S20 High Level Policy Webinar

APPLYING SCIENCE AND TECHNOLOGY FOR CLEAN AND CLIMATE CO-BENEFITS

Green Transition for Cleaning the Air, Cooling the Climate & Saving Lives

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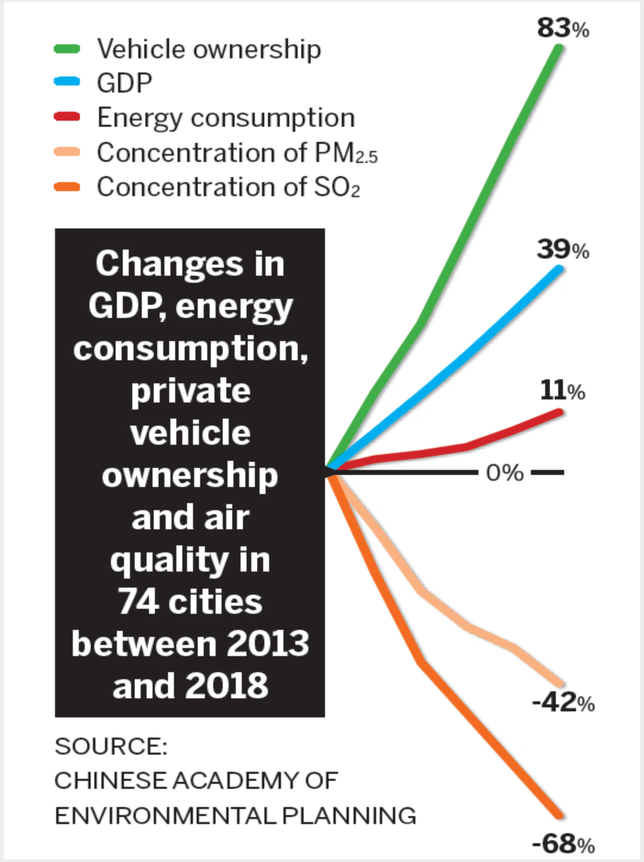
Special Address

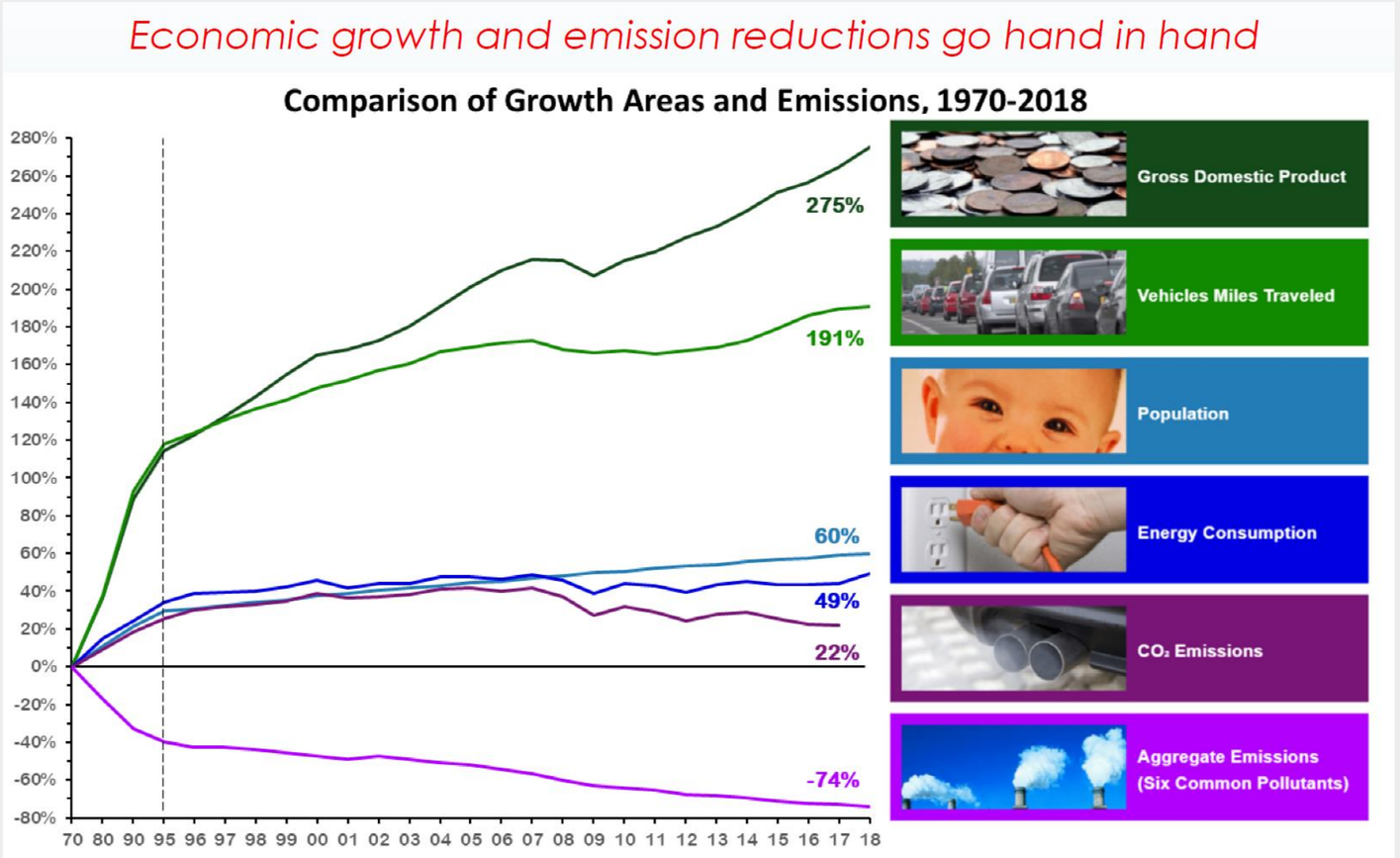
30 June 2022

Decoupling of Economic Growth with Environmental Degradation: China & US



China

NAAQS Revision in 2012, National Action Plan on Air Pollution Prevention and Control in 2013



