LCMR Work Program Abstract (1997)

PROJECT TITLE: Renewable Energy Demonstration and Education in State Parks

Project Manager:	Richard F. Szydlowski, Senior Research Engineer
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Total Biennial Project Budget: $230,000

PROJECT RESULTS: This project demonstrated cost-effective applications of renewable energy technologies in state parks by developing technology selection guidelines; installing projects in state parks; and educating public and state, county, and local park staff about how renewable energy works. DNR staff identified over 48 possible energy applications in selected state parks. CEE evaluated these systems and installed 14 renewable energy systems in 9 state parks. A weather resistant public information sign is displayed at each installation to explain how that particular renewable energy system works.* A 133 page document entitled *Using Renewable Energy in Minnesota Parks: A Guidebook for Park Managers** was also published. The guidebook explains the environmental benefits of renewable energy, types of renewable energy, renewable energy applications for parks, cost/benefit analyses of renewable and conventional systems, renewable energy systems in Minnesota State Parks, and how to determine if renewable energy will work in your park. The guidebook also has a list of consultants, installers, manufacturers and distributors of renewable energy equipment. Both the signs and the guidebook are available for download from CEE's website at *www.mncee.org/frame_parkgif.htm.*

** See attached documents*

Date of Report: June 29, 2000
LCMR Work Program Final Report

Date of Next Status Report: None
Date of Work Program Approval: June 23, 1997
Project Completion Date: June 30, 2000

LCMR Work Program 1997

I. PROJECT TITLE: Renewable Energy Demonstration and Education in State Parks

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Total Biennial Project Budget:

$ LCMR	$230,000	**$ Match**	$0
- $ LCMR Amount Spent	$230,000	**- $ Match Spent**	$0
= $ LCMR Balance	$0	**= $ Match Balance**	$0

A. Legal Citation: ML 97, Chap. 216, Sec. 15, Subd. 12(b).
Appropriation Language: $80,000 of this appropriation is from the trust fund and $150,000 is from oil overcharge money to the commissioner of natural resources for an agreement with the Center for Energy and Environment to demonstrate cost-effective applications of renewable energy technologies in state parks by developing technology selection guidelines; installing projects in state parks; and providing public renewable energy education. This appropriation is available until June 30, 2000, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

B. Status of Match Requirement: Not applicable.

II. PROJECT SUMMARY: This project demonstrated cost effective applications of renewable energy technologies in state parks by (1) installing 14 projects in 9 state parks, (2) displaying a sign that explains renewable power at each installation (3) publishing and distributing over 300 copies of *Using Renewable Energy in Minnesota Parks: A Guidebook for Park Managers* to park managers throughout the state park system and to county and community park boards. CEE gave two presentations for DNR, county, city, and other local park officials at the Minnesota Parks and Recreation Association annual conference which introduced the *Guidebook* and showcased the installed renewable energy and energy efficient technologies. A web page *www.mncee.org/frame_parkgif.htm* was created that highlights the installed projects with (1) a clickable map that launches a sign explaining each system (2) a downloadable color

version of the *Guidebook.* The *Guidebook* includes renewable technologies selection guidelines, cost/benefit analysis of each technology compared to competing traditional applications, and total life cycle-costs.

DNR staff identified over 48 possible energy applications in selected state parks. CEE evaluated these systems and installed 14 renewable energy systems in nine state parks. This project focused on renewable energy technologies which are commercially available. New system configurations made from high quality, durable components were also created to meet specific park needs and to ensure that the systems could withstand Minnesota winters. LCMR funding was leveraged by using $9,000 in existing DNR park betterment and development funds which bought down the additional incremental capital and installation costs of three systems. East Central Energy donated $5,000 towards the installation cost of two systems.

III. PROGRESS SUMMARY:

Result 1. Develop Selection Guidelines for Renewable Energy Technologies

In October 1999, 500 copies *of Using Renewable Energy in Minnesota Parks: A Guidebook for Park Managers* were published. Over 310 have been distributed to state, county, and local park officials throughout Minnesota. The 133 page guidebook includes the following sections: (1) Why Use Renewable Energy?, (2) Types of Renewable Energy, (3) Renewable Energy Applications for Parks, (4) Minnesota State Park Renewable Energy Systems, (5) Is Renewable Energy Right for Your Park, (6) List of Resources, (7) List of Consultants, Installers, Manufacturers & Distributors, (8) Assumptions Used for Life Cycle Costing Examples. The guidebook is geared towards the needs of park managers so they can assess the installation costs, maintenance issues, siting criteria and potential benefits of using renewable energy systems.

