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LETTERS

edited by Jennifer Sills

A Greener Future for China's Cities

IN THEIR PERSPECTIVE "CLEAN AIR FOR MEGACITIES" (30 OCTOBER 2009, P. 674), D. D. Parrish and T. Zhu highlighted the opportunities and challenges that exist for megacities to address air quality and climate change issues. In China, only 60.5% of the 287 large cities monitored in 2007 had air quality that met the standard of the Ministry of Environmental Protection of China (1). However, there is encouraging evidence that China is striving to build more low-carbon cities. In early 2008, the World Wildlife Fund collaborated on pilot programs with Shanghai and Baoding, focusing on how to implement low-carbon development in China's urban areas (2).



Afterward, Beijing, Shanghai, Tianjin, Shenyang, Wuhan, Hangzhou, and Shenzhen all laid out their respective low-carbon road maps (3–6).

The World Exposition Expo to be held in May 2010 will offer a glimpse of a greener future for Shanghai. During the construction of the Shanghai Expo Park, energy use efficiency and low greenhouse gas emissions were prioritized in activities such as planning, building, and transportation. For example, 4.5 MW integrated solar systems will be used to power buildings in the Expo Park. The use of this clean power is expected to save an estimated 4100 tons of carbon dioxide emissions annually, compared with coal-fired electric power (7).

Addressing air pollutants and climate-forcing agents in Chinese cities will require strategic urban planning, large-scale inputs of finances and technology, new regulations, and

lifestyle changes. The carbon emissions during the development of low-carbon cities (mostly existing district-level and larger cities) must also be taken into account. New regulations (8) have recently been issued in China to eradicate the corrupt inflation in statistics (9) associated with the development of low-carbon cities. If these are carefully implemented, we have every reason to look forward to more low-carbon cities in China.

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10. We acknowledge support from the key project of the Chinese Academy of Sciences (grant KZCX2-YW-341).

Bioenergy: Counting on Incentives

THE SUGGESTION BY T. D. SEARCHINGER *et al.* ("Fixing a critical climate accounting error," Policy Forum, 23 October 2009, p. 527) to account for CO₂ by "tracing the actual flows of carbon" appears to promote an approach to carbon accounting in which emissions and removals from a forest are determined on the basis of gross atmospheric fluxes between the forest, or forest products, and the atmosphere. This contrasts with the current "stock-change" approach, in which the annual removals or emissions from a country's forest are assumed to be equal to the net change in carbon stocks in biomass and soils of the forest estate.

We share the concern of the authors that a "critical climate accounting error" exists within the Kyoto protocol and could undermine greenhouse gas (GHG) reduction goals. However, we feel that their solution would create new, unintended disincentives for the sustainable use of biomass.

The practical problem in the current accounting framework is that some countries do not have commitments under the Kyoto Protocol, and they are therefore not obliged to account for emissions from loss of terrestrial carbon. Furthermore, some countries with commitments choose not to account for some sources of emissions (for example, conversion of natural to managed forest, conversion of grassland to cropland). Therefore, loss of carbon stock associated with the supply of biomass for bioenergy may not be accounted for.

Applying the atmospheric-flow accounting approach would not solve this problem. The importing country would account only for the carbon contained in the biomass used for bioenergy, even though the carbon stock losses in the cleared forest, especially if growing on peatland, could be many times greater than the quantity of carbon contained in the imported biomass (1). Replacing the current stock-change accounting approach with the proposed atmospheric-flow-based accounting approach would also lead to unintended incentives. For instance, combustion of biomass may appear in national GHG accounting with higher CO₂ emissions than coal combustion (because the energy content per unit of carbon is higher for coal than for biomass), even if biomass is harvested on a sustainable basis without reducing the biological carbon stock. This would make all imported bioenergy uncompetitive with fossil fuels. The negative impacts of the atmospheric-flow approach have been discussed in depth (2–5); the conclusions favoring a stock-change-based approach, which is applied in the existing GHG accounting framework, remain valid. Rather than abandoning the current approach and implementing the atmospheric-flow-based strategy that they advocate, we suggest retaining the existing stock-change-based accounting framework for biomass while extending the end-user's responsibility to include the terrestrial carbon stocks.

The "end-user country" would be required to take full or partial responsibility for changes in the terrestrial carbon stocks in the "producer country." Quantifying the change in carbon stocks attributable to bioenergy is difficult, especially given that bioenergy is not the only driver of land-use change. (For example, the food industry is also a rapidly growing market for vegetable oils.) Development of feasible accounting rules is thus a challenging task. However, it is critical that policy measures do not create disincentives for bioenergy from sustainable sources.

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Response

PINGOUD *ET AL.* AGREE WITH US THAT A carbon accounting error underestimates greenhouse gas emissions from bioenergy. Our Policy Forum offers a narrower solution than their Letter because we focus on a narrower source of the problem.

