Waste Not: Closing the Loop on Organics Wastes

PI: Lawrence A. Baker, Research Professor, Department of Bioproducts and Biosystems Engineering, 612-626-1258 (cell: 763-370-1796).

Internal collaborators (alphabetical order):

Steve Kelley, Senior Fellow, Humphrey School
William Lazarus, Professor, Department of Applied Economics
Roger Ruan, Professor, Department of Bioproducts and Biosystems Engineering
Carl Rosen, Professor and Chair, Dept. Soil, Water, and Climate
Timothy Smith, Associate Professor, Depart. Bioproducts and Biosystems Engineering.
Gerry Shurson, Professor, Animal Science Department.

External collaborator: Sara Hughes, Currently at U.S. EPA, soon to join the Political Science Department at the University of Toronto as Assistant Professor

External Technical Advisory Group* (TAG) (alphabetical order)

Eric Anderson, Lab Director, Superior Process Technologies
Laura Babcock, Director, Minnesota Technical Assistance Program
Tim Farnan, Laboratory Manager, MPCA Organics Management Team
Dave Heberholz, Director, Solid Waste and Recycling, City of Minneapolis
Paul Kroening, Supervising Environmentalist/Recycling Program Manager, Hennepin County Environmental Services
Rick Rudd, Business Manager, Covanta, operator of the Hennepin County Energy Recovery (HERC) facility
John Snyder, President, Minnesga, Inc.
Leisa Thompson, General Manager, Environmental Services Division, Met Council

*Letters are attached

Proposal category: Research (80%) and Commercialization (20%)

Total funds requested $422,972
PROPOSAL NARRATIVE

OBJECTIVES
The overall objective of this project is to learn how urban organic wastes (sewage biosolids, pre-consumer and post-consumer food waste, and urban vegetation waste) are generated, how they flow through coupled city-farm systems, and how these flows can be re-engineered to improve sustainability. Until very recently, most organic wastes in the Twin Cities were landfilled directly or incinerated and then landfilled—a “flow-through” system. As landfills reach capacity, wastewater treatment processes improve (increasing the volume of biosolids), and wastes are assigned new values, we have started to re-engineer the flows of organic wastes, moving toward a circular economy. For example Baker (2011) concluded that only 4% of the phosphorus (P) entering the Twin Cities was recycled in 2000, but that 75% could be recycled using off-the-shelf technologies. As an example of finding added value in organic wastes, our preliminary calculations (Shurson and Baker) indicated that the Twin Cities generates enough food waste in a year to provide the calorie requirements to bring 250,000 hogs to market weight. However, re-engineering of urban organic waste systems requires technology advances, such as novel processes for treatment and conversion of wastes to renewable energy and bio-products, as well as research to understand the economic, social, and political drivers that structure waste flows. Our case study is the Twin Cities and its foodshed, henceforth the TC-FS, a tightly coupled system of agricultural production and urban consumption (Peterson, et al. prep.).

The timing of this initiative is propitious. Minneapolis and other cities in the region are moving toward household level source-separated organic (SSO), incinerators at the Met Council Wastewater Treatment Plant are nearing obsolescence, conventional fertilizer prices (especially P) have risen quickly, hog farmers are confronted with higher feed prices, and regional landfills are filling up. In this ecosystem, our proposed research has found a receptive audience, ripe for translating “Waste Not” research findings to practice.

METHODS
(1) Quantifying production, flows, and losses of organic wastes. We have started work on this topic through several projects led by co-PIs Baker and Smith. In the Waste Not project, we will develop a complete quantification of organics flows through the TC-FS system, including inputs of animal feeds, production of animal products and manure, flows through food processing operations, consumption by humans and their pets, production of landscape vegetative wastes, disposal of food wastes before and after consumption, processing of sewage, and disposal of biosolids. We will also characterize these wastes with respect to chemical composition and nutrient value using public sector data augmented by more detailed compositional analysis (e.g., nutrient content and availability; see below), building on research now being conducted by co-PI Rosen on biosolids ash. A spreadsheet model tool will be developed for analyzing organics flows under current conditions and various re-engineering scenarios during year 1. We anticipate that this project element will be completed in year 1, to be summarized in a journal article, with results to be used as input to a systems dynamics model (SDM) to be developed in year 2.
1A. Spatial variation in waste generation from large facilities. We (led by Smith and Lazarus) will characterize spatial variation of waste generation of key food processing and wastewater treatment facilities in Minnesota. Although our focus in year 1 is the Twin Cities, this task is best structured to include the entire state; moreover, in year 2 we will expand our geographic scale to the entire state. While wastewater facility data are generally available, spatial characterizations of these resources and their relationships to transportation infrastructure have not been developed at state or regional levels. Similarly, while production facility data are often not difficult to generate, performance and process inputs/outputs are typically limited to benchmarking studies conducted annually at the sector level (e.g. food processing, cement, chemicals). Based on data provided by the EPA Facility Registry System, an integrated source of comprehensive (air, water, and waste) environmental information about facilities, we will identify locations of food processors and water treatment facilities throughout Minnesota. Waste generation will be estimated by sector benchmarking studies and estimates of facility size and production from census data, Google map footprint estimates, and previous Minnesota Technical Assistance Program (MNTAP) studies (letter from MNTAP’s Laura Babcock, attached). Specifically, we will investigate the food production processes of key food sectors (e.g. meat processing, dairy/cheese, etc.) and their waste production during appropriate time intervals (e.g. daily, weekly, seasonally, etc.). We will then construct appropriate aggregation and valuation profiles, based on availability of likely processing sites and transportation costs.

