

This is not an ADB material. The views expressed in this document are the views of the author/s and/or their organizations and do not necessarily reflect the views or policies of the Asian Development Bank, or its Board of Governors, or the governments they represent. ADB does not guarantee the accuracy and/or completeness of the material's contents, and accepts no responsibility for any direct or indirect consequence of their use or reliance, whether wholly or partially. Please feel free to contact the authors directly should you have queries.

PRC'S 10-YEAR PATH TOWARDS CLEANER AIR - AN ASIAN PERSPECTIVE

BAQ
BETTER AIR QUALITY
CONFERENCE



CHINA AIR REPORT TEAM

FU Lu, **WAN Wei**, ZHANG Weihao, CHENG Huihui
WANG Qiuyi, WANG Si, ZHONG Nan
WANG Yue, XIA Dongfei, RAN Zheng

亚洲视角下的清洁空气与气候变化领域关键指标

Clean air and climate change - Asian perspective and key indicators

Region	Country
East Asia	PR China
	Japan
	Republic of Korea
	Mongolia
South Asia	India
	Pakistan
	Bangladesh
	Sri Lanka
	Nepal
Southeast Asia	Singapore
	Republic of the Philippines
	Malaysia
	Thailand
	Viet Nam
	Indonesia
	Cambodia
America	Myanmar
	United States (US)
Europe	United Kingdom (UK)
	Germany

The report covers key indicators of clean air and climate change status and progress, including air quality, air pollutant emissions, greenhouse gas emissions, energy sector, transport sector and key industrial sectors.



Air quality



Air pollutant emissions



Greenhouse gas emissions



Energy sector



Transport sector



Key industrial sectors

* Comparisons between countries in the report are made within the above-mentioned countries unless otherwise specified.

中国的空气质量快速改善，实现环境、经济“双赢”

Rapid air quality improvement and win-win situation in PR China

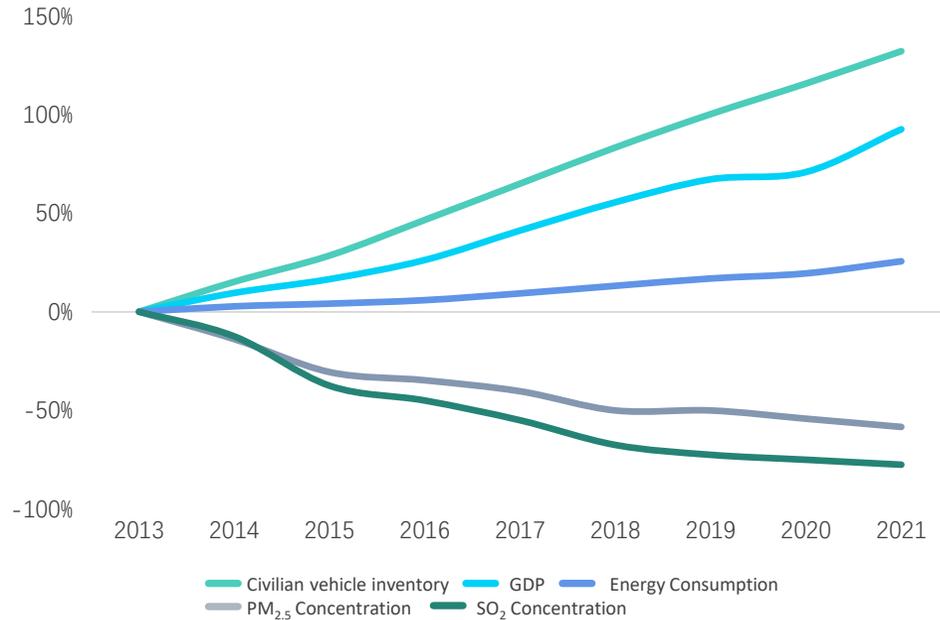


Figure Changes in PR China's GDP, Energy Consumption, Civilian Vehicle Inventory, and Air Pollutant Concentration, 2013-2021

Source: China Statistical Yearbook, 2014-2022

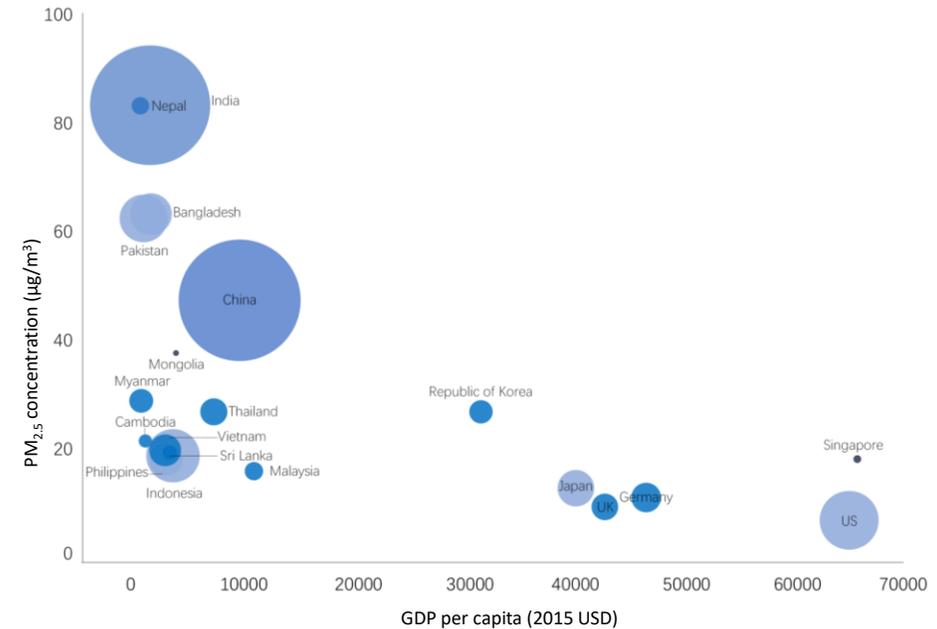


Figure PM_{2.5} and GDP per Capita by Country, 2019

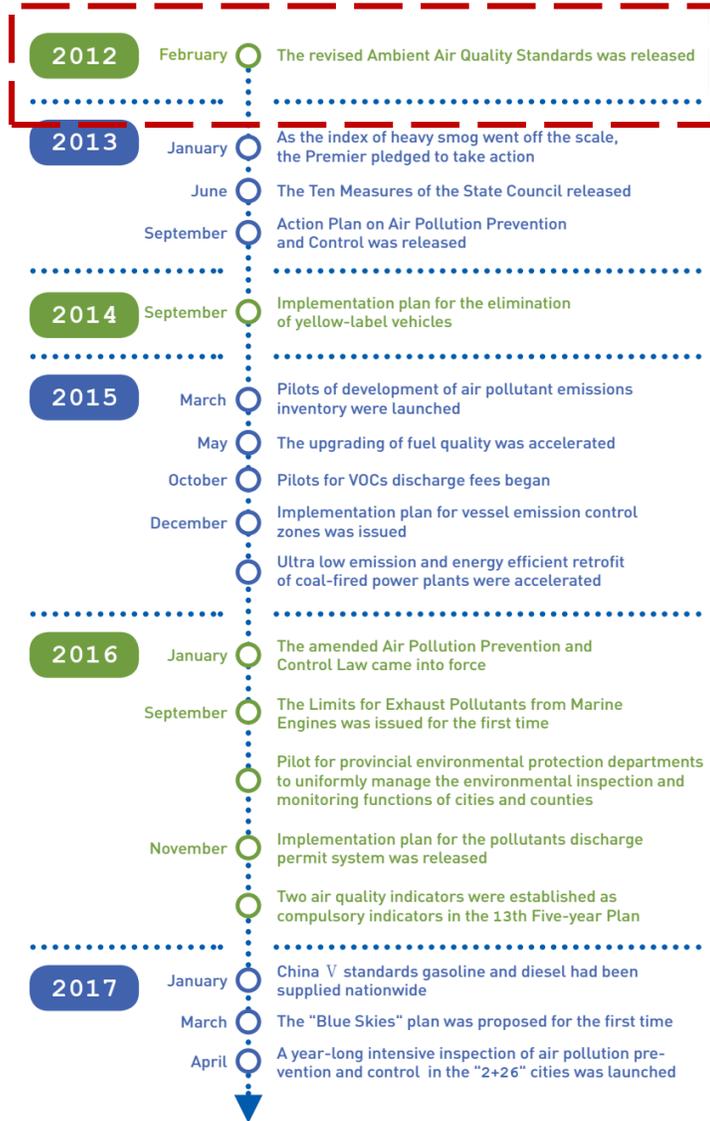
Note: GDP per capita is measured in 2019 US dollars; the size of the bubbles corresponds to the population of each country.