US

Clean Air Act Amendment 1970, 1st NAAQS

Source: USEPA 2019

Drivers of Improved PM2.5 Air Quality in China from 2013 to 2017

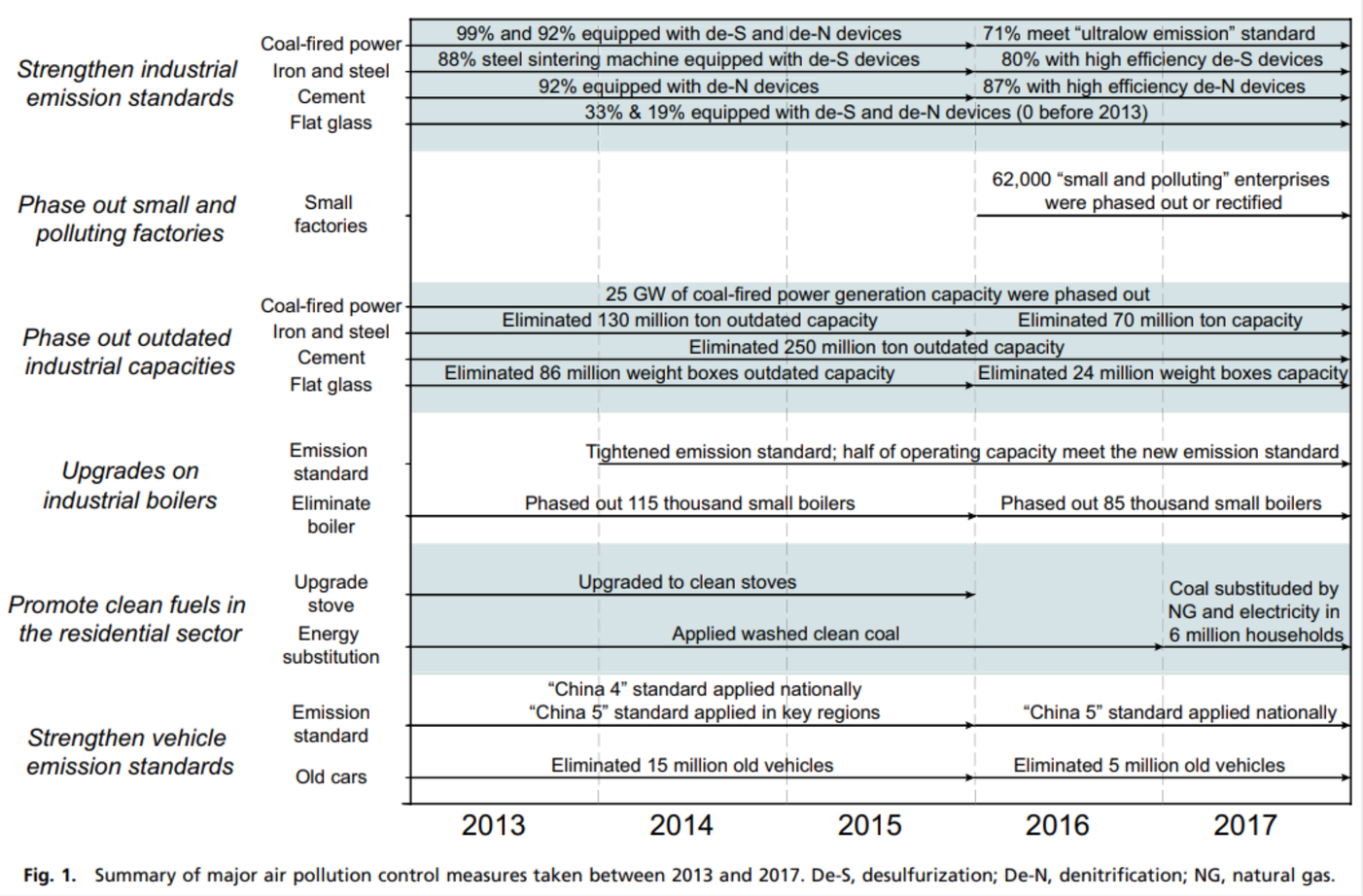
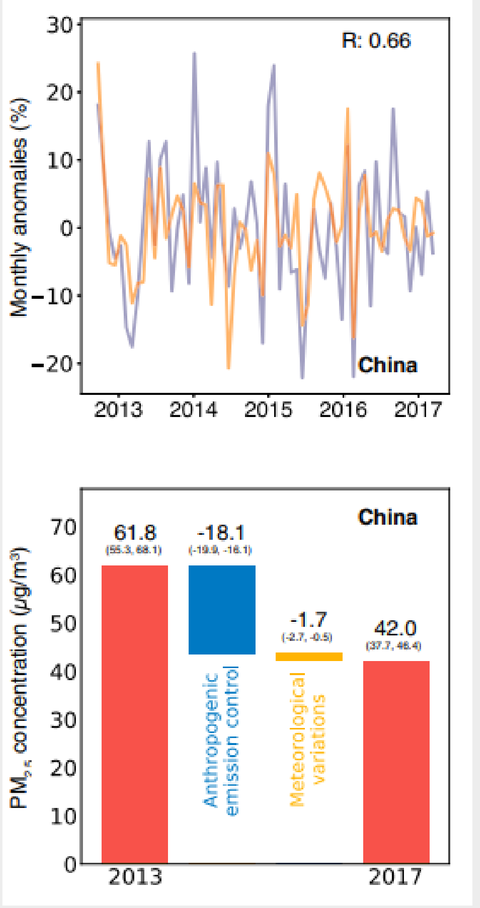
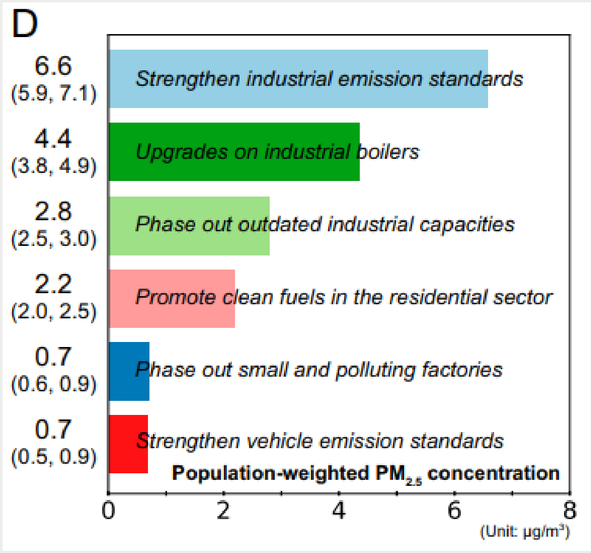