1B. Characterization of source-separated organics (SSO). We note that no studies have been published in the past 15 years on the nutritional variability and composition of household food waste (mostly recently Westerдорf, 1999). This is an important knowledge gap that needs to be filled in order to understand the potential utilization of food wastes as a feedstock (sterilized & dried), which would be blended with other supplements to achieve nutrient requirements for specific animal feeds, especially hogs. To fill this gap, we plan to characterize household SSO wastes, utilizing an ongoing pilot scale (n = 5,000) SSO collection project in Minneapolis. Working with TAG member Dave Herberholz (City of Minneapolis, letter attached), we will conduct a detailed analysis (moisture, protein, fat, major elements, fiber components) of these wastes to better understand variability in time and space. We plan to collect about 480 SSO samples over 6 months, about 80 per month. Samples will be labeled and stored in plastic bags in small freezers provided to participants until pick up. Samples will be analyzed in co-PI Shurson’s lab. Briefly, they will be thawed, ground, and homogenized to obtain a representative samples for chemical analyses. Samples will be analyzed for moisture, crude protein, ether extract, neutral detergent fiber, ash, calcium, and phosphorus. Data will be analyzed by week, month, household, and community to average nutrient content and variability.

(2) Developing and evaluating technologies for re-engineering of waste streams. For this project element, led by co-PI Ruan, we will develop and compare several conversion technologies, including fast microwave assisted pyrolysis (fMAP), fast microwave assisted gasification (fMAG), and hydrothermal conversion to re-engineer select waste streams, to be identified in TAG meetings. Different products including gas, oil, and char will be evaluated by their yields and value as fuels or industrial materials. Gas can be burned for heat and electricity, or used as starting material for other chemicals or fuels after purification and conditioning. Oil from waste
streams is used as an additive to gasoline or heating oil. Bio-char is often used to produce fertilizer or soil amendment, or adsorbents such as activated carbon for pollutant removal. In addition, energy and mass balance, as well as environmental impact assessment will be conducted and compared for these technologies in order to determine the optimal approach for utilizing various waste streams. Meanwhile, economic, social and other sustainable development indicators will also be considered for technology evaluation (element 3 below).

(3) Understanding social, political, and economic drivers that influence the technology developments and investments required to re-engineer waste streams.

3a. Regional drivers of re-engineering. The goal of this element is to learn how policies, actors, and practices affect the flows of organic wastes in the TC-FS, to be led by co-PIs Kelley and Hughes. This will be done using document analysis (e.g., meeting minutes of city and county boards; decision documents, and reports), interviews with key actors, and analysis of regulations that influence the flows of organics (e.g., regulations regarding use of biosolids in agriculture and the use of food wastes for animal feeds). An assessment of key nodes of change will be completed and available for practitioners and used in the SDM (year 2, below).

3b. Household survey. In conjunction with the household SSO pilot study (element 1b), we will conduct a household social survey (lead by Baker and Hughes, with logistic support from the Minnesota Center for Survey Research) to better understand and evaluate household food preparation habits, diets, waste disposal habits, motivations and barriers to participation, and perceptions of waste regulation.

(4) Regional Symposium: “Waste Not”
We will facilitate a regional symposium on organic waste management in the TC-FS in May 2015, with the goal of developing an “organic wastes” community that links practitioners with U of M researchers, modeled after two earlier symposia led by the PI: “Urban Ecosystems and Human Well-Being”, 2010; and the “Twin Cities Urban Sustainability Forum”, 2011.