Result 2a. Complete Needs Assessment

CEE staff identified 48 different renewable energy applications in 25 state parks that were suggested by DNR staff. At the March 1998 State Parks Biennial Conference approximately 45 state park managers and other DNR personnel attended two presentations explaining this project. Ten park staff members returned a survey identifying remote energy needs in state parks. DNR headquarters staff also used e-mails, phone calls and announcements to generate leads for other possible energy needs. The majority of these project suggestions were evaluated by CEE over the phone. CEE staff visited parks to evaluate more promising project ideas. These visits included working with DNR staff to identify two inoperable lighting systems in two State Parks: a boat dock light at Father Hennepin State Park and an exterior restroom light at Moose Lake State Park. The boat dock light was replaced with a working system. The components of the exterior restroom light were dismantled and used in a new system.

Blueprints for Moose Lake State Park's new visitor interpretive center were analyzed by CEE technical staff to determine if active or passive renewable energy technologies and energy conservation applications could be applied. None of the suggestions made to DNR for the visitor center were incorporated into the building due to budget constraints. CEE technical staff also collected data at Moose Lake State Park's existing tempering tank to determine the cost effectiveness of this passive solar water heating technology. A passive solar thermal system proposed for a primitive shower at Afton State Park was infeasible due to public health regulations.

CEE also assessed the following major projects and determined that although they were technically feasible, solar power was too expensive compared to conventional power: (a) using a solar powered pumping station for irrigating a golf course at Fort Ridgely State Park; (b) using solar power or wind power to operate pumps at Soudan Underground Mine State Park; and (c) replacing a utility powered lake aerator at Fort Snelling State Park with a solar powered system. Ultimately, fourteen (14) projects were chosen for installation. Most of the other suggestions were eliminated from consideration due to high installation cost, poor solar access, poor cellular phone reception, light pollution, aesthetics, properly functioning conventional system or existing grid connection.

Result 2b. Install Technologies

Fourteen (14) different renewable energy technologies were installed in 9 state parks during this project. In addition, an inoperable solar powered exterior light at a utility powered restroom was dismantled and reused.

State Park	Renewable Energy Applications Installed	Installed
Afton	*Solar powered pump for remote campground	1998
Banning	Solar powered river level monitor for Kettle River	2000
Father Hennepin	*Replaced solar powered boat dock landing/beacon lights	1998
Lake Louise	Solar powered entrance sign	1999
Lake Maria	Solar powered pump for remote campground	1999
Lake Maria	Solar powered parking area light	1999
Lake Maria	Solar powered camper cabin light	1999
Lake Maria	Solar powered camper cabin light	1999
Sibley	Solar powered pump for handicapped accessible remote campground	2000
Temperance River	Solar powered snowmobile shelter light	1999
Temperance River	Solar powered light for remote wood shed	1999
Tettegouche	Solar powered ventilation fan for poorly sited vault toilet	1999
Tettegouche	Solar powered ventilation fan for poorly sited vault toilet	1999
Wild River	*Solar thermal water heating system for campground shower building	1998

*Denotes systems that CEE monitored using energy tracking devices to ensure the systems were working as designed.

DNR also leveraged $9,720 in non-project DNR funds for two of the systems. East Central Energy donated $5,000 towards the installation costs of the Father Hennepin boat dock light and the Banning river level monitoring system. Three other utilities were

approached for donations but declined to contribute. No utility grant or rebate programs were available for the installed systems.

To help DNR maintain the systems, an "Owner Documents" binder for each of the installations was created to document the bid specifications, manufacturer contact information, parts list, and maintenance tips for each system. CEE kept an original copy. The park managers, DNR State Parks Headquarters and DNR's Bureau of Engineering also received a copy.

Equipment Problems: The pump for the solar thermal water heating system at Wild River State Park became clogged with debris from the well water. This system will require at least annual maintenance to prevent the problem in the future. The controller for the Father Hennepin boat dock light system had to be replaced three times before the manufacturer shipped a properly functioning system. The deep well pump at Afton State Park only operates at 60% pumping capacity and the manufacturer was unable to locate the defect. Lake Maria State Park purchased a packaged solar powered parking area light before this project began. During installation CEE discovered that the system's controller was not capable of keeping the battery from freezing during winter use. A new controller was installed.

