Global warming potential (GWP) is used to measure the relative effect on the climate of a tonne of a greenhouse gas, such as methane, relative to the reference gas, carbon dioxide. New research suggests greater accuracy and economic flexibility can be achieved by using the marginal impact of each unit of GHG emissions over the projected time horizon rather than applying an average or fixed index. The model also suggests that cutting long lived greenhouse gases early could pay off in the long run.

Under the Kyoto Protocol⁴, countries can reduce the overall emissions of six greenhouse gases, (GHGs) through a multi-gas trade-off approach. This approach allows climate polices to be developed that balance emissions of different gases to achieve an overall effect. The Kyoto Protocol uses a model based on a fixed GWP for 100 years. In this study, researchers used a flexible index based on marginal global warming potentials (MGWPs), rather than cumulative or fixed GWPs, to compare different climate change policies.

To compare climate-change policies using MGWPs, with those using fixed GWPs, researchers ran an experiment in which the total level of radiative forcing² would be limited to 4.5W/m², compared to pre-industrial levels, by the year 2100. A ‘business-as-usual’ (BaU) scenario was established as a reference, based on projected economic activities and consumption of resources. The BaU assumes higher per capita GDP growth rates in China and India until 2100, after which GDP growth rates will slow to rates similar to countries in Annexe 1 regions.³ A slower growth rate is expected for the rest of the world during this time. This comparison demonstrated that limiting total radiative forcing to 4.5W/m² would require a significant reduction in the level of GHG emissions.

For the three GHGs, CO₂, methane and N₂O, a climate model was first used to determine the MGWPs. Then, in the economic model, the values of the MGWPs were used for methane and N₂O, relative to the value of CO₂, to model the marginal abatement costs (MACs), which are incurred when cutting emissions of specific GHGs.

By comparing the total abatement costs of the three GHGs, using the flexible MGWP method with the total abatement costs under the fixed GWP method, the study showed that, by 2080, there were clear advantages to cutting emissions of long-lived gases CO₂ and N₂O early. The researchers suggest the economic benefit could be as much as 30-40 per cent of the total abatement costs, which could be valued at one per cent of GDP for the EU15, 1.5 per cent of GDP for the USA and up to 5 per cent of GDP for China and India. In addition, the study shows that the economic benefits continue beyond 2100, when the climate policy experiment reverted to a fixed GWP method.

1. See: [http://unfccc.int/kyoto_protocol/items/2830.php](http://unfccc.int/kyoto_protocol/items/2830.php) for more information on the Kyoto Protocol
2. Radiative forcing (measured in watts per square meter) provides a simplified means of comparing the various factors that are believed to influence climate change.
3. For a list of Annexe 1 countries to the UN Framework Convention on Climate Change, see: [http://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php](http://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php)


Contact: truongt@itls.usyd.edu.au

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