YEAR 2 PLANS
We anticipate that it will take at least two years for this initiative to become self-sufficient with respect to external funds. Hence we plan to submit a year 2 proposal (in consultation with our TAG) that builds upon work in year 1, with three goals: (1) initial development of a SDM as a decision support tool; (2) experiments at the Southern Research Outreach Center to evaluate various organic waste formulations on crop growth, in collaboration with their Long-Term Agricultural Research Network (LTARN), which is also seeking Food Ventures funding; and (3) additional economics analysis of waste disposal options.

DELIVERABLES
Journal articles (with lead). (1) Potential for re-engineering the Twin Cities organics flow system, with linkages to the agricultural system (Baker); (2) Nutrient quality of SSO household wastes and potential utilization of SSO for animal feedstocks (Shurson); (3) Conversion of organic wastes into fuel and other useful products (Ruan); (4) Identifying and evaluating key political nodes of change in organic waste flows for the TC-FS (Kelley and Hughes); (5) Household characteristics of participants in the SSO pilot study (Baker, Hughes). Presentations. In addition to presentations made at the proposed symposium (element 4), we plan to present papers at
two national conferences. Tools. Element 2 will produce a tool or method for identifying points of political leverage in an urban-environmental system; and element 3 will yield a survey tool.

JUSTIFICATION: RELATIONSHIP TO MNDRIVE OBJECTIVES

Objective 1: “Food Ventures”. This research could result in more efficient food production by identifying opportunities for more efficient use of manure, biosolids, and food wastes; and by reducing pre- and post-production losses in the food system. Identifying ways to recycle key nutrients required by food systems would help reduce our dependence on mined phosphate rock, a non-renewable resource that is very unevenly distributed throughout the world (main reserves: Morocco, China, and Russia), potentially leading to major geopolitical and economic tensions over the next few decades.

Objective 2: “Conserving our Environment”. Containing, processing, and recycling wastes greatly reduces the potential for environmental degradation from greenhouse gas emissions, nutrient pollution of surface waters (mainly P), and groundwater pollution (mainly nitrate). Recycling organic wastes could reduce the overall cost of urban waste disposal by reducing the cost of landfills (tipping fees + transportation costs), and also by creating valuable new products with the waste that can be sold.

Objective 3: “Robotics..., Advanced Manufacturing...”. Advanced waste treatment and utilization technologies could lead to business opportunities for food processors, waste management operators, and bioenergy producers in the region. Production of minimally processed wastes (e.g., partially dried biosolids and dried, pelletized food wastes) could also benefit industry. For example, the distribution of biosolids can create a “cottage industry” of specialized applicators; and processed food waste could become a feedstock for animals. Advancement of sustainable, coupled city-farm systems could be a tremendous advancement to global society, which is rapidly confronting resource limitations for food production and urbanization.

LEVERAGING POTENTIAL

We anticipate submitting a proposal for a transdisciplinary study of organics cycling in coupled city-farm systems to one of the NSF’s programs, probably either Coupled Human Natural Systems (CHN, $1.5 million max) or the Sustainability Research Network (SRN) programs ($10 million max). Baker has completed several CHN projects and is on a team for a recently submitted SRN proposal. Co-PIs Ruan, Smith, and Shurson have long histories of securing research support from industries and industrial organizations, about half of our TAG members are from industries, and one (Laura Babcock) is from the MNTAP, a group that works to translate U of M research into practice. Finally, Baker, Lazarus, and Smith frequently receive support from state and local governments, also well represented on our TAG.

REFERENCES

BIOSKETCHES (alphabetical order)

**Dr. Lawrence Baker** is an environmental engineer whose focuses on urban ecosystems started as a member of the founding team for the Central Arizona-Phoenix Project, one of the first of two urban ecosystem sites in NSF’s LTER program. Soon after moving from ASU to the U of M, he catalyzed formation of an urban ecosystems pod, serving as PI for the Twin Cities Household Ecosystem Project; a novel study of nutrient removal by street sweeping; and a study of P flows between agricultural and urban systems. He also co-leads three other studies: a study of flowpaths of nutrients in urban landscapes; a NSF Research Coordinating Network Project “Sustainable Cities - People and the Energy-Climate-Water Nexus”; and a new international water sustainability workshop project. His projects are highly interdisciplinary and often involve substantial translational activities. He has written more than 120 technical articles and book chapters, edited two books, mostly recently *The Water Environment of Cities*, made about 200 technical presentations in diverse venues, and writes occasional columns on environmental issues in public venues.

