2010 Project Abstract
For the Period Ending June 30, 2012

PROJECT TITLE: Demonstrating Sustainable Energy Practices at RELCs – Eagle Bluff
PROJECT MANAGER: Jerome "Joe" Deden
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WEBSITE: www.eagle-bluff.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: MN Laws 2010, Chapter 362, Sect 2, Sub 7d1

APPROPRIATION AMOUNT: $350,000

Overall Project Outcome and Results
Minnesota's six accredited Residential Environmental Learning Center's undertook a collaborative project, "Today's Leaders for a Sustainable Tomorrow," with the intent of acting as a public resource for information regarding energy use and energy technologies. This was accomplished by demonstrating geographically appropriate technologies for reducing energy use and providing public access to energy information through formal education programs and a web presence. In-depth information on each center's energy reduction demonstrations are found in their individual reports. A bulleted summary of each demonstration is as follows:

- **Eagle Bluff Environmental Learning Center – Lanesboro, MN:** Installed deep energy reduction retrofit, solar thermal, and a solar hot water heater.
- **Audubon Center of the North Woods – Sandstone, MN:** Installed geothermal heat pump, solar arrays, solar panels, and a wind generator.
- **Deep Portage Learning Center – Walker, MN:** Installed wood gasification system and lighting upgrades (CFLs to LEDs and T12s to T8s).
- **Laurentian Environmental Learning Center – Britt, MN:** Installed building envelope improvements, energy conservation technologies, and a solar hot water heater.
- **Long Lake Conservation Center – Palisades, MN:** Installed building envelope improvements, a solar hot water heater, and lighting upgrades (trail lighting and T12s to T8s).
- **Wolf Ridge Environmental Learning Center – Finland, MN:** Installed biofuel heating system, solar arrays, wind generation, and lighting upgrades (trail lighting and T 12s to T8s).

Eagle Bluff implemented a deep energy reduction retrofit on its most inefficient building, the staff residence. The building was super insulated using the Cold Climate Housings Research Center's REMOTE (Residence Exterior Membrane Outside-insulate Technique). Solar thermal heat was added for domestic hot water and building heating. A 5.6 Kw solar photovoltaic system provides green power for the heating system. As a result of the retrofit, the building became the 9th house in North America to receive ACI's 1000 Home Challenge for reducing energy consumption by over 78% A pdf describing the project is available from Eagle Bluff.

All centers collaborated in developing over 20 new units of educational curriculum based on the following seven areas: biomass, conservation, efficiency, energy basics, food and energy, solar power and wind power. An activity toolbox was designed for use at the RELC's and in the formal classroom. They range from formal lessons to informal tours to an energy choice challenge and are currently in practice at the RELC's collectively reaching nearly 60,000

visitors/students annually. In order to determine the efficacy of the educational materials and program, an external assessment was done which evaluated the knowledge and behaviors of visitors to the RELC who participated in the activities. The results showed that 88.5% of children and 50.6% of adults had an increase in knowledge and 70.2% of children and 52.6% of adults increased their energy conserving behaviors while visiting an RELC.

Project Results Use and Dissemination

Homeowners, commercial businesses, educators and the general public can access the educational materials, assessment results, demonstration information, and current energy use/production on the Today's Leaders for a Sustainable Tomorrow website at: www.tlfast.org.

In addition, this project has allowed the centers the opportunity to collaborate with Winona State University to offer an Energy Resource Advisor course which is part of Continuing Education program and a core course in WSU's Sustainability major.

Using the TLFAST demonstrations and curriculum as the framework, the centers are also now positioned to collaborate on an innovative program funded by the National Science Foundation which focuses on providing informal STEM (Science-Technology-Engineering-Math) experiences for K-12 students.

In the upcoming year and upon the total completion of the project, the centers' will be participating in tours, conferences, or workshops to share the success of the project and publicize the resources available to the public as a result of the project.

Environment and Natural Resources Trust Fund (ENRTF)
2010 Work Program Final Report

Date of Report: 8/15/2012
Final Report
Date of Work Program Approval: 9/8/2010
Project Completion Date: 6/30/2012

I. PROJECT TITLE: Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs) – Eagle Bluff (7d-1)

Project Manager: Joe Deden
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Location: Aitkin, Cass, Fillmore, Lake, Pine, and St. Louis

Total ENRTF Project Budget:

OVERALL & EAGLE BLUFF PORTION (7d-1)	
ENRTF Appropriation	$350,000
Minus Amount Spent:	$349,415.01
Equal Balance:	$ 584.99

ALL PORTIONS	
7d-1: Eagle Bluff	$ 350,000
7d-2: Audubon	$ 206,000
7d-3: Deep Portage	$ 212,000
7d-4: Laurentian	$ 258,000
7d-5: Long Lake	$ 240,000
7d-6: Wolf Ridge	$ 234,000
TOTAL APPROPRIATION:	$1,500,000

Legal Citation: M.L. 2010, Chp.362, Sec.2, Subd. 7d1

Appropriation Language:
$1,500,000 is from the trust fund to the commissioner of natural resources for agreements as follows: $206,000 with Audubon Center of the North Woods; $212,000 with Deep Portage Learning Center; $350,000 with Eagle Bluff Environmental Learning Center; $258,000 with Laurentian Environmental Learning Center; $240,000 with Long Lake Conservation Center; and $234,000 with Wolf Ridge Environmental Learning Center to implement renewable energy, energy efficiency, and energy conservation practices at the facilities. Efforts will include dissemination of related energy education.

II. and III. FINAL PROJECT SUMMARY

Minnesota's six accredited Residential Environmental Learning Center's undertook a collaborative project, "Today's Leaders for a Sustainable Tomorrow," with the intent of acting as a public resource for information regarding energy use and energy technologies. This was accomplished by demonstrating geographically appropriate technologies for reducing energy use and providing public access to energy information through formal education programs and a web presence. In-depth information on each center's energy reduction demonstrations are found in their individual reports. A bulleted summary of each demonstration is as follows:

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IV. OUTLINE OF PROJECT RESULTS*:*

RESULT/ACTIVITY 1: Implementation of carbon and energy reduction systems for education and demonstration purposes at Eagle Bluff. Budget $245,000. Completion Date June 30, 2012.

Description: Eagle Bluff is the only RELC located in southeastern Minnesota near the town of Lanesboro. We have about 20,000 users a year and teach them about the ecology of "Bluff Country".

Overall, the McKinstry Energy Audit for Eagle Bluff documented that all six of our buildings need envelope improvements to both conserve energy and improve energy efficiency. Three buildings are excellent candidates for solar hot water applications with five of the buildings benefiting from instantaneous domestic hot water backup. All four of our more public buildings would benefit from upgrading mechanical air handling and ventilation systems. McKinstry recommends converting our natural gas heating system to either electronic heat storage or geothermal systems depending on the availability of an on-site green electric power source. They recommend the establishment of a small scale wind turbine on-site for educational purposes. Outdoor and indoor lighting improvements will help reduce our electric energy use. And lastly, the sub-metering of all buildings to collect baseline energy use and to monitor improvements.

Our McKinstry audit and subsequent recommendation confirmed that our oldest buildings are indeed our most energy in-efficient buildings. The target of our LCCMR work plan is the Eagle Bluff's residence which was built in 1973. The retrofitted building will become the centerpiece for our Energy Resource Advisor (ERA) educational activities.

We have assembled a design and builder team with remodeling and energy related experience and have been meeting since the spring of 2008 and plan to have finished plans by July 2010. The funding for the design phase came for internal Eagle Bluff funds and a $15,000 grant from the Beim Foundation.

Our plans are to improve the envelope utilizing the Cold Climate Housing Research Center's recommendations including the re-establishment of a continuous air barrier in the walls and ceilings. All windows and door will be replaced with high efficiency units. Plans include installing a heat recovery ventilator to achieve good interior air quality and to prevent mold.

We also plan to install solar hot water and solar photo-voltaic panels.

Monitoring equipment is already in place to establish base data and monitor improvements.

The reasons these improvements were chosen from the McKinstry report is because they: 1) have the ability to reduce Eagle Bluff's carbon production considerably while

improving efficiency, 2) utilize a renewable energy source (solar), and 3) serve as a visible demonstration for educating users on the benefits of energy conservation and efficiency, and renewable energy.

Summary Budget Information for Result/Activity 1:

ENRTF Budget:	$245,000.00
Amount Spent:	$244,766.56
Balance:	$233.44

Deliverable/Outcome	Completion Date	Budget	Estimated Carbon Reduction (#s)
1-1 Envelope & Mechanical Improvements will be completed	12/31/10	$188,000	7,755
1-2 Solar Hot Water will be installed	12/31/10	$25,000	6,000
1-3 Solar Photovoltaic will be installed	12/31/10	$32,000	TBD depending on size

Final Report Summary: 7/15/2012 A deep energy reduction retrofit was completed on the Eagle Bluff residence, our most energy in-efficient building before the process began. The outside envelope walls have been sealed with a bituminous membrane, super insulated with either six inches of extruded polystyrene (XPS) or six inches of polyisocyanutate (PIC). The inside ceilings were foamed with six inches of PIC foam. A whole house air handling system was installed complete with an environmental recovery unit to recapture waste heat and humidity. All windows and doors were replaced with Loewen Windows with an R value of 8. A blower door test was completed. Results have improved from being unpressurizable in 2007 to 212 cubic feet per minute at 50 Pascals of pressure or from greater than 6 air exchanges per hour to 0.45 air exchanges per hour.

A solar thermal system was installed including: 200 square feet of Heliodyne collectors, an ICM controller and a 400 gallon storage tank. Heat from this system provides primary heat for domestic hot water and secondary, supplemental heat for a hydronic home heating system.

5.44 Kw of solar power was brought online by Winona Renewable Energy to provide power. Data from the Enphase monitoring system is available on Eagle Bluff's website.

Promotion for the project has been ongoing with articles appearing in regional newspapers. Other events include: a builder's tour, a grand opening, participating in the Midwest Builders Conference held in Menomonie, WI March 2011. Ongoing tours of the project occur at least twice monthly.

The project became the 9th home in North America and the first home in Minnesota to complete ACI's 1000 Home Challenge by documenting an energy reduction of over 78% over the past year. See appended ACI letter.

The unspent $233.44 was for a monitoring controller for the solar thermal system that was delayed by the manufacturer and is being installed after the grant period expired.

RESULT/ACTIVITY 2: Measurement and oversight as a basis for education and information sharing. Budget $30,000 Completion Date June 30, 2012

Description: Overall Project Coordination: Managing architect - Kirk Program Management, Inc. (KPM) who supervised the McKinstry Study will help all six centers prioritize their energy projects matching their needs with current technologies, provide advice for contracting for design and construction services, review and critique proposed design solutions and perform periodic on-site observations of the work in progress and contribute updates, provide background information for the website and education materials.

Summary Budget Information for Result/Activity 2:

ENRTF Budget:	$30,000
Amount Spent:	$30,000
Balance:	$0

Deliverable/Outcome	Completion Date	Budget
2-1 Scope of Work & Technical Teams will be established for each center. Centers will be assisted in going out for, receiving, and evaluating procurement options.	12/31/10	$20,000
2-2 Progress on Work Plans will be monitored at each center.	6/31/2012	$10,000

Final Report Summary: Ronald Kirk, Consulting Architect, 7/15/2012

The six Environmental Learning Centers have submitted detailed reports summarizing the work performed and results achieved as a result of the LCCMR approved grant. These summary reports record the timeline of activities culminating with the completion of the work by the end of June 2012, a description of the energy efficiency measures implemented, moneys spent and information on the outcomes in terms of performance and other relevant impacts. I refer the reader to these reports for detailed information. This summary report will focus on the some of the process strategies that were designed to produce predictable high value outcomes and to highlight some of the outstanding accomplishments of this important effort as a result of the LCCMR funded work.

Any funding source wants to have some assurances that the money awarded achieved the stated goals of the request for funding. Much attention was devoted from the beginning of the planning effort to implement proven "project success" strategies to ensure that each energy efficiency and carbon reduction strategy implemented was designed and installed in accordance with appropriate professional standards of care and quality construction methodologies. Several key "project success" strategies were incorporated into this effort.

PROJECT SUCCESS STRATEGIES

1. It was imperative to select highly qualified design professionals with demonstrated successful experience in the work and familiarity with current building science knowledge. A detailed Request for Proposal was prepared for each project outlining the scope of work to be designed, a detailed scope of service and quality assurance measures that were to be implemented and the format for submittals. Interviews were conducted with each firm submitting a proposal and a finalist selected based on a ranking of each firm. The interview process allowed the client to evaluate the individuals assigned to perform the work and to make an informed choice. The firms selected were highly qualified to execute the design services at a high level of professional competence throughout the design process and during the construction process in administering the contract requirements and providing on site observation of the work. The quality of the final finished work is testament to the careful selection of the firms and their highly professional approach to the work.

2. To the extent possible with public sector bidding requirements it was imperative to be able to select highly qualified construction firms to carry out the on-site work. Particularly in more rural areas this objective can be a challenge but with carefully prepared bidding documents with clear qualification criteria the centers were successful in being able to utilize qualified firms. It is acknowledged that not all firms were familiar with current building science based best practices at the beginning of the construction process but with active and close involvement and coaching by the design professionals throughout the construction process the construction firms learning curve not only allowed the work to be completed in accordance with documents and quality construction standards but provided the construction firms with considerable best practice experience that they will now be able to incorporate into their future work. We successfully utilized "Best Value" alternative procurement procedures as approved by the legislature in 2007 to be used by all school districts in Minnesota at one of the centers for work funded by other sources.

3. Implementing quality assurance measures throughout the construction process was believed to be key to achieving desired outcomes. Each project used a variety of approaches and strategies to ensure ultimate project success. Some firms incorporated "stop signs" which were signals to the construction firms to stop the work at key points to allow detailed and timely observation of the work in process to ensure the work was being installed properly. Regular on site pre-construction

meetings were conducted to make sure the construction firms and their personnel understood the requirement of the work and were ready with appropriate on site crews to properly execute each phase of the work prior to commencement of the work.

Blower door tests were conducted prior to commencement of the on-site envelope improvement work to establish a base line point and then after completion of the envelope improvement work to verify that the work was completed properly. For example, on the Eagle Bluff residence project the house had such a high air leakage level that the initial blower door test was not even able to create enough pressurization to record data. After completion of the envelope work the data indicated very little leakage and the measured natural gas use before and after indicated a remarkable 93% reduction in heating energy use.

In a couple cases the solar thermal systems initially experienced some overheating but again these issues were addressed during the commissioning process. One of the lessons learned as a result was that for applications where a wide variation in occupancy and subsequently highly varied hot water demand such as environmental learning centers with smaller occupancy levels during the summers and several days where occupancy levels can be quite low proper provisions for dealing with the excessive generation of hot water by the solar panels has to be given careful attention. Sometimes our best educational opportunities arise in these types of situations and can be very helpful in helping others avoid problems.

SUMMARY HIGHLIGHTS OF ACTUAL OUTCOMES

It is important to note that partially as a result of the LCCMR approved grant several of the centers were able to acquire additional funding to expand the scope of their energy efficiency measures and to be able to achieve even greater carbon footprint reductions.

Not all of the energy efficiency measures were completed in time to be able to record a full year of actual energy use to compare to the original 2007 data used to calculate the initial carbon footprint. It is instructive however to highlight some of the initial data that is available.

Deep Portage with a combination of the LCCMR approved funds and other funding has been able to make the claim of having reached carbon neutral through a reduction of propane use, solar and wind renewable systems and with the purchase of green credits for all of their electricity use. Their actual 2011 propane use compared to the 2007 benchmark data reflects an amazing 77% reduction while their electrical energy use reached a 13% reduction level for an overall on site carbon reduction of 43%. The purchase of green credits for the remaining electrical use allows them to claim a carbon neutral achievement. The early 2012 data suggest a possible even larger carbon reduction level may be achieved.

Eagle Bluff was able to record a 93% reduction of natural gas usage from the 2010 usage data prior to completion of the envelope improvements. This outstanding

accomplishment allowed them to become the first deep energy retrofit in the state of Minnesota to receive the Affordable Comfort Institute 1000 Home Challenge award.

Laurentian has achieved a 42% reduction in propane usage from the July 1-June 30 2011/2012 heating season compared to the same period of the 2007/2008 heating season. This is a dramatic impact and one that is also felt and recognized by all visitors in the obvious change in comfort levels especially in the Lodge and Office buildings which were the primary focus of this effort.

The Audubon Center results are somewhat complicated because of a problem with their electric driven geothermal system which was not operational from April to July of 2011 which necessitated the use of propane backup boilers which of course increased the propane use above normal operations. Even with this anomaly propane use in 2011 was reduced by 10% from the 2010 usage. When comparing the Jan-April 2012 period with the Jan-April 2011 period the propane use data indicates an 80% reduction. The annual results won't be available until December 2012 but the reduction in propane use is expected to be very dramatic as a result of envelope improvements and the solar thermal domestic hot water system installed and fully operational.

Wolf Ridge completed their LCCMR approved funded work by the June 2012 deadline but actual energy and carbon reduction information is not yet available. Engineering calculations for projected impact for the East Dormitory suggests close to a 50% reduction in propane usage. Converting the trail lighting to LED lighting is projected to achieve a 74% reduction in electrical usage. An additional 33% reduction of campus electrical lighting energy usage is projected from the conversion of T12 fluorescent fixtures to the newer T8 technology.

Long Lake

The solar system was only recently completed so no actual production data is available. Again, partially as a result of this funding Long Lake was able to receive additional federal funding to implement significant envelope improvement measures in several of their campus buildings. No engineering calculations were performed to project a realistic estimate but based on comparable other project experience the combination of the new solar system and envelope improvements are expected to make a significant reduction in energy use and subsequent carbon footprint reductions.

In addition to the above center specific highlights each of the centers either has installed or is in the process of installing energy monitoring systems. These systems will have the capability to record energy production of the solar photovoltaic and solar thermal systems. Some of the more extensive systems will be able to record actual energy usage of various systems and/or buildings which in addition to recording energy use will also enable staff to trouble shoot system problems and allow them to identify when systems are using more energy than intended and thus allow the staff to reduce the amount of wasted energy used at each center. Numerous studies around the world have indicated that as much as 40% of a buildings energy use is actually wasted by malfunctioning equipment or improperly controlled mechanical and lighting systems that are running when not needed or desired.

All six centers have collaborated in developing over 20 new units of educational curriculum units based on the following eight areas: biomass, climate change, conservation, efficiency, energy basics, food and energy, solar power and wind power. Each of the centers provide tours of their energy improvements and have incorporated lessons learned into their educational curriculum thus helping to transform the knowledge base of Minnesota students and residents related to these critical energy issues.

The training of local firms in the latest building science construction techniques was a side objective of this effort and will hopefully benefit future construction efforts in the local areas of each of the six centers.