Fig. 1. Summary of major air pollution control measures taken between 2013 and 2017. De-S, desulfurization; De-N, denitrification; NG, natural gas.





Source: Zhang et al. PNAS 2019

Associated Health Benefits in China During 2013–2017

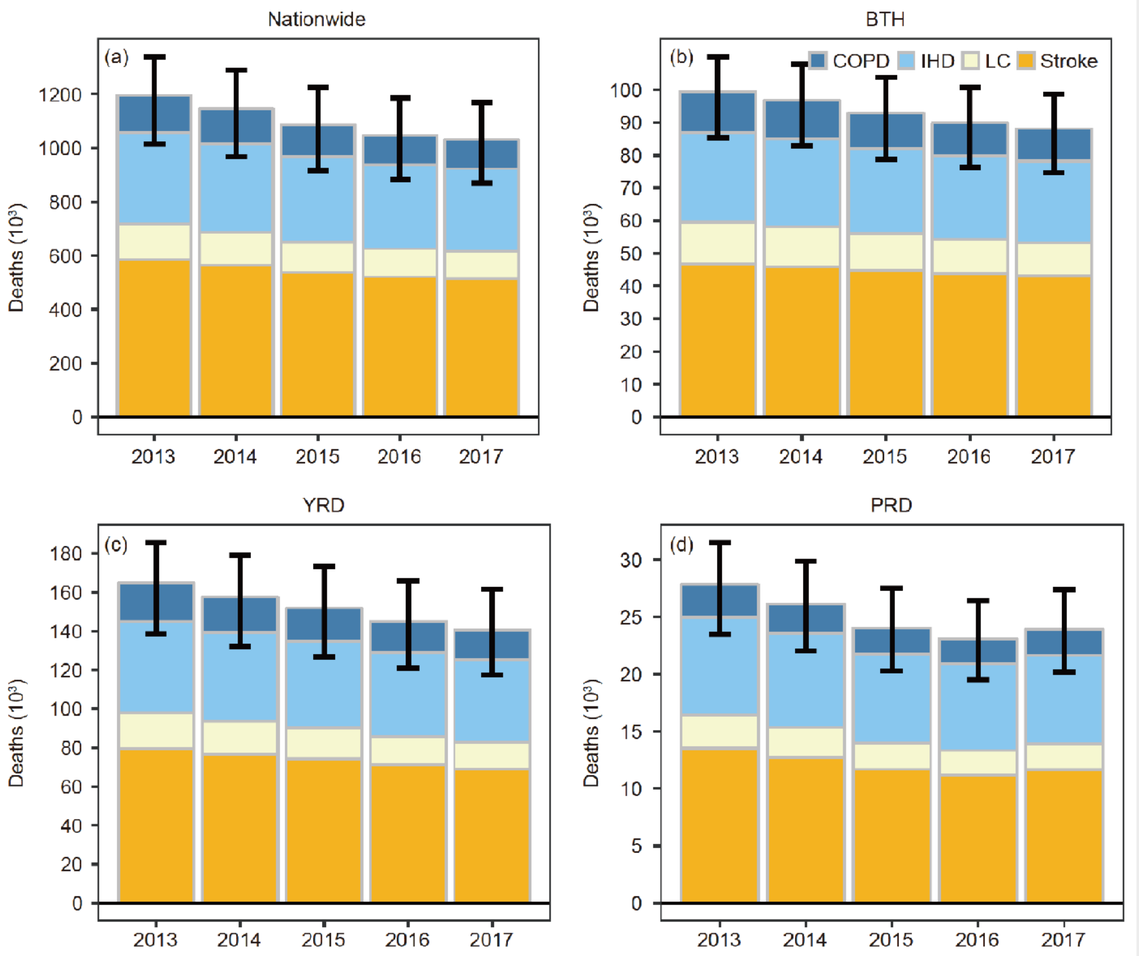
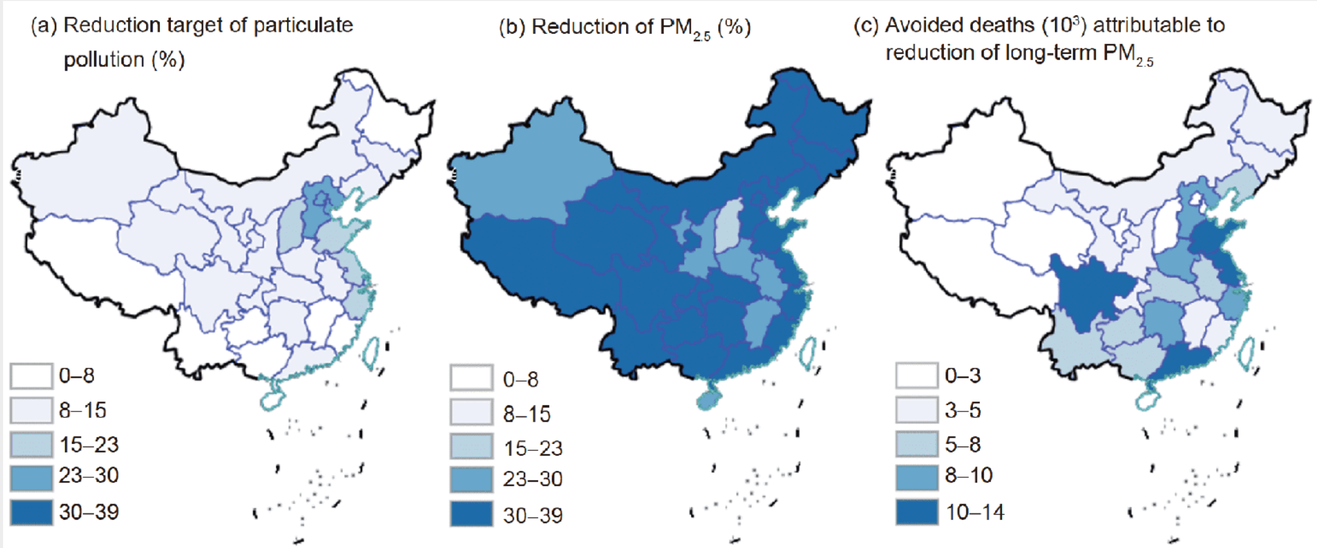
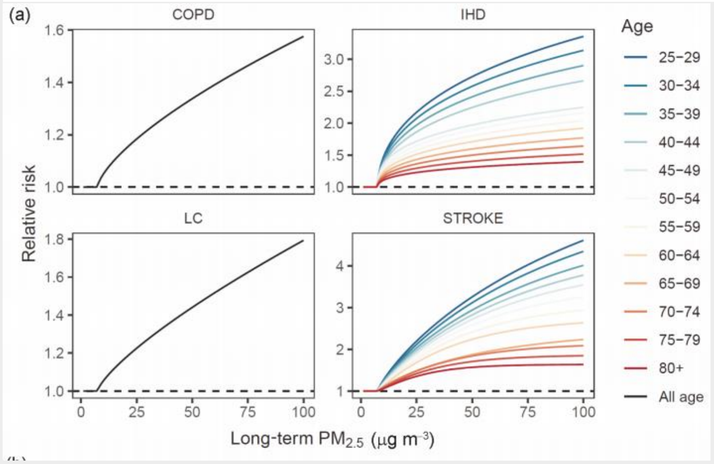


