

## THE IIASA GAINS MODEL

IIASA research sheds new light on two major questions facing negotiators of an international climate change agreement: (1) How much are industrialized countries willing to reduce their emissions of greenhouse gases? and (2) How much are major developing countries like China and India willing to limit the growth of their emissions? The research uncovers the most cost-effective options available and reveals significant additional benefits, including improvements to health and crop production.

# IIASA

## CURTAILING EMISSIONS ●

### IIASA'S GAINS MODEL TACKLES AIR POLLUTION AND GREENHOUSE GAS EMISSIONS SIMULTANEOUSLY, ENABLING

The GAINS (Greenhouse gas – Air pollution Interactions and Synergies model) is an interactive, scenario-generating tool that allows users to identify the best strategies for simultaneously reducing air pollution and greenhouse gas (GHG) emissions.

The GAINS analysis includes all six GHGs included in the Kyoto Protocol (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs, and SF<sub>6</sub>) and covers all anthropogenic sources included in the emission reporting of UNFCCC Annex-I countries. GAINS considers around 300 different national mitigation options, including technological advances, carbon trading schemes, land use and land use change and forestry, and development and population growth.

## COUNTING THE COST OF REDUCING EMISSIONS

In 2007 the Intergovernmental Panel on Climate Change (IPCC) argued that greenhouse gas (GHG) emissions from Annex-I (industrialized) countries must fall by 25–40 percent by 2020 compared with 1990 to keep global warming to a maximum of 2°C. Using the GAINS model, IIASA scientists have analyzed public “pledges” to reduce emissions made by policymakers and found that they fall significantly short of the IPCC recommendation.

As of mid-August 2009, most Annex-I parties to the United Nations Framework Convention on Climate Change (UNFCCC) have presented GHG emissions reduction targets (“pledges”) ahead of the UN Climate Change Conference in Copenhagen in December 2009. These pledges, based on official and unofficial announcements, have been evaluated by IIASA using its GAINS model (described above, center). The results show that the total GHG emission reductions being pledged by Annex I countries will fail to meet the 25–40 percent IPCC target. They also show, importantly, that the cost of meeting the targets is much lower than Annex-I countries anticipate.

This raises two points. First, any emission reductions agreed at Copenhagen need to be far steeper than countries have pledged to date so as to achieve the range outlined by the IPCC. Second, the financial cost of making these bigger emission cuts is lower than countries’ estimates.

In fact, the IIASA GAINS analysis shows that if the “pledges” were implemented, the total GHG emissions of Annex-I countries, relative to 1990, would decrease by only 5 percent, for a conservative interpretation of the “pledges,” to 17 percent, for an optimistic interpretation. The GAINS analysis also suggests that the conservative 5 percent reduction would involve no net costs to Annex-I countries as a whole, as most of the reductions could be satisfied by accounting for surpluses through emission permits, a factor implicit in some countries’ “pledges.” Remaining emission cuts could be achieved through low-cost energy efficiency measures such as improved insulation of buildings or more efficient vehicles, which pay for themselves over their lifetime.

Even for the most optimistic 17 percent emissions reduction, mitigation costs would not exceed 0.01–0.05 percent of the GDP of all Annex I countries—a minor amount, given the projected 42 percent increase in GDP for these countries between now and 2020. Moreover, the economic crisis means emissions will likely be lower and the costs of reaching the “pledges” even lower than suggested in the IIASA study.

The GAINS approach was presented at the November UNFCCC Barcelona climate change talks and will be presented at the UN Climate Change Conference in Copenhagen. ■

**Further information** Wagner F, Amann M (2009). *Analysis of the Proposals for GHG Reductions in 2020 made by UNFCCC Annex I Countries By mid-August 2009*. GAINS Report.

**EMISSION REDUCTION PLEDGES** Until mid-August 2009, the of greenhouse gas emission reductions by 2020.

	Conservative interpretation	Optimistic interpretation
Australia	–5%	–25% through –20% cap and trade of domestic emissions and –5% government purchases of international credits
Canada	–20%	–20%
EU	–20%	–30%
Japan	–15% (relative to 2005; through domestic measures)	–25% (relative to 1990)
New Zealand	–10%	–20%
Norway	–30%	–30%
Switzerland	–20%	–30%
Ukraine	–20%	–20%
USA	–1% (cap: 6,095 Mt CO <sub>2</sub> eq)	–17% (5,123 Mt CO <sub>2</sub> eq) (through cap plus complementary measures)
Russia	–10%	–15%