**Dr. Sara Hughes** is a political scientist with expertise in the production, alteration, and implementation of urban environmental policies and institutions. Previous work has focused on water management, climate change adaptation, and urban vulnerability in Southern California. She is currently a postdoctoral fellow with the Oak Ridge Institute for Science and Education, serving the U.S. Environmental Protection Agency; beginning in January 2015 will be an assistant professor at the University of Toronto Mississauga. She has a PhD in Environmental Science and Management from the University of California, Santa Barbara.

**Steve Kelley, J.D.** is a Senior Fellow at the Humphrey School of Public Affairs. Before joining the Humphrey School in 2007, Steve served in the Minnesota Senate for 10 years and the Minnesota House of Representatives for 4 years. He also served as Director of the Center for Science, Technology and Public Policy for 5 years. He has collaborated with scientists and engineers on engagement with policy issues for NSF funded projects related to sustainable polymers and radio spectrum congestion. Steve is currently working on issues relating to science and math education, innovation and design thinking and public engagement with science. Steve serves on a number of non-profit and advisory boards for organizations that work in civic education, youth development and STEM education. He received a B.A in political science and political economy from Williams College and his law degree from Columbia University.

**Dr. Bill Lazarus** is an agricultural economist who works in farm management research and extension. His research interests and extension programs include crop and livestock production economics, farm machinery economics, biomass energy economics, agricultural impacts on water and air quality, and economic impact analysis. A particular interest area has been development of spreadsheet-based and web-based decision tools for comparing the economic value of livestock manure and handling costs under alternative application methods and rates. The economic feasibility of operating farm-based anaerobic digesters and producing energy crops is another active area of work. He teaches ApEc 4501, Financial Modeling, which teaches students how to develop Excel-based decision tools for economic analysis.
**Dr. Carl Rosen** is Professor and Head in the Department of Soil, Water, and Climate. Along with his administrative duties, he also holds a secondary appointment in the Department of Horticultural Science. His current research involves strategies to improve nutrient management for crop production with a primary emphasis on vegetable and fruit crops commercially grown in Minnesota. Efforts in recent years have also focused on water quality issues related to fertilizer use and use of municipal and industrial by-products as amendments for agricultural and urban soils. He co-teaches a soil fertility course for undergraduates majoring in environmental and plant sciences. He has authored or coauthored over 100 peer-reviewed publications and numerous extension bulletins on the subjects of nutrient management, soil fertility, plant nutrition, and beneficial use of crop by-products.

**Dr. Roger Ruan**'s research focuses on various aspects of value-added processing, renewable energy, and food engineering. His current interests are in algae as an energy crop production, conversion of renewable biomass into energy fuels, chemicals, and materials, biopolymer process improvement, food shelf stability and quality enhancement and safety assurance, and catalytic nonthermal plasma synthesis of ammonia. He has published over 300 papers in refereed journals, co-authored two books, and written many book chapters, over 300 meeting papers and reports, and holds 15 US patents. He has supervised over 60 graduate students, 100 post-doctors, research fellows, and other engineers and scientists, and 9 of his Ph.D. students and 5 other post-doctors hold university faculty positions. He has received over 140 projects totaling over $25 million in various funding for research, including major funding from USDA, DOE, DOT, DOD, and industries. He is an editorial board member of five major journals. He has also given over 200 keynote lectures, invited symposium presentations, company seminars, and short courses, and has been a consultant for government agencies, and many local, national, and international companies and agencies in bioprocess engineering, food engineering, and renewable energy areas.

**Dr. Tim Smith** is Director of the NorthStar Initiative for Sustainable Enterprise (NISE), IonE, and Associate Professor of Environmental Sciences, Policy & Management and Bioproducts and Biosystems Engineering. In addition to teaching courses in corporate sustainability and renewable energy/product markets at UMN, INCAE (Costa Rica) and Wageningen (Netherlands), Smith's research focuses on sustainability performance, governance and decision sciences across supply chains and energy efficiency and renewable energy adoption.
BUDGET FOR “WASTE NOT: CLOSING THE LOOP ON ORGANICS WASTES”

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Enterprise tax $3,667

Contracts
- University of Toronto $25,700
- University of Minnesota Survey Center $5,000
- Conference Services $9,000
- Computers $5,000
- Software licenses $8,000
- Lab supplies $9,300
- Chemical analysis $48,600

Travel
- Travel – Minnesota $1,120
- Travel – Domestic $3,500
- Travel – Foreign (Univ. of Toronto staff) $3,336

**Total Budget** $422,972

BUDGET JUSTIFICATION

Faculty salaries: We request salary for PI Baker (0.25 FTE), who will provide the overall lead and play major roles in elements 1, 3, and 4. (Dr. Baker is self-supporting). and 0.08 FTE for Smith, who will lead on element 1a); 0.08 FTE for Ruan, who will lead in element 2; and 0.10 FTE for Kelley, who will co-lead element 3. We also request funds for a 0.25 FTE Research Assistant Professor to supervise the food waste nutrient analysis, working under Shurson.

Graduate students/Research Associate: We will employ 2 50% time RAs and 1 research associate assigned roughly 1 to Ruan (element 2), 1 to Baker (elements 1 and 3); and 1 to Smith/Lazarus (elements 1 and 3); and one ¼ time RA (assigned to Kelley to work on element 3.
Undergraduates: We will employ undergraduates (0.6 FTE) to work conduct nutrient analysis (Shurson’s lab) and collect data on organic waste flows (supervised by Baker). Total = $10,200. In addition, we will develop research project concepts for BBE’s Undergraduate Research Opportunities (UROP), with the intent that several students would develop independent research projects on the general topic of managing organic waste flows. We will encourage students working on an hourly basis in year 1 to apply for UROP funding in year 2.

Fringe benefits: Fringe benefits are calculated using standard U of M rates.

Contracts:
University of Toronto - $25,700. This is the work being done by co-PI Hughes to University of Toronto. This will include salary for a UT graduate student ($24,200), software for narrative analysis ($1,500), and overhead (44.3%) for a total of $27,500.

University of Minnesota Survey Center $5,000. We will use the MN Survey Center to help implement the survey and code data for the household SSO pilot study.

University of Minnesota Continuing Education and Conference Services $9,000. We will work with the Conference Center for logistics, room rental, food, etc. for the proposed “Waste Not” conference.

Supplies: Software and/or licenses for GIS, statistical analysis, SDM ($8,000).

Non-capital equipment: We plan to purchase 2 computers for $5,000.

Lab/medical supplies: We will need to purchase an industrial grade food grinder to prepare food samples for analysis, for $5,000. We will need to purchase about 20 mini-freezers to put in homes for saving food samples collected over time, at a cost of $200 each, plus minor lab supplies, $300, for a total of $4,300.

Lab/medical services: The cost of analyzing food samples is $100/sample; for 480 samples, $48,600.

Minnesota travel: This is in-state mileage, to travel to various sites within the Twin Cities region (to visit various organic waste generation sites, visit with industries and government units) and to travel to nearby agricultural areas (for focus groups developed by Lazarus), estimate 2,000 miles, for a total of $1,120.

Domestic travel: These are out-of-state conference trips, to present findings from the study. For two conference trips, $3,500.

Foreign travel – Trips for University of Toronto staff to meet with project personnel. Three trips, 9 days at hotel and per diem at $104 per day plus $1,500 in airfare, for a total of $3,336.
April 28, 2014

Dear Reviewers:

With regard to the proposal being submitted by Dr. Baker and his colleagues, “Waste Not: Closing the Loop on Organics” to the University of Minnesota’s Food Ventures Program, I would like to offer the support of the Minnesota Technical Assistance Program (MnTAP) to facilitate bringing new concepts and ideas to Minnesota businesses.

MnTAP is able to support this effort by:

Serving on the Technical Advisory Group, which I understand will meet 3-4 times during the first year.

Sharing data and case studies MnTAP may have based on over 20 years of outreach to Minnesota businesses including large scale food processing facilities that advance research opportunities associated with this proposal.

MnTAP is an outreach and assistance program at the University of Minnesota in the School of Public Health Division of Environmental Health Studies. MnTAP’s mission is to help Minnesota businesses develop and implement industry-tailored solutions that prevent pollution at the source, maximize efficient use of resources, and reduce energy use and costs to improve public health and the environment. MnTAP’s scientists and engineers have been providing on-site technical assistance to business sectors across the state for nearly 30 years and has developed numerous industry connections and case study resources that can be used to bring new ideas and information out to industry.

Sincerely,

Laura M. Babcock, Ph.D.
Director
Minnesota Technical Assistance Program
University of Minnesota
200 Oak St. SE, Suite 350-1
Minneapolis, MN 55455
lbabcock@umn.edu
612-624-4678
Dr. Baker;

I was informed of your Waste Not program today by Randy Kiser of Hennepin County Environmental Services. He mentioned that you had an interest in offering a position to Covanta to sit on your advisory committee as things get started in this program. Covanta is willing to assist you with this request and we are excited to see a move towards Organics collection, processing, and education in Minnesota. We have some robust projects underway in the east coast that I am willing to share with you.

I will offer to you my services on your advisory board. I am the Business Manager here at the HERC and I have some past experience as a business manager with Cargill on their investigation into animal waste to energy projects back in 2009. We had six large dairy anaerobic digester projects in operation under the Cargill program. I later took the position here with Covanta.

I look forward to meeting with you and discussing this project in further details. Please feel free to reach out to me when you are ready.

Kindest regards,

Rick Rud
Business Manager
Hennepin Energy Recovery Center
505 Sixth Avenue North
Minneapolis, MN 55405
Tel: 612-332-9431
April 15, 2014

Dear reviewers:

Minnesga is pleased to endorse your proposal being submitted by Dr. Baker and his colleagues, “Waste Not: Closing the Loop on Organics” to the University of Minnesota’s Food Ventures Program. The proposed research is particularly important to us because our company has a strong interest in waste utilization and environment conservation. The project team has very impressive expertise and capabilities. Their approach to product of renewable energy from wastes has a great chance of success which would be beneficial to my company and many other industries. In my opinion, the proposed development will have a significant impact on the regional renewable energy production, economy, and environment.

Minnesga is a company spun off from Freightmasters Logistics, Inc. We have a long history of collaboration with University of Minnesota. We have a strong interest in converting wastes to transportation fuels to meet our own needs. We will provide our assistance in feedstock supplies and space needed for prototype system testing. We have strong interest in commercialization of the technology developed as a result of the project. We will be happy to make in-kind and/or direct contributions to the proposed project in terms of complementary research, facilities and staff members. This will be reviewed based on the project/tasks of mutual interest. We would also be willing to serve on the Technical Advisory Group, which I understand will meet 3-4 times during the first year.

Sincerely

John Snyder, President
Dear Reviewers:

With regard to the proposal being submitted by Dr. Baker and his colleagues, “Waste Not: Closing the Loop on Organics” to the University of Minnesota’s Food Venture Program, we would like to offer our support, because I have invested interest in the advancement of local renewable programs. As the laboratory manager of a local renewable energy company, focused on process design, I would like to offer my industrial and process development experience. The proposal in question is a great opportunity to use university-funded resources to help solve a practical concern within the Twin Cities. This would be a great learning experience for me and hopefully I can assist with any insight from my own research throughout the process.

I would like to offer support by Serving on the Technical Advisory Group, which I understand will meet 3-4 times during the first year.

Sincerely,

Erik Anderson
April 21, 2014

Lawrence A. Baker, Ph.D.
Research Professor
Department of Bioproducts and Biosystems Engineering
University of Minnesota

Dear Dr. Baker:

Metropolitan Council Environmental Services is supportive of the University of Minnesota's Food Ventures Program "Waste Not: Closing the Loop on Organics". We have collaborated with the University of Minnesota on water and wastewater issues for many years and see this as an opportunity to further enhance this relationship.

Our organization is interested in this research because the proper management of large volumes of organic waste has the potential for significantly decreasing land fill requirements, generating renewable energy, and increasing environmental stewardship.

We would like to offer our support by serving on the Technical Advisory Group for this project, which will meet 3-4 times in the first year.

Sincerely,

Leisa Thompson
General Manager
Environmental Services Division
To: Lawrence A. Baker, Ph.D.
    Research Professor
    Department of Bioproducts and Biosystems Engineering

Dear Reviewers:

With regard to the proposal being submitted by Dr. Baker and his colleagues, “Waste Not: Closing the Loop on Organics” to the University of Minnesota’s Food Ventures Program, we would like to offer our support. Hennepin County is in the initial stages of implementing curbside collection programs for the organic fraction of municipal solid waste, mainly food waste and non-recyclables and food soiled paper. This research can help inform us at the nutrient and content of that organic material and consequently indicate preferred management options for organic waste streams diverted through recycling programs.

We would like to offer support by serving on the Technical Advisory Group, which I understand will meet 3-4 times during the first year. We will also share composition data on the waste disposal stream that we have collected at the County’s transfer station in Brooklyn Park as well as the Hennepin Energy Resource Center in Minneapolis.

Sincerely,

Paul M. Kroening
Supervising Environmentalist/Recycling Program Manager
Solid Waste Division
April 30, 2014

University of Minnesota’s Food Ventures Program
224C Biosystems and Agricultural Engineering Bldg.
1390 Eckles Ave.
St. Paul, MN 55108-1038

Dear Reviewers,

With regard to the proposal being submitted by Dr. Baker and his colleagues, “Waste Not: Closing the Loop on Organics” to the University of Minnesota’s Food Ventures Program, I would like to offer the support of the City of Minneapolis, Solid Waste and Recycling Division. As the City looks to expand our organics collection efforts, we feel that there is information that may be obtained from this project that will benefit us in our organics efforts.