In summary it is this author's opinion that the LCCMR approved funds have been invested wisely and have achieved and will continue to achieve significant energy and carbon footprint reductions for years to come. The joint development of new energy related educational curriculum units by the six centers will lead to evidence based energy and climate education for generations to come for students and other citizens able to experience the examples set by these six centers. It is this author's opinion that it is essential that the citizens of Minnesota understand in an unbiased, scientific, non-political manner the critical energy and climate issues of this period in our planet's history. This citizen awareness and understanding of the palette of proven solutions as demonstrated by the results of this effort could well help establish the state of Minnesota as a national leader in solving the complex energy and climate related challenges that desperately need creative, smart and proven effective solutions.

In closing I would like to commend and express appreciation for the LCCMR's support for this important effort in helping the joint coalition of residence based environmental learning centers make tremendous progress in their pursuit of their goal to reduce their collective carbon footprint by 80%. Much work remains to accomplish this goal but thanks to the LCCMR attainment of this goal is now within sight.

RESULT/ACTIVITY 3: Development of significant public education on energy choices. Budget $60,000 Completion Date June 2011

Description: Overall Project Coordination: Eagle Bluff will coordinate the development of appropriate K-12 curriculum and activities, on-site signage, take-home materials, web interaction and the development of center specific workshops and training seminars will be completed under the guidance of an educational consultant.

3.1 Lessons on Sustainability and Renewable Energy delivered at each RELC

We will develop, pilot test, and teach classes centered on renewable energy and sustainable lifestyles. These lessons will be large-group presentations and interactive classes for groups of 15-20 students, all of varying time lengths to fit each RELC's needs.

3.2 *Participation in sustainable lifestyle activities at the RELC.*

As part of the lessons being designed, all students will be asked to live a more sustainable lifestyle during their RELC visit. This may include, but is not limited to: reducing food waste, composting food, reducing electricity use, reducing water use, recycling, etc.

3.3 *Interactive web-based tools*

We will develop and maintain interactive web tools to complement the pre- and post-visit lessons that students will complete at their own school before and after their visit to the RELC. This curriculum will be a matching in-kind donation to the program.

3.4 *Assessment*

We will develop and implement an assessment tool that will measure the change in behavior and/or knowledge of students who participate in our program.

Summary Budget Information for Result/Activity 3:

ENRTF Budget:	$60,000.00
Amount Spent:	$59,648.45
Balance:	$351.55

Deliverable/Outcome	Completion Date	Budget
3-1 K-12 curriculum will be developed	6/30/2011	$40,000
3-2 On-site signage recommendations will be completed, designed and printed	6/30/2011	$4,000
3-3 Interactive web-based tools will be developed and implemented	6/30/2011	$6,000
3-4 Assessment Tools will be developed	6/30/2011	$10,000

Final Report Summary: 7/15/2012

A curriculum designer was hired to produce the suite of activities that would make the energy education program at the RELC's. During the fall, the contractor visited the RELCs to meet with their staffs, tour the grounds, and see what each site is already doing with regards to renewable energies and sustainability practices. The staffs were able to tell her which topics, within the disciplines of renewable energies and sustainability practices, they would need activities to create new curricula or incorporate into existing curricula. The contractor then vetted existing sustainability and energy-related curriculum currently available which allowed her to see what trends exist in energy education, what common approaches are used with students, and their potential application at the RELC's. Based on the goals laid out by the RELC's and with respect to existing related curriculum, the contractor developed a specialized curriculum for use at the RELC's. A set of 24 activities in the themes of: biomass, climate change, conservation, efficiency, energy basics, food & energy, solar power, and wind power

were designed. The activities are a mixture of games, simulations, and hands-on experimentation that address a variety of Minnesota state standards in science, math, social studies, language arts, technology, and physical education. The activities are designed to not only instruct the students about renewable energy and sustainability topics, but to give the students opportunities to develop and implement strategies for changing behaviors. The staff from the six RELCs met to review the activities which gave the RELC staffs an opportunity to experience what the activities were like and how to lead them, but it also gave feedback on how to improve the activities as well as pilot test the evaluation tool the sites would use as they tried out the activities. Currently, the RELC's have made the TLFAST activities part of their curriculum, collectively reaching nearly 60,000 students and visitors annually.

"Energy Action" cards were designed as way to help students remember what kinds of things they can do to support sustainable behaviors. Students are being engaged to live a more sustainable lifestyle during their RELC visit which includes, but is not limited to: reducing food waste, composting food, reducing electricity use, reducing water use, recycling, etc. An RFP was circulated and a graphic illustrator was hired to produce these materials. Posters and reminder cards are being utilized at each RELC and can be downloaded from the TLFAST website for schools to or other organizations to use.

The tools that were created/compiled for TLFAST are accessible via the state-side composite website: www.tlfast.org for individuals seeking to teach about energy and sustainability. The energy action cards that visitors to the RELC's encounter are also available to download from the site. Lastly, a compilation of relevant mobile apps and online calculators are featured which complement the classroom and RELC activities.

An RFP was circulated and an assessment contractor was hired to evaluate the materials outlined in Result 3.1. In general the results of the assessment found that: "A clear trend of improvement was shown for material taught in the RELC classes. In the 10 different classes, a total of 89 questions were asked of the 550 students and 134 adults who participated in the pre and post testing. Students demonstrated improvement in choosing the correct answer in 79 of the 89 questions showing 88.8% improvement for students overall. Adults provide a little different story, and do not reflect as great a change in the number of participants selecting the correct answer. They arrive with a generally greater set of knowledge prior to the teaching in classes, so the trend among adults showed improvement in 45 of 89 questions for 50.6% improvement overall." The full report as well as the assessment instrument can be found in the Appendix.

RESULT/ACTIVITY 4: Establish and maintain center specific websites to share information and knowledge with all interested individuals and groups. Budget $15,000 Completion date June 2012.

Description: Overall Project Coordination: The centers are committed to collecting real time data that can be used on their websites and also for research on the efficiency of the various selected solutions. It will also be used to monitor the results of construction

and the accuracy of projections. The websites will have similar background information, photos and essays on the project as it develops, and real time monitoring of the energy savings. The six individual center sites will be linked together.

Summary Budget Information for Result/Activity 4:

ENRTF Budget:	$15,000
Amount Spent:	$15,000
Balance:	$0

Deliverable/Outcome	Completion Date	Budget
4-1 Web consultant will be selected & appropriate technologies will be determined	9/1/2011	$3,000
4-2 Center websites will be upgraded	7/15/2011	$10,000
4-3 State-wide composite site recommendations will be completed	1/15/2012	$2,000

Final Report Summary: 7/15/2012

Web designers were interviewed, a web consultant hired, and work completed on a site featuring the partnership of the six centers. During the late 1990's, the six centers worked together to raised $27,000,000 for capital expansion at our centers. This capital campaign was called "Project EarthSense". The group decided to build on the name recognition of this project and to organize together as the EarthSense Alliance. A recommendation was made to build a website that would be a this partnership on a site which would act as a portal for our collective projects such as TLFAST and a standalone TLFAST site linked to the umbrella EarthSense Alliance site. The sites were built to allow members of the TLFAST project to edit the site thus eliminating the need to hire a webmaster site and incur further costs.

Visitors to the RELC's websites can learn about the TLFAST project through their respective links to the state-wide composite site. These links can be found at:

- Eagle Bluff) http://www.eagle-bluff.org/top/projects/energy/
- Deep Portage) http://www.deep-portage.org/renewable-energy.html
- Audubon Center) http://www.audubon-center.org/energy.htm
- Wolf Ridge) http://www.wolf-ridge.org/campus/renewable_energy.shtml
- Long Lake) http://www/llcc.org
- Laurentian Center) http://laurentiancenter.org

The state-wide composite site can be found at: www.tlfast.org. In addition to being connected to each center's sites, a link to the TLFAST site can be found on the www.earthsensealliance.org site under the PROJECTS menu. www.tlfast.org features the energy conservation measures employed by each center as well as current energy use for those with real-time monitoring. In addition, visitors can access curricular materials, web tools, and view the results from the education program assessment.

V. TOTAL ENRTF PROJECT BUDGET:

Contracts: $101,000
Overall Project Coordination $30,000 Ron Kirk, Kirk Program Management Technical Advice
K-12 Curriculum development $40,000. The professional contractors will be determined through a competitive bidding process.
Interactive web-based tool design $6,000 The professional contractors will be determined through a competitive bidding process.
Assessment tools development $10,000 The professional contractors will be determined through a competitive bidding process.
Web Development $15,000 The professional contractors will be determined through a competitive bidding process.

Supplies: $4,000
On-Site Signage $4,000. On-site signage will be determined by the successful curriculum consultant hired in consultation with the project members.

Capital Improvements: $245,000

TOTAL ENRTF PROJECT BUDGET: $350,000

Explanation of Capital Expenditures Greater Than $3,500:
Envelope and Mechanical Improvements $170,000 (60% materials, 40% installation)
Solar Hot Water $25,000 (60% materials, 40% installation)
Solar Photovoltaics $50,000 (60% materials, 40% installation)

The capital improvements made with these funds indicated above are fixed capital assets and will remain in place and will continue to be used for the same program through its useful life.

VI. PROJECT STRATEGY:

A. Project Partners: Audubon Center, Sandstone; Deep Portage, Walker; Eagle Bluff, Lanesboro; Laurentian, Britt; Long Lake, McGregor; and Wolf Ridge, Finland.

7d-1: Eagle Bluff	$ 350,000
7d-2: Audubon	$ 206,000
7d-3: Deep Portage	$ 212,000
7d-4: Laurentian	$ 258,000
7d-5: Long Lake	$ 240,000
7d-6: Wolf Ridge	$ 234,000
TOTAL APPROPRIATION:	$1,500,000

B. Project Impact and Long-term Strategy: The RELCs sustainable energy campaign has two phases or main goals. Phase 1 is to retrofit our campuses using conservation, efficiency, and renewable resources to reduce the RELCs collective carbon emissions by 80% and lower energy costs. The ENRTF funds will be used to implement one quarter of the Phase 1 goal and sets the stage for our Phase 2 educational programs. The Eagle Bluff will continue to seek funds until all of the Phase 1 work identified in the McKinstry report is completed.

Phase 2 is to create and implement education efforts that compliment the building improvements done in Phase 1, thus using the campuses as models for sustainable retrofitting and practical carbon-neutral lifestyles. The ENRTF funds will allow us to complete a deep energy reduction on the Eagle Bluff residence, adding renewable energy use with solar hot water and solar photovoltaics. The completed project will become the centerplace of educational activities with the ERA-Energy Resource Advisor program.

B. Funding Sources	Overall RELC Project	Eagle Bluff
LCCMR 2010 Request - Pending	$1,500,000	
2009 Federal Allocation - $300,000/ctr – 5 Northern Ctrs - Pending		1,500,000
2010 Federal Allocation - $300,000/ctr – 6 ctrs – In Process		$1,800,000
MN DEED – Energy Related - Deep Portage - Received		$135,000
Federal Stimulus EECBG Grant – Long Lake – Under consideration		$100,000

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

C. Other Funds	Overall RELC Project	Eagle Bluff
In-kind Staff - $30,000		$5,000 per ctr
2009 Federal Allocation - $300,000/ctr – 5 Northern Centers		$1,500,000

D. Spending HIstory:

D. Spending History	Overall RELC Project	Eagle Bluff
Bush Foundation – McKinstry Study	$176,000	
Butler Family Foundation – Project Development	$90,000	
AURI – Biomethane Study at Eagle Bluff		$65,000
Beim Foundation - Deep Energy Reduction		$15,000

Design Team at Eagle Bluff		

VII. DISSEMINATION:
Homeowners, commercial businesses, educators and the general public can access the educational materials, assessment results, demonstration information, and current energy use/production on the Today's Leaders for a Sustainable Tomorrow website at: www.tlfast.org.

In addition, this project has allowed the centers the opportunity to collaborate with Winona State University to offer an Energy Resource Advisor course which is part of Continuing Education program and a core course in WSU's Sustainability major.

Using the TLFAST demonstrations and curriculum as the framework, the centers are also now positioned to collaborate on an innovative program funded by the National Science Foundation which focuses on providing informal STEM (Science-Technology-Engineering-Math) experiences for K-12 students.

In the upcoming year and upon the total completion of the project, the centers' will be participating in tours, conferences, or workshops to share the success of the project and publicize the resources available to the public as a result of the project.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports will be submitted not later than 01/15/2011, 7/15/2011, and 1/15/2012 A final work program report and associated products will be submitted between June 30 and August 1, 2012 as requested by the LCCMR.

Dated Material: 10/31/2012

Project Title: Residential Environmental Learning Center's (RELC's) Sustainable Energy Project - Summary

Attachment A: Final Budget Detail for 2010 Projects

Project Title: Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs) - Eagle Bluff 7d-1

Project Manager Name: Joe Deden

Trust Fund Appropriation: $1,500,000 **Eagle Bluff's 7d-1 Portion:** **$350,000**

2010 Trust Fund Budget	**Result 1 Budget:**	**Result 1 Budget:9/9/10**	**Amount Spent** *(6/30/12)*	**Balance** *(6/30/12)*	**Result 2 Budget:**	**Amount Spent** *(6/30/12)*	**Balance** *(6/30/12)*	**Result 3 Budget:**	**Amount Spent** *(6/30/12)*	**Balance** *(6/30/12)*	**Result 4 Budget:**	**Amount Spent** *(6/30/12)*	**Balance** *(6/30/12)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Implementation of carbon and energy reduction systems for education and demonstration purposes.				*Measurement and oversight as a basis for education and information sharing.*			*Developmen of significant public education on energy choices.*			*Establish and maintain a website to share information and knowledge with all interested individuals and groups*				
BUDGET ITEM															
Contracts															
Professional/technical	$0	$0	$0	$0	$30,000	$30,000	$0	$60,000	$59,648	$352	$15,000	$15,000	$0	$105,000	$352
Capital equipment over $3,500															
Conservation - Envelop Improvements 70%materials/30%installation	$150,000	$168,000	$168,000	$0										$168,000	$0
Conservation - Envelop Improvements 70%materials/30%installation	$20,000	$20,000	$20,000	$0										$20,000	$0
Renewables - Solar Hot Water 80%materials/20%installation	$25,000	$25,000	$24,767	$233										$25,000	$233
Renewables - Solar Photovoltaic 80%materials/20%installation	$50,000	$32,000	$32,000	$0										$32,000	$0
COLUMN TOTAL	**$245,000**	**$245,000**	**$244,767**	**$233**	**$30,000**	**$30,000**	**$0**	**$60,000**	**$59,648**	**$352**	**$15,000**	**$3,252**	**$11,748**	**$350,000**	**$585**

2010 Project Abstract
For the Period Ending June 30, 2012

PROJECT TITLE: Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs) – Audubon Center of the North Woods (7d-2)
PROJECT MANAGER: Bryan Wood
AFFILIATION: Audubon Center of the North Woods
MAILING ADDRESS: 54165 Audubon Drive (shipping), P.O. Box 530 (mailing)
CITY/STATE/ZIP: Sandstone, MN 55072
PHONE: 320-245-2648
E-MAIL: bwood@audubon-center.org
WEBSITE: www.audubon-center.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund

APPROPRIATION AMOUNT: $206,000

Overall Project Outcome and Results
As part of the coalition of Minnesota's residential environmental learning centers Today's Leaders for a Sustainable Tomorrow (TLFAST), the Audubon Center of the North Woods has made reducing our carbon footprint, through energy conservation, efficiency and renewable technologies, a top priority. We aim to serve as a sustainable energy demonstration site by modeling responsible energy usage and through energy offering energy curriculum for the nearly 10,000 participants that visit us every year. Through funding from the Environment and Natural Resources Trust Fund (ENRTF), we have been able to make strides in both of these directions. With our ENRTF grant, we hired an architecture and engineering firm to design the envelope improvements and solar hot water systems that would benefit several of our campus buildings. We contracted with local builders and installers to: 1) Improve the envelopes of our two largest buildings, the Dining Hall and Crosby Dormitory, through blown cellulose insulation, foam sealing air penetrations and weather stripping exterior doors 2) Insulate the walls and roof as well as re-side and re-shingle our 100+ year old Wildlife Barn 3) insulate Nationally Historic Registered Schwyzer Lodge through blown cellulose insulation in the crawl spaces and attic, as well as vapor-line and foam-seal the open air basement 4) Install a solar hot water system at our Dining Hall for hot water use in our kitchen and dining hall restrooms 5) install a solar hot water system at Crosby Dormitory for hot water use of showers and sinks in the dormitory rooms. Through these energy improvements we anticipate savings 259,570 lbs. of carbon annually from reduction in propane and electricity usage. As part of TLFAST, we have helped to create 22 energy lessons to engage and inform students about energy issues and topics to be taught at the Audubon Center and outreach programs.

Project Results Use and Dissemination
Information about this project is disseminated through the TLFAST collective website at http://earthsensealliance.org/e_energy.php. We have written about this project in our past two Audubon Center of the North Woods newsletters, and have been leading energy tours for local groups for the past several months, highlighting the outcomes of the ENRTF grant. In the spring of 2011, we contacted our 80+ participating K-12 schools about the opportunity to pilot test the energy curriculum developed and had several schools participate. Information about the completed energy lessons has been sent to all participating schools as options for their on-site or outreach programs.

Environment and Natural Resources Trust Fund (ENRTF)
2010 Work Program Final Report

Date of Report: 10/17/2011
Date of Next Progress Report: Final Report
Date of Work Program Approval:
Project Completion Date: 6/30/2012

I. PROJECT TITLE: Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs) – Audubon Center of the North Woods (7d-2)

Project Manager: Bryan Wood
Affiliation: MN Coalition of Residential Environmental Learning Centers
Mailing Address: Audubon Center of the North Woods, PO Box 530
City / State / Zip: Sandstone, MN 55072
Telephone Number: Work: 320-245-2648 Cell: 320-290-8246
E-mail Address: bwood@audubon-center.org
Fax Number: 320-245-5272
Web Site Address: www.audubon-center.org

Location: City of Sandstone in Pine County, MN

Total ENRTF Project Budget:	**ENRTF Appropriation**	$206,000
	Minus Amount Spent:	$206,000
	Equal Balance:	$0

Legal Citation: M.L. 2010, Chp. 362, Sec. 2, Subd. 7d2

Appropriation Language:
$1,500,000 is from the trust fund to the commissioner of natural resources for agreements as follows: $206,000 with Audubon Center of the North Woods; $212,000 with Deep Portage Learning Center; $350,000 with Eagle Bluff Environmental Learning Center; $258,000 with Laurentian Environmental Learning Center; $240,000 with Long Lake Conservation Center; and $234,000 with Wolf Ridge Environmental Learning Center to implement renewable energy, energy efficiency, and energy conservation practices at the facilities. Efforts will include dissemination of related energy education.