Lessons Learned:. ***If the lowest bid is the sole criteria for choosing a solar powered system, the system will most likely fail.*** *Park staff should perform a comprehensive analysis when selecting a system. Only the most durable components were chosen for this project to make sure the systems would need minimal maintenance from park staff. Ensuring that systems are designed to withstand Minnesota's winter was another important lesson learned during the project. For each system that was installed for this project CEE analyzed 30 years of weather data to identify the cloudiest period that occurred during the busiest time of use for the specified system. For instance, the cloudiest Memorial Day weekend on record for a pumping system. It is absolutely essential that renewable energy systems be sized for worst case operating conditions to ensure that they will function when they are most needed. At the beginning of this project CEE analyzed two previously installed solar powered systems and found that either the battery capacity or photovoltaic panels were extremely undersized causing them both to fail shortly after installation.*

Result 3. Disseminate Educational Materials for Public and Park Staff

Park Signs

CEE staff worked with DNR to develop a color, weather resistant sign that explains each renewable system to park visitors. These signs are also available on CEE's website at *http://www.mncee.org/frame_parkgif.htm*. Website visitors can view a Minnesota map and click on an icon for each park renewable system which displays the color sign.

Guidebooks

A copy of *Using Renewable Energy in Minnesota Parks: A Guidebook for Park Managers* was sent to each of the Minnesota State Parks. Multiple copies were also sent to DNR's

Bureau of Engineering, DNR's State Park Headquarter staff, and additional units within DNR. The guidebook is available in libraries at DNR, Department of Trade and Economic Development, Office of Environmental Assistance, City of Minneapolis, and City of St. Paul. At the November 1999 Minnesota Recreation and Park Association annual conference CEE staff gave two presentations to mostly county and local park staff and handed out guidebooks at the conference's Trade Show to approximately 40 people. Ten guidebooks were sent to the New York State Department of Natural Resources.
Future Plans: *500 guidebooks were printed, 170 remain at CEE and will be distributed at future renewable energy events or as they are requested. CEE staff are available to give presentations about this project's results to interested groups.*

A color version of the guidebook (the printed copy is in black and white) has been available on CEE's website at *http://www.mncee.org/ceedocs/parkguide.pdf* since January 2000. The guidebook has been downloaded by outside webpage visitors at least 180 times. At least five energy related websites are linked to CEE's guidebook webpage including the Minnesota Department of Commerce, DOE's Energy Efficiency and Renewable Energy Clearinghouse, and the Union of Concerned Scientists. **Future Plans**: *The DNR's webpage administrator did not provide a link to CEE's website because an appropriate place on DNR's website could not be located. CEE suggests that DNR could place the electronic version of each system sign on the appropriate park webpage and provide a link to the guidebook somewhere on their website.*

The guidebook and its website link have been publicized in articles in the following park and energy related newsletters: *Keeping Up: A Publication of the Minnesota Recreation and Park Association* (May 2000); *Minnesota Counties: A Publication of the Association of Minnesota Counties* (May 2000); *The NonCom Scoop: Newsletter of the NonCommunity Public Water Supply Program* sent to Dept of Health's list of 7,000 suppliers (Winter 2000); *Sustainable Minnesota* (Spring 2000). The following electronic newsletters also publicized the guidebook: *Minnesota Sustainable Communities Newsletter* (April 2000) and *Trends in Renewable Energies* (March 2000). An article was submitted to the editor of DNR's *Minnesota Volunteer* magazine in early June 2000. The editor is planning to feature the project in a future article about global warming.

Publication of Park Installation Photos by National Renewable Energy Lab
In June 2000 electronic images of ten solar powered systems in Minnesota State Parks were sent with a short caption to the U.S. Department of Energy's National Renewable Energy Lab (NREL). These images will be listed on NREL's on-line PIX photo library in late 2000. Some or all of the images may also be included in a CD of hundreds of photos of U.S.-based solar energy systems that NREL will publish in the fall of 2000.