Figure 4 Number of premature deaths attributable to exposure to ambient $PM_{2.5}$ in 2013–2017.



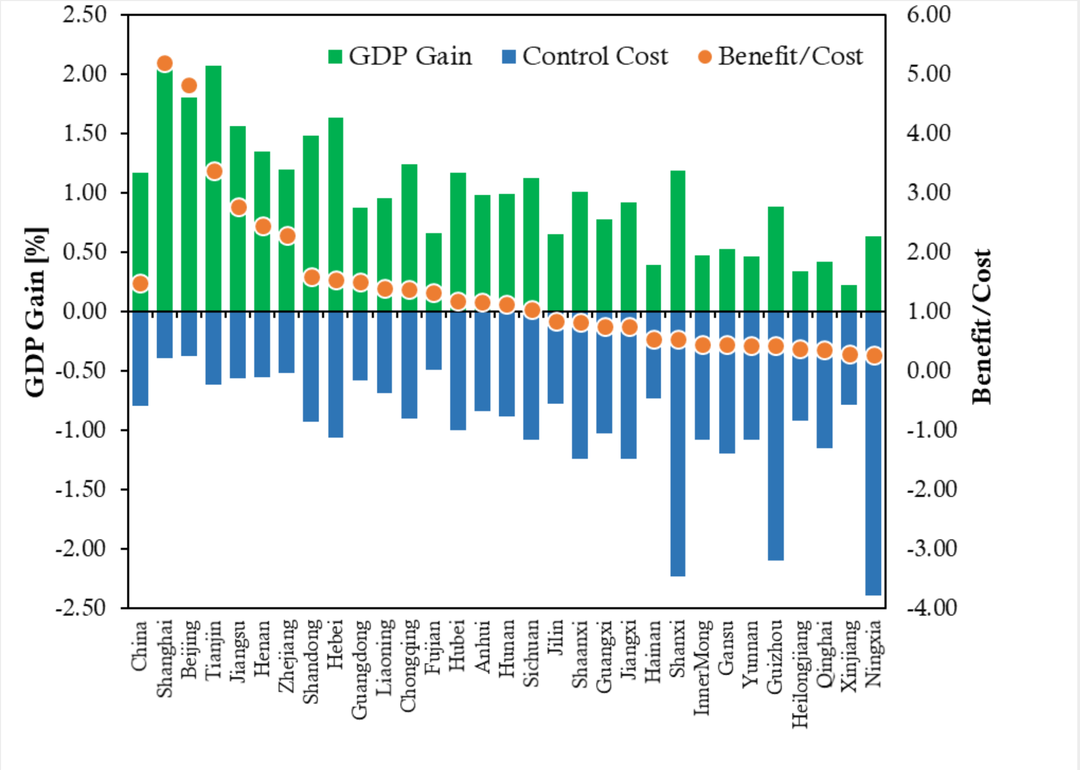


Source: Xue et al. SCIENCE CHINA Earth Sciences 2019

Health and Economic Benefits of $PM_{2.5}$ Pollution Control in China

- **Health benefits:** Air pollution control policies can reduce the number of PM2.5-related patients by 75% and US$6.5 billion in disease expenditures.
- **Economic impact:** By 2030, national control cost at US$101.8 billion, equivalent to 0.79% of GDP, but it will drive GDP recovery by 1.17%.
- **Cost-benefit analysis:** net benefit in more developed provinces is higher, while the benefits in the central and western provinces are not that obvious.

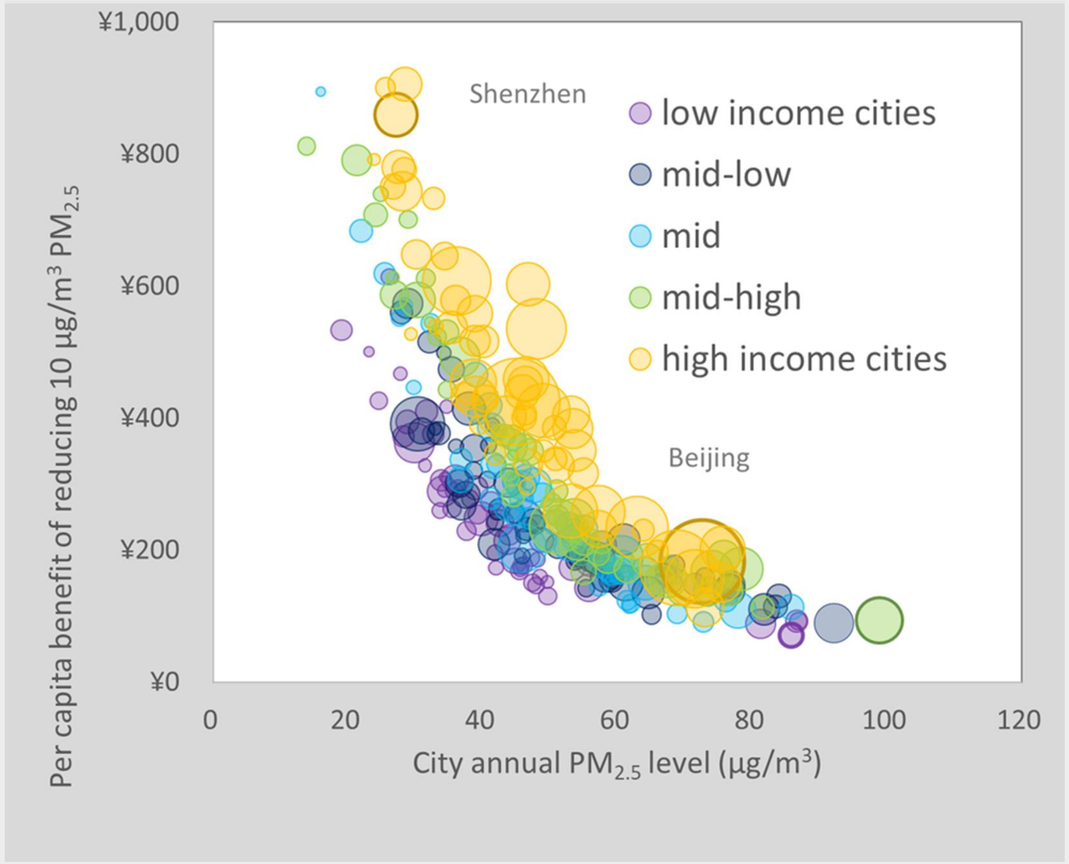
Cost-effectiveness of air pollution control in China

