Advancing a health-driven synergistic approach to address air pollution and climate change challenges based on scientific evidence

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Why ARCH (AiR-Climate-Health)

The Intersecting Health Impacts of Air Pollution and Climate Change

7.9 million

deaths caused by air pollution globally in 2021

Source: HEI & IHME, State of Global Air 2025

3.3 to 3.6 billion

people live in contexts that are highly vulnerable to climate change

Source: Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6)

Air pollution has emerged as the second leading risk factor for death worldwide

In 2023, air pollution contributed to **7.9 million deaths** — about 1 in 8 deaths worldwide. **Low- and middle-income countries** face the largest burden.

In 2023, dementia attributable to air pollution resulted in 626,000 deaths and 11.6 million healthy years of life lost.

95%
of deaths in adults over the age of 60 are due to noncommunicable diseases.

1 in 2 chronic obstructive pulmonary disease (COPD) deaths

1 in 4 heart disease deaths

More than **1 in 4** dementia deaths

Nearly **1 in 6** diabetes deaths

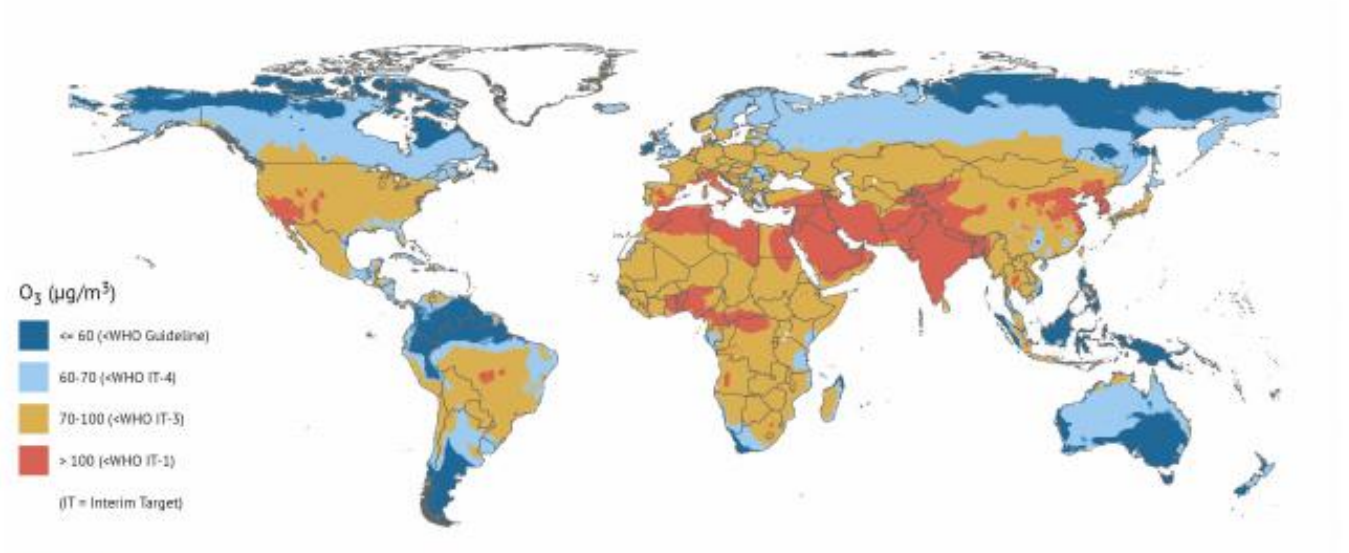


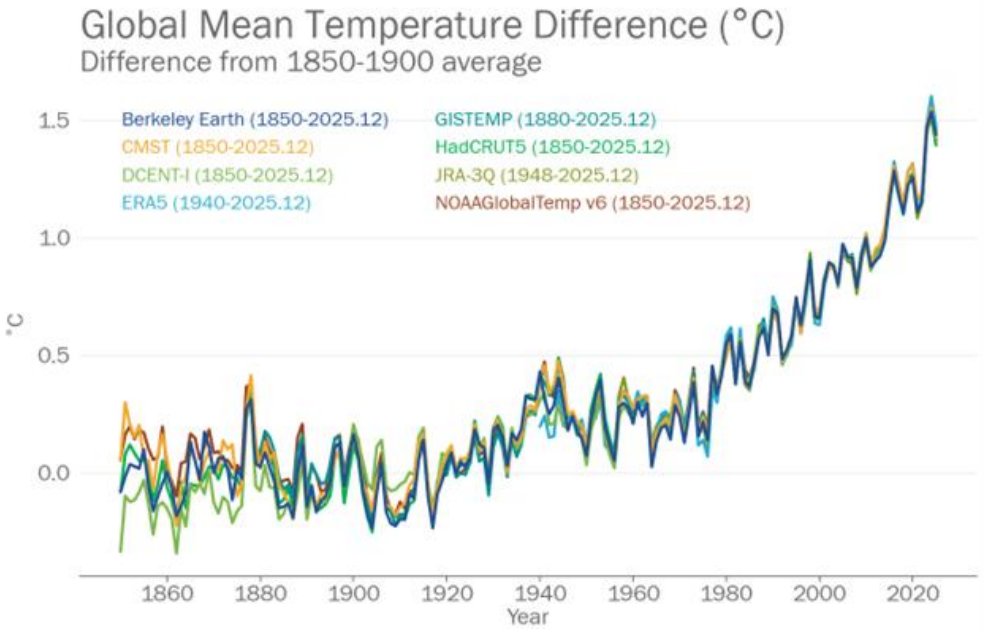
FIGURE 5: **Global map of national population-weighted average seasonal 8-hour daily maximum ozone concentrations in 2020 relative to the WHO Guideline and Interim Targets.**