IV. OUTLINE OF PROJECT RESULTS:

Timeline For Completion Of Results

		7/97	1/98	3/98	7/98	1/99	6/99	10/99	12/99
Result 1.	Selection Guidelines	X	X	X				X	X
Result 2a.	Needs Assessment	X	X	X	X				
Result 2b.	Equipment Installation			X	X	X	X	X	
Result 3.	Educational Materials				X	X	X	X	X

Result 1. Develop Selection Guidelines for Renewable Energy Technologies

LCMR Budget:	$61,800	LCMR Balance:	$0
Match Budget:	$0	Match Balance:	$0

Completion Date: December 31, 1999

1. Technology selection guidelines will be developed so that DNR and other public park personnel can assess the feasibility of various renewable energy and energy efficiency technologies suitable for application in public parks.

A. The Center for Energy and Environment (CEE) and Minnesota Renewable Energy Society (MRES) will identify the energy needs and energy efficiency opportunities in state parks with assistance from DNR personnel.

B. MRES will use existing directories and other research materials to develop an inventory of commercially available renewable energy and energy efficient technologies applicable in Minnesota state parks.

C. A directory of energy technology vendors and contractors will be compiled by MRES using existing directories and research materials. This information will also be updated during telephone interviews.

D. In March 1998, CEE will complete a draft version of selection guidelines for those renewable energy applications and energy efficient technologies which are found to be technically feasible and applicable to the conditions in Minnesota's state parks. Information compiled from the technology inventory and the vendor/contractor directory will be used in conjunction with cost/benefit analyses of various technologies. The guidelines will focus on the cost/benefit analysis of each technology and will be compared with traditional applications. Total life-cycle costs will be included.

E. Beginning in June of 1999, CEE will modify the draft selection guidelines to include any lessons learned during the installation and testing of the renewable energy applications. A final version of the selection guidelines will be distributed at the workshop for park personnel in late fall or early winter of 1999.

Timeline for Result 1.

		7/97	1/98	3/98	7/98	1/99	6/99	10/99	12/99
Result 1.	Selection Guidelines	X	X	X				X	X

Deliverables for Result 1.

1. Develop an inventory of commercially available renewable energy and energy efficient technologies.
2. Compile and print directory of energy technology vendors and contractors.
3. Develop and print at least 300 technology selection guidelines.

Result 2. Complete Needs Assessment and Install Technologies

LCMR Budget:	$137,200	LCMR Balance:	$0
Match Budget:	$0	Match Balance:	$0

Completion Date: October 31, 1999

1. A needs assessment for renewable energy technologies will be performed for four state parks with existing or future needs for off-grid power or other energy services. At least 12 renewable energy and energy efficient technologies will be installed in at least three selected demonstration sites. The plans for the visitor interpretive center for Moose Lake State Park will be analyzed to assess the potential for renewable energy technologies, passive solar applications and energy efficiency improvements.

2. Investor owned utilities and electric cooperatives in Minnesota will be surveyed by CEE to determine if state parks are eligible for renewable energy grants or rebate program funding.

   A. With DNR input, four state parks will be chosen for a complete energy needs assessment. Parks will be evaluated by CEE according to, among other variables, development or betterment plans which have the potential to be met with renewable energy or energy efficient technologies.

   B. At least 12 applications appropriate for energy technologies will be chosen by CEE for three state parks using the selection guidelines. The plans for the new Moose Lake State Park's visitor interpretive center will be reviewed for their potential for active and passive renewable energy technologies and energy conservation applications.

   C. Applications will be completed by CEE for any applicable utility grant or rebate programs.

   D. Wherever possible, LCMR funding will be leveraged by using existing DNR park betterment and development projects as the basis for funding installation projects and using LCMR funding to "buy down" the additional incremental capital and installation costs, if any, of the renewable or energy efficient technologies.

Timeline for Result 2.

	7/97	1/98	3/98	7/98	1/99	6/99	10/99	12/99
Result 2a. Needs Assessment	X	X	X	X				
Result 2b. Equipment Installation			X	X	X	X	X	

Deliverables for Result 2.

1. Survey utilities which serve state parks to identify any renewable energy grants or rebate programs.
2. Perform needs assessment for at least 4 state parks.
3. Install at least 12 renewable energy technologies in at least 3 state parks.
4. Assessment of Moose Lake interpretive center plans for energy efficiency changes.
5. Complete applications for utility rebate or grant programs.

