Agriculture, Resources, and the Environment

I. Energy and Climate Footprinting of Food Production and Supply Chains

Summary
This initiative quantifies energy use and greenhouse gas (GHG) emissions, focusing on the entirety of the food production and supply chain to identify energy and emissions "hotspots", evaluate the impacts of new practices and technologies, and assess trade-offs between interventions at different stages of the supply chain for selected categories of foods. The research uses a life cycle assessment approach, a methodology well-suited for examining environmental impacts emanating from across an entire supply chain, from production to processing, distribution, retailing, preparation, and waste management. This initiative also includes basic field research to measure greenhouse gas emissions and the carbon sequestration potential in cropping systems. Finally, an additional goal is to offer training and outreach for farmers, UC Extension, and related professionals on strategies for reducing energy use and emissions in farming operations.

Problem statement/ Baseline
The food system, including production, processing, distribution, retailing, preparation, and waste handling, looms large as a major user of fossil fuels and producer of greenhouse gases (GHG). Estimates indicate that it accounts for up to 30 percent of the total anthropogenic GHG emissions generated by the consumer economy in industrialized nations.[i] Livestock alone account for a large portion of all human-induced GHG emissions, with estimates varying from 3 percent in the US[ii] to 18 and as high as 50 percent on a global scale.[iii,iv] A stream of new policies are aimed at reducing greenhouse gases, including AB32 in California, which requires a 20% reduction in greenhouse gas emissions across all economic sectors in the state by 2020 and 80% by 2050. To date, however, the main emphasis in implementing this legislation is to regulate emissions from individual sectors. This approach does not account for significant upstream and downstream impacts that occur when changes are made at a single stage in the life cycle of consumer products such as food.

Structural issues/ Broad drivers shaping change
- Global markets, relatively low fuel prices, and new developments in containerized shipping have made exotic, perishable foods shipped long distances as well as highly processed foods easily accessible to most people in industrialized economies like the US.
- Changing American lifestyles and the preponderance of households with both spouses employed has increased the popularity of eating pre-packaged, pre-cooked foods and eating outside of the home.
- Increasing affluence worldwide, especially in emerging economies like China and India, is driving increasing demand for livestock products, which are known to be energy and GHG-intensive.

Strategic opportunity

Individual foods vary tremendously in their energy and climate footprints due to differences in production methods and input intensity, processing technologies, transportation modes, and preparation and waste handling options. Moreover, changes made in one stage of the supply chain often affect energy use and emissions in downstream stages. Research that analyzes these impacts and identifies the key sources of variation for individual foods can help decision makers at all stages of the supply chain to understand opportunities for greater efficiency and potential impacts of energy price increases and possible new climate-related regulations. In addition, interest in "carbon footprinting" and "food miles" is increasing rapidly among the consumer public, the food industry, and policy makers.

Desired outcomes

- Producers, processors, retailers, and food service companies understand the energy and GHG implications of a variety of technical options for their operations. As a result, they make informed management choices that lower the energy and climate impacts of their operations, improve their resource-use efficiency, and prepare their operations for climate-related regulation.
- Consumers understand the differences between key food choices and know which parameters are most important to consider in making environmentally sound choices.
- Policy makers have a more complete understanding of where to target policies for maximum GHG reductions, and how policies to reduce emissions in specific sectors will potentially affect emissions from other sectors.

Key Partners

- Producers (farmers, ranchers, dairies)
- Food processors (California League of Food Processors, Morningstar)
- Food distributors, retailers and institutional food service providers
- UCCE
- CA Air Resources Board and Dept of Food and Agriculture

Activities

- Life cycle assessments. Collaborate with food industry companies to conduct applied research on strategically selected food products, accounting for key production and processing methods, and distribution and consumption choices that are most significant in energy and GHG savings (or hotspots). Examine trade-offs in impacts from new technologies or methods in different stages of the food production and supply chain.
- Field research on emissions in cropping systems. Conduct field-level research to quantify nitrous oxide and methane emissions as well as carbon dioxide emissions and sequestration in different crop and livestock systems under different management regimes.

- Training in climate science and emissions reductions methods for producers. Train UCCE farm advisors, crop advisors, and producers in methods to assess opportunities for lower field emissions and increased carbon sequestration. Additional training may include issues of "carbon footprinting", food labeling, and carbon credit schemes for growers.
- Website development. Create a one-stop shop for UCCE, farmers, and ranchers seeking to increase energy efficiency and reduce GHG emissions.

Resources needed for 5 years

Total need: $5.25 million

- Research grants (intra- or extramural funds) to investigate 5 key topic areas in life cycle assessment @ $150K each = $750K
- Research grants for projects on field emissions and alternative practices to feed into LCA studies @ $800K per year = $4 M*
- Training grant @ $200K
- Website development and updating (part-time IT staff to establish in yr 1 plus students to maintain over 4 yrs) = $75K

- *Additional SAREP/ASI staffing (using extramural funds) dedicated to ARE @ $60K for 5 years = $300K [part of all initiatives]*

Current extramural grants:
$112K for life cycle assessment research
$2M for field emissions research (additional amounts pending)

Additional need: approx $1-2 million

***** projected income from grant applications by J. Six

[i] European Commission. 2006. *Environmental Impact of Products: Analysis of the Life Cycle Environmental Impacts Related to the Final Consumption of the EU-25*. Technical Report EUR 22284 EN. Spain: European Comission, Joint Research Centre, Institute of Prospective Technological Studies.

[ii] Pitesky, M.E., Stackhouse, K.R., and Mitloehner, F.M. 2009. Clearing the Air: Livestock's Contribution to Climate Change. In Donald Sparks, editor: *Advances in Agronomy*, Vol. 103, Burlington: Academic Press, 2009, pp. 1-40.

[iii] Steinfeld, H., P. Gerber, T. Wassenaar, V. Castel, M. Rosales, C. De Haan. 2006. *Livestock's Long Shadow: Environmental Issues and Options*. UN Food and Agriculture Organization.

[iv] Goodland, R. and Anhang, J. 2009. Livestock and Climate Change: What If the Key Actors in Climate Change Are…Cows, Pigs, and Chickens. *World Watch*: Nov-Dec.