State of Global Air 2025

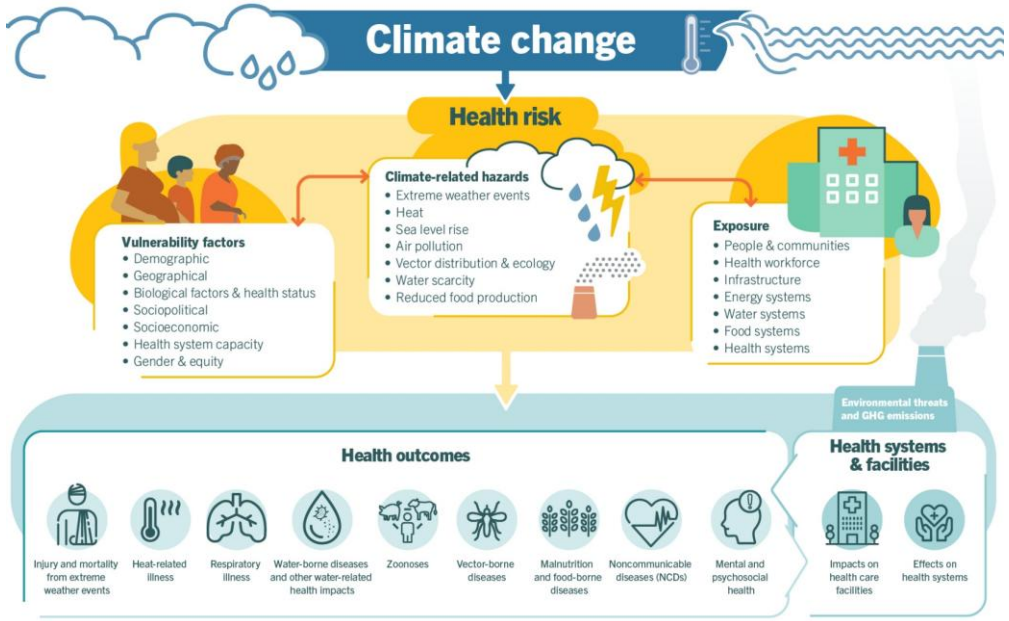
Climate risks are appearing faster and will become more severe

2025 was one of the three warmest years on record, while **2024** marked **the first calendar year to exceed 1.5 ℃** above pre-industrial levels.

Climate change is impacting health in a myriad of ways, and these climate-sensitive health risks are **disproportionately felt by the most vulnerable and disadvantaged**, including women, children, poor communities, and those with underlying health conditions.

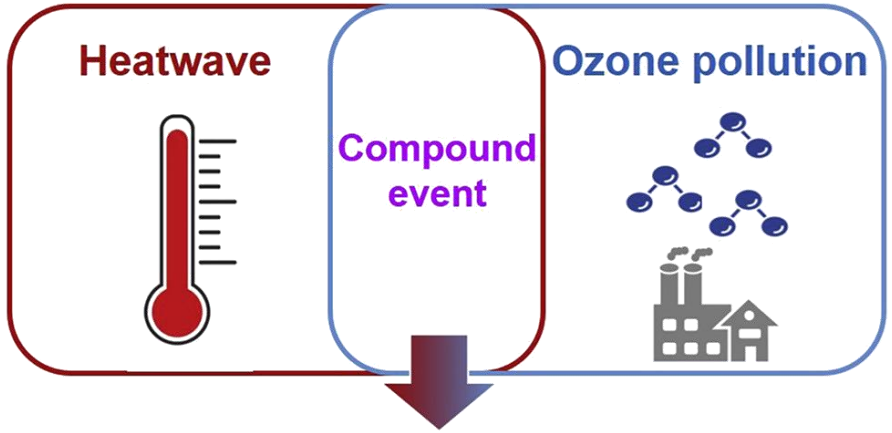


Annual global mean temperature anomalies relative to the 1850-1900 average (WMO)

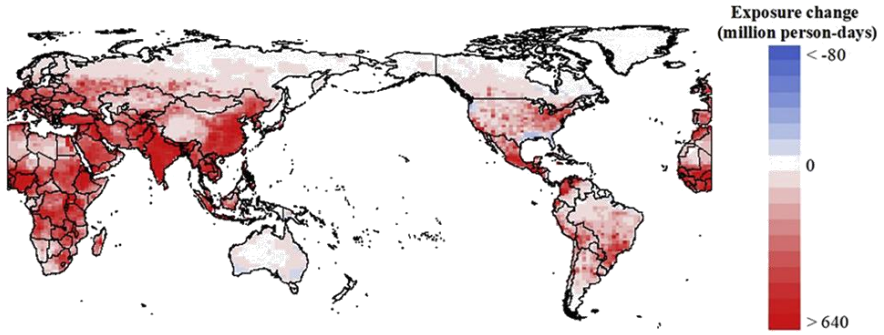


An overview of climate-sensitive health risks, their exposure pathways and vulnerability factors (WHO)

Climate change is exacerbating air pollution issues

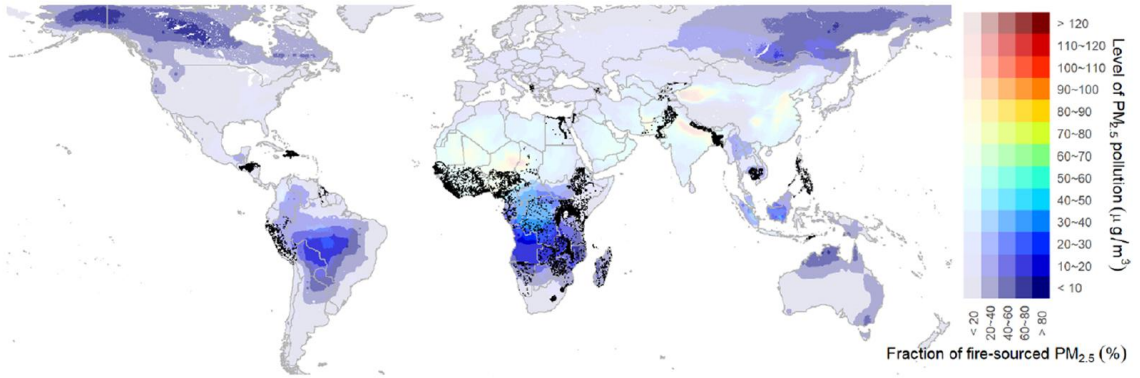


Future changes of compound event exposure in 2080s under SSP3-7.0 scenario (compared to 1995-2014)



Ban et al., ***One Earth***, 2022

- **Synergistic effects of compound events:** heatwave + ozone → greater health risk
- **Cascade consequences of climate change:** heat + draught → wildfire → high PM (BC) exposure