Result 3. Disseminate Educational Materials for Public and Park Staff

LCMR Budget:	$31,000	LCMR Balance:	$0
Match Budget:	$0	Match Balance:	$0

Completion Date: December 31, 1999

3. Educational materials will be displayed in at least 10 park locations where renewable energy or energy efficient technologies have been installed. The technology selection guidelines will be distributed and three presentations about the project will be given to DNR, county, city, and other local park staff at the Minnesota Recreation and Park Association annual conference in November 1999.

A. With DNR assistance, CEE will develop educational messages which explain the installed technologies and their environmental benefits.

B. Educational interpretive displays, information kiosks, plaques, or other educational tools will be installed for at least 10 applications by CEE, with DNR approval.

C. CEE will draft an article about the project for DNR's *Minnesota Volunteer* magazine.

D. Three presentations on the renewable energy/energy efficiency applications installed during this project will be given by CEE at the 1999 annual Minnesota Parks and Recreation Association conference.

E. The project results will be highlighted on a webpage for CEE's website at www.mncee.org.

F. Technology selection guidelines will be distributed at the MRPA conference. Three workshops will feature: (a) DNR personnel from participating parks, (b)

showcase demonstration projects, (c) discuss barriers to implementation, (d) present difficulties encountered during the project and (e) provide a forum for questions and answers.

G. Technology selection guidelines will be sent by CEE to park personnel who do not attend the conference. At least 300 technology guidelines will be distributed at the workshop and by mail.

H. If requested by DNR, CEE will present study results to up to three units within DNR, such as Waterways and Trails, for the planning of renewable energy applications for boat accesses, and bicycle, skiing, and hiking trails, etc.

Timeline for Result 3.

		7/97	1/98	3/98	7/98	1/99	6/99	10/99	12/99
Result 3.	Educational Materials				X	X	X	X	X

Deliverables for Result 3.

1. Develop and install educational interpretive displays, information kiosks, plaques or other educational tools for at least 10 applications.
2. Draft article about the project for DNR's *Minnesota Volunteer* magazine.
3. Give three presentations at MRPA's annual conference for DNR, county and other park employees.
4. Create webpage highlighting project results and selection guidebooks.
5. Distribute 300 technology selection guidebooks at workshop and by mail
6. Present project results for up to three units within DNR, if requested.

V. DISSEMINATION: At least 12 renewable technology applications will be installed in three selected state parks in Minnesota. At 10 sites an educational information kiosk, interpretive display or plaque will be installed to inform park visitors of the energy technologies. A web page highlighting the project will be added to CEE's website at www.mncee.org. Approximately 500,000 park visitors per year are expected to be exposed to at least one renewable energy technology display per year. The project will also be highlighted in an article in DNR's *Minnesota Volunteer* magazine which has a statewide circulation rate of over 150,000.

The renewable technologies selection guidelines, supplier information, needs assessment, funding opportunities and demonstration sites are necessary to educate park managers and planners about the potential for expanding renewable energy and energy efficiency applications. These tools will be introduced to DNR and other professional park personnel by highlighting the demonstration projects during three sessions at the Minnesota Park and Recreation Associations national conference in Mankato. At least 300 copies of the renewable technologies selection guidelines will be produced for distribution to park managers throughout the state park system and to county and community park boards. The study results will also be shared with up to three units within DNR, such as Waterways and Trails, for the planning of boat accesses, trails and other improvements.

VI. CONTEXT:

A. **Significance:** This project is significant to Minnesota because it will increase amenities and services at state parks in a sustainable manner. These renewable energy and energy efficiency improvements will increase recreational opportunities for park visitors without jeopardizing the natural environment by digging conventional electric power and gas lines or increasing fossil fuel emissions from conventional power plants, generators or maintenance vehicles. Currently there are only a handful of renewable energy technology applications operating in the state park systems because there has been no comprehensive effort to increase their use. Sixty state park betterment and development projects are planned for 1996-1997. Without this project, current and future park development plans will most likely follow past patterns and overlook the potential opportunities to sustainably develop the park system by utilizing state-of-the-art energy technologies.

The main barriers to increasing the use of renewable energy systems in state parks include: lack of familiarity with available technologies, lack of cost/benefit data and lack of staff resources to obtain this information in a comprehensive manner. The Center for Energy and Environment and its cooperators will develop the tools necessary to overcome these informational barriers. DNR personnel are enthusiastic about utilizing these resources when planning for future park improvements.

