AUTHOR COMMENTARIES - From Special Topics

Biofuels - August 2008
Interview Date: September 2008

PDF

Prof. Daniel Kammen and Mr. Richard Plevin

From the Special Topic of Biofuels

According to our Special Topics analysis on Biofuels, the paper "Ethanol can contribute to energy and environmental goals," (Farrell AE, et al.*, Science 311 [5760]: 506-8, 27 January 2006) is a core paper in the Research Front Map of Ethanol Biofuels. At present, it has 114 citations. This month,* ScienceWatch.com *talks to two of the paper's authors, Dr. Daniel Kammen and Mr. Richard Plevin.*

Dr. Kammen is the Class of 1935 Distinguished Professor of Energy in the Energy and Resources Group and the Goldman School of Public Policy at the University of California, Berkeley. Mr. Plevin is a Ph.D. candidate in the Energy and Resources Group at Berkeley.

Below, Dr. Kammen and Mr. Plevin discuss this paper and its impact on the biofuels movement.

SW: How did you become involved in this research, and were there any particular successes or obstacles that stand out?

In 2005, the debate over whether corn ethanol had a positive or negative net energy value was raging, with reputable researchers from top universities arriving at opposing conclusions. A group of graduate students in the Energy and Resources Group, who were already working on various aspects of biofuels, were interested to understand how this could be the case. Together with Professors Farrell (deceased), Kammen, and O'Hare, we decided to build a meta-model to compare several corn ethanol studies on an equal footing.

One of the outcomes of this effort was developing a better quantitative understanding of a number of the agricultural inputs to corn production. Studies citing various USDA documents for application rates of agricultural lime showed values spanning three orders of magnitude, but in the course of reviewing this data, we discovered that the high and low values were due to errors. This resulted in corrections from the USDA to their data sets, and an update of the well-known and widely used GREET fuel and vehicle life cycle model.

Our model, EBAMM, is, and has since the time of publication of our paper, been available to download for free. The model is updated periodically.

The objective of this modeling effort has been transparency of assumptions and the sources of the values used in the analysis, as well as maximum flexibility for users to take the model (in Excel®) and conduct runs with parameters of their choosing.

Coauthor
Mr. Richard Plevin

SW: Would you please describe the major points of your paper and why it is garnering citation attention?

Our paper illustrated clearly where several well-known corn ethanol studies differed in their assumptions and how these differences drove the divergent results. Some of these differences were due to legitimate disagreements about system boundaries; other differences were due to the use of outdated data. We cataloged these and normalized system boundaries across studies allowing a meaningful comparison to be made.

We also determined that ethanol from cellulosic feedstocks might be dramatically less greenhouse gas (GHG) intensive than corn ethanol, which even if refined properly, offered at best a slight reduction in GHG emissions versus gasoline. We noted that even this result ignored possible GHG emissions from so-called "indirect" land use conversion induced by increasing the acreage devoted to biofuel feedstock production. When our paper was published this effect had not yet been quantified. The Searchinger *et al.* paper in *Science* ("Use of US croplands for biofuels increases greenhouse gases through emissions from land-use change," 319 [5867]: 1238-40, 29 February 2008) quantified that effect, and we now believe that substituting corn ethanol for gasoline increases net GHG emissions, and a key determinant of the GHG benefits of cellulosic biofuel will be whether it is grown on land that could grow food.

Another key—though less-often noted—point of our paper is that the entire debate over Net Energy Value (NEV) is largely irrelevant. Summing across different types of primary energy doesn't answer any useful question. It's like addressing hunger by shipping biomass to a poor country without distinguishing between food, feed, fiber, and building materials. For example, upgrading coal and natural gas to electricity or to a liquid fuel has a valid societal purpose that is completely outside a calculation of NEV. Minimizing NEV, we wouldn't produce electricity owing to the inevitable losses in generation, transmission, and distribution. This is obviously nonsense, and we are pleased to see little discussion of NEV in the current policy debate.

Our paper computes two metrics that we feel are more salient: petroleum used per unit of ethanol produced and life cycle GHG emissions. These metrics directly address two questions we care about as a society, namely reducing petroleum consumption and mitigating climate change.

SW: Where do you see your research and broader field leading in the future?

We are now focused on the issue of indirect land use change, with several modeling efforts underway and papers in the works addressing two related challenges: (a) quantifying this effect given the large uncertainties and coarse models available, and (b) understanding how to include such an uncertain—yet critically important—effect in fuel regulations that are currently under development. While the GHG emissions from indirect land use change are highly uncertain, our estimates indicate that they are high enough to negate the climate benefits we calculated earlier for fuels like corn ethanol and soybean biodiesel.

"Summing across different types of primary energy doesn't answer any useful question. It's like addressing hunger by shipping biomass to a poor country without distinguishing between food, feed, fiber, and building materials."

The issue of indirect land use effects of biofuel production have led to an expanded analytical basis, as well as academic and commercial interest in biofuels that do not compete with food, such as those produced from algae, municipal solid waste, agricultural residues, and forest wastes.

SW: What are the implications of your work for this field?

Many jurisdictions are already regulating or planning to regulate the GHG effects of biofuels or transportation fuels more generally. In the US, both the California Air Resources Board and the US EPA are studying the issue, and our team is contributing to these efforts. Various European regulatory agencies are also grappling with this issue, and in the UK, the Renewable Fuels Agency just released an important report on the subject of indirect land use change (the so-called Gallagher Review).

The move from volumetric standards, which ignored the differential GHG profiles of

different fuel production systems, to performance-based standards based on life cycle GHG emissions is a major improvement in regulation. At the moment, the science is racing to catch up with the regulations. Our work, and the work of our colleagues around the world, helps inform these critical regulatory efforts.

As a result of these efforts we are now exploring:

- Opportunities for "food-friendly" biofuels, notably in poor regions where food production and biofuel production could both be increased.
- Certification schemes for "sustainably produced" biofuels.
- An expansion of the EBAMM methodology to reflect fuel impacts on water, biodiversity, community livelihoods, and other less easily quantified aspects of sustainability.

Daniel Kammen, Ph.D.
Energy and Resources Group
and
Goldman School of Public Policy
and
Department of Nuclear Engineering
University of California, Berkeley
Berkeley, CA, USA

Richard Plevin, Ph.D. candidate
Energy and Resources Group
University of California, Berkeley
Berkeley, CA, USA

Prof. Daniel Kammen and Mr. Richard Plevin's most-cited paper with 114 cites to date:

Farrell AE, *et al.*, "Ethanol can contribute to energy and environmental goals," *Science* 311(5760): 506-8, 27 January 2006. Source: *Essential Science Indicators* from Thomson Reuters.

Keywords: biofuels, ethanol, net energy value, corn production, GREET, EBAMM, fuel life cycle modeling, indirect land use, greenhouse gas emissions, sustainably produced biofuels.

PDF

back to top

Special Topics : Biofuels : Daniel Kammen & Richard Plevin

Scientific Home | About Scientific | Site Search | Site Map