

IIASA has developed an easy-to-use online calculator to help industrialized countries compare efforts to lower greenhouse gas (GHG) emissions with those of other countries (and vice versa). The calculator is designed to explore alternative schemes for sharing the burden between countries, and it can help industrialized countries identify a mutually agreeable set of GHG emission reduction targets.

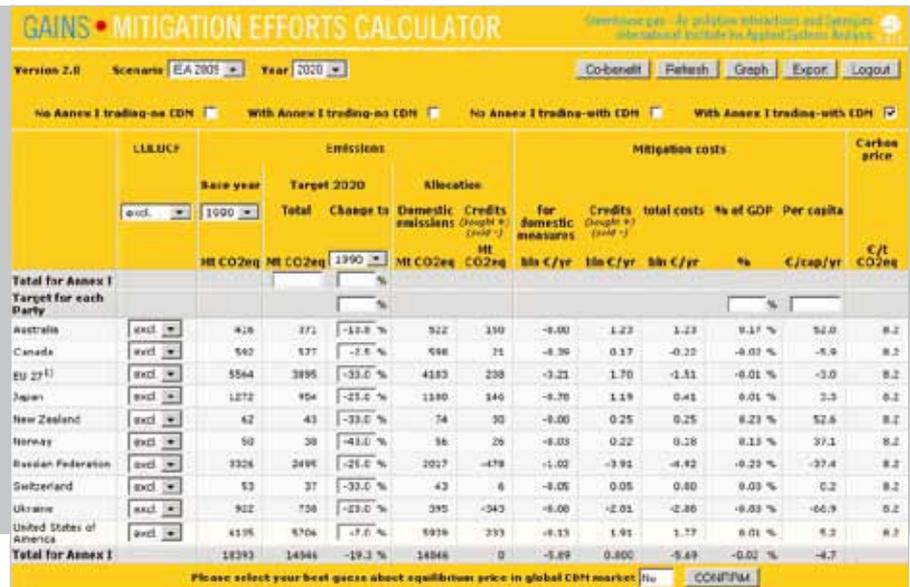
# A Tool for Comparing Countries' Efforts to Reduce Greenhouse Gas Emissions

## Summary

- One of the key issues facing the current negotiations for a post-2012 agreement on climate change is how much industrialized (Annex I) countries are willing to reduce their emissions of greenhouse gases (GHG).
- Agreement on emission targets among the 37 Annex I countries is complex. Only a deal that is fair in sharing the burden of cutting GHG emissions, reflects national circumstances and minimizes the collective cost of tackling climate change will be sustainable.
- Emission targets can be based on a range of criteria such as a country's economic capacity to lower GHG emissions, a country's responsibility for current or past GHG emissions, and the technical potential for a country to reduce emissions.
- An open and transparent comparison of alternative schemes for sharing the burden among industrialized countries can help identify mutually agreeable targets.
- IIASA has developed a scientific tool, known as the GAINS Mitigation Efforts Calculator, that analyzes mitigation efforts up to 2020 for a range of criteria for Annex I countries. The calculator is the only tool that is both freely available on the Internet and developed by an international organization.
- The easy-to-use online calculator of mitigation efforts allows users to pose any number of questions such as: What is the most cost-effective approach to lowering GHG emissions across Annex I countries? How would such targets share the burden of mitigation efforts between countries? How do the mitigation costs differ among countries if a target based on emissions per person is adopted?
- The calculator queries the IIASA GAINS (Greenhouse gas – Air pollution Interactions and Synergies) model, which analyzes all six greenhouse gases included in the Kyoto Protocol and covers all anthropogenic sources included in the emission reporting of UNFCCC Annex I countries. GAINS considers around 300 different national mitigation options, and uses the best available data including new statistics that account for the impact of the current economic crisis.
- GAINS also identifies co-benefits from cutting GHGs in terms of reducing emissions of other air pollutants whose negative impacts include damage to human health and to crop production.