I would like to offer our support by:

- Possibly serving on the Technical Advisory Group, depending on time commitment
- Sharing data that we have collected on residentially collected organics
- Possible involvement in a survey and/or waste composition study on organics if such endeavor could be completed without disruption to our day certain operations

Sincerely,

David A. Herberholz, Director
City of Minneapolis
Solid Waste and Recycling

Cc: Dr. Lawrence A. Baker, Ph.D., Research Professor
Department of Bioproducts and Biosystems Engineering
May 1, 2014

Lawrence A. Baker, Ph.D.
Research Professor
Department of Bioproducts and Biosystems Engineering
224C Biosystems and Agricultural Engineering Bldg
1390 Eckles Ave
St. Paul, MN 55108-1038

Dear Dr. Baker,

With regard to the proposal being submitted for consideration to the University of Minnesota’s Food Ventures Program, “Waste Not: Closing the Loop on Organics”, we would like to offer our support. The Minnesota Pollution Control Agency (MPCA) is committed to reducing and recycling food waste. The MPCA’s mission is to protect and improve the environment and enhance human health.

Organic wastes comprise more than 40% of the trash that is thrown away in Minnesota. Finding and implementing effective strategies to reduce food waste or to recycle food waste through composting, food-to-livestock programs or food donation efforts, is an important part of the MPCA’s mission.

I will support the efforts of the project by serving on the Technical Advisory Group, which I understand will meet 3-4 times during the first year. I will also share pertinent research and data the agency has related to waste composition, food recycling recovery rates and food recycling program performance.

The agency has established aggressive goals for diverting food waste from landfills and incinerators. We’re hopeful that the efforts of the project team will provide more resources to support this goal and we look forward to partnering with you in support of that effort.

Sincerely,

Tim Farnan
State Program Administrator - Principal Organics & Recycling Specialist
Minnesota Pollution Control Agency
1. Sponsor Name: MNDrive Global Food Ventures
2. Proposal Title: Waste Not: Closing the Loop on Organics Wastes
3. Sponsor Due Date/Time: 05/02/2014 - 5 pm CDT
4. RFA/RFP/CFDA/FOA#: valer024@umn.edu
5. Submission Medium: Electronic [other than Grants.gov] faculty submission
6. University Contact: Evans, Kathleen A (612) 625-1905 kevans@umn.edu
7. Administering Dept: BIOPROD&BIOSYS ENG, DEPT OF Department ID: 11032
8. Principal Investigator: Baker, Lawrence A. baker127 ID 1105980 (612) 626-1258 25 0 X X
   RESEARCH PROFESSOR [9401R] BIOPROD&BIOSYS ENG, DEPT OF DeptID 11032
   Paid Cost Share PI Key
9. Investigator(s):
   Smith, Tim smith463 ID 2474314 (612) 624-2648 8 0 X
   ASSOCIATE PROFESSOR [9402] BIOPROD&BIOSYS ENG, DEPT OF DeptID 11032
   Paid Cost Share PI Key
   Ruan, R. R. ruanx001 ID 2110465 (612) 625-1710 8 0 X
   PROFESSOR [9401] BIOPROD&BIOSYS ENG, DEPT OF DeptID 11032
   Paid Cost Share PI Key
   Shurson, Gerald C. shurs001 ID 1043454 (612) 624-2764 0 1 X
   PROFESSOR [9401] ANIMAL SCIENCE, DEPT OF DeptID 11027
   Department will provide cost share cart string in SECTION 20.
   Lazarus, William F. w lazarus ID 2101200 (612) 625-8150 0 1 X
   PROFESSOR [9401] APPLIED ECONOMICS, DEPT OF DeptID 11033
   Department will provide cost share cart string in SECTION 20.
   Urriola, Pedro E. urrio001 ID 3425579 (612) 624-1793 25 0
   RESEARCH ASSISTANT PROFESSOR [9403R] ANIMAL SCIENCE, DEPT OF DeptID 11027
   Paid Cost Share PI Key
   Kelley, Steve kelle644 ID 3803365 (612) 626-6629 10 0
   SENIOR FELLOW [9751] SCIENCE & TECHNOLOGY, CTR DeptID 10761
10. Proposal is for:
    | Basic % | Applied % | Development % | Total % |
    | 30      | 40        | 30            | 100     |
11. Proposal is: New

12. Proposed Duration & Amount Requested:

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<th>Initial/Current Budget</th>
<th>Start</th>
<th>End</th>
<th>Direct $$</th>
<th>Indirect $$</th>
<th>F&amp;A Rate</th>
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<td>422,972</td>
<td>0</td>
<td>0% MTDC</td>
<td>422,972</td>
</tr>
</tbody>
</table>

Departmental Directions to SPA for Award Set Up
SPA should request a PeopleSoft-friendly budget from the department at the time of award. (note that award set up may take additional time since set up cannot be finalized until the budget is furnished to SPA.)