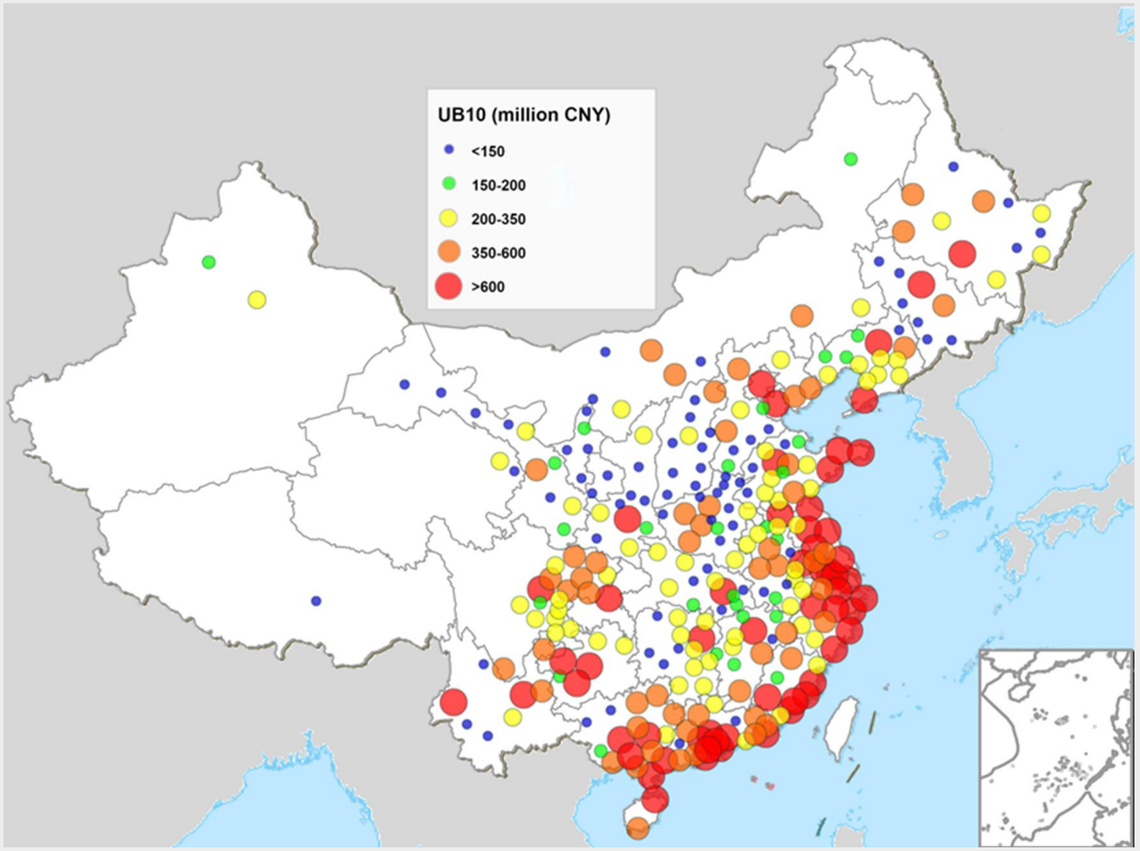


Source: Yang Xie, Hancheng Dai, et al.

Economic Evaluation of the Health Effects of Reducing Fine Particulate Pollution in Chinese Cities

"Marginal" Benefit Distribution of PM2.5 Control





Per capita perspective:
Income and nonlinear effect matter

City level perspective:
Population density dominates
Asian cities: challenges and opportunities

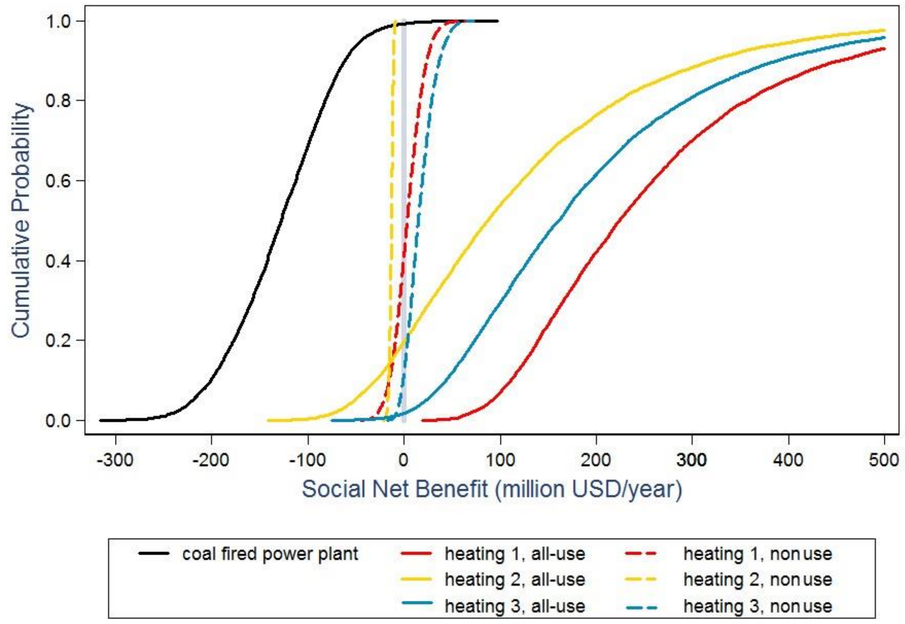
Souce: JIN Yana and ZHANG Shiqiu, Asian Development Review 2018

Economic Perspectives on Clean Air Measures

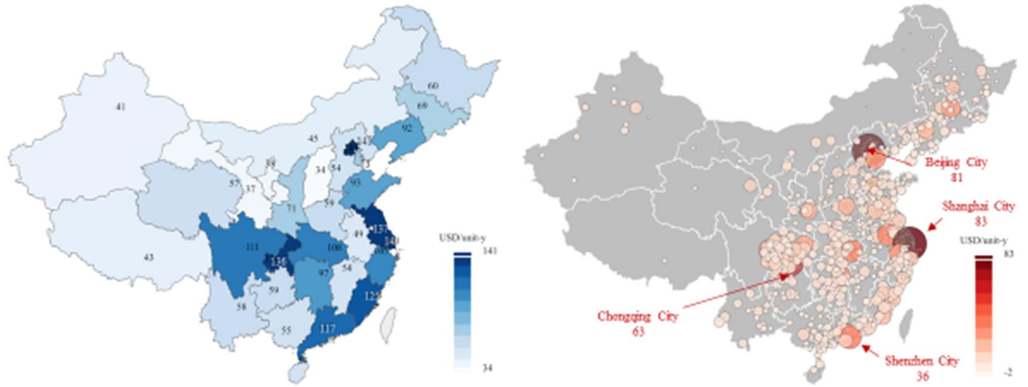
J. Benefit Cost Anal. 2017; 8(2):147–186
doi:10.1017/bca.2017.10