Screenshot 1

In this sample screenshot of the GAINS Mitigation Efforts Calculator, the user has analyzed an optimistic interpretation of pledges made by Annex I countries by August 2009 to reduce GHG emissions. Note that the user can easily compare the efforts of each country in terms of total and percentage emission reductions, in terms of mitigation costs (total, per capita, or as a percentage of GDP) or in terms of carbon price.



### Comparing efforts to reduce greenhouse gases

At the UN Climate Change Conference in Bali in 2007 representatives from over 180 countries agreed to the Bali Action Plan. The agreement called for, among other actions, industrialized countries (Annex I: Australia, Canada, European Union, Japan, New Zealand, Norway, Russia, Switzerland, Ukraine, and the United States) to commit to greenhouse gas (GHG) emission reductions in a post-2012 agreement on climate change. The plan also requested that the mitigation efforts among Annex I countries be comparable and take into account differences in national circumstances. The parties to the Bali Action Plan had recognized that mitigation efforts needed to be fairly shared between countries and reflect national circumstances in order to increase the likelihood of Annex I countries successfully making a deal to jointly cut GHG emissions. Similarly, mutually agreeable targets to cut emissions would need to minimize the collective cost of tackling climate change in order to make any deal sustainable.

However, the comparison of mitigation efforts between countries is complex. Various quantitative measures or indicators are possible. For example, a target based on mitigation costs as a percentage of the country's GDP would reflect the economic ability of a country to act against climate change, whereas a target based on GHG emissions per capita would represent a country's responsibility for current emissions. For each target and each indicator the efforts of each country differ, leading to countries favoring certain targets and indicators that minimize their own efforts. In addition a target based on GHG levels in either 1990 or 2005 dramatically changes the amount of effort required by countries.

Through a transparent and systematic analysis of mitigation costs and potentials according to different criteria, Annex I countries would develop an objective basis to compare mitigation efforts among themselves. In turn, the comparative analyses would help the countries negotiate targets that both lower GHG emissions and fairly share the costs of the mitigation.

### Calculating the costs of reducing greenhouse gas emissions

IIASA has developed a scientific model to make coherent international comparisons of the potentials and costs for emission control measures, for GHGs and air pollutants. Known as GAINS (Greenhouse gas – Air pollution Interactions and Synergies), the model estimates to what extent and at what cost GHG emissions could be reduced across different countries.

The GAINS analysis includes all six greenhouse gases 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.

The GAINS Mitigation Efforts Calculator enables users to compare mitigation costs and potentials for a range of targets and criteria.

Type of target	Quantitative indicator	Rationale for criteria
Emission target	Percentage change of total million tons of carbon dioxide equivalent compared to a base year	Such criteria will target the countries most responsible for current GHG emissions. In other words the countries that generate more greenhouse gas emissions will have to pay more.
	Total carbon dioxide equivalent emissions per capita	
Mitigation costs	Mitigation costs as a percentage of GDP	Such criteria account for a country's ability to pay. In other words richer countries can afford to contribute more to cutting GHG emissions.
	Mitigation costs per capita	
Carbon price	Marginal cost of reducing emissions by a further ton of carbon dioxide equivalent	Such criteria will target cost-efficiency and ensure the collective costs of reducing GHG are lowest.

**GAINS • MITIGATION EFFORTS CALCULATOR** Greenhouse gas - Air pollution interactions and synergies International Institute for Applied Systems Analysis

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Co-benefits of GHG mitigation on Air pollutants emission