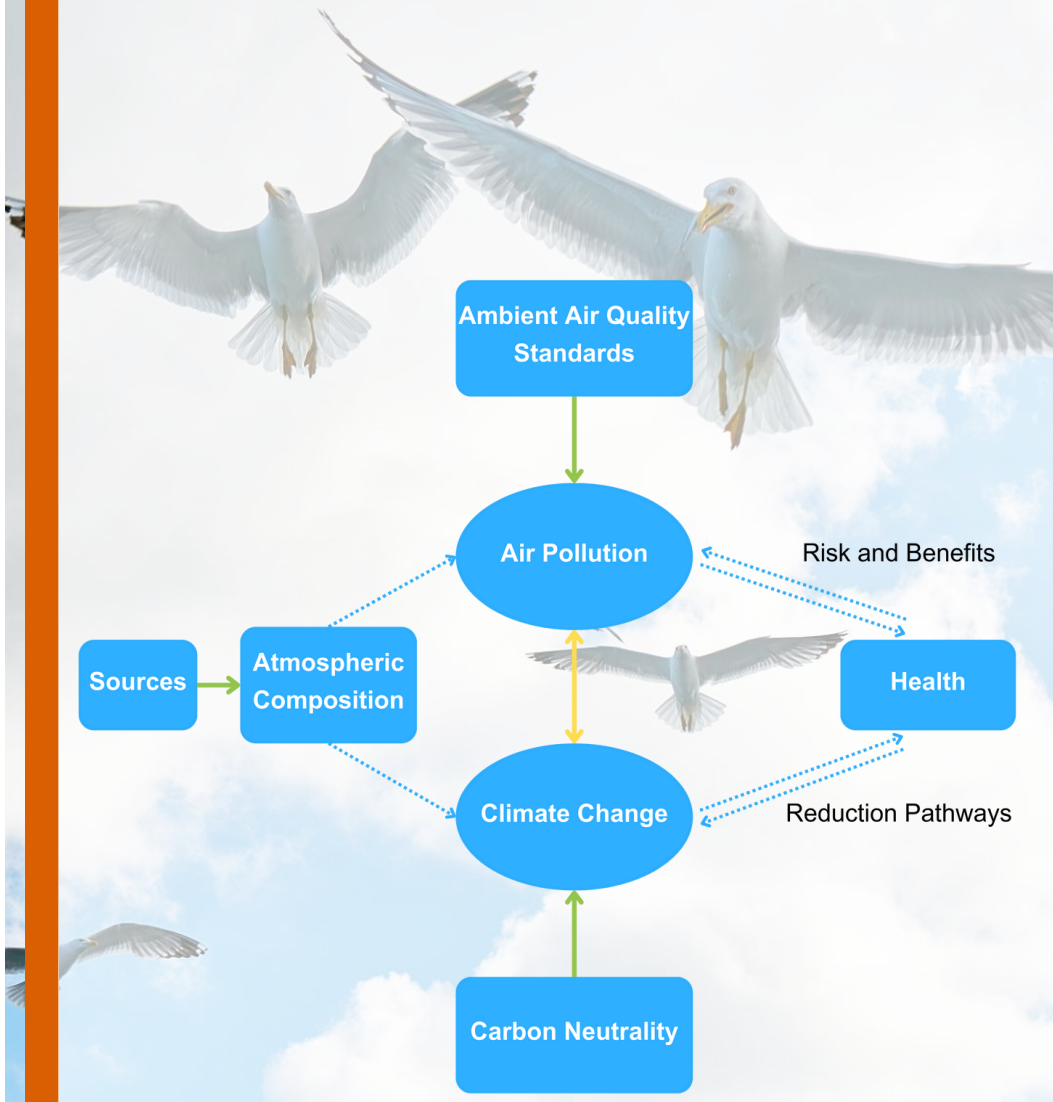


Li et al., ***EI***, 2023

Why ARCH?

- Air pollution and climate change are **two of the biggest threats** to the health of people around the world
- Air pollution, climate change, and health are deeply **interconnected**
- **Human health risks,** especially for people with underlying **vulnerabilities** and adverse medical conditions, are more easily affected by the impacts from climate change, extreme weather, and environmental conditions

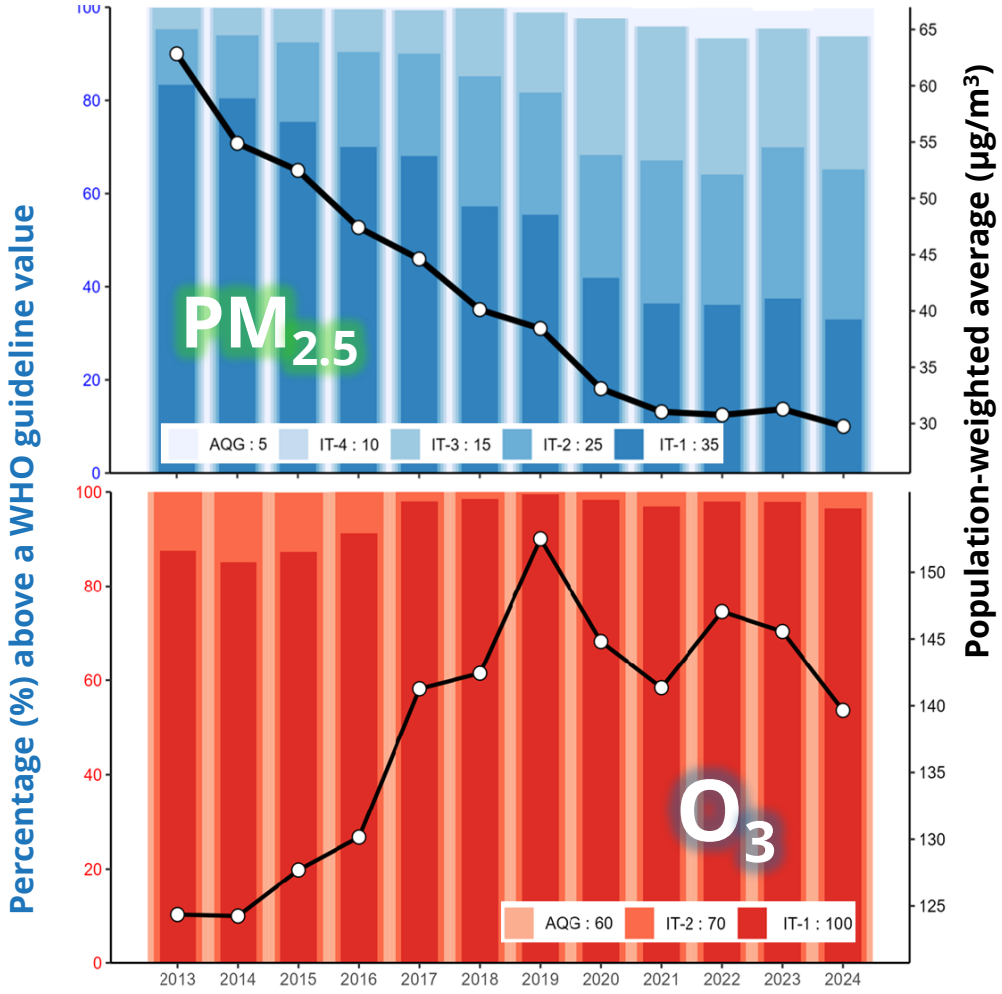
ARCH is promoting for the public interface of the joint activities to provide reliable information, up-to-date technologies, and resources on health, climate, and environmental research.