# GAINS

## CLEANING AIR • CUTTING COSTS

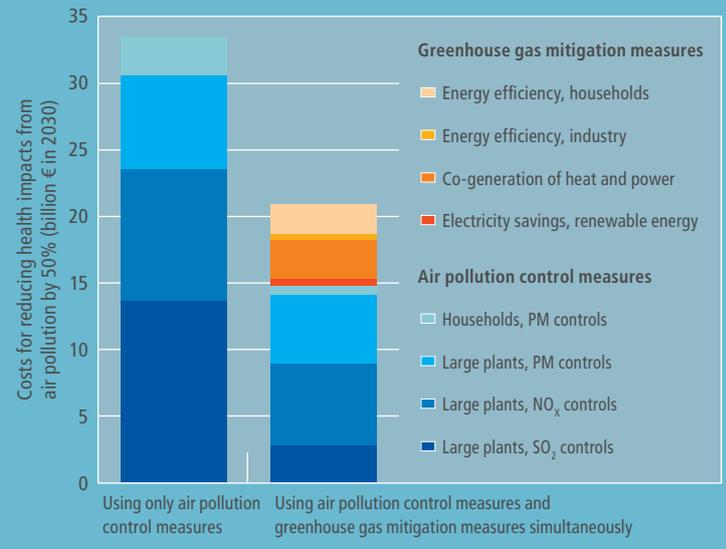
### POLLUTION AND GREENHOUSE GAS GREATER CUTS AT LOWER COST

GAINS, which includes a freely available online emissions calculator, quantifies the implications for and co-benefits of GHG mitigation strategies on air pollution, and vice versa.

Under the EU Sixth Framework Programme on Research, an international team of research institutions has implemented the GAINS model for India and China. The research team, headed by IIASA, included the Chinese Energy Research Institute, Tsinghua University (Beijing, China), The Energy and Resource Institute (New Delhi, India), the Institute for Environment and Sustainability of the Joint Research Centre of the European Commission, and the University of Bern (Switzerland).

Annex 1 (industrialized) countries had publicly pledged a range

Reference year	Inclusion of LULUCF	Status
2000	Yes	Officially announced (4 May 2009)
2006	t.b.d.	Officially announced
1990	Not for the 20% target, t.b.d. for the 30% target	Adopted by legislation
	Not for the 15% target, t.b.d. for the 25% target	Low pledge announced by the previous government; high pledge announced by the new government
1990	Yes (with current rules)	Announced in Bonn (11 August 2009)
1990	Yes (with current rules)	Officially announced
1990	Yes	Switzerland announced it will follow the EU
1990	?	Under consideration
1990	Yes	Waxman-Markey Bill of 19 May (WRI paper 22 June 2009)
1990	?	Announced by President Medvedev



**CUTTING GREENHOUSE GAS EMISSIONS & LOWERING AIR POLLUTION CONTROL COSTS**  
By using a "smart mix" of air pollution control measures and greenhouse gas mitigation measures, China could lower air pollution costs and cut greenhouse gas emissions by 8 percent at no additional cost by 2030.

### IMPROVING HEALTH AND LIVELIHOODS IN CHINA

Air pollution is an immediate concern for many countries, damaging both human health and crop production. IIASA research estimates that in China exposure to fine particulate matter (PM 2.5)—one among many air pollutants—is shortening average individual life expectancy by approximately 40 months. Today, China spends about €14 billion annually (0.37 percent of GDP) on cleaning its air. With Chinese economic growth expected to burgeon over the next decades, the country faces growing air pollution and a potentially massive rise in mitigation costs.

IIASA has been working with Chinese partners using the GAINS model to identify the best combination of strategies for simultaneously reducing air pollution and GHG emissions and thereby help China cut its future mitigation costs.

Today, many industrialized countries use advanced emission control technologies to maintain their air quality levels. If China were to adopt such technologies, it could, according to IIASA estimates, reduce the negative health impacts of air pollution by 43 percent by 2030 at a cost of 0.63 percent of GDP. The IIASA GAINS model, however, which takes into account that air pollutants are often emitted from the same source as greenhouse gases and interact with them in the atmosphere, enables air pollution and greenhouse gas strategies to be developed simultaneously and thus much more cost-effectively. The *simultaneous* reduction of air pollution and greenhouse gases is advantageous not only from the financial perspective, but also for human health.

In fact, use of the GAINS model has identified a "smart mix" of the latest technology and the structural changes needed to China's energy system that will allow China to achieve the same air quality improvements at only 20 percent of the costs of the conventional across-the-board approach, while at the same time improving its population's health and reducing crop losses due to air pollution by 50 percent.

Moreover, using GAINS will also permit China to identify options to cut GHG emissions by 8 percent at no additional cost by 2030 (see figure above). As China is the world's biggest emitter of GHGs, limiting its GHGs is a crucial part of any national—and global—strategy to avoid dangerous climate change.

IIASA has also worked with partners in India to conduct a similar analysis for India. ■

**Further information** Amann M et al. (2008). *Scenarios for Cost-effective Control of Air Pollution and Greenhouse Gases in China*. GAINS ASIA Report.

**Further information** GAINS is available free online at <http://gains.iiasa.ac.at>

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