1995 Project Abstract
For the Period Ending June 30, 1997
This project was supported by Oil Overcharge

Title: 1 Megawatt Hybrid Electrical Generation Simulation Project
Project Manager: Dan Juhl
Organization: DanMar and Associates
Address: 191 West 5th Street, Cottonwood, MN 56229
Legal Citation: ML 1995, Chap.220, Sec.19, Subd 11(c)
Appropriation Amount: $50,000

Statement of Objectives

This projects objective was to gather the required data and information to simulate the use of a hybrid electrical generation system to provide firm power to a municipal utility utilizing local renewable energy resources (wind and biofuel).

Overall Project Results

A total of 20 months of municipal load data from Luverne, MN and wind speed (from a monitoring site just outside of Luverne) was correlated to see the economics of this type of generation technologies. The resulting computation of this information showed that the cost of using these renewable technologies are slightly higher than the conventional methods of importing fossil fuel energy to meet the demand. The economic feasibility of developing wind/soy-diesel projects to supply firm electric power to utilities largely depends on the utilities ability to access long term, low interest financing and the need for capacity in the future. Firm power avoided costs of utilities in Minnesota currently range from about 1.8 cents to 4.7 cents per kilowatt-hour, while levelized costs of production for wind/soy-diesel begin at about 4 to 6 cents per kilowatt-hour. High costs for wholesale peaking power and limitations on capacity for load management are factors that could spark a utilitiy's interest in wind/soy-diesel.

Project Results Use and Dissemination:

The results of this project is being shared with and disseminated to the Minnesota Municipal Utilities Association

Date of Report: July 1, 1997
LCMR Final Work Program Update Report

1. **Project Title and Project Number:** 1 Megawatt Hybrid Electrical Generation Simulation Project # O2
Program Manager: Daniel Juhl
Affiliation: DanMar & Associates
Mail Address: 191 W. 5th St. Cottonwood, MN 56229
Phone: (507) 423-5127
Fax: (507) 423-5532

A. **Legal Citation: ML 1995, Chap. 220, Sec. 19, Subd 11(c).**
Total biennial LCMR appropriation: $50,000
Balance: $0

Appropriation Language: This appropriation is from the oil overcharge money to the commissioner of administration for an agreement with DanMar & Associates in cooperation with the agriculture utilization research institute for a simulation project using biofuel electrical generation to firm up wind power to provide electrical energy on demand.

B. Status of Match Requirement: N/A

II. **Project Summary:** This project promotes reliable electrical generation using renewables by gathering wind data and utility load patterns, then modeling the combined use of biofuel (ethanol or soyoils) and wind energy technologies to supply electricity. This is done by using biofuel generation to firm up wind power to show we can provide electrical energy on demand. The outcomes of this project will demonstrate how renewables can be relied upon for peak as well as intermediate power. This project simulation promotes the commercialization of a hybrid renewable technology for local municipal utilities. The gathering of load data from the utility and tracking the peaks and valleys of their demand, along with the collection of site specific wind speed information, we can simulate how much biofuels is needed to supply the required electrical energy during utility peak demand periods. During the winter, the winds generally cause the utility system to peak. It is at this time the information gathered from the wind monitoring system will indicate that the wind turbines should provide the needed electrical energy. In the summer when the winds aren't as great in our region, we can simulate the use of a biofuel generator to provide the needed electrical generation. By doing this we will be able to calculate how much biofuel will be required and determine the economic viability of a renewable hybrid system using these two technologies.

III. **Six Month Work Program Update Summary: July 1, 1997** The project has been completed. The final report is subbmitted alog with this final summary. Also as Exhibit A of the final report, is all of the graphs showing the corrilation of windspeed data and load profiles for the Luverne Municipal Utility from 8/95 thru 5/97. The final report contains detailed information on the use of methyl soyate to back-up wind generation to supply firm power utilyzing local renewable energy.

Due to the loss of our monitoring system ina ice stom in November of 1996, a rewrite of the software was done to coinside with the information that was recieved from the DPS. We recieved all of the nessassary load information from Red Arndt, the utility coordinator with the Luverne Municipal Utility. During seperate meetings, the wind/load charts have been reviewed by the Minnesota Municipal Utilities Assocoation and Red Arndt of the Luverne Municipal Utility. The complete file of charts and the final report have been made available to all municipal utilities through the Association. The Nomad data logger used to collect the wind data has been turned over to Rory Artig of the DPS to be further used in the departments on going wind studies.

