

LETTERS

Edited by Jennifer Sills

Editorial expression of concern

IN THE 16 SEPTEMBER 2011 issue, *Science* published the Report “Unclicking the click: Mechanically facilitated 1,3-dipolar cycloversions” by J. N. Brantley *et al.* (1).

After concerns were raised in an e-mail to the editors from a reader, the corresponding author supervised a comprehensive evaluation of all data presented in the original manuscript by tracing all figures back to their raw data files. In over 50% of the figure parts, the authors deemed the data unreliable due to uncertainty regarding the origin of data or the manner in which the data were processed. A confidential investigation that is relevant to these concerns is currently being conducted by the University of Texas at Austin.

Pending the conclusion of the investigation, *Science* is publishing this Editorial Expression of Concern to alert our readers to the fact that serious questions have been raised about the validity of findings in the Brantley *et al.* paper.

Marcia McNutt

Editor-in-Chief

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Carbon markets: Effective policy?

IN THEIR POLICY FORUM “Carbon market lessons and global policy outlook” (21 March, p. 1316), R. G. Newell and his colleagues present an optimistic—but ultimately misleading—picture of existing carbon markets. Citing the expanded use of carbon markets, Newell *et al.* use economic theory to calculate the extent to which these policies are reducing net greenhouse gas emissions. In our view, it would be more realistic to look at how carbon markets are performing in practice, not theory. This distinction matters because actual markets are not producing the net emissions reductions for which they were designed.

One key problem is leakage, which refers to emissions that leave a jurisdiction because of the carbon price. Newell *et al.* claim that leakage has been small, but fail

to address problems specific to subnational policies. Both the Regional Greenhouse Gas Initiative (RGGI) (1) and the California market (2, 3) allow companies to swap emissions-intensive power contracts with neighbors in linked electricity markets not subject to carbon limits. Inadequate information precludes any conclusion on the Chinese pilot markets at this time; however, just as in RGGI and California, China’s grids are larger than its carbon markets.

The authors also gloss over the European Union’s problematic experience with international carbon offsets. Many of these offsets came from refrigerant factories that artificially generated extra emissions in order to destroy them for credit; their use in the EU Emissions Trading System has been substantial and came at the expense of actual emissions reductions (4).

Newell *et al.* close with a research agenda focused on the growth and consolidation of carbon markets. A more realistic research agenda would ask: Are existing carbon markets reducing net emissions as intended? If not, what policy reforms are required; and how effectively will these instruments, if left unaltered, scale to larger regions and stricter emissions targets?

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Response

CULLENWARD AND WARA raise two main issues: (i) Are carbon markets delivering the reductions they were designed to deliver? (ii) Can we use economic theory to calculate the extent to which carbon markets are reducing emissions? They then highlight two problems—leakage and offsets—that suggest carbon markets are not performing as designed.

Emission targets and programs are often designed with some understanding of potential problems. The Regional Greenhouse Gas Initiative (RGGI) was fully aware of the potential for leakage to neighboring regions, and intentionally designed their program to operate with low prices that limit leakage (1). California may have believed that it could successfully address leakage, but it also implemented a price floor that largely protects the rest of the program if it occurs (2). The European Union placed strict limits on the use of offsets, in turn limiting the potential for their abuse (3). Similarly, the Bonn and Marrakech conferences after the Kyoto Protocol largely renegotiated the original targets through limits on credits for carbon sinks, highlighting how even credit provisions that are widely acknowledged to influence environmental effectiveness can be part of an intentional program design (4). We believe that although leakage and problematic offsets are never desirable, they are often occurring in a way that was anticipated at the time the program was designed.

To answer Cullenward and Wara’s second question, we do not think that leakage and offsets negate the mitigation effects of the observed carbon price. We argue that carbon markets—even if flawed—are working and are reducing emissions. Leakage and certain offsets can yield reduction credit where it has not actually occurred in aggregate. Such reductions, however, are in addition to all of the real

reductions that have occurred. We believe that although leakage and problematic offsets are never desirable, they are often occurring in a way that was anticipated at the time the program was designed.



abatement activities that will occur at a given market price. We can certainly imagine subtleties that caution us from being too precise about our rough calculations, but our review suggests these issues are not problematic.

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A carbon code of conduct for science

MANY SCIENTISTS SUPPORT emissions reductions, but struggle with the fact that our research programs can produce a substantial amount of greenhouse gas pollution. When our personal emissions are greater than those of an average citizen (1–5), we are faced with a credibility gap in advocating for others to reduce their carbon footprint.

It is unreasonable for modern scientists to avoid emitting carbon entirely—such an action could grind research to a halt. However, it is difficult to determine when and where we should consider carbon usage to be appropriate, as there are no broadly accepted guidelines for ethical emissions in research. Since emissions are globally harmful (6), this issue requires attention and debate within the scientific community.

The dilemma of how to conduct research that causes harm has been thoroughly explored in medical research, where experimentation on animals is critical to the conduct of the discipline (7). Guidelines in modern science are based on three Rs: replacement with less sentient animals (e.g., replacing vertebrates with invertebrates); reduction in the number of animals used; and refinement of the research methods used such that pain and distress are minimized (8). This decision process can permit the conduct of research that is painful or lethal to



Scientists should take a page from animal research guidelines to minimize carbon emissions.

highly sentient animals, such as primates, provided that researchers can demonstrate that they ruled out all other options, and that the research is necessary. However, it establishes expectations for researchers to minimize the harm caused by their activities and to adopt alternatives where possible. These expectations are then enforced by institutional and national animal ethics bodies.

Science should adopt a carbon code of conduct, based on the three Rs. For scientific activities that require the emission of carbon, researchers should replace with less carbon-intensive activities, reduce the scope of the activity, and refine their research plan to maximize the scientific return for each unit of carbon emitted.

If the researcher concludes that their activity is essential and cannot be replaced, reduced, or refined, then a fourth requirement should be to mitigate carbon impacts through the purchase of reputable offsets (9) or by mitigating their emissions in a tangible and defensible manner (e.g., supporting community-based initiatives, such as tree planting). This requirement to offset would need to be initiated by funders, who would have to make such payments allowable within their granting programs.

It may be argued that the contribution of the science community to global emissions is too small to warrant such attention. However, the magnitude of our emissions is less important than the harm associated with the activity. It would not be acceptable to cause undue, unregulated pain to a single animal in the name of research, despite the fact that this harm would represent a tiny contribution to the collective suffering of animals around the world. Carbon emissions threaten the integrity of the global

ecosystem, so we should treat them with a similar level of seriousness.

There is no debate within the scientific community that climate change is dangerous and that emissions must be dramatically and immediately reduced to avoid catastrophic warming (6). Therefore, our actions and behaviors should match our messages. If broadly adopted, a carbon code of conduct would not restrict the advancement of knowledge any more than adopting ethical standards in animal research restricted medical science. However, it would provide accountability, help us reduce our carbon consumption, and ultimately facilitate our ability to engage the public on the issue of reducing emissions across society. We have little to lose and much to gain in seriously considering this most important environmental issue of our time.

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