II and III. FINAL PROJECT SUMMARY:

As part of the coalition of Minnesota's residential environmental learning centers Today's Leaders for a Sustainable Tomorrow (TLFAST), the Audubon Center of the North Woods has made reducing our carbon footprint, through energy conservation, efficiency and renewable technologies, a top priority. We aim to serve as a sustainable energy demonstration site by modeling responsible energy usage and through energy offering energy curriculum for the nearly 10,000 participants that visit us every year. Through funding from the Environment and Natural Resources Trust Fund (ENRTF), we have been able to make strides in both of these directions. With our ENRTF grant, we hired an architecture and engineering firm to design the envelope improvements and

solar hot water systems that would benefit several of our campus buildings. We contracted with local builders and installers to: 1) Improve the envelopes of our two largest buildings, the Dining Hall and Crosby Dormitory, through blown cellulose insulation, foam sealing air penetrations and weather stripping exterior doors 2) Insulate the walls and roof as well as re-side and re-shingle our 100+ year old Wildlife Barn 3) insulate Nationally Historic Registered Schwyzer Lodge through blown cellulose insulation in the crawl spaces and attic, as well as vapor-line and foam-seal the open air basement 4) Install a solar hot water system at our Dining Hall for hot water use in our kitchen and dining hall restrooms 5) install a solar hot water system at Crosby Dormitory for hot water use of showers and sinks in the dormitory rooms. Through these energy improvements we anticipate savings 259,570 lbs. of carbon annually from reduction in propane and electricity usage. As part of TLFAST, we have helped to create 22 energy lessons to engage and inform students about energy issues and topics to be taught at the Audubon Center and outreach programs.

IV. OUTLINE OF PROJECT RESULTS*:*

RESULT/ACTIVITY 1: Implementation of carbon and energy reduction systems for education and demonstration purposes at Audubon Center of the North Woods. Budget $206,000. Completion Date June 30, 2012.

Description: Established in 1971, the Audubon Center of the North Woods is an RELC located in east-central Minnesota near the town of Sandstone. We have over 4,000 k-12 and college students participate in our programs each year and have over 8,000 total users a year which includes adult and community programs ranging from adventure education, to ecology classes, to cultural and crafts, to energy and sustainability.

Overall, the McKinstry, Inc. report for the Audubon Center of the North Woods showed that all six of our campus buildings need envelope improvements to both conserve energy and improve energy efficiency. Our buildings range in age from 11 to 100+ years in age and major savings in energy can be realized through better insulation and reestablishment of continuous air barriers in these buildings. Because of their positioning, four of the buildings are excellent candidates for solar hot water applications. Upgrades of our existing geothermal heating will make this technology which heats the main Dining Hall and Dormitory more efficient. Heating upgrades at three of the buildings will also make them more energy efficient.

The targets of our Environment and Natural Resources Trust Fund work plan are to:

1) Work with a professional architecture/engineering firm to create a plan for the envelope improvements and domestic solar hot water installation

2) Improve the envelope barriers of the Dining Hall/Office building, Crosby Dormitory, and Schwyzer and Lowry Lodge. Our plans are to dramatically increase the envelope barrier protection to a continuous air barrier on these buildings through better insulation in the walls, crawl space and attic, as well as high efficiency windows and doors to keep heat or air conditioning from being lost

to the outside. These envelope improvements will greatly lower the amount of energy we need to use by holding inside temperature and keeping the outside temperature from coming in.

3) Convert our propane heated water system into solar hot water technology through the installation of solar hot-water panels at the Dining Hall/Office and Crosby Dormitory. The Audubon Center's Dining Hall serves meals for hundreds of participants a day, and our dormitory has 14 rooms that house 114 people total. Each dorm room has two 2 sinks, a toilet and shower. Through the installation of solar hot water technology we will be able to significantly lower our propane use.

The reasons these improvements were chosen from the McKinstry report is because they: 1) have the ability to reduce the Audubon Center of the North Woods' carbon production considerably while improving efficiency, 2) utilize a renewable energy source (solar), and 3) serve as visible demonstrations for educating users on the benefits of energy conservation and efficiency, and renewable energy.

Summary Budget Information for Result/Activity 1:

ENRTF Budget:	$206,000
Amount Spent:	$206,000
Balance:	$0

Deliverable/Outcome	Completion Date	Budget	Budget Balance	Estimated Carbon Reduction (#s)
1-1 Professional Architecture and Engineering Services to create plan for energy improvements	09/31/10	$25,000	+$517	0
1-2 Install Envelope & Improvements into Crosby Dormitory, Dining Hall, Schwyzer and Lowry Lodge	12/31/10	$116,000	-$517	192,338
1-3 Install Domestic Solar Hot-Water for use in Dining Hall and Crosby Dormitory	12/31/10	$65,000	$0	67,232

Result Completion Date: *June 31, 2012*

Final Report Summary: 10/17/2011

1-1 The design of envelope improvements for all buildings was completed in March by LHB and bids were put out publicly with all envelope improvement bids awarded at

end of April. The design of the solar hot water system was completed in January, put out for bid in February, and a contract awarded at the end of February. The process of the design went well and we were happy with LHB, their timeliness and thoroughness in completing the specs. They were also willing to incorporate bidder's ideas and send out addendums. Some of our initial bids came back way out of our budget, and we sent them back out again for bid, receiving more favorable quotes. This worked well and allowed us to stay within budget for the improvements. There is a remaining $517 balance which we are cancelling out by using an additional $517 in the envelope improvements budget. This outcome is now complete.

1-2 The insulation improvements of Crosby Dormitory and the Dining Hall by Honeywell Envelope Systems were completed in May which included blowing in 16" of cellulose insulation in the attics and crawl spaces of both buildings, sealing off air intrusions with foam, and adding weather stripping to all the exterior doors. These improvements are already making a bid difference for comfort and energy savings in both buildings. Schwyzer Lodge insulation improvements were completed by Expert Insulation in May, with cellulose insulation blown into attics and crawl spaces, and the open air basement vapor barrier lined and foam sealed. Wildlife Barn wall insulation and siding improvements were completed by Lipe Bros in July through a vapor barrier attached to existing siding, 3 inch Styrofoam sheets screwed on over the existing siding, and new corrugated siding boards attached for the exterior. The barn is much more energy efficient now with the new siding. Work on this project because the wetness of June prevented workers from getting their machinery through the ground to the Barn. Insulated roof improvement for the Wildlife Barn was completed by Northern Extremes Roofing in July as well. A similar process to the barn siding was done, where old shingles were removed, a vapor barrier applied, 3 inch Styrofoam sheets applied, oriented strand board and then new shingles applied. The finished outcome looks and functions very well. This project was also delayed by the wet conditions of June and the inability for workers to get their machinery to the Barn. There was a cost share from the U.S. Department of Energy for $50,100 for this Result. We applied the remaining $517 from Result 1-1 to this budget to zero out the overall budget. This outcome is now complete.

1-3 The installation of the solar hot water system improvement was completed by Energy Concepts in June with 20 panels on Crosby Dormitory and 7 panels on the Dining Hall. We have had several malfunctions with the system from faulting electronic parts, to incorrect settings causing overheating, and a lack of an initial heat dump system in the original bid. There has been constant tweeking of the settings, new replacement computer parts ordered and installed, and a cost add of a heat dump. The first couple months saw the systems usually needing adjustment every week or two. It seems like problems have been addressed and we are now functioning well with both the dorm and dining hall systems. The systems are very efficient when working properly and produce greatly for hot water. There was a cost share of $60,000 from the U.S. Department of Energy on this Result. This outcome is now complete.

V. TOTAL ENRTF PROJECT BUDGET:

Contracts: Professional/technical assistance for a design/implementation team $25,000. The professional contractors will be determined through a competitive bid process.
Supplies: $0
Capital Improvements: Conservation: Envelope Improvements: $116,000
(Estimate of cost: 60% Materials, 40% Installation)
Renewable: Solar Hot Water $65,000
(Estimate of cost: 60% Materials, 40% Installation)

TOTAL ENRTF PROJECT BUDGET: $206,000

Explanation of Capital Expenditures Greater Than $3,500: The capital improvements indicated above that are made with these funds are fixed capital assets and will remain in place and will continue to be used for the same program through its useful life.

VI. PROJECT STRATEGY:

A. Project Partners: Audubon Center, Sandstone; Deep Portage, Walker; Eagle Bluff, Lanesboro; Laurentian, Britt; Long Lake, McGregor; and Wolf Ridge, Finland, MN.

B. Project Impact and Long-term Strategy: The RELCs sustainable energy campaign has two phases or main goals. Phase 1 is to retrofit our campuses using conservation, efficiency, and renewable resources to reduce the overall RELC project carbon emissions by 80% and lower energy costs. The ENRTF funds will be used to implement one quarter of the Phase 1 goal and sets the stage for our Phase 2 educational programs. The Audubon Center of the North Woods will continue to seek funds until all of the Phase 1 work identified in the McKinstry report is completed.

Phase 2 is to create and implement education efforts that compliment the building improvements done in Phase 1, thus using the campuses as models for sustainable retrofitting and practical carbon-neutral lifestyles.The Audubon Center currently uses a 3.7 KB wind turbine, two 4x10 ft. solar hot-water panels, a 208 volt 3-phase geothermal heating system and a 7,680 watt solar array to provide electricity, heat and air conditioning to the Crosby Dormitory and Dining Hall. The ENRTF funds will allow us to expand our renewable energy use by introducing more solar hot-water technology to the campus,and also significantly increase the energy conservation and efficiency of five of our buildings.

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

Item	Overall RELC Project	Audubon Center of the North Woods
C1: 2009 Federal Allocation– 5 Northern Centers, pending	$1,500,000	$300,000
C2: Continue Project Development – Butler Family	$30,000	$5,000

Foundation		
C3: In-kind Staff	$30,000	$5,000

D. Spending HIstory:

Item	Overall RELC Project	Audubon Center of the North Woods
D1: Bush Foundation – McKinstry Study	$176,000	$29,300
D2: Butler Family Foundation – Project Development	$30,000	$5,000

VII. DISSEMINATION:

Overall RELC Project: Information about this project will be disseminated through a collaborative website that will be available to the public for learning about the process and successes of each individual centers projects. The project will also be discussed in all future New Energy Resource Advisor (ERA) training seminars to be held on-site at each center.

The Energy Resource Advisor (ERA) certificate, developed by Winona State University, is a new curriculum designed to accelerate public understanding of energy efficiency, clean energy, carbon emissions, resource conservation, green technologies, and green jobs. This curriculum is the *first of its kind in Minnesota*. It is a non-credit, continuing education course for adults 18 years of age and older, *using online instructional technology combined with applied, field experience at one of the six RELCs*. Participants in this class will learn about: a) the basic components of an energy audit, b) small-scale renewable energy including site suitability, system sizing, and financial incentives that are available, c) alternative building and transportation options, d) ways to "green up" the home or business, and e) the field of emerging "green" jobs. After completing this course, the successful participant may serve as an energy resource advisor and "green" consultant in the community and workplace.

The Audubon Center of the North Woods –The Audubon Center of the North Woods will include project information on our website, in our newsletter, and through articles/press releases in local paper and electronic media. As stated earlier, we will also incorporate these efficiency and renewable energy applications into our two energy lesson plans that educate our users about energy conservation and renewable energy options applicable to their home, communities, and schools. Information about the energy improvements and technologies will be woven into every school stay, so even if that school does not participate in an energy class, they will learn about the technology through other times and activities with ACNW staff.

Final Report Progress

The collective web site is up and running, http://earthsensealliance.org/e_energy.php. The six centers have collaboratively developed 22 units of curriculum for use by each center. These curricula integrate the use of the demonstrated sustainable energy

practices at each of the centers. These lessons were pilot tested in all six centers this past spring, adjustments made over the summer, and are now all available for groups.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports will be submitted not later than 1/15/2011, 7/15/2011, and 1/15/2012. A final work program report and associated products will be submitted between June 30 and August 1, 2012 as requested by the LCCMR.

Attachment A: Final Budget Detail for 2010 Projects

Project Title: Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs) – Audubon Center of the North Woods (7d-2)

Project Manager Name: Bryan Wood

Trust Fund Appropriation: $ 206,000

2010 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
			10/17/2011		
BUDGET ITEM					
Contracts					
Professional/technical- *Architectural/Engineering Firm to create plan for envelope and solar hot water installation.*	25,000	24,483	517	24,483	517
Other contracts					
Capital equipment over $3,500 *(list specific items)*					
Conservation- *Envelope Improvements to Dining Hall, Crosby Dormitory, Schywzer Lodge, Lowry*	116,000	116,517	-517	116,517	-517
Renewables- *Solar Domestic Hot Water for Dining Hall and Crosby Dormitory. 60% materials,*	65,000	65,000	0	65,000	0
COLUMN TOTAL	**$206,000**	**$206,000**	**$0**	**$206,000**	**$0**

2010 Project Abstract
For the Period Ending June 30, 2012

PROJECT TITLE: Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs)—Deep Portage Learning Center (7d-3)
PROJECT MANAGER: Dale Yerger, Director of Deep Portage Learning Center
AFFILIATION: Deep Portage Learning Center - MN Coalition of RELCs
MAILING ADDRESS: 2197 Nature Center Drive NW
CITY/STATE/ZIP: Hackensack, MN 56452
PHONE: 218-682-2325
E-MAIL: portage@uslink.net
WEBSITE: www.deep-portage.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: MN Laws 2010, Chapter 362, Sect 2, Sub 7d-3

APPROPRIATION AMOUNT: $212,000

Overall Project Outcome and Results

Cass County, MN has installed a small wind turbine and solar hot water system and has made electrical and envelope improvements to the environmental education facility known as Deep Portage Learning Center. A $212,000 grant from the Environment and Natural Resources Trust Fund has made this possible. All of these systems have been installed, and we now have a year's worth of energy savings data. The 10 Kw small wind turbine has produced 4,200 Kw hours of electricity and has eliminated the emission of 10,080m lbs. of carbon dioxide. The solar hot water system has produced thousands of gallons of domestic hot water and displaced 1,400 gallons of fossil fuel propane. New LED (light-emitting diodes) lights, E Solutions refrigeration equipment and new Energy Star windows round out the project. These technologies are for demonstration and education. A new sustainable energy curriculum has been developed and piloted with several Minnesota schools. Five-hundred-plus people have now gone on a renewable energy tour at the center. This project shows our residents how to reduce our carbon footprint, save money. and support local jobs and industry. The electrical use at the Deep Portage Learning Center is now an astonishing 2.2 Kw hours per square foot annually. The Carbon footprint has been cut in half, and the total energy savings is $15,000-20,000 per year. This is a model that can be repeated at public schools and government buildings around the State.

Project Results Use and Dissemination

Information about this project will be disseminated in our center's newsletters, website and blogs, emails, and annual reports. It will also be discussed in all future New ERA training seminars held on-site at each center.

The Energy Resource Advisor (ERA) certificate, developed by Winona State University, is a new curriculum designed to accelerate public understanding of energy efficiency, clean energy, carbon emissions, resource conservation, green technologies, and green jobs. This curriculum is the first of its kind in Minnesota. It is a non-credit, continuing education course for adults 18 years of age and older, using online instructional technology combined with applied, field experience at one of the six RELCs. Participants in this class will learn about: a) the basic components of an energy audit, b) small-scale renewable energy including site suitability, system sizing, and financial incentives that are available, c) alternative building and transportation options, d) ways to "green up" the home or business, and e) the field of emerging "green" jobs.

After completing this course, the successful participant may serve as an energy resource advisor and “green” consultant in the community and workplace.

Deep Portage Learning Center – Deep Portage has had over 200 participants attend renewable energy tours and has taught classes to elementary students in renewable energy. We have posted data on our Facebook page, and our website has a renewable energy toolbar with data on the accomplishments of the initiative. The TLFAST and LCCMR websites also feature information.

Final Report Progress

The collective website is up and running, www.tlfast.org/dplc.html . The six centers have collaboratively developed 22 units of curriculum for use by each center. These curricula integrate the use of the demonstrated sustainable energy practices at each of the centers. These lessons were pilot tested in all six centers this past spring, adjustments made over the summer, and are now all available for groups.

Environment and Natural Resources Trust Fund (ENRTF)
2010 Work Program

Date of Report: Final Report 7/30/2012
Date of Next Progress Report: Final Report
Date of Work Program Approval:
Project Completion Date: 6/30/2012

I. PROJECT TITLE: Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs)—Deep Portage Learning Center (7d-3)

Project Manager: Dale Yerger, Director of Deep Portage Learning Center
Affiliation: Deep Portage Learning Center - MN Coalition of RELCs
Mailing Address: 2197 Nature Center Drive NW
City / State / Zip: Hackensack, MN 56452
Telephone Number: 218-682-2325
E-mail Address: portage@uslink.net
Fax Number: 218-682-3121
Web Site Address: www deep-portage.org

Location: City of Hackensack in Cass County, MN

Total ENRTF Project Budget:	**ENRTF Appropriation**	**$212,000**
	Minus Amount Spent:	**$212,000**
	Equal Balance:	**$0**

Legal Citation: M.L. 2010, Chp. 362, Sec. 2, Subd. 7d3

Appropriation Language:
$1,500,000 is from the trust fund to the commissioner of natural resources for agreements as follows: $206,000 with Audubon Center of the North Woods; $223,289 with Deep Portage Learning Center; $350,000 with Eagle Bluff Environmental Learning Center; $258,000 with Laurentian Environmental Learning Center; $240,000 with Long Lake Conservation Center; and $234,000 with Wolf Ridge Environmental Learning Center to implement renewable energy, energy efficiency, and energy conservation practices at the facilities. Efforts will include dissemination of related energy education.

II and III. FINAL PROJECT SUMMARY:
Cass County MN has installed a small wind turbine and solar hot water system and has made electrical and envelope improvements to the Environmental Education facility known as Deep Portage Learning Center. A $212,000 grant from the Environment and Natural Resources Trust Fund has made this possible. All of these systems have been installed, and we now have a year's worth of energy savings data. The 10 Kw small wind turbine has produced 4200 Kw hours of electricity and has eliminated the emission of 10,080m lbs. of carbon dioxide. The solar hot water system has produced thousands of gallons of domestic hot water and displaced 1400 gallons of fossil fuel propane. New LED (light-emitting diodes) lights, E Solutions refrigeration equipment and new Energy Star windows round out the project. These technologies are for demonstration

and education. A new sustainable energy curriculum has been developed and piloted with several Minnesota schools. Five-hundred-plus people have now gone on a renewable energy tour at the center. This project shows our residents how to reduce our carbon footprint, save money and support local jobs and industry. The electrical use at the Deep Portage Learning Center is now an astonishing 2.2 Kw hours per square foot annually. The Carbon footprint has been cut in half, and the total energy savings is $15,000-20,000per year. This is a model that can be repeated at public schools and government buildings around the State.

IV. OUTLINE OF PROJECT RESULTS*:*

RESULT 1/ACTIVITY 1. Implementation of carbon and energy reduction systems for education and demonstration purposes at Deep Portage Learning Center (DPLC). Budget $212,000. Completion Date June 30, 2012.

