

**Environment and Natural Resources Trust Fund  
2014 Request for Proposals (RFP)**

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**Project Title:**

**ENRTF ID: 130-E**

Developing Minnesotas Clean Energy Carbon Neutral BioEconomy

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**Category:** E. Air Quality, Climate Change, and Renewable Energy

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**Total Project Budget: \$** 195,950

**Proposed Project Time Period for the Funding Requested:** 1 Year, July 2014-June 2015

**Summary:**

The project will identify opportunities for advanced energy technologies and biochemicals from agricultural and forest based resources and deliver a consensus framework for establishing a green energy, carbon neutral BioEconomy

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**Name:** Richard Hemmingssen

**Sponsoring Organization:** U of MN, Dept. of Bioproducts and Biosystems Engineering

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St. Paul MN 55108

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**Location**

**Region:** Statewide

**County Name:** Statewide

**City / Township:**

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_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ Employment	_____ TOTAL _____%



**PROJECT TITLE: Developing Minnesota's Clean Energy Carbon Neutral BioEconomy**

**I. PROJECT STATEMENT**

There has been a significant interest and effort in developing sustainable, alternative, renewable bio-based fuels and chemicals. However, the much discussed bio-based economy is still in its infancy, due to the enormous complexity and challenges associated with biomass and their conversion. Minnesota is uniquely suited to be a forerunner in the bio-based economy due to the presence of both a well-established forest industry and a robust agricultural sector. Combined these industries are stewards of significant Minnesota biomass resources and are major contributors to Minnesota’s economy. There is a compelling unmet opportunity to integrate Minnesota’s agricultural and forest industries to more effectively utilize our state’s significant biomass resources and to comprehensively and aggressively explore a robust and sustainable BioEconomy for Minnesota.

This project will integrate Minnesota’s well-established agricultural and forest industries by identifying and comprehensively analyzing synergistic opportunities for next-generation green energy, biochemicals, and carbon-neutral market opportunities, thus enabling the development of an aggressive and sustainable BioEconomy in Minnesota. The project will complete a comprehensive summary of available biomass resources, assess potential market opportunities for “green product” opportunities from those assets, evaluate suitable conversion technology platforms, and provide technical, economic, and life cycle assessment for potential integrated biorefinery approaches. The project will culminate in a Sustainable BioEconomy Forum to present specific recommendations for more sustainable utilization of Minnesota’s agricultural- and forest-based natural resources and higher value economic activity and establish a consensus framework for creating a sustainable BioEconomy in Minnesota.

To realize Minnesota’s potential, it is essential to employ a whole systems approach encompassing biomass supply, logistics, conversion technologies, and market assessment for higher value products including advanced biofuels and biochemicals. Each component in agricultural and forest biomass needs to be converted to its highest value application to help make the bio-based industry sustainable, economically feasible, and synergistic with existing industry. We will interview and engage experts and leaders from the renewable fuels industry, start-up bioproducts companies, the agricultural sector, the forestry, wood products and the pulp and paper industry as well as regional and national research and policy leaders to share their experiences, successes, failures, challenges and identify specific opportunities to sustainably develop Minnesota’s BioEconomy.

**II. DESCRIPTION OF PROJECT ACTIVITIES**

**Activity 1: Resource Inventory Summary**

**Budget \$32,612**

Aggregate, analyze and summarize existing data regarding type, location, sustainable harvest quantity, and characterization of current and potential agricultural and forest-based resources including residues and wastes

<b>Outcome</b>	<b>Completion Date</b>
<i>1. Comprehensive inventory of available forest and agriculture biomass feedstock in Minnesota with associated environmental considerations on their harvest and utilization</i>	<i>December, 2014</i>
<i>2. Comprehensive summary by type, composition, and suitability of available feedstocks</i>	<i>December, 2014</i>

**Activity 2: Market Potential and Interest Assessment**

**Budget \$49,543**

Identify, categorize and quantify potential high value renewable energy and carbon-neutral product market opportunities from Minnesota biomass, including papermaking fiber, biofuels or bioproducts

<b>Outcome</b>	<b>Completion Date</b>
<i>1. Identify potential companies, producers, co-ops and individuals in Minnesota</i>	<i>December, 2014</i>
<i>2. Comprehensive analysis of market opportunities for next-generation fuels and products</i>	<i>January, 2015</i>
<i>3. Comprehensive summary of constituent interest in the bioeconomy system</i>	<i>March, 2015</i>



**Environment and Natural Resources Trust Fund (ENRTF)**

**2014 Main Proposal**

**Project Title:** *Developing Minnesota’s Clean Energy Carbon Neutral BioEconomy*

**Activity 3: Technology Assessment**

**Budget \$42,552**

Identify suitable conversion platforms and synergies specifically suited for Minnesota (e.g. agricultural fibers for Minnesota’s paper mills, advanced bio-fuels, biochemicals or bioproducts)