Yana Jin, Henrik Andersson and Shiqiu Zhang*

China's Cap on Coal and the Efficiency of Local Interventions: A Benefit-Cost Analysis of Phasing out Coal in Power Plants and in Households in Beijing[1]

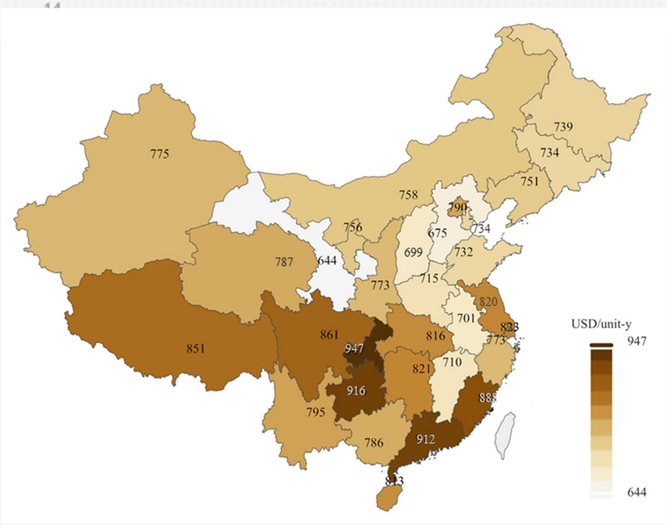


Health benefits are primarily in megacities in China's eastern coastal and southwest regions (e.g., Beijing, Shanghai, & Chongqing)



Health benefits of a GV-to-EV substitution at provincial level (USD/unit-year)

Health benefits of a GV-to-EV substitution in 792 cities in China (USD/unit-year; for Primary $PM_{2.5}$)



Total benefits of a GV-to-EV substitution at provincial level (USD/unit-year

Source: HU Yuhan, JIN Yana, ZHANG Shiqiu 2021 working paper

Maximize the Co-Health Benefits of Air Pollution Control and Climate Change Mitigations (Which, Where, When?)

AIR POLLUTANT / GHG	LIFETIME/ SCALE	CLIMATE IMPACT	HEALTH/ECOSYSTEM IMPACTS
Carbon Dioxide (CO_2)			
Fluorinated Gases (F-gases)			
Methane (CH_4) Nitrogen Oxides (NO_x)			
Nitrogen Oxides (NO_x)			
Nitrous Oxides (N_2O)			
Particulate Matter (PM)			
Sulfur Dioxide (SO_2)			
Tropospheric Ozone (O_3)			
Volatile Organic Compounds (VOCs)/ Carbon Monoxide (CO)			

