

**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

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**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 CO<sub>2</sub>.
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](http://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 21<sup>st</sup> 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

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**Telephone Number:** (218) 353-7414

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**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        | <b>\$234,000.00</b> |
|  | <u>Minus Amount Spent:</u> | <b>\$234,000.00</b> |
|  | Equal Balance:             | <b>\$0.0</b>        |

**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.

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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:

|         |                      |                     |
|---------|----------------------|---------------------|
|         | <b>ENRTF Budget:</b> | <b>\$234,000.00</b> |
|         | <b>Amount Spent:</b> | <b>\$234,000.00</b> |
| Balance |                      | <b>\$ 0.0</b>       |

| <b>Deliverable/Outcome</b>   | <b>Completion Date</b> | <b>Budget (includes contracting costs)</b> | <b>Amount spent</b> | <b>Balance</b> |
|--|------------------------|--|---------------------|----------------|
| <b>1-1 Replace five exterior doors and weather strip others to conserve envelope energy.</b> | 6/28/12                | \$39,735                                   | 39,735              | 0              |
| <b>1-2 Upgrade the efficiency of Interior and exterior lighting throughout campus</b>        | 3/6/12                 | \$59,096                                   | 59,096              | 0              |
| <b>1-3 Deleted as per Amendment approved April 2, 2012</b>                                   |                        | 0  | 0                   | 0              |
| <b>1-4 Install a solar hot water system</b>  | 5/17/12                | \$77,768                                   | 77,768              | 0              |
| <b>1-5 Install a sub-metering monitoring system</b>  | 6/28/12                | \$57,401                                   | 57,401              | 0              |
| <b>Total</b>   |                        | 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 7<sup>th</sup> 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](http://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](http://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.

| <b>Attachment A: Final Budget Detail for 2010 Project</b>   |                        |                     |                |                     |                      |
|---|------------------------|---------------------|----------------|---------------------|----------------------|
|   |                        |                     |                |                     |                      |
| <b>Project Title: 075-B3 Demonstrating Sustainable Energy Practices at Residential Environmental Learning Centers (RELC's) 7d-6 Wolf Ridge Environmental Learning</b> |                        |                     |                |                     |                      |
|   |                        |                     |                |                     |                      |
| <b>Project Manager Name: Pete Smerud</b>  |                        |                     |                |                     |                      |
|   |                        |                     |                |                     |                      |
| <b>Trust Fund Appropriation: \$234,000</b>  |                        |                     |                |                     |                      |
|   |                        |                     |                |                     |                      |
| <b>2010 Trust Fund Budget</b>   | <b>Result 1 Budget</b> | <b>Amount Spent</b> | <b>Balance</b> | <b>Total Budget</b> | <b>Total Balance</b> |
|   |                        |                     |                |                     |                      |
| Conservation- Envelope Improvements--<br>30% equipment, 70% installation  | 39,735                 | 39,735              | -              | 39,735              | -                    |
| Efficiency-Interior Lighting-30% equipment,<br>70% installation   | 59,096                 | 59,096              | -              | 59,096              | -                    |
| Efficiency-Refrigeration Conversion-50%<br>equipment, 50% installation  | -                      |                     | -              | -                   | -                    |
| Renewable- Solar Hot Water -50%<br>equipment, 50% installation  | 77,768                 | 77,768              | -              | 77,768              | -                    |
| Monitoring - Submetering, 40% equipment,<br>60% installation  | 57,401                 | 57,401              | -              | 57,401              | -                    |
| <b>Column Total</b>   | <b>\$ 234,000</b>      | <b>\$ 234,000</b>   | <b>\$ -</b>    | <b>\$ 234,000</b>   | <b>\$ -</b>          |



## 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](http://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.

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| Solar Domestic Hot Water Heating System         | page 2 |
| Envelope Improvements – Energy Conserving Doors | page 3 |
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| Educational Dissemination                       | page 6 |





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**



BTU Heat Meter – Administration Building



Computer Data Logger and Control



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

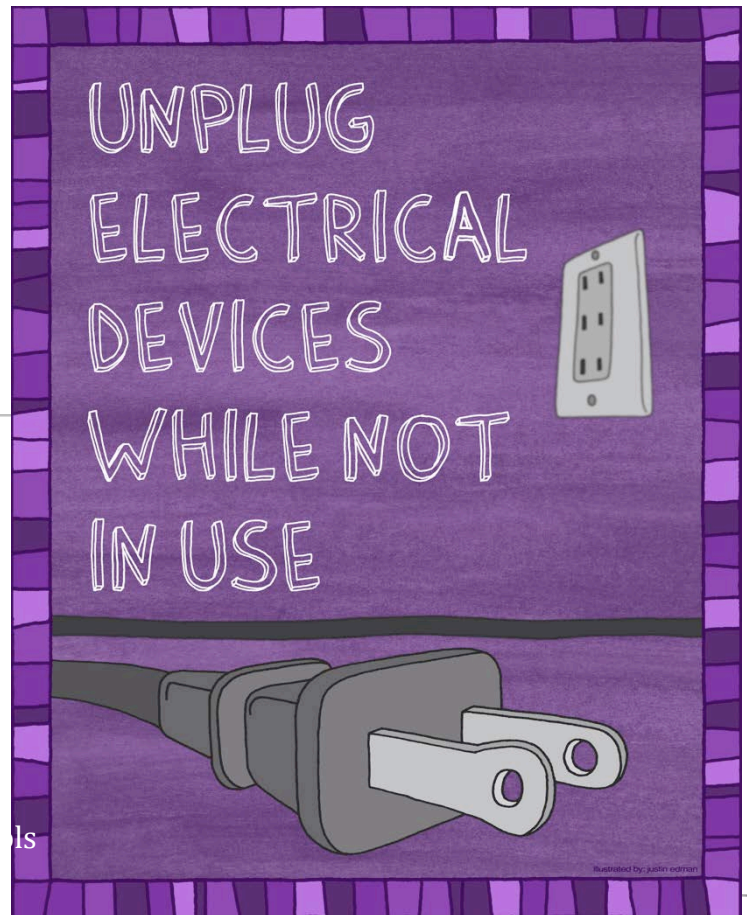
- Square of fabric or paper - 1 meter/side
- 60 watt incandescent lightbulb in a protective holder
- 100 poker chips
- Chunk of coal or pictures of coal
- Leaf (real or plastic)

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. There are benefits, costs and risks to different means of generating and using energy. | Trace the changes of energy forms, including thermal, electrical, chemical, mechanical or others as energy used in devices. Compare local and global environmental and economic advantages and disadvantages of generating electric using various sources or energy. |
|                     | 9-12        | 9.2.4.1.1 |  |  |



#### 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