Source: Global Burden of Disease Study 2019, World Development Indicators

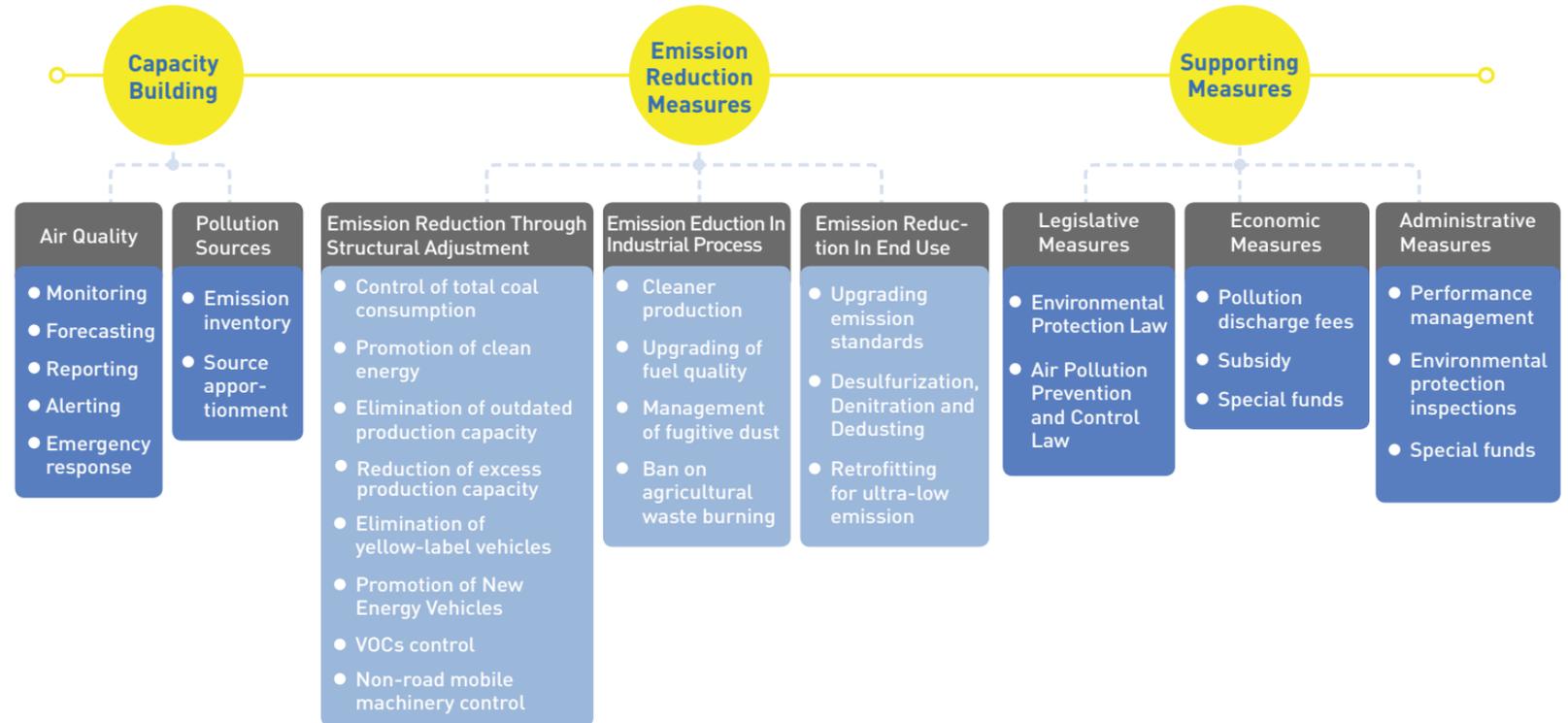
- From 2013–2021, PR China's overall annual average PM_{2.5} and SO₂ concentrations have fallen by approximately 56% and 78%, respectively.
- PR China's GDP maintained a high average growth rate of 6.6%—nearly twice the average growth rate of developing economies.
- PR China's GDP per capita has exceeded the \$10,000 threshold, crossed the “turning point” and successfully broken the connection between economic development and air quality deterioration.
- Energy consumption and the number of civilian vehicles increased by 25.7% and 132.2%, respectively.

标准修订推动了中国空气质量管理体系的升级

Revision of NAAQS started the AQM framework upgrading in PR China



China's Policy Framework for Air Pollution Prevention and Control

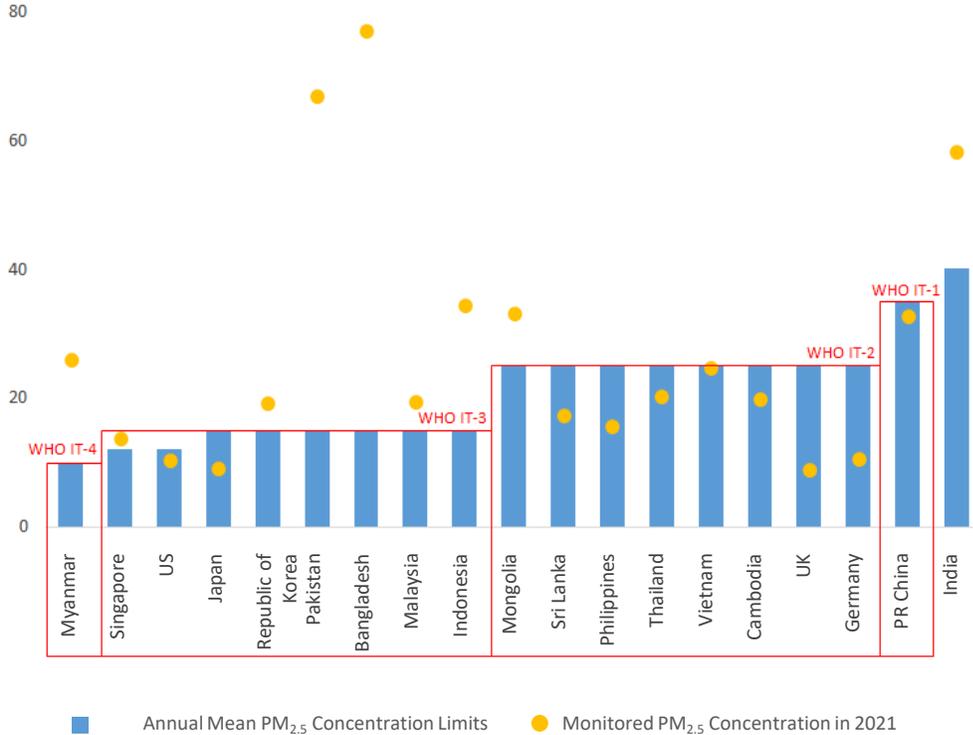


Milestones of PR China's AQM and Policy Framework

Source: Clean Air Asia, 2018. BREAKTHROUGHS: CHINA'S PATH TO CLEAN AIR 2013-2017

标准距离WHO新指导值差距较大，需要进一步提标保护公众健康

WHO AQGs and emerging needs for further public health protection



- PR China's annual PM_{2.5} concentration limit in the NAAQS is the same as WHO IT-1, the most lenient one.
- The monitoring data in cities showed annual average PM_{2.5} concentration was about 30μg/m³ in 2021, lower than the standard requirement.
- **Current air quality in nearly half of the Asian countries does not meet local standards.** Some countries with relatively strict limits (with reference to WHO IT-3 and IT-4) still have poor air quality.
- Upgrading the standards and continuous improvement in air quality can further protect the health of the public (especially vulnerable groups such as the elderly and children), which is crucial for many Asian countries including PR China as the population is aging.