Lifetime in Atmosphere = days/weeks
Impact Scale=local/regional

Lifetime in Atmosphere= years
Impact Scale=global

Warming

Cooling

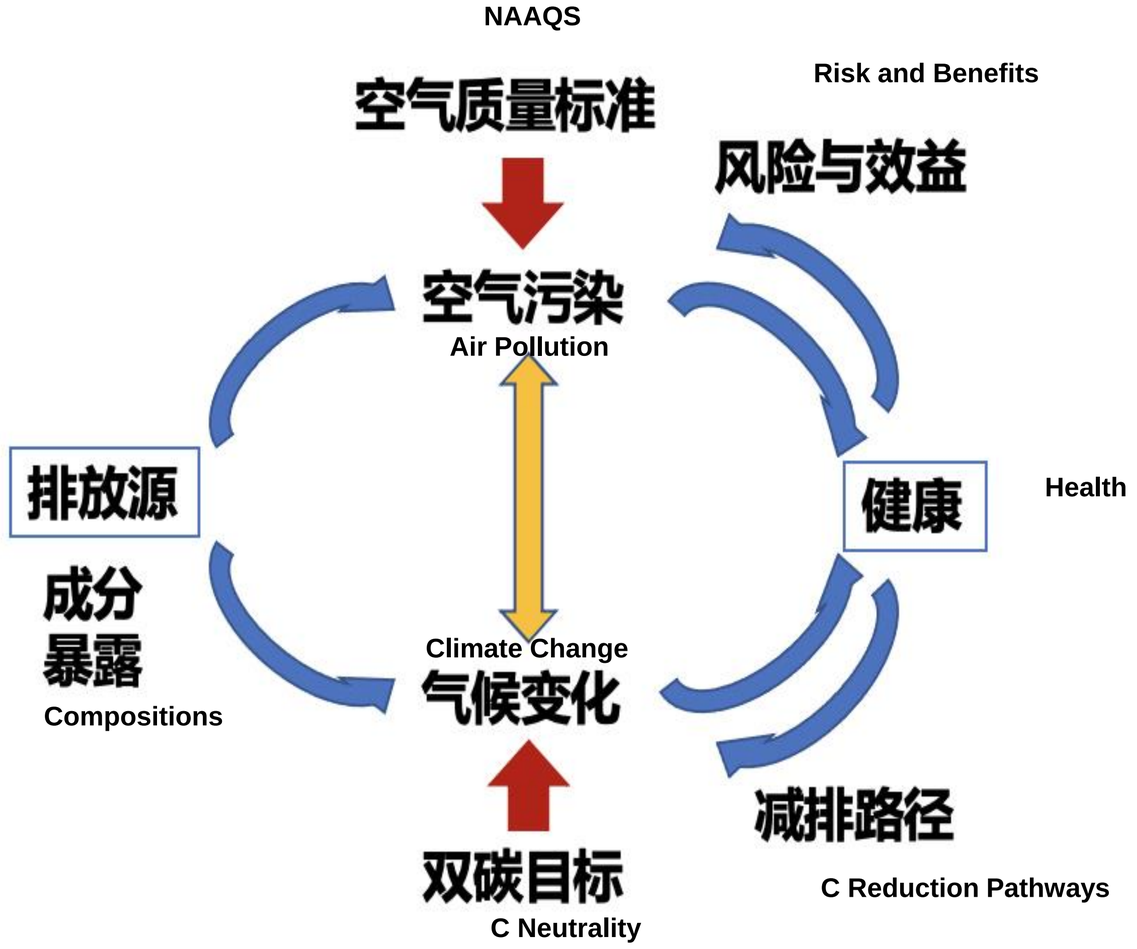
Human Health Impact

Ecosystem Impact

No direct impact on human health or ecosystems*

*No direct impact implies the substance in question either does not directly cause human health or ecosystem impacts or it does not go through a chemical process to create a substance that directly impacts human health and ecosystems

Source: COP24 special report, WHO 2018

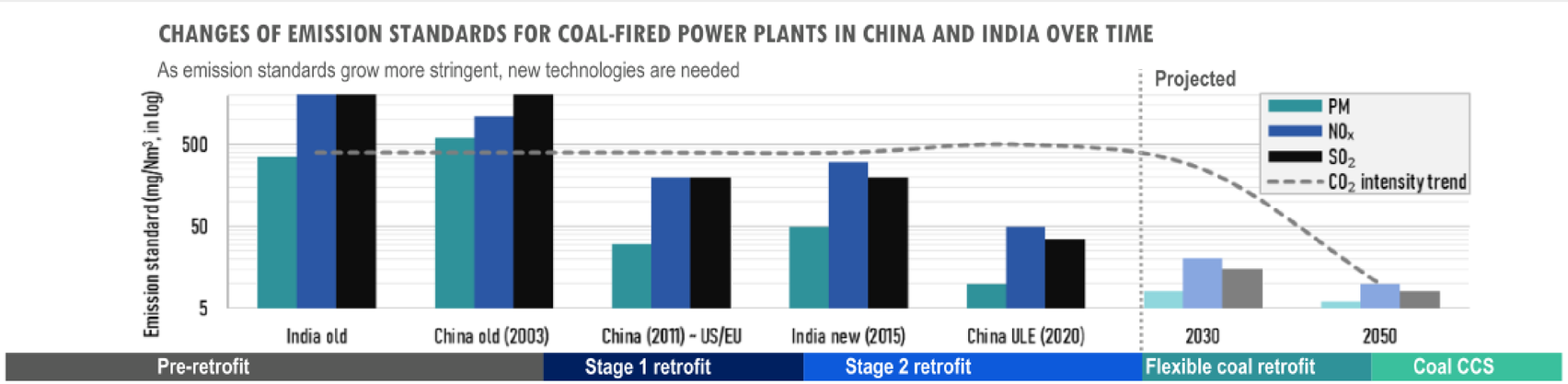


Source: ARCH Framework, Tong Zhu, 2021

Nexus Between Air Pollution and Climate Mitigation and Opportunities to Address them Together

An ultra-low emission coal power fleet for cleaner but not hotter air

Source: JIN et al, Environ. Res. Lett. (2020)



BENEFITS AND COSTS OF DIFFERENT STAGES OF RETROFIT IN COAL FLEET

Air quality, public health and climate benefits vary depending on retrofit progress and electrification in other energy end-use sectors

Benefits (or costs) are negative (-), uncertain(?), otherwise positive, as compared to previous retrofit stage

Air quality and health benefits	**Coal fleet retrofit**	Air quality, tall stack Health benefits, tall stack	Air quality, tall stack Health benefits, tall stack		
	+ coal-to-electricity switch in residential sector (e.g. heating)		Air quality, household stoves Health benefits, household stoves Indoor air quality, 20 years later		
	+ oil-to-electricity switch in transportation sector			Air quality, mobile Health benefits, mobile	