Description: DPLC is located in Cass County, Minnesota. We serve 10-20,000 participants annually—from Minnesota and Iowa, and a small percentage of international groups. Our campus encompasses approximately 60,000 square feet. Our focus is environmental literacy for all ages.

The McKinstry report recommended a number of items that would improve the efficiency of our campus. In April 2008 when our summary was presented we were using 30,000 gallons of propane per year (that's 378,000 lbs of carbon per year). The McKinstry report recommended the following priorities:

- Improve building envelope performance
- Add lighting controls to existing fixtures
- Convert domestic hot water with additional solar heating and instantaneous electric back up
- Upgrade existing temperature controls.

Since the McKinstry report, DPLC has already implemented some carbon reducing modifications using other funds. Instead of upgrading the temperature controls we took an alternative approach and added a wood gasification energy system to our facility in October 2009.

With these ENRTF funds we will continue to implement carbon cutting measures at DPLC by focusing on the following four McKinstry recommendations:

1. Installing a 900 gallon per day solar hot water system
2. Envelope improvements to the main lodge and the interpretive center
3. Small wind project to offset Kw hour usage
4. Electrical Improvements

We have chosen these 4 recommendations based on their ability to reduce carbon and demonstrate alternative energy.

Solar Hot Water. We use 900 gallons of hot water per day, a solar hot water system would reduce our reliance on propane and electricity. We plan to install an engineered system that will supply us with our hot water needs, which is especially efficient during the summer months when our wood system is not in use.

Envelope improvements. The windows and doors in our 54,000 square foot facility are between 10 and 24 years old, they leak a lot of heat and have significant gaps. We plan to replace the oldest windows and doors first.

Small Wind. We plan to install a 10 K wind turbine on a 130 foot high lattice tower help to offset the 232,000 Kw hours that we currently use each year.

Electrical Improvements. McKinstry recommended lighting upgrades to reduce Kw hours usage. We plan to change out lighting fixtures, switches, and refrigeration and freezer compressors.

The Goal of the McKinstry study was to increase building health and efficiency thereby reducing the carbon footprint of our facility. Our plan will achieve to following goals:

1. reduce carbon
2. decrease operating expense
3. demonstrate alternative energy and conservation
4. generally show that an older building can be upgraded to have near LEED certification efficiency, most of us will improve our existing structure if there are technologies available to lower costs and save energy.

In summary, we are reducing propane and Kw hours, these two sources of carbon usage represent the low hanging fruit of carbon reduction . These improvements will be at the heart of our alternative energy demonstration and education program. Through the implementation of envelope improvements, mechanical improvements, and photovoltaic demonstration at DPLC, this project is expected to reduce carbon output by 76,883 lbs per year.

Estimated Carbon Reduction: The ENTRF project will reduce 76,883lbs. of CO2.

Summary Budget Information for Result 1:

ENRTF Budget:	**$212,000**
Amount Spent:	**$212,000**
Balance:	**$0**

Deliverable/Outcome	Completion Date	Budget	Estimated Carbon Reduction (#s)
1-1 Solar Hot Water	9/30/2011	$86,976	8,883 lbs.
1-2 Envelope & Electrical Improvements	9/30/2011	$39,322	32,000 lbs
1-3 Small Wind	9/30/2011	$75,991	36,000 lbs
1-4 Professional/Technical Contracts	9/30/2011	$21,000	0 lbs.

Result Completion Date: June 30, 2012

Final Report Summary:

The Cass County Board as of January 4, 2011 approved bids for 1-1, 1-2, 1-3, and 1-4. This project was delayed due to design time for the solar hot water system and value

engineering, as the first set of bids were all significantly over budget. Also CAM was not prompt with the management of the project. Additionally, the winter was especially cold and snowy and not contusive to certain kinds of construction. On January 31 we had our onsite meeting with the four successful contractors and planned for work to take place in February and March, as well as in the spring when the ground would be thawed and foundations for the wind turbine and solar hot water could be excavated.

As of July 15, 2011, **1-1** was 90% complete; electrical and insulation work remained, and manufacturer start-up was expected to occur within the following two weeks. **1-2** was complete; 400-wing windows, walk-in cooler components, and dining hall and public bathroom lighting upgrades were complete. 200-wing windows and walk-in freezer component upgrades were moved to the Department of Energy grant and were also complete. **1-3**: The 10 Kw wind turbine was erected and had thus far produced 150 Kw hours of electricity. There had been dozens of visitors to the site for tours so far that summer, and the young women's science camp studied the installation and collected data. **1-4:** We had achieved many of our design and engineering objectives, including value engineering and were moving forward on this project forward to meet the completion date. Because alternative energy projects and contractors are still not that widespread, there were budget and design challenges with this project that led to the amendments. However we stayed on track to get the job done with the objective of adding significant educational and demonstration capabilities to our campus.

As of January 15, 2012: The solar hot water system had saved 1,400 gallons of propane and 17,640 lbs. of CO2. The electrical and mechanical improvements had reduced our electric bill by 5% and reduced our carbon output by 9,750 Kw hours of electricity and 23,400 lbs of CO2. The wind turbine had produced 2450 Kw hours, reducing 5880 pounds of CO2.

As of June 30, 2012 all projects were complete and all contractors paid. The total of all deliverable/outcomes was $223,289; this is $11,289 more than the allocation, and the extra funds came from the Deep Portage Foundation. Issues with the solar hot water were resolved by reprogramming the controller; the system has not overheated this summer. We have had about 325 people take part in renewable energy tours this past year, and we have also taught a number of sustainable energy units to elementary school students. We have posted data on our website and Facebook page. There has been a lot of interest and buzz around these projects with lots of visitors enjoying the comfort of the buildings in winter and the excitement of solar and wind energy. Including the Federal matching projects, we have now produced 14,000 Kw hours of electricity on site. Our 2011 electric bill was 13% lower than 2010. Our kw hour per square foot annually is an astounding 2.5 kw hours per square foot. This is practically unheard of in a school (anything below 10 kw hours per square foot is energy star). Our propane reduction this year is 90%; 1,400 gallons of propane are reduced each summer by the solar hot water system. We are using locally sourced fuels and helping to sustain and create local jobs. Deep Portage Learning Center has become a model for the state and the nation.

V. TOTAL ENRTF PROJECT BUDGET:

Contracts: $21,000. These funds will pay for the design and engineering work, including writing the bid specs and creating the RFP for the competitive bid process.
Supplies: $0
Capital Improvements: $202,289
Solar Hot Water – $86,976 - 50% equipment, 50% installation
Envelope & Electrical Improvements - $39,322 - 50% equipment, 50% installation
Small Wind - $75,991 - 80% equipment, 20% installation
TOTAL ENRTF PROJECT BUDGET: $212,000

Explanation of Capital Expenditures Greater Than $3,500: The capital improvements indicated above that are made with these funds are fixed capital assets and will remain in place and will continue to be used for the same program throughout its useful life.

VI. PROJECT STRATEGY:

A. Project Partners: Audubon Center, Sandstone; Deep Portage, Walker; Eagle Bluff, Lanesboro; Laurentian, Britt; Long Lake, McGregor; and Wolf Ridge, Finland.

B. Project Impact and Long-term Strategy: We started the carbon reduction process with the aforemetioned 2009 Deep Portage/DEED Project. The ENRTF project will be the second step. We have an overall campus goal of carbon reduction and energy efficency that is expected to cost $1,000,000 ($6 million for the total partnership). Deep Portage will continue to work with our five other partners to implement educational programs and achieve our goal of modeling efficiency and carbon reduction.

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

Item	Overall RELC Project	Deep Portage Learning Center
C1: In-kind services RELC staff	$30,000	$5000
C2: Continued Project Development, Butler Family Fund	$30,000	$5000
C3: Federal Allocation	$1,500,000	$300,000
C4: Deep Portage Foundation Gift		$11,209

D. Spending History:

Item	Overall RELC Project	Deep Portage Learning Center
Bush Foundation – McKinstry Study	$176,000	$29,300
Butler Family Foundation – Project Development	$30,000	$5,000
Deep Portage Foundation / MN DEED project		$305,000

VII. DISSEMINATION: Information about this project will be disseminated in our center's newsletters, website and blogs ,emails, and annual reports. It will also be discussed in all future New ERA training seminars held on-site at each center.

The Energy Resource Advisor (ERA) certificate, developed by Winona State University, is a new curriculum designed to accelerate public understanding of energy efficiency, clean energy, carbon emissions, resource conservation, green technologies, and green jobs. This curriculum is the *first of its kind in Minnesota*. It is a non-credit, continuing education course for adults 18 years of age and older, *using online instructional technology combined with applied, field experience at one of the six RELCs*. Participants in this class will learn about: a) the basic components of an energy audit, b) small-scale renewable energy including site suitability, system sizing, and financial incentives that are available, c) alternative building and transportation options, d) ways to "green up" the home or business, and e) the field of emerging "green" jobs. After completing this course, the successful participant may serve as an energy resource advisor and "green" consultant in the community and workplace.

Deep Portage Learning Center – Deep Portage has had over 200 participants attend renewable energy tours and has taught classes to elementary students in renewable energy. We have posted data on our Facebook page, and our website has a renewable energy toolbar with data on the accomplishments of the initiative. The TLFAST and LCCMR websites also feature information.

Final Report Progress

The collective website is up and running, www.tlfast.org/dplc.html . The six centers have collaboratively developed 22 units of curriculum for use by each center. These curricula integrate the use of the demonstrated sustainable energy practices at each of the centers. These lessons were pilot tested in all six centers this past spring, adjustments made over the summer, and are now all available for groups.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports will be submitted not later than 01/15/2011, 7/15/2011 and 1/15/2012. A final work program report and associated products will be submitted between June 30 and August 1, 2012 as requested by the ENTRF.

Attachment A: Budget Detail for 2010 Projects - Summary and a Budget page for each partner (if applicable)							
Project Title: Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs) 7d-3 Deep Portage Learning Center							
Project Manager Name: Dale Yerger							
Trust Fund Appropriation $212,000 *							
2010 Trust Fund Budget	**Revised Result 1 Budget**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**		
	Implementation of carbon and energy reduction systems for education and demonstration purposes.						
BUDGET ITEM							
Contracts							
Professional/technical: These funds will pay for the design and engineering work, including writer the bid specs and creating the RFP for the competitive bid process for Solar Hot Water, Envelope & Mechanical and Photovoltaic Demonstration	21,000	21,000	0	21,000	0		
Capital equipment over $3,500							
Solar Hot Water--50% equipment, 50% installation	80,000	80,000	0	80,000	0		
Envelope & Mechanical Improvements--50% equipment, 50% installation	39,000	39,000	0	39,000	0		
Small Wind	72,000	72,000	0	72,000	0		
COLUMN TOTAL	**$212,000**	**$212,000**	**$0**	**$212,000**	**$0**		
NOTE: The actual cost and the checks that Cass County issued total $223,289. The difference--$11,289--was issued to Cass County by the Deep Portage Foundation (the entity that has a contract to operate at the Deep Portage Learning Center).							

2008 Project Abstract (or **2009 Project Abstract** or **2010 Project Abstract**)
For the Period Ending June 30, 2012

PROJECT TITLE: Today's Leaders for a Sustainable Tomorrow.
PROJECT MANAGER: Karl Brown
AFFILIATION:Laurentian Environmental Center
MAILING ADDRESS: Mounds View Public Schools 350 Hwy 96 W
CITY/STATE/ZIP: Shoreview, MN, 55126
PHONE:651-621-7403
E-MAIL:karl.brown@moundsviewschools.org
WEBSITE: www.laurentiancenter.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: [Insert relevant year's citation here]

APPROPRIATION AMOUNT: $ 258,000

Overall Project Outcome and Results

In 2007, a McKinstry study was conducted at the six residential environmental learning centers in Minnesota to identify ways to reduce carbon, and energy consumption. The results of the study were used as the baseline carbon and energy use for Laurentian Environmental Center. This data was submitted as part of the LCCMR ENRTF grant request that focused on carbon reduction as a result of envelope improvements for the lodge and office buildings, and a solar hot water. In 2010, Laurentian Environmental Center (LEC) was awarded $258,000 from the ENRTF. In late early fall of 2010,an RFP was sent out for the design work of the project. Wagner Zaun Architecture of Duluth was selected to design and manage the project. A predesign site assessment determined the scope of work. A design package and RFP for the energy retrofit of the lodge and office was created, and sent out. Nelson Exteriors was selected to complete the project. The retrofit work included air sealing, insulation, high efficiency windows and doors, and mechanical improvements. Construction began in fall 2010, and was completed in spring 2011.

In spring 2011, design work for the solar hot water system was conducted by Wagner Zahn Architecture, and Conservation Technologies. Bid specifications were developed. Qualified contractors were identified, and invited to submit proposals. Innovative Power Systems was awarded the contract for the design and installation of the lodge solar hot water system, and Gruska Construction was awarded the contract for site preparation and slab installation. The slab was installed fall 2011. Solar installation occurred fall/winter 2011/2012.. The solar hot water system was fully operational in April 2012.. Innovative Power Systems designed and installed a solar hot water monitoring package that was below budget, and met the center needs.

The envelope improvements in the lodge and office have made a remarkable difference in the overall comfort of the buildings. Prior to the construction, it was difficult to maintain uniform temperatures. Air sealing, insulation, and operational windows have made the building extremely comfortable for groups and staff to use. Propane use in the lodge has dropped approximately 40%, due to a combination of burning more wood for heating, and the energy retrofit projects. Future energy monitoring and utility bills will likely yield continued reductions in carbon, and energy use.

Project Results Use and Dissemination

Environment and Natural Resources Trust Fund 2010 Work Program
Final Report

Date of Report: 08/15/2012
Date of Next Progress Report: Final Report
Date of Work Program Approval: Final Report
Project Completion Date: 6/30/2012

I. PROJECT TITLE: Demonstrating Sustainable Energy Practices at Residential Environmental Learning Center's (RELC's) – Laurentian Environmental Center (7d-4)

Project Manager: Karl Brown
Affiliation: MN Coalition of Residential Environmental Learning Centers
Mailing Address: • Laurentian Environmental Center, 8950 Peppard Rd.
City / State / Zip: Britt, MN 55710
Telephone Number: (651) 621-6041 Cell: (651) 769-3588
E-mail Address: karl.brown@moundsviewschools.org
Fax Number: (651)621-7405
Web Site Address: www.laurentiancenter.org

Location: St. Louis County

Total ENRTF Project Budget:	**ENRTF Appropriation**	$258,000
	Minus Amount Spent:	$257,826
	Equal Balance:	$ 174

Legal Citation: M.L. 2010, Chp. 362, Sec. 2, Subd. 7d4

Appropriation Language:
$1,500,000 is from the trust fund to the commissioner of natural resources for agreements as follows: $206,000 with Audubon Center of the North Woods; $212,000 with Deep Portage Learning Center; $350,000 with Eagle Bluff Environmental Learning Center; $258,000 with Laurentian Environmental Learning Center; $240,000 with Long Lake Conservation Center; and $234,000 with Wolf Ridge Environmental Learning Center to implement renewable energy, energy efficiency, and energy conservation practices at the facilities. Efforts will include dissemination of related energy education.

II and III. Final Project Summary
In 2007, a McKinstry study was conducted at the six residential environmental learning centers in Minnesota to identify ways to reduce carbon, and energy consumption at the centers. The results of the McKinstry study were used as the baseline carbon and energy for Laurentian Environmental Center. This data was also submitted as part of the LCCMR ENRTF grant request that focused on envelope improvements for the lodge and office buildings, and a solar hot water system that would supplement the lodge hot water needs.

In 2010, Laurentian Environmental Center (LEC) was awarded $258,000 from the ENRTF. In late summer/ early fall of 2010,an RFP was sent out for the design work of the project. Wagner Zaun Architecture of Duluth was selected to design and manage the project. A predesign site visit and assessment was conducted to determine the scope of the work needed. A design package for the energy retrofit of the lodge and office was created, and an RFP for construction work was sent out, and posted on builder's exchanges. Lyle Nelson and Nelson Exteriors was selected to complete the project. The energy retrofit work included air sealing, insulation, high efficiency windows and doors, and mechanical improvements. Construction projects for the lodge and office began in early fall 2010, and were completed by early spring 2011.

In spring 2011, initial design work for the solar hot water system was conducted by Wagner Zahn Architecture, and Michael LeBeau of Conservation Technologies. Bid specifications were developed. Qualified contractors were identified, and invited to submit proposals based on successful completion of projects with the design team. No proposals were submitted by invitation group so the RFP was sent out to additional solar contractors who had positive reviews from other design firms or trusted contractors.
Innovative Power Systems of St. Paul, MN was awarded the contract for the design and installation of the lodge solar hot water system, and Gruska Construction of Cook, MN was awarded the contract for site preparation and the concrete slab installation. The slab was installed fall 2011. Solar installation occurred late fall 2011 through late winter 2012. The solar hot water system was initially commissioned in February 2012, and was fully operational in April 2012, after system leaks were corrected.
Monitoring systems were discussed with Wagner Zaun and Conservation Technologies. Quotes for monitoring packages were submitted by UHL companies, and People's Electric, both of the Twin Cities, MN area. Both quotes were significantly higher than the ENRTF budgeted amount, so both bids were rejected. Monitoring options were discussed with Innovative Power Systems, and a solar hot water monitoring package was selected that will provide monitoring data that will be helpful for operational and educational needs. The system will provide a web-based interface once internet connectivity is established in the lodge. Currently, the solar system displays real-time panel and tank incoming and outgoing temperature data.

The envelope improvements in the lodge and office have made a remarkable difference in the overall comfort of the buildings. Prior to the construction, it was difficult to maintain uniform temperatures. Air sealing, insulation, and operational windows have made the building extremely comfortable for groups and staff to use. Propane use in the lodge has dropped significantly, due to a combination of burning more wood for heating, and the energy retrofit projects.

Total Gallons of LP July 1- June 30
2007-2008= 10,131
2008-2009= 10,520
2009-2010= 8,843
2010-2011= 8,744
2011-2012= 5,845

III. PROGRESS SUMMARY AS OF: 6/15/2012

Amendment Request (06/15/2012)

An alternative for monitoring equipment was found that was less than the projected monitoring budget. We would like to request the transfer of $4500 from the budget category of monitoring to the budget category of renewals. In the budget category of renewals the actual cost for the installation of the hot water solar system has exceeded the projected budget by $7900 and the approval of this transfer would help offset some of the cost that will be covered by local funding.

Amendment Approved: [7/26/12]

IV. OUTLINE OF PROJECT RESULTS*:*

RESULT/ACTIVITY 1: Implementation of carbon and energy reduction systems for education and demonstration purposes at Laurentian Environmental Center. Budget $258,000. Completion Date June 30, 2012.

Description: The Laurentian Environmental Center (LEC) is located on Minnesota's Iron Range north of Virginia near the town of Britt. It is owned and operated by the Mounds View Public School district since 1977 on Minnesota School Trust land. LEC serves 6000 statewide users annually.

