

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

## **2010 Work Program**

**Date of Report:** December 22, 2009

**Date of Next Progress Report:** January 31, 2011

**Date of Work Program Approval:**

**Project Completion Date:** August 1, 2012

### **I. PROJECT TITLE:** Analysis of Options for Minnesota's Energy Independence

**Project Manager:** Melisa Pollak

**Affiliation:** University of Minnesota, Humphrey Institute

**Mailing Address:** 154 Hubert H. Humphrey Center

**City / State / Zip:** Minneapolis, MN 55455

**Telephone Number:** (612) 625-3046

**E-mail Address:** fryxx035@umn.edu

**FAX Number:** (612) 625-3513

**Web Site Address:**

**Location:** Statewide

<b>Total ENRTF Project Budget:</b>	<b>ENRTF Appropriation</b>	<b>\$ 143,000</b>
	<b>Minus Amount Spent:</b>	<b>\$ 0</b>
	<b>Equal Balance:</b>	<b>\$ 143,000</b>

**Legal Citation:** ML 2010, Chap.[\_\_\_\_], Sec.[\_\_\_\_], Subd.\_\_\_\_\_.

**Appropriation Language:**

### **II. PROJECT SUMMARY AND RESULTS:**

This project will analyze the various technologies that could be used to generate low-carbon electrical power for Minnesota, from environmental, economic and policy perspectives, with the goal of creating a consistent, transparent means of comparing the alternatives. Meeting our state's future electric energy demand will require a portfolio of options, but choosing the preferred composition of that portfolio depends on being able to make informed decisions about the full costs and impacts of each technology, as well as the feasibility of actually getting the technology deployed where it's needed in the state. Life-cycle analysis (LCA) offers a rigorous technical understanding of the greenhouse gas reductions that developing alternative electricity technologies can offer. Life-cycle based approaches will be employed and serve as a foundation for technical evaluation of emission reduction estimates and a state-specific environmental assessment of Minnesota's electrical power generation potential from these technologies. Included in this analysis will be an assessment of economic costs and potential incentives impacting the competitiveness of low-carbon technologies. Experience shows, however, that it takes more than technical potential to generate real change in complex infrastructure: human factors act as both barriers and opportunities

for new energy technologies. We will create a road map for deployment of low-carbon electrical power in Minnesota by describing key institutional, regulatory, legal, and public acceptance issues that face each particular technology. By combining environmental, economic and policy analyses, we will offer insight on which low-carbon electric power technologies offer the most promise for Minnesota, and help identify opportunities for transparent deployment.

### **III. PROGRESS SUMMARY AS OF:**

### **IV. OUTLINE OF PROJECT RESULTS:**

#### **RESULT 1: Life cycle assessment of low-carbon electrical power in Minnesota**

##### **Description:**

To determine the current state of knowledge concerning the environmental impacts associated with the implementation of low carbon electrical power options within the state of Minnesota the following tasks will be completed:

- Review LCA model options and related economic cost documentation. Analyze the sources and methodology of each to determine which may be appropriate to the State of Minnesota. Selection of technologies for life cycle analysis will be based on their potential to reduce emissions from the electric power sector in Minnesota, and on data availability. Preliminarily, we plan to analyze the following technologies:
  - Renewables: Wind power, solar power, and biomass
  - Advanced combustion: (high efficiency coal, biomass co-firing, carbon capture with pipeline CO<sub>2</sub> transport to out-of-state reservoirs)
  - Nuclear power
- Select and calibrate an LCA-based greenhouse gas (GHG) model appropriate to Minnesota for a limited set of “likely” technologies based on system constraints of resource availability (feedstock, water, etc.), infrastructure (transmission, transportation, etc.), and anticipated technology development. Several models have been developed by researchers throughout the country, but existing approaches vary widely in their use of data inputs and in the economic and technical assumptions on which they operate. Model selection and calibration will be made based on factors such as the compatibility of a model’s methodology with the framework developed in this project, and the ability to consistently adapt a model’s data inputs for Minnesota.
- Compare life cycle greenhouse gas (GHG) emissions and costs of the technologies reviewed. The total GHG emissions will be expressed as tons of CO<sub>2</sub> equivalent per 1 GWh of electricity generated.

To benchmark environmental and economic performance, the project will establish benchmark indices by identifying and estimating electrical power inputs and outputs associated with likely pathways and where sufficient data is available.