IV. **Statement of Objectives:**
A) Locate and make agreement with municipal utility
B) Equipment procurement and Installation
C) Gather and correlate data
D) Disseminate information

Timeline for Completion of Objectives:

	7/95	9/95	11/95	1/97	6/97
Objective A: Locating a municipal utility	xxxxxxxxxxxxx				
Objective B: Equipment procurement and installation		xxxxxxxxxxxxxxxxxxxxxxxxx			
Objective C: Gather and correlate data				xxxxxxxxxxxxxxxxxxxxxxxxxxx	
Objective D: Disseminate information				xxxxxxxxxxxxxxxxxxxxxxxxx	

V. **Objectives/Outcome:**

A. Title of Objective/Outcome: Locate and make agreement with a municipal utility.

A.1 Activity: Search for a cooperative utility which has winter peaking load characteristics and an interest in renewable technologies.

A.1.a. Context within the project: A specific utility is required to determine load patterns.

A.1.b. Methods: A cross reference of location, utility load patterns and local wind speed information is used to determine the most applicable utility.

A.1.c. Materials: No materials required for this objective.

A.1.d. Budget
Total Biennial LCMR Budget: $4,000
LCMR Balance: $0

A.1.e. Timeline:

	7/95	9/95	6/96	1/97	6/97
PRODUCT #1: Locate and make agreement with utility	xxxxxxxxxxxx				

A.1.f. Workprogram Update: January 1, 1997 After an extensive background investigation, the field of potential municipal cooperators was narrowed down to five which had the right criteria to be selected for this project. The short list consisted of the following Minnesota cities; Adrian, Worthington, Luverne, Barnsville, and Jackson. Meetings were set up to look at the load patterns, available site to place the data logger tower, and the willingness to cooperate in the project. After multiple visits the city of Luverne was selected to host the project. This object has been completed.

B. Title of Object/Outcome: Equipment procurement and installation.

B.1 Activity: The purchasing and the installation the data logger and the computer at the chosen site.

B.1.a. Context within the project: Proper equipment must be acquired to have quality data and the ability to process it. The wind monitoring equipment and the computer hardware and software must be installed properly to secure and process all the information needed for this project.

B.1.b. Methods: None of the equipment to be acquired is of experimental design. It is all off-the-shelf proven systems. The person doing the installation of the equipment has extensive experience in this procedure.

B.1.c. Materials: The project will use a NRG 9202 Data Logger. This will be mounted on a 40 meter tower with anemometers located at 10, 30,and 40 meters. At the 40 meter level there will also be a wind directional indicator. This equipment will also have the ability to log temperature and relative humidity. The cost of the total package for the logger, the tower and all sensors is $10,000. A 486 PC will be required to compile the data collected. Special software will be written to process all of the information gathered from the wind monitoring equipment, utility load profiles, and biofuel generator requirements. The computer and software will cost $5,000. Installation of the tower and data logger along with setting up the computer software will cost $3,000. After the term of this project the equipment will be turned over to the Minnesota Department of Public Service to be used in their wind resource assessment program.

B.1.d. Budget
Total Biennial LCMR Budget: $18,000
LCMR Balance: $0

B.1.e. Timeline:

	7/95	9/95	11/95	1/97	6/97
PRODUCT #1: NRG 9202 Data Logger	xxxxxxxxxxxxxxxxxxxxxxxxx				
PRODUCT #2: 40 Meter tower	xxxxxxxxxxxxxxxxxxxxxxxxx				
PRODUCT #3: Anemometers	xxxxxxxxxxxxxxxxxxxxxxxxx				
PRODUCT #4: Sensors	xxxxxxxxxxxxxxxxxxxxxxxxx				
PRODUCT #5: 486 Personal Computer	xxxxxxxxxxxxxxxxxxxxxxxxx				
PRODUCT #6: Processing software	xxxxxxxxxxxxxxxxxxxxxxxxx				

B.1.f. Workprogram Update: January 1, 1997 The monitoring equipment was purchased from and installed by Environmental Energy Systems. The equipment consisted of the following; a SecondWind Nomad data logger with all of the required sensors, data cards, and weather tight enclosure; a 40 meter tall tower with all of the necessary hardware for complete installation. Some software was purchased from SecondWind but the bulk of the processing software was custom written and 486SX/33 computer time leased by DanMar & Associates. All of the equipment is up and running and the software is working perfectly providing high quality reports for the project and the utility. This object has been completed.

