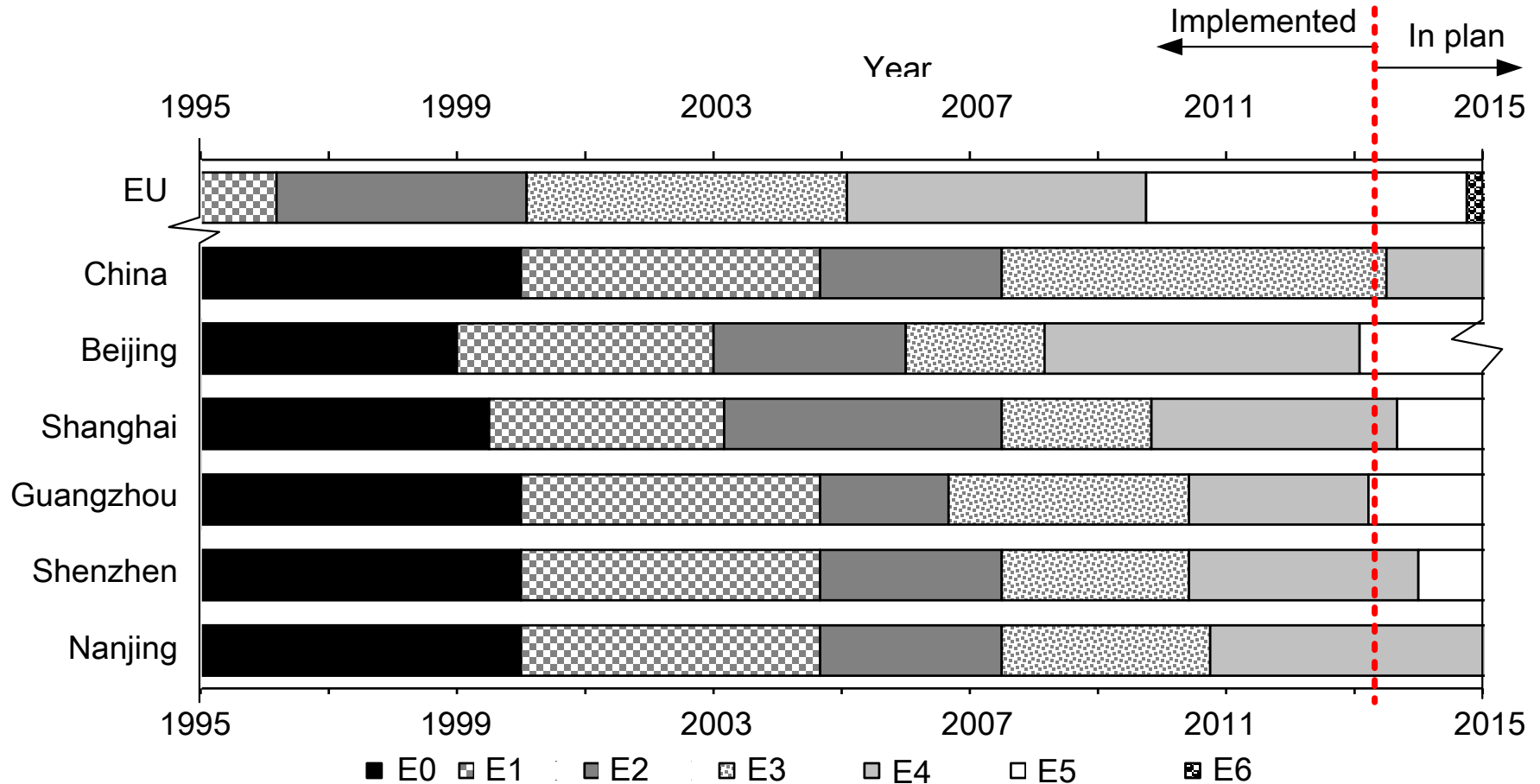


Diesel trucks

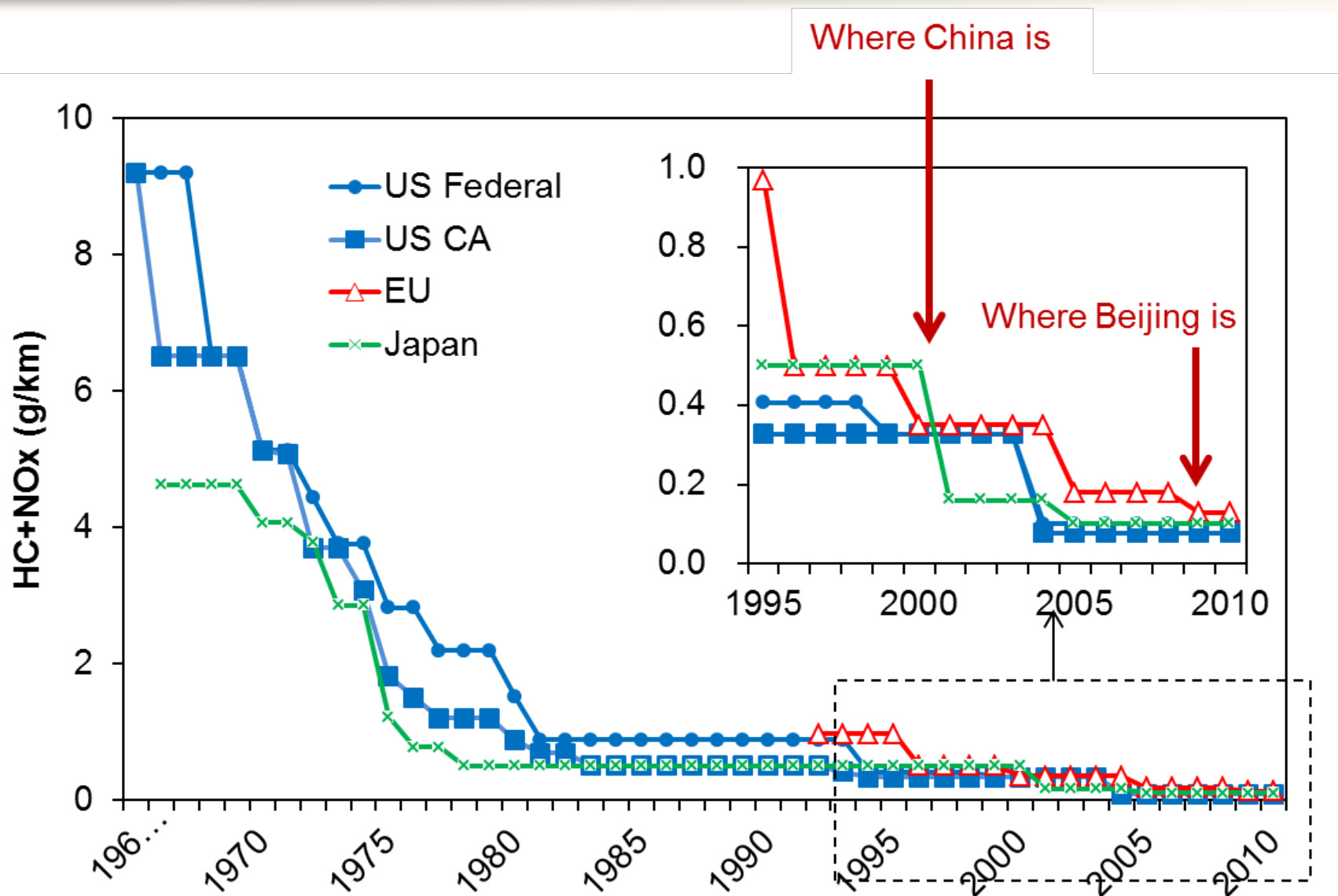


Rural Vehicles

China's Vehicle Emission Standards Are Following EU's Standard System



China's Standards Are Years Behind the US and EU Level, and Oil Quality Is the Largest Bottleneck to Further Promote the Standards



Standards for GV

Country	Year	90	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05	06	07	08	09	10	11	
	Standard																							
US	Emission Standard	Tier0				Tier1										Tier2								
	S content	338								0~500						Avg.120 Max.300		Avg.30 Max.80						
EU	Emission Standard			EURO1			EURO2				EURO3				EURO4			EURO5						
	S content				1000		500			150				50			10							
CHINA	Emission Standard												CHN1			CHN2			CHN3		CHN4			
	S content									1000				800		500		150						
BEIJING	Emission Standard											CHN1			CHN2			CHN3			CHN4			
	S content															500		150		50				

Standards for DV

Country	Year	90	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05	06	07	08	09	10	11	
	Standard																							
US	Emission Standard	Tier0				Tier1										Tier2								
	S content	2000			500													30		15				
EU	Emission Standard			EURO1			EURO2			EURO3				EURO4			EURO5							
	S content	3000			2000		500			350				50			10							
CHINA	Emission Standard										CHN1					CHN2			CHN3		CHN4			
	S content				10000							2000			500									
BEIJING	Emission Standard										CHN1			CHN2		CHN3			CHN4		CHN5			
	S content															500		350		50				

Policies for Reducing Oil Demand of Vehicles

❖ **Fuel economy standards:**

For light-duty passenger cars

- Stage I and Stage II: implemented in 2005 and 2008, respectively, improved the fuel economy by 15% (**30mpg** in 2009);
- Stage III: Implemented in 2012, is expected to bring another 15% of improvement in fuel economy by 2015 (**34 mpg** in 2015);
- Stage IV: achieve **47 mpg** by 2020;

❖ **Advanced Vehicles:**

- Development Plan of Energy-Efficient and New-Energy Vehicles (2012–2020) : achieve accumulated sales of 500,000 new-energy vehicles (hybrids and electric vehicles) by 2015, and 5 million by 2020.

Policies for Controlling Vehicle Emissions

- ❖ **The new national ambient air quality standard was issued in 2012 and will be implemented in 2016, which**
 - Tightens the annual NO_x concentration from 0.08mg/m³ to 0.04mg/m³.
 - Includes PM_{2.5} and 8-hour O₃ for the first time.
- ❖ **A national goal is set for NO_x emission control in the 12th Five-Year Plan**
 - To reduce the national NO_x emissions by 10% from 2010 to 2015.
 - On-road transport is the second largest NO_x emission contributor after power plants, and thus is targeted as a key control sector.
- ❖ **Emission standards**
 - More stringent standards will be implemented in near future
- ❖ **Accelerating vehicle scrappage**
 - Subsidies are provided for scrapping old vehicles

Thanks!