- Physical data will be used to develop an indexing methodology for low carbon electrical power consumed in Minnesota based on the in-service value of electricity provided (i.e. kWhs, sales, costs) to its environmental influence ( i.e. material feedstocks, water consumption, emissions of pollutants and, waste materials).
- A framework will be constructed within which the State can create and maintain an “index” for low-carbon power that treats all technologies in a consistent and transparent manner. This framework will examine, among other elements, how such a system would deal with monitoring and recording activities that affect the environment. Both regulation and pollution market structures, if adopted by the State, will be able to make use of this indexing system.

**Summary Budget Information for Result 1:**

<b>ENRTF Budget:</b>	<b>\$ 64,246</b>
<b>Amount Spent:</b>	<b>\$ 0</b>
<b>Balance:</b>	<b>\$ 64,246</b>

<b>Deliverable</b>	<b>Completion Date</b>	<b>Budget</b>
1. Assessment of current LCA knowledge of low carbon power	January 31 2011	\$18,038
2. LCA based GHG model of MN low carbon power	June 30 2011	\$30,675
3. MN low carbon power indexing framework	January 31 2012	\$15,533

**Result Completion Date:**

**Result Status as of January 31, 2011:**

**Result Status as of June 30, 2011:**

**Result Status as of January 31, 2011:**

**Result Status as of June 30, 2011:**

**Final Report Summary:**

**Result 2: State-wide context for low-carbon electricity in Minnesota**

**Description:**

To analyze the state-wide context for low-carbon electrical power deployment in MN we will begin by characterizing the policy environment that influences decisions about which technologies are best suited to our state’s circumstances. This includes factors that apply to all potential technologies, such as characteristics of the electricity market, as well as factors that will be distinct for particular technologies, such as stakeholder

coalitions. Once we have characterized the policy environment, we will create a technology specific matrix of key barriers and opportunities for deployment. The analysis will outline policy options for addressing these barriers and opportunities.

To characterize the policy environment for low-carbon electric power in Minnesota, we will complete the following tasks:

- Develop a concise description of technical factors that influence low carbon electrical power deployment in MN, including: transmission considerations, energy demand patterns, existing infrastructure, and resource availability.
- Outline economic factors that influence low carbon electrical power deployment in MN, including: the cost of electricity, economic development impacts, electrical use patterns of important industries within the state, and ease of market entry.
- Describe the institutional context for low carbon electrical power deployment in MN, including: characteristics of the electricity market, ownership structure, dispatch policy, and institutional authority and experience.
- Detail regulatory and legal requirements that shape low-carbon electrical power deployment in MN, including: energy policy goals from existing legislation and executive orders; federal and state environmental and energy regulations; state and local siting policies; federal and state financial incentives; insurance requirements and availability; property ownership laws; and, liability considerations.
- Investigate human factors that affect low-carbon electrical power deployment in MN, including: the stakeholders associated with various technologies, perception of the technologies by key actors; interest groups and coalitions that support/oppose particular technologies; salience of environment/energy/climate issues in relation to competing priorities; and public trust and past relations with industry. This task will include interviews with key stakeholders state-wide.

To describe the state-wide context for deployment of low-carbon electric power in Minnesota we will complete the following tasks:

1. Create a technology specific matrix of key barriers and opportunities for deployment of low-carbon electric power technology in Minnesota.
2. Outline policy options for addressing barriers and opportunities for deployment, focusing on areas where state-level policy action could facilitate development of new, environmentally sound, low-carbon electrical power sources for Minnesota.

**Summary Budget Information for Result 2:** Trust Fund Budget: \$ 78,904  
Amount Spent: \$ 0  
Balance: \$ 78,904

<b>Deliverable</b>	<b>Completion Date</b>	<b>Budget</b>
1. Policy environment for low-carbon electric power in Minnesota	June 30, 2011	\$43,326
2. State-wide context for low-carbon electric power in	January 31,	\$35,428

Minnesota	2012	
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**Result Completion Date:**

**Result Status as of January 31, 2011**

**Result Status as of June 30, 2011**

**Result Status as of January 31, 2012**

**Result Status as of June 30, 2012**

**V. TOTAL ENRTF PROJECT BUDGET: \$143,000**

**Personnel:** \$ 141,811

\$10,291 to Elizabeth Wilson (8% FTE) to oversee Result 2;  
 \$11,764 to Tim Smith (8% FTE) to oversee Result 1;  
 \$29,521 to Melisa Pollak (25% FTE) for project management, research activities, research assistant supervision, and report production;  
 \$4,896 to Leah Wilkes (5% FTE) for project specific administrative support;  
 \$51,887 for Research Assistants on Result 1;  
 \$33,452 for Research Assistants on Result 2.

