A scientific model aims to help China and India combat air pollution and climate change simultaneously

Clean air in Asia

THE GAINS-ASIA MODEL integrates a number of established economic and environmental models developed by experts at the following institutions:

- IIASA – International Institute for Applied Systems Analysis, Laxenburg, Austria
- ERI – Energy Research Institute, Beijing, China
- TERI – The Energy and Resources Institute, Delhi, India
- JRC-IES – Institute for Environment and Sustainability of the Joint Research Centre of the European Union, Ispra, Italy
- UBERN – The University of Bern, Switzerland

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Close collaboration between scientists in China, India, Italy, Switzerland, and IIASA has resulted in a tool to help policymakers in China and India make sense of the complexities of air pollutant controls and greenhouse gas mitigation. Together, the policymakers and scientists hope to identify and implement activities that reduce both air pollution and greenhouse gases in China and India without compromising economic development.

Air pollution is a far more visible and imminent problem for China and India than climate change. Current and future economic growth will cause serious air quality problems in Asia, worsening human health and crop production, unless further air pollution policies are implemented. Statistical life expectancy in India is expected to shorten by over three years by 2030 compared with 2005 because of outdoor exposure to just one air pollutant—fine particulate matter. Another air pollutant, higher ground ozone, is likely to at least triple crop losses of wheat, corn, and rice by 2030.

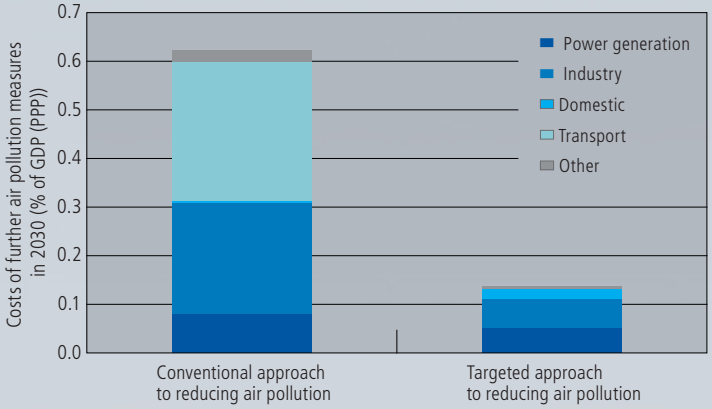
At the same time, increased economic activity will also lead to more greenhouse gas emissions and subsequent climate change. Emissions are expected to grow by a factor of four in China and India by 2030. Yet most of the global warming that will result from the world's greenhouse gas emissions is still in the future. Consequently, governments around the world are postponing taking difficult measures today to reduce emissions.

But what if policies to tackle air pollution could also tackle greenhouse gas emissions at little additional cost? In theory it is possible. Both often come from the same sources. Yet setting the right policies is not easy and needs to resolve complex scientific and political issues, as well as ensure costs are kept to a minimum.

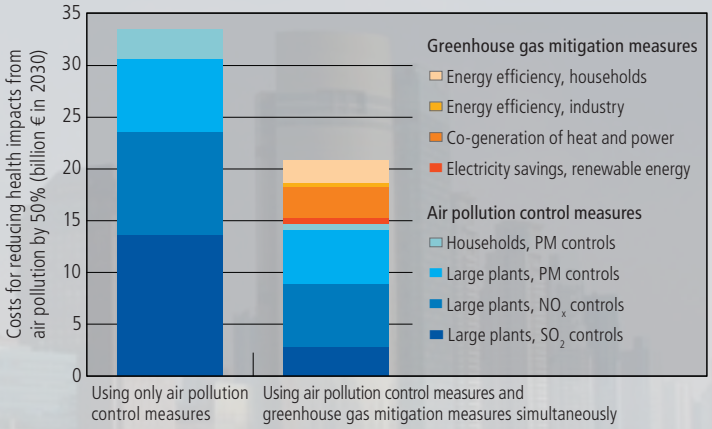
An effective policy must consider all the numerous sources of air pollution and greenhouse gases, ranging from agriculture through industry to transport. Measures to reduce air pollution and greenhouse gases must therefore also be equally numerous. A successful policy must understand the range of air pollutants and greenhouse gas emissions which, individually and in combination, have multiple effects on the environment.

In China and India, different regions generate distinct amounts of air pollution and greenhouse gas emissions; they also feel the effects unequally. The governments must therefore ensure there is a fair division of the clean up costs between regions.

An international team of researchers (see "The GAINS-Asia Model" above) has developed a scientific tool to guide policymakers



REDUCING THE COSTS OF AIR POLLUTION CONTROL Air pollution in China can be reduced far more economically by carefully selecting the most cost-effective portfolio of measures. The left column shows the costs of a conventional, across-the-board approach to reducing air pollutants in 2030. The resulting cleaner air will reduce losses in statistical life expectancy from air pollution by 43%. It will also reduce crop losses by around 50%. The right column shows how China could achieve these same benefits at a far lower cost by using GAINS to carefully identify the most effective and efficient portfolio of emission control measures.



