Unmask temporal trade-offs in climate policy debates
Both 20- and 100-year time scales should always be reported

By Ilissa B. Ocko,1 Steven P. Hamburg,1
Daniel J. Jacob,2 David W. Keith,3
Nathaniel O. Keohane,4 Michael
Oppenheimer,5 Joseph D. Roy-Mayhew,4
Daniel P. Schrag,6 Stephen W. Pacala6

Global warming potentials (GWP) have become an essential element of climate policy and are built into legal structures that regulate greenhouse gas emissions. This is in spite of a well-known shortcoming: GWP hides trade-offs between short- and long-term policy objectives inside a single time scale of 100 or 20 years (1). The most common form, GWP20, focuses on the climate impact of a pulse emission over 100 years, diluting near-term effects and misleadingly implying that short-lived climate pollutants exert forcings in the long-term, long after they are removed from the atmosphere (2). Meanwhile, GWP100 ignores climate effects after 20 years.

We propose that these time scales be ubiquitously reported, not necessarily “supporters” of a 100-year time horizon but prefer the status quo. GWP20

cause of the urgency of climate action, we believe that benefits of advocating different time horizons do not compensate for delays of implementation that continued wrangling could incur.

An example of our approach is as follows: Using GWP20, a pulse of emissions from cars fueled by compressed natural gas (CNG) (see the photo) versus gasoline (8) emits 80 versus 89 kg CO2e per unit energy, respectively (carbon dioxide equivalent, CO2e, represents emissions weighted by GWP). Here, CNG appears better for the climate. If GWP100 is used, the same pulse of emissions yields 115 versus 95 kg CO2e per unit energy, respectively. Here, gasoline appears better for the climate. Our reporting method would yield: “the CNG car emits 115/80 kg CO2e per unit energy, the gasoline car emits 95/89 kg CO2e per unit energy.” This makes it clear that a shift from gasoline to CNG would create more short-term warming but less in the long-term. Although ethical considerations remain, the technical implications are transparent.

This convention can extend to other metrics should users choose different constructs (although we emphasize that GWP should also be used for consistency). For example, global temperature potential (GTP), the change in global mean surface temperature due to an emission relative to that by CO2, is considered by some to be a superior metric to GWP, as it gives less weight to short-lived climate pollutants in the long-term (2, 5, 6, 9), by focusing on temperature change at a specific point in time rather than radiative forcing averaged over a time period. The time horizon contrast is even starker with GTP; this makes the use of a two-valued approach an even greater imperative.

The two-valued strategy will provide much-needed clarity to climate policy analyses, which typically use only one time horizon and thus suffer from confusing and often misleading debates about policy trade-offs. Consider two gas-versus-coal studies with conflicting conclusions regarding climate benefits (10): Anti–shale gas advocacy often emphasizes GWP20, whereas the pro–shale gas community emphasizes GWP100. Similar contradictions have occurred in an analysis of diesel versus CNG buses (11). Advocates of vegan diets often emphasize GWP20 Because it elevates the importance of methane emissions associated with livestock (12).

Although occasional reports reference both metrics (e.g., (13, 14)), the lack of a standardized format means the two-valued approach has not become the norm. GWP100 users are not necessarily “supporters” of a 100-year time horizon but prefer the status quo. GWP20

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users are indeed supporters of a shorter time horizon, because GWP_{100} dilutes the impact of short-lived pollutants. Requiring both time horizons should satisfy the latter community’s concern that GWP_p has not received the same official imprimatur as GWP_{100} [i.e., in the United Nations Framework Convention on Climate Change (UNFCCC)].

The origination and acceptance of two-valued metrics in other fields reveals no major pushbacks. Default reporting of systolic-diastolic blood pressure and city-highway fuel economy quickly became norms once a clear case was made for the importance and incompleteness of each measure in the pair by itself and once the measure was adopted by a collection of influential and diverse first users. Widespread adoption of a two-valued GWP would be facilitated by working with editorial boards of key scientific journals, scientific societies, and the Intergovernmental Panel on Climate Change to encourage use in the scientific literature, and with the U.S. Environmental Protection Agency, UN Environmental Programme, and UNFCCC to recommend use in reports. A two-valued convention would improve decision-making by turning short-term versus long-term into short-term and long-term.

REFERENCES AND NOTES
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CLIMATE POLICY

A climate policy pathway for near- and long-term benefits

Climate actions can advance sustainable development

By D. Shindell, N. Borgford-Parnell, M. Brauer, Haines, J. C. I. Kuylenstierna, S. A. Leonard, V. Ramanathan, A. Ravishankara, M. Amann, L. Srivastava

The Paris Climate Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) explicitly links the world’s long-term climate and near-term sustainable development and poverty eradication agendas. Urgent action is needed, but there are many paths toward the agreement’s long-term, end-of-century, 1.5°C to 2°C climate target. We propose that reducing short-lived climate pollutants (SLCPs) enough to slow projected global warming by 0.5°C over the next 25 years be adopted as a near-term goal, with many potential benefits toward achieving Sustainable Development Goals (SDGs). As countries’ climate commitments are formally adopted under the agreement and they prepare for its 2018 stocktaking, there is a need for them to pledge and report progress toward reductions not just in CO2 but in the full range of greenhouse gases (GHGs) and black carbon (BC) (plus co-emissions) in order to track progress toward long-term goals.

Climate changes over the next few decades will limit the ability of human and natural systems to adapt. This is especially problematic for the poorest populations, which are particularly vulnerable. Additionally, impacts such as sea-level rise and glacier melting are influenced by cumulative heat uptake, and many impacts may be nonlinear.

Given these challenges, reductions in emissions of SLCPs, including methane and BC—the second and third most important warming agents after CO2 (1)—can provide near-term climate benefits while CO2 emission reductions are implemented for long-term stabilization. Without reductions in both CO2 and SLCPs, temperature increases are likely to exceed 1.5°C during the 2030s and exceed 2°C by mid-century (24).

Many actions to reduce near-term warming by mitigating SLCPs inextricably link human and ecosystem health, development, and sustainability benefits (2, 3). For example, providing 3 billion of the world’s poorest people access to modern forms of energy could eliminate the large health burden from household BC-related air pollution. Reducing methane emissions (see the photo) will help reverse the trend of increasing background levels of health- and crop-damaging tropospheric ozone. Transitioning to climate-friendly alternatives to hydrofluorocarbons (HFCs) in combination with improved energy efficiency can reduce both CO2 and co-emitted air pollutants.

If limiting long-term peak temperature change were the sole objective, SLCP reductions could be implemented much later with only a modest penalty (3). The case for urgency comes from the fact that early mitigation of SLCPs helps to meet SDGs and, within the goal of climate action, (i) reduces damages due to climate change over the next few decades, including those dependent upon the pace of climate change such as biodiversity losses; (ii) slows amplifying feedbacks, such as snow-and-ice albedo that are highly sensitive to BC; (iii) reduces the risk of potential nonlinear changes, such as release of carbon from permafrost or ice-sheet collapse; (iv) increases the probability of staying below 2°C through mid-century (2, 3); (v) reduces long-term cumulative climate impacts; (vi) reduces costs of meeting temperature targets relative to late SLCP mitigation (5); and (vii) stimulates progress toward the long-term 2°C target through achievement of near-term benefits (6).

A near-term goal provides a way to incor-