C. Title of Objective/Outcome: Gather and correlate data

C.1 Activity: The data will be gathered and fed into the personal computer for correlation and analysis.

C.1.a. Context within the project: The data must be gathered and correlated properly so this project is completed correctly and accurately .

C.1.b. Methods: The monthly wind data will be downloaded and processed from the data logger. Utility load profiles will be collected from the utility Scada system which can provide the necessary peak demand information. By correlating these sets of information we can establish the quantity of biofuels generation to meet the committed capacity of the project.

C.1.c. Materials: The equipment used in this objective is the 486 computer and software which has been budgeted in Objective B.

C.1.d. Budget
Total Biennial LCMR Budget: $20,000
LCMR Balance: $0

C.1.e. Timeline:

	7/95	9/95	11/95	1/97	6/97
PRODUCT #1: Gather and correlate data	xxxxxxxxxxxxxxxxxxx				

C.1.f. Workprogram Update: January 1, 1997 Information has all been gathered and correlated and wind/load charts have been prepared and are compiled in the final the report (Exhibit A).

D. Title of Objective/Outcome: Disseminate information

D.1 Activity: Compile and disseminate the information to applicable parties.

D.1.a. Context within the project: The data will be required to understand the advantages of utilizing hybrid renewable generation systems for future power needs.

D.1.b. Methods: Presentations have been made to utilities and state agencies on th operation and costs of the hybrid system. A report will be compiled with data to be used as referenc material.

D.1.c. Materials: Publishing of the report will be required for this objective.

D.1.d. Budget
Total Biennial LCMR Budget: $8,000
LCMR Balance: $0

D.1.e. Timeline:

	9/95	11/95	6/96	1/97	6/97
PRODUCT #1: Presentations and report publication			xxxxxxxxxxxxxxxxxxxxxx		

D.1.f. Workprogram Update: January 1, 1997 Wind/load charts and final report will be given t Luverene Municipal Utility and the MMUA. The report has been compiled and update with new charts an information every month. A draft report has been reviewed by the Minnesota Municipal Utilities Associatio A final report has been completed now that all of the required data and information is in.

VI. Evaluation: The results of this project will be evaluated on the basis of the need for biofuel generato during the utilities peak demand periods. This evaluation will be used to successfully complete futu projects using wind turbines and biofuel generators simultaneously.

VII. Context within field: The use of wind technology for electrical generation and biofuels for powerin combustion engines has been proven and accepted worldwide. This project looks at combining these tw proven technologies to supply a specific energy need. Max Norris with the Agricultural Utilization Researc Institute is exploring new ways to utilize biofuels for energy production. Also, Steve Downer with Th Minnesota Municipal Utilities Association is interested in finding ways for it's members to produce clea energy using local resources.

VIII. Budget context: The Minnesota Dept. of Public Service is doing a wind resource assessment study o the whole state.

IX. Dissemination: The data collected from this project will be assembled and presented to intereste utilities and state agencies and used as a credible reference to enhance interest in using these alternati energies either separately or in combination.

X. Time: This project has been completed in the allowed two year period.

XI. Cooperation: The program manager will complete 100% of Objectives A, B, C, D & E. Throughout the project the program manager will be working with the Minnesota Municipal Utilities Association and the Agriculture Utilization Research Institute.

XII. Reporting Requirements: Semiannual six-month workprogram update reports will be submitted not later than January 1, 1996, July 1, 1996, January 1, 1997, and a final six-month workprogram update and final report by June 30, 1997. *Or* **December 31, 1997.**

XIII. REQUIRED ATTACHMENT:
1. Qualifications:

2. Project Staffing Summary: