Air Quality and Climate Change in Asia: Making Co-Benefits Work

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Air pollution in Asia continues to impact public health and damage agricultural productivity, tourism, and historic buildings, even as Asia's air quality seems to be improving. Further control is needed, as Asian cities struggle to meet air quality standards and the recommended guideline values of the World Health Organization,[1] while also being pressured to address climate change by reducing their greenhouse gas (GHG) emissions.

Bangkok skyline on a hot and hazy day.

An optimal strategy to decrease air pollution can have co-benefits in mitigating climate change. A co-benefits approach actively integrates air quality management with climate change management—which is critical to addressing both issues. There are several reasons for applying a co-benefits approach. For one, both air pollutants and GHGs are emitted from fuel combustion in transport, power generation and industry, and from biomass burning; therefore, solutions, whether policy or technological, often overlap through energy and fuel efficiency (see Figure 1).

Moreover, air pollutants can significantly affect climate both positively and negatively.[2] Recent scientific studies confirm that large co-benefits are achieved in controlling short-lived air quality pollutants that also act as climate forcers (i.e., contribute to global warming). In Asia, black carbon is the most important short-lived climate forcer, considered second only to carbon dioxide (CO_2) and more important than methane.[3] The reduction of short-lived pollutants like ozone and black carbon can provide immediate climate benefits, improve local air pollution, and benefit public health (see Table 1).

Actions that reduce airborne particulate matter, such as the adoption of cleaner technologies, fuel switching, and reductions in fuel consumption, can simultaneously reduce a substantial amount of black carbon emissions. Aside from the obvious positive effect on public health, the benefits of co-controlling black carbon also translates in air quality improvement and climate change mitigation.

Black carbon and ozone are not addressed by climate regulatory frameworks such as the Kyoto Protocol, but can be easily integrated in air quality management policies. The Intergovernmental Panel on Climate Change (IPCC) states that integrated policies offer potentially large cost reductions compared to treating pollutants in isolation.[4] In addition, developing countries have limited institutional capacity and financial means to address air pollution and climate change.

In view of the above, the authors of this article advocate

1. An alignment of institutional responsibilities and integrated climate change and air pollution plans and policies;
2. Combined measurement and assessment tools and databases; and
3. Expertise and financing that place climate change and GHGs reduction within the context of sustainable development by explicitly including local development goals.

Policies and Institutions

To make co-benefits work, air quality management and GHG management policies and institutions must be explicitly integrated or aligned, whether at the national, city, or sectoral (i.e., transport, energy, industry) level. Ideally, one institution and one law would cover both types of emissions. The U.S. Environmental Protection Agency (EPA), for instance, regulates CO_2 along with other air pollutants under the U.S. Clean Air Act.

This is not always the case in Asia. For example, in China, climate change issues fall primarily under the mandate of the National Development and Reform Commission, while air quality concerns are largely dealt with by the Ministry of Environmental Protection. This kind of institutional setup requires

__Figure 1.__ Air pollution and GHG emissions co-benefits.

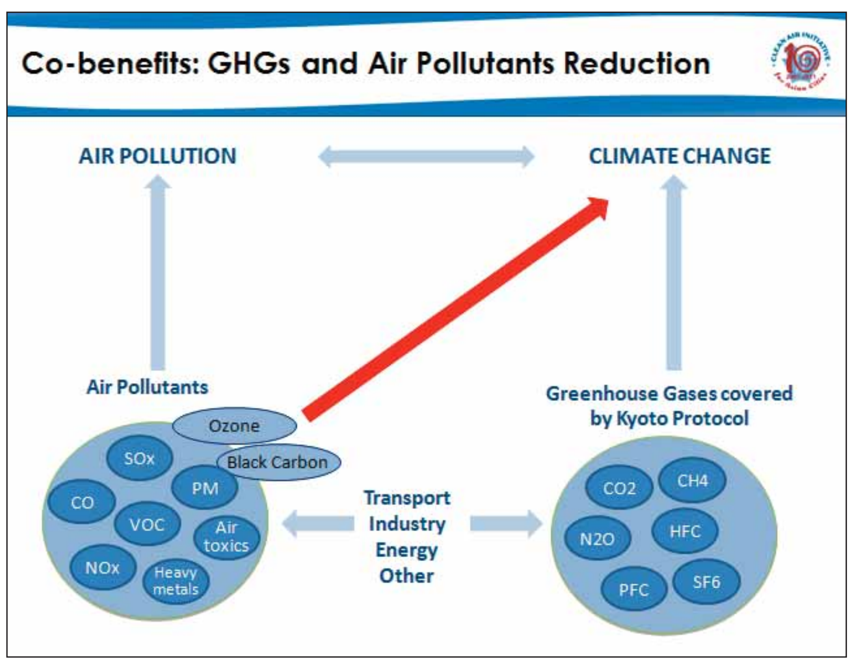

Table 1. Air pollutants that have been identified as important in affecting human health, environment, and climate forcing in Asia.[3]