BENEFITS OF TACKLING AIR POLLUTION AND CLIMATE CHANGE SIMULTANEOUSLY To achieve a given target in ambient air quality, China can dramatically save costs by adopting a smart mix of measures to reduce air pollution and greenhouse gas emissions. The left column shows the most cost effective way for halving negative health impacts from air pollution using only air pollution control measures. The right column shows how much more cheaply the same target can be reached using measures to lower air pollution and greenhouse gas emissions simultaneously. This cost savings also results in a 9% reduction in greenhouse gas emissions.

LESSONS LEARNED IN EUROPE

Twenty years ago, acid rain ravaged Europe, turning trees yellow and killing populations of fish. Caused by air pollution, acid rain is now under control in Europe, thanks, in part, to the role played by IIASA.

Today, air pollution remains harmful, but its effects, such as causing respiratory diseases, are often less visible. Fortunately, plans now in place will clean Europe's air over the coming 15 years adding, on average, three months to the lives of people living in Europe through improved health. Once again, IIASA's research has played a vital role.

Cleaning up Europe's air has not been easy. It has required an effective environmental policy to reduce air pollution in over 30 European countries, and making the policy has required resolving complex scientific and political issues.

IIASA's scientific model RAINS (Regional Air Pollution Information and Simulation) has helped European countries resolve such issues by showing various strategic options to achieve long-term environmental goals at the lowest possible cost. Europe's nations used this scientific tool to help negotiate the Convention on Long-range Transboundary Air Pollution of the United Nations Economic Commission for Europe. Since the 1980s, the Convention has dramatically reduced emissions, first for sulfur dioxide and then for many air pollutants simultaneously.

GAINS Asia (see main text) enables China and India not only to follow this successful approach, but also, thanks to advances in the model, to leapfrog European practices and tackle both air pollutants and greenhouse gas emissions together. GAINS Asia is the result of three years' work by an international, multidisciplinary team of researchers to develop and expand RAINS to offer an integrated analysis of air pollution and greenhouse gas emissions in China and India. ■

through this complex process of air pollutant control and greenhouse gas mitigation in China and India. Known as GAINS (Greenhouse Gas and Air Pollution Interactions and Synergies), this state-of-the-art interdisciplinary model builds on a scientific tool that has already helped European governments slash air pollution across the continent without compromising economic development (see "Lessons learned in Europe" below).

There are two broad methods to cut air pollution: either reducing the levels of activities that emit the pollutants; or not changing production and consumption levels but controlling the waste they produce. The latter method is known as end-of-pipe emission control technology and, by fully applying existing technical measures, Asia can avoid serious deterioration in air quality. However, such an undifferentiated across-the-board approach would impose significant burdens on the economy.

An optimized emission control strategy, which selectively allocates specific reduction measures across economic sectors, pollutants, and regions, could achieve equal air quality improvements at only 20% of the costs of a conventional across-the-board approach (*top chart*). The GAINS optimization tool allows a systematic search for those measures that ensure total emission control costs are minimized. For Asia, an integral element of such an air pollution control strategy will be measures to eliminate indoor pollution from the combustion of solid fuels.

Well-designed air pollution control strategies can also reduce emissions of greenhouse gases and vice versa. Climate-friendly measures such as energy efficiency improvements, cogeneration of heat and power, fuel substitution, and integrated coal gasification combined cycle plants, reduce, simultaneously, air pollution and greenhouse gas emissions. For example, for China, India, and Europe, GAINS estimates that each percent of CO_2 reduction will typically reduce health impacts from fine particulate air pollution by 1%.

Indeed, a smart mix of measures to simultaneously cut air pollution and greenhouse gas emissions will help combat climate change and air pollution more cheaply than tackling either issue separately. GAINS demonstrates that China, by selecting such a smart mix of measures, can almost halve air pollution control costs as well as lower greenhouse gas emissions by 9% (*bottom chart*).

GAINS helps policymakers identify the best strategy to tackle air pollution and greenhouse gas emissions by acting as a scenario-generating device. It helps users understand the impacts of future actions—or inaction—and design strategies to achieve long-term environmental goals at the lowest possible cost. With a few days of training, scientists, civil servants, politicians, and other non-technical users can pose any number of "what-if" questions to GAINS: How much would it cost to reduce air pollution levels to a given standard for all of India? For the worst-affected areas only? What is the cheapest way to reduce the health impacts of air pollution on China's population? What air pollution controls maximize the reduction of greenhouse gases? Fed with the relevant data for China and India, GAINS gives answers to such questions within minutes. ■

Further information IIASA's GAINS model is freely accessible on the Internet at http://gains.iiasa.ac.at

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