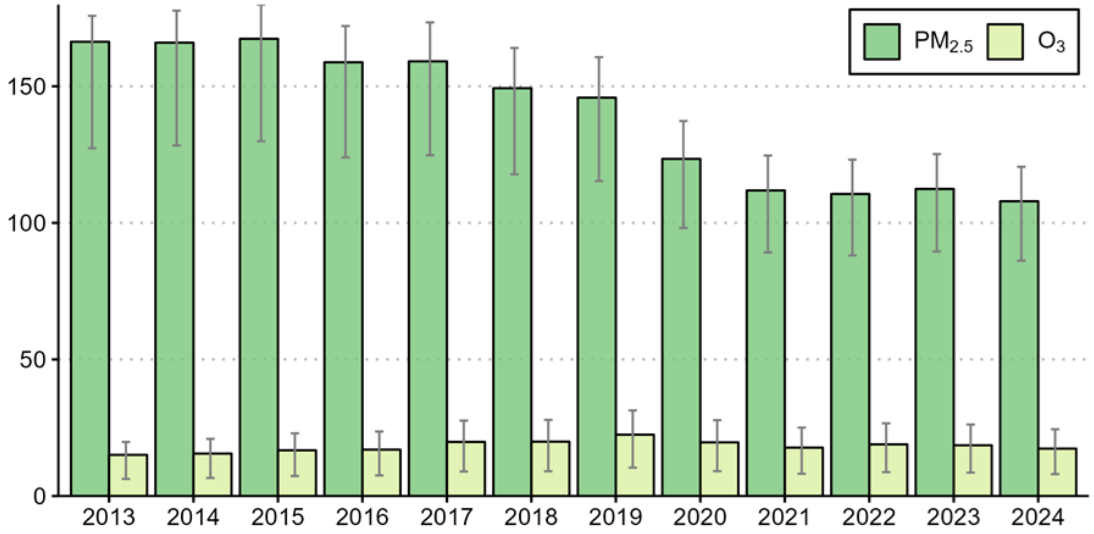
Air Pollution - Climate Change - Health Effects Nexus Framework

Air-Climate-Health Nexus: Bridging Science and Policy in PR China

Improvements in PR China's air quality yield significant health benefits



- Deaths attributable to **$PM_{2.5}$** decreased from **1.66 million in 2013** to **1.08 million in 2024**
- **O_3**-attributable deaths rose from 150,000 to a peak of **220,000 in 2019,** subsequently falling to **170,000 in 2024**

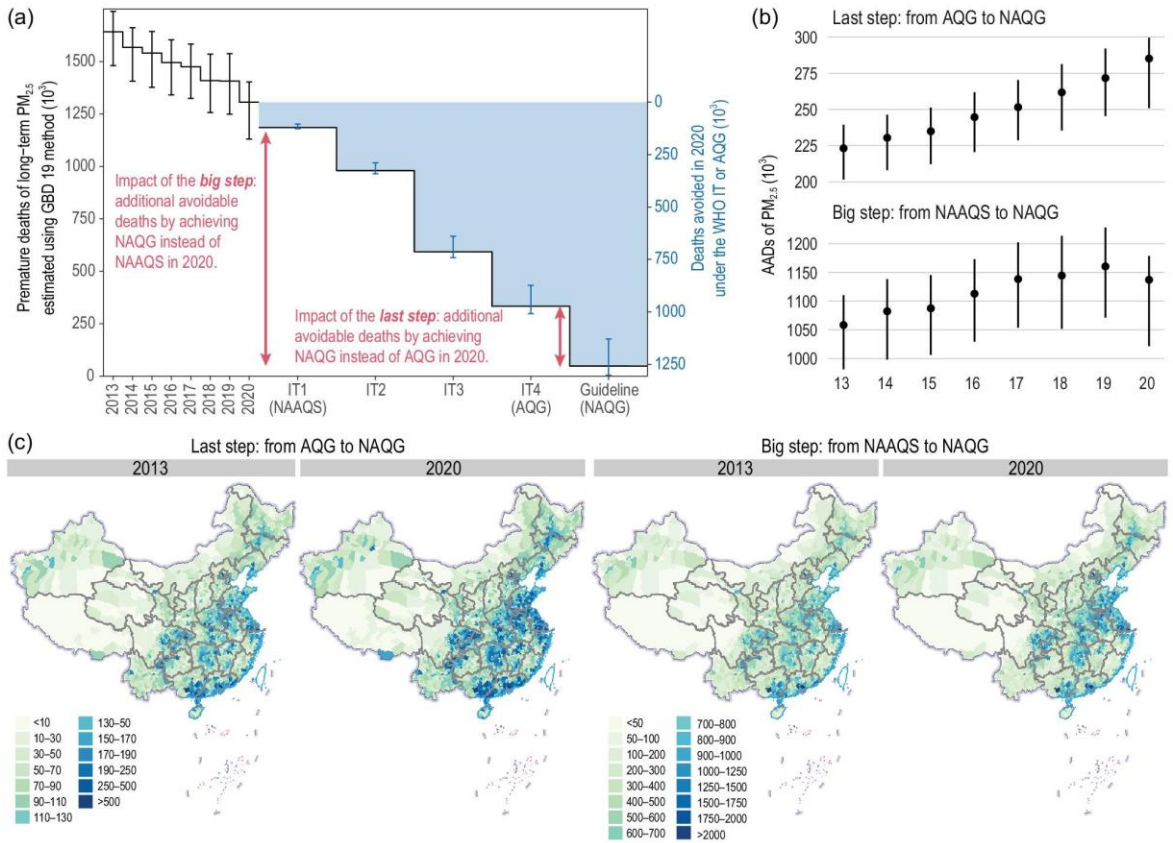


ARCH-CAA Joint report: Health benefits from clean air actions of PR China 2025

Achieving WHO 2021 Air Quality Guidelines will deliver considerable health benefits in PR China

Based on 2020 data for long-term $PM_{2.5}$ exposure, going from achieving the 2005 AQGs to achieving the 2021 AQGs would prevent an **additional 285,000 premature deaths annually** in PR China.

