

## LETTERS

Edited by Jennifer Sills

## Reduce, relegalize, and recycle food waste

J. ASCHEMANN-WITZEL (“WASTE not, want not, emit less,” *Perspectives*, 22 April, p. 408) describes the challenges and benefits of reducing food waste, but does not discuss what to do with the food waste that remains. Because not all food waste is avoidable, it is critically important to pair efforts to reduce food waste with legislation that allows resource-efficient recycling of food waste when it does arise. Europe has yet to seize this opportunity for sustainability.

Countries such as South Korea already understand the importance of twinning food waste reductions with improved disposal. Since 2005, South Korea has reduced household and restaurant food waste by 30 to 40% while simultaneously improving food waste recycling. The disposal of food waste in landfills is banned, and 85% of food waste is recycled as animal feed or compost (1).

Europe lags behind. The European Union’s Waste Directive stipulates that by 2025 no biodegradable waste (including food waste) should be sent to landfills, but progress toward this target is highly variable. Although some nations, including Germany and the Netherlands, do divert food waste, across the whole of the EU-27 approximately 40% of municipal waste (including food waste) is still sent to landfills (2). Worse, some EU legislation prevents resource-efficient use of food waste. Despite evidence of the potential economic and environmental benefits (1, 3) and tentative steps to reclassify some surplus food as fit for animal feed (4), it remains illegal to use the vast majority of food waste as animal feed in the European Union because of historical disease control concerns (1). Meanwhile, countries such as Japan, South Korea, and Taiwan are all operating systems that safely recycle more than one-third of their food waste as animal feed (1). When it comes to reducing the impact of food waste, the European Union has much to learn from the Far East.

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Unlike some countries in Asia, the European Union still disposes of food waste in landfills.

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10.1126/science.aaf9630

## Burial law impedes scientific discovery

THE NEWS AT A GLANCE item “Ancient One’ to get Native American burial” (6 May, p. 634) reports the reburial of the 9300-year-old skeletal remains of Kennewick Man after 2 decades of legal wrangling between Native American communities and scholars. The story does not address the scientific ramifications of this decision.

The legal battles are the result of the dissolution of American skeletal and archaeological museum collections mandated by the 1990 Native American Graves Protection and Repatriation Act (NAGPRA). This law requires museums receiving federal money to turn over skeletal remains and archaeological objects to local Native American communities who can trace genetic or cultural affiliation to the human or cultural remains. NAGPRA was enacted by the U.S. Congress in response to political agitation and concerns about social justice.

The skeletal remains of about 50,000 people and 1.4 million archaeological objects have subsequently left major museums in the United States, and are therefore lost to science (1). Museum skeletal and archaeological collections constitute the raw data for biological anthropological and archaeological research. The reburial of the Kennewick material is deeply unfortunate for science. Scholars had only 2 weeks to examine the skeleton, and their results can never be replicated. Furthermore, no future refinements to ancient DNA analysis or the chemical analysis of prehistoric bone and enamel can be applied to the Kennewick specimen. In the context of war in the Middle East, the destruction of museum collections is routinely deplored as a crime against the cultural heritage of humankind. As a scientist, I feel a similar sense of loss when I hear the results of the NAGPRA legislation.

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## Modeling the effects of climate engineering

IN THEIR POLICY FORUM “Opportunities for advances in climate change economics” (15 April, p. 292), M. Burke *et al.* highlight three areas of climate change economics research: social cost of carbon, climate policy impacts, and developing economies. They overlook an important avenue of research that affects all three: climate engineering technologies, in particular solar radiation management (SRM).

SRM is an engineered change in Earth’s radiative forcing in an effort to reduce climate changes (1). Direct costs are low (2). SRM acts quickly (years) so it reduces part of the effective inertia of the climate system, profoundly altering the dynamics of any climate policy. SRM would substantially change the profile of climate impacts, disconnecting temperature from other changes caused by CO<sub>2</sub>, such as ocean acidification. It would also alter the distribution of climate impacts and policy choices across countries (3). Importantly, SRM would introduce new risks to the equation (4).

Integrated assessment models have a damage function that is largely calibrated in terms of temperatures. Recent versions

also add sea-level rise (5). This is a good approximation when damages from carbon concentrations and temperature are linked. SRM would change this relationship by reducing temperature without lowering carbon concentrations. Integrated assessment models must recognize the newly differentiated impacts. Naïvely introducing SRM into these models without further consideration would bias the results toward implementation of SRM.

SRM is an important part of the future climate policy research agenda, as illustrated by the latest National Academy of Sciences report (6, 7). Economists need to embrace research on SRM technologies, recognize their capacity to disrupt the climate policy agenda, focus on understanding the new impacts and risks introduced, and integrate this new understanding into models and policy design.

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#### TECHNICAL COMMENT ABSTRACTS

##### Comment on "The Atlantic Multidecadal Oscillation without a role for ocean circulation"

*Rong Zhang, Rowan Sutton, Gokhan Danabasoglu, Thomas L. Delworth, Who M. Kim, Jon Robson, Stephen G. Yeager*  
Clement *et al.* (Reports, 16 October 2015, p. 320) claim that the Atlantic Multidecadal Oscillation (AMO) is a thermodynamic

response of the ocean mixed layer to stochastic atmospheric forcing and that ocean circulation changes have no role in causing the AMO. These claims are not justified. We show that ocean dynamics play a central role in the AMO.

Full text at <http://dx.doi.org/10.1126/science.aaf1660>

##### Response to Comment on "The Atlantic Multidecadal Oscillation without a role for ocean circulation"

*Amy Clement, Mark A. Cane, Lisa N. Murphy, Katinka Bellomo, Thorsten Mauritsen, Bjorn Stevens*

Zhang *et al.* interpret the mixed-layer energy budget in models as showing that "ocean dynamics play a central role in the AMO." Here, we show that their diagnostics cannot reveal the causes of the Atlantic Multidecadal Oscillation (AMO) and that their results can be explained with minimal ocean influence. Hence, we reaffirm our findings that the AMO in models can be understood primarily as the upper-ocean thermal response to stochastic atmospheric forcing.

Full text at <http://dx.doi.org/10.1126/science.aaf2575>



**Modeling the effects of climate engineering**

David Keith, Gernot Wagner and Juan Moreno-Cruz (June 23, 2016)

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Editor's Summary

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