GAINS-Asia

Greenhouse Gas and Air Pollution Interactions and Synergies

A scientific model designed to identify the most viable and cost-effective methods of jointly reducing emissions of air pollution and greenhouse gases in Asia, without compromising economic development.

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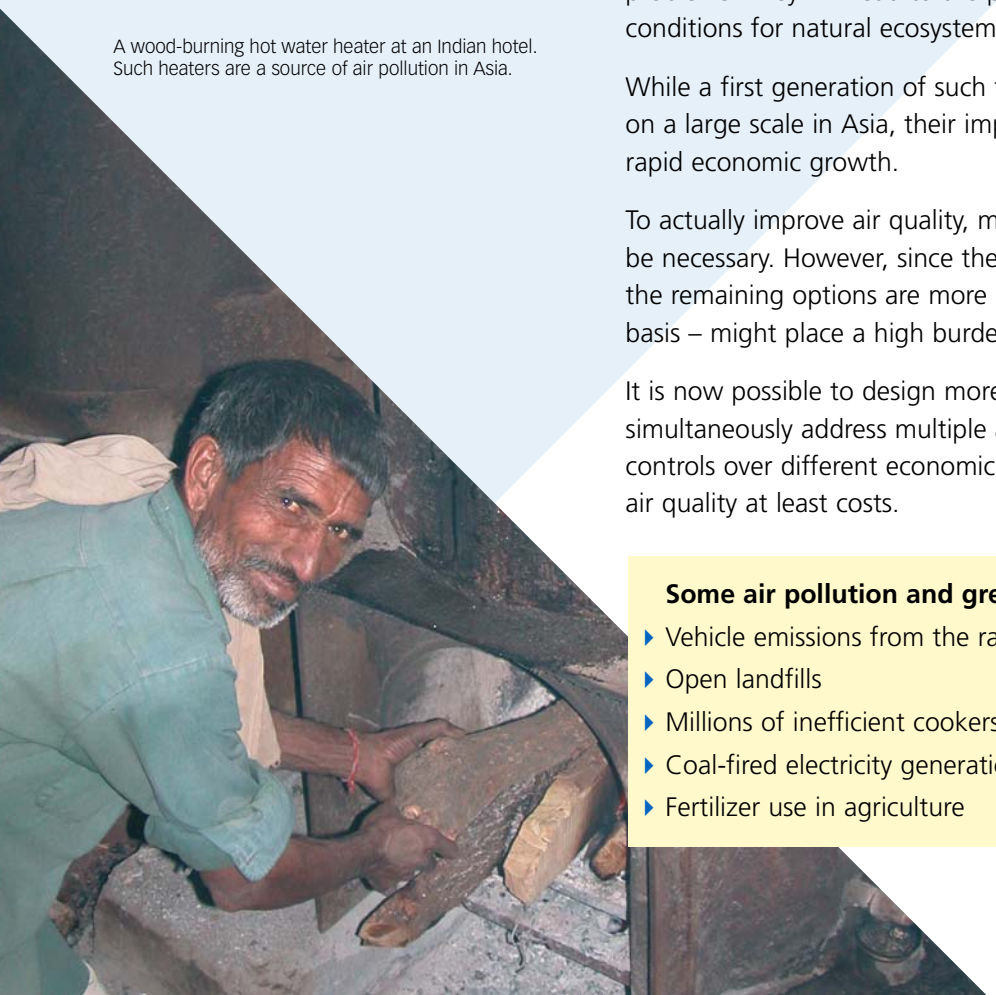
More blue sky days…

Throughout the Asian continent, air pollution from smog, soot, small particles, and ozone are adversely affecting health and reducing the quality of life. Blue sky days are becoming the exception rather the norm in many Asian cities.

Without targeted measures, air pollution emissions from human activities are set to rise dramatically over the next 20 years, driven by economic prosperity, population growth, and industrial development over the continent.

Many Asian countries have begun taking advanced technical measures to reduce emissions and improve local air quality. These measures affect different economic sectors (e.g., vehicles, power generation, industrial activities), different pollutants (SO_2, NO_x, PM, VOCs, CO), and aim at reducing different air quality problems. They will lead to the protection of human health, to sustainable conditions for natural ecosystems, and to improved agricultural practices.



A wood-burning hot water heater at an Indian hotel. Such heaters are a source of air pollution in Asia.