13. Project Involves: [x] Chemicals
There will be chemicals used
The appropriate chemical safety training and hazardous waste training records have been completed

14. Subawards: [x] University of Toronto

15. Conflict of Interest: [x]
There is not a potential financial and/or business conflict of interest

16. Inventions: [ ]

17. Space: [x]
There is sufficient and suitable space to house this project presently assigned to the principal investigator's or other investigator's department or college.

224C 206, 224D, BioAgeng

There is sufficient and suitable space to house this project presently assigned to the principal investigator's or other investigator's department or college.

221 Ruttan Hall

There is sufficient and suitable space to house this project presently assigned to the principal investigator's or other investigator's department or college.

155 301 19th Ave S

There is sufficient and suitable space to house this project presently assigned to the principal investigator's or other investigator's department or college.

335D AnSci/VM

18. Resources/Space/Staff: [x]
This project involves University resources, space or staff from more than one department

Bioproducts/Biosystems Eng
Humphrey Public Affairs
Animal Science
Applied Economics

19. Indirect Cost Recovery: [x]
No ICR associated with this proposal

20. Matching and Cost Sharing: [ ]

21. Program Income: [ ]

22. International Component: [x]
Foreign travel is contemplated
A foreign component (collaboration or field work) is contemplated

23. Fairview Health Services: [ ]

24. PROPOSAL ABSTRACT or EXECUTIVE SUMMARY
With increasing environmental demands and diminishing resources, cities will need to reduce production of organics wastes and recycle organic wastes that are produced: food and food processing wastes, biosolids, and landscape wastes. This study characterizes the flows of organic wastes in the Twin Cities, examines new processes to convert wastes to useful products, analyzes the political, social and economic factors associated with re-engineering the organics wastes systems, and convenes a conference to bring stakeholders and researchers together around this vital topic.
25. NOTES

05/01/14  kevans  corrected salary amount on Kelley
APPROVALS and CERTIFICATIONS

Principal Investigator:
(1) I certify the information submitted within the application is true, complete and accurate to the best of the PI's knowledge;
(2) that any false, fictitious, or fraudulent statements or claims may subject the PI to criminal, civil, or administrative penalties; and
(3) that the PI agrees to accept the responsibility for the scientific conduct of the project and to provide the required progress reports if a grant is awarded as a result of the application.

Investigator(s):
The information provided on this form and in the accompanying proposal is correct to the best of my knowledge. Equipment budgeted in this application is not otherwise available for use on this project from existing departmental or collegiate inventories. In the event this application is awarded, I (we) agree to abide by all applicable institutional and sponsoring agency policies and procedures including the Intellectual Property Policy of the University of Minnesota and to follow commonly accepted scientific practices in recording and maintaining records of research. I (we) certify that I (we) have read the University of Minnesota Code of Conduct policy and agree to abide by the rights and responsibilities as identified therein.

Signature
Lawrence A. Baker
05-01-2014
Lawrence A. Baker (baker127) : Principal Investigator

Department Head(s) and/or Division Head(s): Academic Dean(s), Chancellor or Provost:
We certify that the above statements are correct to the best of our knowledge. The commitment of departmental and collegiate resources, if any, has been noted and approved. We agree that the scientific objectives of this application are in keeping with departmental and collegiate goals. We certify that the individuals from our unit(s) listed on this PRF have filed a current Report of External Professional Activities (REPA).

Signature
Ramaswamy, Shri
05-01-2014
Ramaswamy, Shri (shri) : Dept Head/Delegate

Signature
Lee, Jacqueline J
05-01-2014
Lee, Jacqueline J (leexx079) : Dept Administrator/Representative

Signature
White, Michael E
05-01-2014
White, Michael E (mwhite) : Dept Head/Delegate

Signature
Sullivan, Melissa A
05-01-2014
Sullivan, Melissa A (missy) : Dept Administrator/Representative

Signature
Homans, Frances R
05-01-2014
Homans, Frances R (thomans) : Dept Head/Delegate

Signature
Pioske, Elaine R
05-01-2014
Pioske, Elaine R (piosk001) : Dept Administrator/Representative

Signature
Bloomberg, Laura L
05-01-2014
Bloomberg, Laura L (bloom004) : Research Associate Dean/Delegate

Signature
Ebbert, Lettie
05-01-2014
Ebbert, Lettie (ebber001) : Research Associate Dean/Delegate