Party	Carbon Price €/t CO2	GHG emissions		Domestic emissions Mt CO2 eq	SO2		NOx		PM2.5	
		Nominal Mt CO2 eq	Change comp. to 1990		kt SO2	Change comp. to Baseline 2020	kt NOx	Change comp. to Baseline 2020	kt PM2.5	Change comp. to Baseline 2020
Australia	8.2	371	-10.60%	522	1218	-3.62%	814	-5.55%	125	-14.11%
Canada	8.2	577	-2.50%	598	1477	-9.19%	859	-8.98%	103	-10.53%
EU 27	8.2	3895	-30.00%	4103	2767	-6.55%	5144	-5.80%	1176	-4.33%
Japan	8.2	954	-25.00%	1100	594	-5.74%	969	-7.10%	135	-3.02%
New Zealand	8.2	43	-30.00%	74	49	-5.05%	83	-5.07%	11	-13.63%
Norway	8.2	30	-40.00%	56	30	-4.90%	141	-2.08%	54	-0.59%
Russian Federation	8.2	2495	-25.00%	2017	4223	-15.47%	3552	-6.25%	1034	-12.40%
Switzerland	8.2	37	-30.00%	43	12	-11.55%	38	-8.15%	7	-3.00%
Ukraine	8.2	738	-20.00%	395	1297	-1.24%	720	-1.97%	321	-9.46%
United States of America	8.2	5706	-7.00%	5939	4201	-10.56%	6871	-5.86%	628	-11.45%

Screenshot 2

Following the scenario generated in Screenshot 1, the GAINS Mitigation Efforts Calculator has analyzed the co-benefits of the GHG mitigation measures in terms of lower sulfur dioxide, nitrogen oxide, and particulate matter emissions.

## What GAINS can compare

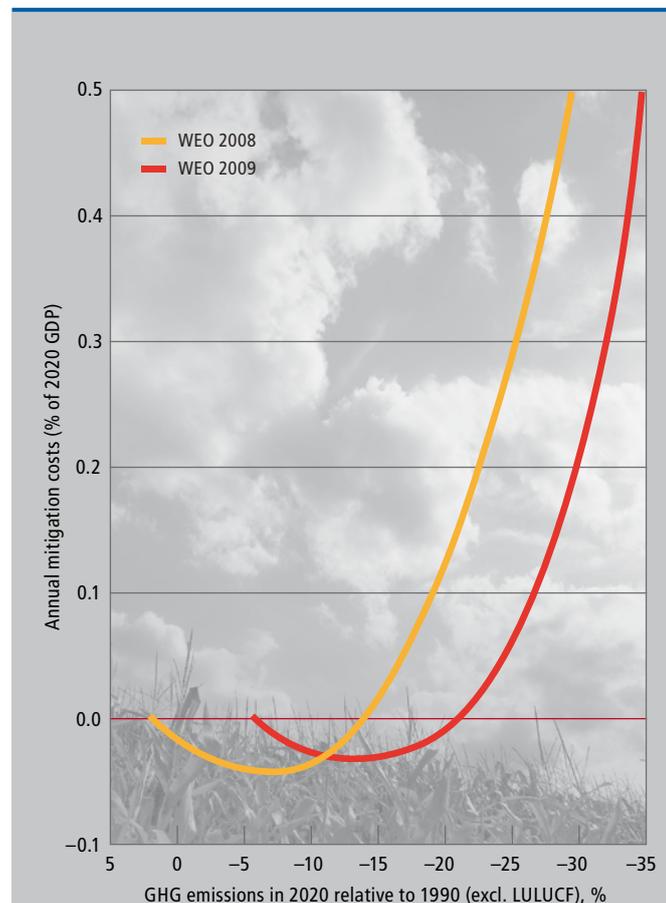
The GAINS Mitigation Efforts Calculator enables users to explore the costs for a range of climate change commitments for Annex I countries up to 2020. On a national level, the tool will calculate the portfolio of emission control measures that achieve a certain climate change commitment at the lowest cost. It will also analyze the co-benefits of achieving such targets in terms of lowering air pollution. The calculations can be performed simultaneously for all Annex I countries, allowing users to compare efforts for a range of targets and criteria (see table).

Users can examine the implications of changing the base year for percentage reductions between 1990 and 2005 as well as the implications of an international carbon market—for example, users can calculate the impact of international trading in carbon between Annex I Parties or of offsetting GHG emissions by investing in emission-reduction projects in developing countries through the clean development mechanism.