While a first generation of such technical measures is now being implemented on a large scale in Asia, their impacts on actual air quality are being offset by rapid economic growth.

To actually improve air quality, more stringent pollution control measures will be necessary. However, since the cheapest measures have been consumed, the remaining options are more costly. Simple policies – taken on an ad hoc basis – might place a high burden on further economic development.

It is now possible to design more refined emission control strategies that simultaneously address multiple air quality problems, balancing emission controls over different economic sectors so that societies can improve their air quality at least costs.

Some air pollution and greenhouse gas sources in Asia

- Vehicle emissions from the rapidly growing transportation sector
- Open landfills
- Millions of inefficient cookers burning wood, dung, and other bio fuels
- Coal-fired electricity generation
- Fertilizer use in agriculture

A changing climate

The rapid economic development in Asia also leads to a strong increase in greenhouse gas emissions. Asia is becoming one of the largest emitters of greenhouse gases worldwide, and action at Asian sources must constitute an integral part of any effective global approach to protect the global climate.

Air pollution and greenhouse gases are often generated by the same sources and interact in the atmosphere through complex chemical reactions. Simultaneous air pollution and greenhouse gas mitigation is considered by air pollution and climate experts to be the most economically efficient method of improving local air quality while addressing climate change.

GAINS-Asia

IIASA is now working with Indian and Chinese partners to implement a state-of-the-art co-benefits model that will assess the environmental and economic benefits of concurrent reductions of the major air pollutants and greenhouse gases. The Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model identifies least-cost approaches for further improving local and regional air quality while controlling emissions of various greenhouse gases. The model addresses the near- to medium-term planning horizon (5–20 years) and covers all provinces in China and all states in India.

The GAINS model is an extension of the RAINS air pollution model, which has been successfully used for policy analyses in Europe, and the RAINS-Asia model, which has been implemented for Asia. The project is funded by the European Commission.

Some of the costs of air pollution in Asia

- WHO estimates 1.5 million air-pollution-related deaths each year
- Cosmetic damage to buildings and cultural monuments
- Reduced forest productivity and decreased crop yields
- Harm to biodiversity and natural habitats
- Exacerbation of hemispheric air pollution
- Increased health-care costs

Wind power is the world's fastest growing energy sector.

GAINS-Asia: A tool for environmental decision making

Transport is the fastest-growing contributor to air pollution and greenhouse gas emissions in Asia.

What is GAINS-Asia?

GAINS-Asia is an integrated assessment model, developed to assess the co-benefits, as well as the economic impacts, of concurrent reductions in air pollution and greenhouse gases for the Asian continent.

What will GAINS-Asia achieve?

The Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model addresses local health impacts associated with fine particulate matter and ozone, vegetation damage to natural ecosystems and agricultural crops, and greenhouse gas emissions. GAINS has a medium-term planning horizon (up to 2030) and considers more than 1500 concrete options for reducing air pollution emissions of PM, SO_2, NO_x, NH_3 and VOC and 200 options for reducing CO_2, CH_4 and N_2O. It takes full account of the interactions between these measures, and assesses their local application potentials and costs.

Environmentally, the GAINS model aims to identify the most practical policies for reducing air pollution and greenhouse gas emissions in the region over the near and medium term (5–20 years). Economically, GAINS-Asia will not only identify the most cost-effective methods of achieving emission targets, but the model will also identify opportunities to generate revenue through instruments such as the Clean Development Mechanism (CDM) of the Kyoto Protocol.

GAINS-Asia mitigation options

Among the hundreds of options considered in GAINS:

- Fuel switching in the power sector
- Vehicle fuel switching
- Industrial energy efficiency improvements
- Increased renewable energy supply
- Improved vehicle fuel efficiency
- Domestic energy efficiency measures
- Electrical appliance labeling
- Reducing gas pipeline leakages
- Improved waste management
- Animal diet and manure management options
- Upgraded gas recovery in coal mines
- Reduced fertilizer application on agricultural soils

Building scientific capacity among partners

Who will be involved?
A multinational team of experts will carry out the data collection, scenario development, relevant research, modeling, and analysis. The team will also rely on input from policy makers, industry, academics, and nongovernmental organizations.

IIASA's Asian partner institutions in the GAINS-Asia project are the Chinese Energy Research Institute (ERI) and The Energy and Resources Institute (TERI) of India. Through this partnership the GAINS-Asia project will be able to maximize global environmental benefits by drawing on local expertise. Scientific capacity will be further developed within India and China during the project, enabling valuable knowledge sharing among all partners.