The McKinstry Study noted that at the Laurentian Environmental Center, "Building envelopes require attention, particularly the five buildings with crawl spaces under the main level. The slab-on-grade buildings are performing better. Domestic hot water is provided primarily by propane-fired storage water heaters with some minor use of electric. Except for the Lodge kitchen, and restroom exhaust fans, there is no mechanical ventilation in the buildings. Lighting is provided by a variety of fixtures and some change out of the older magnetic ballast fluorescents and incandescents is recommended. Control systems are generally lacking and will require upgrading."

A design consultant, Wagner Zaun Architecture of Duluth, was hired (through a competitive RFP process) to create a work plan for this project, create specifications for work to be completed and to prepare bid documents for the project. Inservicing the contractor and subs, along with monitoring the work progress was also required of the design consultant.

The target of the LEC ENRTF work plan was sealing the lodge, a 1930's CCC construction project that serves as the LEC dining building. As stated in the 2008 McKinstry Study – "The envelope of the Lodge requires attention. Voids in the air barrier and inadequate insulation cause higher than necessary energy usage." Plans included adding significant levels of insulation and to re-establish a continuous air barrier in the walls connecting into the roof. All windows and doors were replaced with high efficiency units. It was concluded after construction began that the lodge had no insulation in the exterior walls, and that improper framing techniques had been used to install many windows. The crawl space and floor of the lodge were insulated and water infiltration issues were mitigated. A surprising discovery was that the ducting for the forced air furnace was in the uninsulated crawl space, which explained why

minimal heated air made it from the furnace to the registers, and why the furnace ran constantly during cold months.

A second priority was to seal the office building – a 1960's former dorm cabin that was repurposed in the 1990's. Again, as stated in the McKinstry Study – "The office lacks an adequate air barrier and requires additional insulation." Insulating the walls and roof, along with sealing up the crawl space reduced energy consumption and began the reduction of the LEC carbon footprint. All doors and windows were replaced with high efficiency units.

In addition, the current propane heated domestic hot water systems in the lodge were enhanced with a solar system in the lodge. Original designs were to include the two restrooms in the solar hot water system, but the cost to connect the plumbing, and anticipated heat loss from long lengths of hot water pipe changed the design to include electric instantaneous water heaters for the restrooms, and the kitchen hot water needs are supplemented on cloudy days by a propane boiler that was previously installed, and integrated into the solar system. The propane boiler does not run as often or long as the solar hot water system preheats the water going into the boiler by 50-100 degrees Fahrenheit. Originally, the office buildings were to be part of the solar hot water system, but design consultants determined that the cost/benefit analysis of adding solar hot water to the office was not great enough as minimal hot water is used in the office. Instead of solar hot water, it was recommended that a low-capacity, high-efficiency electric hot water heater be installed on a timer, to only produce hot water during office hours. The office solar system will not require a back up due to the infrequent need for hot water. The solar hot water system has only been in production since April 2012. The system is generating hot water, and it is clear from the LP consumption that the energy improvements and the solar system are reducing the amount of LP needed at the center.

Monitoring equipment was installed in both buildings to monitor improvements. Monitoring systems design plans were reconfigured to fall within budget constraints. Monitoring is achieved through a combination of an integrated monitoring system as well as flow meters and gauges on the solar system, electric meters, and propane tanks. Future monitoring projects will expand the integrated systems to utilize web-based displays and data tracking. The monitoring data will be collected and shared on the LEC website as well as the Today's Leaders for a Sustainable Tomorrow (TLFAST) website. The monitoring system will further be enhanced when internet connectivity will be added in the lodge building in the fall of 2012.

Additional envelope improvements have been completed on other dorm and classroom buildings as a result of a 2009 Federal Allocation of $300,000 and school district deferred maintenance funds. These improvements were also part of the McKinstry study, and will lead to additional carbon reduction and reduced energy consumption for years to come.

The overall significance of the carbon and energy reduction systems at Laurentian Environmental Center is great.

Total Gallons of LP July 1- June 30
2007-2008= 10,131
2008-2009= 10,520
2009-2010= 8,843
2010-2011= 8,744
2011-2012= 5,845

In addition to the significant propane use reduction (close to 40%), which results in dramatic carbon reduction, the lodge and office buildings are much more energy efficient. The project created an excellent educational opportunity for student and adult groups to learn more about carbon reduction and energy conservation. This topic fits seamlessly into the mission of the center. The design and construction process also helped increase the knowledge of local contractors on areas of envelope improvements, current energy codes as well as build skills on energy retrofitting buildings. Future energy retrofitting projects will follow the design principle created for the ENRTF project. The education staff of the center has also worked to translate many of the complex construction techniques into simplified actions students and other visitors to the center can apply at home. These efforts should help further reduce carbon, and help people make their homes more energy efficient in safe, practical ways.
Another significant result of the project is the overall comfort of the buildings after high-quality materials and construction techniques were applied. This is an improvement over other construction projects at the center over the last 20 or more years where energy codes were less stringent and/or contractors were less knowledgeable about energy efficient construction. Groups attending the center since the completion have commented on how comfortable and cool the lodge is with cross-ventilation from open windows, and how warm and draft-free the lodge is in the winter months.

The ENRTF grant was a key part in securing the 2009 $300,000 Federal allocation at each of the 5 northern residential environmental centers. It is our hope that the center can demonstrate responsible use of taxpayer supported funds and that the projects further educate the public on energy reduction, as well as renewable energy options. The ENRTF has also been very helpful to identify Laurentian Environmental Center as one of the leaders in residential environmental education along with the other 5 RELCs in Minnesota. The collaboration as a result of the grant process has strengthened the collegial involvement between center directors and education staff. While each center needs to maintain a strong client base, the centers have strengthened their commitment to sustaining energy and environmental education in Minnesota and across the country.

Please note that Nick Temali was Director of Laurentian Environmental Center (LEC) when the original request for ENRTF funds was made. He retired in December 2010. Karl Brown assumed his position in the school district and LEC, as well as took over with the construction projects and grant reporting. Some of the information and history from the McKinstry study, and ENRTF request is unclear, but hopefully, all reporting requirements have been met, and we have been good stewards of the funds.

Summary Budget Information for Result/Activity 1:

ENRTF Budget: $258,000
Amount Spent: $ 257,826
Balance: $ 174

Deliverable/Outcome	Completion Date	Budget	Amount Spent	Estimated Carbon Reduction (#s)
1-1 Prof/Tech – Improvement Plans and Designs	6/31/11	$26,000	$25,826	0
1-2 Envelope Improvements in the	01/31/11	$158,500	$158,500	29,935

Lodge and Office				
1-3 Solar Hot Water installed for the Lodge and Office	2/29/12	$68,000	$68,000	18,446
1-4 Monitoring Equipment installed in the Lodge and Office	3/31/12	$5,500	$5,500	0

Result Completion Date: *June 30, 2012*

V. TOTAL ENRTF PROJECT BUDGET:

Contracts: Prof/tech assistance for a design consultant (through a competitive RFP process) $26,000
Supplies: $ 0
Capital Improvements: Lodge and Office insulation, doors and windows $158,500
(Estimate 55% for materials and 45% for installation)
Solar Hot Water Systems $68,500
(Estimate 60% for materials and 40% for installation)
Monitoring Equipment $5,500
(Estimate 85% for materials and 15% for installation)

TOTAL ENRTF PROJECT BUDGET: $258,000

Explanation of Capital Expenditures Greater Than $3,500: The capital improvements made with these funds are fixed capital assets and will remain in place and will continue to be used for the same program through its useful life.

VI. PROJECT STRATEGY:

A. Project Partners: Audubon Center, Sandstone; Deep Portage, Walker; Eagle Bluff, Lanesboro; Laurentian, Britt; Long Lake, McGregor; and Wolf Ridge, Finland.

B. Project Impact and Long-term Strategy: This ENRTF request represents one third of the McKinstry Study improvement goal for the Laurentian Environmental Center. . The centers will continue to work together to complete the McKinstry goal through state and federal resources and the assistance of foundations.

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

ITEM	Overall RELC Project	Laurentian Env. Center
In-kind Staff - $30,000	$30,000	$5,000
2009 Federal Allocation - $300,000/ctr. – 5 Northern Centers	$1,500,000	$300,000
Butler Family Foundation - Continue Project	$30,000	

Development		
2010 Federal Allocation - $300,000/ctr. – 6ctrs. – In Process	$1,800,000	$300,000

D. Spending HIstory:

ITEM	Overall RELC Project	Laurentian Env. Center
Bush Foundation – McKinstry Study	$176,000	
Butler Family Foundation – Project Development	$30,000	

VII. DISSEMINATION:

Information about this project will be disseminated through a collaborative website that will be available to the public for learning about the process and successes of each individual centers projects. Laurentian Environmental Center (LEC) will have information available on its own website as well as the Mounds View Public Schools website. LEC will put this information out in its newsletter, email blasts, and through articles/press releases through local paper media.

LEC will enhance its "Earthwise Challenge" for our participants that have them conduct their own energy audit of the campus and their behaviors while they are here for three to five days, incorporating the ENRTF funded projects. Participants will also use components of the SEE energy program to better understand the impact of energy conservation on carbon reduction and decreased energy expenses.

It will also be discussed in all future New Energy Resource Advisor (ERA) training seminars to be held on-site at each center. The Energy Resource Advisor (ERA) certificate, developed by Winona State University, is a new curriculum designed to accelerate public understanding of energy efficiency, clean energy, carbon emissions, resource conservation, green technologies, and green jobs. This curriculum is the *first of its kind in Minnesota*. It is a non-credit, continuing education course for adults 18 years of age and older, *using online instructional technology combined with applied, field experience at one of the six Minnesota RELCs*. Participants in this class will learn about: a) the basic components of an energy audit, b) small-scale renewable energy including site suitability, system sizing, and financial incentives that are available, c) alternative building and transportation options, d) ways to "green up" the home or business, and e) the field of emerging "green" jobs. After completing this course, the successful participant may serve as an energy resource advisor and "green" consultant in the community and workplace.

Laurentian has been working with Mounds View Public Schools marketing and communications staff to explore ways to increase exposure of the center, it's programs, and facilities. Marketing brochures that highlight educational programs have been

created. Additional work is in progress to increase the centers social networking presence on Facebook, Twitter, and YouTube. These sites will also be linked to the TLFAST website , www.tlfast.org, which includes pages to all of the 6 residential environmental learning centers that have been part of the ENRTF grant. Real-time energy data from the energy monitoring system will be posted on the LEC and TLFAST site once wireless upgrades are completed. The educational materials created by the TLFAST group are being integrated into Laurentian school programs so that the 10,000 annual visitors to the centers will gain a better understanding of carbon reduction, energy conservation and renewable energy sources.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports will be submitted not later than 01/15/2011, 7/15/2011, and 1/15/2012 A final work program report and associated products will be submitted between June 30 and August 1, 2012 as requested by the LCCMR.

Attachment A: Budget Detail for 2010 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: *#075-B3 - Residential Envirnmental Learning Center's (RELC's) Sustainable Energy Project*

Project Manager Name: *Karl Brown*

Trust Fund Appropriation: $ *258,000*

2010 Trust Fund Budget	**Result 1 Budget:**	**Revised Result 1 Budget (6/15/12)**	**Amount Spent** *(date)*	**Balance** *(8/15/12)*	**TOTAL BUDGET**	**TOTAL BALANCE**	
	Implementation of carbon and energy reduction systems for education and demonstration purposes.						
BUDGET ITEM							
Contracts							
Professional/technical - for a design consultant to be determined after a RFP process.	26,000		25,826	174	26,000	174	
Conservation - Envelope Improvments on the Lodge and Office	158,500		158,500	0	158,500	0	55% materials 45% labor
Renewables - Solar Hot Water system for Lodge and Office	~~63,500~~	68,000	68,000	0	68,000	0	60% materials 40% labor
Momitoring - Submetering	~~10,000~~	5,500	5,500	0	5,500	0	85% materials 15% labor
COLUMN TOTAL	**$258,000**		**$257,826**	**$174**	**$258,000**	**$174**	

2010 Project Abstract

PROJECT TITLE: **Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs) – Long Lake Conservation Center (7d-5)**

Project Manager: Ross Wagner
Affiliation: MN Coalition of Residential Environmental Learning Centers
Mailing Address: c/o Long Lake Conservation Center, 28952 438th Lane
City / State / Zip: Palisade, MN 56469
Telephone Number: (218) 927-7305
E-mail Address: rwagner@co.aitkin.mn.us
Fax Number: (218) 927-7374
Web Site Address: www.llcc.org

Location: Aitkin, Cass, Fillmore, Lake, Pine, and St. Louis

Total ENRTF Project Budget:	**ENRTF Appropriation**	**$**240,000.00
	Minus Amount Spent:	**$**202,641.05
	Equal Balance:	**$** 37,358.95

Legal Citation: M.L. 2010, Chp. 362, Sec. 2, Subd. 7(d5)

Minnesota's six Residential Environmental Learning Centers (RELC) including Long Lake Conservation Center (LLCC) teamed up to obtain grant funding to reduce their carbon footprints and provide energy education that focuses on renewable energy. In order to get the most value from the energy efficiency measures a study was conducted for each RELC. As a result, a series of recommendations were given to reduce carbon and energy consumption. Each RELC is unique, so recommendations varied between them. Specifically for LLCC, the recommendations were to improve the energy efficiency in campus buildings, convert campus lighting to solar and LED's, design and install solar energy sources for the Northstar Lodge and Dining Hall.

LLCC goals for this project were;

1) Increase conservation measures and energy efficiency in the targeted buildings.

2) Invest in renewable energy technology applications that LLCC currently does not have.

3) Use these conservation measures and renewable energy applications to educate users on making choices about conservation and renewable energy options that are applicable to their everyday lives.

All three goals have been met and the project was under budget.

In 10 years this collective education program will reach nearly 100,000 people who will attend LLCC and participate in its programs. This includes 55-60 K-12 schools annually and a number of other colleges and organizations who use LLCC.

The project is completed with the monitoring equipment installed and tested during the last week in June. Final installation and testing of the Solar Panel for the Dining Hall was completed in May, 2012. An issue with the Mille Lacs Energy Cooperative regarding the 3 Phase inverter was solved resulting in the final installation. The issue was technical in nature and the inverter's Manufacturer's specifications were submitted to Mille Lacs Energy Cooperative, which they approved. The experience could assist in future solar projects with the cooperative. Overall the project went very well. However, over the 4th of July Holiday, LLCC experienced a lightning strike that disabled the entire phone system and the Directors computer, where the monitoring software was loaded. Aitkin County IT Department has rebuilt the computer and has re-installed the system at LLC. The phone system was also just recently repaired.

Environment and Natural Resources Trust Fund (ENRTF)
2010 Work Program Final Report

Date of Report: 8/12/12
Date of Next Progress Report: Final Report
Date of Work Program Approval: 6/9/2010
Project Completion Date: 6/30/2012

I. PROJECT TITLE: Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs) – Long Lake Conservation Center (7d-5)

Project Manager: Ross Wagner
Affiliation: MN Coalition of Residential Environmental Learning Centers
Mailing Address: c/o Long Lake Conservation Center, 28952 438th Lane
City / State / Zip: Palisade, MN 56469
Telephone Number: (218) 927-7305
E-mail Address: rwagner@co.aitkin.mn.us
Fax Number: (218) 927-7374
Web Site Address: www.llcc.org

Location: Aitkin, Cass, Fillmore, Lake, Pine, and St. Louis

Total ENRTF Project Budget:	**ENRTF Appropriation**	**$**240,000.00
	Minus Amount Spent:	**$**202,641.05
	Equal Balance:	**$** 37,358.95

Legal Citation: M.L. 2010, Chp. 362, Sec. 2, Subd. 7(d5)

Appropriation Language:
$1,500,000 is from the trust fund to the commissioner of natural resources for agreements as follows: $206,000 with Audubon Center of the North Woods; $212,000 with Deep Portage Learning Center; $350,000 with Eagle Bluff Environmental Learning Center; $258,000 with Laurentian Environmental Learning Center; $240,000 with Long Lake Conservation Center; and $234,000 with Wolf Ridge Environmental Learning Center to implement renewable energy, energy efficiency, and energy conservation practices at the facilities. Efforts will include dissemination of related energy education.

II, III. FINAL PROJECT SUMMARY:
Minnesota's six Residential Environmental Learning Centers (RELC) including Long Lake Conservation Center (LLCC) teamed up to obtain grant funding to reduce their carbon footprints and provide energy education that focuses on renewable energy. In order to get the most value from the energy efficiency measures a study was conducted for each RELC. As a result, a series of recommendations were given to reduce carbon and energy consumption. Each RELC is unique, so recommendations varied between them. Specifically for LLCC, the recommendations were to improve the energy

efficiency in campus buildings, convert campus lighting to solar and LED's, design and install solar energy sources for the Northstar Lodge and Dining Hall.

LLCC goals for this project were;

1) Increase conservation measures and energy efficiency in the targeted buildings.

2) Invest in renewable energy technology applications that LLCC currently does not have.

3) Use these conservation measures and renewable energy applications to educate users on making choices about conservation and renewable energy options that are applicable to their everyday lives.

All three goals have been met and the project was under budget.
In 10 years this collective education program will reach nearly 100,000 people who will attend LLCC and participate in its programs. This includes 55-60 K-12 schools annually and a number of other colleges and organizations who use LLCC.

The project is completed with the monitoring equipment installed and tested during the last week in June. Final installation and testing of the Solar Panel for the Dining Hall was completed in May, 2012. An issue with the Mille Lacs Energy Cooperative regarding the 3 Phase inverter was solved resulting in the final installation. The issue was technical in nature and the inverter's Manufacturer's specifications were submitted to Mille Lacs Energy Cooperative, which they approved. The experience could assist in future solar projects with the cooperative. Overall the project went very well. However, over the 4th of July Holiday, LLCC experienced a lightning strike that disabled the entire phone system and the Directors computer, where the monitoring software was loaded. Aitkin County IT Department has rebuilt the computer and has re-installed the system at LLC. The phone system was also just recently repaired.

IV. OUTLINE OF PROJECT RESULTS*:* Implementation of carbon and energy reduction systems for education and demonstration purposes at Long Lake Conservation Center. Budget $240,000. Completion Date June 30, 2012.

RESULT/ACTIVITY 1: Implementation of carbon and energy reduction systems for education and demonstration purposes at Long Lake Conservation Center. Budget $240,000. Completion Date June 30, 2012.

Description: Long Lake Conservation Center (LLCC), an RELC situated on 760 acres is located in northeastern Minnesota near the towns of Aitkin and Palisade. The facility is owned and operated through Aitkin County. Every year around 10,000 users come to learn about the ecology of the Arrowhead region of Minnesota and how to be good environmental citizens.

The McKinstry study done at Long Lake Conservation Center showed that each one of nine buildings on the property was in need of envelope improvements to improve energy efficiency. Certain buildings were shown to have capabilities to have solar applications to reduce dependency on grid electricity. Some buildings also were shown

to have opportunities for reducing dependency on propane use through updates of air/heating systems. Outdoor lighting was indentified as well for helping reduce energy dependence and further solar applications.