Pollutant	Averaging Time	China NAAQS		2005 AQG	2021 AQG
		Primary	Secondary		
$PM_{2.5}$ (μg/m³)	Annual	15	35	10	5
	24-hour	35	75	25	15
PM_{10} (μg/m³)	Annual	40	79	20	15
	24-hour	50	150	50	45
O_3 (μg/m³)	Peak season	–	–	–	60
	8-hour	100	160	100	100
NO_2 (μg/m³)	Annual	40	40	40	10
	24-hour	80	80	–	25
SO_2 (μg/m³)	24-hour	50	150	20	40
CO (mg/m³)	24-hour	4	4	–	4



Zhu et al., ***Chinese Science Bulletin***, 2022

Xue et al., ***National Sci Rev,*** 2022

New National Ambient Air Quality Standards (NAAQS) in PR China

Key proposed amendments include:

- **tightening the $PM_{2.5}$ annual average concentration limits to 10 μg/m³ (Grade I) and 25 μg/m³ (Grade II);**
- tightening PM_{10} annual limits to 20 μg/m³ (Grade I) and 50 μg/m³ (Grade II);
- aligning the SO_2 secondary limit with its Grade I limit;
- lowering both the annual and 24-hour average NO_2 concentration limits.

关于发布国家生态环境质量标准《环境空气质量标准》的公告

为贯彻《中华人民共和国环境保护法》和《中华人民共和国大气污染防治法》，保护和改善生态环境，保障公众健康，现批准《环境空气质量标准》为国家生态环境质量标准，并由生态环境部与市场监管总局联合发布。

标准的名称、编号如下：

《环境空气质量标准》（GB 3095—2026）。

依据有关法律规定，以上标准具有强制执行效力。

以上标准自2026年3月1日起实施。自以上标准实施之日起，《环境空气质量标准》（GB 3095—2012）及其修改单废止。

以上标准内容可在生态环境部网站（http://www.mee.gov.cn）查询。

特此公告。

(此公告业经国家市场监督管理总局邓志勇会签)

生态环境部

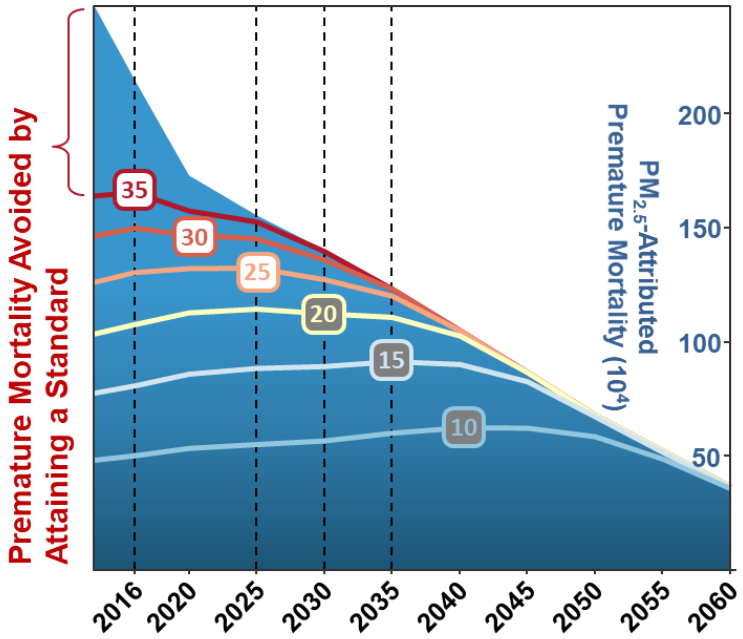
2026年2月13日

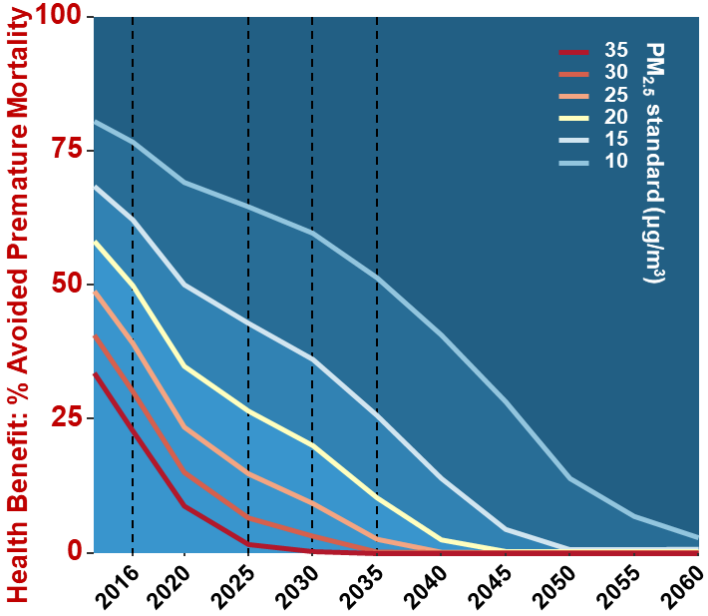
序号	污染物项目	平均时间	过渡阶段浓度限值		浓度限值		单位
			一级	二级	一级	二级	
1	二氧化硫（SO_2）	年平均	20	60	20	20	μg/m³
		日平均	50	150	50	50	
		1 小时平均	150	500	150	150	
2	二氧化氮（NO_2）	年平均	40	40	30	30	
		日平均	80	80	50	50	
		1 小时平均	200	200	200	200	
3	一氧化碳（CO）	日平均	4	4	4	4	mg/m³
		1 小时平均	10	10	10	10	
4	臭氧（O_3）	日最大 8 小时平均	100	160	100	160	μg/m³
		1 小时平均	160	200	160	200	
5	颗粒物（粒径小于等于 10 μm，PM_{10}）	年平均	40	60	20	50	
		日平均	50	120	50	100	
6	颗粒物（粒径小于等于 2.5 μm，$PM_{2.5}$）	年平均	15	30	10	25	
		日平均	35	60	25	50	

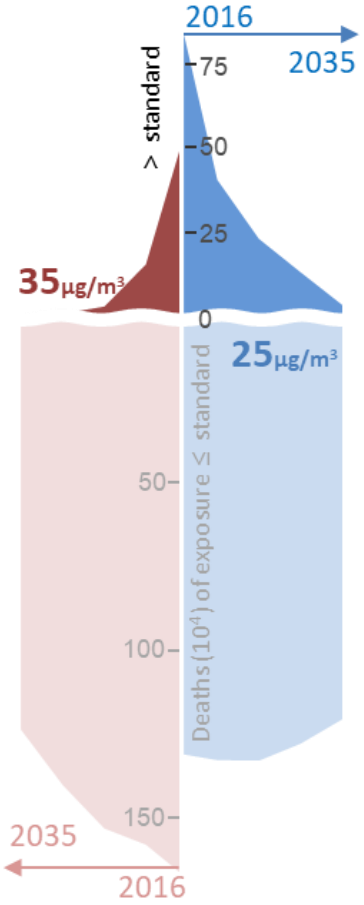
Ministry of Ecology and Environment of PR China, 2026

Health benefits of new NAAQS under carbon-zero pathway

- Effectiveness of the current 35 μg/m³ standard is fading as air quality improves, with the non-attainment population projected to drop from 69% (2016) to 5% (2030), under the carbon-zero pathway.
- Tightening standards is essential to bring **"hidden" health risks,** premature deaths occurring below the current standard, into the scope of active administrative management.







Unpublished data under peer review

Cost-benefit analysis of new NAAQS: early action and more strengthened standards implies more benefits

The net benefit of achieving an annual average $PM_{2.5}$ concentration of **20μg/m³ in 2030** is **2.4 and 3.9 times** that of achieving **20μg/m³ in 2035** and **25μg/m³ in 2035** respectively, based on a CGE analysis, which considering the health benefits and impact on macro economy.

Zhang et al., 2025

Cost and Health Benefit Analysis under Different NAAQS Revision Scenarios (Unit: 100 million RMB)

	S35–25	S35–20	S30–25	S30–20
Year 2030 (Annual)				
Economic Cost	3547	7608	6293	12952
Engineering Cost	3029	5482	4699	9398
Health Benefits	2815	6263	10308	19939
Net Benefit	-732	-1345	4016	6986
Year 2030 (Cumulative)				
Economic Cost	12692	27593	22712	46956
Engineering Cost	12116	21929	18797	37593
Health Benefits	5913	13233	20604	41309
Net Benefit	-6779	-14360	-2108	-5648
Year 2035 (Annual)				
Economic Cost	7103	14666	8643	16482
Engineering Cost	5193	9398	4699	9398
Health Benefits	14756	28535	14756	28535
Net Benefit	7653	13869	6113	12053
Year 2035 (Cumulative)				
Economic Cost	41163	87096	61869	123911
Engineering Cost	33752	61089	42292	84584
Health Benefits	52089	104556	85312	166441
Net Benefit	10927	17460	23444	42530

Cost-benefit analysis of new NAAQS: early action and more strengthened standards implies more benefits

The **health benefits** accounts for **0.8%-3.6% of GDP** for various scenarios, which also demonstrate early action and more strengthen standards implies more benefits.

Accumulated health benefits (illness and premature death) during 2024-2035

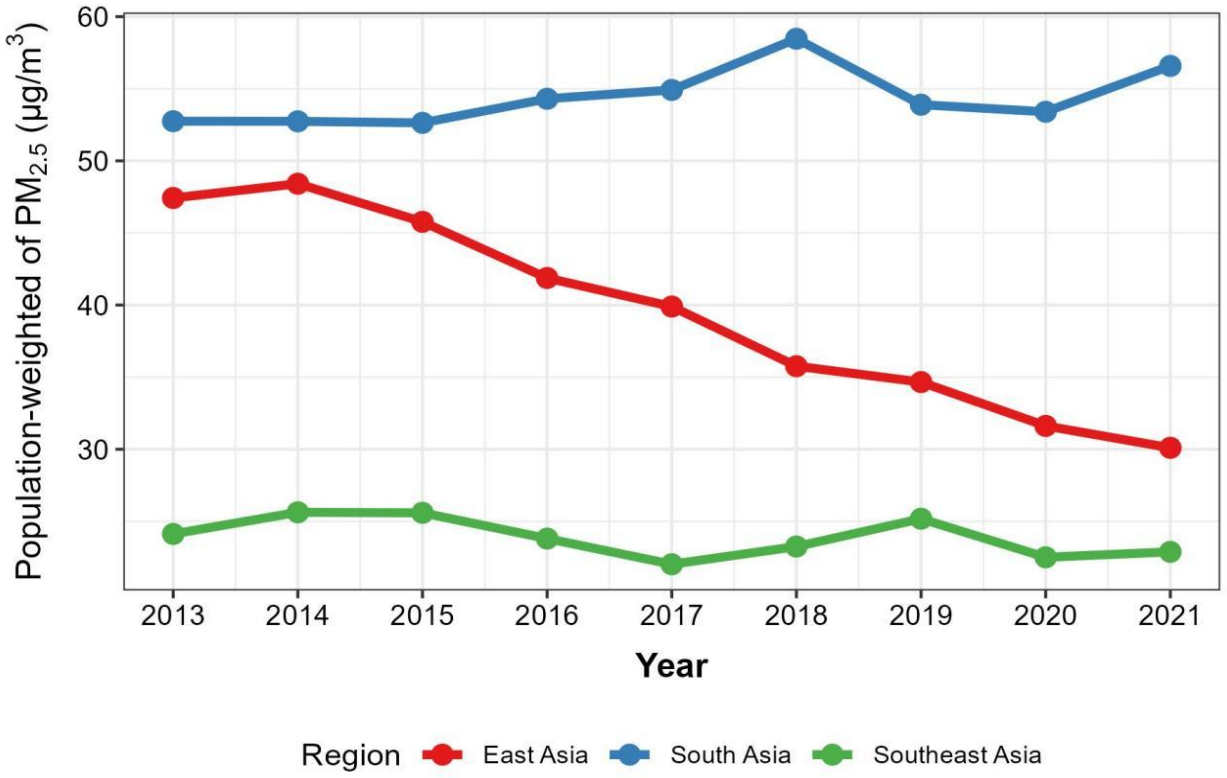
scenario	Varies compliance Scenaria		Low range: VSL Trillion RMB	Health benefits as a percentage of GDP
2030-25μg/m³	M1	National wide	29-34	1.5%-1.8%
	M2	5 years late for JJJ and Fenwei	25-30	1.3%-1.6%
	M3	5 years late for JJJ	26-31	1.4%-1.6%
2035-25μg/m³	M4	National wide	17-21	0.9%-1.1%
	M5	5 years late for JJJ and Fenwei	15-18	0.8%-0.9%
	M6	5 years late for JJJ	16-19	0.8%-1.0%
2030-20μg/m³	M7	National wide	57-69	3.0%-3.6%
	M8	5 years late for JJJ and Fenwei	51-61	2.7%-3.2%
	M9	5 years late for JJJ	53-63	2.8%-3.3%
2035-20μg/m³	M10	National wide	35-42	1.8%-2.2%
	M11	5 years late for JJJ and Fenwei	33-40	1.7%-2.1%
	M12	5 years late for JJJ	34-40	1.8%-2.1%

Zhang et al., 2025

Opportunities and Prospects in the Asia-Pacific Region

Air Pollution and Health Effects in the Asian Region: By Emission Sectors

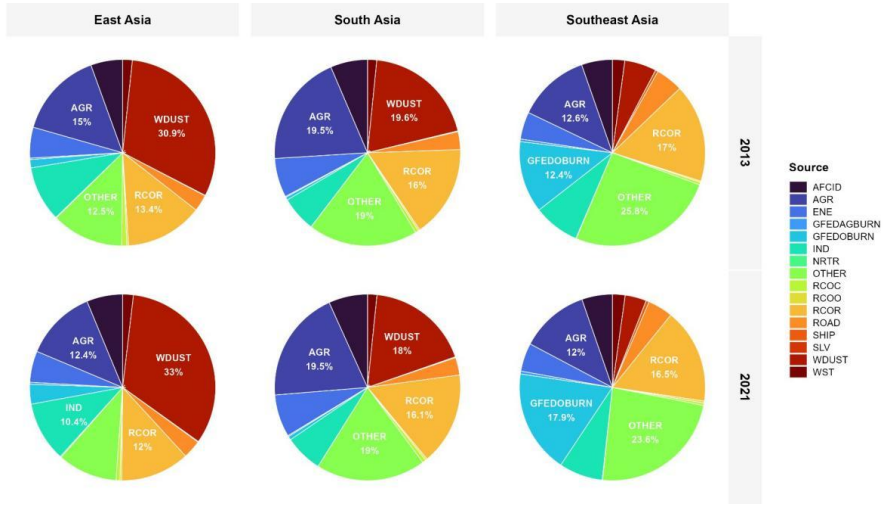
While **East Asia** achieved **significant improvements** in air quality, **South Asia** experienced **a worsening crisis.**

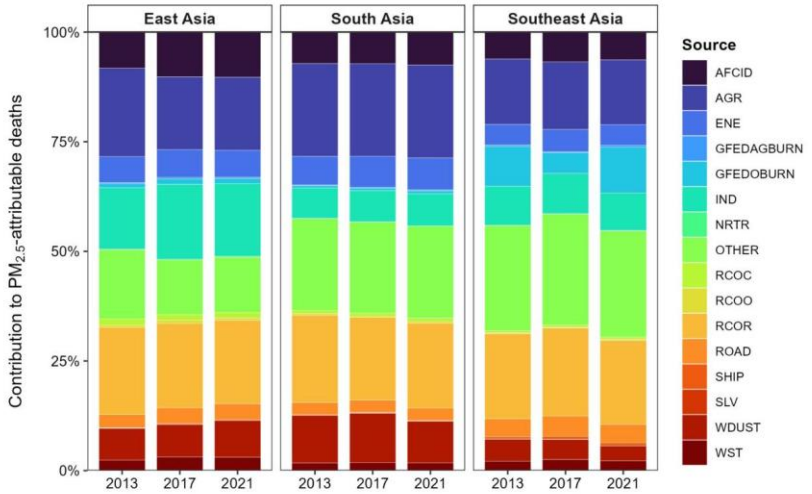


Air Pollution and Health Effects in the Asian Region: By Emission Sectors (cont'd)

The dominant drivers of **$PM_{2.5}$ pollution** vary significantly by geography, necessitating region-specific policies.

- **East Asia:** The burden is distributed across **agriculture (AGR), residential combustion (RCOR),** and **industry (IND),** with natural **windblown dust (WDUST)** being a major mass contributor.
- **South Asia:** The mortality burden is heavily concentrated in **agriculture** and **residential combustion,** which together account for **~ 40%** of attributable deaths.
- **Southeast Asia:** This region is uniquely characterized by the significant and volatile role of **open biomass burning (GFEDOBURN),** which accounted for **18%** of $PM_{2.5}$ mass.





WHO urges bold commitments to protect public health

In March 2025, **the WHO 2nd Global Conference on Air Pollution and Health** is calling on all stakeholders to pledge voluntary actions to achieve in countries a:

50% reduction in the health impacts of air pollution by 2040

Credits: Andrea Puentes/Presidencia de la República

World Health Organization

Executive Board
156th session

Provisional agenda item 21 — EB156/24

27 January 2025

Updated road map for an enhanced global response to the adverse health effects of air pollution

Report by the Director-General

Background

1. Following the establishment of the first Road map for an enhanced global response to the adverse health impacts of air pollution[1] in response to resolution WHA68.8 (2015), this draft road map updates the previous version and proposes a voluntary target to address the health impacts of air pollution[2] from 2025 to 2030. It aligns with WHO's Fourteenth General Programme of Work (GPW 14) by including actions proposed to meet the GPW 14 call for promoting low-carbon societies and a primary healthcare approach to tackling the critical environmental determinants of health and mitigating climate change. From March to July 2024, the WHO Secretariat met with Member States via briefings and consultations to report on implementing the first Road map and gather feedback.

Target and timeline for draft road map implementation

2. The overall target of this draft road map is for countries to achieve a 50% reduction in the population-attributable fraction of mortality from anthropogenic sources of air pollution by 2040, relative to 2015 baseline values.[3]

3. Acknowledging countries' different baselines and contexts, the target proposed for the draft road map is relative in order to ensure that countries progress towards clean air.

4. All actions highlighted should be immediately initiated and integrated into policy and programmatic decision-making processes by 2030. Progress towards this target should be reviewed and updated in 2030 to align with new global development agreements and climate goals.

[1] See document WHA69/18 and decision WHA69(11) (2016).