How will GAINS-Asia work?
For GAINS-Asia, IIASA has integrated leading environmental models to analyze individual aspects of environmental and economic measures for controlling air pollution and greenhouse gas emissions. The GAINS model will rely on information from the RAINS-Asia databases, as well as updated in-country data provide by the scientific partners in India and China.

GAINS-Asia will be made available on the Internet, allowing interested parties around the globe to benefit from the project.

Models used in GAINS-Asia

- **BernCC** carbon cycle model
- **GAINS-Europe**
- **MARKAL** and **IPAC** energy models for India and China, respectively
- **MESSAGE** global energy scenario model
- **RAINS** air pollution integrated assessment model
- **TM5** hemispheric atmospheric chemistry and transport model

This Indian taxi runs on compressed natural gas (CNG) – a clean transportation fuel.

Collaboration among international partners

The GAINS-Asia project will provide multiple benefits for all partners involved. Not only will Asia's two largest countries benefit from the knowledge transfer and increased capacity afforded by collaboration among distinguished international partners, but the project also brings together a unique team of experts with different modeling capabilities and knowledge bases.

The following international partners are participants in the GAINS-Asia project:

The International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria
IIASA's work – authoritative, comprehensive, and unbiased – is an important foundation for environmental policy decisions. Notably, IIASA's Regional Air Pollution Information and Simulation (RAINS) model was used to assist negotiations of two major protocols to the 1979 Geneva Convention on Long-range Transboundary Air Pollution.

The Energy Research Institute of the National Development and Reform Commission (ERI), Beijing, China
Now the key modeling team in China conducting comprehensive studies on energy issues, ERI will implement the GAINS-Asia tool for China. ERI will rely on local knowledge to interface GAINS-Asia with the IPAC energy analysis tools for assessment of co-benefits mitigation potentials and costs.

The Energy and Resources Institute (TERI), Delhi, India
TERI, a dynamic and flexible institution with a global vision and a local focus, is committed to every aspect of sustainable development. TERI will interface the GAINS-Asia model with the India-specific MARKAL energy analysis tool to assess air pollution and greenhouse gas emission reduction options in India.

GAINS-Asia strives to provide a cleaner environment for future generations.
Credit: Sharmistha Dutta

The Institute for Environment and Sustainability of the Joint Research Centre of the European Union (IES–JRC), Ispra, Italy

JRC provides scientific and technical support for the development, implementation, and monitoring of European Union policies. JRC will utilize the TM5 model to assess air pollution at the regional and hemispheric scale resulting from the various GAINS-Asia emissions control scenarios.

The University of Bern (UBERN), Switzerland

The Division of Climate and Environmental Physics, Physics Institute, University of Bern, are pioneers in biogeochemical and climate modeling with emphasis on the global carbon cycle. UBERN will develop a reduced-form carbon cycle-climate model for incorporation into the MESSAGE energy model.

Capturing the energy in sunlight. Electrifying a traditional home is one method of reducing indoor air pollution and improving health.

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Concurrent reductions in air pollution and greenhouse gas emissions

The GAINS-Asia project brings together an international team of experts to develop a state-of-the-art interdisciplinary model, based on a number of established economic and environmental models in reduced-form representations. The co-benefits model will assess concurrent reductions in air pollution and greenhouse gas emissions, while simultaneously considering the economics of different mitigation options.

Cost-effectiveness and environmental benefits will be analyzed for a wide range of policy options. The comparison of different policy benefits and costs will be an important utility of the GAINS-Asia model. Combinations of policies aimed at concurrent reductions of long-range and hemispheric air pollution and greenhouse gas emissions will be analyzed with an eye to optimizing the overall benefits and costs in the near to medium term. These policy measures will be embedded in long-term global strategies aimed at stabilizing greenhouse gas concentrations.

GAINS-Asia will be implemented for China and India. The model will interface with GAINS-Europe which contains all European countries including Russia. The Rest of the World will be represented at the aggregated level to allow analysis at the global scale. The GAINS-Asia interactive Web-based model is being developed to provide policy makers, industry, and researchers alike, with the opportunity to conduct independent analyses of the interactions between air pollution and climate change policies.

For more detailed information see the IIASA Web site: **www.iiasa.ac.at** or contact IIASA directly at **gains@iiasa.ac.at**

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