The targets identified from the McKinstry study to use ENRTF funds for is our dining hall, two dormitories and current outdoor campus lighting systems. One of these buildings was constructed in the mid eighties with the other two being built in the late nineties. All three buildings see a significant amount of use by our users. With these three buildings using the majority of hot water, installing a solar application to one dormitory and the dining hall, while updating the control systems in the other dorm which already has the capability to heat domestic hot water with current bio mass wood boiler system in use on campus to be a good application of funds. Solar LED applications will be applied to the campus lighting system and indoor lighting in multiple buildings to reduce the dependency on grid electricity and to increase efficiency. The reasons these applications from the McKinstry study were chosen is: 1)they have the ability to reduce LLCC's carbon production the most while increasing efficiency; 2)the applications use a renewable energy application; 3) and they all can be used for demonstration purposes for educating users on their benefits to reduce carbon. A design/build team will be brought in to help develop and oversee the best way to accomplish these goals. Monitoring equipment will also be installed this time on the new and existing systems to establish base line data and monitor improvements.

Summary Budget Information for Result/Activity 1:

ENRTF Budget: **$** 240,000.00
Amount Spent: **$** 202,641.05
Balance: **$ 37,358.95**

Deliverable/Outcome	Completion Date	Budget	Estimated Carbon Reduction #'s
1-1 Solar Hot Water installed in two buildings	6/30/12	$71,690	75,008
1-2–Update Bio mass domestic hot water controls in one building	6/30/12	$4,900	31,812
1-3 Campus outdoor and indoor lighting installed	6/30/12	$75,410	41,600
1-4 Monitoring equipment installed	6/30/12	$88,000	0

Result Completion Date: *June 31, 2012*

Result Status as of 1/10/2011: 1/10/2011: Following approval of the LCCMR grant by the state legislature for Long Lake Conservation Center, a search was done to secure a professional design/build team to contract with for design/oversight of installation of carbon and energy reductions systems as listed and outlined in IV. Outline of Project Results. Request for proposals were sent to three companies who showed interest in the project. Two companies submitted proposals and were interviewed by the project

manager and a consultant helping all six RELC's with their projects. From these interviews, Wagner-Zaun Architects and Conservation Technologies a co-business group was awarded the contract.
Since the approval of the contract, an initial meeting was held between the project manager and Mike LeBeau who would be leading the design of systems to be installed. Through this meeting, the project manager identified the spring of 2011 as being the best time to install the new systems. This was done due to the lateness of the time of year (October 2010), by the time the search process was completed. By working towards a late spring/early summer installation, ample time would be given for an appropriate design for the systems and to allow for any issues that may arise with developing a design to work with existing buildings. As a result of this change in plans, the completion date of 12/31/10 for the deliverables was unable to be met. The deliverable completion date has been changed to reflect this. Since the time of the meeting, two more meetings have taken place with Mr.LeBeau gathering information on the facility and working with the project manager to come up with design parameters. At the time of this progress report, the designs are currently being drawn-up for the deliverables outlined in this work program.

Result Status as of 7/15/2011: 7/15/2011: During the course of pre-design work it was discovered LLCC needed to amend its work program. Through the amendment process this was accomplished in late April 2011. Mike LeBeau of Conservation Technologies then proceeded to complete the designs for all systems to be installed at LLCC. He then commenced to develop and write all the construction documents and specifications to allow for bidding to take place on the various deliverables outlined in this work program. Due to needing to amend the work program, this process was delayed and the project was unable to get started in the spring of 2011 as earlier identified. Once all construction documents were completed deliverable 1-1 was let out for bids. Unfortunately, not enough bids were received to make it a competitive process. This deliverable needed to be put out for bids again with these being due by the end of July. As a result of this and having to amend LLCC's work program, the completion date of 7/30/2011 will not be obtainable. The goal has now been set to have deliverable 1-1 completed by September 2011. Other deliverables outlined in the work program will also be bid out in the next several weeks with the hopes of them being completed by late September as well. These developments have forced LLCC to move back our completion date to 12/31/2011. Please note the deliverable completion date has been changed to reflect this.

Result Status as of 1/15/2012: An amendment to change the date for completion of deliverable is included at the top of this report. Envelope improvements have been completed by Northway Construction Services and their sub contractors. Other deliverables now complete are exterior lighting and the solar work at the North Star Lodge. Remaining deliverables that have yet to be completed consist mainly of the Solar work at the Dining Hall and installation of the monitoring equipment. Dining Hall Solar work is being worked on as of this report, work is expected to completed by the end of January. This brings the project to the remaining deliverable of the monitoring equipment and installation. Previously, Mike LeBeau, Todd Roggenkamp and Ross Wagner met with representatives of Peoples Electric Co. Inc, DBA as System One Control. A work plan was agreed upon based on Wagner Zaun Architects with input

from Mr. LeBeau. As a result, the monitoring will be campus wide with a computer running the results placed in the Administration Building. Additional station may be placed in a classroom setting as well. System One is expected to begin their work end of January.

V. TOTAL ENRTF PROJECT BUDGET:

Contracts: Professional/technical assistance for a design/build team (to be determined through competitive process) $28,400
Supplies: $0
Capital Improvements: Renewable: Solar Hot water $59,690= 60% equipment/40% installation
Conservation: Mechanical improvements $4,500= 60% equipment/ 40% installation
Conservation: Campus lighting $67,410= 70% equipment/30% installation
Monitoring Equipment: $80,000= equipment 70% equipment/30% installation

TOTAL ENRTF PROJECT BUDGET: $240,000

Explanation of Capital Expenditures Greater Than $3,500: The capital improvements made with these funds are fixed capital assets and will remain in place and will continue to be used for the same program through its useful life.

VI. PROJECT STRATEGY:

A. Project Partners: Audubon Center, Sandstone; Deep Portage, Walker; Eagle Bluff, Lanesboro; Laurentian, Britt; Long Lake, McGregor; and Wolf Ridge, Finland.

B. Project Impact and Long-term Strategy: The RELCs sustainable energy campaign has two phases or main goals. Phase 1 is to retrofit our campuses using conservation, efficiency, and renewable resources to reduce the RELCs collective carbon emissions by 80% and lower energy costs. The ENRTF funds will be used to implement one quarter of the Phase 1 goal and sets the stage for our Phase 2 educational programs. Long Lake Conservation Center will continue to seek funds until all of the Phase 1 work identified in the McKinstry report is completed.
Phase 2 is to create and implement education efforts that compliment the building improvements done in Phase 1, thus using the campuses as models for sustainable retrofitting and practical carbon-neutral lifestyles. Long Lake Conservation Center currently uses 5 GARN wood burning units to heat all of Long Lake's campus buildings. The ENRTF funds will allow us to expand our renewable energy use by introducing solar hot-water technology and solar campus lighting. This added technology will help to significantly increase the energy conservation and efficiency of three of our buildings as well as the whole campus proper. Monitoring equipment will also be installed to track

our renewable energy technology and help maintain a high level of energy efficiency and for use in our education programs in Phase 2.

B. Funding Sources	Overall RELC Project	Long Lake Conservation Center
LCCMR 2010 Request - Pending	$1,500,000	
2009 Federal Allocation - $300,000/ctr. – 5 Northern Ctrs. - Pending	1,500,000	
2010 Federal Allocation - $300,000/ctr. – 6ctrs. – In Process	$1,800,000	
Federal Stimulus EECBG Grant – Long Lake – Under consideration		$100,000

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

C. Other Funds	Overall RELC Project	Long Lake Conservation Center
In-kind Staff - $30,000		$5,000 per ctr.
2009 Federal Allocation - $300,000/ctr. – 5 Northern Centers	$1,500,000	$300,000
Continue Project Development – Butler Family Foundation	$30,000	
2010 Federal Allocation - $300,000/ctr. – 6ctrs. – In Process	$1,800,000	

D. Spending History:

D. Spending History	Overall RELC Project	Long Lake Conservation Center
Bush Foundation – McKinstry Study	$176,000	
Butler Family Foundation – Project Development	$30,000	

VII. DISSEMINATION: Information about this project will be disseminated through a collaborative website that will be available to the public for learning about the process and successes of each individual centers projects. Long Lake Conservation Center (LLCC) will also have information available on its own website as well as the Aitkin County Government website. LLCC will also put this information out in its newsletter, email blasts, and through articles/press releases through local paper media. It will also be discussed in all future New Energy Resource Advisor (ERA) training seminars to be held on-site at each center.

Update 1/10/11: Collaborative website is currently under construction and is nearing completion. Along with this, a general statement has been crafted to be inserted into

LLCC's website about the overall project. A short article was released in the local paper in August of 2010 outlining the event of LCCMR rewarding the grant to LLCC and the other five RELC's. Plans are also in place for LLCC to partner with a local college Central Lakes College to host an ERA training seminar at LLCC.

Energy Resource Advisor (ERA) Certificate

This curriculum is the *first of its kind in Minnesota*. It is a non-credit, continuing education course for adults 18 years of age and older, using online instructional technology combined with applied, field experience. It is intended to foster understanding and leadership of environmental sustainability in our communities, homes and workplaces. This class will be taught online as well as having a contextual field component. The contextual field component will give participants a chance to apply knowledge gained to real world challenges. After completing this course, the successful participant may serve as an energy resource advisor and "green" consultant in the community and workplace.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports will be submitted not later than 1/15/2011, 7/15/2011, and 1/15/2012 A final work program report and associated products will be submitted between June 30 and August 1, 2012 as requested by the LCCMR.

Attachment A: Budget Detail for 2010 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs) 7d-5 Long Lake Conservation Center

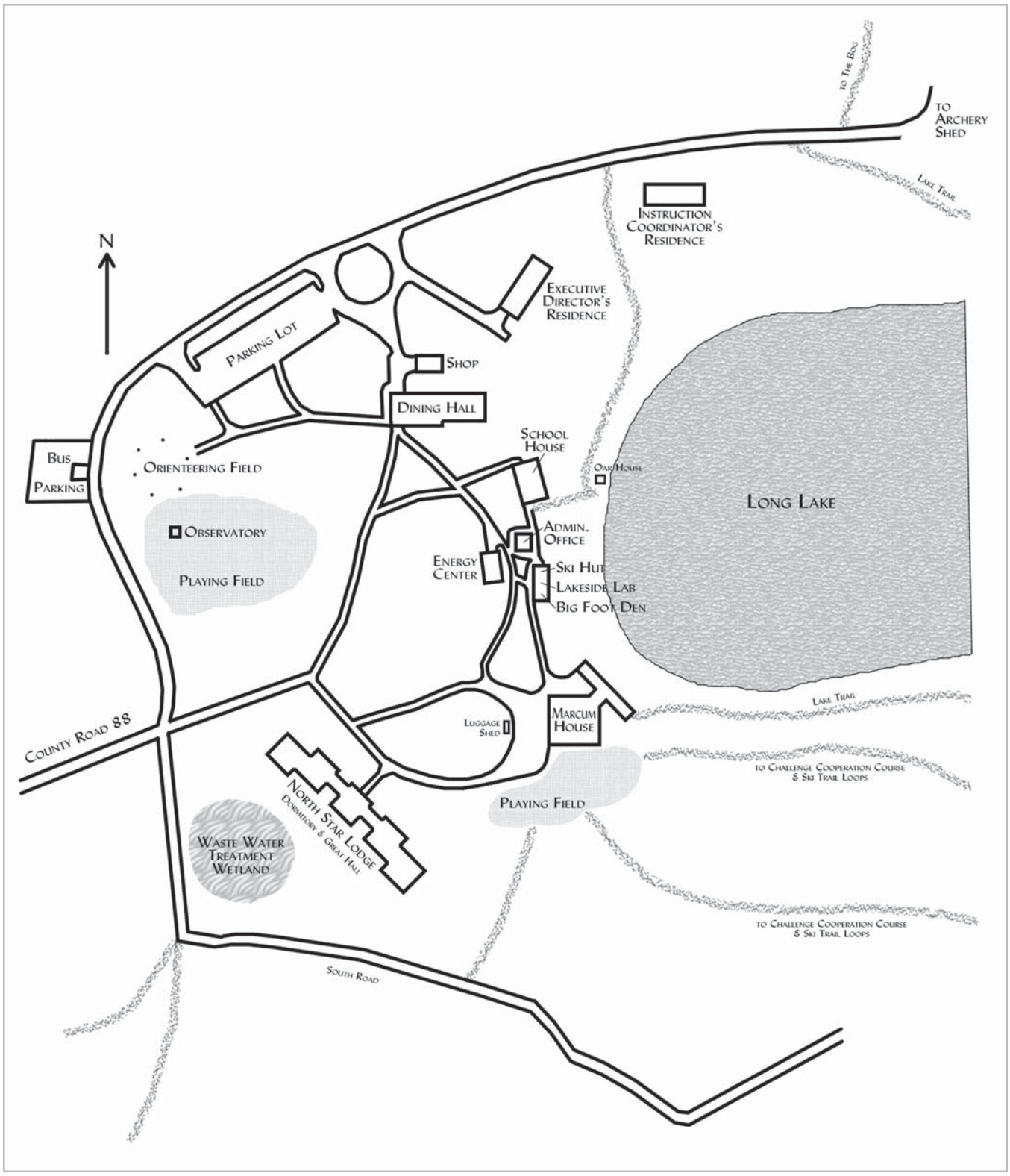
Project Manager Name: Ross Wagner

Trust Fund Appropriation: $ 1,500,000

2010 Trust Fund Budget	Revised Result 1 Budget 10/04/11	Amount Spent *(7/1/12)*	Balance 7/1/12	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM					
Contracts					
Professional/technical- for design/build (contractor will be determined through competitive process)	28,400	28,400	0	28,400	0
Capital equipment over $3,500					
Installation of Bio-mass controls 4/15/11	4,500		4,500	4,500	4,500
Renewables-Solar Hot Water- 60% equipment,40% installation	59,690	56,975	2,715	59,690	2,715
Conservation-Campus Lighting- 70% equipment, 30% installation	67,410	48,618	18,792	67,410	18,792
Monitoring Equipment-70% equipment,30% installation	80,000	68,648	11,352	80,000	11,352
		0			
COLUMN TOTAL	**$240,000**	**$202,641**	**$37,359**	**$240,000**	**$37,359**

Long Lake Conservation Center

Campus Map



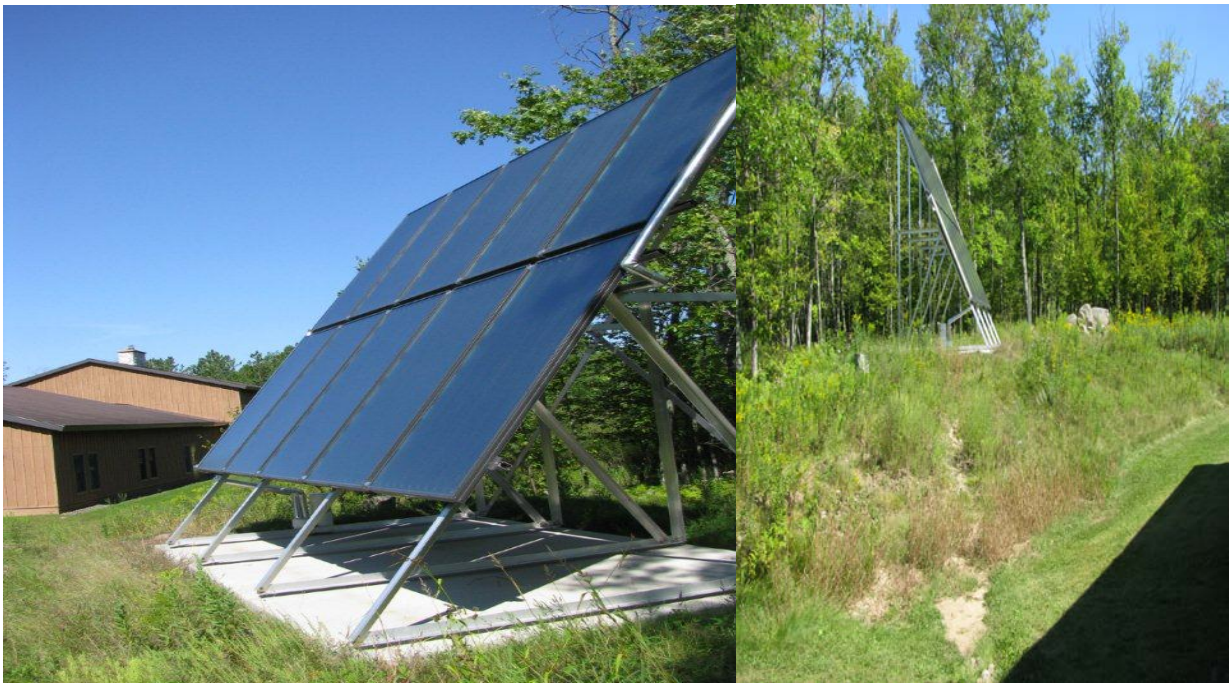
Long Lake Conservation Center LCCMR Project

The Solar Array for the Long Lake Conservation Center Dining Hall Building, the Dining Hall is in the background. Originally the array was going to be placed closer to the building but the area it is in now offers a better solar view.

From the solar array, lines go to the meter box.

From the meter box to the Dining Hall.

Feronius Converter located in Dining Hall Electrical Room.
Last stop for the solar electricity.



Hot Water Solar Array for the North Star Lodge building at Long Lake Conservation Center. Trenching to the North Star Lodge is still evident in the right hand photo.

Hot water enters the North Star Lodge, line is protected by PVC pipe.

Monitoring equipment at the North Star Lodge for the Solar Hot Water.

Heated water is stored in one of two 10,000 gallon hot water heaters in the North Star Lodge.

Biomass Controls were installed in the Energy Center.

2010 Project Abstract: For the Period Ending June 30, 2012

PROJECT TITLE: Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs) – Wolf Ridge Environmental Learning Center (7d-6)
PROJECT MANAGER: Peter Smerud
AFFILIATION: MN Coalition of Residential Environmental Learning Centers
MAILING ADDRESS: c/o Wolf Ridge ELC, 6282 Cranberry Road
CITY/STATE/ZIP: Finland, MN 55603
PHONE: 218-353-7414
E-MAIL: director@wolf-ridge.org
WEBSITE: www.wolf-ridge.org
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2010, Chp. 362, Sec. 2, Subd.7d6

APPROPRIATION AMOUNT: $ 234,000.00

Overall Project Outcome and Results

In 2007, the six residential environmental learning centers (RELCs) of Minnesota organized a collaborative group naming themselves Today's Leaders For A Sustainable Tomorrow (TLFAST). The TLFAST group that collectively serves over 550 schools in the region and over 40,000 students annually, began an effort to raise the energy education capacity of each center, along with a stronger commitment to model sustainable energy practices. Needing a baseline to begin, the TLFAST group hired McKinstry Engineering in 2007 to conduct an energy audit of each facility and recommend the best efforts to reduce energy and/or carbon footprints at each center. The McKinstry recommendations were used as a basis for action items chosen to implement at each center. At Wolf Ridge Environmental Learning Center (WRELC), the ENRTF funding enabled four projects.

