2017 REQUEST FOR INNOVATION

Increasing Food Preservation Efficiencies to Optimize Energy Usage and Health Outcomes

INTRODUCTION

Cold food preservation has revolutionized our ability to safely distribute nutritious products worldwide. However, the cold chain has severe limitations in its requirement for continuous energy and need for temperature controlled storage and transportation. The "dry chain" is one potential complement, reducing energy to only a single input in drying and transforming food into shelf stable products that do not require temperature control. While an ancient form of food preservation, drying practices remain primitive and provide ripe opportunity for innovation. We hope you will join us in identifying new ways to innovate the food system.

BACKGROUND

Energy inputs present the greatest cost for food production and processing. Yet ineffective preservation results in huge spoilage waste across storage and distribution channels, and introduces food-borne toxins that affect countless populations in the US and abroad. Disrupting this high-cost, high-waste scenario will be our target for impact in the next 12-24 months. Thereafter, the nutrition benefits of sustainably grown, well preserved food sources can be the focus of innovations to ensure food safety and affordable access into the future.

Last year, the Innovation Institute for Food & Health at the University of California seeded projects in food, agriculture, health, engineering and technology. Having consulted with research and industry colleagues in 2015 and 2016, two interdisciplinary themes have subsequently emerged as priorities. This year, partnerships will focus on innovative solutions at the interface of energy and food. An initial joint endeavor between the Energy Institute at Colorado State University (CSU) and the University of California at Davis (UCD) emphasizes technologies and processes to address energy inefficiencies, food safety and nutritional content in food preservation. Additional academic and industry partners are welcome to join a proposal, or engage with us directly in expanding the initiative.

ENERGY-FOOD NEXUS

An illustrative area of interest includes, but proposals should not be limited to, innovations to augment cold storage approaches, such as improving traditional drying practices used for tree nut, corn and rice preservation in the US. Instruments of change beyond food preservation technologies include advances in packaging, distribution, consumer education and behavior, as well as market and policy drivers.

Team Composition: At minimum, teams should comprise one faculty each from UCD and CSU. It is strongly encouraged that teams also include members of external groups willing to commit resources to the project (materials, expertise or funding). Please register your interest via the following survey to assemble a list of potential faculty and partners: https://www.surveymonkey.com/r/XT7W9KH.

Project Guidelines: Projects should be scoped for a maximum of two years, however one year projects are strongly encouraged. Total funds for the project should fall in the range of $50,000 to $250,000 direct-cost over two years, with approximately equal division of effort between UCD and CSU counterparts. Faculty salaries are not supported. We expect to award two to three collaborative projects, starting in October 2017. Funded projects will be expected to report quarterly on progress, with biannual meetings to review related challenges and opportunities.

Proposal Timeline & Requirements: Applications are due no later than **5pm PST on July 31**, and will be submitted online in PDF format to innovation@ucdavis.edu. Proposals should include a public abstract (1/4 page), and describe the project concept and the expected impact in terms of energy savings, mitigation of food waste, nutrition capture or stable storage (4 pages); synergistic capabilities of the team (1 page); budget and justification (1 page); and proposed timeline with quarterly deliverables clearly defined (1 page). Arial font size 11 with single spacing and 1 inch margins are expected. References are expected, along with 2 page CVs, but not included in page limits. Awards will be announced in September, with projects commencing in October. Priority will be given to applications that demonstrate excellence in the following areas:

1. Clear milestones and deliverables, with proposed mitigation strategies for anticipated challenges.
2. At a stage where project funding will result in reduced technical, business or social risk for implementation.
3. Articulated competitive and cultural opportunity, with need and beneficiary of the innovation clearly defined.
4. Leveraged interdisciplinary relationships (e.g., scientific, technological, social and/or cultural) for contributing to increased energy efficiency in healthful food preservation. Partnership with industry is strongly encouraged.
5. Clear steps to translate the project towards impact (e.g., elements of design, user acceptance, social diffusion, political feasibility, governance and enforcement).

UC DAVIS INNOVATION INSTITUTE FOR FOOD AND HEALTH   ENERGY INSTITUTE   Colorado State University

EXPANDED PROBLEM STATEMENT

The food system currently is estimated to consume over 15% of energy within the United States. Between 1997 and 2002, energy usage in the food system rose six times faster than the rate of total energy usage within the US. While usage declined from 2003 to 2012, the dominant source of food-related energy remained electricity, at 57% in 2012. Across the food sector, energy usage breaks down as follows (according to the most recent 2012 data):

Sector	Quadrillion BTUs	Percent Energy Consumption of Food System
Farm Production	1.4	12%
Food Processing	2.2	18%
Packaging	0.7	6%
Transportation	0.8	7%
Wholesale/retail	1.0	8%
Food Service	1.7	14%
Household food service	3.5	29%
Household transportation	0.6	5%
Total	11.9	100%

While energy usage in the food system is highly fragmented between sectors, refrigeration is one form that cuts across sectors and requires continuous energy input as part of cold chain storage and transport. Cold food preservation is designed to capture nutrients for stable storage and transport prior to sale and consumption. One potential complement to address limitations of the cold chain is to introduce the concept of a "dry chain". For many products, a single input of energy could be used to dry the food for safe storage over extended periods. This would not only cut down on constant energy usage along the cold chain, but transformation of products through a single energy input into shelf stable packaging could address the current US food waste crisis, where it is estimated that roughly 40% of food currently produced is discarded between farm and fork.

Drying is not a new concept within the food system, but current standards for drying remain primitive, with significant room for improvement. The fraction of energy used in drying varies by crop, location and weather. For example, in the Midwest where corn usually requires removal of 5 to 10% of total fresh weight in moisture after harvest, "the amount of energy consumed by drying can be greater than that used in field operations". In California, rice is harvested with an average moisture content of 21% and must be dried to about 14% for safe storage; about 70% of the crop is dried using heated-air column dryers, whose natural gas fuel represents 20% of total production costs. Similarly, drying of prunes currently represents up to 30% of the total production cost. Fruit and vegetable dehydration in the US is estimated to account for 15% of total energy use in the sector. Large-scale drying is also employed elsewhere in the food industry. For example, in producing dehydrated mashed potatoes, soups, and juices for concentrates such as tomato paste, ketchup and sauces. In fact, "the drying process is one of the most energy intensive processes employed in the entire US food processing industry, with typical energy intensity values ranging from around 1,500 BTUs per pound of water in the product to over 28,000 BTUs per pound of water in the product". Based on the amount of total energy used for food production and its distribution, we estimate that agricultural and food drying could have accounted for at least 1.6 quadrillion BTUs of energy usage in 2002 (the latest accessible data).

In order to improve energy efficiency across the system, steps must be taken to address wasteful preservation processes, compromised humid storage, nutrient retention at the source, and informed consumer decision-making. You are invited to contribute to the next innovation cycle to make a systemic difference.

Further reference material:

* Energy Use in the U.S. Food System. Economic Research Report Number 94 March 2010.
* Cuellar and Webber. 2010. Env. Sci. & Technol. 44: 6464-6469
* https://www.ers.usda.gov/webdocs/publications/82194/err-224.pdf?v=42804
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* http://coststudies.ucdavis.edu/current/
* Sikirica, S.J., J. Chen, J. Bluestein, A. Elson, J. McGervey, and D. Caughey. (2003). Topical Report: Research Collaboration Program Food Processing Technology Project, Phase 1. Gas Technology Institute, Des Plaines, Illinois. Report GRI-03/0075