<b>Outcome</b>	<b>Completion Date</b>
<i>1. Identify biomass conversion technologies suitable for existing MN facilities</i>	<i>April, 2015</i>
<i>2. Identify biomass conversion technologies suitable for stand-alone operations in MN</i>	<i>May, 2015</i>
<i>3. Identify next generation technologies suitable for integration with current MN facilities</i>	<i>May, 2015</i>

**Activity 4: Techno-Economic Analysis (Process Modeling) and Life Cycle Assessment**

**Budget \$32,746**

Utilize WINGEMs and ASPEN Plus process modeling and analysis software to complete preliminary process engineering, economic analysis, and Life Cycle Assessment for selected biorefinery approaches

<b>Outcome</b>	<b>Completion Date</b>
<i>1. Techno-economic analysis of selected technologies with high probability of success</i>	<i>June, 2015</i>
<i>2. Preliminary life cycle assessment to quantify environmental advantages and identify potential pitfalls</i>	<i>June, 2015</i>

**Activity 5: Sustainable BioEconomy Forum**

**Budget: \$38,497**

Formulate, organize and conduct a Sustainable BioEconomy Forum engaging leaders from the agricultural and forestry sectors, government organizations and non-government organizations to establish framework for creating a Sustainable BioEconomy in Minnesota

<b>Outcome</b>	<b>Completion Date</b>
<i>1. Plan, organize and conduct the Sustainable BioEconomy Forum</i>	<i>June, 2015</i>
<i>1a. Present initial findings from Activities 1-3 and solicit stakeholder feedback</i>	<i>June, 2015</i>
<i>1b. Facilitate focused discussion around successes, challenges and opportunities</i>	<i>June, 2015</i>
<i>2. Develop clear goals, policy initiatives and concrete action steps that can be recommended to the State to assist with the creation of the Sustainable BioEconomy</i>	<i>June, 2015</i>

**III. PROJECT STRATEGY**

**A. Project Team/Partners**

The project team is led by faculty and staff in the University of Minnesota’s Department of Bioproducts and Biosystems Engineering. Project partners will include leaders of the forest and agricultural industries, government agencies and non-government organizations, and other relevant organizations.

<b>Team Member</b>	<b>Roles/Responsibilities</b>	<b>ENRTF Funds</b>	<b>In-kind</b>
Richard Hemmingsen, Senior Fellow	Project PI, overall project management, Activities 1, 2, 3, and 5	\$79,070	\$2,915
Professor Shri Ramaswamy	Activities 3, 4, and 5		\$3,373
Professor Ulrike Tschirner	Activities 3, 5 and student supervision	\$16,211	
Dr. Omar Espinoza	Activities 1, 2, 3, and 5		\$ 961
Dr. H. Huang	Activities 3, 4, and 5	\$36,143	
Grad., Under Grad, CSOM	Activities 1,2, 3, 4, and 5	\$52,526	

**B. Timeline Requirements**

This will be a one year project with specific timelines for each activity indicated in Section II above

**C. Long-Term Strategy and Future Funding Needs**

The long term strategy resulting from the proposed work is the successful creation of a robust BioEconomy that sustainably utilizes biomass resources, enhances the environment, strengthens agriculture and forest economies, and helps create new industries and job opportunities especially in greater Minnesota. We envision a Governor’s BioEconomy initiative with significant new investments, policy advantages and financing strategies that will help accelerate the development of a clean energy and carbon neutral BioEconomy in Minnesota.

## 2014 Detailed Project Budget

**Project Title: Developing Minnesota's Clean Energy Carbon Neutral BioEconomy**

### IV. TOTAL ENRTF REQUEST BUDGET 1 years

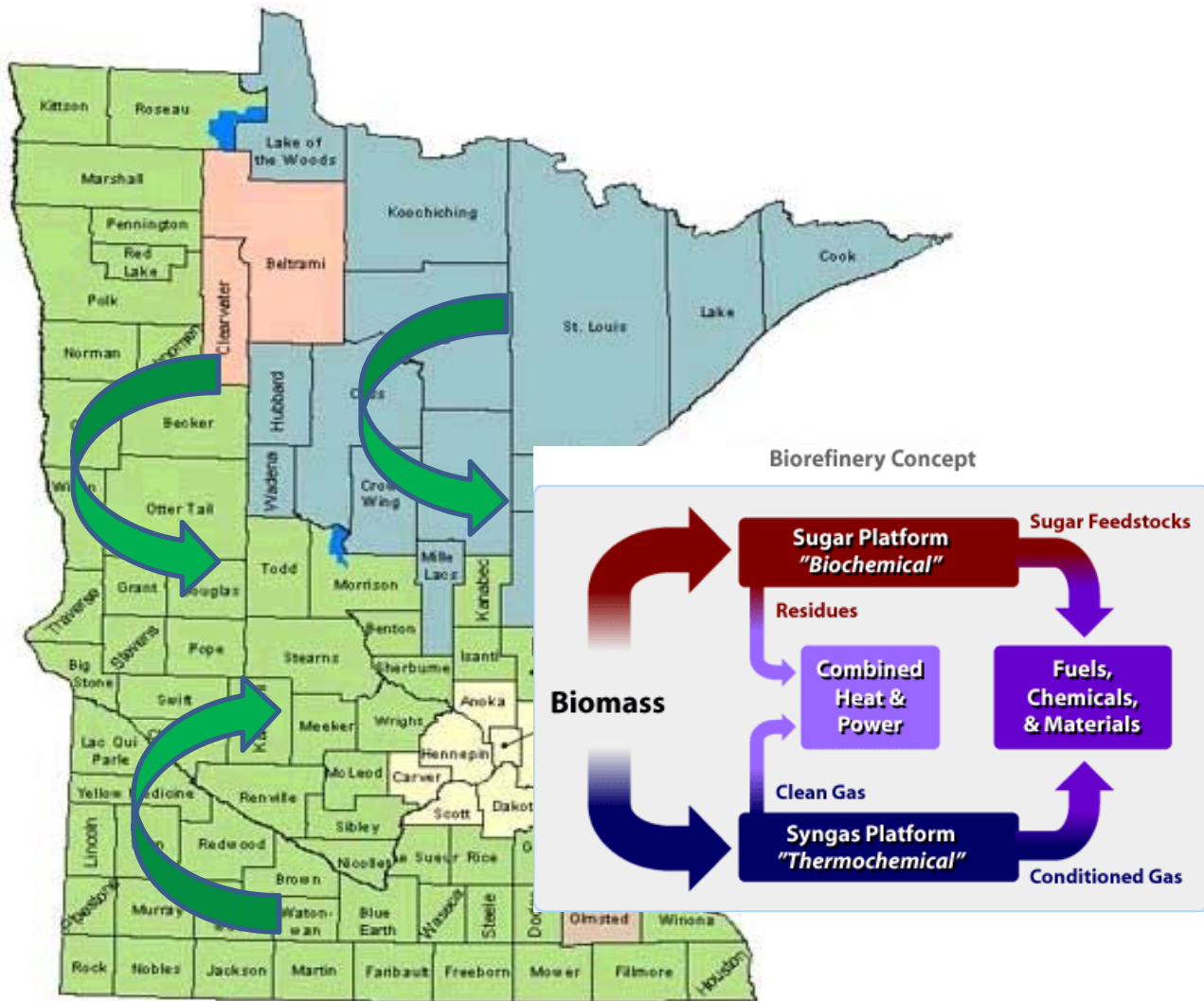
<u>BUDGET ITEM</u>	<u>AMOUNT</u>
<b>Personnel:</b> PI Richard Hemmingsen 40% time including 33.6% fringe benefits. PI will be responsible for overall project management, Biomass Resource Inventory (Activity 1) and Market Potential Assessment, in conjunction with Carlson School of Management Ventures Program (Activity 2). Together with co-PIs he will also be responsible for organization of the Sustainable Bioeconomy Forum (Activity 5)	\$ 79,070
Dr. H. Huang 50% time including fringe at 33.6%. Dr. Huang will work closely with Professor Shri Ramaswamy on Technology Assessment (Activity 3), the Techno-Economic Analysis and Life Cycle Assessment (Activity 4), and assist with the Sustainable Bioeconomy Forum (Activity 5)	\$ 36,143
Dr. Ulrike Tschirner, one month summer salary including 33.6% fringe (Tschirner is on a 9 month appointment). Dr. Tschirner will work with Professor Ramaswamy and Dr. Huang on Technology Assessment (Activity 3), the Sustainable Bioeconomy Forum (Activity 6), and supervise undergraduate students assisting on all project activities.	\$ 16,211
.5 FTE Graduate Research Assistant at 40% fringe benefits to work with Dr. Espanosa, Dr. Ramaswamy, Dr. Tschirner, and PI Hemmingsen on Biomass Resource Inventory (Activity 1); Market Potential and Interest Assessment (Activity 2); and Technology Assessment (Activity 3)	\$ 20,756
Undergraduate Research Assistants, 500 hours total to help collect and compile data from literature and collaborators, prepare correspondence, arrange meetings, and assist with the Sustainable Bioenergy Forum	\$ 6,770
<b>Contracts:</b>	N/A
<b>Equipment/Tools/Supplies:</b> room rental, and other costs for informational meetings and the Sustainable Bioeconomy Forum	\$ 4,000
Licensing fee for WINGEMs and Aspen Plus software to be used for techno-economic process modeling	\$ 2,000
<b>Acquisition</b>	N/A
<b>Travel:</b> Travel cost for in-state travel for PI's and reimbursement for Sustainable Bioeconomy Forum speakers.	\$ 6,000
<b>Additional Budget Items:</b> University of Minnesota Carlson School (CSOM) Venture program. Support for team of second year CSOM MBA students (Fall Semester, 2014) to assist with Market Potential Assessment (Activity 2)	\$ 25,000
<b>TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =</b>	<b>\$ 195,950</b>