1. Installation of an energy monitoring system that provides data on the generation and total consumption of energy, both electrical and heating, in each building of the facility. Use of the system provides accurate information to instructors of conservation lessons while also providing maintenance personnel with data to focus on documented energy wasting conditions.
2. Upgrading the building envelopes in 5 buildings by replacing the worst insulating and sealing doors with a Curries Trio-E Door. This door product is one of the most energy efficient, highest performing commercial doors available. Following professional site evaluation and calculation, replacing the five doors will achieve savings of 125,034 kBtu or 42,673 kWh of energy. Four of the five doors are in buildings heated by wood, thus carbon neutral; at the fifth location, the door is calculated to conserve 2,888 kg of CO2.
3. Upgrade to energy efficient interior lighting by conversion of the last of the campus' T12 fluorescent fixtures, 106 total, to T8 technology; a reduction of 33% energy use, thus 33% reduction in carbon footprint. Also upgraded was the entire outdoor campus lighting system by replacing all 46 fixtures with LED lighting technology. This achieved a 74% reduction in energy consumption and carbon footprint for lighting at the center.
4. The addition of a solar domestic hot water heating system to the East Dormitory that houses 180 students. The installed system will supply 50% of the annual hot water need for the building occupancy while reducing the domestic hot water carbon footprint by 49%.

A fifth project was originally proposed and approved with the ENRTF funding, a recapture of waste heat from refrigeration systems in the center's kitchen, but following initial work on the project, expert opinion and consultation quickly revealed problems and the project was aborted following an approved amendment for redistribution of funds. The budgeted funds were moved into three of the other four projects.

As the project only recently concluded, data collection is not yet adequate to document the change in carbon footprint for the entire center, but examples listed above by project, provide via calculation the reductions in energy and/or carbon footprint. To further enhance the education effectiveness of these demonstrations, 24 energy education lessons were created with the ENRTF funding and have been implemented at the six respective centers.

Project Results Use and Dissemination

It is important within every energy sustainability learning experience that students' understand that to achieve energy sustainability the best investment value for the effort is to first begin with conservation, then move to increased efficiencies and finally to new renewable energy generation. Wolf Ridge chose and implemented projects that will demonstrate and be regularly used to teach all three concepts. On a daily basis our students will engage with energy efficient doors, view the trail in front of them lit by an energy efficient LED light fixture, see the panels that renewably generate the hot water for their shower, and learn from a monitoring system how much energy was used or conserved in their dormitory. These are the learning experiences that occur simply by living at WRELC as a student for a week.

Immediately after the ENRTF funding was made available to the TLFAST group, the energy education specialists of the six centers met and outlined plans for over 20 new units of energy curriculum to be developed. Twenty-four new curricular units on energy were developed, pilot tested with students, refined, and written lesson plans were prepared with accompanying Minnesota graduation standards. Lessons were created for eight subject areas: biomass, climate change, conservation, efficiency, energy basics, food and energy, solar power and wind power. Developed lessons have been incorporated into curriculum in the following WRELC courses: Climate Change, Renewable Energy, and Conservation Challenge. All of the lessons as well as 19 point of action posters are available at the web site for free download, www.tlfast.org. The free and publicly available curriculum on the web site is also made available to the over 550 schools that attend the collective group of RELCs. See the comprehensive report from Eagle Bluff ELC that provides more detail on the educational dissemination of the collective effort of the six RELCs known collectively as TLFAST.

The fulfillment of the project as per its title became evident even before the project was complete. Not only are the participants in WRELC programs learning from the demonstrated installations, but also political leaders, agency staff of Minnesota and corporate business leaders. To date 123 people have come to tour and learn from the sustainable energy installations including: the Ambassador of Sweden, leaders of several different offices of the Minnesota Department of Natural Resources, staff of US Senator offices, native tribal leadership and corporate leaders interested in renewable energy. In program participation, WRELC recorded 13,084 participants last year on the WRELC campus, with another 10,843 in off site programs. The on-campus attendance is an extremely consistent number of students that are annually learning from these models of energy sustainable practices at WRELC. With support from the ENRTF, WRELC is changing how our future generations will see their own future. What is considered "cutting edge" to adults, is being learned and viewed by our children as behaviors and technologies that are simply "the appropriate way we live" in the 21st century. Through this project we have furthered established this transformation for thousands of Minnesota children each year.

Environment and Natural Resources Trust Fund (ENRTF)
2011 Work Program Final Report

Date of Final Report: August 15, 2012
Final Report
Date of Work Program Approval: July 1, 2010
Project Completion Date: June 30, 2012

I. PROJECT TITLE: Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs) – Wolf Ridge Environmental Learning Center (7d-6)

Project Manager: Peter Smerud
Affiliation: MN Coalition of Residential Environmental Learning Centers
Mailing Address: % Wolf Ridge Environmental Learning Center, 6282 Cranberry Road
City / State / Zip: Finland, MN 55603
Telephone Number: (218) 353-7414
E-mail Address: director@ wolf-ridge.org
Fax Number: (218) 353-7762
Web Site Address: www.wolf-ridge.org

Location: Aitkin, Cass, Fillmore, Lake, Pine, and St. Louis counties (Wolf Ridge is in Lake County).

Total ENRTF Wolf Ridge Project Budget:	ENRTF Appropriation	**$234,000.00**
	Minus Amount Spent:	**$234.000.00**
	Equal Balance:	**$0.0**

Legal Citation: M.L. 2010, Chp. 362, Sec. 2, Subd. 7d6

Appropriation Language:
$1,500,000 is from the trust fund to the commissioner of natural resources for agreements as follows: $206,000 with Audubon Center of the North Woods; $212,000 with Deep Portage Learning Center; $350,000 with Eagle Bluff Environmental Learning Center; $258,000 with Laurentian Environmental Learning Center; $240,000 with Long Lake Conservation Center; and $234,000 with Wolf Ridge Environmental Learning Center to implement renewable energy, energy efficiency, and energy conservation practices at the facilities. Efforts will include dissemination of related energy education.

II. and III. FINAL PROJECT SUMMARY: In 2007, the six residential environmental learning centers (RELCs) of Minnesota organized a collaborative group naming themselves Today's Leaders For A Sustainable Tomorrow (TLFAST). The TLFAST group that collectively serves over 550 schools in the region and over 40,000 students annually, began an effort to raise

the energy education capacity of each center, along with a stronger commitment to model sustainable energy practices. Needing a baseline to begin, the TLFAST group hired McKinstry Engineering in 2007 to conduct an energy audit of each facility and recommend the best efforts to reduce energy and/or carbon footprints at each center. The McKinstry recommendations were used as a basis for action items chosen to implement at each center. At Wolf Ridge Environmental Learning Center (WRELC), the ENRTF funding enabled four projects.

1. Installation of an energy monitoring system that provides data on the generation and total consumption of energy, both electrical and heating, in each building of the facility. Use of the system provides accurate information to instructors of conservation lessons while also providing maintenance personnel with data to focus on documented energy wasting conditions.
2. Upgrading the building envelopes in 5 buildings by replacing the worst insulating and sealing doors with a Curries Trio-E Door. This door product is one of the most energy efficient, highest performing commercial doors available. Following professional site evaluation and calculation, replacing the five doors will achieve savings of 125,034 kBtu or 42,673 kWh of energy. Four of the five doors are in buildings heated by wood, thus carbon neutral; at the fifth location, the door is calculated to conserve 2,888 kg of CO2.
3. Upgrade to energy efficient interior lighting by conversion of the last of the campus' T12 fluorescent fixtures, 106 total, to T8 technology; a reduction of 33% energy use, thus 33% reduction in carbon footprint. Also upgraded was the entire outdoor campus lighting system by replacing all 46 fixtures with LED lighting technology. This achieved a 74% reduction in energy consumption and carbon footprint for lighting at the center.
4. The addition of a solar domestic hot water heating system to the East Dormitory that houses 180 students. The installed system will supply 50% of the annual hot water need for the building occupancy while reducing the domestic hot water carbon footprint by 49%.

A fifth project was originally proposed and approved with the ENRTF funding, a recapture of waste heat from refrigeration systems in the center's kitchen, but following initial work on the project, expert opinion and consultation quickly revealed problems and the project was aborted following an approved amendment for redistribution of funds. The budgeted funds were moved into three of the other four projects.

As the project only recently concluded, data collection is not yet adequate to document the change in carbon footprint for the entire center, but examples listed above by project, provide via calculation the reductions in energy and/or carbon footprint. To further enhance the education effectiveness of these demonstrations, 24 energy education lessons were created with the ENRTF funding and have been implemented at the six respective centers.

IV. OUTLINE OF PROJECT RESULTS*:* Implementation of carbon and energy reduction systems for education and demonstration purposes at Wolf Ridge Environmental Learning Center. Budget: $234,000. Completion date: June 30, 2012.

RESULT/ACTIVITY 1

Description: Wolf Ridge Environmental Learning Center is located in northeastern Minnesota off the shore of Lake Superior and near the town of Finland, MN in Lake County. Wolf Ridge was established in 1971 as a private 501(c)3 accredited residential outdoor school. Funding is primarily through program fees. We serve about 17,000 users a year and teach environmental science, natural and cultural history, team building and personal growth, and outdoor recreation.

Overall, the McKinstry, Inc. report for Wolf Ridge showed that seven of our buildings need envelope improvements to both conserve energy and improve energy efficiency. Three of the buildings are excellent candidates for solar hot water applications with six buildings benefiting from instantaneous domestic hot water back up. One building needs an upgraded air handling and ventilation system; one building is a candidate for total solar heating. McKinstry, Inc. recommends converting our propane domestic hot water system in the wing of one building to the existing wood heat source used by the other wing. Outdoor and indoor lighting improvements will help reduce electrical energy use. Replacing our degraded underground heat pipes around campus will vastly improve the efficiency of our wood/hot water heating system--- we are currently implementing this improvement through another funding source. Sub-metering at all buildings to collect baseline energy use and to monitor improvements was also a recommendation.

The specific targets for the Environment and Natural Resources Trust Fund funding are: 1) address envelope improvements in the West Dorm, Education Building, Dining Hall, Administration Building and Science Center by replacing the exterior and entry way doors with high efficiency units, and weather stripping 17 existing door units throughout campus; 2) continue to improve the efficiency of interior lighting around campus by replacing T-12 light fixtures with T-8 light fixtures and installing motion sensor switches, replace exterior lighting fixtures with LED fixtures, and upgrade the exterior lighting control system; 3) Deleted as per Amendment approved April 2, 2012. 4) convert the electric domestic hot water system to a solar hot water system in the East Dorm by installing solar thermal panels, re-using the existing heat exchangers and adding storage capacity, and 5) install utility sub-metering and monitoring equipment campus-wide to establish baseline data and monitor energy improvements.

The reasons these improvements were chosen from the McKinstry report is because they: 1) have the ability to reduce Wolf Ridge's carbon production considerably while improving efficiency, 2) utilize a renewable energy source (solar), and 3) serve as visible demonstrations for educating users on the benefits of energy conservation and efficiency, and renewable energy. Monitoring equipment is important for evaluating the projects and for collecting data for future improvements.

Summary Budget Information for Result/Activity 1:

	ENRTF Budget:	$234,000.00
	Amount Spent:	**$234,000.00**
Balance		**$ 0.0**

Deliverable/Outcome	Completion Date	Budget (includes contracting costs)	Amount spent	Balance
1-1 Replace five exterior doors and weather strip others to conserve envelope energy.	6/28/12	$39,735	39,735	0
1-2 Upgrade the efficiency of Interior and exterior lighting throughout campus	3/6/12	$59,096	59,096	0
1-3 Deleted as per Amendment approved April 2, 2012		0	0	0
1-4 Install a solar hot water system	5/17/12	$77,768	77,768	0
1-5 Install a sub-metering monitoring system	6/28/12	$57,401	57,401	0
Total		234,000	234,000	

Result Completion Date: *June 30, 2012*

Final Report Summary: August 15, 2012
Planning began immediately after notice of approval for the funding in July of 2010. Wolf Ridge leadership decided that given a fixed budget and timeline, professional design and project management was crucial to successful use of the funding. Wagner Zaun Architects was chosen and conducted pre-design and design for each project. They compiled bid and contract documents, managed implementation and inspections to assure efficient and appropriate performance from all contractors. As the action items chosen for implementation by Wolf Ridge with the ENRTF funds were based upon recommendations from McKinstry, Inc. Wagner Zaun began with assessment of the recommendations. It quickly became clear that not all characterizations contained in the McKinstry study were accurate. An amendment was proposed, based upon detailed site pre-design analysis by Wagner Zaun as well as from manufacturers and contractor consultation, which was accepted by the LCCMR and resulted in redistribution of funds within the project task list and movement of the solar hot water system to the East Dorm instead of the West Dorm as it would enable greater carbon reduction. Months later during implementation it was again discovered that McKinstry's recommendations were inaccurate which resulted in another amendment accepted for

deletion of Deliverable 1-3. As one deliverable was eliminated, the funds freed by that amendment allowed greater achievement on three of the four other projects, for example - five doors were installed versus the originally planned two.

Many of the challenges of implementation related to Wolf Ridge's location. In a remote area, a great distance from contractors and services, difficulty arose in getting multiple bids to choose from and higher than estimated costs due to travel distance. Once work began, implementation generally went well and all projects were completed by the June 30, 2012 end date. The final six months saw the conclusion of all four projects.

As the title and goals of this funding were Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs), Wolf Ridge Environmental Learning Center prioritized projects that truly enable exposure and understanding for students on a daily, if not hourly basis at the center.

The act of changing the collective behavior of our society relative to energy first begins with understanding of value and investment. It is a goal of an energy education experience that student's understand the fact that we must first begin with conservation, then move to increased efficiencies and finally to new renewable energy generation. This enables the highest value in any behavior aimed at energy reduction and carbon footprint reduction. Wolf Ridge chose projects that will teach all three concepts and as we modeled in implementation of the ENRTF funded projects, the majority of Wolf Ridge ELC efforts, two of the four projects, focused on conservation.

Everyone attending a residential program at the center participates in a conservation lesson, shortly after arrival at the center. The energy monitoring system will provide the education staff with accurate data that will be used to understand the impact of the energy we have used or saved. At the same time, center maintenance staff now have the tools to track and record up to the minute changes in building systems and usage by residents that will alert of behaviors or problems that can be averted to a more conservation oriented effort.

Doors are something every participant in Wolf Ridge programs engages with multiple times per day. Twenty five year old doors were replaced with one of the highest performance doors in the commercial industry. The new doors will continue to be showcased as stories of conservation. In our Renewable Energy Class students learn and conduct basic energy audits of a building, providing them with a skill they can take home. The new doors will now become a portion of that audit as they compare them to existing doors on campus.

Increasing the efficiency of lighting in one's business or home is one of the simplest actions you can take to reduce your carbon or energy footprint. The LED lights throughout campus attract attention, entice question and provide a sample analysis for the energy audit as mentioned above as well as an example of what anyone can do to improve our collective behavior.

The solar domestic hot water system was purposely located immediately next to the entrance of the East Dormitory, a structure housing 180 participants. Every one who

enters sees and understands that the hot shower they took that morning was in part heated by a truly renewable resource, the sun, and the panels that produce that energy were constructed within the state of Minnesota. There is no better connection of what is possible or attainable in renewable energy than that link, now achieved for thousands of children and adults every year.

The cumulative impact of these projects has further cemented Wolf Ridge ELC's position as a leader in energy education in this state. The Wolf Ridge ELC 2010-11 fiscal year saw 13,084 people attend on-site center programs, with another 10,843 attending off-site programs. With the help of the ENRTF we are changing how our future generations will see their own future. What is "cutting edge" to adults, is quickly becoming considered by our children as behaviors and technologies that are simply the sensible appropriate way we live in society. Through this project we've further established this transformation for thousands of children each year.

** Wolf Ridge heats with a wood/hot water system. Since carbon is stored in wood while growing then released when burned, according to McKinstry's calculations, wood is considered to be a carbon neutral source of heat.

SUMMARY HIGHLIGHTS OF ACTUAL OUTCOMES

It is important to note that partially as a result of the LCCMR approved grant, several of the centers were able to acquire additional funding to expand the scope of their energy efficiency measures and to be able to achieve even greater carbon footprint reductions.

Not all of the energy efficiency measures were completed in time to be able to record a full year of actual energy use to compare to the original 2007 data used to calculate the initial carbon footprint. It is valuable however to highlight some of the initial data that is available.

Deep Portage with a combination of the LCCMR approved funds and other funding has been able to make the claim of having reached carbon neutral through a reduction of propane use, solar and wind renewable systems and with the purchase of green credits for all of their electricity use. Their actual 2011 propane use compared to the 2007 benchmark data reflects an amazing 77% reduction while their electrical energy use reached a 13% reduction level for an overall on site carbon reduction of 43%. The purchase of green credits for the remaining electrical use allows them to claim a carbon neutral achievement. The early 2012 data suggest a possible even larger carbon reduction level may be achieved.

Eagle Bluff was able to record a 93% reduction of natural gas usage from the 2010 usage data prior to completion of the envelope improvements. This outstanding accomplishment allowed them to become the first deep energy retrofit in the state of Minnesota to receive the Affordable Comfort Institute 1000 Home Challenge award.

Laurentian has achieved a 42% reduction in propane usage from the July 1-June 30 2011/2012 heating season compared to the same period of the 2007/2008 heating season. This is a dramatic impact and one that is also felt and recognized by all visitors

in the obvious change in comfort levels especially in the Lodge and Office buildings which were the primary focus of this effort.

Audubon Center results are somewhat complicated because of a problem with their electric driven geothermal system which was not operational from April to July of 2011 which necessitated the use of propane backup boilers which of course increased the propane use above normal operations. Even with this anomaly, propane use in 2011 was reduced by 10% from the 2010 usage. When comparing the Jan-April 2012 period with the Jan-April 2011 period the propane use data indicates an 80% reduction. The annual results won't be available until December 2012 but the reduction in propane use is expected to be very dramatic as a result of envelope improvements and the solar thermal domestic hot water system installed and fully operational.

Wolf Ridge was already 83% carbon neutral relative to space heating of the facility and this project will move the center closer to carbon neutral with domestic electric use. As the center completed their LCCMR approved funded work in the winter and spring of 2012 the actual energy and carbon reduction data is not yet available. Engineering calculations for projected impact for the East Dormitory suggests a 49% reduction in electric use for domestic hot water heating and corresponding carbon footprint. Converting the outdoor campus lighting to LED lighting will result in a 74% reduction in electrical usage and corresponding carbon footprint. An additional 33% reduction of campus electrical lighting energy usage and corresponding carbon footprint is projected from the conversion of T12 fluorescent fixtures to the newer T8 technology.