Climate change mitigation benefits	**Coal fleet retrofit**	Reduced aerosols (-) Change in CO_2 (?)	Reduced aerosols (-) Change in CO_2 (?)	CO_2 reduction, renewables CO_2 from flexible coal (-)	
	+ coal-to-electricity (residential)		Short-lived climate pollutants Change in CO_2 (?)		
	+ oil-to-electricity (transportation)			Short-lived climate pollutants Change in CO_2 (?)	
Economic costs	**Coal fleet retrofit**	Investment in retrofit Change in O&M (?)	Investment in ULE Change in O&M (?)	Investment in flexible coal Change in O&M Control extra NO_x	Investment in CCS Change in O&M
	+ coal-to-electricity (residential)		Investment in residential sector Net change in fuel cost (coal/electricity)		
	+ oil-to-electricity (transportation)			Investment in infrastructure, battery, etc Net change in fuel cost (oil/electricity)	

Figure 1. The pathway of a 2 °C-consistent global coal-fired power generation fleet. The graphic shows how the global coal-fired power generation fleet needs to evolve over time to first reduce air pollution and then mitigate climate change. From left to right,

Carefully Choose, Design Policies Considering Efficiency, Effectiveness, Equity and Justice

- Addressing the local, regional and global problems under the framework of sustainability through greening the economy, low/de-carbon practice, restructuring and innovation
  - Address the co-benefits, identify least cost solution
  - Better use MBIs, price signals, incentive for behaviors changes
  - Enhance environmental governance through information disclosure and public participation etc.