



## **Comparing the impacts of greenhouse gases on peak global warming and the rate of warming**

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Global warming potential integrated over 100 years (GWP-100) is widely used as a metric to compare the impacts of different greenhouse gases on climate change. GWP-100 is often the metric used when calculating the carbon dioxide equivalent (CO<sub>2</sub>e) of different greenhouse gases (GHGs), however other metrics such as global temperature potential (GTP) also exist.

In this paper we consider a number of different metrics for comparing GHGs and explore their relevance to different indicators of climate change. The main indicators we consider are peak global warming, which can be used as a proxy for many key climate-related impacts, and the peak global warming rate, which will affect the feasibility and cost of adapting to climate change. We introduce the concept of global peak temperature potential (GPTP), a metric for comparing GHGs' impact on peak global warming, and consider the relationship between GWP-20 and warming rate.

We find that metrics that are useful for comparing GHGs' impact on peak warming are not as useful when considering a GHGs' impact on the peak rate of warming, and vice versa. Hence if avoiding dangerous climate change is defined as limiting both peak warming and the peak warming rate, then it is inherently impossible to define a single one-dimensional metric that can usefully compare the effect of different GHGs' impact on the risk of causing dangerous climate change. We therefore propose a two-dimensional metric for comparing a GHGs' impact on peak warming and rate of warming. Finally, we suggest one possible way that a two dimensional metric could be used in emissions trading, where GWP is used almost exclusively at present.