**PROJECT TITLE: Identifying Agricultural Energy Consumption and Impacts in Minnesota**

**I. PROJECT STATEMENT**

Minnesota farms provide an abundance of food and economic opportunities for the citizens of the state, with on-farm production of crops and livestock valued at over $20 billion annually (USDA-NASS). These products help drive the state’s large food manufacturing sector, which brings the total economic activity for agriculture in Minnesota to $121 billion per year (MN Dept. of Ag). Among the most important inputs needed to make this level of agricultural production possible is energy resources. Over the last decade, the feasibility of a number of new agricultural technologies, renewable energy production systems, and conservation measures have been studied to the point that they are ready to begin deployed on Minnesota's farms. However, a lack of knowledge about agricultural energy use in the state is limiting potential adoptions of these technologies.

This project will use several data sources to develop up-to-date energy models that can overcome this energy information gap for Minnesota. The *primary objective of the project is to generate county level energy use maps* that identify farming activities within counties and the energy use associated with those activities. This work will also provide average energy use information for the different farming enterprises in the state (i.e. cropping, dairy, or swine). *A second objective for the project is to identify areas where technological advances will enhance the sustainability and economics of Minnesota's agricultural production*. In addition to the farm base solutions such as renewable energy sources and conservation, there will likely be changes in the state's electricity grid that will influence the economics and sustainability of agricultural production. Modeling will analyze how these changes alter fossil energy use and the related sustainability impacts on agricultural commodities. *The final objective is to produce a concise set of information on Minnesota’s agricultural energy use that is available to stakeholders, policy-makers, citizens, and researchers.* This project has a two year timeline for the data collection and analysis proposed. *The broader goal of this effort is to foster development of renewable energy and energy conservation projects that will help maintain the environmental sustainability and economic competitiveness of Minnesota’s agricultural sector*.

The need for this information was recognized while our staff at the West Central Research and Outreach Center worked with Morris Community-Climate Smart Municipalities working group to determine how to meet a county-wide strategic goal of producing 80% of energy consumed in the county as well as reducing energy consumption by 30%. Unfortunately, very little specific information was found to indicate how much energy regional farmers are using and what activities are responsible for most of that energy use. The best estimates made for the Stevens County project indicate that agricultural energy is a much larger component of county-wide energy use than that used in cities and small towns.

Accomplishing energy reduction goals will rely on a combination of community energy production, such as solar and wind energy, and reductions in energy using new lighting, heating, cooling, and ventilation systems. Similarly, precision cropping equipment can allow farmers to reduce agronomic inputs and tractor fuel use for cropping systems and other research is examining renewably-produced cropping inputs made in Minnesota, such as nitrogen fertilizer. The current lack of data limits our ability to predict economic benefits, engage the farmers who would benefit most from updated technologies, or estimate how Minnesota's statewide agricultures environmental and economic footprints could be improved. Farmers and businesses need to have reliable energy use information before they will make investments or changes to their operations.

The significant consumption of fossil-based energy in agriculture has led to a perception among some that current agriculture production is not sustainable. While producers may or may not be concerned with the impacts of energy use on the environment, they should be aware of this perception and that it can impact consumer willingness to purchase their products. In addition, other nations and states are beginning to use sustainability measures to evaluate agricultural products and assign regulatory rules, tax credits, or economic values to them. The most well know example of this is the California regulations covering import of ethanol into the state, which limits ethanol tax credit values based on fossil energy needed for production and transport.

The costs of these fossil energy inputs has a direct impact on farmer’s incomes and Minnesota’s economy. Without significant energy natural resources, much of the energy consumed and crude oil-based inputs used in Minnesota must be imported into the state at significant cost. One example is the roughly $400 million that Minnesota farmers spent to apply the 800,000 tons of anhydrous ammonia fertilizer used yearly. Likewise, livestock operations are heavily impacted by propane and electricity demands for building heating and cooling. Minnesota is also at the end of the supply chain for several agricultural inputs and occasionally experiences shortages which either drive up input prices, cause rationing, or force farmers to do without. For these reasons, Minnesota’s agricultural community has a need to move towards a less fossil-energy intense future.

**II. PROJECT ACTIVITIES AND OUTCOMES**

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| **Activity 1 Title: Collection and Analysis of Current Agricultural Energy Data****Description:**This activity brings together data from different sources to evaluated farm energy use at the county and farm level to form a more accurate picture of energy use in agriculture across. Specifically, USDA-National Agricultural Statistics Service (NASS) and the U of M Dept. of Applied Economics information would be included as they are well documented and collected at regular intervals. Existing state and national farm surveys provide reliable details about the size, scope, and operations of farms in different regions of the state. Information about the energy use for specific agricultural activities can be found in scientific literature and within the USDA- Data Commons, which is the USDA's central repository for research information. This work will also provide average energy use information for the different farming enterprises in the state (i.e. cropping, dairy, or swine). **ENRTF BUDGET: $58,716** |
| **Outcome** | **Completion Date** |
| *1. Collect Minnesota Agricultural Demographic Data* | *3/31/21* |
| *2. Identify Energy usage by agricultural enterprise for major agricultural activities* | *4/31/21* |
| *3. Compile county and state totals for energy use* | *5/31/21* |

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| **Activity 2 Title: Modeling Energy Savings and Future Energy Use Scenarios****Description:**This activity uses energy data, pricing information, and energy use reductions to evaluate potential energy and economic savings to Minnesota's agricultural community, as well as sustainability improvements.An important component of this modeling will be an analysis of fossil energy use and the related sustainability impacts of agricultural commodities.**ENRTF BUDGET: $58,716** |
| **Outcome** | **Completion Date** |
| *1. Develop county level data on impacts of MN energy mix changes to agriculture*  | *12/31/21* |
| *2. Develop county level data on potential energy reduction/sustainability improvements* | *2/1/22* |

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| **Activity 3 Title: Outreach and Information Dissemination****Description:**The information generated will be developed into outreach documents to reach several different audiences via online and print formats, as well as presentations at regional meetings. The agricultural community and agricultural policy makers would be provided a brief report summarizing where technologies would best help them reduce energy use and related costs. Infographics would be designed to convey important findings to stakeholders in handouts and online. A complete final report and data set would be available on our website and be submitted to the USDA National Agricultural Library Data Commons, for access by other researchers.**ENRTF BUDGET: $29,358** |
| **Outcome** | **Completion Date** |
| *1. Infographics developed to present important findings* | *3/31/22* |
| *2. Brief summary of findings written* | *4/30/22* |
| *3. Full research report finished and data published in print and online* | *6/30/22* |

**III. PROJECT PARTNERS AND COLLABORATORS:** The project will rely on stakeholder input, but will not have formal additional partners or collaborators.

**IV. LONG-TERM IMPLEMENTATION AND FUNDING:** It is intended that this work will assist others in their implementation of energy saving, thus further funding requests is not anticipated.