**Contracts:** \$ 0

**Equipment/Tools/Supplies:** \$ 789

\$300 software: SPSS, ArcGIS, LCA database subscriptions  
 \$300 printing interim and final reports  
 \$189 stakeholder meeting support

**Acquisition (Fee Title or Permanent Easements):** \$ 0

**Travel:** \$ 400

Expenses to interview stakeholders for analysis of state-wide context for low-carbon electricity.

**Additional Budget Items:** \$ 0

**TOTAL ENRTF PROJECT BUDGET: \$ 143,000**

**VI. PROJECT STRATEGY:**

**A. Project Partners:**

**Elizabeth Wilson**, Asst. Prof., Humphrey Inst. of Public Affairs: PI for socio-political analysis. (\$10,291 from appropriation)

**Tim Smith**, Director, NorthStar Initiative for Sustainable Enterprise, IonE. Asst. Prof., Bio-Products Bio-Systems Engineering: PI for life-cycle analysis and assessment of low carbon electrical energy potential. (\$11,763 from appropriation)

**Melisa Pollak**, Humphrey Inst. of Public Affairs: Lead Researcher/Project Manager (\$29,521 from appropriation)

**B. Project Impact and Long-term Strategy:**

Incorporating life-cycle considerations and real and perceived policy challenges into a comprehensive study of the MN electricity sector will help to better identify opportunities and challenges for Minnesota in the transition to a low-carbon energy system. It will also help to identify business opportunities, appropriate policies to facilitate deployment, and metrics to assess implementation.

This proposal builds on several ongoing efforts by the research team. Wilson and Pollak are involved in a Doris Duke Foundation project to develop a regulatory framework for carbon sequestration. They are also leading a comparative analysis of state climate action planning, funded by the Institute for Renewable Energy and the Environment. Smith is involved in numerous efforts addressing the integration of life cycle methodologies in the development of sustainable product systems, including an assessment of MN low carbon transportation fuel policy, the national Green Products Roundtable, and an evaluation of LCA information visualization schemes. He, in collaboration with Dr. Wilson, has also developed assessments of state energy policy as they relate to carbon emissions of consumer owned utilities. This effort builds upon these projects and makes it specifically relevant to Minnesota and the Minnesota policy context.

**C. Other Funds Proposed to be Spent during the Project Period:**

Not applicable

**D. Spending History:**

Not applicable

**VII. DISSEMINATION:**

We will present results of this project at seminars and forums within the state of Minnesota. Results on the policy environment for low carbon power deployment will be integrated into energy policy course material at the University of Minnesota. Results will be presented at academic conferences and published in peer-reviewed journals. We will also produce a white paper on de-carbonizing Minnesota's electricity supply suitable for a lay audience.

**VIII. REPORTING REQUIREMENTS:** Periodic work program progress reports will be submitted not later than (January 31 2011, June 30 2011, and January 31 2012). A final work program report and associated products will be submitted between June 30 and August 1, 2012 as requested by the LCCMR.

**IX. RESEARCH PROJECTS:**

Attachment A: Budget Detail for 2010 Projects - Summary and a Budget page for each partner (if applicable)								
<b>Project Title:</b> Analysis of Options for Minnesota's Energy Independence								
<b>Project Manager Name:</b> Melisa Pollak								
<b>Trust Fund Appropriation:</b> \$ 143,000								
2010 Trust Fund Budget	<b>Result 1 Budget:</b>	Amount Spent (date)	Balance (date)	<b>Result 2 Budget:</b>	Amount Spent (date)	Balance (date)	<b>TOTAL BUDGET</b>	<b>TOTAL BALANCE</b>
	<i>Life cycle assessment of low carbon electrical power in Minnesota</i>			<i>Development of a road-map for low-carbon electricity deployment in Minnesota</i>				
<b>BUDGET ITEM</b>								
<b>PERSONNEL: wages and benefits</b>	63,651		63,651	78,160		78,160	141,811	
Elizabeth Wilson: \$10,291 (8%)								
Tim Smith: \$11,764 (8%)								
Melisa Pollak: \$29,521 (25%)								
Leah Wilkes: \$4,896 (5%)								
Research Assistants:								
Result #1: \$51,887 (50% 3 semesters and 2 summers)								
Result #2: \$33,452 (25% 3 semesters and %75 2								
<b>Other direct operating costs</b>	250			50			300	
Software - SPSS licenses, ArcGIS license, subscriptions to LCA databases								
<b>Printing</b>	150			150			300	
interim and final reports								
<b>Supplies</b>				189			189	
meeting support for stakeholder meetings								
<b>Travel</b>				400			400	
in state for stakeholder meetings								
<b>COLUMN TOTAL</b>	\$64,051	\$0	\$64,051	\$78,949	\$0	\$78,949	\$143,000	\$0