## Example results

GAINS is continually updated with the best available data. The following results were calculated using GAINS between September and November 2009:

- The economic crisis has reduced economic activity, which in turn lowers GHG emissions. GAINS, updated with the latest 2009 projections on future energy use, suggests that if Annex I countries were to take no further climate measures, then their emissions would be 6 percent less in 2020 than in 1990—compared to the 2 percent higher that was calculated using 2008 projections—thus leading to lower mitigation costs (see graph).
- If the pledges made by Annex I countries to reduce emissions were implemented, their total GHG emissions would decrease by between 5 and 17 percent relative to 1990—less than the 25–40 percent reduction recommended by the Intergovernmental Panel on Climate Change (Screenshot 1).
- By using a “smart mix” of air pollution control measures and greenhouse gas mitigation measures, Annex I countries can benefit from reducing air pollution while simultaneously cutting greenhouse gas emissions (Screenshot 2).



Annual mitigation costs

Estimates of future greenhouse gas mitigation potentials and costs are sensitive toward assumptions on economic growth. The graph shows how the economic downturn and other developments have lowered the annual mitigation costs for Annex I countries through changing greenhouse gas emissions. The results for the pre-economic crisis use data from the International Energy Agency's World Energy Outlook 2008. The results for the post-economic crisis have been updated with data from the World Energy Outlook 2009.



## Alternative models of mitigation costs for Annex I countries

The GAINS model is one of several bottom-up tools used by different countries to estimate mitigation costs. Similar models have been developed by Japan, the European Commission, and McKinsey. Other models, such as those used by the U.S. Environmental Protection Agency, OECD (Organisation for Economic Co-operation and Development) and the Australian government adopt computable general equilibrium (CGE) techniques to study the macro-economic implications of carbon constraints. The latter models generally generate lower or more optimistic cost estimates because of the inclusion of adjustments to consumer demand and the industrial structure in response to increasing carbon prices, and through consideration of carbon leakage to non-Annex I countries.

An analysis by the IIASA team indicates that despite these different approaches, when assumptions are harmonized there is very close agreement between the cost estimates of different models.

IIASA Policy Briefs present the latest research for policymakers from IIASA—an international, interdisciplinary research institute sponsored by scientific organizations in Africa, the Americas, Asia, and Europe. This brief is based on research from IIASA's Atmospheric Pollution and Economic Development Program. The views expressed herein are those of the researchers and not necessarily those of IIASA.

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GAINS is the only tool that is freely available on the Internet and covers the entire Annex I countries in sufficient depth. In addition, GAINS is developed by an international team of researchers at an international institute funded by 16 member countries, ensuring that the results from GAINS are trustworthy and independent of political interests.

## Further information

The GAINS Mitigation Efforts Calculator, including an introductory video to guide first-time users, is available at <http://gains.iiasa.ac.at/MEC>. The calculator has been presented at numerous UN climate change talks, including the UN Climate Change Conferences COP14 (Poznan, December 2008) and COP15 (Copenhagen, December 2009).

- Amann M, Cofala J, Rafaj P, Wagner F (2009). The impact of the economic crisis on GHG mitigation potentials and costs in Annex I countries. *GAINS Report*.
- Amann M, Rafaj P & Höhne N (2009). GHG mitigation potentials in Annex I countries. Comparison of model estimates for 2020. IIASA Interim Report IR-09-034.
- Stephenson J (2009). Comparing climate change commitments: Technical versus political judgment. OECD paper prepared for the Round Table on Sustainable Development at the OECD.
- Wagner F & Amann M (2009). Analysis of the proposals for GHG reductions in 2020 made by UNFCCC Annex I Parties: Implications of the economic crisis. *GAINS Report*.
- 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*.
- Amann M et al. (2008). Scenarios for cost-effective control of air pollution and greenhouse gases in China. *GAINS Report*.

Copies of the above IIASA and GAINS publications are available at: [www.iiasa.ac.at/Research/APD](http://www.iiasa.ac.at/Research/APD)