Impact/Issue/ Feature	Primary Particulate Matter (PM)	Sulfur Dioxide (SO_2)	Oxides of Nitrogen (NO)	Ammonia (NH_3)	Ozone (O_2)
Main anthropogenic sources in Asia	Industrial processes, residential fossil fuel and bio-fuel, transportation and biomass burning	Power plants, industrial combustion and processes, residential fossil fuel and bio-fuel, transportation and biomass burning	Power plants, industrial combustion and processes, residential fossil fuel and bio-fuel, transportation and biomass burning	Agricultural emissions related to intensive animal rearing	Secondary pollutant formed from NO_x, methane (CH_4), VOCs and CO. NO_x: see NO_x VOC: transportation, chemical plants and products, refineries, solvents CH_4: agricultural emissions, coal mining, power plants, landfill, biomass burning CO: biomass burning, power plants, industrial combustion and processes, residential fossil fuel and bio-fuel, transportation
Atmospheric Residence Time	Hours to weeks	SO_2 gas: hours to days sulphate aerosol: days to weeks	NO_2 gas: hours to days nitrate aerosol: days to weeks	NH_3 gas: hours to days ammonium aerosol: days to weeks	Days to months
Climate change effects	**Black Carbon:** *-ve effect* Direct positive radiative forcing*** *-ve effect* Indirect positive radiative forcing through changes in albedo of snow and ice cover** *-ve effect/+ve effect* Semi-direct effects on clouds and precipitation** **Organic Carbon:** *+ve effect* Direct negative radiative forcing** Indirect negative radiative forcing via aerosol-cloud interactions	**Sulphate aerosol (secondary PM):** *+ve effect* Direct negative radiative forcing** *-ve effect/+ve effect* Indirect negative forcing (+ve) and alteration of precipitation patterns (-ve) via aerosol-cloud interactions**	**Nitrate aerosol (secondary PM):** *+ve effect* Direct negative radiative forcing** *-ve effect/+ve effect* Indirect negative forcing (+ve) and alteration of precipitation patterns (-ve) via aerosol-cloud interactions**	**Ammonium aerosol (secondary PM):** *+ve effect* Direct negative radiative forcing** *-ve effect/+ve effect* Indirect negative forcing (+ve) and alteration of precipitation patterns (-ve) via aerosol-cloud interactions**	*-ve effect* Direct positive radiative forcing (third-most important GHG)***
Air pollution effects					
Human health – mortality and morbidity	*-ve effect* Primary PM causing cardio-vascular and respiratory diseases***	*-ve effect* SO_2 and secondary PM (sulphate aerosol) causing cardio-vascular and respiratory diseases***	*-ve effect* NO_2 and secondary PM (nitrate aerosol) causing cardio-vascular and respiratory diseases***	*-ve effect* secondary PM (ammonium aerosol) causing cardio-vascular and respiratory diseases***	*-ve effect* Primary PM causing cardio-vascular and respiratory diseases**
Crop yield	*-ve effect* ABCs reducing light intensity** Dust covering leaves reducing yield**	*-ve effect* SO_2 causing crop damage near point sources*** and SO_2 and sulphate aerosol contributing to acidic deposition***	*-ve effect* NO_2 causing crop damage near point sources*** and NO_2 and nitrate aerosol contributing to acidic deposition***	*-ve effect* ammonium aerosol contributing to acidic deposition***	*-ve effect* O_3 causing crop damage***
Vegetation and soils	*-ve effect* Reduced light intensity lowering growth and carbon sink*	*-ve effect* SO_2 causing vegetation damage near point sources*** and SO_2 and sulphate aerosol contributing to acidic deposition***	*-ve effect* NO_2 causing crop damage near point sources*** and NO_2 and nitrate aerosol contributing to acidic deposition*** *-ve effect* Increased nitrous oxide emissions from soils* *+ve effect* Growth stimulation increasing carbon sink**	*-ve effect* NH_3 gas near point sources** and NO_2 ammonium aerosol contributing to acidic deposition*** *-ve effect* Increased nitrous oxide emissions from soils* *+ve effect* Growth stimulation increasing carbon sink**	*-ve effect* Reduced growth decreasing carbon sink*