Pollutant	Averaging time	Interim target				AQG level
		1	2	3	4	
PM _{2.5} μg/m ³	Annual	35	25	15	10	5
	24-hour ^a	75	50	37.5	25	15

Figure Annual Mean PM_{2.5} Concentration Limits and Monitored Concentration Levels in 2021 of

Each Country

Source: see report references for details.

空气质量监测网络跨越式发展，站点密度和类别仍待提升

Leap-frogging of monitoring stations and needs for more comprehensive network

City	No. of continuous monitoring stations	Ranking by No. of stations per million habitants	Ranking by No. of stations per 1,000 sq km ²	PM _{2.5}	PM ₁₀	SO ₂	NO ₂	CO	O ₃	NO	Ox	NH ₃	TSP	PM ₁
London, UK	129	2	2	✓	✓	✓	✓	✓	✓					
Tokyo, Japan	82	14	6	✓	✓	✓	✓	✓		✓	✓			
Bangkok, Thailand	64	3	5	✓	✓		✓	✓	✓					
Guangzhou, PR China	52	10	16	✓	✓	✓	✓	✓	✓					
Seoul, South Korea	51	4	1	✓	✓	✓	✓	✓	✓	✓				
Xi'an, PR China	41	9	17	✓	✓	✓	✓	✓	✓					
Delhi, India	40	18	8	✓	✓	✓	✓	✓	✓	✓		✓		
Beijing, PR China	35	16	22	✓	✓	✓	✓	✓	✓					
Hangzhou, PR China	33	11	23	✓	✓	✓	✓	✓	✓					
Mumbai, India	30	15	4	✓	✓	✓	✓	✓	✓	✓		✓		
Singapore	22	7	7	✓	✓		✓	✓	✓					
Wuhan, PR China	22	17	21	✓	✓	✓	✓	✓	✓					
Shanghai, PR China	19	22	20	✓	✓	✓	✓	✓	✓					
Hong Kong, PR China	18	12	10	✓	✓	✓	✓	✓	✓					
Berlin, Germany	17	5	9	✓	✓		✓	✓	✓					
Los Angeles, USA	15	6	12	✓	✓	✓	✓	✓	✓					
Shenzhen, PR China	15	23	15	✓	✓	✓	✓	✓	✓					
Ulaanbaatar, Mongolia	15	1	18	✓	✓	✓	✓	✓	✓	✓				
Chengdu, PR China	14	24	25	✓	✓	✓	✓	✓	✓					
Nanjing, PR China	11	19	24	✓	✓	✓	✓	✓	✓					
Hanoi, Vietnam	10	20	19	✓	✓	✓	✓	✓	✓					
Jakarta, Indonesia	9	21	11	✓	✓	✓	✓	✓	✓					
Kathmandu, Nepal	7	13	14	✓	✓								✓	✓
Dacca, Bangladesh	3	25	13	✓	✓	✓	✓	✓	✓					
Colombo, Sri Lanka	2	8	3	✓	✓	✓	✓	✓	✓	✓				

- Prior to 2012, PR China's national ambient air quality monitoring network covered only 113 key cities with 661 state-controlled sites monitored PM₁₀, SO₂, and NO₂.
- In 2021, the number of state-controlled monitoring sites for ambient air quality in 339 cities of PR China was 1734, monitoring PM_{2.5}, PM₁₀, O₃, SO₂, NO₂ and CO.

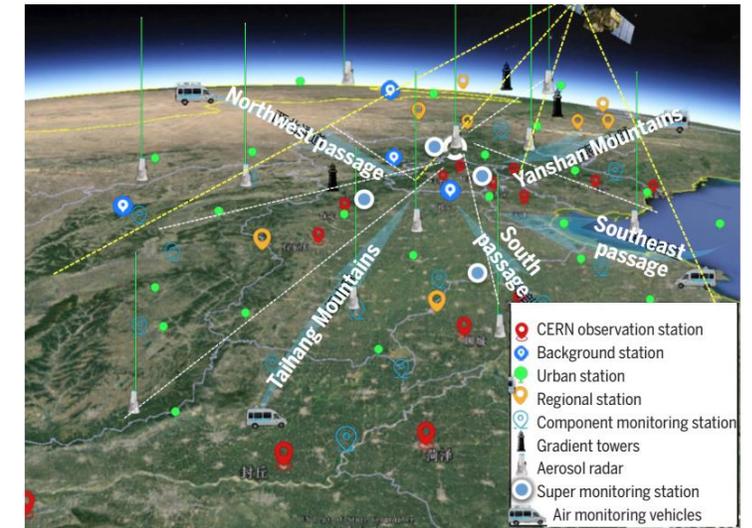
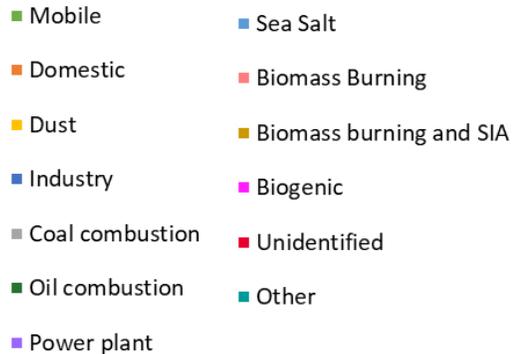
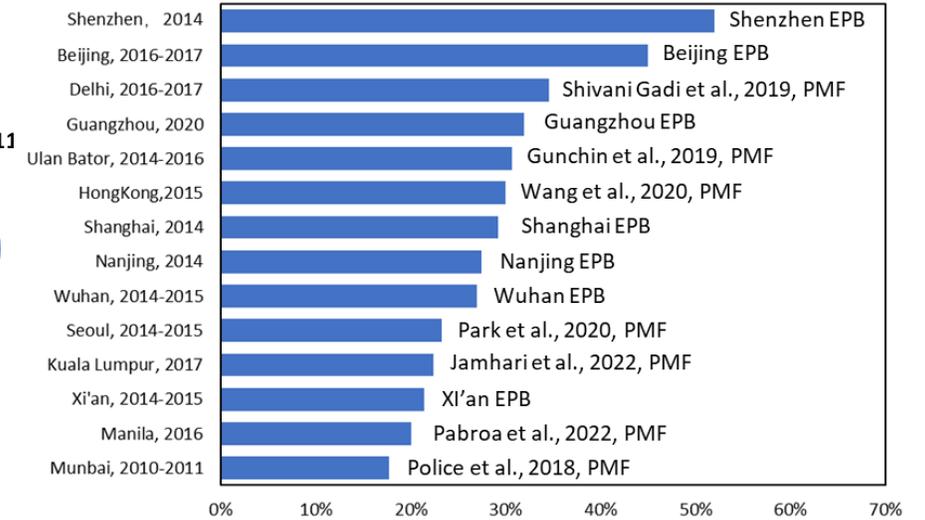
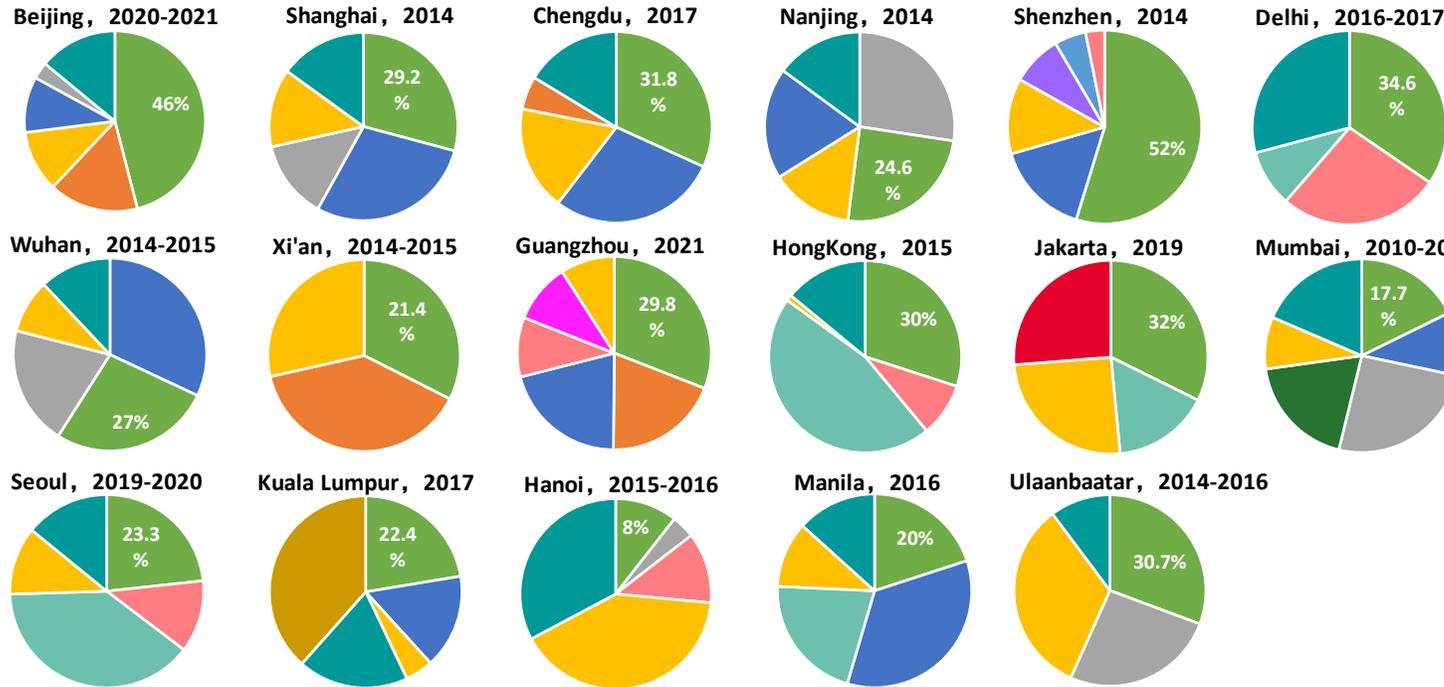