### V. OTHER FUNDS

<u>SOURCE OF FUNDS</u>	<u>AMOUNT</u>	<u>Status</u>
<b>Other Non-State \$ Being Applied to Project During Project Period:</b>		N/A
<b>Other State \$ Being Applied to Project During Project Period:</b>		N/A
<b>In-kind Services During Project Period:</b> Waived UofMN Indirect Cost Recovery (\$101,894); Shri Ramasawamy, 1% time (\$3,373) ; Omar Espanoza, 1% time (\$961); Richard Hemmingsen 1% time (\$2,915)	\$ 109,143	
<b>Remaining \$ from Current ENRTF Appropriation (if applicable):</b>	\$ -	N/A
<b>Funding History:</b>	\$ -	N/A

# Developing Minnesota's Clean Energy Carbon Neutral BioEconomy

Efficiently utilizing agricultural and forest-based resources...



...to enable a Clean Energy Carbon Neutral BioEconomy



### **Project Manager Qualifications and Organization Description**

Richard A. (Dick) Hemmingsen, M.Ed. will serve as project lead and coordinator for the project. Dick is a Senior Fellow in the Department of Bioproducts and Biosystems Engineering in the College of Food, Agricultural, and Natural Resource Sciences at the University of Minnesota. Dick was the founding director of the Initiative for Renewable Energy and the Environment (IREE) at the University and was responsible for developing funding protocols and managing a research portfolio typically consisting of 100 active research projects in a wide range of renewable energy technologies with a strong emphasis on interdisciplinary, systems-oriented approaches. Dick serves as the University of Minnesota's representative on the Next Generation Energy Board.

Dr. Shri Ramaswamy, Professor and Head, Department of Bioproducts and Biosystems Engineering, University of Minnesota holds graduate degrees in Chemical Engineering and Paper Science and Engineering and has relevant industry experience as Research Engineer in the paper industry (Scott Paper Company and Hercules Inc.). Dr. Ramaswamy joined the University of Minnesota in 1995. Dr. Ramaswamy has extensive background in bio-based process engineering, process modeling and techno-economic analysis. In addition, Dr. Ramaswamy has extensive experience in working with Minnesota's forest and agricultural industry sectors and has recently been working on the analysis and development of sustainable bioeconomy concepts.

Dr. Ulrike Tschirner, Professor, Department of Bioproducts and Biosystems Engineering, University of Minnesota has a strong background in biomass conversion, including a Ph.D. in lignin chemistry and nine years of industry experience in pulping and bleaching (Scott Paper Company, Philadelphia). She has been a faculty member at the University of Minnesota since 1995. She has worked extensively with several paper mills in Minnesota. Some of her most recent research activities include projects focused on development of fibers from agricultural residues for papermaking, biomass pretreatment methods and biocatalytic conversion of fermentable sugars to bioethanol and biobased polymers.

Dr. Huajiang Huang, Research Assistant Professor, Department of Bioproducts and Biosystems Engineering, University of Minnesota holds a Ph.D. in Chemical Engineering and has a strong background in process modeling and techno-economic analysis of biorefineries. He also has experience in separation and purification of bioproducts and multiphase chemical reactions. Since 2005 he has been working in the areas of biomass conversion, biorefineries, bioenergy, biochemicals, and biocomposites.

Dr. Omar Espinoza, holds the Forest Products Management Development Institute Endowed Chair in the Department of Bioproducts and Biosystems Engineering, University of Minnesota. His Ph.D. Degree is in Forestry and Forest Products. He has extensive background in forest products manufacturing, new products development, supply chain logistics, and market analysis. Some of Dr. Espinoza's recent work includes forest certification, green building standards, lean manufacturing and process improvement, environmental certification, product development for market performance and sustainability, and energy efficiency.

Team members are faculty and staff from the Department of Bioproducts and Biosystems Engineering in the College of Food, Agricultural and Natural Sciences at the University of Minnesota. The department conducts research and academic programs which are at the forefront in the discovery, development and application of the renewable resources and sustainable technologies required to meet the global population's increasingly sophisticated needs, while at the same time enhancing and preserving the Environment