*Notes: The sign of the effect (+ve or –ve) denotes whether the pollutant is considered to have a positive or negative impact on the relevant receptor. Stars denote the current level of scientific understanding of effects: ***Good evidence of effects in Asia; **Limited evidence of effects in Asia; *Effects in Asia uncertain (with concern often based on scientific knowledge transferred from Europe/North America.*

close inter-agency coordination to promote development goals that can have both air quality and climate benefits. Other countries have streamlined functions. For example, in 2007, Australia established the Department of Climate Change and Energy Efficiency to manage the overall climate change framework.[5]

At the policy level, India's National Action Plan on Climate Change (NAPCC), released in 2008, specifically states: "the [NAPCC] identifies measures that promote our development objectives, while also yielding co-benefits for addressing climate change effectively."[6] Singapore's National Climate Change Strategy also adopts a co-benefits approach, noting that "it is worthwhile to pursue climate action due to the co-benefits of cleaner air, economic opportunities, energy cost savings, and enhanced energy security."[7]

Tools and Databases

Policy-makers, development agencies, corporations, and other stakeholders require reliable air pollution and GHG emissions data in order to develop policies, projects and measures, and calculate their impact on emissions. Methodologies to measure emissions for CO_2 and air pollutants exist at various levels.

At the national level, GHG inventories are required under the United Nations Framework Convention on Climate Change (UNFCCC). However, this does not include emissions measurements for air pollution. The Corporate Greenhouse Gas Accounting and Reporting Standard, or GHG Protocol,[8] is the most widely used international accounting tool for organizations to understand, quantify, and manage greenhouse gas emissions. The GHG Protocol was developed by the World Resources Institute and the World Business Council for Sustainable Development and focuses on the six main GHG emissions covered by the Kyoto protocol. The Clean Air Initiative for Asian Cities (CAI-Asia) has adapted GHG Protocol[9] to also take air pollutants from energy use into account, recognizing

Table 2. Some of the relevant examples of Asian co-benefit partnerships.

Partnerships	Regional Scope	Year	Focus
Clean Air Initiative for Asian Cities (CAI-Asia) Partnership *Secretariat: CAI-Asia Center*	Asia	2007	Partnership of organizations aimed at promoting better air quality and livable cities by translating knowledge to policies and actions to reduce air pollution and GHG emissions from transport, energy, and other sectors.
Co-Benefits Partnership *Secretariat: IGES*	Asia	2010	Partnership of organizations working to improve knowledge management and stakeholder cooperation on co-benefits in Asia.
Project Atmospheric Brown Cloud (ABC) *Secretariat: UNEP*	Asia	2002	Partnership of national environmental agencies focused on ABC as an emerging regional climate change issue in Asia; includes black carbon mitigation.
Male' Declaration *Secretariat: UNEP*	South Asia	1988	Intergovernmental cooperation of South Asian countries aimed at the control and prevention of air pollution and its likely transboundary effects for South Asia.
Global Atmospheric Pollution Forum (GAPF) *Secretariat: Stockholm Environment Institute*	Global	2004	Partnership of organizations aimed at developing effective policies and programs to protect public health and the environment from the harmful effects of atmospheric pollution.
Partnership on Sustainable Low Carbon Transport *Secretariat: UN DESA*	Global	2009	Partnership of organizations to reduce the growth of GHG emissions generated by land transport in developing countries by promoting more sustainable, low-carbon transport.

that in Asian developing countries:

- air pollution is an important local issue for companies, with local impacts such as reduced health, agricultural output, and visibility;
- air pollutant emissions are generated from the same types of energy as GHG emissions and are thus relatively easy to quantify;
- companies should consider measuring GHG and air pollutant emissions in parallel, preferably integrating air pollutants in a GHG accounting system; and
- air pollution reduction is one of the sustainable development benefits of GHG emission reductions, required under prospective Clean Development Mechanism (CDM) projects.

At the project level, methodologies are also made available in Asia for measuring CO_2 and air pollutant emission from specific transport projects, including rural roads, urban roads, bike projects, rural expressways, light rail transit/metro rail transit, and bus rapid transit systems. These are applied to planned and existing transport projects to measure and find ways to reduce emissions. Tools developed by the CAI-Asia and Institute for Transportation and Development Policy (ITDP) for the Asian Development Bank (ADB) and the Global Environment Facility aim to establish a globally-accepted methodology for quantifying emissions from transport projects.[10]

From measurements to management, tools can take the form similar to the Clean Fleet Management Toolkit, which allows companies to quantify air pollution and CO_2 from their vehicle fleets, identify actions, and monitor emissions reductions.[11] Meralco, the largest electricity distributor in the Philippines, recorded 16% fuel savings and associated emissions by its fleet after using the toolkit. Another tool available and applied in Asia is the Clean Air Scorecard, used to systematically assess a city's management of air pollution and GHG emissions and help local authorities identify areas of improvement and form action plans (see Figure 2).[12]

A key issue is that data are not always available, reliable, or readily accessible, although the amount of data are growing, especially for the transport and energy sectors. To help address these data gaps, the CitiesACT (Air, Climate and Transport) database[13] was established in Asia to provide data on air pollution and GHG emissions at the national, city, and sectoral levels.

Aside from data, Asia also needs technology databases that can help reduce CO_2 and other emissions. This must be combined with an independent verification and certification system. An example is the technologies database for retrofit technologies for trucks, established by the EPA under the National Clean Diesel Campaign.[14]

Expertise and Finanacing

Some government agencies in Asia collaborate closely with research institutions for the needed expertise, such as the relationship of Japan's Ministry of Environment and Institute for Global Environmental Strategies (IGES), as well as Indonesia's Ministry of Science and Technology and the Agency for the Assessment and Application Technology (BPPT).

Aside from regular banks, governments can also obtain financial support from donors (e.g., Swedish International Development Cooperation Agency, AusAID), development agencies (e.g., United Nations Environment Programme [UNEP]), development banks (e.g, ADB, World Bank), and foundations (e.g., Hewlett Foundation). Regional partnerships and networks can facilitate the access to a broader range of expertise and experiences in Asia and globally. A&WMA collaborates with some of the partnerships in Asia relevant to the co-benefits approach, as described in Table 2.

Conclusions

The application of the co-benefits approach will allow Asia to participate actively in climate mitigation efforts that are aligned with development priorities, such as air pollution reduction, energy efficiency, and sustainable transport, and do so at a lower cost. Particular focus is needed on black carbon because of its significant short-term climate impacts.

Overarching institutions and integrated climate change and air pollution plans would certainly help Asian countries to effectively develop a co-benefits approach and oversee its implementation. Moreover, a range of co-benefits tools exist, but these need to be applied more extensively. Databases need significant investments to improve availability, reliability, and central access to emissions data and technologies. Partnerships can support Asian governments and companies to adopt a co-benefits approach by facilitating access to expertise and financing. **em**

Air Pollution and Health Index *– assesses air pollution levels of cities against World Health Organization guideline values and interim targets*
Clean Air Management Capacity Index *– assesses a city's capacity to determine sources and their contribution, assess air quality status, estimate impacts, and reduce air pollution and GHG emissions through an institutional and policy framework and financing*
Clean Air Policies and Actions Index *– assesses existence and enforcement of national and local policies and actions to address emissions from relevant sources (e.g., mobile, stationary, area, transboundary)*

The Clean Air Scorecard was initially applied in eight Asian cities: Bangkok, Colombo, Hangzhou, Hanoi, Jakarta, Jinan, Kathmandu, and Manila. While none of the surveyed cities received a "minimal" score, neither did any of them score "excellent," showing there is ample room for improvement. CAI-Asia is currently working on Clean Air Scorecard 2.0, which will be made available at http://cleanairinitiative.org/portal/scorecard.

Figure 2. *Clean Air Scorecard.*

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10. See CO2 Emissions Methodology for Transport: www.cleanairinitiative.org/portal/CO2emissionsmethodologytransport.
11. See Roll-Out of Clean Fleet Management Toolkit in Asia: www.cleanairinitiative.org/portal/CleanFleetManagement.
12. See Clean Air Scorecard for Asian Cities: www.cleanairinitiative.org/portal/Scorecard.
13. See CitiesACT portal: www.citiesact.org.
14. See U.S. Environmental Protection Agency's National Clean Diesel Campaign: www.epa.gov/diesel.