Figure Integrated ground-air-space stereo observation network in BTH 2+26 cities

Source: CRAES, 2021

交通是大城市PM_{2.5}污染的首要贡献来源

Transport is the primary contributor to PM_{2.5} pollution in mega cities



Source apportionment study results published in the recent years,
Source: Compiled by Philip Hopke, 2022

- The average contribution of mobile sources to PM_{2.5} in major Asian cities is about 30%.
- **Transport sector is the main contributor to PM_{2.5} in most mega cities**, including Chinese cities such as Beijing, Shanghai, Chengdu and Shenzhen, as well as Delhi and Jakarta, with the highest ratio over 50% for Shenzhen.

交通排放标准“起步慢、进展快”，快速跃升至先进水平

PR China upgraded the automobile emission standards to most stringent levels

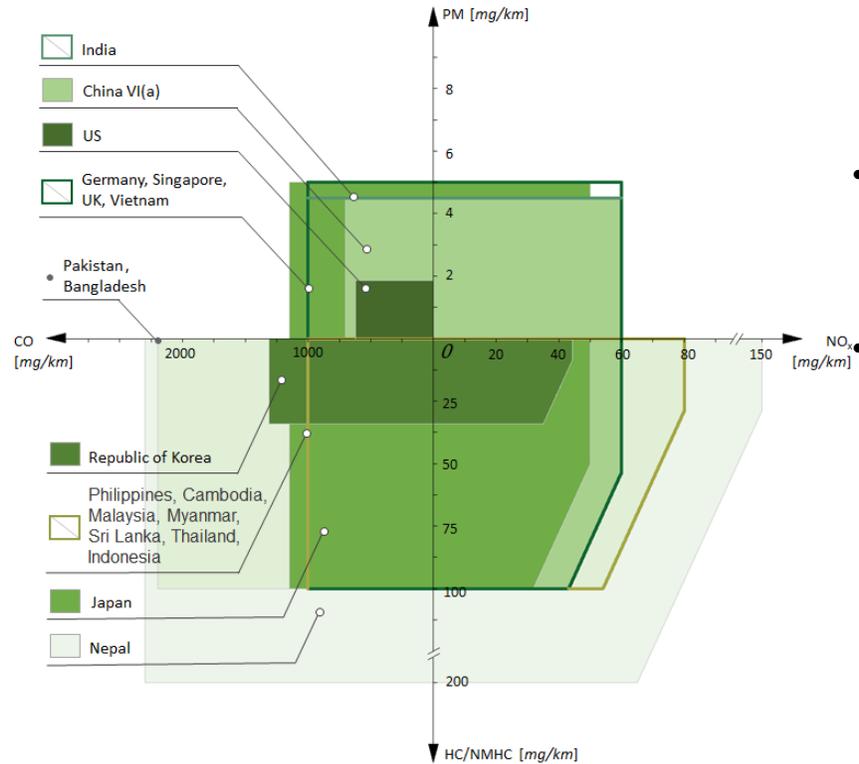


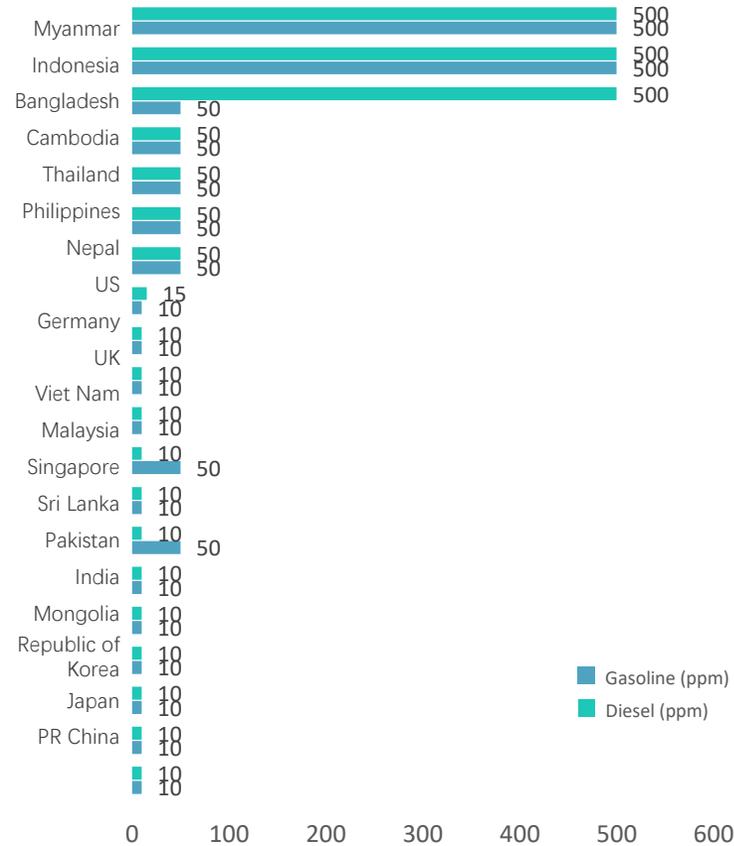
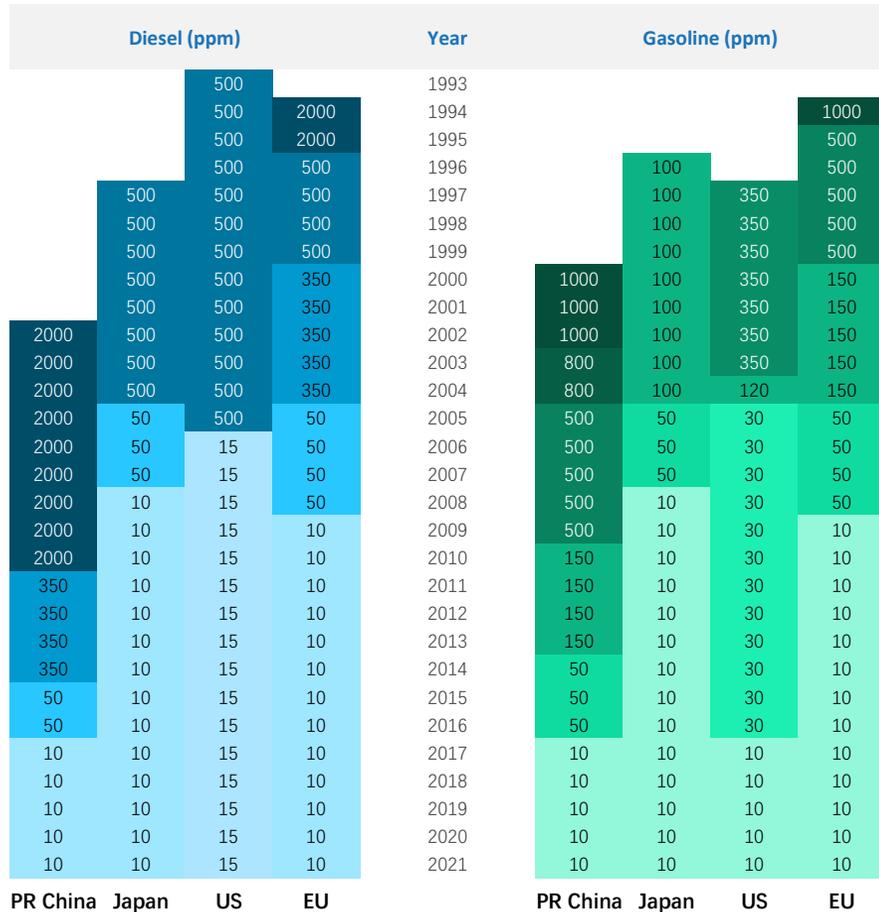
Figure Current Emission Limits for Light-Duty Vehicles in Some Countries and Regions (Gasoline Passenger Cars)