Long Lake
The solar system was only recently completed so no actual production data is available. Again, partially as a result of this funding Long Lake was able to receive additional federal funding to implement significant envelope improvement measures in several of their campus buildings. No engineering calculations were performed to project a realistic estimate but based on comparable other project experience the combination of the new solar system and envelope improvements are expected to make a significant reduction in energy use and subsequent carbon footprint reductions.

Collective TLFAST Group
In addition to the above center specific highlights each of the centers either has installed or is in the process of installing energy monitoring systems. These systems will have the capability to record energy production of the solar photovoltaic and solar thermal systems. Some of the more extensive systems will be able to record actual energy usage of various systems and/or buildings which in addition to recording energy use will also enable staff to trouble shoot system problems and allow them to identify when systems are using more energy than intended and thus allow the staff to reduce the amount of wasted energy used at each center. Numerous studies around the world have indicated that as much as 40% of a buildings energy use is actually wasted by malfunctioning equipment or improperly controlled mechanical and lighting systems that are running when not needed or desired.

All six centers have collaborated in developing 24 new units of educational curriculum units based on the following eight areas: biomass, climate change, conservation,

efficiency, energy basics, food and energy, solar power and wind power. Each of the centers provide tours of their energy improvements and have incorporated lessons learned into their educational curriculum thus helping to transform the knowledge base of Minnesota students and residents related to these critical energy issues.

The training of local firms in the latest building science construction techniques was a side objective of this effort and will hopefully benefit future construction efforts in the local areas of each of the six centers.

In summary it is this author's opinion that the LCCMR approved funds have been invested wisely and have achieved and will continue to achieve significant energy and carbon footprint reductions for years to come. The joint development of new energy related educational curriculum units by the six centers will lead to evidence based energy and climate education for generations to come for students and other citizens able to experience the examples set by these six centers. It is this author's opinion that it is essential that the citizens of Minnesota understand in an unbiased, scientific, non-political manner the critical energy and climate issues of this period in our planet's history. This citizen awareness and understanding of the palette of proven solutions as demonstrated by the results of this effort could well help establish the state of Minnesota as a national leader in solving the complex energy and climate related challenges that desperately need creative, smart and proven effective solutions.

In closing I would like to commend and express appreciation for the LCCMR's support for this important effort in helping the joint coalition of residence based environmental learning centers make tremendous progress in their pursuit of their goal to reduce their collective carbon footprint by 80%. Much work remains to accomplish this goal but thanks to the LCCMR attainment of this goal is now within sight.

V. TOTAL ENRTF PROJECT BUDGET:

Contracts: Wagner Zaun Architecture of Duluth, MN was hired as the professional design, implementation and project management team for $23,081.The professional contractor was determined through a competitive bid process. The contractor's fee was distributed respectively throughout the individual project deliverable fees.
Supplies: $0
Capital Improvements:
Conservation: Exterior Door Envelope Improvements $39,735
(30% equipment, 70% installation)
Efficiency: Interior and Exterior Lighting upgrades $59,096
(30% equipment, 70% installation)
Efficiency: Refrigeration upgrades – deleted per amendment approval
Renewable: Solar Hot Water 77,768 (50% equipment, 50% installation)
Monitoring: metering and sub-metering equipment $57,401
(40% equipment, 60% installation)

Exterior Doors: McKinstry, Inc. recommended and explicitly called for high performance doors "professionally installed". Five doors, in five different buildings, were installed by a professional contractor: Administration, Dining Hall, Education Building, West Dormitory and the Science Center. The Curries Trio-E commercial door, recently highlighted in the magazine Environmental Building News, as one of the highest performing commercial doors available was used in all installations.

Solar Hot Water: The McKinstry, Inc. report estimated that 7 solar collectors would be needed to meet the needs of the East Dormitory. Actual engineering specs call for 16 solar collectors to meet these needs. A total of 8 panels, tanks, piping and controls were installed, meeting 50% of the demand for the East Dormitory.

Monitoring: The original proposed cost was for the core system of the energy monitoring, which consists of a data base server, network manager, transceivers, and building hookups. However, to actually monitor the energy use at the different campus buildings and demonstrate energy savings to our customers requires additional components including wireless transceiver modules at the different buildings, current transformers, and BTU meters that need to be installed directly into the existing heating pipe. A system was installed that monitors all the electrical consumption in all 7 main campus buildings and 6 of the same buildings for heat monitoring. The 7th building requires no specific heating as it houses the boilers where ambient room temperature is supplied by radiant heat from the boilers themselves. The computer data logger and controls were placed in the centers network administration room in the basement of the Administration Building.

Interior and Exterior Lighting: As proposed, all the remaining interior fluorescent lighting fixtures, 106 total, using T12 technology was upgraded to T8 technology. Also, all the outdoor or exterior campus lighting was upgraded from metal halide to LED light fixtures and bulbs.

TOTAL ENRTF PROJECT BUDGET: $234,000

Explanation of Capital Expenditures Greater Than $3,500: The capital improvements made with these funds are fixed capital assets and will remain in place and will continue to be used for the same program through its useful life.

VI. PROJECT STRATEGY:

A. Project Partners: Audubon Center, Sandstone MN; Deep Portage, Walker MN; Eagle Bluff, Lanesboro MN; Laurentian, Britt MN; Long Lake, McGregor MN; and Wolf Ridge, Finland MN.

B. Project Impact and Long-term Strategy: The RELCs sustainable energy campaign has two phases or main goals. Phase 1 is to retrofit our campuses using conservation, efficiency, and renewable resources to reduce the RELCs collective carbon emissions by 80% and lower energy costs. The ENRTF funds will be used to implement one quarter of the Phase 1 goal and sets the stage for our Phase 2

educational programs. Wolf Ridge will continue to seek funds until all of the Phase 1 work identified in the McKinstry report is completed.

Phase 2 is to create and implement education efforts that compliment the building improvements done in Phase 1, thus using the campuses as models for sustainable retrofitting and practical carbon-neutral lifestyles.Wolf Ridge currently uses a 10 KW wind turbine and a 880 watt solar array to provide electricity to one of our education buildings. The ENRTF funds will allow us to expand our renewable energy use by introducing solar thermal technology to the campus,and also significantly increase the energy conservation and efficiency of two of our 22-year old buildings. Wolf Ridge plans to expand it's current real time energy displays from the wind tower to include the new solar thermal array, and share this technology with the other centers. The current real time energy displays can be viewed on our website.

C. Other Funds Proposed to be spent during the Project Period

Item	Collective	Wolf Ridge
C1: 2009 Federal Allocation– 5 Northern Centers	$1,500,000	$300,000
C2: Continue Project Development – Butler Family Foundation	$30,000	$5,000
C3: In-kind Staff	$30,000	$5,000
C4: Fred C. and Catherine B. Andersen Foundation		$43,000

D. Spending History:

Item	Collective	Wolf Ridge
D1: Bush Foundation – McKinstry Study	$176,000	$29,300
D2: Butler Family Foundation – Project Development	$30,000	$5,000
D3: Heating System Evaluation by McKinstry, Inc.		$15,000

VII. DISSEMINATION:

Collective TLFAST Group: Information about this project has been disseminated through a collaborative website that will be available to the public for learning about the process and successes of each individual centers projects, www.tlfast.org. It will be highlighted in future center newsletters, made available to schools and teachers that attend Wolf Ridge as well as in center specific tours held for visitors who have interest in energy sustainability. It will also be discussed in future Energy Resource Advisor (ERA) training seminars.

The ERA certificate, developed by Winona State University, is a new curriculum designed to accelerate public understanding of energy efficiency, clean energy, carbon emissions, resource conservation, green technologies, and green jobs. This curriculum is the *first of its kind in Minnesota*. It is a non-credit, continuing education course for adults 18 years of age and older, *using online instructional technology combined with applied, field experience at one of the six RELCs*. Participants in this class will learn about: a) the basic components of an energy audit, b) small-scale renewable energy

including site suitability, system sizing, and financial incentives that are available, c) alternative building and transportation options, d) ways to “green up” the home or business, and e) the field of emerging “green” jobs. After completing this course, the successful participant may serve as an energy resource advisor and “green” consultant in the community and workplace.

Wolf Ridge ELC Final Report

A web designer was hired and web site created to specifically showcase the Today’s Leaders for a Sustainable Tomorrow set of projects, www.tlfast.org. General information about each center is available, their energy sustainability efforts, energy production and reductions. All the curriculum, 24 lessons and 19 supporting posters, developed for instruction relative to the ENRTF projects is available as free download to any educator or interested party. This resource is being distributed to educators that bring students to Wolf Ridge ELC through ongoing correspondence we have with our partner schools.

Wolf Ridge has included project information on our website, in past newsletters, and will include a final component in the October 2012 upcoming newsletter. These conservation, efficiency and renewable energy projects have been incorporated into our Renewable Energy and Climate Change classes that educate our users about energy conservation and renewable energy options applicable to their home, communities, and schools. Every participant that attends Wolf Ridge residential programs, 13,084 last year, participates in a revised “Conservation Challenge” lesson now incorporating the ENRTF funded projects, where they learn to assess their energy behaviors while attending for three to five days.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports will be submitted not later than 1/15/2011, 7/15/2011, and 1/15/2012. A final work program report and associated products will be submitted August 15, 2012 as requested by the LCCMR.

Attachment A: Final Budget Detail for 2010 Project

Project Title: 075-B3 Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELC's) 7d-6 Wolf Ridge Environmental Learning

Project Manager Name: Pete Smerud

Trust Fund Appropriation: $234,000

2010 Trust Fund Budget	Result 1 Budget	Amount Spent	Balance	Total Budget	Total Balance
Conservation- Envelope Improvements--30% equipment, 70% installation	39,735	39,735	-	39,735	-
Efficiency-Interior Lighting-30% equipment, 70% installation	59,096	59,096	-	59,096	-
Efficiency-Refrigeration Conversion-50% equipment, 50% installation	-		-	-	-
Renewable- Solar Hot Water -50% equipment, 50% installation	77,768	77,768	-	77,768	-
Monitoring - Submetering, 40% equipment, 60% installation	57,401	57,401	-	57,401	-
Column Total	**$ 234,000**	**$ 234,000**	**$ -**	**$ 234,000**	**$ -**

Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELCs) – Wolf Ridge (7d6).

Final Report Photos – August 14, 2012

Wolf Ridge Environmental Learning Center
6282 Cranberry Road
Finland, MN 55603
www.wolf-ridge.org

A Project funded through the Minnesota Environmental and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources.

Water storage and computer controls

Drain bank tank and pumps

Solar Domestic Hot Water System • Wolf Ridge ELC East Dormitory

Panel array producing 50% of the need for a 180 bed facility

Funding for this project was provided by the **Minnesota Environment and Natural Resources Trust Fund** as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

West Dormitory

Energy Conserving Doors • Wolf Ridge ELC
Three examples of the five replaced

Education Building

Administration Building

Funding for this project was provided by the **Minnesota Environment and Natural Resources Trust Fund** as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Outdoor LED Lighting • Wolf Ridge ELC
Two styles, forty-six fixtures replaced

Funding for this project was provided by the **Minnesota Environment and Natural Resources Trust Fund** as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Energy Monitoring System

•

Wolf Ridge ELC

Monitoring all heat and electric:
7 buildings, 98,000 square feet,
380 bed facility

Computer Data Logger and Control

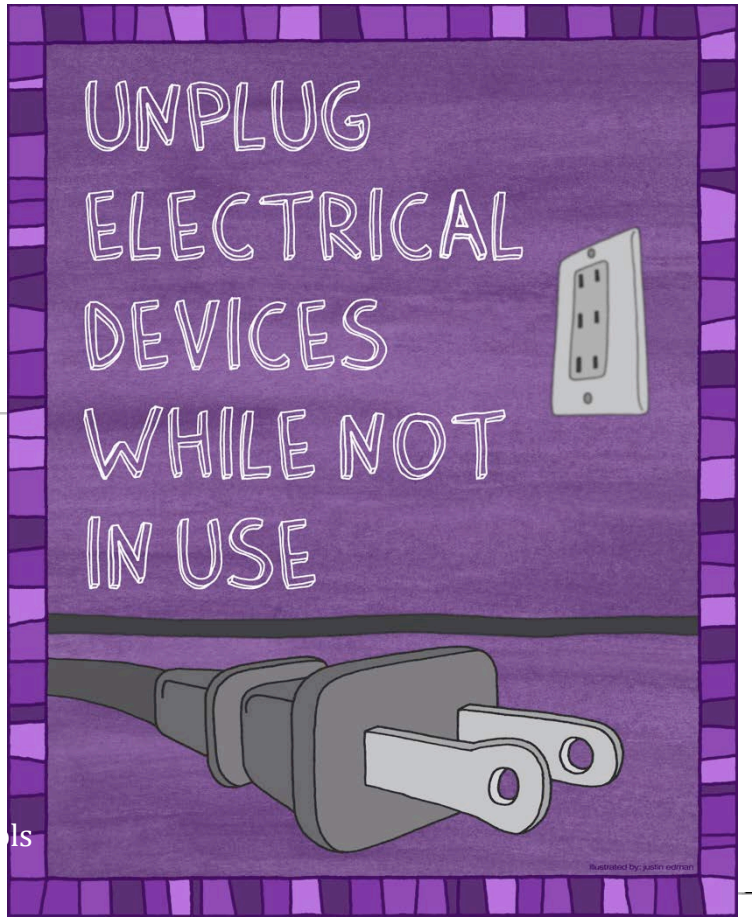
BTU Heat Meter – Administration Building

Wireless Data Transmitter

Funding for this project was provided by the **Minnesota Environment and Natural Resources Trust Fund** as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

Educational Dissemination
•
Wolf Ridge ELC

Example components of lesson plans (24 total) and point of action posters (19 total)



HOW MUCH ENERGY FROM THE SUN

This is an activity to help students to understand how much energy comes from the sun.

OBJECTIVES
The student will be able to
- Explain that energy from fossil fuels is not as efficient as solar energy.

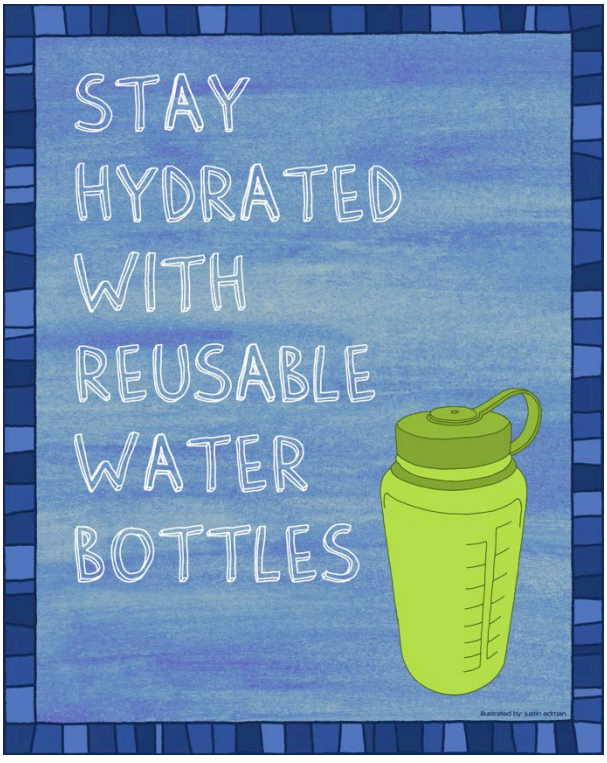
MATERIALS/EQUIPMENT
- Square of fabric or paper - 1 meter/side
- 60 watt incandescent lightbulb in a protective holder
- 100 poker chips
- Chunk of coal or pictures of coal
- Leaf (real or plastic)

TIME NEEDED – 10 minutes

DEGREE OF PHYSICAL ACTIVITY – low

APPENDIX C: Standards

Subject	Grade Level	Code	Standards	Benchmark
Science K-12 (2010)	5	5.3.4.1.1	In order to maintain and improve their existence, humans interact with and influence Earth systems.	Identify renewable and non-renewable energy and material resources that are found in Minnesota and describe how they are used.
	5	5.4.4.1.1	Humans change environments in ways that can be either beneficial or harmful to themselves and other organisms.	Give examples of beneficial and harmful human interaction with natural systems.
	6	6.2.3.2.2	Energy can be transformed within a system or transferred to other systems or the environment.	Trace the changes of energy forms, including therma electrical, chemical, mechanical or others as energy used in devices.
	9-12	9.2.4.1.1	There are benefits, costs and risks to different means of generating and using energy.	Compare local and global environmental and econor advantages and disadvantages of generating electric using various sources or energy.



ENERGY EFFICIENCY OF LIGHTBULBS
(Training Powerpoint Available)

This is an activity where students will compare how much energy is used to power different kinds of lightbulbs in order to see which is most energy-efficient.

OBJECTIVES
The student will be able to
- Develop an understanding of energy-efficiency and the importance of energy conservation.
- Discover that some devices do the same job but use less energy to do so.
- Explain how using energy-efficient light bulbs can help the environment.

MATERIALS/EQUIPMENT
- Several different pairings of CFL and incandescent light bulbs that produce equivalent lumens (e.g. 60 watt incandescent and 13 watt CFL) with their packaging (For a consistent test you should choose all light bulbs from the same manufacturer.)
- Infrared surface thermometers
- Light meter (e.g. LM-81 8X)
- Rulers
- Lamps or holders for lightbulbs

SET-UP
Place different lightbulbs in the lamps or holders around the room. Have the packaging for the lightbulbs, a thermometer, a ruler, and a light meter at each station.

TIME NEEDED: 20-30 minutes

DEGREE OF PHYSICAL ACTIVITY: low

RUNNING THE ACTIVITY
Show students an incandescent lightbulb and ask them what "job" is being performed by a light bulb? In other words, what is it that we want the energy used for when we turn on a lightbulb? *(We want the energy to produce light.)* Explain to students that not all of the energy that a device uses gets used in the way we want. To illustrate this point, use the following example: What do you want a vacuum cleaner to do? *(to remove/suck up dirt.)* But what else does it do that we don't necessarily want it to do? *(also produces sound and heat)* So, with lightbulbs, what do they produce besides the light? *(heat)* Ask the students if we need the lightbulb to give off the heat.

Ask students what the word "efficient" means. List their ideas on the board or on chart paper.

Show the class incandescent and CFL lightbulbs and find out what they already know about them. Explain that today students will have an opportunity to test different lightbulbs to determine how efficient they are.

Have students suggest what should be considered when comparing light bulbs, listing their ideas on the board or on chart paper. Make certain that students have included the following in their list:
- Amount of light produced (lumens – define for the students)
- Amount of energy a lightbulb uses (watts – define for the students)
- Amount of heat the lightbulb gives off
- Length of time the lightbulb lasts ("life")
- Cost of lightbulb

Funding for this project was provided by the **Minnesota Environment and Natural Resources Trust Fund** as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).