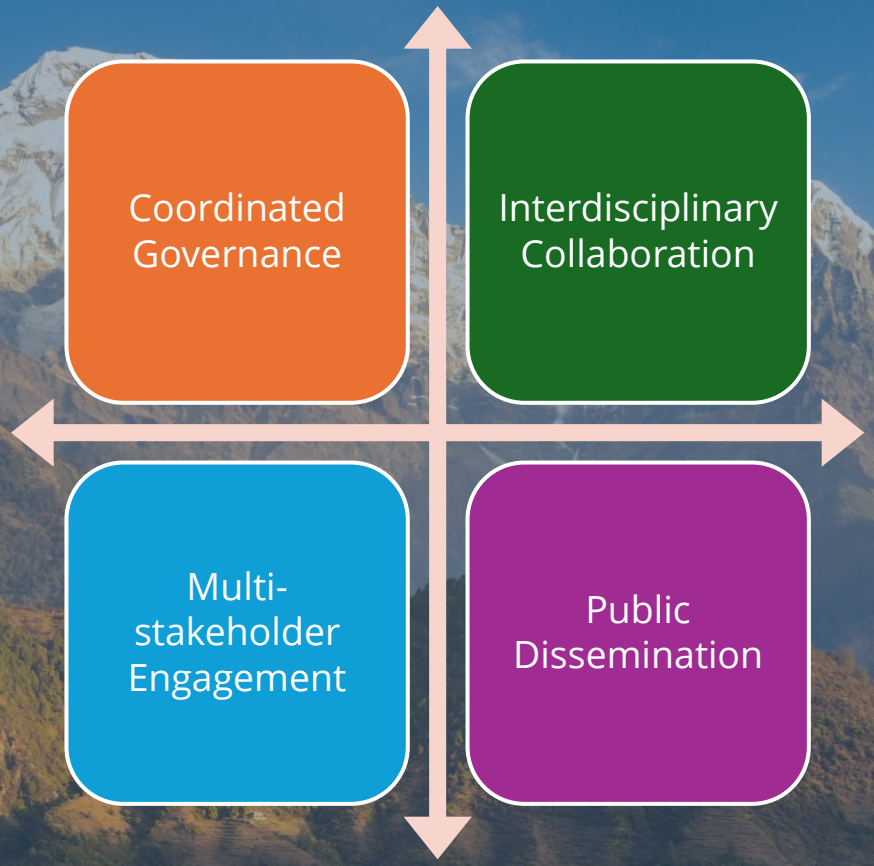
[2] See WHO Air pollution data portal (accessed 2 October 2024).

[3] Those countries already achieving WHO guideline interim target 4 (IT-4) should continue making progress towards the WHO guidelines value, as the 50% target may not be attainable in this time frame.

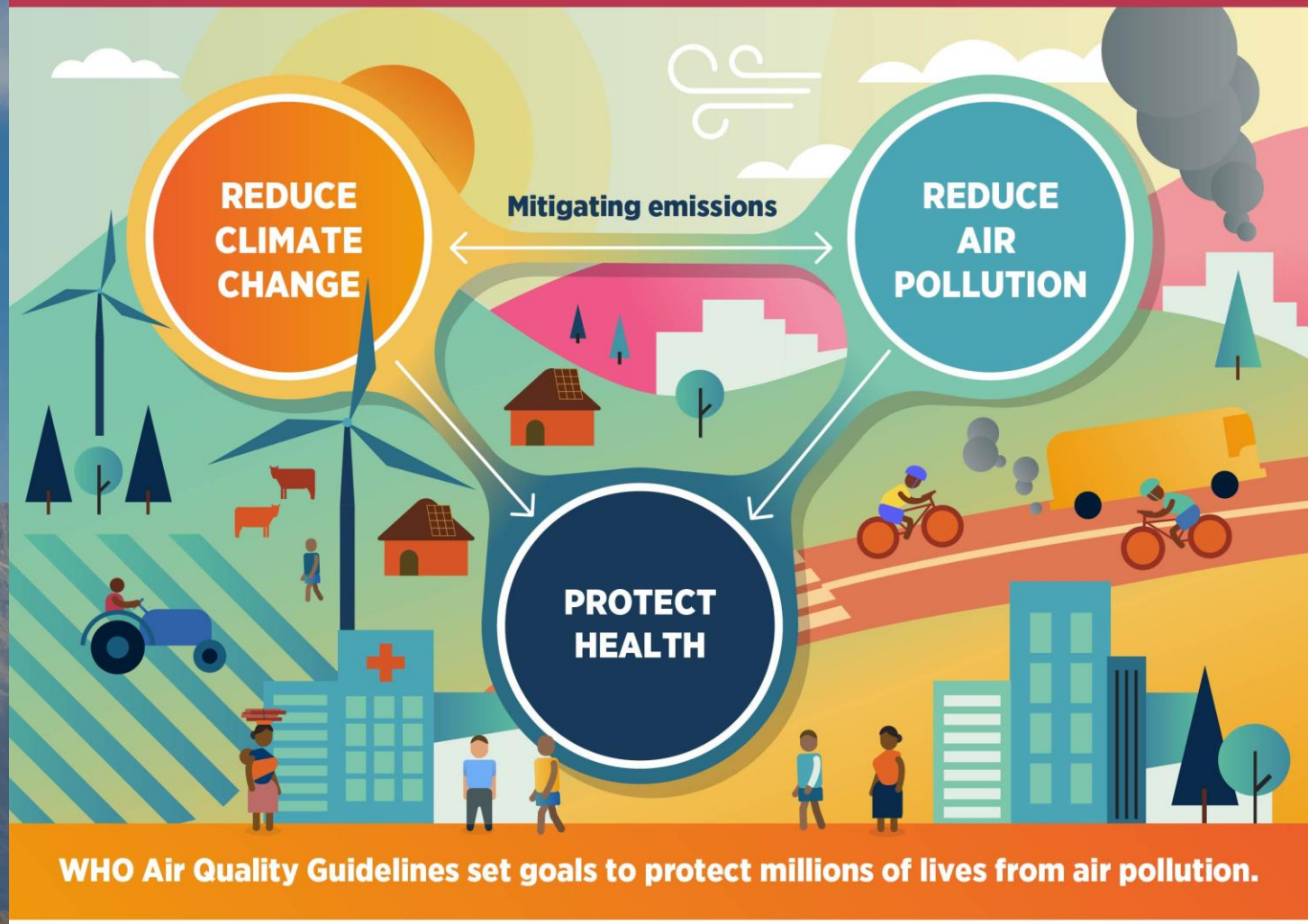
Future Research & Collaboration

- Population dynamics, socio-economic and health futures
- Resilience and security futures in times of polycrises
- Navigating overshoot
- Urbanization and better built environment
- Regenerative economy and sustainable biosphere management
- Systems analysis in the age of social and technological disruptions
- Building common ground for a just and sustainable world
- Science diplomacy as a bridge

ARCH: Triple wins for clean air, climate stabilization and public health



REDUCING AIR POLLUTION AND MITIGATING CLIMATE CHANGE, TOGETHER HELP TO PROTECT OUR HEALTH



CLEAN AIR FOR HEALTH #AirPollution World Health Organization

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References

Scan QR code for more information:

Towards Clean Air in China: Revising Air Quality Standards for a Healthier Future

Air-Climate-Health Nexus Indicators

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Thank you for listening!

For any questions, feel free to reach out to
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