Pingoud *et al.* focus on the Kyoto Protocol decision not to limit most land-based emissions, which is equally true of many European and U.S. laws. Just as this decision leaves out most emissions from agriculture and forestry, it also means that emissions from the produc-

tion and use of bioenergy could potentially exceed those saved from fossil fuels, particularly over decades. This deliberate omission reflects measurement challenges, resistance by landowners, and the difficulty of distinguishing human from natural causes of many land-based emissions. We agree that some increased accountability for land-based emissions would be desirable, but worldwide enforceable limits are unlikely to come into effect soon. Incentives are likely to remain the main tool for reducing land-based emissions.

The decision to exempt most land-use emissions does not require the separate decision to exempt CO₂ emitted by using bioenergy from limits that are applied to energy emissions. Our Policy Forum focuses on the undercounting of net greenhouse gas emissions created by this exemption. Land use is affected because this energy rule incorrectly rewards activities that cut down forests or otherwise reduce carbon stocks to make bioenergy.

CORRECTIONS AND CLARIFICATIONS



News: "Armed and dangerous" by E. Pennisi (Special Section on Food Security, 12 February, p. 804). The potato blight leaf photo showed early blight, not late blight. Late blight is shown here. The image has been corrected in the HTML version online.

Random Samples: "Loading springs" (29 January, p. 507). The term "radioisotopes" should have been "environmental isotopes." Also, K. Shivanna is an isotope hydrologist.

Reports: "²³⁸U/²³⁵U variations in meteorites: Extant ²⁴⁷Cm and implications for Pb-Pb dating" by G. A. Brennecke *et al.* (22 January, p. 449). There was an error in the numerator of the expression on the left-hand side of Eq. 1. The correct expression is here. $\frac{^{207}\text{Pb}^*}{^{206}\text{Pb}^*}$

News Focus: "From medfly to moth: Raising a buzz of dissent" by I. Chen (8 January, p. 134). Light brown apple moth larvae have been observed feeding on only around 265 species, not more than 2000 plant species, as the story and photograph caption stated. The higher number is the agriculture agencies' estimate of all potential plant hosts for the pest, including relatives (such as cypress trees) in the same genera as those 265 species. Critics say that the larger figure is unsubstantiated.

TECHNICAL COMMENT ABSTRACTS

COMMENT ON "Movement Intention After Parietal Cortex Stimulation in Humans"

Hans-Otto Karnath, Svenja Borchers, Marc Himmelbach

Desmurget *et al.* (Reports, 8 May 2009, p. 811) applied direct electrical stimulation (DES) to the human cortex to study the origin of movement intention. Their interpretation assumed that DES causes cortical activation, whereas it is possible that it actually evokes deactivation. The lack of certain knowledge about the true effects of DES limits its use for validation of cognitive models.

Full text at www.sciencemag.org/cgi/content/full/327/5970/1200-c

RESPONSE TO COMMENT ON "Movement Intention After Parietal Cortex Stimulation in Humans"

Angela Sirigu, Carmine Mottolise, Michel Desmurget

Karnath *et al.* argue that the behavioral effects observed in our study after direct parietal and premotor electrical stimulation (DES) could reflect a decrease of local cortical activity. If so, intention and awareness would not reflect the activity of the stimulated area but the recruitment of remote regions. Although tenable, this view does not seem to be the most plausible.

Full text at www.sciencemag.org/cgi/content/full/327/5970/1200-d

Our solution is to count the CO₂ from all energy use but then to reward bioenergy to the extent it results from “additional” biomass—i.e., carbon that would not otherwise be stored in plants or soils. This approach does not treat liquid and solid biofuels as automatically equivalent to coal but credits them to the extent they truly offset energy emissions. This solution would not control land-based emissions spurred by economic factors or policies, as Pingoud *et al.* would wish, but it would properly count energy emissions and avoid creating inaccurate incentives to clear land and release carbon through the laws aimed at reducing global warming.

Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 3 months or issues of general interest. They can be submitted through the Web (www.submit2science.org) or by regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt, nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.

Our proposal does not imply using carbon fluxes instead of stock changes to measure carbon or otherwise change the accounting used in the U.N. Framework Convention on Climate Change (UNFCCC). Under that approach, emissions from land-use change are counted in the countries where they occur for international reporting purposes, not where timber or crops are consumed. By definition, the “carbon stock” approach can work only in a legal regime like the UNFCCC that counts changes in carbon stock—i.e., land-use emissions. The problem we identified is found in laws and treaties that do not legally “count” land-use emissions.

Our modest fix does not require “end-user responsibility” for land-use emissions, as suggested by Pingoud *et al.*, or any other direct or indirect regulation of those emissions. Instead, our approach is about accurately counting energy emissions and offsetting sinks. It treats bioenergy in the same way that the Kyoto Protocol and many other climate laws already treat agricultural and forestry activities. Although most of their land-use emissions are unregulated, land-use activities can only receive credits for off-

setting energy emissions when net effects are counted; thus, only “additional carbon” receives credits. The same approach should apply whether the offset involves sequestering carbon in forests or generating biomass for energy.

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