Cost-effectiveness criteria will allow cost competitive, renewable energy technologies to compete against traditional applications which usually have lower capital costs but in many cases have higher installation and operating costs. State funds will be leveraged through existing utility renewable energy and conservation grant and rebate programs.

The information developed for this project will be distributed to county and local park officials as well as to DNR staff. The renewable technologies selection guidelines can also become the basis for including criteria for renewable energy and conservation technologies in DNR's Outdoor Recreation Grants Program. This program distributes funds to at least 20 communities per year for county and local park development projects.

B. **Time:** All results will be completed on or before December 31, 1999. An additional six months past the June 31, 1999 deadline is required because many of the technologies must be installed during the summer months and the installations will not be completed and thoroughly tested until October 31, 1999. Once the technologies have been installed and tested, the one-day conference will be presented in late fall or early winter of 1999. Approximately $53,000 (23 percent of the total budget) will be required beyond July 31, 1999.

C. **Budget Context:** Equipment costs will be used to buy down the incremental cost of renewable energy or energy efficient technologies, if any, compared to the cost of conventional technologies. For instance, if a water pump with a diesel generator is planned for a state park it might be replaced with a non-polluting, photovoltaic array. Preparation of the well and the cost of the pump would be paid for with DNR funds but any additional capital or installation costs from the photovoltaic array would be paid for from LCMR project funds.

	July 1995 - June 1997 Prior expenditures on this project	July 1997-Dec. 1999 Project period	Dec 1999-June 2001 Future expenditures on this project
LCMR	$0	$230,000	$0
Other State	$0	$0	$0
Non State Cash	$0	$0	$0
In Kind	$0	$0	$0
Total	$0	$230,000	$0

Budget:

Personnel	$86,700
Equipment	$102,400
Acquisition	$0
Development	$0
Other	
subcontractors	$24,800
supplies, printing, misc. expenses	$3,300
travel	$9,000
conference expenses	$3,800
Total	**$230,000**

Equipment

All of the renewable energy and energy efficiency equipment used for this project will become the property of DNR directly after installation. Energy monitoring equipment purchased with LCMR funds will be used by CEE to assess sites or monitor system performance. Monitoring equipment will become the property of DNR unless CEE arranges with LCMR to pay back to the Fund an amount equal to either the cash value received or a residual value approved by the director of the LCMR if the monitoring equipment is not sold. All of the equipment used for educational interpretive displays, information kiosks, plaques or other education tools will become the property of DNR upon installation.

VII. COOPERATION: The nonprofit Minnesota Renewable Energy Society and the Department of Natural Resources (DNR) are cooperating with the Center for Energy and Environment (CEE) on this project. The associated personnel, affiliation, percentage of personnel time, and allocated funding costs are divided accordingly:

Position Title and Employer	Employee Name	% of Time Spent on Project*	Amount Allocated
Project Manager, CEE	Richard Szydlowski	25% = 1st half 15% = 2nd half	$21,900 $13,100
Policy Analyst, CEE	Karen Linner	20% = 1st half 30% = 2nd half	$8,900 $13,400
Energy Analyst, CEE	Mario Monesterio	15% = 1st half 15% = 2nd half	$6,200 $6,200
Energy Engineer, CEE	Mark Hancock	0% = 1st half 15% = 2nd half	$0 $8,300
Graphics/Clerical Support, CEE		7% = 1st half 15% = 2nd half	$2,800 $5,900
Researcher, MN Renewable Energy Society	To be named	15% = 1st half 0% = 2nd half	$24,000 $0
Park Develop. & Acquisition Division Mgr., DNR	John Strohkirch	3% = 1st half 3% = 2nd half	no associated costs
State Park Directors, DNR	To be named	0% = 1st half 5% = 2nd half	no associated costs

* The first half of the project covers July 1997 - September 1998 (15 months). The second half of the project covers October 1998 - December 1999 (15 months).

VIII. LOCATION: Renewable energy applications will be installed in at least three state parks. The location of these parks will be chosen with DNR's guidance as part of the needs assessment phase of the project.

IX. REPORTING REQUIREMENTS: Periodic work program progress reports will be submitted not later than March 31, 1998 and June 30, 1999. A final work program report and associated products will be submitted by June 30, 2000, the completion date as set in the appropriation.

X. FOR RESEARCH PROJECTS: Not applicable.