Source : see report references for details

- Compared to Europe, Japan, and the US, PR China had a late start in the emission control of motor vehicles. The implementation time for setting the same level of limits for light-duty vehicles was 5-8 years behind that of the EU. However, in the last 10 years, PR China has raised its emission standards quickly. Comparing CHINA 6b with CHINA 1, the limits for CO and HC+NO_x have become stricter by 82% and 91%, respectively. **PR China has reached the global advanced level of light-duty vehicles emission control.**

燃油快速实现“低硫化”，已达全球领先水平

PR China upgraded the fuel quality standards to most stringent levels



- In recent years, PR China has rapidly progressed in tightening its fuel sulfur content. **In 2017, both its diesel and gasoline sulfur contents decreased to 10 ppm.**
- There is a marked difference in fuel sulfur content among Asian countries, ranging from 10–500 ppm. PR China, India, Japan, the Republic of Korea, and Singapore have implemented the most stringent motor vehicle emission standards and stringent fuel standards at the same time.

Figure Timeline of the Tightening of Sulfur Content in Automobile Fuel in PR China, the EU, Japan, and the US

Source : see report references for details

Figure Current Gasoline and Diesel Sulfur Content Limits in Various Countries

Source : see report references for details

中国电力行业排放控制力度空前，排放标准全球最严

PR China upgraded the emission control standards of coal-fired power plants to most stringent levels

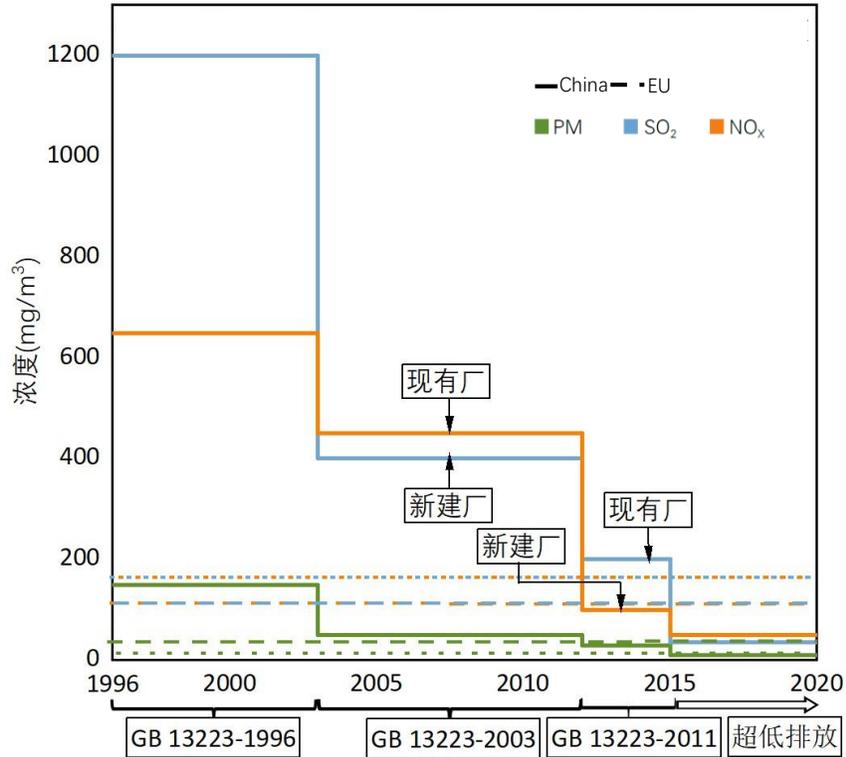


Figure Cause of Upgrades for the Power Sector's Emission Standards in PR China
Source: see report references for details

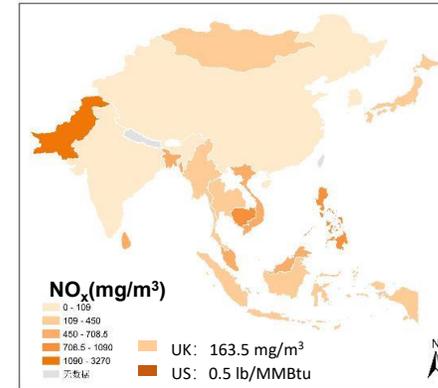
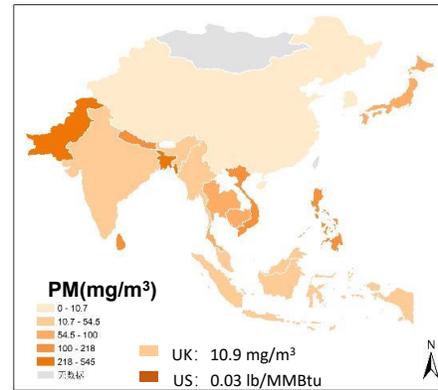
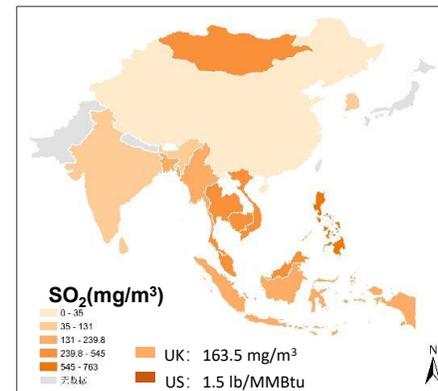


Figure Emission Standards of the Power Sector in Various Countries

Source: see report references for details



- Over the past 30 years, the emission control of air pollutants in PR China's power sector has developed rapidly, with the standards constantly being upgraded and tightened. **Under the ultra-low emission policy requirements, the current emission limits of PM, SO₂, and NO_x are 10, 35, and 50mg/m³, respectively, which are stricter than the original standard limits in 1996 (by 93%, 97%, and 92%, respectively).**
- The emission limits of SO₂ and NO_x are 1/5 and 1/3 of the European Union (EU) standard, respectively.

大气污染物排放总量与单位GDP排放趋势

Emission reduction of key air pollutants

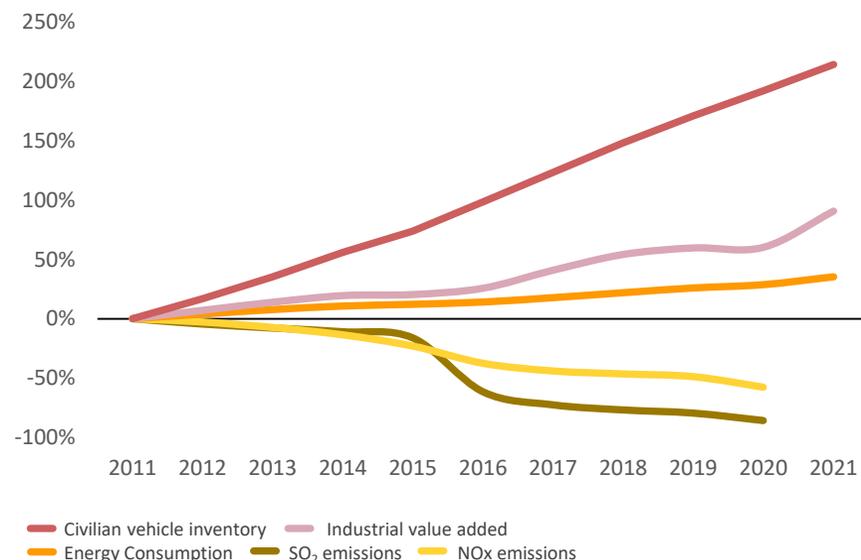
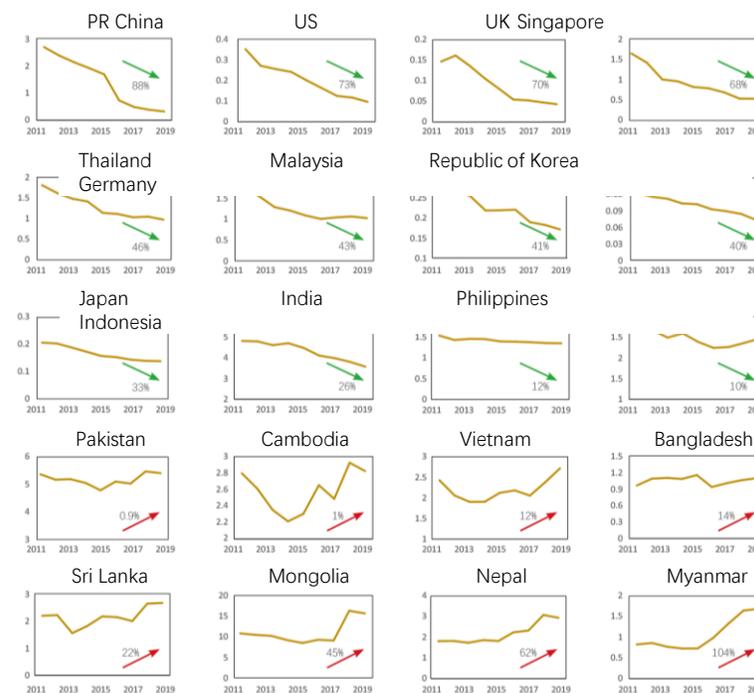


Figure Changes in PR China's Industrial Value Added, Energy Consumption Inventory, Civilian Vehicle Inventory, and Air Pollutant Emission, 2011-2021

Source: China Statistical Yearbook, 2012-2022



Unit: kg/1,000 (2015 USD)

Figure Changes in SO₂ Emission per Unit of GDP of Various Countries, 2011-2019

Source: Community Emissions Data System (CEDS), World Development Indicators

- PR China's energy consumption, industrial value added, and the number of vehicle had a steady growth of 35%, 91%, and 214%, respectively.
- **PR China's emissions of SO₂ and NO_x, both major air pollutants, rapidly declined.** SO₂ emission decreased by 86%, from 22.179 million tons to 3.182 million tons, while NO_x emission decreased by 58%, from 24.043 million tons to 10.197 million tons.
- From 2011–2019, **SO₂ emission per unit of GDP in PR China dropped by 88%.**

亚洲迈向脱碳目标，将为清洁空气提供动能

Decarbonization of Asia will bring driving forces and co-benefits to clean air

- As the world moves towards carbon neutrality and net-zero emission, many Asian countries have announced their decarbonization goals. Moving towards "carbon neutrality" will provide momentum for continuous improvement of air quality and fundamentally solve the air pollution problem.
- However, approximately 1/3 of the world's energy consumption and 1/2 of the world's CO₂ emission comes from Asia, making the task of emission reduction for developing Asian countries challenging.
- PR China has promised to achieve carbon neutrality from peak CO₂ emissions in about 30 years, much shorter than that promised by developed countries.

Country	2020 CO ₂ emissions (million tons)	Year	Goal
 China	11,680.4	2060	Carbon neutral
 US	4,535.3	2050	Net zero
 India	2,411.7	2070	Net zero
 Japan	1,061.8	2050	Net zero
 Germany	636.9	2045	GHG neutral
 Republic of Korea	621.5	2050	Net zero
 Indonesia	568.3	2060	Net zero
 Vietnam	321.9	2050	Net zero
 UK	313.7	2050	Net zero
 Malaysia	262.2	2050	Carbon neutral
 Thailand	255.5	2050	Net zero
 Pakistan	217.0	2050	Net zero
 Philippines	139.2		
 Bangladesh	108.5		
 Singapore	56.1	2050	Net zero
 Mongolia	38.2		
 Myanmar	37.7	2050	Net zero
 Sri Lanka	23.7	2060	Carbon neutral
 Nepal	17.9	2045	Net zero
 Cambodia	15.8	2050	Net zero

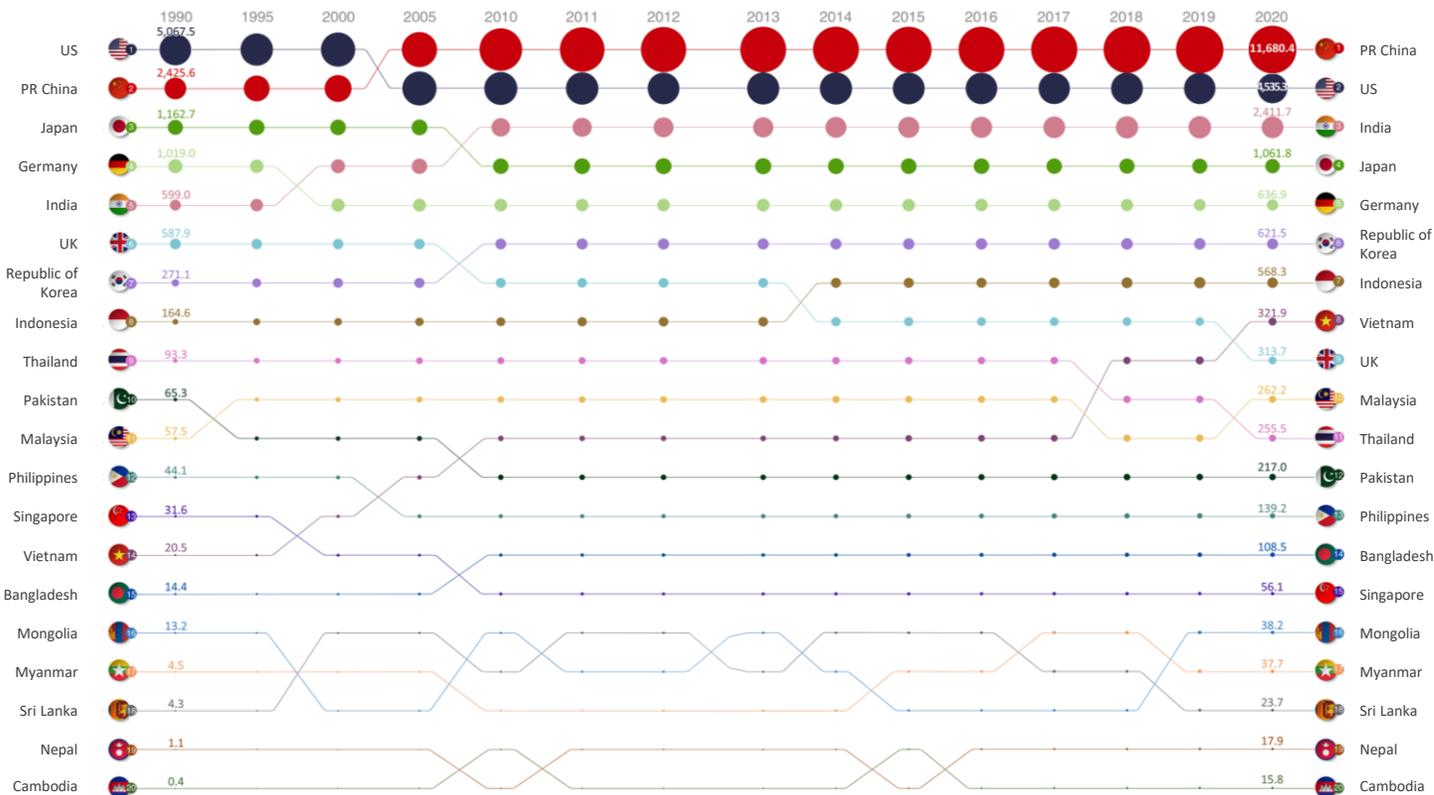
Figure Carbon Reduction Goals of Various Countries

Note: Empty cells mean that the country haven't announced carbon neutral or net zero related goal.

Source: Zerotracker

中国碳排放总量大于其它亚洲国家总和，近十年增速放缓

PR China contributed major CO₂ emission of Asia, a slowing-down appeared in the last decade



• Figure CO₂ Emissions and Ranking by Country, 1990-2020

- Unit: million tons
- Source: Emissions Database for Global Atmospheric Research

- Germany, Japan, the UK, and the US have achieved peak CO₂ emissions, while **Asian developing countries including PR China are still “climbing the hill.”**
- Over the past 10 years, PR China has taken various climate change mitigation actions to control greenhouse gas emissions, **slowing down the growth rate of carbon emission.**
- However, PR China has ranked as the highest emitter globally since 2015. Currently, PR China accounts for one-third of global CO₂ emissions, exceeding the sum of all other Asian countries.

中国碳排放强度十年降幅超1/3，排放结构电力为主

PR China's carbon emission per unit GDP has dropped more than 1/3 in the last decade

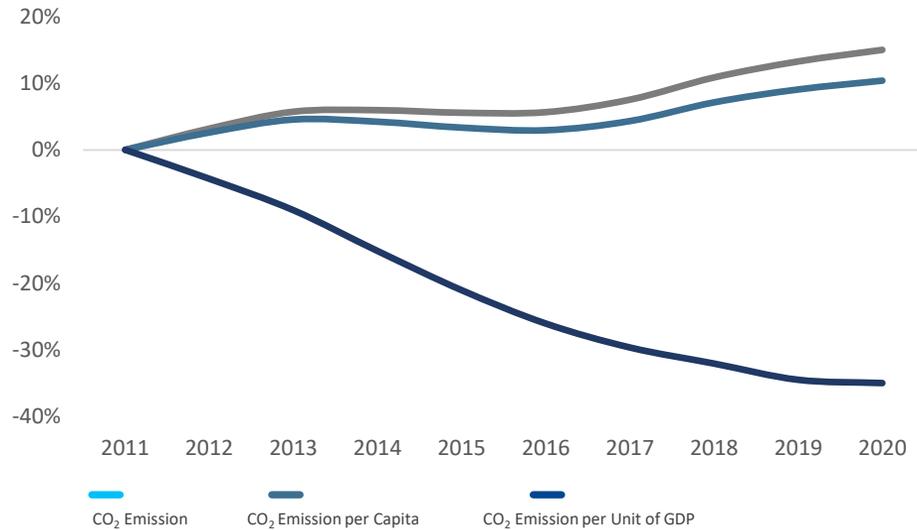


Figure Changes in PR China's CO₂ Emission, Emission per Capita, and Emission per Unit of GDP, 2011-2020

Source: Emissions Database for Global Atmospheric Research

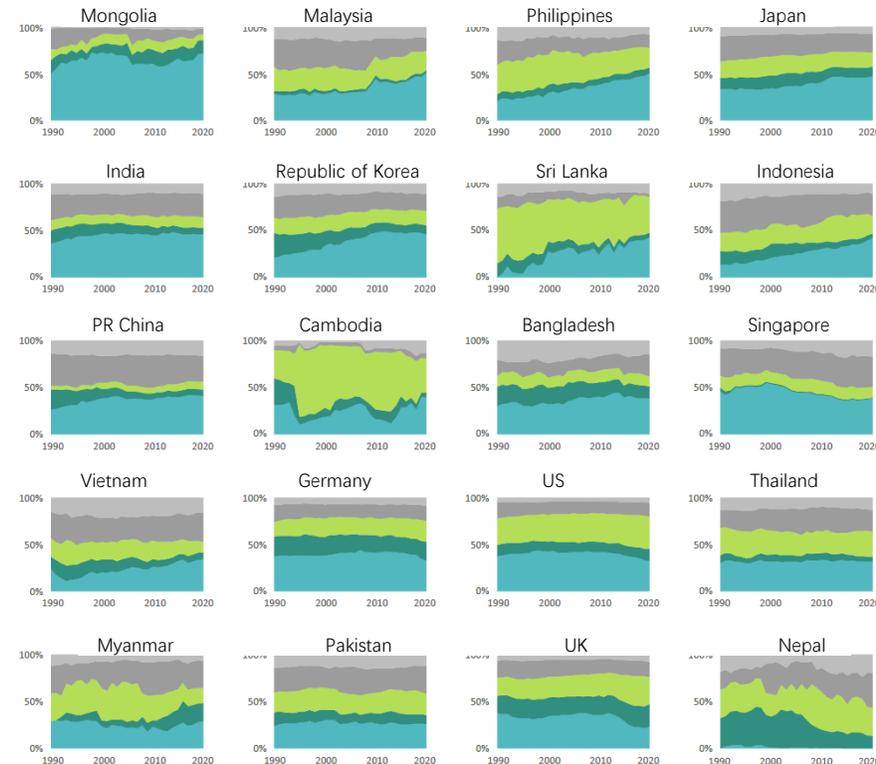


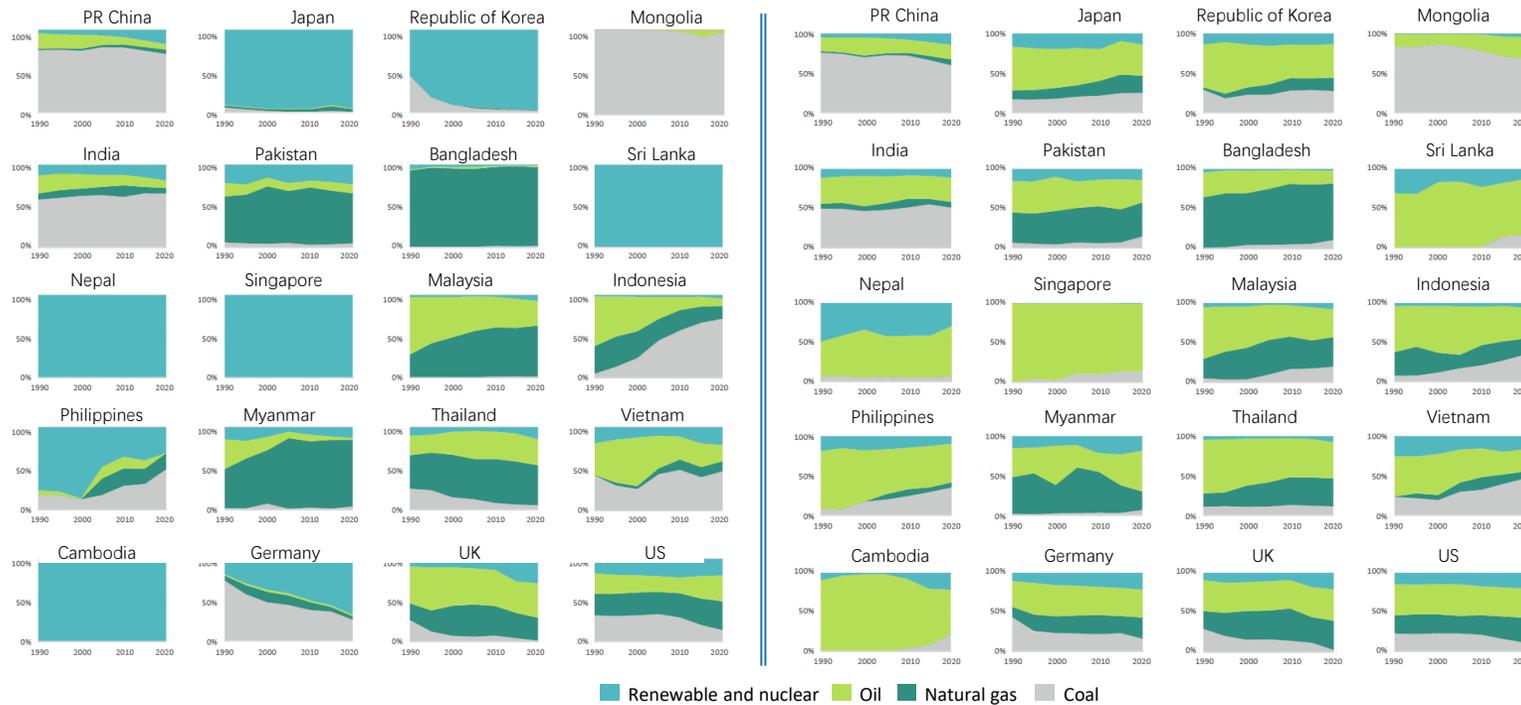
Figure Changes in CO₂ Emission Structure by Sector in Various Countries, 1990-2020

Source: Emissions Database for Global Atmospheric Research

- From 2011–2020, following rapid economic development and an increase in energy consumption, PR China's total CO₂ emission continued to increase. Meanwhile, PR China is gradually moving from an “intensive” economic development model to a greener development model, with **CO₂ emission per unit of GDP decreasing by 34.4% in 2020 compared to 2011.**
- Currently, power and industry are the highest carbon-emitting sectors in PR China, accounting for nearly 70% of the country's total emissions. The transportation sector will be the key sector to peak in the last, and face more difficulties to achieve carbon neutrality.

亚洲国家化石能源依赖度较高，中国煤炭消费比重仍超过一半

Fossil fuel is the main energy for Asia, coal still domains energy consumption and production in PR China



- Compared with typical countries in Europe and America, which gradually shift to a cleaner and more balanced energy structure, most Asian countries have a higher dependence on fossil energy.
- Because of PR China's "rich in coal, lacking in oil, and short in gas" resource endowment characteristics, **coal holds an important position in its energy production and consumption, but its proportion is gradually declining.**

Figure Changes in the Energy Production Structure of Various Countries, 1990-2019
Source: U.S. Energy Information Administration

Figure Changes in the Energy Consumption Structure of Various Countries, 1990-2019
Source: U.S. Energy Information Administration

中国是机动车保有量最大国，并成为新能源车市场主力

With the largest population of vehicles, PR China has become the major market of EVs



Unit: 10,000 Figure Automobile Population and Ranking of Various Countries, 2005-2020

Source: see report references for details

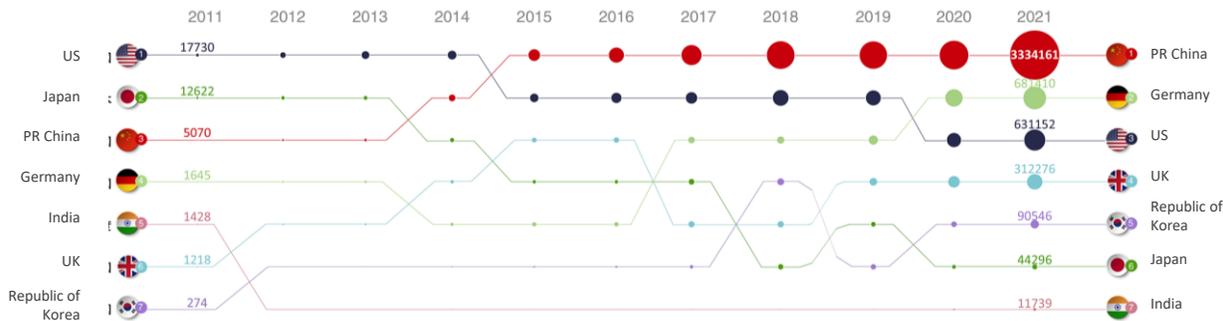


Figure Sales of Electric Vehicles and Ranking by Country, 2011 -2021

Source: see report references for details

Notes: "Electric Vehicles" refers to battery electric vehicles and plug-in hybrid electric vehicles

- PR China is the world's largest country in terms of new car sales and ownership. Since 2015, **PR China has become the world's largest electric passenger car market, accounting for half of the global market.**
- In 2011–2021, the average compound annual growth rate of electric passenger cars in PR China reached 91.3%, significantly higher than the overall global growth rate. In PR China, electric passenger car sales accounted for about 15.5% of overall passenger vehicle sales, exceeding the global average.

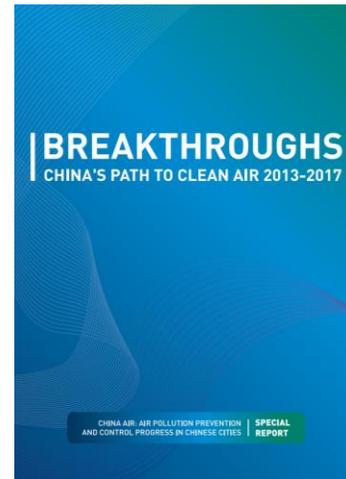
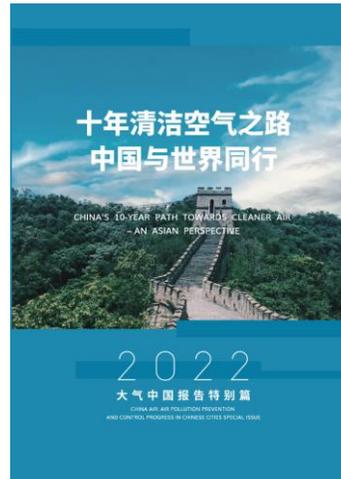
Call for Collaboration

Tackle the Air Pollution & Climate Change Challenges Together in Asia

- PR China has achieved rapid air quality improvement in the past decade through science-based management, comprehensive measures and advanced standards etc.
- Currently, the end-of-pipe control measures are very strict, further emission reduction need to be done through a shift to cleaner structure of energy, transport and industries.
- Moving towards "carbon neutrality" will provide momentum for continuous improvement of air quality and synergies between clean air action and climate change mitigation.
- PR China's experience will be useful for developing countries facing with similar challenges to combat air pollution and climate change together.

By taking a comprehensive approach that combines research, collaboration, capacity building, and advocacy, as a regional consortium, we aim to play a crucial role in facilitating the effective sharing of experiences from PR China to other Asian countries.

Reports



Contact Us

Address: Suite 3-41, JianGuoMenWai Diplomatic Residence
Compound, No.1 XiuShui Street, ChaoYang District, Beijing,
China,

Email: china@cleanairasia.org

Tel: +86 10 85326172

Web: www.cleanairasia.org (EN) www.allaboutair.cn (CN)

